SCIENCE EDUCATION AND THE MEDIUM OF INSTRUCTION:
CHINESE OR ENGLISH?

BY

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This study investigated the relationship between academic achievement and proficiency in the language of instruction in a situation where instruction was in the second language of both students and teachers. The subjects were grade 10 physics students in Hong Kong whose first language was Chinese. After an extensive review of the literature, five specific problems were identified and a major hypothesis formulated. For the study, data were gathered from one hundred seventy six subjects selected from four classes in two secondary schools, one Chinese and one Anglo-Chinese.

The first part of the study was to compare the physics achievement of groups receiving instruction in Chinese and English respectively. For three months (with four lessons per week), two classes of students learned the content material (Light and Sound) in Chinese and two classes learned the material in English. Group differences were controlled by using the individual aptitude scores (measured by an aptitude test battery) as covariates in the analysis.

The second part of the study was to compare the physics achievement of the two classes of students in the same school. For two months (with five lessons per week), one class learned the content material (Mechanics) bilingually while another class learned the material in English. The third part of the study used the same subjects as in the second part. One class learned the material (Atomic Physics), for four lessons only, in English while the other learned the material in Chinese. The same kinds of procedures were used to control group differences as in the
first part of the study.

The fourth part of the study investigated the relationships among (i) physics achievement, English proficiency and other factors (motivation, etc.), and also among (ii) English proficiency and the affective factors. English proficiency of the students was measured by a test battery consisting of five subtests. The motivational, affective factors and background variables were measured by a set of questionnaires. The English proficiency test battery and the questionnaires were administered to the students at different times during the controlled study periods.

The following conclusions were drawn:

1) Achievement in physics at the grade 10 level in the secondary schools of Hong Kong did not depend on the language of instruction.

2) Achievement in physics at the grade 10 level in the Anglo-Chinese schools of Hong Kong depended heavily on proficiency in English.

3) There seemed to be no significant differences in motivation in learning English between the Chinese and Anglo-Chinese school students.

4) The important factors in acquiring proficiency in English by the Chinese students appeared to be: self concept of academic ability, Chinese language usage, motivational intensity in
5) It did not take the students extra time and effort to learn physics at the grade 10 level when instruction is done in English rather than Chinese.

The present study had certain weaknesses in its design. It would be desirable to replicate if using an improved method of sampling, refined tests and scales and also doing it in a longitudinal manner.
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CHAPTER 1
INTRODUCTION

1.1 GENERAL AND SPECIFIC PROBLEMS INVESTIGATED

The general problem investigated is the relationship between academic achievement and proficiency in the language of instruction in a situation where instruction is in the second language of both students and teachers.

The investigation was carried out in Hong Kong and focused specifically on the following questions related to the general problem stated above:

1) How does achievement in physics at the grade 10 level in the secondary schools of Hong Kong depend on the language of instruction, Chinese and English?

2) To what extent does achievement in physics at the grade 10 level in Anglo-Chinese schools in Hong Kong depend on proficiency in English?

3) How much time and effort is required to achieve proficiency in English as needed for teaching and learning in physics? Is the time and effort spent commensurate with the level of proficiency attained?

4) What factors are important in acquiring proficiency in
English by Chinese students? How can these factors be manipulated to improve proficiency in English and achievement in physics?

5) In terms of cost-effectiveness (cost in terms of time and effort) in the light of (1)-(4) above, should physics be taught in Chinese at grade 10 instead of English?

1.2 THE PROBLEM OF BILINGUALISM

The problem of using different languages appeared to be partly solved about half a century ago because several major European languages were widely used around the world. After the Second World War, the picture changed quickly as many new nations were born.

Many of these new nations were former colonies of developed countries. Ever since that colonial period, the ability to speak a foreign language has been considered necessary for political and professional advancement in these newer nations (Kehoe, 1968, p.1). Following the achievement of independence, the pressure for a wider use of local languages for the sake of national pride and identity increased. At the same time, due to the rapid development of international business, technology and science, the need for using a second language as a tool for political, technological, and socioeconomic progress also increased. Even for a predominantly monolingual society like the United States, the increasing number of immigrants in recent years has forced educators to question the truth of the 'melting pot' idea and to pay more attention to the study of learning in
a second language. Hence the problem of bilingualism is a universal concern rather than a local matter.

1.3 THE USE OF SECOND LANGUAGE AS THE MEDIUM OF INSTRUCTION

As the need for learning a second language grows, many people seem to feel that 'immersion' in a second language is the key to fluency in the language. For this reason, schools often use the second language of the nation as the medium of instruction. Evidently, the second language which served the colonists as a culture-controlling tool, has now become an important key to success for the average citizens in developing nations and, consequently, is often the preferred medium of instruction in the higher grade levels in spite of the language difficulties encountered.

Generally, educators consider the use of a second language as the medium of instruction as problematic in teaching and learning. On the other hand, administrators and politicians, from financial, practical and political points of view, consider the use of a second language as the medium of instruction to be beneficial, at least for a certain period of time (Daum, 1976).

There have been many studies and much discussion in the use of the second language as the medium of instruction. Using this large body of literature, Engle (1975) has done a very comprehensive comparison between schooling using the mother tongue and schooling using the second language. Though her study is mainly concerned with early school years, most of the findings are probably applicable to other levels too. Engle concludes that there is still no substantial evidence as to
which approach is better since there are so many variables to be controlled and existing studies are inadequate in this aspect.

The purpose of the present study is to meet this problem of control to a greater extent and to shed more light on this controversial area of using the second language as the medium of instruction. Hopefully a clearer picture will eventually be formed as more carefully controlled studies are carried out.

1.4 TEACHING SCIENCE IN THE SECOND LANGUAGE

Science education requires students to have the ability to read and understand scientific material as well as the ability to communicate these concepts. In order to do this, complex modes of thought have to be used. Quite often, science teachers assume that it is only the technical vocabulary which is special about the language of science. In practice, introducing new vocabulary may in fact be relatively the easiest part of science teaching. The scientific meaning of an experiment or a principle is often more difficult to teach and learn. Another difficulty which often occurs is the use of common words in a special sense, for example, the term "work" refers to quite a different meaning in the "common sense" than in the "scientific sense". (Strevens, 1972).

It is possible to view students who use their second language to learn science in at least two ways. Some people believe that the learner is likely to encounter additional language problems. One problem is that, although science lessons provide subject matter in the same way that the language teacher does in language lessons, the language proficiency of the
science teacher may affect the eventual language standard of the students in science. If the language proficiency is not high the efficiency of science teaching may be lower as well as the standard of achievement in the second language. (Bolger, 1967)

Others take the second point of view. They note that scientific study is customarily pursued in several languages which are widely used throughout the world and that the switch from learning in the mother tongue to learning using a second major language is desirable. This is due, in part, to the fact that most vernaculars do not have the technical terms essential for advanced study. The adaptation of a vernacular to a language suitable for science teaching takes time and money. This is not possible at the present stage for most developing countries.

Part of the present study deals with the learning of physics at a grade level equivalent to the Canadian grade 10 level. In particular, it examines the effectiveness of the second language as the medium of instruction.

1.5 THE EFFECTS OF AFFECTIVE FACTORS IN SECOND LANGUAGE LEARNING

Carroll (1962) suggests that second language achievement varies as a function of three general variables: language aptitude, general intelligence, and motivation. It also depends on two instructional variables: the opportunity for learning and the adequacy of presentation of the material to be learned. Jakobovits (1970) even estimates the variance contributions of various factors in predicting success in second language learning as follows: aptitude 33%, intelligence 20%, motivation or perseverance 33%, others 14%.
For the last two decades, there has been an increasing amount of research on the socio-psychological aspects of second language learning. Emphasis has been placed on the affective factors of language learning, such as the learner's attitudes and motivation. Over time, a socio-psychological theory of language learning has emerged. As Lambert (1972) has noted,

'This theory, in brief, holds that an individual successfully acquiring a second language gradually adopts various aspects of behaviour which characterize members of another linguistic-cultural group. The learner's ethnocentric tendencies, his attitudes toward language learning are believed to regulate or control his motivation to learn and ultimately his success or failure in mastering the new language.' (p. 291)

Part of the present study is to probe further the relationship between affective factors and second language learning. In particular, what is the variance contribution of individual affective factors to second language achievement?

1.6 THE GENERAL SITUATION OF EDUCATION AND LANGUAGE TEACHING IN HONG KONG

1.6.1 General Background

Hong Kong is a 400 square mile territory located on the southern coast of China. When Hong Kong first became a British Colony in 1842, there was a Chinese population of about 7,000,
made up of fishermen, farmers and villagers. There are now 4,720,200 people crowding into this small place. The great bulk are urban dwellers, three quarters of Hong Kong's population being compressed into an area of about 15 square miles. The population density for the metropolitan areas of Hong Kong Island, New Kowloon and Tsuen Wan is 25,400 persons per square kilometer (Hong Kong, 1979, p. 220).

About 98% of the population is Chinese, and 86% usually speak Cantonese, a southern Chinese dialect (Agassi, 1969). About 55% of the urban population is Hong Kong born while the remainder come from Mainland China (Fu, 1975, p.79). A large proportion of the older generation (age over 30) did not plan to remain in Hong Kong when they first went there during the 1949 Chinese civil war. They thought that, someday, they might be able to return to the Mainland again. This waiting time has been extended indefinitely. Though most of the people have a negative feeling toward the colonial government (Mitchell, 1972, pp. 364-5), they generally keep silent or to react only to grossly unfair policies that affect them immediately. The main reason for this is that they do not want to 'turn the boat over' since any change of the present political state might be even more disastrous. But by 1997, when the lease of the New Territories (365 square miles) from China expires, nobody (not even the Chinese or British governments) really knows what will happen politically.

Up to the outbreak of the Second World War, Hong Kong was an entrepot, owing its life to trade, banking and shipping. The Japanese occupation, the Chinese civil war and the U.N. embargo
of Chinese trade after the outbreak of the Korean war ruined the entrepot trade fatally. But a thriving industrial economy was built up at the same time, which was able to absorb millions of immigrants that poured into the colony in the 1950's. The building up of an industrial economy was a result of series of historical coincidences rather than any well thought out plan on the part of the government. Even to this day, the Hong Kong government interferes as little as possible in the affairs of the local economy. One of the key factors in the economic growth of Hong Kong over the past decades has been the great influx of Chinese capital, skill and entrepreneurship (Johnson, 1971, pp. 6-8).

In brief, Hong Kong is a place of great contrasts. Fu (1975) offers a general description of Hong Kong:

'The city on the edge of the "Middle Kingdom" attracts businessmen and refugees, missionaries and dope peddlars, tourists and prostitutes. It exhibits "cultural clash, time lag and future shock - all at once"; sophisticated technology and coolies with rattan baskets, unimaginable stench and the latest from Chanel, imperial banquets and skimpy bowls of rice, pop cassettes and shrill Cantonese opera, strobe lights and muted Chinese scrolls. Hong Kong is as beautiful as it is squalid, as exciting as it is depressing, as modern as it is dilapidated. It is a city dedicated to money, and anything that makes it is done here and implicitly condoned - business, exploitation, corruption,
prostitution, ingenuity, diligence, sheer hard work...

It is a hard city where everyone has to look out for himself. No one else is going to! (p. 79)

1.6.2 Education

There are 1,323,098 school students in Hong Kong, of whom 563,384 are primary students and 529,712 are secondary students (Hong Kong, 1979, p. 274). Some students in Hong Kong start school between the ages of three and five at one of the many private kindergartens. Almost every child gets into primary school at the age of six. At present, the admission policy of primary schools is not unusual except for a few famous schools which have exceptionally high admission standards. Although every child has the right to nine years of free education, this does not mean that he will stay in the same school for nine years. In the past, the secondary school attended would have been determined by aptitude, choice of school, and area of residence at the end of the sixth year. In the future, each student will be sent to a senior high school for further studies up to grade 11 at the end of the ninth year. The details of selection and allocation have not been fully established as yet (Hong Kong, 1979, p. 57). At present, almost every student writes the Certificate of Education Examination at the end of the eleventh year.1 Following this, the great majority leave

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1 The Certificate of Education Examination is an achievement test on various subjects administered to all students at the end of grade 11. The examination in most of the subjects is offered in two equivalent translations, English and Chinese. Candidates can answer in either language.
school to look for jobs, while only one third continue to grade 12 and 13 pre-university classes. The chance of entering university is very small; out of every eight candidates, only one is admitted. Education in Hong Kong is like a pyramid with a very broad base which narrows sharply at grade 10 and 12. This is topped by a pinnacle of very few select students who manage to get through the entrance examination into university.

1.6.3 Language Teaching

As pointed out by Fu (1975, pp. 85-87), one fundamental problem which all Hong Kong students have to face is the complex and frustrating beauty of their own language(s). They are exposed to Cantonese from birth. Since there is no written Cantonese, Hong Kong students do not use their spoken language as a medium for written expression. When children learn to read and write, they have to use a new language, Mandarin. The books in Mandarin are written in a style very different from their spoken mother dialect. Linguistic insecurity is deepened in the later stages when students go to higher forms of schooling. It is then that they have to learn classical Chinese which is as unrelated to Mandarin as Mandarin is to Cantonese. It is no wonder that Chao (1953) says that English is a third language to a Chinese student.

The schools in Hong Kong can be divided into two types according to the language of instruction: Chinese and Anglo-Chinese schools. These schools, respectively, use Chinese and English as the medium of instruction. At the primary level (grade 1-6), about 90% of the schools are Chinese and pupils
start to learn English as a subject from grade 2 upwards. At the secondary level (grade 7-11), the situation is just reversed. About 81.8% of the schools are Anglo-Chinese while only the remaining 18.2% are Chinese schools (Chan, Hinton, and Yau, 1979). This abrupt change in enrollment does not mean that the Chinese school curriculum is inferior to the Anglo-Chinese one. It is a mere personal choice of the students or their parents who think that learning more English will enhance their prospect for the future. Further, a sound knowledge of English is rated equally as important as the students' intelligence or academic achievement by many employers (Simpson, 1966, P. 42). From the discussion above, one might get the impression that the standard of English in Hong Kong is high. But only a small fraction of the population can speak fluent English. Even among the elite group of students who can get into university, the average standard of English is not as high as expected by university educators (Vince, 1970).

Curiously enough, the academic pressure and the economic benefits of studying English seem insufficient to override a basic emotional and psychological hesitation on the part of the students. Though students are not actively hostile toward English, they seem to resist dedicating themselves to its study for personal and psychological reasons. This may be the chief reason, as noted by Lambert (1972) why, after studying English for so many years, their average achievement is still

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1 From Agassis' study, less than 9% of the population can speak fluent English. This figure might be a litte bit out of date since there are more Anglo-Chinese school students graduated in the past ten years.
unsatisfactory.

It is not surprising that Fu (1975, p. 185) suspected that the fluency in English of many Hong Kong students was incommensurate with the amount of time and effort they put into that second language. This is so, in part, because their attitudes toward the language are ambivalent and because they might be uncertain about aligning themselves with the English who governed Hong Kong and who more than any other people humiliated China in the 19th century. After all, Hong Kong is not and has never been a cosmopolitan melting pot like Singapore, but remains basically Chinese (Chaney, Podmore, and Lu, 1973, pp. 2-3). She is 'flexibly westernized' at the superficial level but 'stubbornly Chinese' underneath (Jarvie and Agassi, 1969, p. 156).

1.7 SCOPE AND LIMITATIONS OF THE PRESENT STUDY

The purpose of the present study is to shed some additional light on the relationship between school achievement and the medium of instruction. In particular, it explores the relationship between achievement in high school physics, second language proficiency, and attitudes toward the second language, in a situation where the medium of instruction is the second language of both students and teachers. The scope of the study is confined to a particular problem of practice in teaching science, the use of a second language in teaching and learning high school physics.

In reading the conclusions of the present study, the readers must bear in mind the following limitations.
1) Strictly speaking, the results are not generalizable to other schools and classes since the selection of subjects was very restrictive. However, cautious generalizations based on the results might be made to other similar school situations, i.e., the government subsidized secondary schools which are academically above average in Hong Kong.

2) In the controlled-teaching study, the students were exposed to instructions given by the author and the assisting teacher. Although every effort was made to ensure that the instruction in both groups was equivalent, it was questionable whether the character and teaching style of the teachers might affect the learning of the students. Furthermore, certain parts of the instructions, which might pose problems due to the language barrier, might have been emphasized by either the author or the assisting teaching.

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1 Secondary schools in Hong Kong can be broadly divided into three types according to their financial situation. They are government, government subsidized, and private schools respectively. Government schools are completely controlled by the government. Government subsidized schools are partially controlled by the government since they receive quite a large proportion of their funds from the government. Private schools are independent as long as the schools are obeying the general educational laws set up by the government. In general the academic standard of the government and government subsidized school is higher than that of the private ones. (Of course, there are also variations within each type of schools.)

2 For example, when students learnt Chapter 7 (Work, Energy and Power) of the textbook, they might find that learning it bilingually was easier than in English alone since that chapter involved a lot of things which were closely related with their daily life experience.
3) The reliability of the tests and scales was, in general, not too high. This condition was not conducive for detecting small differences which might exist. It might have led to the acceptance of a null hypothesis when small but significant differences existed.

4) Due to the shortage of money, time and manpower, the number of subjects (i.e. students) involved in the study was comparatively small. This might affect the power of the study and hence might miss the actual result (as stated in the hypothesis) if the difference was small.

5) The study was confined to bilingual physics programs only. This was not a study of the desirability of bilingual programs in general. Extrapolations to other subject matters like social science, mathematics, etc. might not be applicable.

6) The study involved only Chinese high school students from Hong Kong. Generalization to other students might be inappropriate.

1.8 SIGNIFICANCE OF THE STUDY

As far as the writer has been able to determine, there has been very little research done in teaching and learning in a second language at the senior secondary level. In particular, studies of the relationship between achievement in physics and the language of instruction have been almost totally neglected.
A study of this problem is particularly timely, from a political-economic viewpoint in Hong Kong and in nations of the world which are immersed in second language problems and in adoption of western science and technology.

Furthermore, the considerable increase of the Chinese population in Canada, especially in the Vancouver area, and the politically unsettled situation in Asia in recent years indicate that studies comparing the achievement of Chinese students under various teaching conditions are timely and appropriate. This is an important period for Chinese adults and children alike since the next few decades may well determine whether Canadians of Chinese ancestry will be partially or totally integrated into Canadian society.

From an educational standpoint, if one accepts the position of Broudy that the "interpretive use" of learnings acquired in school is more important than the "replicative use" or even "applicative use" of school learnings in everyday life, the problem of how teaching and learning in a second language affects the acquisition of such learnings is of major educational importance. To illustrate, can the ideas of physics be used to make problems of societal concern sensible when these ideas have to be "filtered through the screen" of a second language? How distorted are the ideas? Would the learner even attempt to overcome the language barrier unless under considerable pressure to do so?

Finally, if we accept the following points of view:

1) that prevalent Canadian educational philosophy
supports provision of equal educational opportunity for all, hoping that ultimately each individual who has been educated will achieve happiness;

2) that each new Canadian is potentially a useful human resource for the nation;

3) that the integration of immigrant children into the Canadian society is a responsibility of the schools;

4) that immigrants from China, Hong Kong and elsewhere will continue to increase in number;

Then this study should also serve as providing insight into how the use of English as a second language would affect the school learning of immigrant children in Canada, especially Chinese.
CHAPTER 2
REVIEW OF RELATED INVESTIGATIONS

Many studies have been done in the field of bilingualism. Most were concerned with the effect of bilingualism upon the linguistic or cognitive development of bilinguals. Very little research has been done on the effect of teaching in a second language on achievement in particular subject areas, e.g., science, and attitudes (Cooper, 1971; Macnamara, 1967).

It is not possible to give a thorough account of all the studies which have been reviewed, so it will be necessary to go over many studies with just a indication as to what the findings were, and where they were carried out, and concentrate on those few that are particularly interesting or closely related to the present research.

For the sake of quick reference, three symbols are given at the end of each study. The first symbol refers to the research method or design used in the study. Educational research designs are broadly divided into three categories:

Survey (S),
Post hoc comparative (PH),
Experimental (E).

The second symbol refers to the result of the study. The results

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1 Quasi-experimental design is included under the title Experimental design. For detailed distinctions between the three kinds of studies, see Gay (1976, Ch. 6)
are classified as follows:

Using the second language as the medium of instruction is not detrimental (S+)

Using the second language as the medium of instruction is detrimental (S-)

Using the second language as the chief medium of instruction and the first language as an assisting medium is not detrimental (B+)

Inconclusive (I)

Not applicable (NA).

The third symbol refers to the levels of the sample selected for the study. They are classified as follows:

All levels (A)
College (C)
Senior high school (SH)
Junior high school (JH)
Primary or preschool (P)
Not specified (N).

For example, the symbols (S, B+, P) after a study means that: (1) it was a survey study; (2) the result indicated that using the second language as the chief medium of instruction and the first language as an assisting medium is not detrimental; (3) the sample was chosen at the primary or preschool level.

2.1 STUDIES ON THE USE OF A SECOND LANGUAGE AS THE MEDIUM OF
INSTRUCTION

This section is a general review on the use of a second language as the medium of instruction. Since this section consists of a review of 18 studies, it is broken into two subsections according to chronological order. At first sight, the choice of 1970 as the line of division seems to be quite arbitrary. But closer examination reveals that studies done before and after 1970 are quite different. The details of their differences can be found in Section 2.5.1 and 2.5.2.

2.1.1 Research done before 1970

2.1.1.1 The earliest study in this era was probably that done by Bovet (1932) in Geneva. He reported that after four years of education in a bilingual school, students had scores equivalent to those in a monolingual school. Students were probably from middle class families, although no further details about the groups were reported. (PH, B+, P)

2.1.1.2 Malherbe (1946) reported that a careful survey of 18,773 students in over 200 representative primary and secondary schools in South Africa was done in 1938. The results indicated that in the bilingual school situation in which the second language was used as the medium of instruction, the duller students were not hindered any more than the brighter students in regard to content and that they could still maintain their normal standard of achievement in their first language. The most
significant result was that their relative gain in their second language was nearly twice as great as that registered by the higher intelligence group. This is one of the few studies that questioned the belief that brighter students are not handicapped by the use of the second language as a medium of instruction while the duller students suffer badly. Furthermore, he found that the bilinguals using the second language as the medium of instruction were behind at first, but managed to catch up by the sixth grade. (S, S+, P & JH)

2.1.1.3 Fife and Manual (1951) reported that for the Spanish-speaking students in Puerto Rico, the use of English as a medium of instruction hindered academic achievement. (PH, S-, P)

2.1.1.4 Taylor and Grieve (1952) carried out a survey in Ghana to find if there was any measurable difference in the relative efficiency of English and the native language as the medium of instruction. Because of methodological difficulties they could only tentatively conclude that the English medium resulted in higher scores in English tests while the native medium resulted in higher scores in other subjects. (S, S-, N)

2.1.1.5 One of the most famous studies on the medium of instruction was carried out by the department of Education, Manila, during the period, 1948-1955. The study, called the Iloilo Experiments, was designed to analyze the effects of initial instruction in the mother tongue on the eventual learning of the curriculum in English. The study was well
designed. The experimental group received all instruction in the mother tongue (Hiligaynon) in grades 1 and 2 and then in English in grades 3 to 6. The change of language was abrupt. The control group were taught in English in grade 1 through 6. The teaching materials were the same throughout, with the exception of grade 1 and 2 where the materials were translated to the native language for the experimental group. Students' abilities and achievements were assessed before grade 1 and after each grade through grade 6. The experimental group was assessed in the native language while the control group was assessed in English during grade 1 and 2. Subsequently all were assessed in English. The assessment included tests of reading, arithmetic problems, social studies, and language skills for each grade.

The sample consisted of fourteen elementary schools, equated for teacher quality, socio-economic status (SES), the principals' and supervisors' qualifications. Experimental teachers were generally of higher SES than the control teachers. Students were also equated on school attendance, chronological age and scores on the Philippines Mental Ability Test. When the project began, there were 1164 control students and 758 experimental students. The sample size decreased to 188 experimental subjects and 189 control subjects when matching was done. However, the drop-out rate was very high; only 28% of the sample remained at the end of the study.

The method used to teach the second language was different from standard methods used in most schools. It was based on language patterning and drills with emphasis on both structure and phonetics. Teachers were trained in the teaching of both the
At the end of the first year of the study, the experimental group was significantly superior in reading and social studies while the differences in arithmetic were not significant. At the end of the fourth year, there was no significant difference between the two groups in reading and arithmetic, while the control group was significantly superior in language. At the end of the study, there were no significant differences in any of the areas. At the end of grade 4, 5, and 6, the experimental group members reported themselves significantly higher on one of the four or five dimensions of a personality inventory test, though the dimensions varied from grade to grade. Furthermore, the majority of parents thought that their children showed more enthusiasm for school when they were taught through the mother tongue than when they were taught in English. The results of this study were widely accepted in the Philippines. All students were then taught in their mother tongue for the first two years of school and in English in the following years.

Engle (1975, p. 294) pointed out that the study had a number of problems. The tests were inadequately validated in English and then simply translated into the native language. Variables were not isolated. A new method of teaching was confounded with the basic hypothesis. No control for the Hawthorne effect was made. The two curricula in grades 1 and 2

1 The effect is named after the Hawthorne plant of the Western Electric Corporation where it was first noted. It refers to the fact that almost any change, any extra-attention, any experimental manipulation or even the absence of manipulation but the knowledge that a study is being done, is enough to cause subjects to change.
were not equivalent as the English materials were carefully presented while the native lessons were on rough dittoes, often poorly edited. The standard of English of the teachers was low. The high attrition rate suggested that the final sample was extremely selective in terms of the factors which allowed a student to stay in school.

On the whole, severe criticisms were raised about the interpretation of the study, it could probably be taken as support for using the mother tongue in early school years or support for using the second language in later school years. (E, I, P)

2.1.1.6 Carroll (1961) studies the mastery of English by Ghanaian students in five primary schools. It was reported that the native language vocabulary of the Ghanaian students was consistently better than their English vocabulary.

Furthermore, the native language was a much more efficient medium of instruction for them than was English. It was also discovered that the educational standards of secondary school and college students educated under the most favorable conditions with native English speaking teachers, seemed to be far below that of the comparable English groups. Two surveys of teachers' opinion indicated that African students could not show their true intellectual abilities in English alone. (PH, S-, A)

2.1.1.7 Macnamara (1966) studied the effects of teaching arithmetic in Irish to students from English speaking homes in Ireland. Groups of schools belonging to the two linguistic
categories were selected at random and the fifth-standard students were given a problem arithmetic test and a mechanical arithmetic test printed in Irish or English according to the medium of instruction used in the school. The multiple regression technique was used to analyze the results with the subject's non-verbal reasoning ability, socio-economic status, and the teacher's teaching skill as independent variables. The results showed that teaching arithmetic in Irish to native English speaking students hindered the students' progress in solving verbal problems, but not in mechanical skills in arithmetic. Macnamara explained that the difference between the findings was probably due to the fact that in mechanical arithmetic, the student was simply required to do an arithmetic operation indicated by an arithmetic symbol. However, in solving verbal problems he was required to read and understand verbal statements. Hence, language played a very important role in the second type. He concluded that the findings relating to the teaching of other subjects through the medium of the second language were quite discouraging. It seemed that the teaching of other subject through the medium of the second language did not benefit the second language, but was detrimental to the students' progress in mathematics. (E, S-, P).

2.1.1.8 Another research project (the Rizal study) was completed in the Philippines on the medium of instruction by Ramos, Aguilar and Sibayan (1967). It was designed to find out the most appropriate time to introduce reading in the second language (English) and the second language as the medium of instruction.
Five groups were chosen as shown in Table 2.1 according to the grade level of the student at the introduction of second language for reading and as a medium of instruction.

Table 2.1 is here

Schools were systematically chosen, equated on what were thought to be relevant variables and carefully matched. Teachers received training in the teaching of the second language, and in teaching various subjects in the second language. They received no training in the teaching of, or with, the native language and continued to use the old material made after the first Iloilo Experiment.

The dependent variables were arithmetic and second language scores.

The results were as follows: (i) The time at which reading in the second language was introduced apparently made little difference on the second language reading test. (ii) Changing the medium of instruction did not have a great influence on educationally relevant skills. The only effects were on arithmetic and language scores. Those who had been taught in the second language most recently scored highest on the arithmetic test while those who had experienced the second language as the medium of instruction for the longest time had the highest scores on the second language tests in grade six. (E, S-, P).

2.1.1.9 Trevino (1968) used students of Spanish speaking background as subjects for his experiment. The subjects were
assigned randomly to a monolingual or bilingual program of study. The subject matter taught was mathematics. Students under the bilingual program were taught through both their mother tongue and English, while students under the monolingual program received all instruction through the medium of English. Achievement tests were administered to the students afterwards to find out their progress in the two programs. Since inconsistent results were obtained, no firm conclusions were drawn. (E, I, P).

2.1.1.10 Discussion

Almost all of the studies done before 1970 took subjects from primary schools, so any conclusion drawn from these studies might be applicable to primary school students only. Among these 9 studies, Macnamara's study and the Rizal study were among the better and more well designed ones. Both of their results pointed in one direction: the use of a second language as the medium of instruction might not be good for primary school students. For the remaining 7 studies, though they had deficiencies which rendered them less dependable than the two noted above, more than half of them were still pointing toward the same direction.

2.1.2 Research Done in the 70's

2.1.2.1 Tucker (1970) studied three classes in a laboratory school of a university in the urban Philippines. One class was
taught only in English, one only in Filipino, and the third was taught in English and Filipino on alternating days. The subjects taught on those alternate days were not exactly the same. All the students came from middle class families. After one year of the experiment, the results were conflicting; all did equally well on reading in Filipino and on oral English. This suggested that the students using only English learned to read by themselves or by transferring skills, and there was a fair amount of English in all of the students' environments. One strange result was this: Filipino-trained students scored higher than English-trained students on the English social studies test, and vice versa. Tucker concluded that there were no substantial gains for the bilingual group over the other two groups and the year was not detrimental to the students. (E, S+, P).

2.1.2.2 Gile (1971) did a research study in Toronto making use of a model similar to Lambert's Direct Method (which will be discussed later). English speaking students from middle class families were taught in French from the time they were three years old. Then English and French were used alternately as the medium of instruction every half year. Students started to read French in grade one, and started to read English in grade two. The students were not handicapped in the process, and gradually achieved as much as monolingual speaking students. (E, S+, P).

2.1.2.3 Weffer (1972) used primary students of Spanish background as subjects. The subjects were assigned randomly to a
monolingual or a bilingual program of study. The subjects were taught language, arts, and mathematics. Students in the bilingual program were taught both their mother tongue and English, while the students in the monolingual program received all instruction in English. Achievement tests were administered to the students afterwards to find out their progress in the two programs. Weffer reported that the two groups progressed at the same rate in English language and mathematics (in English), but the bilingual group achieved significantly better results in Spanish language and mathematics (in Spanish) than the monolingual group. (E, B+, P).

2.1.2.4 Gallop and Kirkman (1972) compared the performance of two matched groups of Welsh bilingual students on a mathematics test. All the subjects used Welsh as their first language. The test was presented in English to one group, but bilingually (English and Welsh) to the other group. No significant difference was found between the mean scores obtained by the two groups. A follow-up study found that when the students were given the choice when responding to bilingual mathematical questions, there was far more bias towards the use of English than that of Welsh. The study just brought to light the linguistic preference of the Welsh children in that sample. No other conclusion was reached. (E, I, N).

2.1.2.5 Duyne and Gutierrez (1972) used four to seven year old bilingual children of Spanish background to perform a complex perceptual-motor task. They were given only Spanish or English
verbal instructions. These were repeated until the child made four consecutive correct verbal responses to each instruction. The child was asked to perform the task when he had met the above criterion. The scoring of performance for both treatment groups was the number of correct responses. The results showed that the children performed better when Spanish instructions were given. It might be that the children's ability to decode and encode verbal instructions in Spanish into specific perceptual-motor connections was more fully developed than in English. (E, S-, P).

2.1.2.6 One of the most thoroughly conceived and well-conducted studies in this area was the famous Saint Lambert Experiment carried out by the South Shore Protestant Regional School Board of Montreal. The intent was to determine (i) whether reading and content matter learned in the second language would transfer to the first language without systematic instruction, (ii) whether students would learn the second language as well as students who were native speakers of that language, (iii) whether students would be handicapped cognitively or emotionally by the experiment.

Students from English speaking homes were introduced to French in kindergarten. From grade 2 to 6, 60% of the instruction was in French and 40% was in English. The language of the school as a whole was English. Students spoke English to each other outside the classroom. The subjects taught in French were always taught by a native French speaking teacher and English language arts was taught by a native English speaking
teacher.

Two treatment groups were used. The pilot group started first and the follow-up group enrolled in the kindergarten in the following year. The follow-up group was a replication of the pilot group. The control groups were monolingual English speaking or French speaking groups. All were from similar socioeconomic situations and home background (middle class). The progress of the experimental group was compared each year with the control group.

An attempt was made to control for a Hawthorne effect by seeing that control groups were also special in some way. The French control group was engaged in an experimental mathematics program. One of the two English control groups was taken from a school that was well known for excellent language teaching. The second English control group was in the same school as the experimental groups. This attempt at controlling the Hawthorne effect was quite unique among other studies in the same area.

After five successive years of assessments, the results indicated that this program of second language teaching was not detrimental either in the native language or in the subject areas. Furthermore, there appeared to be no adverse cognitive or emotional effects due to participation in this program. (E, S+, P).

2.1.2.7 A replication study using working-class students from Montreal, ranging from lower middle to upper middle-class students also was carried out by Tucker, Lambert and d'Anglejan (1973). The results were quite similar to those of the original
St. Lambert experiment. (E, S+, P).

2.1.2.8 Collison (1974) took Ghanaian students of age 12 to 14 as his subjects. The subjects were divided into 2 groups. The medium of instruction of the first group was their native language and of the second group their second language. Students had to express their questions and opinions in one of these languages according to which group they belonged to. The results indicated that the majority of the second language group were not able to express their conceptual potential while the native language group was more fruitful for enhancing language-thought interaction. He concluded that when the medium of communication was foreign to the students, they might mimic adult concepts without any appreciable contribution to their own conceptual growth and that this was detrimental to the students. (E, S-, JH).

2.1.2.9 After Lambert's comprehensive study of the use of a second language as the medium of instruction, a number of replication studies were done in Canada, especially in the Eastern part of the country. Stern and his associates (1976) reported that the available evidence did not suggest that students in an extended French program fell behind in the academic subjects taught in French. Students enrolled in these programs became more proficient in French and their learning of academic subjects taught through French did not lag behind that of students in the regular program. Furthermore, students and teachers' attitudes towards the program were found to be
positive. (E, \( S^+ \), N).

2.1.2.10 Discussion

All the studies done after 1970 and reviewed here were experimental studies. In general, they were of higher quality than those done before 1970 since many relevant variables were under control. The St. Lambert experiment is probably representative of this group of studies. These studies (except for Duyne's and Collison's studies) seem to suggest that learning through the second language is not detrimental to the achievement of the students. One special feature was that all these studies were carried out by Canadian researchers, and mainly in Canada. Recalling that Canada is a bilingual country and that the Canadian government is trying very hard to push the country from a predominantly monolingual society to a bilingual one in the past ten years, the results from these studies might be heavily influenced by political atmosphere. Furthermore, French and English are two language quite close together in linguistics. Learning one language may help the learning of the second. For countries whose native language is very different from the second language, whether research will arrive at the same kind of result is questionable.

2.2 STUDIES RELATED TO THE TEACHING OF SCIENCE THROUGH A SECOND LANGUAGE

2.2.1 Raisner (1967) selected Puerto Rican students at the
junior high level in the city of New York as his subjects. The subjects were divided into two groups. One group was taught science in Spanish while the other was taught in English. The achievement of the two groups was compared. The results showed that the students achieved better in Spanish and also showed improvement in their own self-image. (E, S-, JH).

2.2.2 Bolger (1967), basing his hypothesis on the same program (i.e. Raisner's study), found that: (i) grade seven students taking the bilingual science program achieved significantly better results than comparable students taking the regular program; (ii) the bilingual science program was effective only when conducted by fluent bilingual teachers. Bolger also discovered that the amount of Spanish spoken at home was not the same among the groups. The experimental group spoke more Spanish than the control groups. When analysis of covariance was used to take this factor into account, the achievement of the groups taught in Spanish showed no significant difference when compared with the achievement of the control groups. He concluded that the language ability of both teacher and student had an effect on the program. (E, I, JH).

2.2.3 Knight (1969) investigated the effects on elementary school students of the bilingual science materials developed by the Southwest Educational Laboratory. He found that the achievement of the Spanish speaking students was statistically not significantly higher when the science materials were presented in Spanish than when they were presented in English.
He speculated that this inconclusive results might be due to the variation of Spanish fluency among the teachers chosen for the study. (E, I, P).

2.2.4 Ng (1970) chose 51 Chinese immigrant students of the fifth and sixth grade in the Los Angeles area as his subjects of study. The subjects were assigned randomly to a monolingual or a bilingual program of study. Students in the bilingual science program were taught through both their mother tongue and English, while students in the monolingual program were taught through the medium of English. The subjects were given both a pretest and a posttest. The duration of the study was four weeks with two one hour lessons each week for each group. He found that students taught bilingually achieved better in vocabulary and conceptualization when compared with the monolingual group. He explained that using the students' mother tongue may especially motivate the students in the bilingual group, enabling them to learn vocabulary better and to conceptualize better since both required the children's memory and the teachers' explanation to facilitate recall. But this method might not help comprehension achievement which requires understanding of the reading materials in which the relationships of ideas and reasoning processes are involved. (E, B+, P).

2.2.5 Cooper (1971) investigated problems of teaching physics to Latin American college students. His study was divided into many parts which investigated different questions. For simplicity,
just those related to the language of instruction are reviewed here. The first part tried to evaluate the teaching of physics units in both Spanish and English to two groups of students from Latin America. The experiment was first performed in 1969 and repeated in 1970 with a slight variation of design. He found that the differences in physics achievement between units taught in Spanish and those taught in English were small.

The third and fourth part evaluated tests of reading in both Spanish and English. He found that the language in which the tests were given did not significantly affect the scores when the reading material contained mathematical components, but it did significantly affect the scores when the reading material was non-mathematical. Furthermore, the scores on the tests given in Spanish were significantly higher.

The fifth part tried to compare the improvement in English ability of a group which was taught physics in English and Spanish and that of a control group taught only in Spanish. He found that students in the experimental group did not show as great an improvement in English as those in the control group. (E, S-, C).

2.2.6 Juarez (1976) tried to determine if single language instruction was more effective than bilingual instruction in a science context. He found no significant difference between treatment groups receiving instruction bilingually, and those receiving single language instruction through English and Spanish. (E, I, P).
2.2.7 Goh (1978) reported that there was a significant drop of science achievement and no improvement in English after switching from Chinese to English as the medium of instruction in teaching science and mathematics at the primary level in Singapore. Goh concluded that language exposure time was not the sole determining factor for the learning of a language. (PH, S-, P).

2.2.8 Discussion

Among the seven studies reviewed here, there are several features which might be very distinct when compared with Section 2.1.2. First, none of the studies suggested that using the second language as the medium of instruction would benefit the students' achievement in science and the second language. Secondly, five of the studies were using immigrants as subjects and two studies used developing country students as subjects. There were no studies based on, say, Canadian students as the subjects. Thirdly, none of these studies focused on the senior high school level when students began to learn science by choice. (This is also the case in Section 2.1.2.)

2.3 STUDIES REGARDING AFFECTIVE FACTORS IN SECOND LANGUAGE LEARNING

2.3.1 Lambert and Gardner (1972) have been doing studies in this area since 1959. The first studies were carried out with English-speaking high school students who were studying French
in the Montreal area. They were tested for language aptitude, intelligence, attitudes toward the French community and intensity of motivation to learn French. Factor analysis of these variables showed that language aptitude and intelligence formed a single factor independent of a second factor interpreted as a composite of orientation toward language learning and attitudes (i.e., affective factors) toward French Canadians. The general findings from this set of studies can be summarized as follows:

1) Motivation and attitude functioned in second language learning as an independent variable by itself.

2) A favourable attitude toward another culture, a desire to learn about that culture and a favourable attitude toward the second language were conducive to foreign language learning.

3) Integrative motivation was more characteristic of successful second language learning than instrumental motivation\(^1\) except for certain areas like the Philippines where there was an urgency about mastering the second language. (E, NA, JH).

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\(^1\) 'Integrative' refers to learners who wish to acquire a new language in order to identify with members of that language community. In other words, they wish to integrate themselves into the culture of the new language group. 'Instrumental' refers to those who wish to use the language as a way of gaining social recognition or an instrument to help them achieve their goals.
Similar studies were carried out in other schools and areas. Results obtained tended to support the above findings, except for the following two cases. In a study of learning Hebrew, the attitudinal measures were found to change from one school to another, depending on the social class of the community. American students learning French in a total immersion program were found to have increased feelings of unrest, uncertainty, and dissatisfaction during that period.

2.3.2 Spolsky (1969) tested three groups of foreign students attending universities in the United States in regard to the affective factors of language learning. He also found that integrative motivation accompanied higher scores in English. (E, NA, C).

2.3.3 Lukmani (1972) studies the relationship between motivation to learn the second language and second language proficiency in Bombay. The subjects were 60 girls from a high school graduating class. They had studied English as a second language for about seven years. The factors, type of motivation, attitude towards their first language, attitude towards English speaking Indians, self concept, and ideal self concept were investigated. The results indicated that instrumental motivation scores correlated significantly with English proficiency scores. This result is opposed to Lambert's general findings but agreed with Lambert's Philippine study. Lukmani argued that the situation of language learning in India and the Philippines was completely different.
from that of French-speaking Canadians learning English, English-speaking Jews learning Hebrew, English-speaking Americans learning English. India and the Philippines are post-colonial societies which were torn by a struggle between tradition and modernization. Since they were trying to establish their own identity, new reference groups had to be forged. These groups might draw heavily on certain aspects of Western society but would ultimately be of indigenous origin. Hence the instrumental orientation towards English was healthy in this kind of situation. (S, WA, SH).

2.3.4 Discussion

There are only three studies reviewed here regarding affective factors in second language learning. Lambert and Gardner's study is probably representative in this field. It appears that there are very few researchers working along these lines, especially in assessing the predictive power of the affective factors on second language proficiency.

2.4 RELATED STUDIES DONE IN HONG KONG

2.4.1 Kvan (1969) did two studies in this area of using second language as the medium of instruction. In the first study, he administered a reading test in English to the first year undergraduate students of Hong Kong University. The subject were told to read as fast as possible, just as they would read background materials. He found that 50% of the subjects read at
a speed of less than 150 words per minute and that 75% read at under 175. This speed was equivalent to that of children of 12-
13 years of age in the U.S.A. or that of British students reading French as their second language. A similar reading test in Chinese was then administered to the subjects. The average speed was 300 characters per minute, which was much higher than the average reading rate in English.

In the second study, Kvan wanted to compare the maturity of essays written by students in Chinese and Anglo-Chinese middle schools. Two sets of essays were obtained from the students on the same subject but written in the two languages. Judges were asked to assess the essays with regard to maturity but disregarding the linguistic expression of detail as far as possible. He reported that the Chinese middle school students showed much more originality of thought and greater maturity in general than did the Anglo-Chinese middle school students. He commented that the results agreed closely with the impression of experienced educators who found that the Chinese middle school students were more responsive and more interested in their surroundings both in and out of the school. (E, S-, C & SH).

2.4.2 Vince (1970) held Language Analysis Sessions for the 216 freshmen of the Arts Faculty of University of Hong Kong. Besides various diagnostic tests and a reading test in Chinese, the analysis included a lengthy questionnaire about the socio-linguistic background, language background, language use, self rating in language proficiency, attitudes towards language and education of this intellectually elite group. The result
included the following:

1) 92% of the students being tested had spent more than ten years studying English, but some of these students were still in need of remedial English in university;

2) students were not actively hostile towards the English language but almost unanimously respected Chinese as a language having traditions and values of one of the world's greatest cultures. (S, S-, C).

2.4.3 Four young Chinese (Cheng, Shek, Tse and Wong) who had been through the Hong Kong education system and who felt compelled to point out what they saw as a serious weakness in the system, did a study in this area in 1973. The study (called AT WHAT COST) used portions of the above Language Analysis Sessions questionnaire with a sample of 170 students in the Chinese University of Hong Kong. The questionnaire was revised and simplified to some extent. A major change was that the questionnaire was translated into Chinese. The results from this survey basically duplicated the results indicated by the previous study in Hong Kong University. The following were some of the results:

1) When rating their abilities in Chinese, most subjects felt that they had no difficulty in listening comprehension (88%) and in reading (64%). They were less certain of their productive skills: 56% of them thought
they had no problem in expressing themselves formally or informally in speech (Cantonese), and 52% of them felt they could express themselves fluently in written Chinese.

2) In self rating of English, only a minority felt they were good in reading (13%), in oral abilities (4%) and in writing (4%).

3) There was little difference in self rating between the students from Chinese or Anglo-Chinese middle schools.

4) The majority of Anglo-Chinese school graduates confessed that they encountered difficulty in understanding English, and more difficulty in expressing themselves in English than in Chinese. (S, S-, C).

2.4.4 Cheung (1974) investigated the effects of medium of instruction on two samples of Form I and Form III subjects selected from an Anglo-Chinese secondary school. Each sample was randomly divided into two groups of equal size. A lesson in topology was taught to both groups in each sample, but through different mediums of instruction. The instruction was taped beforehand and reproduced in class. Relevant charts were shown to the class at appropriate times. After the lesson, a test in multiple-choice form was administered to the subjects to determine their understanding and retention of the lesson. The test results indicated that the two groups of students learning the lesson in Chinese performed consistently better on the
posttest. Cheung concluded that Chinese was a more effective medium of instruction for both of the Form I and III samples tested. (E, S-, JH).

2.4.5 Fu (1975) designed a questionnaire to determine students' opinions on certain aspects of the language situation in Hong Kong. The subjects were 561 students from five different schools. After detailed analysis, Fu found several trends among the opinions of the students.

1) English was an important and necessary subject.

2) Students felt uneasy about using English in speech.

3) Students were proud of their own Chinese culture.

4) Students generally had negative attitudes toward western culture and toward English speaking people. (S, S-, SH).

2.4.6 Poon (1978) investigated difficulties among Hong Kong primary school leavers in learning mathematics through English. Subjects for the study were chosen from the recently graduated grade 6 students of four primary schools. The schools were categorized according to the medium of instruction and the school results on the Hong Kong Ability Test. The results follow:
1) Students whose mother tongue was Cantonese but who had learned English as a foreign language would learn mathematics more efficiently in Chinese than in English except for those with high ability.

2) Chinese primary school students obtained higher scores in mathematics than their counterparts in Anglo-Chinese primary schools. In particular, they were better in specific vocabulary, concept differentiation, problem comprehension, and self-expression in the presentation of solution, but not in the speed of problem reading. (E, S-, P).

2.4.7 B. Chan, Hinton, and Yau (1979) compared the Certificate of Education Examination (CEE) results for students who had completed the course of study in English with those who had studied in Chinese. Nine pairs of schools, each consisting of one Anglo-Chinese and one Chinese Middle School with similar Secondary School Entrance Examination (SSEE) allocation patterns were chosen and their students were taken as the subjects of the study.¹ Student questionnaires, school information sheets, medium of instruction sheets, SSEE results, and CEE results were collected from the subjects and their schools. The results of

¹ The Secondary School Entrance Examination (SSEE) was an achievement test of Chinese, English and Mathematics administered to all students at the end of grade six before 1978. All grade 6 students who had reached a certain standard were then allocated to different secondary schools according to their academic achievement, personal choice and area of residence.
the study were as follows:

1) The Chinese middle school students were culturally and socially less privileged (in terms of education of other family members and expectation and encouragement from the family) than their Anglo-Chinese counterparts.

2) The Anglo-Chinese students generally obtained better CEE results than their Chinese counterparts with comparable SSEE results.

3) The medium of instruction in Anglo-Chinese schools ranked as one of the most important predictors in the CEE results. (PH, S+, SH).

2.4.8 Tam (1979) did a survey to compare the actual medium of instruction used in the Form I (i.e., Grade 7) classroom with that preferred by the students. Utilizing a stratified three stage sampling plan he distributed questionnaires to 71 classes of students in 53 schools. The actual complex sample size was 2,471 students. Multivariate analysis of profiles using Wilk's Likelihood Ratio revealed that students preferred Chinese as the language of instruction, and in classroom discussions in subjects such as English, Mathematics, Science and the Social Subjects. (S, B+, J).

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1 In the Anglo-Chinese schools, the medium of instruction should be English, but many of the teachers use a good deal of Chinese.
2.4.9 Siu and his associates (1979a) did an extensive study in this area. On the basis of patterns of bilingual instruction identified in the sample survey earlier referred to by B. Chan et al, nineteen schools were selected. Four classes in each form (Form II to IV) from each school were asked to take part in the study. A test battery consisting of eight tests and two questionnaires were administered to the students.

After detailed data analysis, the following conclusions were reached.

1) Students who started to use English as the medium of instruction in grade one did not achieve higher scores on English tests than those who started English as a second language at the Form II and III levels (i.e. Grade 8 and 9). The same students made lower scores on the Chinese tests.

2) Using English as the medium of instruction in the Anglo-Chinese secondary schools did not guarantee effective learning of it as a second language.

3) Students perceived that the Chinese language served the functions of communication, cultural and academic development while English language had social and economic values. (S, S-, JH).

2.4.10 P. Chan, Cheng, Fong and Tsui (1979), realizing the high educational cost of using English as the medium of instruction
in Hong Kong schools, constructed an English language test conforming to the grade 4 standard and gave it to a sample of 2,947 grade 7 pupils drawn from 22 schools. The results obtained were disturbing. About 65% of the pupils failed the test.

The researchers also interviewed more than 50 secondary school teachers on the subject of English teaching and using English as the medium of instruction. On the basis of these interviews, they concluded that raising the standard of English and using it as the medium of instruction for school subjects other than English were two entirely separate issues and that it was extremely unrealistic to impose English as a medium of instruction on the majority of pupils. (S, S-, JH).

2.4.11 Discussion

Of the ten studies reviewed in this section, only three studies deal with the effect of using English as the medium of instruction on the achievement of certain subject areas. Among these three studies, the two better designed ones (Cheung, Poon) concluded that the use of English would hamper the students' achievement while the remaining one (B. Chan) indicated that the use of English as the medium of instruction might be beneficial. However, B. Chan's study was not an experimental one, the SES of the students was not adequately controlled with the advantage going to the Anglo-Chinese schools, and hence the conclusions were weak. The authors (i.e. B. Chan et al) even mentioned that this result was contrary to their original expectation.

The remaining 7 studies were mainly concerned with the affective factors in second language learning. All of them
pointing in the same direction—students preferred more Chinese and less English. Furthermore, they also found that the long hours of studying English in primary and secondary schools did not help to improve the standard of English as much as expected by society.

2.5 SUMMARY OF INVESTIGATIONS

A total of 38 studies have been reviewed in the last sections. Though most of them relate directly to the effects of the medium of instruction, teaching of science, and affective factors in learning a second language, they still cover a very broad area. The following is a summary of the studies according to the method used, effects, and levels of samples selected. The summary is in a tabular form showing the frequencies that occurred in different areas. Though each study is different and their individual contribution to knowledge may not be of the same weight, the author feels that it is hard for one to assimilate all the results (38 studies!) at once if one does not put it in some form (e.g., frequency tables) which is more comprehensible. In reading the tables, one must bear in mind that the result of each study is assumed to be approximately equal in weight.

2.5.1 The methods used in different students were roughly divided into three kinds: survey, experimental and post hoc comparison. The following is a table showing the frequencies that occurred in different areas.
Table 2.2 is here.

In Table 2.2, one notices that among the 38 studies, 23 of them were experimental studies done after 1970. This indicates that recently there has been a trend towards more control of the variables in the studies in this area. This is a healthy sign since more control means that we are not being misled by nuisance variables.

2.5.2 Studies of the effects of the medium of instruction on academic achievement in the studies were divided into four groups as indicated in the following table:

Table 2.3 is here.

In Table 2.3 one notices there was a tendency to conclude that using the second language as the medium of instruction was detrimental to students. An interesting point was that after 1970, there were six studies claiming that the use of the second language as the medium of instruction might be beneficial to the students. A closer look at these studies revealed that five of them were done by Canadian researchers. Four of the studies were actually carried out in Canada. On the other hand, of the twelve studies that claimed that the use of the second language was detrimental, three of them were done in science and seven of them were done in Hong Kong. What do these diverging results mean? Does it suggest that English and French are two similar
languages and learning one might generally help the other?

In the case of Chinese, since it is very different from English, the same effect might not occur. J. Chan (1976) points out

'... The fact that the Chinese written language is "ideographic" whereas the English written language is "phonetic", and that spoken Chinese and written Chinese are quite different. Very often, too, the Chinese characters give away the answer to an item ...'

2.5.3 In general, there are three different kinds of students using second language as the medium of instruction, hoping to improve their second language competency. They are students who are from developed countries, developing countries and immigrants respectively. Their motives of learning second language may be different. Students from developed countries probably have integrative motives while students from developing nations have instrumental motives. Immigrants will probably have both motives at the same time.

If Table 2.3 is recategorized with the column heading changed to different types of students using second language as the medium of instruction, the following table is obtained.

Table 2.4 is here.

From Table 2.4, more obvious trends are revealed. Students in the developed nations learn well when second language is used
as the medium of instruction while students in the developing nations are hampered in learning when second language is used as the medium of instruction. Immigrants seem to be lying between the two extremes. Does it indicate that students in the developed countries are more gifted linguistically than others? Or, is it because they have confidence in their own mother tongue so that the learning of a second language is an addition to them (additive bilingualism)? In the case of students from developing countries, they may have an inferior feeling about their own mother tongue. The learning of second language which is usually a language of wider communication will make them become confused about whether they should give up the mother tongue. This kind of confusion will hamper their learning in second language (subtractive bilingualism).

As for learning science, this requires the understanding of many concepts which depend greatly on a good command of language; the use of the second language as the medium of instruction may hinder the students' learning.

2.5.4 The samples selected for the studies were divided into four levels as shown in the Table.¹

Table 2.5 is here.

¹ One study under the 'General Studies' column covered four levels, so it was counted four times instead of one. Similarly, another study under the 'General Studies' column covered two levels, it was counted two times instead of one.
Table 2.5 shows that of the four different levels, the senior high school students were seldom chosen as subjects of study. In particular, there was no study done on the teaching of science through the second language at the senior high school level.

2.6 WEAKNESSES IN THE RESEARCH

Thirty eight studies were reviewed for this investigation, and while they covered many aspects of the problems relating to the medium of instruction, several areas have not been explored or fully investigated.

From the tables shown in Section 2.5.4, we note that there has been no research done in bilingual science education at the senior high school level. Besides that, there appear to be very few studies focusing on the affective factors of learning in a second language. Furthermore, few studies involving experimental research could be found among those done in Hong Kong.

Any problems that may be created by the use of a second language as the medium of instruction will affect thousands in Hong Kong and millions around the world, this gap in the research literature should be bridged. The present study is an attempt to address specific issues within this problem area.
The Chapter describes how the specific questions raised in Section 1.1 were investigated. Included is a schematic chart of the research design to clarify the test. Figure 3.1 is here.

3.1 RESEARCH HYPOTHESES

Based on the finding in Section 2.5 and 2.6, the following hypotheses were formulated, detailed rationale will be explained later in each relevant sections.

General Hypothesis I: Students whose first language is Chinese but who have been taught English as a second language will achieve higher scores in physics when physics is taught through the medium of Chinese than when it is taught through the medium of English.

This hypothesis was formulated to answer Problem 1 raised in Section 1.1. To test this hypothesis, three specific

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1 The two studies (No. 1 and 2) on the comparison of physics achievement between the two classes in the ACS group are not in the original proposal. The purpose of adding these two studies is to strengthen the credibility of the original study if the ACS and CS groups are very different from each other.
hypotheses were formulated. Specifically how these relate to the general hypothesis is elaborated in Chapter 5.

**Hypothesis Ia:** Grade 10 students in Chinese schools will achieve higher scores in physics than grade 10 students in Anglo-Chinese schools.

**Hypothesis Ib:** Grade 10 students of Anglo-Chinese schools will achieve higher scores in physics when it is taught bilingually than when it is taught through English only.

**Hypothesis Ic:** Grade 10 students of Anglo-Chinese schools will achieve higher scores when physics is taught through the medium of Chinese than it is taught through the medium of English.

For Problem 2 and 5 in Section 1.1, multiple regression methods were used to find out which factors (proficiency in English, motivation in physics, study habit in physics, etc.) would be significant in predicting the achievement of physics.

To answer Problem 3 and 4 in Section 1.1, similar methods were used to find out which factors (aptitude, motivation in English, etc.) would be significant in predicting the proficiency of English.

3.2 THE SELECTION OF SUBJECTS
Ideally, a probability or systematic sample of schools and/or subjects should have been chosen. Such a sample is required to safeguard the internal validity of the study and enhance generalization to the target population. For reasons given below, this method was not followed:

1) The study was done in a politically sensitive area. Because of the present government's language policy, very little cooperation from government agencies such as the Education Department (i.e. The Ministry of Education) could be expected for sampling purposes.

2) The research involved about 8 months of controlled instruction in physics to parallel classes in two different languages. Very close cooperation between the writer and assisting teachers was required. The demands of the study on the classes and teachers involved was extraordinarily heavy. These conditions necessitated using available, intact classes and carefully selected assisting teachers.

Following Fu's recommendation for further studies after her comprehensive research on language problems of Hong Kong students (Fu, 1975), two secondary schools (one Chinese and one Anglo-Chinese secondary school) were chosen for the study.¹ The schools available to the writer for this purpose were government

¹ From now on, the two schools will quite often be written in the short-form as CS (i.e. Chinese secondary school) and ACS (i.e. Anglo-Chinese secondary school).
subsidized and above average\textsuperscript{2} in academic achievement compared to all other secondary schools in Hong Kong, and administered by the same Christian organization. The selection consisted of the students and teachers at the Form 4 level (i.e., Grade 10 level) in the two schools. There were two classes in each school at this grade level taking the same course in physics; thus the subjects consisted of four classes of grade 10 students in physics.

The reasons for making this selection for the present study were as follows.

1) Although the selection was too restrictive for unequivocal generalizations, experience and intuition led the writer to believe that cautious generalizations based on the results of the selection could be made to other similar school situations.

2) The research program could fit quite naturally into the school program and thereby reduce a possible Hawthorne effect. This is in keeping with the principle of unobtrusive experimental design.

3.3 METHOD OF ESTABLISHING THE COMPARABILITY OF THE GROUPS

Since the two groups of subjects were not randomly chosen from the target population of all the grade 10 physics students in Hong Kong, it was questionable whether they were comparable.

If the comparability of the groups was unknown, it would be

\textsuperscript{2} The Chinese School - Pui Ying Middle School
The Anglo-Chinese School - Ming Kei College
Based on the annual mean Certificate of Education Examination scores, the two schools were consistently above the average of all the secondary schools in Hong Kong.
difficult to tell whether any difference found in achievement in this study was due to the treatment effect or the initial group difference. Hence the following method was used to establish the comparability of the groups.

3.3.1 Pretest of Physics Achievement

From the results of the Certificate of Education Examinations in Hong Kong, the two schools chosen for the present study were evidently above-average in academic achievement when compared to other secondary schools in Hong Kong. To explore the possibility that the students in the experimental classes of the two schools did not have equivalent knowledge and experience in the content area to be taught, a pretest in physics achievement was administered to all four classes.

The pretest was given to the students in the first physics period in September 1978. Although the first periods of the two schools were at different times, there was very little, if any, possibility of students' exchanging information about the test because the two schools were quite far apart and the students did not know they were participating in the same research study.

3.3.2 Equivalence of the Two Groups on Other Factors

In order to determine whether the Chinese and the Anglo-Chinese groups were equivalent with respect to other factors

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1 The two schools are situated in two different areas of Hong Kong, like North and West Vancouver in this area. They are about five miles apart.
likely to threaten internal validity, the following steps were taken.

1) Background information on the two groups of students including age, sex, socioeconomic background, S.S.E.E. results and their reasons for choosing or otherwise being in their present school was carefully investigated through a survey study in order to find out whether the groups could be presumed to be similar with respect to these factors.

2) To check whether the two groups were of equal ability, an aptitude test battery (Siu, 1978) was administered to the two groups of students. The battery consisted of eight subtests. They included the following: Chinese verbal reasoning (CVR), Chinese language usage (CLU), English language usage (ELU), English verbal reasoning (EVR), mathematical reasoning (MR), abstract reasoning (AR), mechanical reasoning (MER), and spatial reasoning tests (SR). Since the total time for administering all eight subtests was 4 1/2 hours, it was not possible to administer the entire battery in one session. Instead, several shorter sessions were used to administer the

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1 The background information collected in the survey will be described in a later section. (Section 3.4.2)
battery. 2

3) Multivariate analysis of variance study (MANOVA), was used to study the equivalence of the groups. In this study the independent variable was group membership. Students enrolled in grade 10 physics in the Chinese school (N=90) constituted members of Group 1, and students in grade 10 physics in the Anglo-Chinese school (N=86) constituted Group 2 in the analysis.

The dependent variables (potential covariates) in the study were physics background as measured by the pretest, and aptitude as measured by the subtests in the aptitude test battery. The central purpose of MANOVA was to determine whether the two groups differed significantly on the dependent variables (criteria) identified above when considered together. In this analysis it would be possible

2 In the original thesis proposal, the writer did not know of any aptitude or intelligence test which was suitable for grade 10 students in Hong Kong. So the writer proposed to take the grades on proficiency in Chinese, English and Mathematics as measured by the Secondary School Entrance Examination (S.S.E.E.) taken in May 1975 by the students as an indication of students' ability. This was not ideal since the S.S.E.E. was taken by the students three years before the present study. One did not know whether there were any changes due to other effects during that period of three years. When the writer actually carried out the study, he found that out of the 176 students, only 126 students had S.S.E.E. grades. Since this large percentage of missing data would seriously hamper the consequent statistical analysis, the author was forced to abandon this idea and tried to find a substitute for S.S.E.E. Fortunately, Siu's aptitude test battery was just ready in the market and it was used to replace the S.S.E.E. Judging from the original purpose of finding a measure for the ability of the subjects, Siu's aptitude test battery would suit the purpose even better than the original proposed S.S.E.E. grades.

The correlation coefficients of S.S.E.E. grades and the aptitude test battery obtained from the 126 subjects were as follows:

- S.S.E.E. Chinese vs Sum of CVR and CLU 0.38
- S.S.E.E. English vs Sum of EVR and ELU 0.76
- S.S.E.E. Mathematics vs Sum of MR, AB, MER, SR 0.56
to detect significant differences between the two groups even if they differed only slightly on each criterion taken alone. The intent of the analysis was that if significant differences between the two groups would be found, subsequent discriminant analysis would be used to determine the nature of the group differences in order that these differences might be taken into account in subsequent analysis.

3.4 INSTRUMENTATION

The present study made use of a number of achievement tests and scales for measuring the background variables. Some of the tests were existing tests for which test statistics from previous applications were available. Other tests which did not have developed test statistics were analyzed by making use of a computer program designated as the Laboratory of Education Research Test Analysis Package (LERTAP). The purpose of the LERTAP program is to do item and test analysis.

3.4.1 The Achievement Tests

3.4.1.1 Pretest of Physics Achievement (Appendix 1)

The pretest was a 40-item multiple choice written examination. The items in the test mainly covered the topic of

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1 Details of the program can be obtained from the Educational Research Service Centre, Faculty of Education, the University of British Columbia.
Light and Sound, to be taught under controlled conditions. The content validity of the test (see Appendix 2) was checked by a panel of judges consisting of the teachers involved in the present study and two not involved in the present study.

Since the test was presented to one group (2 classes) in Chinese and another group (2 classes) in English, the equivalence of the two versions had to be established. The original test was in English; the Chinese translation of the test was prepared by the teacher who taught in the Chinese school, with the help of the writer (see Appendix 3). To make sure that the Chinese translation was accurate, it is translated back into English by another fluent bilingual teacher. The resulting two English versions were then compared by Dr. Gamal Nasr. Out of the 40 translated items, 26 items were judged to be exact translation, 10 items were good translations, and 4 items were acceptable. Hence the Chinese translation of the test was taken to be equivalent in content to the original version in English.

3.4.1.2 Post-test of Physics Achievement

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3 Dr. Gamal Nasr (B.Sc., M.Sc., M.Ed., Ph.D.), an Ed.D. student in the Science Education Department, University of British Columbia.

The degree of accuracy of translation was arbitrarily divided into five levels:

- **Exact** - the two items were the same.
- **Good** - the two items were of almost the same meaning.
- **Acceptable** - the two items were of roughly the same meaning.
- **Bad** - the two items were slightly different.
- **Different** - the two items were of different implications.
The content of this test was the same as the pretest except for one item (No. 27) which was deleted since its index of item discrimination in relation to total score was negative.

3.4.1.3 Post-test of Physics Achievement 2 (Appendix 8)

This was a 25 item multiple choice test. The items in the test mainly covered the topic of Light and Sound that was taught in the present study. The content validity of the test was judged by the assisting teacher and the writer. The original test items were in English. They were translated to Chinese by the writer with the help of the assisting teacher (see Appendix 10). The Chinese version was then retranslated back to English by another physics teacher. The two English versions were then compared for equivalence by Dr. Gamal Nasr. Out of the 25 translated items, 19 were judged to be exact, 3 good, 2 acceptable and 1 different. Further checking of the item that was judged to be different revealed that the Chinese translation was correct but the retranslation to English was not good. Hence the English and Chinese version of that item was still the same in meaning and the equivalence of the two translations was established.

3.4.1.4 Retest (Appendix 9)

Thirty good items of Posttest 1 and Posttest 2 were chosen to form the Retest. Good items referred to those having suitable

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1 Mr. C.C. Wong (B.Sc., Dip.Ed., Dip.System Analysis), a bilingual physics teacher.
difficulty level (0.35-0.70) and discrimination index (0.20-0.70). Furthermore content validity was taken into consideration in making the test.

The reliability of the post-tests was obtained by the test-retest method. The test of the 'good items' (i.e. the Retest) was administered to the two groups of students at the end of May 1979. The students were notified that they would have a test just several days before the date of administration without being told that it was a retest of the previous test. As the test-retest method is seldom used in Hong Kong, the students would not expect to meet the same items they had seen several months earlier though they had copies of the item (it is a common practice in Hong Kong to return the test items to students after each test). Hence memory and coaching effects were reduced. The correlation of test and retest scores constitute an indicator of the reliability of the test. The reason that the test-retest reliability coefficient was used rather than the internal consistency coefficient was mainly that it was also related to the purpose of the present study. What the research required was mainly the stability of the test results.

3.4.1.5 Test on Mechanics (Appendix 12)

Mechanics test items were chosen from some previous Certificate of Education Examination papers. They were first administered to the grade 11 students of the Anglo-Chinese school as a pilot study. Only 41 items of suitable difficulty level and discrimination index were retained to form the present
3.4.1.6 **Test on Atomic Physics** (Appendix 14)

This test was developed by a research group in the School of Education, the Chinese University of Hong Kong. It was first used in a research project (Siu, 1979b) and was adopted here.

3.4.1.7 **English Proficiency Test Battery** (Appendix 15)

This test battery appears to be very similar to the Test of English as a Foreign Language (TOEFL). It consisted of five subtests to measure five different areas of English proficiency. They were respectively, listening comprehension, English structure, vocabulary, reading comprehension and writing ability.

3.4.1.8 **Aptitude Test Battery** (Siu, 1978)

This test battery was developed by Dr. P. K. Siu, Lecturer of the School of Education of the Chinese University of Hong Kong. It was specially normed for an average grade 9 student in Hong Kong. Dr. Siu suggested that it was also a reliable instrument for grade 10 students. The reliability (KB-20) of the test battery was as follows: Chinese verbal reasoning (0.80), Chinese language usage (0.71), English language usage (0.87), English verbal reasoning (0.91), mathematical reasoning (0.81), abstract reasoning (0.86), mechanical reasoning (0.69), spatial

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1 The author used these test booklets to prepare for TOEFL and achieved a high score. He concluded from this experience that the test items were very similar.
reasoning (0.84). The above data on reliability was the only available information obtainable from the author of the test, Dr. Siu. They were based on a random sample of about 3000 students taken from the whole grade 9 population in Hong Kong.

3.4.1.9 Summary of Statistics on the Achievement Tests

Table 3.1 gives the most important test statistics of the achievement tests discussed in this section.

Table 3.1 is here.

Of note in Table 3.1 is that the reliability of the Pretest is somewhat low. But, recalling that when the test was administered, the students had not been taught the content being tested, low reliability can be expected since students presumably guessed blindly.

The test-retest reliability between the 'good' items of Posttest 1, Posttest 2 and the Retest was 0.70. The time between the tests was five months. In calculating this value, the scores of one whole class (the 4B class of the Chinese school) were dropped because evidence of coaching was found. Before taking the Retest, the average score of these students was consistently lower than the average score of the students in the other three classes. However, on the Retest, the scores of the students dropped were the highest among the four classes. Interview of the students revealed the fact that they had reviewed only the content of Posttest 1 and Posttest 2 rather than all the things learned before the Retest. Hence, the scores of these students
were dropped in the calculation of test-retest reliability.

The five English tests were sub-tests of the English Proficiency test battery. The reliability (internal consistency proposed by Hoyt) of the complete battery of tests was 0.94.

3.4.2 Survey Questionnaire

In order to facilitate a detailed analysis of the relationship between achievement in physics and the language of instruction, relevant background information was collected from the students and teachers involved in the research study. A description of the variables measured is given below. The parentheses at the end of each description indicates the relevant section of the questionnaire.

3.4.2.1 The Scales

1) Socioeconomic background (SES)

This refers to the background or environment indicative of both the social and economic status of an individual. The questionnaire was used to collect data on students' family income, social class, parents' education, and other miscellaneous matters (Set I, Section A).

2) Motivational intensity in physics (MIP)
Motivational intensity refers to the intensity of a student's efforts and desires to achieve a certain goal and educational objective. The present scale was used to find out the amount of homework students did in the study of physics, their intentions for further study, and the importance they attributed to learning physics (Set III, Section C).

3) **Desire to learn physics** (DLP)

Desire refers to a conscious wish to achieve certain goals. The present scale was designed to find out the students' eagerness for doing assignments in physics and how much attention they paid in physics class (Set III, Section D).

4) **Study habits in physics** (SHP)

Habits refers to a pattern of behaviour which through practice has become easy and familiar, and is performed without conscious thought. The present questionnaire was designed to find out the students' study habits in preparing for physics classes (Set III, Section E).

5) **Students' knowledge of English** (SKE)

This includes the students' language history and use
of English in and out of the classroom (Set I, Section B).

6) Parents' knowledge of English (PKE)

Information about the parents' use of English (Set I, Section C).

7) Orientation toward English (OTE)

This refers to the process of making a person aware of factors in his environment for the purpose of facilitating effective adaptation in learning English. The present scale was a rating of possible reasons, instrumental and/or integrative, for studying English in terms of students' sentiments toward learning English (Set I, Section D).

8) Attitude toward English as a medium of instruction in secondary schools (AEMI)

Attitude refers to a learned predisposition of favourableness or unfavourableness towards an object. In the present scale, the object was "English as a medium of instruction" (Set I, Section E).
9) **Motivational intensity in English (MIE)**

The scale was used to find out the amount of homework students do in the study of English, their intentions for further study, and the importance they attribute to learning English (Set II, Section A).

10) **Parental encouragement (PE)**

This is the amount of encouragement students receive from parents to do well in English (Set II, Section B).

11) **Attitude toward English speaking Westerners (ATES)**

This scale was used to find out how a student felt about English speaking Westerners (Set I, Section G).

12) **Desire to learn English (DLE)**

This scale was designed to find out students' eagerness for doing assignments in English and how much attention they paid in English class (Set II, Section C).

13) **Attitude toward foreign languages (ATFL)**
This scale deals with students' general attitude toward learning foreign language (Set I, Section F).

14) *Study_habits_in_English* (SHE)

This scale was used to determine students' study habits in preparing for English classes (Set II, Section D).

15) *Reading_habits* (RH)

This scale was designed to determine the kind of books that students chose to read apart from those connected with their school work (Set II, Section E).

16) *Attitude_toward_life_in_Hong_Kong* (ALHK)

This scale deals with how a student feels about present life in Hong Kong (Set II, Section F).

17) *Authoritarianism* (AU)

This refers to the general position that a source of control and order (external to the reasoned judgement of the individual and to the common persuasion of a free man) should prevail and settle human choices. The present scale consisted of items
chosen from the California F-scale of authoritarianism which were relevant to Hong Kong\textsuperscript{1} (Set II, Section G).

18) Ethnocentrism (ETH)

This refers to a relatively consistent frame of mind concerning "aliens" generally. A primary characteristic is the generality of outgroup rejection. The present scale was specially constructed for students in Hong Kong (Poon, 1977) (Set III, Section G).

19) Cultural allegiance (CA)

This refers to one's support of or loyalty to one's own culture. The present scale was used to determine students' preference for Chinese and/or Western ways of life (Set III, Section B).

20) Anomie (ANO)

This refers to the feelings of social uncertainty or dissatisfaction which sometimes characterizes not

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\textsuperscript{1} The California F-Scale of Authoritarianism consists of many items originally constructed for Americans. Some items did not suit Hong Kong because Hong Kong people don't have the same background as Americans so those items had to be deleted by the author.
only the bilingual but also the serious student of a second language. The present scale was designed to measure the degree of satisfaction/dissatisfaction with Hong Kong society (Set II, Section H).

21) **Rating of English skills (RES)**

The reference here is competency in the use of language. The present scale was concerned with students' self rating and rating of parents' skill in English (Set II, Section I).

22) **Self-concept of academic ability (SCAB)**

The content of this scale deals with behaviour in which one indicates to self (publicly or privately) one's ability in academic work as compared with others engaged in the same work. The present scales consisted of self concept in four different directions: self, parent, friend and teacher (Set III, Section A).

The above information was collected both from the students and teachers involved in the study. In the case of the teachers, the following information was also required in addition to the information required of the students.

23) **Self report of teaching**
Behaviour in which one indicates to self one's teaching as compared with other who are engaged in the same task.

24) **Qualification and experience**

25) **Teaching performance** (TP)

This involved evaluation of teaching performances by students (Set III, Section F).

Background information 1 and 22 deal with variables which were suggested by Brookover (1967) and Mitchell (1968) as possibly having direct or indirect relation with the students' general academic achievement. Variables 2-4 are an indication of the students' interest in physics which might influence the students' achievement in physics. Variables 5-21 are those variables which were suggested by Fu (1975, pp. 187-189), Gardner and Lambert (1972) as possibly influencing proficiency in English of the students. Variables 23-24 deal with important factors about the teachers' ability to teach which might affect the students' learning.

Since the whole questionnaire was extremely long, it was broken into three sub-sets (see Appendix 6) so that each sub-set required not more than 35 minutes to complete. Furthermore, the data
were collected at the beginning, middle, and end of the first term in order to reduce possible fatigue and boredom.

The original questionnaire was in English. Later, it had to be translated into Chinese for students expected to respond in Chinese. The translation (see Appendix 7) was done by the writer and a professional translator. To make sure the Chinese translation was accurate, it was translated back into English by another fluent bilingual. The two English versions were then compared.

The equivalence of the two translated versions of the Questionnaire was judged by Mr. Stanley Taylor. Out of the 296 translated items, ninety-four were judged to be exact, ninety good, eighty-four acceptable, eleven bad and seventeen different. Among the twenty-eight items that were judged to be bad or different closer examination by another bilingual teacher revealed that the non-equivalence was mainly due to the retranslation of the Chinese version into English rather than the first translation of English into Chinese. Out of the above twenty-eight items, only six items were judged.

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1 Miss Rosemary W.K. Lo, (B.A.), a professional translator working for the Hong Kong Government.
3 Mr. Stanley Taylor (B.Sc., M.Sc., M.Ed.), a doctoral candidate of the Science Education Dept., the University of British Columbia.
to be bad or different when they were translated from English to Chinese. Hence the two versions of the Questionnaire were probably very much the same. Furthermore, out of the 176 students who answered the Questionnaire, only one student chose to answer the English version in Set I of the Questionnaire. The comparability of the scores between the two versions is thus not considered to be a serious problem affecting interpretation of results.

3.4.2.2 Statistics of the Scales

There were a total of twenty-three scales in the Questionnaire administered in this study which required statistical analysis. Table 3.2 is a summary of the statistics for the scales.

Table 3.2 is here.

In calculating the reliabilities of the scales, several scales were modified by dropping certain items in order to increase the reliability while at the same time not reducing the content validity (see Appendix 17 for detailed discussion). Even after this modification (i.e. with some of the items dropped), some of the scales still had low reliability (in the sense of internal consistency). Upon checking the origins of the scales (Gardner and Lambert, 1972), it came to light that the scales were probably not asking questions on exactly the same area and hence of low internal consistency (see Appendix 18).
3.5 COMPARISON OF PHYSICS ACHIEVEMENT BETWEEN CHINESE AND ANGLO-
CHINESE SCHOOLS

To study how much influence the language of instruction had on the students' achievement in physics, a research design following the quasi-experimental design designated Design 10 by Campbell and Stanley (1963) was used. To make the study feasible, the following specific hypothesis was formulated.

Hypothesis Ia: Grade 10 students in the Chinese school will achieve higher scores in physics than grade 10 students in the Anglo-Chinese school.

This hypothesis was transformed to the following statistical hypothesis.

\[ H_0 : \mu_c = \mu_a \]

\[ (\alpha = 0.05) \]

\[ H_1 : \mu_c > \mu_a \]

where \( \mu_c \) = mean physics score of grade 10 students from Chinese schools

\( \mu_a \) = mean physics score of grade 10 students from Anglo-Chinese schools.

This hypothesis was formulated to answer Problem 1 raised in Section 1.1.

In this study, all the selected subjects were involved. Two

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1 Teacher in the Chinese School—Mr. C.C. Wong (B.Sc., Dip. System Analysis, Dip.Ed.).
Teacher in the Anglo-Chinese School—the Writer himself.
teachers took part in the study. One taught the two classes in the Chinese school and the other taught the two classes in the Anglo-Chinese school. The two teachers were the regular physics teachers of the classes involved. The two schools are quite far away from each other, reducing the possibility of sharing of information between subjects.

3.5.1 Three Months of Controlled Teaching in Physics

During the period, September 4 to December 11, 1978, the two groups of students were taught the same content in physics, one group in Chinese by the assisting teacher and the other group in English by the writer. The content chosen for this study was "Light and Sound". The reason for selecting "Light and Sound" rather than other topics in physics was mainly that the physics content background of the two groups was different. For example, the Chinese group had studied some Mechanics in grade 9 while the Anglo-Chinese group had not. After careful consideration, the unit on Light and Sound was found to be suitable since the groups were judged to have about the same background in the subject and its difficulty level was appropriate for the grade 10 students.

In order to control as much as possible the teacher effect and the effect due to the methods of instruction, the two groups used the same textbook (Abbott, 1969) but different translations (English or Chinese). The teachers followed the textbook as closely as possible. Their teaching schedules (see Appendix 4) were cross-checked every week to ensure that they were teaching at about the same rate. The two groups did the
same experiments with approximately the same kind of apparatus. Furthermore, if there were any questions or discussions raised in class, they would be noted down and the other teacher would be notified so that he could present the salient points to his class in the pre-determined language of instruction. Some of the teaching materials are included in Appendix 5.

To sum up, every reasonable effort was made to maintain uniformity in teaching style and handling of content so that the two groups differed only in the language of instruction during that period of learning.

3.5.2 Post-test of Physics Achievement

Upon completion of the controlled teaching-learning period, an achievement test (Posttest 1) on the content studied was given to the groups of students, in Chinese or English according to the medium of instruction used. After a month, another achievement test (Post-test 2) (see Appendix 8) on the content studied was administered to the students.

Each student's score was the number of correct items over all the 'good' items. It was foreseen that comparison of these post-test scores might require that the scores first be adjusted for initial differences on factors revealed in the MANOVA study. Differences in the adjusted post-test results, if any, could then be attributed to the language of instruction with great confidence, since other possible factors would have been taken

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1 Actually, this test was a part of the ordinary term examination paper consisting of multiple choice items and essay type questions.
into account or balanced out across the groups as much as possible. (See the section 'Three Months of Controlled Teaching in Physics').

3.6 METHOD OF INVESTIGATING THE RELATIONSHIP BETWEEN PHYSICS ACHIEVEMENT, PROFICIENCY IN ENGLISH AND OTHER RELEVANT FACTORS

The present study was designed to answer Problems 2 and 5 in Section 1.1. Since the focus was on learning physics through the second language, only the data collected from the Anglo-Chinese group were analyzed in detail while those data collected from the Chinese group were taken as a reference.

The scores on physics achievement were obtained as described in 3.5.2. Proficiency in English was measured by a test battery similar to the Test of English as a Foreign Language (TOEFL). It consisted of five subtests: listening comprehension, English structure, vocabulary, reading comprehension and writing ability (see Appendix 15). The total administration time for the test was 140 minutes. Since the test was too long for the time period of an ordinary lesson, the administration of the test battery was broken into several shorter sessions. Further, since the writer did not want the students to know they were under special study, the tests were given during the English lesson periods by the regular English teachers as a normal assessment. The total marks of all five of

1 The two subtests (English verbal reasoning and English language usage) of the Aptitude Test Battery could be used as a measure of English proficiency also. But the present test battery of English proficiency was an internationally recognized one which should be more reliable and so is adopted.
the subtests were considered as a measure of proficiency in English.

When a Chinese student learns physics through English, his proficiency in English will definitely affect his learning of physics. Besides that, his aptitude, motivation to learn, etc. will also affect his learning. What we want to know is how important English proficiency is in affecting the learning of physics when compared with other factors such as aptitude, motivation to learn, etc. So the scores of physics achievement were analyzed, using multiple regression with English proficiency (5 variables), aptitude (8 variables), socioeconomic background, motivational intensity in physics, desire to learn physics, study habits in physics, self-concept of academic ability and teacher factors as independent variables in order to find out which variables contributed significantly to the variance of physics achievement.

3.7 METHOD OF INVESTIGATING THE RELATIONSHIP BETWEEN ENGLISH PROFICIENCY, AFFECTIVE FACTORS AND OTHER RELEVANT FACTORS

This study was designed to answer Problem 3 and 4 raised in Section 1.1. It made use of the data collected in the previous studies but focused on English proficiency rather than achievement in physics of the Anglo-Chinese subjects.

The English proficiency scores were treated as the dependent variable in the statistical analysis. The independent variables were: aptitude, socioeconomic background, students' knowledge of English, parents' knowledge of English, orientation toward English, attitude toward English as a medium of
instruction in secondary schools, motivational intensity in English, parental encouragement, attitude toward English speaking Westerners, desire to learn English, attitude toward foreign languages, study habits in English, reading habits, attitude toward life in Hong Kong, authoritarianism, ethnocentrism, cultural allegiance, anomie, rating of English skills and self concept of academic ability. Multiple regression was used to analyze the data in order to find out which variables contributed significantly to the variance of English proficiency.

3.8 ADDITIONAL STUDIES

Since subjects in the present study were available (intact classes from two schools), there was always the possibility that the two groups would be very different if the two schools were very different (which should not be). Section 3.3 was just a technique to find out initial group differences so that the experimental results might be adjusted accordingly. In case the two groups were very different, the results obtained from Section 3.4 might not be too reliable and major inference from the study would be seriously hampered. The present two additional studies were designed so that they would give extra support to the original study in Section 3.4.

Since our interest was focused on students' learning physics through the second language, the two classes of the Anglo-Chinese group were selected for the present two additional studies. This selection would eliminate errors due to the difference of school or teacher since subjects were studying in
the same school and under the same teacher (i.e. the writer himself).

Making use of the method and the data collected on the Anglo-Chinese group in Section 3.3, the equivalence or initial difference of the two classes could be determined and so appropriate adjustment could be made in subsequent studies if required.

3.8.1 **Comparison of Physics Achievement Between English and Bilingual Instruction**

In this study, the following hypothesis was investigated.

**Hypothesis Ib:** Grade 10 students of Anglo-Chinese school will achieve higher scores in physics when it is taught bilingually than when it is taught through English only.

This hypothesis was transformed to the following statistical hypothesis.

\[ H_0 : \mu_b = \mu_e \]  
\[ (\alpha = 0.05) \]
\[ H_1 : \mu_b > \mu_e \]

where \( \mu_b \) = mean physics scores of bilingual class
\( \mu_e \) = mean physics score of English class.

During the period February 7 to April 20, 1979, the two classes of students were taught the same content in physics, one group in English only and the other group in English, but with
the help of Chinese explanations whenever necessary (i.e. bilingual instruction).

The content taught was 'Mechanics' (see Appendix 11). The reason for selecting 'Mechanics' were that the topic had not been taught before, and it was included in the syllabus for grade 10 physics in Hong Kong.

Since the two classes were from the same school, they had almost the same academic background. The teacher effect was minimized since only the writer was involved in teaching the two classes. Furthermore, the physics lessons of the two classes usually followed very closely in time. The writer had no difficulty in recalling what he had taught the other class in the previous period. The writer also tried to follow the textbook as closely as possible during the lessons and the two classes did the same experiments with exactly the same kind of apparatus. Finally, if there were questions or discussions in one class, the writer would present the problem and a summary of the discussions to the other class as well.

Upon completion of the teaching-learning period, an achievement test on the content studied was given to the two classes of students in English only. The achievement test was piloted beforehand with another group of students in the same school. Only those items with suitable difficulty level were retained for the post-test. (See Appendix 12).

A comparison of the post-test scores might require that the post-test scores first be adjusted for differences on factors revealed in the MANOVA study. Differences in the adjusted post-test results, if any, would probably be due primarily to the
language of instruction, since other possible factors would have been taken into account or balanced out across the groups as much as possible.

3.8.2 **Comparison of Physics Achievement Between Chinese and English Instruction**

The previous two studies (i.e. 3.5 and 3.8.1) were relatively long term studies compared with the present one. They were more practical, and closer to an ordinary class situation. This study was more theoretical. It attempted to investigate just one question: if students are taught physics using English or Chinese only, through which medium do they learn more? To a certain extent, this study was better controlled than the second study mentioned above since it also limited the history (in the sense of Campbell and Stanley) of the two groups of students so that they would not be too different. The following hypothesis was investigated.

Hypothesis Ic: Grade 10 students of Anglo-Chinese school will achieve higher scores when physics is taught through the medium of Chinese than when it is taught through the medium of English.

This hypothesis was transformed to the following statistical hypothesis.

\[ H_0 : \mu_a = \mu_c \]

\[ (\alpha = 0.05) \]

\[ H_1 : \mu_a > \mu_c \]
\[ \mu_C = \text{mean physics scores of the Chinese class} \]
\[ \mu_E = \text{mean physics scores of the English class}. \]

During the period May 15-17, 1979, the two classes of students were taught the same content in physics, one class in English only and the other class in Chinese only. The class which was taught in Chinese in this study was the class which was taught in English and the class which was taught in English in this study was the class which was taught bilingually in the previous study (Section 3.8.1). The reason for using this changeover design compared with 3.8.1, was that it seemed to be a more direct way of finding out what effect the medium of instruction had on student achievement in physics if there were effect.

The content taught was 'Atomic Structure and Radioactivity'. The lesson plans for these four periods were produced by the School of Education of the Chinese University of Hong Kong\(^1\) in both Chinese and English (see Appendix 13). During the lessons, the teacher followed the lesson plan strictly to ensure reasonably equivalence of content taught to the two classes.

Upon completion of the four teaching-learning periods, an achievement test (see Appendix 14) on the content studied was given in the fifth period, to the two classes of students in Chinese or English, according to the medium of instruction used.

The achievement test differed in several ways from those in

\(^1\) These materials were originally used in a research project named "Effect of Medium of Instruction Upon Student Cognitive Development and Academic Achievement" by a research team from the School of Education of the Chinese University of Hong Kong. (Siu, 1979b).
the previous studies. Firstly, the students were not informed about the test until the day before the test was administered. Secondly, the reading material they received on the first day of the project was collected to ensure that no student did any extra-study before the test. Hence one could be quite sure that the results obtained from the test indicated how much the student could understand and learn only during the class period. Any systematic achievement differences between the two groups would probably be due to the effects of the medium of instruction. Detailed comparison of the post-test scores followed the same plan described in 3.8.1.
4.1 COMPARABILITY OF THE CS AND ACS GROUPS

4.1.1 General Background

One hundred seventy-six subjects were selected for the study, eighty-six from an Anglo-Chinese secondary school and ninety from a Chinese secondary school. The following table shows the distribution of the subjects in terms of sex, age, place of birth, dialect spoken at home, socioeconomic background, choice of school and S.S.E.E. results on Chinese, English and Mathematics.1 Background Variables 1, 5, 7, 8 and 9 were analyzed by a t-test (two-tailed, 174 degrees of freedom), while background variables 2, 3, 4 and 6 were analyzed by a X²-test (1 degree of freedom). Significant age difference (t=9.62) was probably due to the fact that comparatively more students in the Chinese school were repeaters than in the Anglo-Chinese school. In other

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1 During the study (Section 3.5), one student in the CS group dropped out from school.
2 Since not all the students sat for the S.S.E.E., only 126 students (85 of ACS and 41 of CS group) possessed results on choice of school and S.S.E.E. For S.S.E.E. results, students received classification grades 1, 2, 3, etc. as an indication of their standard in that subject area. A smaller grade number means a better result (grade 1 is the best) in that subject area. (Note this fact in Table 4.1).
words, students in the Chinese school might probably be less able than students in the Anglo-Chinese group. In fact, this agrees with the differences between the two groups on S.S.E.E. Chinese \(t=6.87\), English \(t=9.14\) and Mathematics \(t=8.39\), all these indicate that the Anglo-Chinese group was better than the Chinese group three years before when they first entered secondary school. Furthermore, there was also a significant difference \(X^2=44.13\) between the two groups in their choice of schools. Almost all students in the Chinese school indicated that they did not choose to enter their present school but were forced to do so since they had inferior S.S.E.E. results.

Table 4.1 is here.

The present result also revealed the fact that even though both schools were above average in academic achievement when compared to other secondary schools in Hong Kong, they were not comparable on many background variables and hence appropriate adjustment in the subsequent comparison of achievement between the two groups would probably be required.

4.1.2 Pretest Results of Physics Achievement

The Pretest was administered to the two groups of students during the first physics lesson periods of the two schools. The CS and the ACS groups took the Chinese and English version of the pretest respectively. Since students had not been taught the material, it was likely that they would guess. When correction for guessing, \(1 - \), was applied to the scores, the following
Table 4.2 shows that the scores of both groups were not very different from zero. The assumption that both groups had not previously learned much of the content material seemed tenable. The table also shows that the Chinese group had a mean score that was higher (significant statistically at the 0.01 level, t=2.88, two-tailed) than the Anglo-Chinese group on what they did know. This may possibly be due to the difficulty in understanding the second language. Questions about unfamiliar material might have made more sense when presented in their native language.

4.1.3 Aptitude Test Results

Having established that the two groups of students had essentially very little prior knowledge of the content learned, a check on the equivalence of aptitude scores was made. The following results were obtained from the aptitude tests. (See Table 4.3 and Fig. 4.1)

Multivariate analysis of variance was used to study the difference between the two groups on the various aptitudes measured. A computer program written by Cooley and Lohnes (1962) was used for the analysis. The F-value with 8 and 166 degrees of freedom was found to be 94.99. If two populations are not different, then samples as extreme as these (or more extreme) would occur extremely rarely. Indeed, F values of 3.55 or
greater would occur no oftener than .001 of the time; the corresponding probability for an F of 94.99 is of course far smaller. Hence the hypothesis that the groups differ in aptitude is tenable.

Table 4.3 is here.

Fig. 4.1 is here.

Discriminant analysis subsequently was used to determine the nature of the group differences. The computer program given by Cooley and Lohnes (1962) was used to carry out the analysis. The intercorrelation matrix can be found in Appendix 20. The vector of the scaled weights is shown in Table 4.4. The scaled weights give the relative contribution of each variable in the discriminant function, they help to determine the qualitative nature of the dimension. Since there are just two groups, only one discriminant function exists.

Table 4.4 is here.

English verbal reasoning is outstandingly the most important variable for discriminating between the two schools. It is notably more important than mathematical reasoning and considerably more important than Chinese verbal reasoning. Since English verbal reasoning demands a good command of word knowledge as well as the mastery of complex processes, such as
analysis, abstraction and generalization, it is a component of aptitude which serves quite well to discriminate the two (known) groups. Abstract reasoning is the least important variable for this purpose. Its relative importance is considerably less than that of English verbal reasoning.

From the MANOVA study of the aptitude results, it is quite clear that the two groups were very different from each other. This also agrees with the results in Section 4.1.1.

4.2 ANALYSIS OF RESULTS ON PHYSICS ACHIEVEMENT BETWEEN CHINESE AND ANGLO-CHINESE SCHOOLS

4.2.1 Comparing Results of Physics Achievement

Since the two groups of students were not equivalent, the posttest scores were compared by analysis of covariance (ANCOVA). By choosing suitable covariates, ANCOVA is a statistical technique to adjust the initial difference between two randomly chosen groups for comparison of treatment effect. If the groups are non-random, ANCOVA might be inadequate to cancel out all initial group differences since there are too many variables involved. However, it may be the best we can do for the present study.

The eight aptitude scores were chosen to be the covariates since they were thought to be more directly related to learning
than other background variables in Section 4.1. The computer program BMD 04V was used to carry out the analysis. The following ANCOVA table was obtained.

Table 4.5 is here.

Since \( F(1, 120) = 3.92 > 1.33 \), the difference between the two adjusted means was not statistically significant and therefore the null hypothesis was considered tenable. The following table gives the means before and after adjustment.

Table 4.6 is here.

These results suggest that, to the extent analysis of covariance can adjust for pre-existing differences in aptitude, there was no statistical evidence that the groups differed in posttest performance even though they had learned the content through different media of instruction in those three months. It was mainly due to the superiority in aptitude of the Anglo-Chinese school students that the mean scores (unadjusted) on the achievement test favoured them.

4.2.2 \textbf{The Effect of Motivational Factors on the Results of} \textbf{\ldots}

\footnote{The S.S.E.E. results were measured 3 years before the present study. One really doesn't know what happened during that three years before the treatment. Taking them as covariates would be unsatisfactory since some unknown treatments during those three years had been included.}

\footnote{Details of the program can be obtained from the UCLA BMD documentation.}
Physics Achievement

The present result is unexpected. It does not agree with the general trend indicated in Table 2.3. Were the results comparable because teachers and students in the Anglo-Chinese school were compensating in some way for lack of proficiency in English, e.g., spending a lot of extra time and energy overcoming language difficulties, better teaching etc? A comparison on the response of the two groups on the scales (Section 3.4.2.1) like motivational intensity in physics (MIP), desire to learn physics (DLP), study habits in physics (SHP), and teaching performance (TP), would reveal to us the underlying facts. Table 4.7 shows all the mean scores and standard deviation of the two groups on the above four factors.

Table 4.7 is here.

It is clear from the table that the two groups were not statistically different on all the four variables. Referring back to the meaning of MIP, DLP and SHP on Section 3.4.2.1 and their individual items in Appendix 6, one could consider them as operational measures of students' motivation, time and effort spent in physics. Hence there was no strong evidence to say that (1) the students in the Anglo-Chinese group were spending extra time and energy overcoming language difficulties, (2) they received better teaching, or (3) they had a higher motivation to learn physics when comparing with the Chinese group. So the effects of these factors on physics achievement should be about the same among the two groups.
4.2.3 The Effect of English Proficiency on the Results of Physics Achievement

One possible explanation of the results in Section 4.2.1 was that students and teacher in the Anglo-Chinese school were sufficiently proficient in English to produce no significant difference in achievement scores when compared with students in the Chinese school. To find out the degree of English proficiency, the English Proficiency Test Battery was administered to the students.

The English Proficiency Tests were administered in the two schools at about the same time during the school year. Since the battery of tests took a long time to administer, testing was done in five sessions. Attendance at these sessions varied and so the number of individuals taking the subtests was not constant (see Table 3.2). The following table gives the results of the two schools on the English Proficiency Tests.

Table 4.8 is here.

It is clear that the level of English proficiency of the Anglo-Chinese school was considerably higher than the Chinese school on all five aspects of English proficiency. This level of English proficiency (of the ACS) has already reached the lowest acceptable standard for a foreign student applying for admission in some colleges in the United States.1 Bearing in mind that

1 Foreign students getting scores above 400 (out of 800) in TOEFL are already considered to be acceptable to some colleges in the United States of America.
these were just grade 10 students and that they were not living in an English speaking society as are the foreign students in the United States (which would require a higher level of English proficiency), the present level of proficiency should be good enough for the Anglo-Chinese school students to pursue physics in the medium of English.

Furthermore, the teacher in the Anglo-Chinese school (i.e., the writer) has been using English to teach the subject for eight years and has been studying abroad in English speaking countries (the United States and Canada) for over two years. He should have no difficulty in teaching physics through English. So the two teachers should have taught fluently in their predetermined languages of instruction.

To sum up, students (and teachers also) in the Anglo-Chinese school were sufficiently proficient in English to produce no significant difference in achievement test scores when compared with students in the Chinese school. Thus it should be an acceptable explanation of the present result in Section 4.2.1.

As the Anglo-Chinese students were sufficiently proficient in English and they did not suffer in learning physics through English, it would be interesting to know how much time and effort had been and was being (relative to the Chinese students) spent in attaining this level of proficiency in English. (Problem 3 in Section 1.1). A comparison on the response of the two groups on the scales (Section 3.4.2.1) like student's knowledge of English (SKE), motivational intensity in English (MIE), orientation toward English (OTE), desire to learn English
(DLE), study habits in English (SHE), and reading habit (RH) would reveal to us the underlying facts. Table 4.9 shows all the mean scores and standard deviations of the two groups on the above six factors.

There were no significant differences (MANOVA and t-test) between the two groups on all the four motivational variables MIE, OTE, DLE, and SHE. This agrees with the result of Siu (1979b). It might be that the environmental pressure, encouragement, and stimulation were about the same among the two schools and had similar influence on the motivational variables. The highly significant results of SKE and RH just confirm again the results indicated in Table 4.1 and 4.8. Since the Anglo-Chinese students had better S.S.E.E. grades in English three years ago and higher scores in English Proficiency Test Battery, they certainly had a better knowledge of English. Furthermore, as the Anglo-Chinese students were more proficient in English, they could of course read more books in English.

Table 4.9 is here.

Referring back to the meaning of MIE, OTE, DLE and SHE on Section 3.4.2.1 and their individual items in Appendix 6, one could consider them as operational measures of students' motivation, time, and effort spent in English. Hence, though the Anglo-Chinese students were more proficient in English, it appeared that when compared with the Chinese students, they did not need to spend extra time and effort to attain this level of proficiency except for their normal immersion in English during
4.3 RELATIONSHIP BETWEEN PHYSICS ACHIEVEMENT, ENGLISH PROFICIENCY AND OTHER RELEVANT FACTORS

In order to investigate how physics achievement at the grade 10 level of Anglo-Chinese schools in Hong Kong depends on English proficiency and other relevant factors such as aptitude, motivation to learn etc., the scores on English proficiency test battery, aptitude test battery, and other relevant factors (i.e. MIP, DLP, SHP, SCAB, TP) were taken as independent variables while physics achievement scores (i.e. the scores used in Section 4.2.1) were taken as dependent variable. The computer program BMD O2R\(^1\) which computes a sequence of multiple linear equations in a stepwise manner was used to analyze the data. In the stepwise solution, tests are performed at each step to determine the contribution of each variable already in the equation if it were to be entered last. It is thus possible that a variable that was initially a good predictor may be dropped. Criteria for removal of a variable are set at the 0.05 level of significance for the present study.\(^2\) Stepwise regression methods are described in Kerlinger and Pedhazur (1973).

The following results (Table 4.10 and 4.11) were obtained

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\(^1\) Details of the program can be obtained from the UCLA BMD documentation.

\(^2\) The cutoff value, corresponding roughly to the value of \(F(1,60)\) at the 0.05 level of significance, was used in the analysis. All variables associated with \(F\)-value less than the cutoff value of 4.00 were not entered into the equation.

\(^3\) Independent variables not listed in Table 4.11 indicated that they were not significant in explaining a substantial variance of physics achievement.
from regression analysis. The intercorrelation matrix of the predictors can be found in Appendix 19.

Table 4.10 is here.

Table 4.11 is here.

A component of English proficiency—English structure, is the best predictor of physics achievement. It explains more variance in physics achievement than those factors like mechanical reasoning or desire to learn physics which are usually considered to be more relevant factors in learning physics. Hence, a component of English proficiency did play a significant role in physics achievement of the Anglo-Chinese school students.

4.4 RELATIONSHIP BETWEEN ENGLISH PROFICIENCY, THE AFFECTIVE FACTORS AND OTHER RELEVANT FACTORS

Since English structure, a component of English proficiency appears to be an important factor in physics achievement, it is useful to know further what factors are important in acquiring proficiency in English by the Anglo-Chinese school students. The computer program BMD 02R was used to determine the relationship between English proficiency (dependent variable) and other relevant factors (independent variables, listed in Section 3.7). In particular, two aptitude scores (English verbal reasoning and English language usage) were removed from the list of independent variables since high correlation with English
proficiency was obvious. Table 4.12 and 4.13 give results obtained from stepwise multiple regression analysis. The intercorrelation matrix of the independent variables can be found in Appendix 19.

Table 4.12 is here

Table 4.13 is here.

Table 4.13 suggests that self concept of academic ability is the most significant independent variable for success in English. Referring back to Table 4.10, self concept of academic ability is also a significant independent variable in physics achievement there. Since physics is usually considered to be one of the most difficult subjects in secondary school, and so is English (for Chinese students), it is understandable that a very strong self concept of academic ability is required to achieve excellence in both areas. The affective factors like cultural allegiance, anomie, etc. do not account for a significant amount of variance in English proficiency as expected by some researchers, for example, Fu (1975).

Inference of causal relations from a multiple regression equation is not mathematically justifiable. However, it is not unreasonable to speculate that manipulation of some independent variables may lead to improvement of English proficiency. Among

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1 Independent Variables not listed out in Table 4.13 indicated that they were not significant in explaining a substantial variance of English proficiency.
these four important factors which explain a significant variance of English proficiency, three of them (except for motivational intensity in English) cannot be manipulated easily because their formation is a long term process (in terms of years). Self concept of academic ability deals with behaviour in which one indicates to oneself about one's ability in academic work as compared with others engaged in the same work. Since the measures of academic work are only carried out several times a year, one does not know whether one is really improving in academic work in a short period (less than a year). Similarly, Chinese language usage and Chinese verbal reasoning are factors that start their formation since primary school, substantial improvement cannot be expected in a short period.

Motivational intensity in English is the only factor that can be changed in a short time. This will involve encouragement and help from teachers, friends, classmates, parents, etc. This is still not easy but possible if the people involved can cooperate well. Future experimental studies may shed light on this possibility.

4.5 RESULTS ON ADDITIONAL STUDIES

As revealed in Section 4.1, the two groups of subjects were very different in many different aspects. Since these differences would seriously hamper inferences from the original design, the two additional studies were included to give extra support to the original study (i.e. Section 4.2) if the results of all three studies agree with each other.
4.5.1 The Comparability of the Two Classes in the Anglo-Chinese School

There were 86 students selected from two grade 10 classes of the Anglo-Chinese School. From now on, the two classes will be referred to as Class 1 and Class 2 for the sake of convenience. Table 4.14 shows the distribution of subjects in terms of age, sex, place of birth, dialect spoken at home, socioeconomic background, choice of school, and S.S.E.E. results on Chinese, English and Mathematics.

Background variables 1, 5, 7, 8, and 9 were analyzed first by MANOVA and then by t-test (two-tailed, 84 degrees of freedom) while background variables 2, 3, 4, and 6 were analyzed by X²-test (1 degree of freedom). Only mean age of the two classes was significantly different at the 0.05 level (t=2.01), while other background variables were not significantly different among the two classes. Hence the two classes could be considered comparable except for age.

A check on the equivalence of aptitude scores was also made. The results were listed out on Table 4.15 and Fig. 4.2.

Table 4.14 is here.

Table 4.15 is here.

Fig. 4.2 is here.

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1 These 86 students were the same subjects in the original study reported in Section 4.1 and 4.2.
Multivariate analysis of variance was used to study the difference between the two groups. The computer program written by Cooley and Lohnes (1962) was used to do the analysis. The calculated F-value with 8 and 77 degrees of freedom was 2.12. This value was significant at the 0.05 level \( \frac{95}{8,60} = 2.10 \) and therefore the null hypothesis (i.e. no difference between the two groups) was rejected.

Discriminant analysis was then used to determine the nature of the group differences. The vector of scaled weights computed is shown on Table 4.16. The intercorrelation matrix can be found in Appendix 20.

Table 4.16 is here.

The relative contributions of the eight variables to the discriminant function are shown in the Table. English verbal reasoning appears to be the most notable discriminator. This agree with the result obtained in Section 4.1.3. English language usage however, discriminates least between the two classes. This is reasonable as the two classes were both from the Anglo-Chinese school.

4.5.2 Comparing Results of Physics Achievement Between English and Bilingual Instruction

During the experimental period, Class 1 was taught by bilingual instruction while Class 2 was taught by English instruction.

Since the two classes of students were not overall equal on
aptitude, the posttest scores on mechanics were analyzed by analysis of covariance (ANCOVA) with the 8 aptitude variables as covariates. The computer program BMD 04V was used to analyze the data. The following ANCOVA table was obtained from the computer.

Table 4.17 is here.

Since the calculated F-value was less than 1, the null hypothesis that the groups did not differ significantly in achievement in mechanics was regarded as tenable. The following is a table of adjusted means for the two classes and shows that the adjusted means were almost identical.

It is reasonable to conclude, therefore, that to the extent that statistical adjustment compensates for initial differences in background variables, the difference in language of instruction (Bilingual or English) produces no discernable difference in performance on the Test on Mechanics.

Table 4.18 is here.

4.5.3 Comparing Results of Physics Achievement Between Chinese and English Instruction

During the experimental period, Class 1 was taught by English instruction while Class 2 was taught by Chinese instruction. Since the two classes of students were not overall equal on aptitude, the scores on Test on Atomic Physics were
analyzed by analysis of covariance (ANCOVA) with the 8 aptitude variables as covariates. The computer program BMD 04V was used to analyze the data. The following ANCOVA table was obtained.

Table 4.19 is here.

Since \( .95^{(1,60)}=4.00>2.37 \), the null hypothesis (i.e., the two adjusted means are equal) was retained. It is reasonable to conclude, therefore, that to the extent statistical adjustment compensates for initial differences in background variables, the difference in language of instruction (Chinese or English) produces no clear difference in the performance on the Atomic Physics Test. The following table shows the mean scores of the two classes before and after adjustment. It is interesting that the means before and after adjustment are equal here. This is probably due to a balance of adjustment produced by the eight covariates. This is rare, but possible as can be seen from Table 4.15 where each class is superior in four areas of aptitudes.

Table 4.20 is here.
CHAPTER 5
CONCLUSIONS AND RECOMMENDATIONS

5.1 CONCLUSIONS

Based on the results discussed in Chapter 4, the following conclusions about the specific problems raised in Section 1.1 seem warranted bearing in mind the limitations expressed in Section 1.7.

1) Achievement in physics at the grade 10 level in the two secondary schools studied does not seem to depend on the language of instruction no matter whether it is Chinese, English or Bilingual (Section 4.2.1, 4.5.2, 4.5.3).

2) Achievement in physics at the grade 10 level in Anglo-Chinese schools of Hong Kong depends heavily on students' English proficiency. A component of English Proficiency (English structure) contributes to more than one-third of 52% of the explained variance (Section 4.3).

3) There seem to be no significant differences in motivational factors in learning English between the Anglo-Chinese and Chinese school students. In other words, the Anglo-Chinese school students do not seem to be especially motivated to spend extra time and make extra effort to learn English (Section 4.2.3).

4) Important factors related to proficiency in English by Chinese students appear to be: self concept of academic ability,
Chinese language usage, motivational intensity in English, and Chinese verbal reasoning. Of the above factors, self-concept of academic ability, Chinese language usage, and Chinese verbal reasoning cannot be manipulated easily because their formation is a long-term process. Motivational intensity in English is the only factor that can be changed in a short time if one wants to be more proficient in English (Section 4.4).

5) It does not take the students extra time and effort to learn physics at the grade 10 level when it is done in the English language. In terms of cost-effectiveness, there is no strong case to be made for using Chinese instead of English at the grade 10 level for the present Anglo-Chinese school students (Section 4.2.3).

5.2 DISCUSSION

5.2.1 The Effect of Language of Instruction on Physics Achievement

5.2.1.1 Comparing the Results of Physics Achievement in the Chinese and Anglo-Chinese Schools

Section 4.1.3 gives data to show that the two groups of students were very different in scholastic aptitude (as measured by the Aptitude Test Battery). This was contrary to the author's original expectation that since the two schools were both above-average in academic performance among the secondary schools in
Hong Kong, they should be of comparable scholastic aptitude. The result that the Anglo-Chinese school students were superior in aptitude to the other group was largely due to economic conditions in Hong Kong and the additional language problem the students had to face. Simpson (1966) has pointed out that a sound knowledge of English was rated as equally important as the students' intelligence or academic knowledge by many employers. Everyone wants to get into an Anglo-Chinese school and usually the better students are admitted. Furthermore, due to the additional language problem students would have to face when using English as the medium of instruction, it was expected that the more academically capable students would choose to go to such a school.

Though the two groups were so different, their posttest results were compared by making use of the best available statistical methods as shown in Section 4.2.1. The results indicate that the difference in medium of instruction between the two schools did not significantly affect academic achievement in physics during the three months of controlled-teaching. This was just opposite to the results obtained by Cheung (1974) and Poon (1978), but similar to those obtained by B. Chan et al (1979). A closer examination of these studies revealed that they focused on different grade levels. Poon studied the grade 6 level, Cheung investigated grade 7 and 9, while B. Chan et al examined the grade 11 level. The present study filled the gap at the grade 10 level. Further, Cheung's study reported that the superiority of the Chinese group over the English group diminished considerably from grade 7 to grade
9, though the difference were still statistically significant. Maybe the present study has uncovered the possibility that the English proficiency of the Anglo-Chinese school students at the grade 10 level is high enough, so that the medium of instruction is no longer a significant factor affecting their academic achievement (see Section 4.2.3).

5.2.1.2 Comparing the Results of Physics Achievement Between the Two Classes in the Anglo-Chinese School

Section 4.5.1 indicates that the two classes of students were quite different in scholastic aptitude. The results were compared by making use of the best available statistical methods as shown in Section 4.5.2. They indicated that the Anglo-Chinese school students at the grade 10 level did not perform better when bilingual instructions were used. This is consistent with the interpretation given in Section 5.2.1.1. Further, based on the results of Section 4.5.3, there was no difference in achievement between the two classes making use of Chinese or English as the medium of instruction under controlled conditions. This is additional support for the interpretation in Section 5.2.1.1. The above results were contrary to many Hong Kong people's belief that if students don't understand in class when the class is conducted in English, it is probably due to the language barrier rather than to other problems. This belief may be true in junior forms like grade 7 or 8, but in senior forms, unless the students' English standard is extremely poor, it is probably a rationalization of bad teaching or due to other unknown problems.
5.2.1.3 Recapitulation

Based on the above discussion of the influence of the medium of instruction on academic achievement, there seems no evidence that the medium of instruction is an important factor in physics achievement at the grade 10 level. It would appear that the Anglo-Chinese school students have been immersed in the use of English long enough so that the language of instruction does not affect achievement in a significant way.

5.2.2 The Relationship Between Physics Achievement, English Proficiency and Other Relevant Factors

Among all the variables tested in the multiple regression analysis, the score on English structure is the most significant predictor of physics achievement in the Anglo-Chinese School (Section 4.3). It may be queried why English structure is the most significant factor in predicting physics achievement while other factors are comparatively less important. The following are three plausible explanations.

1) Students have to learn the second language in some structural way, bearing in mind grammatical rules, patterns, etc. What they need to do is to plug appropriate words or phrases into the right pattern. This is very similar to the learning of laws in physics. What the students are required to do is to put the appropriate quantities into the right formula in order to find the unknown things required.

2) In English, the students have to pay attention to grammar in different parts of a sentence and try to fit different parts into a complete whole which should be
grammatically correct. While they work at one part of the sentence, they have to keep in mind the other parts of the sentence.

\[\text{e.g. Before the old man died, he made a will which said that all his money should be given to a local orphanage.}\]

In this sentence, students have to attend to agreement of tense, word order, voice, pronouns and clause structure all at the same time in one sentence.

In physics, the same kind of process is called for in many places. For example, in designing an experiment, one has to know what to measure. If some quantities cannot be measured directly, one has to find out if there is any subsequent relation that can be derived so as to measure the required quantity indirectly. Further, one has to know what kind of equipment he can have, how to use it, and what its accuracy is. All these factors have to be considered before starting to do the experiment. So the learning of English structure and physics is quite similar in this respect.

3) The test items in the English structure paper may be better items in predicting the score in physics achievement than in the Aptitude Test Battery. To study the details of test items in each paper (i.e. the English structure and Aptitude tests), one needs to return to the content and construct validity of the tests. This is beyond the scope of the present study.

Another point to note is that there are no significant differences between the motivational variables of learning physics in the two schools as shown in Section 4.2.2. This
could mean that the Anglo-Chinese school students do not need to be more highly motivated to learn physics in order to get results comparable with the Chinese school students. This speculation is somewhat contradictory to many Hong Kong people's opinion that learning a subject in English may require students to put extra effort in comparison with learning a subject in Chinese. On the other hand, this speculation is in accordance with the results discussed in Section 5.2.1: the students were probably good enough or had been immersed long enough in English so that the difference of medium of instruction did not hinder achievement.

5.2.3 The Relationship Between English Proficiency, Affective Factors and the Background Variables

The results obtained in Section 4.4 were not in keeping with those discussed by Jakobovits (1970). In the present study, only about 37% of the variance of English proficiency could be explained by the proposed factors for the Anglo-Chinese school students. By comparison, Jakobovits proposed that about 86% of the variance of second language learning could be explained by factors such as aptitude, intelligence and motivation. A closer look at the present study uncovered the fact that ELU and EVR had not been included in the analysis and some explained variance was lost. Hence the two results are not comparable.

Among those significant variables in Anglo-Chinese school students shown in Table 4.13, the motivational variable (motivational intensity in English) contributed just about 15% to the explained variance. Though there was a noticeable
correlation between the two variables, 'self concept of academic ability' and 'motivational intensity in English' (about 0.35), the fraction of variance that could be explained by motivational variables was still small when compared with Jakobovits' estimation. The idea raised by Fu (1975) that motivational and attitudinal variables might be very important factors in learning English for Hong Kong students is probably not valid.

Further, when mean scores on the motivational variables of the two schools were compared (Section 4.2.3), there also was no significant difference. Maybe more immersion in English has no significant effect on changing the motivation for learning English among Hong Kong students. Another possible reason is that the Anglo-Chinese school students had already obtained a high proficiency in English, their motivation to learn it has presumably dropped.

5.3 IMPLICATIONS

5.3.1 About the Medium of Instruction

The main purpose of the present study is to explore the relationship between academic achievement in physics and English proficiency in a situation where the medium of instruction (i.e. English) is the second language of both students and teachers. The results of the study are important to those who are involved in bilingual education. It shows that for students of above average aptitude, the use of their second language as the medium of instruction in some subject areas may not seriously hamper
their learning if they have been immersed in the second language long enough. This can be considered as a partial support (in senior Forms only) for the present education policy in Hong Kong which does not discourage the use of English as the medium of instruction in secondary schools as indicated in the Hong Kong Education Department White Paper (1974).

Taking Hong Kong as an example, previous studies (Cheung 1974, Poon 1978) indicated that using English as the medium of instruction might be harmful to students at grade 9 or lower. At the present time, it now appears that the use of English as the medium of instruction may not be detrimental if it can be postponed to grade 10 as suggested by Cheng et al (1973). This will not only allow the students to establish a firm background in English but will also avoid the adverse effects revealed by Cheung (1974), Poon (1978) and other research workers as discussed in Chapter 2. Furthermore, it can still satisfy the demands for a higher English standard placed on the students by the parents and society. Finally, if we take into consideration that secondary education is developing rapidly in Hong Kong, we have to accept the fact that there are more less able students attending school now and there will be more in the foreseeable future. The delay of using English as the medium of instruction in secondary schools appears to be an unavoidable step to cope with reality.

The results of the present study might also be applicable to countries which face the same problems as Hong Kong. A late immersion might not only avoid the detrimental effects as revealed in Chapter 2, but also facilitate the general
development of students' cognition and national pride. At the same time, late immersion could also produce students who can master the second language well enough for their future study or careers in science, technology or business.

If the results of the present study can really be generalized to other subject areas, to other schools in Hong Kong, and to other developing nations as mentioned in Section 1.7, the problem of when is the best time to immerse students in the second language could be solved gradually in the future. We can allow the teachers to use their mother tongue as the chief medium of instruction and the students to learn the second language as a subject until the end of junior high school (grade 9). After that the students who would like to learn more about a second language will be put into schools using the second language as the medium of instruction while those who would like to continue their studies in the mother tongue will be put into school using their mother tongue as the medium of instruction.

5.3.2 About the Learning of Physics

No matter which argument is the true explanation of the high correlation between physics and English structure as stated in Section 5.2.2, one has to be aware of this significant relationship. There is often a tendency for physics students in senior Forms to neglect second language learning (e.g. English in Hong Kong) and to concentrate just on the science subjects. Of course, we know that this kind of attitude is counter-productive. The results of the present study can be an additional warning to the physics students who have this kind of
attitude. These students might have to be informed about the present results that the learning of a second language, especially its grammatical structure, might of an indirect help to their learning of physics, and vice versa.

5.3.3 About English Teaching

In the discussion of Section 5.2.3, readers might notice that the results of the present study are somewhat against Fu's expectations in her comprehensive study of English language learning and the Chinese students in Hong Kong. But the fact that the fluency in English of many Hong Kong students is incommensurate with the amount of time and effort they put into English still remains. What the present study indicates is that the cultural factors and affective factors may not be that important in the learning of English among Hong Kong students. We may have ruled out one possible reason, but we still do not know what the actual causes are. Is it because expectation are too high that what parents, educators or employers want is a native-like standard of English which is too difficult for the majority of students to acquire? Is it necessary to have that high standard of English in a society that consists of more than 98% non-native English speakers? Do all students, regardless of intelligence and career plans, require the same amount and the same kind of English? Would the standard of English be improved if the English the students did learn was of a better and more useful quality than that which they are currently learning? Would it be better to offer intensive and well taught English language classes in their later school years to students who
will continue their education and who begin to realize a real need for English in their prospective jobs?

5.4 RECOMMENDATIONS FOR FUTURE RESEARCH

The present study has certain weaknesses in its design, such as the non-random selection of subjects, the incomplete refinement of the tests and scales, the failure to take account the teacher variable, etc. It would be desirable to replicate the present study using an improved method of sampling, thoroughly refined tests and scales, and to conduct it on a much larger scale involving a more representative sample of students and teachers.

Further, the following recommendations are made for future researchers:

1) As indicated in Limitation (5) and (6) of Section 1.7, generalizability of the present study is very limited. Replication of the present study in other school-subject areas like chemistry, biology, geography, etc., in other developing nations, and in other grade levels is recommended.

2) Replication of the present study with students of average or below average abilities is strongly recommended since the present results might only be applicable to students of above average abilities. Students of average or below average abilities might encounter difficulties when the second language is used as the medium of instruction.

3) Longitudinal studies such as the St. Lambert Experiment (Lambert 1972) but following the present design
during the whole secondary school period are recommended. This may be quite possible for some above-average secondary schools in Hong Kong since the changeover of students there is quite low. The only trouble is how to get two equivalent groups of subjects at the beginning of secondary school. This will not be too difficult if the Ministry of Education is willing to help.

4) To confirm the implications mentioned in Section 5.3.1, another longitudinal study is recommended. As suggested above, students would be randomly assigned to two groups at the beginning of secondary school. One group would learn all the subjects, except English language, through the medium of Chinese from grade 7 to 9 inclusively. The other group would learn all the subjects, except Chinese language, through the medium of English during the same period. At the end of each year, the two groups would be assessed by equivalent tests presented in different languages. The Chinese group would write the tests in Chinese and the English group would write the tests in English. At the start of grade 10, the two groups would learn all the subjects, except Chinese language, in English. Their achievements in different subject areas would be compared at the end of grade 10 and 11. This study would be a test of the suggestion made by Cheng et al (1973) and others.

After all, Hong Kong lack research in many areas of education, language learning and teaching, student needs, motivation and attitudes. The present study is just a study

\[\text{Usually, more than 80\% of students stay in the same secondary school for five years.}\]
after Fu (1975), hoping to initiate a climate of interest and enthusiasm in research in this important but under-cultivated area.
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Table 2.1
Identification of Groups According to the Time of Introduction of Second Language for Reading and as A Medium of Instruction

<table>
<thead>
<tr>
<th>Grade in which second language is first used as a medium of instruction</th>
<th>Grade in which reading in the second language starts</th>
</tr>
</thead>
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<tr>
<td>One</td>
<td>One</td>
</tr>
<tr>
<td>Three</td>
<td>Two</td>
</tr>
<tr>
<td>Five</td>
<td>Group 1</td>
</tr>
<tr>
<td>Group 2</td>
<td>Group 2</td>
</tr>
<tr>
<td>Group 3</td>
<td>Group 4</td>
</tr>
<tr>
<td>Group 5</td>
<td>Group 5</td>
</tr>
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</table>

Table 2.2
Categorization According to the Research Methods Used in the Studies

<table>
<thead>
<tr>
<th>Area of Interest</th>
<th>General Studies Pre 1970 Post 1970</th>
<th>Bilingual Science Education</th>
<th>Hong Kong</th>
<th>Affective Factors</th>
<th>Row Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Method of Study:</td>
<td>Survey (S)</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2 0</td>
<td>0</td>
<td>6</td>
<td>1</td>
<td>9</td>
</tr>
<tr>
<td></td>
<td>Post hoc comparison (PH)</td>
<td>3 0</td>
<td>1</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td></td>
<td>Experimental (E)</td>
<td>4 9</td>
<td>6</td>
<td>3</td>
<td>22</td>
</tr>
<tr>
<td></td>
<td>Column Sum</td>
<td>18</td>
<td>7</td>
<td>10</td>
<td>3</td>
</tr>
</tbody>
</table>
Table 2.3
Categorization According to the Effects of the Studies

<table>
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<tr>
<th>Area of Interest</th>
<th>General Studies Pre 1970</th>
<th>General Studies Post 1970</th>
<th>Bilingual Science Education</th>
<th>Hong Kong</th>
<th>Row Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Effects:</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Using the second language as the medium of instruction is not detrimental (S+)</td>
<td>1</td>
<td>5</td>
<td>0</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Using the second language as the chief medium of instruction and with the first language for explanation is not detrimental (B+)</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Using the second language as the medium of instruction is detrimental (S-)</td>
<td>5</td>
<td>2</td>
<td>3</td>
<td>8</td>
<td>16</td>
</tr>
<tr>
<td>Inconclusive (I)</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>0</td>
<td>6</td>
</tr>
</tbody>
</table>
### Table 2.4
Recategorization According to the Effects of the Studies

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<th>Developed</th>
<th>Immigrant</th>
<th>Developing</th>
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<tr>
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<td>0</td>
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</tr>
<tr>
<td>B+</td>
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<td>2</td>
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<td>I</td>
<td>1</td>
<td>4</td>
<td>1</td>
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### Table 2.5
Categorization According to the Levels of Samples Used in the Studies

<table>
<thead>
<tr>
<th>Area of Interest</th>
<th>General Studies</th>
<th>Bilingual Science Education</th>
<th>Hong Kong</th>
<th>Affective Factors</th>
<th>Row Sum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Level of Sample</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>College (C)</td>
<td>1</td>
<td>1</td>
<td>3</td>
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<tr>
<td>Senior High (SH)</td>
<td>1</td>
<td>0</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Junior High (JH)</td>
<td>3</td>
<td>2</td>
<td>4</td>
<td>1</td>
<td>10</td>
</tr>
<tr>
<td>Primary or Preschool (P)</td>
<td>13</td>
<td>4</td>
<td>1</td>
<td>0</td>
<td>18</td>
</tr>
<tr>
<td>Not specified</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Name</td>
<td>Number of Items</td>
<td>Highest Score</td>
<td>Mean Score</td>
<td>Lowest Score</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>-----------------------------</td>
<td>-----------------</td>
<td>---------------</td>
<td>------------</td>
<td>--------------</td>
<td>--------------------</td>
</tr>
<tr>
<td>Pretest</td>
<td>40</td>
<td>17</td>
<td>7.46</td>
<td>1</td>
<td>3.32</td>
</tr>
<tr>
<td>Posttest 1</td>
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<td>30</td>
<td>17.45</td>
<td>3</td>
<td>4.94</td>
</tr>
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<td>5</td>
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<td>29</td>
<td>20.34</td>
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<td>5.05</td>
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<tr>
<td>Test in Mechanics</td>
<td>41</td>
<td>34</td>
<td>20.51</td>
<td>9</td>
<td>5.81</td>
</tr>
<tr>
<td>Test in Atomic Physics</td>
<td>35</td>
<td>32</td>
<td>23.15</td>
<td>11</td>
<td>4.69</td>
</tr>
<tr>
<td>Listening Comprehension</td>
<td>50</td>
<td>37</td>
<td>21.08</td>
<td>9</td>
<td>7.71</td>
</tr>
<tr>
<td>English Structure</td>
<td>40</td>
<td>33</td>
<td>19.75</td>
<td>6</td>
<td>6.89</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>40</td>
<td>25</td>
<td>14.19</td>
<td>6</td>
<td>4.27</td>
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<tr>
<td>Reading Comprehension</td>
<td>31</td>
<td>23</td>
<td>13.16</td>
<td>5</td>
<td>4.81</td>
</tr>
<tr>
<td>Writing ability</td>
<td>40</td>
<td>32</td>
<td>16.66</td>
<td>6</td>
<td>6.61</td>
</tr>
<tr>
<td>English Proficiency Test Battery</td>
<td>201</td>
<td>138</td>
<td>84.84</td>
<td>32</td>
<td>25.83</td>
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Table 3.1 Statistics on the Achievement Tests.
<table>
<thead>
<tr>
<th>Name</th>
<th>No. of Items</th>
<th>Total Score</th>
<th>Highest Score</th>
<th>Mean Score</th>
<th>Lowest Score</th>
<th>Zero Point</th>
<th>Standard Deviation</th>
<th>Reliability (Hoyt)</th>
<th>Items deleted in analysis</th>
<th>Meaning of High Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>Attitude toward English Speaker (ATES)</td>
<td>31</td>
<td>186</td>
<td>139</td>
<td>99.06</td>
<td>56</td>
<td>31</td>
<td>16.22</td>
<td>0.89</td>
<td>Nil</td>
<td>Like</td>
</tr>
<tr>
<td>Desire to Learn English (DLE)</td>
<td>6</td>
<td>23</td>
<td>23</td>
<td>15.6</td>
<td>9</td>
<td>6</td>
<td>2.76</td>
<td>0.46</td>
<td>4, 7</td>
<td>Desire to Learn</td>
</tr>
<tr>
<td>Attitude Toward Foreign Language (ATFL)</td>
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<td>35</td>
<td>24</td>
<td>15.4</td>
<td>9</td>
<td>7</td>
<td>2.57</td>
<td>0.39</td>
<td>Nil</td>
<td>Dislike</td>
</tr>
<tr>
<td>Study Habit in English</td>
<td>24</td>
<td>120</td>
<td>104</td>
<td>78.62</td>
<td>55</td>
<td>24</td>
<td>9.9</td>
<td>0.76</td>
<td>Nil</td>
<td>Good Habit</td>
</tr>
<tr>
<td>Reading Habit (RH)</td>
<td>5</td>
<td>15</td>
<td>14</td>
<td>7.15</td>
<td>4</td>
<td>3</td>
<td>1.9</td>
<td>0.65</td>
<td>1</td>
<td>Read more English</td>
</tr>
<tr>
<td>Attitude to Life in Hong Kong (ALHK)</td>
<td>10</td>
<td>70</td>
<td>63</td>
<td>37.84</td>
<td>20</td>
<td>10</td>
<td>7.68</td>
<td>0.76</td>
<td>Nil</td>
<td>Dislike</td>
</tr>
<tr>
<td>Authoritarianism (AU)</td>
<td>13</td>
<td>78</td>
<td>72</td>
<td>53.01</td>
<td>20</td>
<td>13</td>
<td>7.93</td>
<td>0.71</td>
<td>Nil</td>
<td>Authoritative</td>
</tr>
<tr>
<td>Ethnocentrism (ETH)</td>
<td>5</td>
<td>30</td>
<td>30</td>
<td>18.22</td>
<td>5</td>
<td>5</td>
<td>3.81</td>
<td>0.45</td>
<td>4</td>
<td>Ethnocentric</td>
</tr>
<tr>
<td>Cultural Allegiance (OA)</td>
<td>11</td>
<td>66</td>
<td>56</td>
<td>38.29</td>
<td>20</td>
<td>11</td>
<td>7.09</td>
<td>0.69</td>
<td>8</td>
<td>Conservative</td>
</tr>
<tr>
<td>Anomie (ANO)</td>
<td>8</td>
<td>48</td>
<td>44</td>
<td>27.13</td>
<td>13</td>
<td>8</td>
<td>6.44</td>
<td>0.60</td>
<td>2, 7, 11</td>
<td>Dislike Hong Kong</td>
</tr>
<tr>
<td>Rating of English Skills (RES)</td>
<td>9</td>
<td>36</td>
<td>27</td>
<td>14.86</td>
<td>9</td>
<td>9</td>
<td>3.18</td>
<td>0.78</td>
<td>Nil</td>
<td>Good English</td>
</tr>
<tr>
<td>Self Concept of Ability (SCAB)</td>
<td>23</td>
<td>115</td>
<td>93</td>
<td>70.26</td>
<td>37 '</td>
<td>23</td>
<td>10.54</td>
<td>0.92</td>
<td>Nil</td>
<td>Poor Ability</td>
</tr>
<tr>
<td>Teaching Performance (TP)</td>
<td>22</td>
<td>154</td>
<td>128</td>
<td>91.6</td>
<td>51</td>
<td>22</td>
<td>14.1</td>
<td>0.75</td>
<td>Nil</td>
<td>Good Teaching</td>
</tr>
</tbody>
</table>

Table 3.2. Statistics on the Scales
<table>
<thead>
<tr>
<th>Name</th>
<th>No. of Items</th>
<th>Total Score</th>
<th>Highest Score</th>
<th>Mean Score</th>
<th>Lowest Score</th>
<th>Zero Point</th>
<th>Standard Deviation</th>
<th>Reliability (Hoyt)</th>
<th>Items deleted in analysis</th>
<th>Meaning of High Score</th>
</tr>
</thead>
<tbody>
<tr>
<td>SES</td>
<td>11</td>
<td>33</td>
<td>33</td>
<td>26.77</td>
<td>15</td>
<td>9</td>
<td>2.96</td>
<td>.56</td>
<td>Nil</td>
<td>Low</td>
</tr>
<tr>
<td>Motivation in Physics (MIP)</td>
<td>7</td>
<td>21</td>
<td>21</td>
<td>13.93</td>
<td>7</td>
<td>7</td>
<td>2.87</td>
<td>.64</td>
<td>Nil</td>
<td>High Motivation</td>
</tr>
<tr>
<td>Desire to Learn Physics (DLP)</td>
<td>10</td>
<td>39</td>
<td>36</td>
<td>26.05</td>
<td>15</td>
<td>10</td>
<td>3.95</td>
<td>.59</td>
<td>7</td>
<td>Desire to Learn</td>
</tr>
<tr>
<td>Study Habit in Physics (SHP)</td>
<td>22</td>
<td>110</td>
<td>97</td>
<td>69.41</td>
<td>43</td>
<td>22</td>
<td>8.94</td>
<td>.67</td>
<td>5,20,21</td>
<td>Good Habit</td>
</tr>
<tr>
<td>Students' Knowledge of English (SKE)</td>
<td>13</td>
<td>65</td>
<td>40</td>
<td>25.96</td>
<td>15</td>
<td>13</td>
<td>5.18</td>
<td>.67</td>
<td>Nil</td>
<td>Good English</td>
</tr>
<tr>
<td>Parents' Knowledge of English (PKE)</td>
<td>7</td>
<td>28</td>
<td>24</td>
<td>8.5</td>
<td>7</td>
<td>7</td>
<td>2.54</td>
<td>.84</td>
<td>Nil</td>
<td>Good English</td>
</tr>
<tr>
<td>Orientation toward English (OTE)</td>
<td>7</td>
<td>49</td>
<td>43</td>
<td>32.15</td>
<td>20</td>
<td>7</td>
<td>4.37</td>
<td>.49</td>
<td>8</td>
<td>Like English</td>
</tr>
<tr>
<td>Attitude to English as a medium of instruction (AEMI)</td>
<td>9</td>
<td>63</td>
<td>63</td>
<td>32.41</td>
<td>13</td>
<td>9</td>
<td>8.53</td>
<td>.86</td>
<td>Nil</td>
<td>Dislike</td>
</tr>
<tr>
<td>Motivation in English (MIE)</td>
<td>7</td>
<td>21</td>
<td>20</td>
<td>13.28</td>
<td>7</td>
<td>7</td>
<td>2.85</td>
<td>.58</td>
<td>Nil</td>
<td>Highly Motivate</td>
</tr>
<tr>
<td>Parental Encouragement (PE)</td>
<td>6</td>
<td>42</td>
<td>29</td>
<td>15.93</td>
<td>6</td>
<td>6</td>
<td>4.17</td>
<td>.58</td>
<td>Nil</td>
<td>Discourage</td>
</tr>
</tbody>
</table>

Zero point means the lowest possible score one can get in the scale. This is just opposite to full score.
<table>
<thead>
<tr>
<th>Background Variables</th>
<th>School</th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Anglo-Chinese</td>
<td>Chinese</td>
<td></td>
</tr>
<tr>
<td>1) Age (years)*</td>
<td>Average</td>
<td>15.3</td>
<td>16.7</td>
</tr>
<tr>
<td></td>
<td>Standard deviation</td>
<td>0.8</td>
<td>1.1</td>
</tr>
<tr>
<td>2) Sex</td>
<td>Male (N)</td>
<td>66</td>
<td>79</td>
</tr>
<tr>
<td></td>
<td>Female (N)</td>
<td>20</td>
<td>11</td>
</tr>
<tr>
<td>3) Place of Birth</td>
<td>Hong Kong (N)</td>
<td>82</td>
<td>85</td>
</tr>
<tr>
<td></td>
<td>Other places (N)</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>4) Dialect Spoken at Home</td>
<td>Cantonese (N)</td>
<td>83</td>
<td>82</td>
</tr>
<tr>
<td></td>
<td>Others (N)</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>5) SES</td>
<td>Average</td>
<td>26.86</td>
<td>26.68</td>
</tr>
<tr>
<td></td>
<td>Standard deviation</td>
<td>2.53</td>
<td>3.33</td>
</tr>
<tr>
<td>6) Choice of School*</td>
<td>Their own choice (N)</td>
<td>47</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>Not their choice (N)</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>7) S. S. E. E. Chinese*</td>
<td>Grade average</td>
<td>2.95</td>
<td>4.30</td>
</tr>
<tr>
<td></td>
<td>Standard deviation</td>
<td>1.01</td>
<td>1.06</td>
</tr>
<tr>
<td>8) S. S. E. E. English*</td>
<td>Grade average</td>
<td>2.91</td>
<td>4.85</td>
</tr>
<tr>
<td></td>
<td>Standard deviation</td>
<td>0.97</td>
<td>1.35</td>
</tr>
<tr>
<td>9) S. S. E. E. Mathematics*</td>
<td>Grade average</td>
<td>2.54</td>
<td>4.10</td>
</tr>
<tr>
<td></td>
<td>Standard deviation</td>
<td>0.78</td>
<td>1.28</td>
</tr>
</tbody>
</table>

Table 4.1 Distribution of Subjects (or Subject Scores) on 9 Different Background Variables of the CS and ACS.

* The difference of the two groups was statistically significant at the .001 level.
### Table 4.2 Comparison of Pretest Results.

<table>
<thead>
<tr>
<th>Components of Aptitude (Dependent Variable for MANOVA Study)</th>
<th>Anglo-Chinese School</th>
<th>Chinese School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Score</td>
<td>1.18</td>
<td>2.54</td>
</tr>
<tr>
<td>Standard Deviation</td>
<td>2.65</td>
<td>3.53</td>
</tr>
<tr>
<td>Number of Subjects</td>
<td>86</td>
<td>90</td>
</tr>
</tbody>
</table>

Table 4.3 Comparison of Aptitude Test Results of the Two Schools.

<table>
<thead>
<tr>
<th>Components of Aptitude (Dependent Variable for MANOVA Study)</th>
<th>Anglo-Chinese School</th>
<th>Chinese School</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean Standard Deviation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Mathematical Reasoning (MR)</td>
<td>32.0 3.70</td>
<td>26.0 4.60</td>
</tr>
<tr>
<td>Abstract Reasoning (AR)</td>
<td>32.7 6.30</td>
<td>27.6 7.58</td>
</tr>
<tr>
<td>Mechanical Reasoning (MER)</td>
<td>33.7 3.83</td>
<td>30.6 4.30</td>
</tr>
<tr>
<td>Spatial Reasoning (SR)</td>
<td>31.1 5.59</td>
<td>28.2 6.17</td>
</tr>
<tr>
<td>Chinese Verbal Reasoning (CVR)</td>
<td>40.3 4.10</td>
<td>33.4 6.62</td>
</tr>
<tr>
<td>Chinese Language Usage (CLU)</td>
<td>36.2 4.31</td>
<td>32.4 5.07</td>
</tr>
<tr>
<td>English Language Usage (ELU)</td>
<td>38.5 5.12</td>
<td>23.0 5.21</td>
</tr>
<tr>
<td>English Verbal Reasoning (EVR)</td>
<td>40.4 4.80</td>
<td>20.8 5.66</td>
</tr>
<tr>
<td>Dependent Variable</td>
<td>Scaled Weights</td>
<td></td>
</tr>
<tr>
<td>---------------------------------</td>
<td>---------------</td>
<td></td>
</tr>
<tr>
<td>English Verbal Reasoning</td>
<td>46.12</td>
<td></td>
</tr>
<tr>
<td>English Language Usage</td>
<td>25.07</td>
<td></td>
</tr>
<tr>
<td>Mathematical Reasoning</td>
<td>24.52</td>
<td></td>
</tr>
<tr>
<td>Spatial Reasoning</td>
<td>-21.33</td>
<td></td>
</tr>
<tr>
<td>Mechanical Reasoning</td>
<td>17.35</td>
<td></td>
</tr>
<tr>
<td>Chinese Language Usage</td>
<td>-10.57</td>
<td></td>
</tr>
<tr>
<td>Chinese Verbal Reasoning</td>
<td>-5.47</td>
<td></td>
</tr>
<tr>
<td>Abstract Reasoning</td>
<td>-1.21</td>
<td></td>
</tr>
</tbody>
</table>

Table 4.4 Vector of Scaled Weights for the Variables in the Discriminant Function.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Sum of Squares (due to reg.)</th>
<th>Sum of Squares (about reg.)</th>
<th>df adjusted</th>
<th>Mean Square (adjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>487.89</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>173</td>
<td>2971.39</td>
<td>492.07</td>
<td>2479.31</td>
<td>165</td>
<td>15.03</td>
</tr>
<tr>
<td>Total</td>
<td>174</td>
<td>3459.28</td>
<td>959.92</td>
<td>2499.35</td>
<td>166</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>20.04</td>
<td>1</td>
</tr>
</tbody>
</table>

$F=1.33$

Table 4.5 ANCOVA Table of the Two Schools.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Means</th>
<th>Adjusted Means</th>
<th>S.E. (Adjusted Means)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Anglo-Chinese School</td>
<td>17.42</td>
<td>14.91</td>
<td>0.76</td>
</tr>
<tr>
<td>Chinese School</td>
<td>14.08</td>
<td>16.51</td>
<td>0.74</td>
</tr>
</tbody>
</table>

Table 4.6 Means before and after Adjustment for the Two Schools.
Table 4.7 Comparison of Variables affecting Physics Achievement.

<table>
<thead>
<tr>
<th>Variables</th>
<th>ACS (N=86)</th>
<th>CS (N=90)</th>
<th>t</th>
</tr>
</thead>
<tbody>
<tr>
<td>1) MIP ( \bar{x} )</td>
<td>14.14</td>
<td>13.72</td>
<td>-0.97</td>
</tr>
<tr>
<td>S</td>
<td>3.01</td>
<td>2.72</td>
<td></td>
</tr>
<tr>
<td>2) DLP ( \bar{x} )</td>
<td>25.59</td>
<td>26.59</td>
<td>1.67</td>
</tr>
<tr>
<td>S</td>
<td>4.49</td>
<td>3.31</td>
<td></td>
</tr>
<tr>
<td>3) SHP ( \bar{x} )</td>
<td>68.22</td>
<td>70.56</td>
<td>1.75</td>
</tr>
<tr>
<td>S</td>
<td>8.93</td>
<td>8.85</td>
<td></td>
</tr>
<tr>
<td>4) TP ( \bar{x} )</td>
<td>91.00</td>
<td>92.17</td>
<td>0.55</td>
</tr>
<tr>
<td>S</td>
<td>15.20</td>
<td>13.03</td>
<td></td>
</tr>
</tbody>
</table>

Critical value \( t_{120}^{0.975} = 1.98 \) (two-tailed)

Table 4.8 Results on English Proficiency Tests.

<table>
<thead>
<tr>
<th>Name of Test</th>
<th>Anglo-Chinese School</th>
<th>Chinese School</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Raw Score</td>
</tr>
<tr>
<td></td>
<td>% Score</td>
<td>N</td>
</tr>
<tr>
<td>Listening Comprehension</td>
<td>54.44</td>
<td>27.22</td>
</tr>
<tr>
<td>English Structure</td>
<td>66.03</td>
<td>26.41</td>
</tr>
<tr>
<td>Vocabulary</td>
<td>42.98</td>
<td>17.19</td>
</tr>
<tr>
<td>Reading Comprehension</td>
<td>53.74</td>
<td>16.66</td>
</tr>
<tr>
<td>Writing Ability</td>
<td>53.78</td>
<td>21.51</td>
</tr>
<tr>
<td>The Whole Battery</td>
<td>54.19</td>
<td>108.99</td>
</tr>
<tr>
<td>Variables</td>
<td>ACS (N=86)</td>
<td>CS (N=90)</td>
</tr>
<tr>
<td>-----------</td>
<td>------------</td>
<td>-----------</td>
</tr>
<tr>
<td>1) SKE X</td>
<td>27.19</td>
<td>24.68</td>
</tr>
<tr>
<td></td>
<td>5.19</td>
<td>5.01</td>
</tr>
<tr>
<td>2) MIE X</td>
<td>12.92</td>
<td>13.63</td>
</tr>
<tr>
<td></td>
<td>2.91</td>
<td>2.75</td>
</tr>
<tr>
<td>3) OTE X</td>
<td>31.97</td>
<td>32.33</td>
</tr>
<tr>
<td></td>
<td>3.90</td>
<td>4.79</td>
</tr>
<tr>
<td>4) DLE X</td>
<td>15.71</td>
<td>15.49</td>
</tr>
<tr>
<td></td>
<td>2.61</td>
<td>2.91</td>
</tr>
<tr>
<td>5) SHE X</td>
<td>78.77</td>
<td>78.48</td>
</tr>
<tr>
<td></td>
<td>9.33</td>
<td>10.47</td>
</tr>
<tr>
<td>6) RH X</td>
<td>7.5</td>
<td>6.82</td>
</tr>
<tr>
<td></td>
<td>1.98</td>
<td>1.78</td>
</tr>
</tbody>
</table>

* Significant at the 0.005 level (two-tailed).
** Significant at the 0.01 level

Table 4.9 Comparison of Variables Affecting English Proficiency.

<table>
<thead>
<tr>
<th></th>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Square</th>
<th>F-ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>6</td>
<td>798.6</td>
<td>133.1</td>
<td>14.3</td>
<td>.001</td>
</tr>
<tr>
<td>Residual</td>
<td>79</td>
<td>736.4</td>
<td>9.32</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>1535.0</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Table 4.10 ANOVA Table for the Multiple Regression Analysis of the Anglo-Chinese School Physics Achievement.
<table>
<thead>
<tr>
<th>Step No.</th>
<th>Predictor Variable</th>
<th>R</th>
<th>$R^2$(%)</th>
<th>$\Delta R^2$(%)</th>
<th>F-ratio</th>
<th>p-value</th>
<th>Standard Error</th>
<th>Regression Coeff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>English Structure</td>
<td>0.42</td>
<td>17.75</td>
<td>17.75</td>
<td>18.13</td>
<td>&lt;.001</td>
<td>0.09</td>
<td>0.51</td>
</tr>
<tr>
<td>2</td>
<td>Mechanical Reasoning</td>
<td>0.58</td>
<td>33.99</td>
<td>16.24</td>
<td>20.41</td>
<td>&lt;.001</td>
<td>0.09</td>
<td>0.49</td>
</tr>
<tr>
<td>3</td>
<td>Desire to Learn Physics</td>
<td>0.65</td>
<td>42.41</td>
<td>8.42</td>
<td>11.99</td>
<td>&lt;.001</td>
<td>0.08</td>
<td>0.20</td>
</tr>
<tr>
<td>4</td>
<td>Self Concept of Ability</td>
<td>0.68</td>
<td>45.61</td>
<td>3.20</td>
<td>4.76</td>
<td>&lt;.05</td>
<td>0.04</td>
<td>-0.09</td>
</tr>
<tr>
<td>5</td>
<td>Chinese Verbal Reasoning</td>
<td>0.70</td>
<td>49.05</td>
<td>3.45</td>
<td>5.41</td>
<td>&lt;.025</td>
<td>0.09</td>
<td>-0.28</td>
</tr>
<tr>
<td>6</td>
<td>Chinese Language Usage</td>
<td>0.72</td>
<td>52.03</td>
<td>2.97</td>
<td>4.90</td>
<td>&lt;.05</td>
<td>0.09</td>
<td>0.19</td>
</tr>
</tbody>
</table>

Constant Term of the Regression Equation = -7.16

Table 4.11 Summary Table of Stepwise Multiple Regression Analysis for the Physics Achievement of the Anglo-Chinese School as Criterion Variable.
### Table 4.12 ANOVA Table for the Multiple Regression Analysis of the Anglo-Chinese School, English Proficiency as the Dependent Variable.

<table>
<thead>
<tr>
<th>df</th>
<th>Sum of Squares</th>
<th>Mean Squares</th>
<th>F-ratio</th>
<th>p-value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Regression</td>
<td>4 5489.75</td>
<td>1372.43</td>
<td>11.99</td>
<td>&lt; .001</td>
</tr>
<tr>
<td>Residual</td>
<td>81 9275.14</td>
<td>114.51</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td>85 14764.87</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

### Table 4.13 Summary Table of Stepwise Multiple Regression for the Anglo-Chinese Schools, English Proficiency as the Criterion Variable.

<table>
<thead>
<tr>
<th>Step No.</th>
<th>Predictor Variable</th>
<th>R</th>
<th>$R^2$ (%)</th>
<th>$\Delta R^2$ (%)</th>
<th>F-ratio</th>
<th>p-value</th>
<th>Standard Error</th>
<th>Regression Coeff.</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Self Concept of Academic Ability</td>
<td>0.46</td>
<td>21.03</td>
<td>21.03</td>
<td>22.37</td>
<td>&lt; .001</td>
<td>0.12</td>
<td>-0.37</td>
</tr>
<tr>
<td>2</td>
<td>Chinese Language Usage</td>
<td>0.54</td>
<td>28.62</td>
<td>7.59</td>
<td>8.83</td>
<td>&lt; .005</td>
<td>0.30</td>
<td>0.58</td>
</tr>
<tr>
<td>3</td>
<td>Motivational Intensity in English</td>
<td>0.58</td>
<td>33.85</td>
<td>5.24</td>
<td>6.49</td>
<td>&lt; .025</td>
<td>0.43</td>
<td>1.21</td>
</tr>
<tr>
<td>4</td>
<td>Chinese Verbal Reasoning</td>
<td>0.61</td>
<td>37.18</td>
<td>3.33</td>
<td>4.29</td>
<td>&lt; .05</td>
<td>0.32</td>
<td>0.65</td>
</tr>
</tbody>
</table>

Constant Term of Regression Equation = 71.57
## Table 4.14 Distribution of Subjects on 9 Different Background Variables of the Two Classes.

* The difference of the two classes was statistically significant at the 0.05 level.
## Components of Aptitude (Dependent Variable for MANOVA Study)

<table>
<thead>
<tr>
<th>Components of Aptitude</th>
<th>Class 1</th>
<th>Class 2</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>Standard Deviation</td>
</tr>
<tr>
<td>Mathematical Reasoning</td>
<td>32.23</td>
<td>3.56</td>
</tr>
<tr>
<td>Abstract Reasoning</td>
<td>31.95</td>
<td>7.18</td>
</tr>
<tr>
<td>Mechanical Reasoning</td>
<td>34.26</td>
<td>3.65</td>
</tr>
<tr>
<td>Spatial Reasoning</td>
<td>31.19</td>
<td>5.95</td>
</tr>
<tr>
<td>Chinese Verbal Reasoning</td>
<td>40.49</td>
<td>4.50</td>
</tr>
<tr>
<td>Chinese Language Usage</td>
<td>35.63</td>
<td>4.18</td>
</tr>
<tr>
<td>English Language Usage</td>
<td>37.58</td>
<td>4.79</td>
</tr>
<tr>
<td>English Verbal Reasoning</td>
<td>38.84</td>
<td>4.66</td>
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</tbody>
</table>

### Table 4.15 Aptitude Tests Results of the Two Classes.

<table>
<thead>
<tr>
<th>Dependent Variable</th>
<th>Scaled Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>English Verbal Reasoning</td>
<td>28.61</td>
</tr>
<tr>
<td>Chinese Verbal Reasoning</td>
<td>-15.68</td>
</tr>
<tr>
<td>Mechanical Reasoning</td>
<td>-13.54</td>
</tr>
<tr>
<td>Spatial Reasoning</td>
<td>-11.04</td>
</tr>
<tr>
<td>Abstract Reasoning</td>
<td>9.93</td>
</tr>
<tr>
<td>Mathematical Reasoning</td>
<td>-9.47</td>
</tr>
<tr>
<td>Chinese Language Usage</td>
<td>8.93</td>
</tr>
<tr>
<td>English Language Usage</td>
<td>-1.89</td>
</tr>
</tbody>
</table>

### Table 4.16 Vector of Scaled Weights of Variables in the Discriminant Function for the Two Classes.
<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Sum of Squares (due to reg.)</th>
<th>Sum of Squares (about reg.)</th>
<th>df (adjusted)</th>
<th>Mean Square (adjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>40.48</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>84</td>
<td>2680.98</td>
<td>753.41</td>
<td>1927.57</td>
<td>76</td>
<td>25.36</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>2721.46</td>
<td>787.79</td>
<td>1933.67</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td>6.09</td>
<td>1</td>
<td>6.09</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

$F = 0.24$

Table 4.17 ANCOVA Table of the Two Classes Learning Mechanics.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Means</th>
<th>Adjusted Means</th>
<th>S.E. (Adjusted Means)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bilingual Class</td>
<td>19.84</td>
<td>20.23</td>
<td>0.81</td>
</tr>
<tr>
<td>English Class</td>
<td>21.21</td>
<td>20.82</td>
<td>0.81</td>
</tr>
</tbody>
</table>

Table 4.18 Means before and after Adjustment for the Two Classes Learning Mechanics.
### Table 4.19 ANCOVA Table of the Two Classes Learning Atomic Physics.

<table>
<thead>
<tr>
<th>Source of Variation</th>
<th>df</th>
<th>Sum of Squares</th>
<th>Sum of Squares (due to reg.)</th>
<th>Sum of Squares (about reg.)</th>
<th>df (adjusted)</th>
<th>Mean Squares (adjusted)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Treatment</td>
<td>1</td>
<td>35.17</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Error</td>
<td>84</td>
<td>1295.59</td>
<td>370.26</td>
<td>925.32</td>
<td>76</td>
<td>12.18</td>
</tr>
<tr>
<td>Total</td>
<td>85</td>
<td>1330.76</td>
<td>376.62</td>
<td>954.14</td>
<td>77</td>
<td></td>
</tr>
<tr>
<td>Difference for Testing Adjusted Treatment Means</td>
<td></td>
<td>28.82</td>
<td></td>
<td>1</td>
<td>28.82</td>
<td></td>
</tr>
</tbody>
</table>

\[ F = 2.37 \]

### Table 4.20 Means before and after Adjustment for the Two Classes Learning Atomic Physics.

<table>
<thead>
<tr>
<th>Treatment</th>
<th>Means</th>
<th>Adjusted Means</th>
<th>S.E. (Adjusted Means)</th>
</tr>
</thead>
<tbody>
<tr>
<td>English</td>
<td>22.77</td>
<td>22.77</td>
<td>0.56</td>
</tr>
<tr>
<td>Chinese</td>
<td>24.05</td>
<td>24.05</td>
<td>0.56</td>
</tr>
</tbody>
</table>

Table 4.19 ANCOVA Table of the Two Classes Learning Atomic Physics.

Table 4.20 Means before and after Adjustment for the Two Classes Learning Atomic Physics.
3.1 Statement of the specific problems and research hypothesis

3.2 Selection of subjects

3.3 Check on the comparability of the ACS and CS groups

3.5 Comparison of physics achievement between CS and ACS groups

3.6 Relationship between physics achievement and English proficiency of the ACS group

3.7 Relationship between English proficiency and selected factors of the ACS group

3.8.1 Comparison of physics achievement between the two classes in the ACS group (Study No. 1: English and Bilingual instruction)

3.8.2 Comparison of physics achievement between the two classes in the ACS group (study No. 2: Chinese and English instruction)

Ch. 4 Results and analysis

Ch. 5 Conclusion and recommendation

Fig. 3.1 Schematic Chart of the Research Design
Fig. 4.1 Aptitude Profile of the Two Schools
Fig. 4.2 Aptitude Profile of the Two Classes.

Class 2

Class 1

Mean Score

MR AR MER SR CVR CLU ELU EVR
APPENDIX 1

THE PRETEST
A1. Whenever the centres of the sun, moon and earth are in a straight line (in that order):
   I. some part of the earth must be in the moon's umbra
   II. there is a total eclipse of the sun visible from somewhere on the earth
   III. part of the earth is in the moon's penumbra

Which of the above statements is/are true?
A. I only  B. II only  C. III only  D. I and II only  E. I, II and III

A2. The effect of increasing the diameter of the pinhole in the pinhole camera is
A. increased sharper  B. reduced sharper  C. increased unchanged  D. reduced blurred  E. increased blurred

A3. We can see the image of ourselves in the plane mirror but not on a plane sheet of white paper because
A. white paper absorbed all the light energy falling on it.  B. white paper is too rough to give regular reflection.  C. white paper transmitted nearly all the light falling on it.  D. the coefficient of white paper is unknown.  E. the image formed in white paper is virtual.

A4. The rays \( X \) and \( Y \) diverging from a point source \( S \) are reflected from a plane mirror \( MM' \). The reflected rays \( X \) and \( Y \) will now diverge at an angle of
A. \( 75^\circ \)  B. \( 15^\circ \)  C. \( 30^\circ \)  D. \( 45^\circ \)  E. \( 75^\circ \)

A5. Which of the following mirrors can give an image (real or virtual) of the same size as an object which is not in contact with the mirror?
   I. plane mirror  II. convex mirror  III. concave mirror
A. I only  B. II only  C. I and II only  D. I and III only  E. I, II and III

A6. If an object is placed 20 cm from a convex mirror of focal length 20 cm, the image formed by the mirror will be
A. magnified  B. real and inverted  C. diminished and upright  D. between the object and the mirror  E. at infinity.
17. (i) The above diagrams show a parallel beam of light entering from one medium to another. Which of the beam will emerge as converging rays in the above 3 cases.
A. i only  B. ii only  C. iii only  D. i and ii

18. Rays from a point source at S are reflected by a concave mirror M and converge to a point F as shown in the diagram above. If we wish to obtain a parallel beam of light after reflection we could
I. move the mirror M further away from S  II. move the mirror M nearer to S  III. keep the source at S and replace mirror M by a suitably chosen concave mirror of shorter focal length
A. I only  B. II only  C. III only  D. I and III only

19. When a beam of monochromatic yellow light pass from air to glass, there must be a change in the ...
A. speed at which the light travels  B. directions of propagation of the light wave  C. frequency of the light wave
A. i  B. ii  C. iii  D. i, ii and iii

20. Total internal reflection can occur at a surface of separation between a dense medium A and a rare medium B only when
I. the ray travels from A towards B  II. the angle of incidence is greater than the critical angle  III. the refractive index for light travelling from A to B is greater than 1
Which of the above statements is/are correct?
A. I only  B. II only  C. I, II only  D. II, III only  E. I, II and III

21. A ray of light coming from point O in a clear liquid approaches the surface, as shown by ray OQ making an angle with the normal which is less than the critical angle. After meeting the surface, the ray will continue along the path or paths
A. OX only  B. OY only  C. OZ only  D. OX and OZ  E. OY and OZ

Cont'd.
A black spot at X inside a block of glass is observed from the point Y. The image of X appears to be
A. between Y and Z.
B. between Z and X.
C. at X.
D. between X and V.
E. between Y and X.

1.13. The angle of incidence of a ray of light on a liquid is 60° and its angle of refraction is 30°. What is the critical angle for the liquid?
A. 15°
B. 30°
C. 45°
D. 60°
E. 75°

1.14. The angle of incidence of a ray of light on a liquid is 60° and its angle of refraction is 30°. What is the critical angle for the liquid?
A. 15°
B. 30°
C. 45°
D. 60°
E. 75°

1.15. The diagram shows a thin-walled prism filled with air. The air prism is immersed in water. A ray of light is incident along the line PO. Along which line the direction of the light emerges ...
A. 1
B. 2
C. 3
D. 4
E. 5

1.16. Which of the following give optical instrument use concave lens as the eye-piece?
A. Compound microscope
B. prism monocular
C. prism binocular
D. terrestrial telescope
E. Galilean telescope

1.17. An object is placed between a concave lens and its focal point. What is the nature of the image produced?
A. Magnified, virtual and erect
B. Magnified, real and inverted
C. Diminished, real and inverted
D. Diminished, virtual and erect
E. No image is produced by the arrangement

Cont'd
With a lens at X, a real, inverted and magnified image of the illuminated pin is seen on the screen. When the lens is moved to position Y, an image of the pin is seen again. This image will be

A. real, inverted and diminished
B. real, inverted and magnified
C. real, erect and magnified
D. real, erect and diminished
E. virtual, erect and magnified

A parallel beam of rays after passing through a converging lens L converges to a point F. If the lens is now completely surrounded by a clear liquid having the same refractive index as the lens, you would expect the beam to

A. converge to the point X.
B. converge to the point F as before.
C. converge to the point Y.
D. emerge as a parallel beam.
E. diverge from the point Z.

A real image I of an object is formed by a convex lens, locate at a distance of 25 cm from the lens. If a plane mirror incline at 45° in the axis of the lens is placed at a distance of 15 cm from it, as shown in the diagram above. What will be the nature and position of the final image formed?

A. real, 10 cm below the axis of the lens.
B. real, 15 cm below the axis of the lens.
C. virtual, 15 cm below the axis of the lens.
D. virtual, 15 cm above the axis of the lens.
E. virtual, 10 cm above the axis of the lens.

Two parallel rays of light pass through a box containing a piece of glass and emerge as shown:

(I) (II) (III) (IV)

Which of the above pieces of glass could produce this result?

A. I only
B. II only
C. III only
D. IV only
E. either II or IV
A22. Short-sight can be corrected by using a suitable concave lens. BECAUSE the image seen through a concave lens appears to be closer than the object.

A. True True (correct explanation)
B. True False (irrelevant or wrong explanation)
C. True False
D. False True
E. False False

A23. The reason why a rainbow has several colours is that
A. the refractive indices for colours in white light are not quite identical.
B. all of the colours in sunlight have the same refractive index.
C. the different colours in sunlight have travelled from the sun at the same velocity.
D. the different colours in sunlight have travelled from the sun at different velocity.
E. the critical angle for different colours is always the same, regardless of the colour.

A24. A red disc is placed on a green grass ground and is then illuminated with coloured light given below, which could make the disc in-distinguishable from its background...

A. red
B. white
C. green
D. blue
E. magenta

A25. Red and blue filters are placed directly in the path of white light. What is the colour of the light coming through?
A. magenta
B. white
C. yellow
D. green
E. black (no light pass through)

A26. Which of the following will affect the velocity of sound in air?
I the frequency of sound
II the loudness of sound
III the temperature of the air
A. I only
B. II only
C. III only
D. I, II and III
E. none of the above

A27. Which of the following will occur at a displacement node of the longitudinal wave set up in an air column?
A. Maximum variation in pressure and maximum displacement of air particles
B. Maximum variation in pressure but no displacement of air particles
C. Moderate variation in pressure and moderate displacement of air particles
D. No change in pressure but maximum displacement of air particles
E. No change in pressure and no change in displacement of the air particles.

A28. The closed pipe shown is 0.9 m long and contains a stationary sound wave with nodes N and antinodes A at the position shown. The wave length of the sound is
A. 0.9 m
B. 0.6 m
C. 0.45 m
D. 0.3 m
E. 0.15 m

Cont'd
The velocity of sound in air is $340 \text{ m/s}$. An electronic whistle, situated 3 m from a vertical wall, sounds sharply from $t = 0$ s to $t = 0.4$ s only. A sound recorder (which draws an amplitude time graph) is started at the same moment as the whistle. The graph obtained is:

![Graph Image]

A loudspeaker is emitting sound waves of frequency 500 Hz towards a solid wall. On moving a microphone between the loudspeaker and the wall, it is found that there are positions of maximum loudness at regular spaced intervals of 0.3 m. We can deduce from this that the wavelength of the note is

- A. 0.3 m
- B. 0.6 m
- C. 0.66 m
- D. 1.2 m
- E. Impossible to calculate

The above diagram shows a disc siren; the pitch emitted by this disc will depend on

- I. the number of holes in the disc
- II. the distance of the holes from the axle of the disc
- III. the number of revolutions the disc turns through per second

- A. II only
- B. I and II only
- C. II and III only
- D. II and III only
- E. I, II and III

Two loudspeakers X and Y broadcast the same pure note. The sound from loudspeaker X is louder than that from loudspeaker Y. The sound waves produced by X

- A. have higher frequency than those by Y
- B. have longer wavelength than those by Y
- C. have shorter wavelength than those by Y
- D. have greater amplitude than those by Y
- E. travel faster than those by Y

With respect to a sound wave,

- I. the pitch depends on frequency
- II. the quality depends on velocity
- III. the loudness depends on amplitude

Which of the above statements is/are correct?

- A. I only
- B. II only
- C. II only
- D. I and II only
- E. I and III only

Cont'd
A34. A note sounded on a violin **BECAUSE** a violin sets more air in vibration than a tuning fork the same note produced by a tuning fork

A. True True **(Correct explanation)**
B. True True **(Wrong or irrelevant explanation)**
C. True False
D. False True
E. False False

A35. When the air in a tube closed at one end and open at the other is made to vibrate, it has:

A. an antinode at the closed end
B. an antinode exactly at the open end
C. maximum amplitude halfway along its length
D. the frequency of any strongly vibrating tuning fork placed near the open end
E. a node at the closed end

A36. The sound in air caused by the vibrating string must ...

i. have the same frequency as the stationary wave
ii. have the same wavelength as the stationary wave
iii. also be a stationary wave

Which of the above statements is/are correct?

A. 1  B. 2  C. 3  D. 1 and 2 only  E. all

A37. Sound is produced by pouring water into a resonance tube closed at one end. As the tube fills, it is found that

I. the velocity of the sound produced remains constant
II. the pitch of the sound produced becomes lower and lower
III. the pitch of the sound produced becomes higher and higher

A. I only  B. II only  C. III only  D. I and II only  E. I and III only

A38. A sonometer wire emits a note of frequency 300 Hz than under a tension of 2 kgf. If the tension is increased to 8 kgf and the length is kept constant, the frequency of the note becomes

A. 75 Hz  B. 150 Hz  C. 600 Hz  D. 1200 Hz  E. 4800 Hz

A39. An open tube A has a diameter twice that of another open tube B, but the fundamental length of A is only half of B. Neglecting the end correction, frequency of the sound emitted by A will be ...

A. 4 times than emitted by B  B. 2 times than emitted by B  C. same as B  D. a quarter of that emitted by B  E. half of that emitted by B

A40. As in the figure, the column of air in the glass tube is resonating with vibrating tuning fork of unknown frequency. If the level is gradually reduced by a distance 1 metre, resonance occurs again. From the above results only, which of the following can be determined?

i. frequency of the sound emitted by fork
ii. wavelength of the sound emitted by fork
iii. velocity of sound in water

A. i only  B. **ii only**  C. iii only  D. i and ii only  E. all

END
APPENDIX 2

CONTENT ANALYSIS OF THE PRETEST
<table>
<thead>
<tr>
<th>Analysis of content</th>
<th>Recall</th>
<th>Comprehension</th>
<th>Application</th>
<th>Subtotal</th>
</tr>
</thead>
<tbody>
<tr>
<td>Reflection by a plane surface</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>4</td>
</tr>
<tr>
<td>Reflection by a curved surface</td>
<td>1</td>
<td>2</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Refraction by a plane surface</td>
<td>1</td>
<td>5</td>
<td>1</td>
<td>7</td>
</tr>
<tr>
<td>Lens and optical instrument</td>
<td>2</td>
<td>3</td>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>Dispersion and color</td>
<td>0</td>
<td>3</td>
<td>0</td>
<td>3</td>
</tr>
<tr>
<td>Propagation of sound</td>
<td>2</td>
<td>1</td>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>Quality of sound</td>
<td>3</td>
<td>1</td>
<td>0</td>
<td>4</td>
</tr>
<tr>
<td>Strings and resonance tube</td>
<td>2</td>
<td>1</td>
<td>3</td>
<td>6</td>
</tr>
<tr>
<td>Subtotal</td>
<td>12</td>
<td>18</td>
<td>10</td>
<td>40</td>
</tr>
</tbody>
</table>

Judges:  
Mr. C.C. Wong (B.Sc., Dip.Sys.An., Dip.Ed.)  
Mr. H.H. Wong (B.Sc., Dip.Ed.)  
Mr. H.C. Au (B.Sc., Dip.Ed.)
APPENDIX 3

CHINESE TRANSLATION OF THE PRETEST
中四物理測驗卷

1. 隨著太陽、月球、地球依次同在一直線上時：
   I. 地球上某些地區必定在於月球的本影區上
   II. 在地球上某些地區可看到日全蝕的像相
   III. 地球上某些地區仍於月球的半影區上
   閱上述那些敘述正確
   A. 只有I  B. 只有II  C. 只有III
   D. 只有I及II  E. I、II、III全部

2. 增加針孔照相機的針孔直徑對下述有何影響？
   像的亮度 像的清晰度
   A. 增加 增加
   B. 減少 增加
   C. 增加 無改變
   D. 減少 減少
   E. 增加

3. 我們可從平面鏡中看到自己的形像，但不能從白紙上看到自己的形像是因為……
   A. 白紙吸收所有落在它上面的光
   B. 白紙非常粗糙，所引起的散射不能產生規則反射
   C. 白紙幾乎把全部落在它上面的光反射出去
   D. 白紙的係數是未知
   E. 白紙上的成像等於實像
4. 圖中白點光束發出的光線 HK 被平面鏡 MM' 反射，則反射後 XY 之夾角為
A. 75°  B. 15°  C. 30°  D. 40°  E. 75°

5. 下列何者會使實物產生一個同大小相等的實像或虛像，該實像並不與鏡面接觸者。
I. 平面鏡   II. 凸鏡   III. 四面鏡
A. 只有 I   B. 只有 II   C. 只有 I 及 II
D. 只有 I 及 II   E. I、II 及 III 全部

6. 將一實物置于焦距為 20 cm. 之凸鏡前，距鏡面為 20 cm，則其成像將會是
A. 放大的像   B. 虛像則倒立
C. 增小則正立   D. 位於物與鏡面間
E. 位於無限遠處

7. 上圖中的平行光線由一種介質進入另一種介質（a 代表空氣，b 代表玻璃），上述那些情況會產生會聚的折射光線？
A. 只有 I   B. 只有 II   C. 只有 II
D. 只有 I 及 II   E. 只有 II 及 III
8. 圖中的點光源S所發的光波照鏡M所反射而會聚於下點上，如欲產生平行的反射光線，則是
I. 把M移到S
II. 把M接近S
III. 固定S而把另一較短焦點之凹鏡取代M。

A. 只有I B. 只有II C. 只有III
D. 只有I及II E. 只有II及III

9. 有三束不同之光自空氣進入玻璃，下列何者決定改變？
I. 光速 II. 光行進的方向 III. 光的頻率
A. 只有II B. 只有III C. 只有II
D. 只有I及II E. 全部

10. 光束射入光密介質與光疏介質的分界面上發生折射，假如
I. 光線自空氣進入B. 光入射角大於臨界角
II. 光自A進入B. 折射率大於1
上述何者正確？
A. 只有I B. 只有II C. 只有I及II
D. 只有II及III E. 全部

11. 導目老光源C之光線自透明液體到非液體
在空氣之分界面上，若入射線
CG與法線成之夾角θ
小於臨界角時，則該光線能否下到何種途徑前進？
A. 只有QX B. 只有QY C. 只有QZ
D. 只有QX及QZ E. QY及QZ
12. 有一黑点X位于玻璃薄片内，观察者自Y点观察，则X之像位于：
A. X与Y之间
B. Y与X之间
C. 在Y上
D. X与V之间
E. V与Y之间

13. 光线自空气进入液体，入射角为45°，折射角为30°，则该种液体之折射率是
A. 15°  B. 30°  C. 45°  D. 60°  E. 75°

14. 上图中之观察者所看到之现象为：
I. 比实物缩短
II. 比实物变长
III. 距离比实际者为近
IV. 距离比实际者为远
A. 只有I
B. 只有II
C. 只有I及III
D. 只有I及IV
E. 只有II及IV

15. 图中三菱镜由薄透明片构成，内藏空气，置入水中，通过PA之光将会怎样路径前进？
A. ①  B. ②  C. ③  D. ④  E. ⑤

16. 下列五种光学仪器中，何者选用单透镜为其中段？
A. 复式显微镜
B. 投影机
C. 教学双筒望远镜
D. 伽利略望远镜
E. 伽利略望远镜

17. 实物置于凹透镜前其焦点之间，则其成像之性质为
A. 放大，正立虚像
B. 放大，倒立实像
C. 缩小，倒立虚像
D. 缩小，正立虚像
E. 缩小，正立实像
C. 縮小，倒立實像。 D. 縮小，正立實像
E. 根本不可以成像

19. 平行光通過一會聚透鏡而聚於下點上，由此透鏡完全被一同折射率之液體包圍，則此光將會
A. 聚於 X 点
B. 聚於 F 点
C. 聚於 Y 点
D. 平行出射

20. 一實物之光通過凸透鏡成一實像，像距鏡 25 cm，若平面鏡自透鏡主韌上，與主軸成 45° 與透鏡距 15 cm，如上圖所示，則最後成像之性質及位置如何？
A. 成實像，在主軸下 10 cm
B. 猶み像，在主軸下 15 cm
C. 猶虚像，在主軸下 15 cm
D. 猶虛像，在主軸上 15 cm
E. 猶虛像，在主軸上 10 cm
21. 正交平行光穿越一盒，盒中放置光学元件之一

上述各情况会产生怎样的结果？
A. 只有 I   B. 只有 II   C. 只有 III   D. Ⅰ、Ⅱ或 Ⅲ

22. 近视可用适当之凹透镜矫正。因为通过凹透镜所观察到的像较为实际清晰。
A. 前镜及后镜均正确，且为分立解释正确。
B. 前镜及后镜均正确，但不是分立解释正确。
C. 前镜正确，后镜不正确。
D. 前镜不正确，后镜正确。
E. 两镜均不正确。

23. 夜空有各种颜色照理由是
A. 太点对白光中各色光的折射率不相等。
B. 太点对白光中各色光的折射率相同。
C. 由太阳发出的各色光有相等的速度。
D. 由太阳发出的各色光有不相等的速度。
E. 太点对齐光中各色光有相等的弥散角。

24. 一红箔置于黑色地面上，下列何种光照射可令红色箔
无法被辨认出来？
A. 红   B. 白   C. 绿   D. 蓝   E. 紫

25. 白光经红色滤色镜后，其出射光的颜色是
A. 红   B. 白   C. 黄   D. 绿   E. 黑（无光射出）
26. 下列何者对空气之声波有影响？
   I. 声波之频率
   II. 声波之强度
   III. 空气之密度
   A. 只有I  B. 只有II  C. 只有III
   D. I. II 及 III  E. 非上述之组合

27. 在空气柱所形成的声波波长处，在下列哪种情形发生？
   A. 有最大压力变化及粒子有最大位移
   B. 有最大压力变化及粒子无位移
   C. 中度压力变化及中度粒子位移
   D. 无压力变化但粒子有最大位移
   E. 无压力变化且粒子无位移

28. 上图之圆管长 0.9 m，形成一声波之驻波，其中 n 代表波节之位置，A 代表波腹之位置，求声波之波长
   A. 0.9 m  B. 0.6 m  C. 0.45 m  D. 0.3 m  E. 0.15 m

29. 空气声速为 340 m/s，一电话置放一端直的墙前 34 m 处，
   电讯器发出声波由 t = 0 s 至 t = 0.4 s 止，一录器录
   音并显示与时间的函数图线，其图线所示时间函数
   开始录音时所得图线是

   A
   B
   C
   D
   E
30. 擴音器所一端播送之聲波頻率是 500 Hz。若將動磁
揚聲器設於擴音器之側，測得有一固定的最小聲響間
之距離為 0.3 m。吾人因此可推出此聲波之波長為
A. 0.3 m  B. 0.6 m  C. 0.66 m  D. 1.2 m  E. 不可計算

31. 圖中有一股音響，其發聲之音響與下列何者有關？
I. 空氣之壓強
II. 空氣中軸的位置
III. 空氣中軸的距離
A. 只有 I  B. 只有 II  C. 只有 III  D. 只有 II 及 III  E. I, II 及 III

32. X 與 Y 二擴音器產生同一音調之聲波。若 X 聲之聲響度
較 Y 小，則 Y 所產生之聲波
A. 比 Y 產生者有較高頻率
B. 比 Y 產生者有較長波長
C. 比 Y 產生者有較短波長
D. 比 Y 產生者有較大振幅
E. 比 Y 產生者有較大速度

33. 對音波而言，
I. 聲調與頻率有關
II. 聲調與波速有關
III. 壓強與振幅有關
上述何者正確
A. 只有 I  B. 只有 II  C. 只有 III  D. 只有 I 及 II  E. I, II 及 III

34. 小提琴所產生的音調較高，僅稍微提高音調之音響會因有
小提琴所產生的音調較高，僅稍微提高音調之音響會因有
A. 前後說均正確，且後者較合理解釋
B. 前後說均正確，但後者非合理解釋
C. 前說正確，後說不正確
D. 前說不正確，後說正確
E. 兩者均不正確
35. 開管一端封閉，另一端開口，其中空氣起振動，形成波
A. 閉管的一端是波腹所在
B. 波腹剛好位於開口處
C. 管中部有最大振幅
D. 有強度的任何頻率的聲波在管口振動
E. 閉管的一端是波節所在
36. 振動會傳遞被空氣中的聲波
I. 必有振幅波頻率相同
II. 必有振幅波有同波長
III. 亦為聲波
A. 只有I
B. 只有II
C. 只有III
D. 只有I及II
E. 全部
37. 將水注入一端封閉的空管中，在傾注時可發現
I. 管所發聲波速度不變
II. 管所發聲波頻率減低
III. 管所發聲波頻率升高
A. 只有I
B. 只有II
C. 只有III
D. 只有I及II
E. 只有I及III
38. 新音計發音之頻率是300 Hz，其聲所受壓力是2 kPa，若壓力增至8 kPa，而頻率保持不變，其發音頻率成為
A. 75 Hz
B. 150 Hz
C. 300 Hz
D. 1200 Hz
E. 4800 Hz
39. 開管A之長經為另一開管B之兩倍，但A之管長為B之一半，則A發音音之頻率為B之
甲 微 乙 丁 丙 丙 丁 乙

图中之玻璃管中之空氣柱會因水位起共鳴，但頻率為未知值。若水位上升1m又有共鳴現象產生，下列那些物理量可由此結果確定之：
工 高之頻率
Ⅱ 高波之波長
Ⅲ 水中之聲速
A. 只有工 B. 只有Ⅱ C. 只有Ⅲ
D. 只有Ⅱ及Ⅲ E. 全部
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APPENDIX 5

TEACHING MATERIAL IN OPTICS
1. A thin converging lens of focal length 4 cm forms a real image twice as large as the object. Calculate the distance of the object from the lens and draw a ray diagram to scale showing how the image is formed.

2. A small object is viewed through a diverging lens (concave lens) held closed to the eye. An image 1.5 cm long is formed 25 cm from the lens whose focal length is 40 cm. Find the position of the object and its size.

3. ABC is a triangular prism, made of glass of refractive index 1.5, in which the angle A is 30° and the angle B is 60°. A ray of light is incident on the face AB with an angle of incidence 30° as the diagram shown. Calculate the angle of emergence and the angle of deviation.

4. A glass cube of length 15 cm on each side has a small bubble made in it. If observe this bubble on one side face, the apparent depth is 6 cm. If observe it on the opposite face, the apparent depth is 4 cm. Find the distance between the bubble and the first face and the refractive index of glass also.

5. Copy the following table on the answer sheet, fill in suitable words.

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<td>Invert</td>
<td>Diminished</td>
</tr>
<tr>
<td>Concave Mirror</td>
<td>Infinity</td>
<td>Real</td>
<td>Invert</td>
<td>Magnified</td>
</tr>
<tr>
<td>Plane Mirror</td>
<td>In front of mirror</td>
<td>Real</td>
<td>Invert</td>
<td>Diminished</td>
</tr>
</tbody>
</table>
1) Let object distance be \( u \), making use of the real or positive convention, then
\[ \frac{1}{u} + \frac{1}{f} = \frac{1}{u_f} \]  
\[ \Rightarrow u_f = \frac{uf}{u + f} = \frac{12u}{u + 2u} = 4 \text{ cm} \]  
Answer: object and image are on the opposite side of the lens, and the object is 4 cm from the lens.

2) Let object distance be \( u \), making use of the real or positive convention, then
\[ \frac{1}{u} + \frac{1}{f} = \frac{1}{u_f} \]  
\[ \Rightarrow u_f = \frac{uf}{u + f} = \frac{12u}{u + 2u} = 4 \text{ cm} \]  
Answer: The object is on the same side of the image of a distance of 66.7 cm from the lens, and of a height of 4 cm.

3) The diagram shows how the light ray passes through the prism. Making use of the law of refraction,
\[ \sin 30^\circ = \frac{1.5}{x} \Rightarrow x = 19.5^\circ \]  
\[ \frac{y}{1.5} = \frac{10.5}{1.5} \Rightarrow r = 15^\circ \]  
Angle of deviation \( \alpha = (30^\circ - x) + (r - y) = 159^\circ \)

4) Let the bubble be a distance \( x \) away from face AB. Making use of the formula:
\[ \frac{\text{Real depth}}{\text{Refractive index of the medium where the object is}} = \frac{\text{Object depth}}{\text{Refractive index of the medium where the bubble is}} \]
\[ \frac{x}{B} = \frac{x}{n} \]  \[ \Rightarrow \] \[ x = \frac{nx}{B} \]
\[ \text{Diverging} \] \[ \text{(1)} \] \[ \text{When the observer looks at the bubble through face BC, then} \]
\[ 15 - x = \frac{x}{B} \]  \[ \Rightarrow x = 9 \]  \[ \Rightarrow x = 15 \]  \[ \Rightarrow x = 1.5 \]

5) position of object | position of image | property of image | property of image | property of image | property of image | property of image | property of image
| | | real or virtual | erect or inverted | right or left | diminished |
| Concave mirror | at infinity | in front of the mirror on the same side of mirror | real | inverted | right or left | diminished |
| Plane mirror | behind the mirror | in front of the mirror | real | inverted | right or left | magnified |
| Convex mirror | at infinity | behind the mirror | virtual | erect, inverted | unchanged | |
| Concave mirror | at infinity | behind the mirror | virtual | erect, inverted | unchanged | |
| Plane mirror | behind the mirror | in front of the mirror | real | inverted | right or left | magnified |
1. A thin converging lens of focal length 5 cm forms a virtual image twice as large as the object. Calculate the distance of the object from the lens and draw a ray diagram to scale showing how the image is formed.

2. A small object is viewed through a diverging lens (concave lens) held closed to the eye. An image 2 cm long is formed 30 cm from the lens whose focal length is 40 cm. Find the position of the object and its size.

3. ABC is a triangular prism made of glass of refractive index 1.5. Which the angle A is 50°. A ray of light is incident on the face as shown. Calculate the angle of emergence and the angle of deviation of light.

4. There is a particle inside a rectangular transparent block. The apparent depth of the particle is 8 cm if viewed on the side AB. The apparent depth is 6 cm if viewed on the side CD. Find the refractive index of the block and the distance X shown in the diagram.

5. a) State the reason of long sight and the method of correction.
   b) Write down the structural differences and similarities between the eye and the camera.

--- END OF PAPER ---
1) Two plane mirrors making 45° with each other are shown in the diagram. A point source of light is placed between the two mirrors. Following the scale shown in the diagram, construct ray diagrams to show how light is first reflected by mirror 1 and then mirror 2 to form an image. Find the position of the image also. (Two rays are required.)

2) A concave mirror of radius of curvature 40 cm forms a sharply focused image of a small object on a screen placed at a distance of 80 cm from the mirror. Calculate (a) the position of the object (b) the magnification.

3) An object is placed on and perpendicular to the axis of a convex mirror of focal length 8 cm. The object is at a distance of 15 cm away from the mirror. Find, by accurate drawing, the position of the image and its nature. (end)

[ SOLUTION ]

1) A point source of light is placed 10 cm in front of the concave mirror. A ray is drawn parallel to the axis of the mirror. This ray reflects back through the center of the mirror. A ray is another ray drawn through the center of the mirror. This ray reflects parallel to the axis. The image is formed at the intersection of these two rays.

2) An object distance be U.

Given: \( U = 80 \text{ cm} \), \( R = 40 \text{ cm} \)

Find: \( f \) and \( l \) using the mirror formula, \( \frac{1}{f} + \frac{1}{l} = \frac{1}{R} \)

\( \frac{1}{f} + \frac{1}{l} = \frac{1}{40} \)

\( \frac{1}{f} = \frac{1}{40} - \frac{1}{l} \)

\( l = 26.7 \text{ cm} \)

Magnification: \( m = \frac{h'}{h} = \frac{50}{24.1} = 2.07 \)

Answer: The object is placed 26.7 cm in front of the concave mirror. Magnification = 2.07

3) A ray of light is incident on the mirror. The ray is reflected and passes through the center of the mirror. The image is formed at the intersection of this ray with another ray drawn parallel to the axis of the mirror.
E.4  Optics test 1

1) A small object is placed on the principal axis of a convex mirror of focal length 10 cm and the object is 1.5 cm from the mirror. Find by calculation, the position and nature of the image.

2) A concave spherical mirror of radius of curvature 20 cm forms an erect image 40 cm from the mirror. Find the position and size of the object and show with a scaled diagram how the image is formed.

3) A man is standing in a room of area 6 x 6 m, height 3 m. The diagram shown is a cross section of the room. A large mirror PC of height 1.2 m is hanged on the middle of wall CD. If the observer wants to see the whole image of wall AB in the mirror PC, find the furthest position of the observer from the mirror. (i.e. find x & y in the diagram)

4) An optical pin of length 10 cm is placed in front of a convex mirror of focal length 20 cm. Find the position of the image. If the optical pin is placed such that it lies on the principal axis with its head of distance 50 cm from the mirror and its tail is 10 cm further away from the mirror, find the length of the image. (Note: not the height of the image !)

5) As shown in the diagram, PA & AB are two plane mirrors placed perpendicular to each other with AB lying 30° with the horizon. Pole AB of length 2 m is placed perpendicular to the horizon. Draw this diagram on your answer sheet with exact scale. Construct a ray diagram to show how the light from AB would be reflected from PA to form an image. Find the position of the image also.
APPENDIX 6

THE QUESTIONNAIRE
Instruction: The following is a list of questions which is aimed to find out your background and opinion on certain ideas. This is not a test. There are no right or wrong answers since people have different background and opinions. Your answers will be kept confidential and will strictly be used in research only. It will not have any slight effect or influence on you, so please try to be as accurate as possible.
Section A. Please answer the following questions:

1. What is your age

   _______________________

2. Where do you live? (which district)

   _______________________

3. Which dialect do you speak at home?

   _______________________

4. Where were you born?

   _______________________

5. When did you come to Hong Kong?

   _______________________

6. What is your father's occupation?

   _______________________

7. What kind of career would you like to pursue in the future?

   _______________________

8. Do you remember your secondary school entrance examination result? Please fill in the grades if you remember:
   
   (a) Chinese __________________
   (b) English __________________
   (c) Mathematics _______________
   (d) Overall ________________

9. Was the present school you are studying among the first three choice of your secondary school entrance examination?

   Yes ______
   No ______

10. How does your total family income compare with others?

    (a) poor
    (b) below average
    (c) average
    (d) above average
    (e) rich
11. Indicate which of the following items you have in your house:
   a) refrigerator
   b) telephone
   c) car
   d) bathtub
   e) piano
   f) washing machine
   g) colour television
   h) radio-phonograph combination
   i) air conditioner

12. Does your family have servants?
   a) yes
   b) no

13. Have you ever had a private tutor?
   a) yes
   b) no

14. Do you have your own bedroom at home?
   a) yes
   b) no

15. Do members of your family occasionally leave Hong Kong for vacation (excluding trip to Macau or the Kwangtung province)?
   a) yes
   b) no

16. Did your mother go to high school?
   a) yes
   b) no

17. Did your mother go to college?
   a) yes
   b) no

18. Did your father go to high school?
   a) yes
   b) no

19. Did your father go to college?
   a) yes
   b) no

20. How many books are there in your home?
   a) under 100
   b) 100-500
   c) above 500
Section B. Answer the questions by marking the one best response for each question.

21. Do your parents speak English with you?
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

22. Do your parents teach you English at home?
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

23. When did you start learning English?
   a) nursery school
   b) kindergarten
   c) grade 1
   d) grade 2
   e) grade 3 or above

24. Did you study in an English primary school? (i.e., receive instruction in English)
   a) yes, since primary one
   b) yes, since primary three
   c) yes, since primary five
   d) yes, since primary six
   e) no

25. What was your standard of English in primary school?
   a) poor
   b) below average
   c) average
   d) above average
   e) good

26. What was your standard of English in the past three years in Secondary school?
   a) poor
   b) below average
   c) average
   d) above average
   e) good

27. Do you ask and answer questions in English in class (outside English language lessons)?
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always
28. Do you speak in English to your friends in class?
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

29. Do you speak in English to your friends outside class?
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

30. Usually, in which language do you write letters to your friends?
   a) English
   b) Chinese
   c) a mixture of half Chinese and half English
   d) mainly Chinese, some English
   e) mainly English, some Chinese

31. When you are watching an English movie, do you try to follow the spoken dialogue rather than read the Chinese captions (translation)?
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

32. Do you listen to the radio programme broadcast on the English channel?
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

33. Do you watch English television programmes?
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always
Section C. Answer the questions by marking the one best response for each question.

34. Do your parents speak English with their friends?
   a) never
   b) sometimes
   c) often
   d) always

35. Do your parents use English in their jobs?
   a) never
   b) sometimes
   c) often
   d) always

36. Do your parents read English books, newspapers, or magazines?
   a) never
   b) sometimes
   c) often
   d) always

37. Do your parents write English letters?
   a) never
   b) sometimes
   c) often
   d) always

38. Do your parents watch English television programmes?
   a) never
   b) sometimes
   c) often
   d) always

39. Do your parents listen to the radio programmes broadcast on the English channel?
   a) never
   b) sometimes
   c) often
   d) always

40. When you meet difficulties while doing your homework in English, can your parents help you with the language?
   a) never
   b) sometimes
   c) often
   d) always
Section D. The following is a list of eight reasons frequently given by people for studying English. There are no right or wrong answers since many people have different opinions. Please read each reason carefully and indicate the extent to which it is descriptive of your believe about studying English. Use the following scale as a description of your believe:

Neutral
Strongly disagree: Disagree: Slightly or Slightly disagree: Neither: Agree: Agree: Agree:
1 2 3 4 5 6 7

41. It will help me to understand better the English people and their way of life. 1 2 3 4 5 6 7

42. It will enable me to gain good friends more easily among English-speaking people. 1 2 3 4 5 6 7

43. It should enable me to begin to think and behave as the English do. 1 2 3 4 5 6 7

44. It will allow me to meet and converse with more and varied people. 1 2 3 4 5 6 7

45. I think it will some day be useful in getting a good job. 1 2 3 4 5 6 7

46. One needs a good knowledge of at least one foreign language to merit social recognition. 1 2 3 4 5 6 7

47. I feel that no one is really educated unless he is fluent in the English language. 1 2 3 4 5 6 7

48. I need it in order to finish secondary school. 1 2 3 4 5 6 7
Section E. The purpose of this questionnaire is to measure the meaning of certain topics and concepts to various people by having them judge the meanings against a series of descriptive scales. The right answer is what these things mean to you. Sometimes you may feel as though you have had the same item before on the test. This will not be the case, so do not look back and forth through the items. Do a separate and independent judgement.

Work at fairly high speed through the items. Do not worry over individual items. It is your first impressions, the immediate feelings about the items, that we want. What do you feel about USING ENGLISH AS A MEDIUM OF INSTRUCTION IN SECONDARY SCHOOLS?

<table>
<thead>
<tr>
<th></th>
<th>Very</th>
<th>Quite</th>
<th>Slightly</th>
<th>Neither</th>
<th>Slightly</th>
<th>Quite</th>
<th>Very</th>
</tr>
</thead>
<tbody>
<tr>
<td>49. Good</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Bad</td>
</tr>
<tr>
<td>50. Beneficial</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Harmful</td>
</tr>
<tr>
<td>51. Wise</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Foolish</td>
</tr>
<tr>
<td>52. Agree</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Disagree</td>
</tr>
<tr>
<td>53. Flexible</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Nonflexible</td>
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<tr>
<td>54. Fair</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Unfair</td>
</tr>
<tr>
<td>55. Important</td>
<td>-</td>
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<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Unnecessary</td>
</tr>
<tr>
<td>56. Adequate</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Inadequate</td>
</tr>
<tr>
<td>57. Difficult</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>Easy</td>
</tr>
</tbody>
</table>
Section F. Answer the questions by marking the one best response for each question.

58. I would study a foreign language in school even if it were not required.
   a) definitely
   b) probably
   c) possibly
   d) probably not
   e) definitely not

59. I would enjoy going to see foreign films in the original language.
   a) some
   b) not much
   c) quite a bit
   d) not at all
   e) a great deal

60. Our lack of knowledge of foreign languages accounts for many of our political difficulties abroad.
   a) strongly disagree
   b) disagree
   c) doubtful
   d) agree
   e) strongly agree

61. I want to read the literature of a foreign language in the original.
   a) strongly agree
   b) doubtful
   c) agree
   d) strongly disagree
   e) disagree

62. I wish I could speak another language perfectly.
   a) a great deal
   b) quite a bit
   c) some
   d) not much
   e) not at all

63. If I planned to stay in another country, I would make a great effort to learn the language even though I could get along in Chinese.
   a) definitely not
   b) probably not
   c) possibly
   d) probably
   e) definitely

64. Even though Hong Kong is relatively far from countries speaking other languages, it is important for the Chinese to learn foreign languages.
   a) strongly agree
   b) agree
   c) doubtful
   d) disagree
   e) strongly disagree
Section G. The following statements are ones with which some people agree, and other people disagree. There are no right or wrong answers since different people have different opinions. Please indicate your agreement or disagreement by writing on the line preceding each statement the number from the following scale which best describes your feelings:

+1 slight support, agreement
+2 moderate support, agreement
+3 strong support, agreement
-1 slight opposition, disagreement
-2 moderate opposition, disagreement
-3 strong opposition, disagreement

65. ____ The English-speaking Westerners who have moved to Hong Kong have made a great contribution to the richness of our society.

66. ____ The more I get to know English-speaking Westerners, the more I want to be able to speak their language.

67. ____ English-speaking Westerners are very democratic in their politics and philosophy.

68. ____ English-speaking Westerners have produced outstanding artists and writers.

69. ____ By bringing Western ways to our society, English-speaking Westerners have contributed greatly to our way of life.

70. ____ English-speaking Westerners' faith in their religious beliefs is a positive force in this modern world.

71. ____ English-speaking Westerners have every reason to be proud of their race and traditions.

72. ____ If Hong Kong should lose the influence of English-speaking Westerners, it would indeed be a loss.

73. ____ English-speaking peoples are much more polite than many Chinese in Hong Kong.

74. ____ We can learn better ways of cooking, serving food, and entertaining from the English-speaking Westerners.

75. ____ English-speaking Westerners are dependable.

76. ____ Chinese children can learn much of value by associating with English-speaking Western playmates.

77. ____ English-speaking Westerners set a good example for us by their family life.

78. ____ English-speaking Westerners are generous and hospitable to strangers.

79. ____ Chinese people in Hong Kong should make a greater effort to meet more English-speaking Westerners.
Section G (Continued)

80. It would be wrong to try to force English-speaking Westerners to become completely Chinese in their habits.

81. If I had my way, I would rather live in an English-speaking Western country than in Hong Kong.

82. Hong Kong would be a much better city if more English-speaking Westerners would move here.

83. The English-speaking Westerners show great understanding in the way they adjust to the Chinese way of life.

84. In general, Hong Kong industry tends to benefit from the employment of English-speaking Westerners.

85. English-speaking Westerners are straightforward and honest.

86. English-speaking Westerners are ready to trust others.

87. English-speaking Westerners are ready to sympathize with people who are in trouble.

88. English-speaking Westerners are people of principle who look for positive meaningful lives.

89. English-speaking Westerners are academically intellectual and we can gain much from their knowledge and experience.

90. The moral behavior of English-speaking Westerners is enlightened and should be copied by other countries.

91. English-speaking Westerners are really concerned about the Chinese people in Hong Kong and are eager to learn from them and listen to their ideas.

92. English-speaking Westerners are sincerely committed to Hong Kong and its problems and work selflessly for its improvement.

93. English-speaking Westerners truly consider Hong Kong to be their home and are really concerned about its future.

94. English-speaking Westerners are careful not to appear as "instant experts" but consider the situation carefully before expressing opinions and giving advice.

95. English-speaking Westerners treat the Chinese in Hong Kong as their equals.

THAT'S THE END, THANK YOU VERY MUCH!
Set II
Section A. Read each of the statements below and for each one place a check mark on the alternative which seems to best describe you.

1. Compared to other students in my English class, I think I:
   a) do less studying than most of them
   b) study about as much as most of them
   c) study more than most of them

2. If English were not taught in school, I would:
   a) not bother learning English at all
   b) try to obtain lessons in English somewhere else
   c) pick up English in everyday situations (i.e., read English books and newspapers, try to speak it whenever possible, etc....)
   d) none of these (explain)

3. I actively think about what I have learned in my English classes:
   a) hardly ever
   b) once in a while
   c) very frequently

4. On the average, I spend about the following amount of time doing home study in English (include all English homework) everyday:
   a) less than 15 minutes
   b) 15 minutes to one hour
   c) more than one hour

5. Considering how I study my English, I can honestly say that I:
   a) will pass on the basis of sheer luck or intelligence because I do very little work
   b) really try to learn English
   c) do just enough work to get along
   d) none of these (explain)

6. After I finish school, I shall probably:
   a) try to use my English as much as possible
   b) make no attempt to remember the English I have learned
   c) continue to improve my English (e.g., daily practice, night school, etc.)
   d) none of these (explain)

7. Compared to my other school courses, I:
   a) do less work in English than any other course
   b) work harder on English than any other course
   c) do about as much work in English as I do in any other course
Section B. Answer the following questions in the format shown below:

<table>
<thead>
<tr>
<th>Question</th>
<th>slight-</th>
<th>not sure/</th>
<th>slight-</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>yes</td>
<td>ly yes</td>
<td>neutral</td>
</tr>
</tbody>
</table>

8. **My parents encourage me to study English.**
   very definitely yes

9. **My parents think that there are more important things to study in school than English.**
   very definitely yes

10. My parents have stressed the importance that English will have for me when I leave school.
    very definitely yes

11. **My parents believe that studying English is a waste of time.**
    very definitely yes

12. Whenever I have homework in English, my parents make sure I do it.
    very definitely yes

13. **My parents believe that I should really try to learn English.**
    very definitely yes
Section C. Please reply to the following questions by placing a mark on the best response:

14. Place a check mark on one of the spaces below to indicate how much you like English compared to all your other courses.

| English is your | English is your |
| least preferred | most preferred |
| course | course |

15. When you have an assignment to do in English, do you:
   a) do it immediately when you start your homework
   b) become completely bored
   c) put it off until all your other homework is finished
   d) none of these (explain) __________________________________________________________________________

16. During English classes, you:
   a) have a tendency to daydream about other things
   b) become completely bored
   c) have to force yourself to keep listening to the teacher
   d) become wholly absorbed in the subject matter

17. If you have the opportunity and knew enough English, you would read English newspapers and magazines:
   a) as often as you could
   b) fairly regularly
   c) probably not very often
   d) never

18. After you have been studying English for a short time, you find that you:
   a) have a tendency to think about other things
   b) are interested enough to get the assignment done
   c) become very interested in what you are studying

19. If you had the opportunity to change the way English is taught in your school, you would:
   a) increase the amount of training required for each student
   b) keep the amount of training as it is
   c) decrease the amount of training required for each student.

20. You believe English should be:
   a) taught to all secondary school students
   b) taught only to those students who wish to study it
   c) omitted from the school curriculum

21. You find studying English:
   a) very interesting
   b) no more interesting than most subjects
   c) not interesting at all
Section D. Please reply to the following questions by placing a mark on the best response:

22. Whether I like English or not, I still work hard to make a good grade.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

23. I lose interest in my studies after the first few days or weeks.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

24. I memorize grammatical rules, etc., without really understanding them.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

25. When I get behind in my school work for some unavoidable reason, I make up back assignments without prompting from the teacher.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

26. Daydreaming about dates, future plans, etc., distracts my attention from my lesson while I am studying.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

27. Even though an assignment is dull and boring, I stick to it until it is completed.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always
28. I keep all the notes for English together, carefully arranging them in some logical order.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

29. When I am having difficulty with my English, I try to talk over the trouble with the teacher.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

30. I keep my place of study business-like and cleared of unnecessary or distracting items such as pictures, letters, etc.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

31. It takes a long time for me to get warmed up to the task of studying.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

32. When I sit down to study, I find myself too tired, bored, or sleepy to study efficiently.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

33. Prolonged reading or study gives me a headache.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

34. After reading several pages of English, I am unable to recall what I have just read.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely
35. I waste too much time "chewing the fat," reading magazines, listening to the radio, going to the movies, etc., for the good of my studies.
   a) almost always  
   b) occasionally  
   c) sometimes  
   d) often  
   e) rarely  

36. My studying is done in a random, unplanned manner, and is impelled mostly by the demands of approaching classes.
   a) almost always  
   b) occasionally  
   c) sometimes  
   d) often  
   e) rarely  

37. I utilize the vacant hours between classes for studying so as to reduce the evening's work.
   a) rarely  
   b) occasionally  
   c) sometimes  
   d) often  
   e) almost always  

38. I am on time with written assignments.
   a) rarely  
   b) occasionally  
   c) sometimes  
   d) often  
   e) almost always  

39. I like to have the radio playing while I am doing my homework.
   a) almost always  
   b) occasionally  
   c) sometimes  
   d) often  
   e) rarely  

40. When reading a long assignment, I stop periodically and mentally review the main facts and ideas that have been presented.
   a) rarely  
   b) occasionally  
   c) sometimes  
   d) often  
   e) almost always
41. I seem to accomplish very little in relation to the amount of
time I spend studying.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

42. I prefer to sit in the back of the classroom.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

43. With me, studying is a hit-or-miss proposition, depending on the
    mood I'm in.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

44. Before each study period I set up a goal as to how much material
    I will cover.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

45. I keep my assignments up to date by doing my work regularly from
day to day.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always
Section E. Please reply to the following questions by placing a mark on the best response:

46. On the average, how much time do you spend in reading books apart from those having connection with your school work every day?
   a) less than 15 minutes
   b) 15 minutes to 30 minutes
   c) more than 30 minutes

47. Which kinds of books would you prefer to read during your leisure time?
   a) Chinese
   b) English
   c) no preference

48. Which kind of newspapers would you prefer to read?
   a) Chinese
   b) English
   c) no preference

49. Which kinds of magazines would you prefer to read?
   a) Chinese
   b) English
   c) no preference

50. If you have both the Chinese and English version of "Reader's Digest", which one would you prefer to read first?
   a) Chinese
   b) English
   c) no preference

51. Usually, in which language do you read faster?
   a) Chinese
   b) English
   c) about the same
Section F. The purpose of this questionnaire is to measure the meanings of certain topics and concepts to various people by having them judge them against a series of descriptive scales. The right answer is what these things mean to you. Sometimes you may feel as though you have had the same item before on the test. This will not be the case, so do not look back and forth through the items. Do not bother trying to remember how you check similar items earlier. Make each item a separate and independent judgement.

Work at fairly high speed through the items. Do not worry over individual items. It is your first impressions, the immediate feelings about the items, that we want.

What do you feel about LIFE IN HONG KONG?

<table>
<thead>
<tr>
<th>Item</th>
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</table>
Section G. Instruction: The following statements are opinions which have often been expressed by students in your age group. They cover a wide range of topics and it has been found that some people agree with each statement and others disagree. There are no right or wrong answers. You are asked to mark each statement in the left hand margin according to your agreement or disagreement as follows:

+3 strongly agree  -3 strongly disagree
+2 agree           -2 disagree
+1 slightly agree  -1 slightly disagree

62. Obedience and respect for authority are the most important virtues children should learn.

63. What youth needs most is strict discipline, much determination, and the will to work and fight for family and country.

64. Nowadays when so many different kinds of people move around and mix together so much, a person has to protect himself especially carefully against catching an infection or disease from them.

65. What this place needs most, more than laws and political programs, is a few courageous, tireless, devoted leaders in whom the people can put their faith.

66. No weakness or difficulty can hold us back if we have enough will power.

67. Human nature being what it is, there will always be war and conflict.

68. A person who has bad manners, habits, and breeding can hardly expect to go along with decent people.

69. People can be divided into two distinct classes: the weak and the strong.

70. There is hardly anything lower than a person who does not feel a great love, gratitude, and respect for his parents.

71. The true Chinese way of life is disappearing so fast that force may be necessary to preserve it.

72. Nowadays more and more people are inquiring curiously into matters that should remain personal and private.

73. If people would talk less and work more, everybody would be better off.

74. Most people don't realize how much our lives are controlled by plots thought out and produced in secret places.
Section H. The following statements are ones with which many people agree, and many people disagree. There are no right or wrong answers since many people have different opinions. Please indicate your agreement or disagreement by writing on the line preceding each statement the number from the following scale which best describes your feelings:

+1 slight support, agreement
+2 moderate support, agreement
+3 strong support, agreement
-1 slight opposition, disagreement
-2 moderate opposition, disagreement
-3 strong opposition, disagreement

75. ____ In Hong Kong today, public officials are not really very interested in the problems of the average man.

76. ____ Hong Kong is by far the best place in which to live.

77. ____ The state of the world being what it is, it is very difficult for the student to plan his career.

78. ____ In spite of what some people say, the lot of the average man is getting worse, not better.

79. ____ These days, a person does not really know whom he can count on.

80. ____ It is hardly fair to bring children into the world with the way things look for the future.

81. ____ No matter how hard I try, I do not seem to get ahead in school.

82. ____ The opportunities offered young people today are far greater than they have ever been.

83. ____ Having lived this long in Hong Kong, I would be happier living in some other place now.

84. ____ In Hong Kong, it's whom you know, not what you know, that makes for success.

85. ____ The big trouble with Hong Kong is that it relies, for the most part, on very aggressive competition.

86. ____ Sometimes I cannot see much sense in putting so much time into education and learning.
Section I. Check the statement that best applies to you.

87. I speak English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently

88. I read English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently

89. I write English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently

90. My mother speaks English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently

91. My mother reads English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently

92. My mother writes English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently

93. My father speaks English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently

94. My father reads English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently

95. My father writes English:
   a) not at all
   b) a little
   c) fairly well
   d) fluently
Set III
Section A. Circle the letters in front of the statement which best answers each question.

1. How do you rate yourself in school ability compared with your close friends?
   a) I am the best
   b) I am above average
   c) I am average
   d) I am below average
   e) I am the poorest

2. How do you rate yourself in school ability compared with those in your class at school?
   a) I am among the best
   b) I am above average
   c) I am average
   d) I am below average

3. Where do you think you would rank in your class in high school?
   a) among the best
   b) above average
   c) average
   d) below average
   e) among the poorest

4. Do you think you have the ability to complete college?
   a) yes, definitely
   b) yes, probably
   c) not sure either way
   d) probably not
   e) no

5. Where do you think you would rank in your class in college?
   a) among the best
   b) above average
   c) average
   d) below average
   e) among the poorest

6. In order to become a doctor, lawyer, or university professor, work beyond four years of college is necessary. How likely do you think it is that you could complete such advanced work?
   a) very likely
   b) somewhat likely
   c) not sure either way
   d) unlikely
   e) most unlikely
7. Forget for a moment how others grade your work. In your own opinion how good do you think your work is?
   a) my work is excellent
   b) my work is good
   c) my work is average
   d) my work is below average
   e) my work is much below average

8. What kind of grades do you think you are capable of getting?
   a) mostly A's
   b) mostly B's
   c) mostly C's
   d) mostly D's
   e) mostly E's

Please answer the following questions as you think your PARENTS would answer them. If you are not living with your parents answer for the family with whom you are living. Circle the letter in front of the statement that best answers each question.

9. How do you think your PARENTS would rate your school ability compared with other students your age?
   a) among the best
   b) above average
   c) average
   d) below average
   e) among the poorest

10. Where do you think your PARENTS would say you would rank in your high school graduating class?
    a) among the best
    b) above average
    c) average
    d) below average
    e) among the poorest

11. Do you think that your PARENTS would say you have the ability to complete college?
    a) yes, definitely
    b) yes, probably
    c) not sure either way
    d) probably not
    e) definitely not

12. In order to become a doctor, lawyer, or university professor, work beyond four years of college is necessary. How likely do you think your PARENTS would say it is that you could complete such advance work?
    a) very likely
    b) somewhat likely
    c) not sure either way
    d) somewhat unlikely
    e) very unlikely
13. What kind of grades do you think your PARENTS would say you are capable of getting in general
   a) mostly A's
   b) mostly B's
   c) mostly C's
   d) mostly D's
   e) mostly E's

Think about your closest friend at school. Now answer the following questions as you think this FRIEND would answer them.

14. How do you think the FRIEND would rate your school ability compared with other students your age?
   a) among the best
   b) above average
   c) average
   d) below average
   e) among the poorest

15. Where do you think this FRIEND would say you would rank in your high school graduating class?
   a) among the best
   b) above average
   c) average
   d) below average
   e) among the poorest

16. Do you think that this FRIEND would say you have the ability to complete college?
   a) yes, definitely
   b) yes, probably
   c) not sure either way
   d) probably not
   e) definitely not

17. In order to become a doctor, lawyer, or university professor, work beyond four years of college is necessary. How likely do you think this FRIEND would say it is that you could complete such advance work?
   a) very likely
   b) somewhat likely
   c) not sure either way
   d) somewhat unlikely
   e) very unlikely

18. What kind of grades do you think this FRIEND would say you are capable of getting in general?
   a) mostly A's
   b) mostly B's
   c) mostly C's
   d) mostly D's
   e) mostly E's
Think about your favorite teacher—the one you like best; the one you feel is most concerned about your schoolwork. Now answer the following questions as you think this TEACHER would answer them.

19. How do you think this TEACHER would rate your school ability compared with other students your age?
   a) among the best
   b) above average
   c) average
   d) below average
   e) among the poorest

20. Where do you think the TEACHER would say you would rank in your high school graduating class?
   a) among the best
   b) above average
   c) average
   d) below average
   e) among the poorest

21. Do you think that the TEACHER would say you have the ability to complete college?
   a) yes, definitely
   b) yes, probably
   c) not sure either way
   d) probably not
   e) definitely not

22. In order to become a doctor, lawyer, or university professor, work beyond four years of college is necessary. How likely do you think this TEACHER would say it is that you could complete such advance work?
   a) very likely
   b) somewhat likely
   c) not sure either way
   d) somewhat unlikely
   e) very unlikely

23. What kind of grades do you think this TEACHER would say you are capable of getting in general?
   a) mostly A's
   b) mostly B's
   c) mostly C's
   d) mostly D's
   e) mostly E's
Section B. The following statements are ones with which many people agree, and many people disagree. There are no right or wrong answers since many people have different opinions. Please indicate your agreement or disagreement by writing on the line preceding each statement the number from the following scale which best describes your feelings.

+1 slight support, agreement
+2 moderate support, agreement
+3 strong support, agreement
-1 slight opposition, disagreement
-2 moderate opposition, disagreement
-3 strong opposition, disagreement

24. _____ Compared to English-speaking Westerners, Chinese are more sincere and honest.

25. _____ Family life is more important to Chinese than it is to English-speaking Westerners.

26. _____ Chinese children are better mannered than English-speaking children are.

27. _____ Chinese appreciate and understand the arts better than do most people in English-speaking countries.

28. _____ Compared to the Chinese, the English-speaking Westerners are very unimaginative people.

29. _____ The way of life of English-speaking Westerners seems crude when compared to ours.

30. _____ The English-speaking Westerners would benefit greatly if they adopted many aspects of the Chinese culture.

31. _____ People are much happier in English-speaking countries than they are here.

32. _____ English-speaking Westerners should study Chinese language and culture.

33. _____ The Chinese are morally better than English-speaking Westerners.

34. _____ Chinese people are more intelligent than English-speaking Westerners.

35. _____ Compared to the Chinese, English-speaking Westerners are disrespectful and impolite people.
Section C. Read each of the statements below and for each one place a check mark to the left of the alternative which seems to best describe you.

36. Compared to the other students in my physics class, I think I:
   a) do less studying than most of them
   b) study about as much as most of them
   c) study more than most of them

37. If physics were not taught in school, I would:
   a) not bother learning physics at all
   b) try to obtain lessons in physics somewhere else
   c) pick up physics in everyday situations (i.e. read physics books and articles about physics in newspapers or magazines, etc.)
   d) none of these (explain)

38. I actively think about what I have learned in my physics classes:
   a) hardly ever
   b) once in awhile
   c) very frequently

39. On the average, I spend about the following amount of time doing home study in physics (include all physics homework) everyday:
   a) less than 15 minutes
   b) 15 min. to one hour
   c) more than an hour

40. Considering how I study physics, I can honestly say that I:
   a) will pass on the basis of sheer luck or intelligence because I do very little work
   b) really try to learn physics
   c) do just enough work to get along
   d) none of these (explain)

41. After I finish school, I shall probably:
   a) try to use my physics as much as possible
   b) make no attempt to remember the physics I have learned
   c) continue to improve my physics (e.g. daily reading, extra-mural course, etc.)
   d) none of these (explain)

42. Compared to my other school courses, I:
   a) do less work in physics than any other course
   b) work harder in physics than any other course
   c) do about as much work in physics as I do in any other course
Section D. Please reply to the following questions:

43. Place a check mark in the appropriate space of the seven spaces below to indicate how much you like physics compared to all your other courses that you are now taking:

Physics is your least preferred course

Physics is your most preferred course

44. When you have an assignment to do in physics do you:
   a) none of these (explain)
   b) become completely bored
   c) put it off until all your other homework is finished
   d) do it immediately when you start your homework

45. During physics classes, do you:
   a) become completely bored
   b) have to force yourself to keep listening to the teacher
   c) have a tendency to daydream about other things
   d) become wholly absorbed in the subject matter

46. If you had the opportunity and knew enough physics, you would read more books and magazines about physics:
   a) never
   b) rarely
   c) fairly regularly
   d) as often as you could

47. After you have been studying physics for a short time, you find that you:
   a) have a tendency to think about other things
   b) are interested enough to get the assignment done
   c) become very interested in what you are studying

48. If you had the opportunity to change the way physics is taught in your school, you would:
   a) decrease the amount of training required for each student
   b) keep the amount of training as it is
   c) increase the amount of training required for each student

49. You believe physics should be:
   a) omitted from the school curriculum
   b) taught only to those students who wish to study it
   c) taught to all secondary school students

50. You find studying physics:
   a) not interesting at all
   b) no more interesting than most subjects
   c) very interesting
51. On the average, how much time do you spend in reading physics books apart from the physics text every week?
   a) less than 30 minutes
   b) 30-60 minutes
   c) 1-2 hours
   d) more than two hours

52. Which kinds of books would you prefer to read during your leisure time?
   a) always science
   b) often science
   c) sometimes science
   d) never science

53. Do you like to read science articles from newspapers or magazines?
   a) never
   b) sometimes
   c) often
   d) always
Section E. Circle the letter in front of the statement which best answers each question.

54. Whether I like physics or not, I still work hard to make a good grade.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

55. I lose interest in my studies after the first few days or weeks.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

56. I memorize definitions of technical terms, formulas, etc., without really understanding them.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

57. When I get behind in my school work for some unavoidable reason, I make up back assignments without prompting from the teacher.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

58. Daydreaming about dates, future plans, etc., distracts my attention from my lesson while I am studying.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

59. Even though an assignment is dull and boring, I stick to it until it is completed.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

60. I keep all the notes for physics together, carefully arranging them in some logical order.
   a) rarely
   b) occasionally
   c) sometimes
Section E. (Continued)

d) often

e) almost always

61. When I am having difficulty with my physics, I try to talk over the trouble with the teacher.

a) rarely
b) occasionally
c) sometimes
d) often
e) almost always

62. I keep my place of study business-like and cleared of unnecessary or distracting items such as pictures, letters, etc.

a) rarely
b) occasionally
c) sometimes
d) often
e) almost always

63. It takes a long time for me to get warmed up to the task of studying.

a) almost always
b) occasionally
c) sometimes
d) often
e) rarely

64. When I sit down to study, I find myself too tired, bored, or sleepy to study efficiently.

a) almost always
b) occasionally
c) sometimes
d) often
e) rarely

65. Prolonged reading or study gives me a headache.

a) almost always
b) occasionally
c) sometimes
d) often
e) rarely

66. After reading several pages of physics, I am unable to recall what I have just read.

a) almost always
b) occasionally
c) sometimes
d) often
e) rarely
Section E. (continued)

67. I waste too much time "chewing the fat," reading magazines, listening to the radio, going to the movies, etc., for the good of my studies.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

68. My studying is done in a random, unplanned manner, and is impelled mostly by the demands of approaching classes.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

69. I utilize the vacant hours between classes for studying so as to reduce the evening’s work.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

70. I am on time with written assignments
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

71. I like to have the radio playing while I am doing my homework.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

72. When reading a long assignment, I stop periodically and mentally review the main facts and ideas that have been presented.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

73. I seem to accomplish very little in relation to the amount of time I spend studying.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely
74. I prefer to sit in the back of the classroom.
   a) almost always
   b) occasionally
   c) sometimes
   d) often
   e) rarely

75. With me, studying is a hit-or-miss proposition, depending on the mood I'm in.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

76. I study three or more hours per day outside of class.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

77. Before each study period I set up a goal as to how much material I will cover.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always

78. I keep my assignments up to date by doing my work regularly from day to day.
   a) rarely
   b) occasionally
   c) sometimes
   d) often
   e) almost always
Section F. Please read each reason carefully and indicate the extent to which it is descriptive of your belief. Use the following scale as a descriptive of your belief.

<table>
<thead>
<tr>
<th>strongly agree</th>
<th>slightly agree</th>
<th>neutral</th>
<th>slightly disagree</th>
<th>strongly disagree</th>
</tr>
</thead>
</table>

79. I learn more when other teaching methods are used.
    strongly agree __ __ __ __ __ __ __ strongly disagree

80. The course was quite useful.
    strongly agree __ __ __ __ __ __ __ strongly disagree

81. The textbook was good.
    strongly agree __ __ __ __ __ __ __ strongly disagree

82. The teacher exhibited professional dignity and bearing in the class.
    strongly agree __ __ __ __ __ __ __ strongly disagree

83. The teacher seemed to be interested in students as persons.
    strongly agree __ __ __ __ __ __ __ strongly disagree

84. Generally, the course was quite boring.
    strongly agree __ __ __ __ __ __ __ strongly disagree

85. The teacher did not synthesize, integrate or summarize effectively.
    strongly agree __ __ __ __ __ __ __ strongly disagree

86. The content of the course was too elementary.
    strongly agree __ __ __ __ __ __ __ strongly disagree

87. The teacher encouraged the development of new viewpoints and appreciation.
    strongly agree __ __ __ __ __ __ __ strongly disagree

88. Ideas and concepts were developed too rapidly.
    strongly agree __ __ __ __ __ __ __ strongly disagree

89. Homework assignments were helpful in understanding the course.
    strongly agree __ __ __ __ __ __ __ strongly disagree

90. Generally, the course was well organized.
    strongly agree __ __ __ __ __ __ __ strongly disagree

91. The teacher had a thorough knowledge of his subject matter.
    strongly agree __ __ __ __ __ __ __ strongly disagree

92. The examinations were too difficult.
    strongly agree __ __ __ __ __ __ __ strongly disagree
Section F. (Continued)

93. The demands of the students were not considered by the teacher.
   strongly agree __ __ __ __ __ __ __ __ strongly disagree

94. I can approach the teacher with questions.
   strongly agree __ __ __ __ __ __ __ __ strongly disagree

95. The teacher spoke audibly and clearly.
   strongly agree __ __ __ __ __ __ __ __ strongly disagree

96. Blackboard work is legible, clear and organized.
   strongly agree __ __ __ __ __ __ __ __ strongly disagree

97. The teacher has graded fairly.
   strongly agree __ __ __ __ __ __ __ __ strongly disagree

98. Labs supplemented lectures and assignments effectively.
   strongly agree __ __ __ __ __ __ __ __ strongly disagree

99. The labs stimulated my learning and interest.
   strongly agree __ __ __ __ __ __ __ __ strongly disagree

100. The teacher made procedures to be used in the lab quite clear.
    strongly agree __ __ __ __ __ __ __ __ strongly disagree

Part 7

101) Standard Chinese (国 genetically) should be practised.

102) It is impossible to keep to the Chinese way of life with all the westernization around.

103) Traditional Chinese values are incompatible with modern living.

104) We should stick to proper translations of English terms instead of just following fashionable translations.

105) The mixed Cantonese and English language of ours may be the beginning of a Hong Kong Language.

106) There is no need to insist on using Chinese (so as to keep our dignity as Chinese) while interacting with foreigners.
SELF-REPORT FORM FOR INSTRUCTORS

To be completed and retained by the instructor

This self-report form is for your own use. If you fill it out at the time your students are filling out the Student Instructional Report, you will have the opportunity to compare your own perceptions with those of your students when you receive the SIR Report.

Respond to each item according to how you would describe this course, your teaching, or the students enrolled. The items parallel those in the student form, with those asking for student background information left out.

SECTION I Items 1-20. Directions: Circle the number that represents the response closest to your opinion.

NA (0) = Not Applicable or don't know. The statement does not apply to this course or your teaching, or you simply are not able to give a knowledgeable response.
SA (1) = Strongly Agree. You strongly agree with the statement as it applies to this course or your teaching.
A (2) = Agree. You agree more than you disagree with the statement as it applies to this course or your teaching.
D (3) = Disagree. You disagree more than you agree with the statement as it applies to this course or your teaching.
SD (4) = Strongly Disagree. You strongly disagree with the statement as it applies to this course or your teaching.

<table>
<thead>
<tr>
<th>Item</th>
<th>NA</th>
<th>SA</th>
<th>A</th>
<th>D</th>
<th>SD</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. I feel my objectives for the course have been made clear to students...</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>2. There has been considerable agreement between the announced objectives of the course and what is being taught...</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>3. I feel that I have been using class time well...</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>4. I have been readily available for consultation with students...</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
</tr>
<tr>
<td>5. I feel I knew when students didn't understand the material...</td>
<td>0</td>
<td>1</td>
<td>2</td>
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<td>4</td>
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<td>6. Lectures were repetitive of what was in the textbook(s)...</td>
<td>0</td>
<td>1</td>
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<td>7. I encourage students to think for themselves in this course...</td>
<td>0</td>
<td>1</td>
<td>2</td>
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<td>8. I have been genuinely concerned about whether students learn and I try to be actively helpful...</td>
<td>0</td>
<td>1</td>
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<tr>
<td>9. I made a point of adding helpful comments on student's papers or exams...</td>
<td>0</td>
<td>1</td>
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<td>10. I have been raising challenging questions or problems for discussion...</td>
<td>0</td>
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<td>4</td>
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<tr>
<td>11. In this class, students were free to ask questions or express their opinions...</td>
<td>0</td>
<td>1</td>
<td>2</td>
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<td>4</td>
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<tr>
<td>12. I think that I have been well-prepared for each class...</td>
<td>0</td>
<td>1</td>
<td>2</td>
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<td>13. I have informed students of how they would be evaluated in the course...</td>
<td>0</td>
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<td>2</td>
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<tr>
<td>14. I have summarized or emphasized major points of lectures or discussions...</td>
<td>0</td>
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<tr>
<td>15. I feel that students' interest in the subject area has been stimulated by this course...</td>
<td>0</td>
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<td>16. The scope of the course has been too limited; not enough material has been covered...</td>
<td>0</td>
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<tr>
<td>17. Examinations reflected the important aspects of the course...</td>
<td>0</td>
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<td>18. Students seem to be putting a good deal of effort into this course...</td>
<td>0</td>
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<td>4</td>
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</tbody>
</table>
SECTION II Items 21-25. Directions: Circle one response number for each question.

21. For the students enrolled, the level of difficulty of this course is:
1 Very elementary
2 Somewhat elementary
3 About right
4 Somewhat difficult
5 Very difficult

22. In my opinion the work load for this course in relation to other courses of equal credit is probably:
1 Much lighter
2 Lighter
3 About the same
4 Heavier
5 Much heavier

23. For the students enrolled, the pace at which the material in this course is being covered is:
1 Very slow
2 Somewhat slow
3 Just about right
4 Somewhat fast
5 Very fast

24. I have been using examples and illustrations to help clarify the material of this course:
1 Frequently
2 Occasionally
3 Seldom
4 Never

25. Was class size satisfactory for the method of conducting the class?
1 Yes, most of the time
2 No, class was too large
3 No, class was too small
4 It didn’t make any difference on way or the other

SECTION III Items 32-39. (Item numbers correspond to SIR answer sheet) Directions: Circle one response number for each question.

32. Overall, I would rate the textbook(s) .............................................. 0 1 2 3 4 5
33. Overall, I would rate the supplementary readings .................................. 0 1 2 3 4 5
34. Overall, I would rate the quality of the exams ...................................... 0 1 2 3 4 5
35. I would rate the general quality of the lectures .................................... 0 1 2 3 4 5
36. I would rate the overall value of class discussions ................................ 0 1 2 3 4 5
37. Overall, I would rate the laboratories .................................................. 0 1 2 3 4 5
38. I would rate the overall value of this course to the students as .............. 0 1 2 3 4 5
39. How effective do you think you have been as a teacher compared to other instructors you know or have known ............................................. 0 1 2 3 4 5
1) Do you have a Bachelor's degree? In which area?
   a) physics
   b) mathematics
   c) education
   d) other
   e) no degree

2) Do you have a master's degree? In which area?
   a) physics
   b) mathematics
   c) education
   d) other
   e) no degree

3) Do you have a doctor's degree? In which area?
   a) physics
   b) mathematics
   c) education
   d) other
   e) no degree

4) Do you have a diploma in education?
   a) yes
   b) no

5) Do you have any other post-graduate training? Please specify.
   a) yes:
   b) no

6) Do you have any publications? Please specify.
   a) yes:
   b) no

7) Years of teaching experience up to September 1978.
   a) 2 or less
   b) 2 to 5
   c) 5 to 10
   d) more than 10

8) How many different schools have you taught in?
   a) 1
   b) 2
   c) 3
   d) 4 or more

9) Are you the chairman of a department in a school?
   a) yes
   b) no

10) What major subjects have you taught in the past?(Just choose one)
    a) physics
    b) mathematics
    c) general science
    d) others (please specify)
11) At what grade level(s) have you done most of your teaching in the past?
   a) grade 9
   b) grade 10 & 11
   c) grade 12 & 13
   d) about the same in each level
APPENDIX 7

CHINESE TRANSLATION OF THE QUESTIONNAIRE
問卷編號 ____ 日期 _____
姓名 ______ 班別 ______

說明：下面是一系列的問題，用意在瞭解你的背景及對一些事物的看法，這並不是一個測驗，因各人的背景及看法不同，故此並沒有對或錯的答案之分。
除了應用在研究方面外，我們會將你的答案保密，使你的答覆不會對你有絲毫的影響，故此請你誠實的填寫。
請回答下列問題：

1) 年齡：

2) 居住地區：

3) 你在家居裡說甚麼方言？

4) 出生地點（如非本港出生者，請詳述國家、省份和縣名）

5) 何時到港？

6) 父親職業：

7) 你預算將來從事何種職業？

8) 你記得升中試的成績嗎？要是記得，請填寫下列的空格：
   (a) 中文
   (b) 英文
   (c) 數學
   (d) 總成績

9) 你現在所就讀的學校是否你升中試的首三個志願之一？是□ 否□

10) 與別人相比之下，你的家庭總收入怎樣？（照你自己的看法）
    (a) 貧窮
    (b) 中下
    (c) 中等
    (d) 中上
    (e) 富有

(第 4 頁)
11) 在下列各物中，请你将你所拥有的圈出：
(a) 電視
(b) 電話
(c) 私家車
(d) 浴缸
(e) 鋼琴
(f) 洗衣機
(g) 彩色電視
(h) 音響器材
(i) 冷氣機

12) 你家裏有佣人沒有？
(a) 有
(b) 沒有

13) 你曾有過私家補習老師嗎？
(a) 有
(b) 沒有

14) 你有自己個人的睡房嗎？
(a) 有
(b) 沒有

15) 你的家人會否間中離港到外地渡假？（澳門和廣東省除外）
(a) 有
(b) 沒有

16) 你母親讀過中學沒有？
(a) 有
(b) 沒有

17) 你母親讀過專上學院沒有？
(a) 有
(b) 沒有

(第二頁)
21）你父親讀過中學沒有？
   (a) 有
   (b) 沒有

22）你父親讀過大學沒有？
   (a) 有
   (b) 沒有

23）你家裏有多少書籍？(雜誌報刊不計在內)
   (a) 一百本以下
   (b) 一百至五百本
   (c) 五百本以上

第二部份
請在下列各題中選擇最適合你的答案

24）你的父親跟你說英語否？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 經常

25）你的父母有否教佢學習英文？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 經常

26）你何時開始學英文？
   (a) 幼兒班或之前
   (b) 幼稚園
   (c) 一年級
   (d) 兩年級
   (e) 三年級或以上

(第三頁)
2) 你曾否讀過英文小學？
(a) 曾，由一年級起
(b) 曾，由三年級起
(c) 曾，由五年級起
(d) 沒有

3) 你讀小學時的英文程度怎樣？
(a) 很差
(b) 中下
(c) 中等
(d) 中上
(e) 很好

4) 你在中學過去幾年的英文程度怎樣？
(a) 很差
(b) 中下
(c) 中等
(d) 中上
(e) 很好

5) 除了上英文課外，你有用英文發問或回答問題否？
(a) 很少
(b) 偶然
(c) 有時
(d) 很多時
(e) 差不多全都

6) 在上課的時候，你是否跟同學說英語？
(a) 很少
(b) 偶然
(c) 有時
(d) 很多時
(e) 差不多全都

7) 下課後，你是否跟同學說英語？
(a) 很少
(b) 偶然
(c) 有時
(d) 很多時
(e) 差不多全都
30. 當你寫信給朋友時，你通常會用何種語文？
   (a) 中文
   (b) 主要是中文，間中用些英文
   (c) 半中半英
   (d) 主要是英文，間中用些中文
   (e) 英文

31. 當你看西片時，你會否看中文字幕？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 經常

32. 你有否收聽英文電台？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 經常

33. 你有否收看英文電視台？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 經常

第三部份
請在下列各題中選擇最適合你的答案

39. 你的父母用英語跟朋友交談否？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常
33) 你的父母在工作时需否應用英語？
   (a) 不需要
   (b) 有時
   (c) 很多時
   (d) 常常

34) 你的父母閱讀英文書、報、雜誌嗎？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常

35) 你的父母寫英文信嗎？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常

36) 你的父母收看英文電視節目嗎？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常

37) 你的父母收聽英文電台嗎？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常

當你用英文做功課時，若遇到困難，你的父母能在語言方面幫助你嗎？
   (a) 不能
   (b) 有時
   (c) 很多時
   (d) 常常

(備註)
第四部份
下面列出八個人們通常學習英文的理由，請細讀
每個理由，然後照下面的尺度表示你的看法：

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44) 學習英文會幫助我更明白說英語的人及他們的生活方式。

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44) 它讓我能更容易在一些說英語的人中結交到一些好朋友。

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44) 它能讓我想起英國人的想法及表現。

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44) 它讓我能在更多不同的人有交往及談論。

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44) 我認為學英文能幫助我將來找到一份好的工作。

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44) 一個人要在社會上獲得一些名聲，他最少應該懂得一種外國語言。

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44) 我認為除非一個人能流利地運用英文，他不能真正算為受過教育。

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44) 我需要學習英文才能中學畢業。

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(第七頁)
第五部分

這問題的用意是測量不同的人對一些題目或觀念的看法。測量方面是請你將該題目或觀念放置在下列一個描述性尺度的適當位置上，正確的答案因人而異，最重要的是你個人對這些題目或觀念的感受。有時你或許以為你已見過同一個尺度，但實際並非這樣，故此請你作答時不要前後參閱尺度上的項目，而只就該題作一個獨立的決定。

請迅速的選擇答案，不要為個別的項目猶豫，我們所需要知道的是你的第一個印象—即時的反應。

你對“採用英文作為中學各科的教學語言”的看法如何？

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(第十八頁)
第五部份
請在下列各題中選擇最適合你的答案

58)縱然學校沒有規定，我們仍會選讀外國語文。
   (A) 必定會
   (B) 大概會
   (C) 有可能
   (D) 大概不會
   (E) 必定不會

59) 我喜歡觀看沒有中文字幕的外國電影。
   (A) 絕不喜歡
   (B) 不大喜歡
   (C) 有時喜歡
   (D) 頗喜歡
   (E) 十分喜歡

60) 我們很多外交上的困難是由於缺乏外文知識所造成的。
   (A) 非常同意
   (B) 同意
   (C) 不能決定
   (D) 不同意
   (E) 非常不同意

61) 我要閱讀一些文學的原著。
   (A) 非常同意
   (B) 同意
   (C) 不能決定
   (D) 不同意
   (E) 非常不同意

62) 我渴望能說一口流利的外文。
   (A) 十分渴望
   (B) 頗渴望
   (C) 有時渴望
   (D) 不大渴望
   (E) 絕不渴望
（236）

6. 打算移居外地，纵使中文已经够用，我会
d. 一定
b. 有
c. 不会
d. 不会

6. 比较上来说，虽然香港距离说其他语文的国家很远，但学习外文仍然是很重要的。
a. 非常同意
b. 同意
c. 不能决定
d. 不同意
e. 绝不同意

第七部分
以下是一些见解，有很多人同意，亦有不少人不同意，因为各人的观点不同，故此没有标准的答案。以下有六个不同程度的看法，请你将最能表达自己看法的数字填在每题之前的空格上。
+1：稍微同意 
+2：同意 
+3：十分同意 
-1：不甚同意 
-2：不同意 
-3：十分不同意

65. 移居香港而又说英语的外國人对本港社会的繁荣有很大的贡献。
66. 聶我愈瞭解说英语的外國人时，愈希望说他们的语言。
67. 聶说英语的外國人在政治和法律方面都是很民主。
68. 聂说英语的外國人中有很多傑出的藝術家和作家。
69. 聂说英语的外國人将西方的生活方式带进来，我們的社会对改进我們的生话方式有很大的贡献。

（第十頁）
79. --- 说英语的外國人對宗教信仰的信心成了現代社會的推動力。
80. --- 说英语的外國人有充分理由為他們自己的種族和傳統而驕傲。
81. --- 要是香港失去了说英语的外國人的影响，這將會是一個很大的損失。
82. --- 在香港，说英语的外國人比較中國人更有禮貌。
83. --- 我們可以從說英语的外國人中學到更好的烹飪、服侍和款待的方法。
84. --- 说英语的外國人是可靠的。
85. --- 中國孩子在與說英語的外國孩子嬉戲時可以學到很多有價值的東西。
86. --- 说英语的外國人的家庭生活是我們一個很好的榜樣。
87. --- 说英语的外國人對陌生人很慷慨和熱誠。
88. --- 香港的中國人應加倍努力去認識更多說英語的外國人。
89. --- 強逼說英語的外國人完全中國化是不對的。
90. --- 要是我有選擇，我寧可離開香港住在一个說英語的地方。
91. --- 要是有更多說英語的外國人遷到這裡，香港會成為一個更好的城市。
92. --- 说英语的外國人在適應中國人的生活方式上表現了很大的諒解。
93. --- 一般來說，香港的工業每因僱用了說英語的外國人而得到益處。
94. --- 说英語的外國人是率直和誠實的。
95. --- 说英語的外國人容易信任別人。
說英

87) —— 說英語的外國人對困苦中的人富同情心。

88) —— 說英語的外國人是有原則的人，他們尋求積極有意義的人生。

89) —— 說英語的外國人是知識份子，我們可以在他們的知識和經驗上得到很大的益處。

90) —— 說英語的外國人有高尚的道德水平，應該為別國人所效法。

91) —— 說英語的外國人真正關心香港的中國人，他們渴望跟中國人學習和聽取中國人的意見。

92) —— 說英語的外國人誠懇地投身在香港及她的問解上，他們捨己地為香港的進步而努力。

93) —— 說英語的外國人誠懇地將香港當為自己的家，他們非常關心香港的前途。

94) —— 說英語的外國人很小心的避免表現出自己是個“萬事通”，他們仔細考覈事情始末之後才表達自己的看法及提議。

95) —— 說英語的外國人對香港的中國人平等待。

（完）

（第十二頁）
問巻二
請細讀下面問題，並指出最適合你的答案：

1) 以英文科來說，與其他同學比較，我認為我：
   (a) 不及大部分同學競爭
   (b) 跟大部分同學一樣競爭
   (c) 比大部分同學競爭

2) 如在校內沒有教授英文，我
   (a) 我不會學習英文
   (b) 會在日常場合裏學習英文（即如閱讀英文書籍，
       盡可能常說英語等等。）
   (c) 會設法在別處上英文課
   (d) 不是在任何一項（說明）

3) 你主動去思考上英文課時學到的東西
   (a) 每次
   (b) 偶爾
   (c) 經常

4) 平均來說，我每天在家溫習英文（包括所有英文家課）
   的時間是：
   (a) 少於十五分鐘
   (b) 十五分鐘至一小時
   (c) 一小時以上

5) 以我的學習情況來看，坦白地說，我
   (a) 每次
   (b) 只做少許的工夫
   (c) 努力學習英文
   (d) 不是在任何一項（說明）

6) 畢業後，我多數
   (a) 不會回想起我所學過的英文
   (b) 會盡量運用英文
   (c) 會繼續進修英文（例如口語練習，上夜校等等）
   (d) 不是在任何一項（說明）

7) 與其他學科比較，我
   (a) 花在英文的工夫較其他任何一科相同
   (b) 花在英文的工夫比其他任何一科少
   (c) 花在英文的工夫比其他任何一科多

8) 不是以上任何一項（說明）
第二部份
請參照下列形式回答以下問題：
（1）（2）（3）（4）（5）（6）（7）
8) 父母鼓勵我們學英文 1 2 3 4 5 6 7
9) 父母認為學校其它科目較英文更為重要 1 2 3 4 5 6 7
10) 父母強調日後欲英文 1 2 3 4 5 6 7
（11）（12）（13）（14）（15）（16）（17）

第三部份
請指出最適合的答案
14) 請在下面其中一格加上符號以表示在聽寫課時
（1）你喜歡英文的程度
（2）你是最不喜歡的科目
（3）你感到十分煩燥
（4）你將其他功課做完才去做
（5）首先做完家課
（6）不是以上任何一項（說明）

15) 上英文課時，你是否
（1）感到十分煩燥
（2）有胡思亂想的傾向
（3）要強迫自己留心聽講
（4）完全投入

16) 如果你有機會並且英文程度足夠，你會閱讀英文書籍
（1）永不
（2）少數不會經常
（3）頗為定期
（4）盡可能會常讀
18) 温習英文之前後，你發覺自己：
   (a) 須要按及其他事情
   (b) 發生興趣去完成它
   (c) 對於修功課極感興趣

19) 如果有機會去改變校內教授英文的方法，你會
   (a) 減少課程
   (b) 保留原有課程
   (c) 增加課程

20) 你認為英文
   (a) 不應列入數學範圍內
   (b) 應授予更多寫意學英文的學生
   (c) 應授予所有中學生

21) 你覺得學習英文是
   (a) 絕不興趣
   (b) 跟大部份科目一樣，不見得特別有趣
   (c) 非常有趣

第四部分
請指出最適合的答案：
22) 無論我是否喜歡英文，我們會用功以爭取好成績。
   (a) 常少
   (b) 偶然
   (c) 有時
   (d) 通常
   (e) 無常
   (f) 無常常常如此

23) 學習英文數天或數週後，我的興趣就會消失。
   (a) 常少
   (b) 偶然
   (c) 有時
   (d) 通常
   (e) 無常常常如此

24) 我未能了解就死記文法上的規則等
   (a) 常少
   (b) 偶然
   (c) 有時
   (d) 通常
   (e) 無常常常如此
25) 當我因某種無法避免的原因必須功課落後時，我

(a) 緊急
(b) 偶然
(c) 有時
(d) 常常
(e) 幾乎常常如此

26) 當我溫習時，因為及約會將來的計劃等等就不能集中

精神在英文課本上。

(a) 緊急
(b) 偶然
(c) 有時
(d) 常常
(e) 幾乎常常如此

27) 雖然功課沉悶，我仍然堅持去做好它。

(a) 緊急
(b) 偶然
(c) 有時
(d) 常常
(e) 幾乎常常如此

28) 我把所有英文筆記放在一起，細心編排。

(a) 緊急
(b) 偶然
(c) 有時
(d) 常常
(e) 幾乎常常如此

29) 當我遇見英文難題時，我會找老師商量。

(a) 緊急
(b) 偶然
(c) 有時
(d) 常常
(e) 幾乎常常如此

30) 我將我讀書的地方收拾整齊，不會擺放無關重要或分散

精神的物品，諸如圖畫、信件等。

(a) 緊急
(b) 偶然
(c) 有時
(d) 常常
(e) 幾乎常常如此
31) 我需要很长的时间才能安定下来睡觉。
   (a) 甚少
   (b) 偶然
   (c) 有時
   (d) 常常
   (e) 几乎常常如是

32) 每当我坐下阅读后就变得非常疲倦、厌烦或懒懒欲睡，以致不能好好温习。
   (a) 甚少
   (b) 偶然
   (c) 有時
   (d) 常常
   (e) 几乎常常如是

33) 今日的阅读或温习英文使我感到头痛。
   (a) 甚少
   (b) 偶然
   (c) 有時
   (d) 常常
   (e) 几乎常常如是

34) 读完几页英文后我没法记得，刚刚读过的东西。
   (a) 甚少
   (b) 偶然
   (c) 有時
   (d) 常常
   (e) 几乎常常如是

35) 我浪费太多时间去闲谈、读报纸、听收音机、上电影院等等，以致影响学业。
   (a) 甚少
   (b) 偶然
   (c) 有時
   (d) 常常
   (e) 几乎常常如是

36) 我的学习情况是毫无系统，未经过计划的，多数在功课到期时才去做。
   (a) 甚少
   (b) 偶然
   (c) 有時
   (d) 常常
   (e) 几乎常常如是
31) 我利用校内没有课的时间来温习，以减轻晚上的工作
   (a) 基本上
   (b) 偶然
   (c) 有
   (d) 时而
   (e) 几乎常常如此

32) 我准备交英文的功课
   (a) 基本上
   (b) 偶然
   (c) 有
   (d) 时而
   (e) 几乎常常如此

33) 拿家作课时，我喜欢把收音机关了
   (a) 基本上
   (b) 偶然
   (c) 有
   (d) 时而
   (e) 几乎常常如此

43) 我发现自己在指定要读的英文时我问自己地停下来细想文章内
    提及过的每点
   (a) 基本上
   (b) 偶然
   (c) 有
   (d) 时而
   (e) 几乎常常如此

44) 按时间比例来算，我所完成的似乎很少
   (a) 基本上
   (b) 偶然
   (c) 有
   (d) 时而
   (e) 几乎常常如此

45) 我喜欢坐在课室后边
   (a) 基本上
   (b) 偶然
   (c) 有
   (d) 时而
   (e) 几乎常常如此

46) 对我来说，温习时若不成功就算失败要看我的心情如何
   (a) 基本上
   (b) 偶然
   (c) 有
   (d) 时而
   (e) 几乎常常如此
47. 每次溫習英文之前我都定下目標，確定溫習範圍。
(a) 少
(b) 偶然
(c) 有時
(d) 時常
(e) 幾乎常常如此

48. 我每天都有規律地工作以確保自己能依時完成功課。
(a) 少
(b) 偶然
(c) 有時
(d) 時常
(e) 幾乎常常如此

第五部分
請指出最適合的答選。
49. 平均來說，你每天用多少時間閱讀與功課無關的書籍？
(a) 十五分鐘以下
(b) 十五分鐘至半小時
(c) 半小時以上

50. 你喜歡讀甚麼書？
(a) 中文
(b) 無特別偏好
(c) 英文

51. 你喜歡讀甚麼報紙？
(a) 中文
(b) 無特別偏好
(c) 英文

52. 你喜歡讀甚麼雜誌？
(a) 中文
(b) 無特別偏好
(c) 英文

53. 如果你兼有中英文本的讀者文摘，你會先讀那一本？
(a) 中文
(b) 無特別偏好
(c) 英文

54. 通常你讀那一種文字會較感快速？
(a) 中文
(b) 相同速度（指中文）
(c) 英文
第六部份

此問題的目的是當一門課題可能對不同的人有何意義時，研究者希望能有較多的項目。正確的答法正是你自己的選項。有時你會覺得某一項目似乎在這測試中出現過，事實並非如此，所以請勿前後翻查，而不要回想當你曾設怎樣回答類似的項目，請就你每個項目分別作一個主觀判斷。

請盡量作答，不要為個別項目疑慮，我們所需要的是你對各項目的第一個印象及當時的感覺。

### 你對於香港的生活有何感受？

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<td>56.</td>
<td>漂亮</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>57.</td>
<td>病態</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>58.</td>
<td>病態</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>59.</td>
<td>病態</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>60.</td>
<td>病態</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
<tr>
<td>61.</td>
<td>病態</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
<td>6</td>
</tr>
</tbody>
</table>

第五部份

說明：以下的語語是一些與你年紀相近的學生經常遭遇的。這些話語包括多方面的問題，而句話語都有人同意，亦有人不同意，所以沒有全對或全錯的答案。請根據你自己同意或不同意的程度，依下列計分方法在各題左欄內評分：
+7 完全同意
+6 頗加同意
+5 稍微同意
+4 同意
+3 稍微不同意
+2 不同意
+1 頗加不同意

(62) 對於香港事務及尊嚴是兒童最要學習的美德
(63) 年幼人最需要嚴格的紀律，甚大的決心與及為國家國工作和戰鬥的意志
(64) 共和國內各式各類活動及活動時，個人必須特別小心防範，以免染上他人的傳染病或其他疾病
(65) 這地方最需要的政府法及政治大計是需要的，是幾個
(66) 只要有篤定的意志力，沒有任何困難或困難可以阻礙我們
人生既然如此，就永遠都有競爭與衝突。
如果一個人的名聲、地位和所受教養都不好的話，難道其中沒有好的人處所亦來。
人可以清楚地分辨出善、惡和絕善。
絕對沒有沒有愛心，不知感恩及不知孝敬的人，世上沒有可以東西比他更高尚的了。
真正的中國生活方式，是這樣快的消逝，需要努力才能使它保存下來。
現在愈來愈多人對別人的事並不陌生。
如果人人都少說話，多做事，多人的生活都會較好了。
大部份人都不知道他們的生活是受到許多問題而被奴役及被迫的陰謀所控制。

差人部分
以下是一些意見，有很多人同意或不同意。
• 你同意或不同意的程序，表示你同意或不同意的程度，從下列比例表來選擇最能代表你的感覺或想法，填在每題前面的空格中。

| +5 | 不同意，稍微反對 |
| -5 | 同意，稍微支持 |
| 1  | 不同意，中度反對 |
| -1 | 同意，中度支持 |
| 3  | 不同意，極度反對 |
| 3  | 同意，極度支持 |

78) 在今日的香港，公職人士究竟不是關心一般人的問題。
79) 香港是目前最好的居所的地方。
80) 世界的情況既然如此，學生要充實將來的事業是非常困難的一回事。
81) 無論事情是怎樣的，一般人的命運實在是每況愈下，並非較高的好處。
82) 這個時代，每人社會界都有十分清楚的阶梯可以攀登。
83) 以將來的情況來看，應該把孩子帶到世上來。
84) 無論成怎樣努力，總見不到在較大的品質。
85) 今天各界可以得到的機會遠比彼時為多。
86) 在香港居住了這麼久，若現在移居別地，我會比較快樂。
87) 在香港要成才，看你認識甚麼人，而不是念書有甚麼關係。
88) 香港最大的毛病，是這地方在新都領帶領導性的競爭。
89) 有時我常懷疑這麼多時間在教員及學習方面有什麼意義。

第九題
評選最適合你的答案。
80) 我說英文
(a) 全不
(b) 少少
(c) 頗好
(d) 流利
81) 我讀英文
(a) 全不
(b) 少少
(c) 頗好
(d) 流利
89) 我寫英文
(a) 全
(b) 少
(c) 好
(d) 流利

90) 我母親教英文
(a) 全
(b) 少
(c) 好
(d) 流利

91) 我母親讀英文
(a) 全
(b) 少
(c) 好
(d) 流利

92) 我父親教英文
(a) 全
(b) 少
(c) 好
(d) 流利

93) 我父親讀英文
(a) 全
(b) 少
(c) 好
(d) 流利
問卷三
第二部分 回答这些题目

1. 在你自己的感觉上，你如何看待你的学习能力？
   1) 我是中等的
   2) 我是中等之上
   3) 我是中等之下
   4) 我是最差的

2. 与同班同学相比，你如何看待你的学习能力？
   1) 我是中等的
   2) 我是中等之上
   3) 我是中等之下
   4) 我是最差的

3. 你认为你在班上成绩属于什么等级？
   1) 最好的一级
   2) 中等之上
   3) 中等
   4) 中等之下
   5) 最差的一级

4. 你认为你有能力读完大学吗？
   1) 完全肯定
   2) 有可能
   3) 不太肯定
   4) 没有

5. 你认为你在班上成绩属于什么等级？
   1) 最好的一级
   2) 中等之上
   3) 中等
   4) 中等之下
   5) 最差的一级
6. 若我与医生、律师或大学教授意见不合，你会怎么做？
   (a) 将意见付诸行动
   (b) 考虑医生或律师的意见
   (c) 不敢肯定
   (d) 多数人可能

7. 设想你与别人如何评估你的成就。根据你本人的意见，你认为自己的成绩有多好？
   (a) 我的成绩非常差
   (b) 我的成绩良好
   (c) 我的成绩毫无意义
   (d) 我的成绩属中等
   (e) 我的成绩能排在中等之下

8. 你认为你目前可以取得什么等级的分数？
   (a) 多数是A级
   (b) 多数是B级
   (c) 多数是C级
   (d) 多数是D级
   (e) 多数是E级

下列的问题，由你与你父母回答的。如果你不是与父母一起生活，或者不是与你同住的家庭单位，请由生来自定义：

9. 跟其他同学的学业比对，你认为你父母对你的学业能力？
   (a) 最好
   (b) 中等之上
   (c) 中等
   (d) 中等之下
   (e) 最差
10. 你认为与父母联系最重要的是什么？
   (1) 求学帮助
   (2) 生活照顾
   (3) 心理沟通
   (4) 其他

11. 你认为与父母沟通最重要的是？
   (1) 言语
   (2) 动作
   (3) 姿态
   (4) 其他

12. 你是否曾经与父母发生过冲突？
   (1) 经常
   (2) 偶尔
   (3) 从未

13. 你认为你与父母关系如何？
   (1) 紧密
   (2) 相对
   (3) 疏远

14. 你认为与父母沟通最重要的是？
   (1) 言语
   (2) 动作
   (3) 姿态
   (4) 其他

15. 你认为与父母沟通最重要的是？
   (1) 言语
   (2) 动作
   (3) 姿态
   (4) 其他
5. 在完成学业之后，你最想去与谁交朋友？
(a) 同学
(b) 老师
(c) 兄弟姐妹
(d) 其他

6. 你认为你在学习上有能力考取大学吗？
(a) 一定可以
(b) 比较困难
(c) 可能
(d) 不可能

7. 舒适的大学宿舍，你认为你会选择什么？
(a) 单人
(b) 双人
(c) 四人
(d) 其他

8. 你认为你最适合在哪个年级就读？
(a) 高一
(b) 高二
(c) 高三
(d) 其他
第二部分

第二部分

以亮光一些見解，在這個問題上，許多人同意，且認為
亦有
人不同意，因此，在這個問題上，許多人可能
同意，亦有許多人不同意。

<table>
<thead>
<tr>
<th>同意</th>
<th>反對</th>
<th>反對</th>
<th>不同意</th>
<th>反對</th>
</tr>
</thead>
<tbody>
<tr>
<td>五</td>
<td>五</td>
<td>五</td>
<td>五</td>
<td>五</td>
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<td>五</td>
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<td>五</td>
<td>五</td>
<td>五</td>
<td>五</td>
<td>五</td>
</tr>
</tbody>
</table>

或

或

或

或

或
第三部分

靠譜下面...
第8页

40. 我每天在大学的物理实验室里待
A. 少于十五分钟
B. 十五分钟至一小时
C. 一小时以上

41. 我的实验室设备齐全，但我还是常去:
A. 有合适的研究工具
B. 有实验器材
C. 没有实验器材
D. 工作是完全一样的

42. 我参加的实验课程:
A. 化学与物理课程
B. 有机化学与物理课程
C. 其他课程

第44页

41. 你是否在研究项目中遇到过困难？
A. 是的
B. 没有遇到

42. 你是否对化学课程感兴趣？
A. 是的
B. 不感兴趣

43. 你是否对物理课程感兴趣？
A. 是的
B. 不感兴趣

44. 你是否对实验课程感兴趣？
A. 是的
B. 不感兴趣
259

47. 最近你有沒有想去改做校內教授物理的工
法，你會
(1) 增加課時
(2) 增加課程
(3) 增加課程

48. 你認為物理
(1) 應列入非選修範圈內
(2) 應給予有志於物理的學生
(3) 應給予所有中學生

49. 你覺寫物理是
(1) 絕不有趣
(2) 沒大科學利目一樣，亦是應該特別有趣
(3) 非常有趣

49. 每兩天來說，你是否有時間多做同步課科的物理書？
第五部分 决出最终的方案之一

什么方法是等效的物理，我们选用方法（1）

(1) 手动
(2) 自动
(3) 这手常带如此

求学宜放发欲较近处，我学等物理的旧学

(1) 放手
(2) 放于
(3) 有时

(4) 手常带如此
60. 我把所有整理的筆記放在一起，心中
6. 无论我遇到什么困难，我都会坚持到底。
   a) 不会
   b) 有时
   c) 大多数
   d) 经常如此

7. 我将根据自己的兴趣和经验来选择无菌室或无菌实验室的物品。
   a) 不会
   b) 有时
   c) 大多数
   d) 经常如此

8. 我通常在做实验时才能安定下来。
   a) 不会
   b) 有时
   c) 大多数
   d) 经常如此

9. 夜间可能会有不规律的活动，就寝时非常不安
   a) 不会
   b) 有时
   c) 大多数
   d) 经常如此

10. 长时间阅读或过度熬夜，会导致感觉沉重。
    a) 不会
    b) 有时
    c) 大多数
    d) 经常如此
比完之后您要再接再厉。我一定会努力的。

(1) 本场考试
(2) 有
(3) 没
(4) 是

6. 我要多花点时间，多多练习，尽量保持专注。以确保学业

(1) 有
(2) 有时
(3) 有时
(4) 是

法我的进度控制无系统，手边计划

(1) 有
(2) 有时
(3) 是
(4) 有时

7. 我利用校内没有的时间来温习。以便

(1) 有
(2) 有时
(3) 是
(4) 有时

8. 我会多参加课外活动。

(1) 有
(2) 有时
(3) 是
(4) 有时
71. 故家家有，我手无。收吾舍闻之。
   1) 余告示
   2) 有
   3) 无
   4) 是

72. 若吾闻一言，指定吾意，而理表文曰：
   1) 余
   2) 有
   3) 无
   4) 是

73. 若吾闻一言，指定吾意，而理表文曰：
   1) 余
   2) 有
   3) 无
   4) 是

74. 若吾闻一言，指定吾意，而理表文曰：
   1) 余
   2) 有
   3) 无
   4) 是

75. 若吾闻一言，指定吾意，而理表文曰：
   1) 余
   2) 有
   3) 无
   4) 是
第七天 从早上以外

1. 起床
2. 喝水
3. 吃早餐
4. 阅读英文书籍

第七天重复前五天，设定下目标，

1. 目标
2. 计划
3. 任务
4. 俣
5. 实际工作

每天都要有计划工作，以完成自己

任务和计划，完成计划。

6. 图书馆
7. 电影
8. 音乐
9. 运动
10. 睡觉

第六部分

在学习过程中，每一题或每个步骤都可以显示了

你对于这些知识的掌握程度。可用

可列比例来表示你被看出：

非常同意 同意 稀疏同意 中立/不同意 不同意 非常不同意

如图其他的做法：

非常好 同意

非常同意 同意
A. 教科书是新的。

B. 与同意_________ 与不同意_________

C. 师父立堂上走时，一般变化在眉眼和姿态。

D. 与同意_________ 与不同意_________

E. 师父身前有三圈学生。

F. 与同意_________ 与不同意_________

G. 事实是重要的，观察和思考。

H. 与同意_________ 与不同意_________

I. 检查内容太详细。

J. 与同意_________ 与不同意_________

K. 教师鼓励学生发展新观念、新能力。

L. 与同意_________ 与不同意_________

M. 意见及叙述方面超得太多。

N. 与同意_________ 与不同意_________

O. 将给定的题目可以了的课程。

P. 与同意_________ 与不同意_________

Q. 与大致上掌握组织等良好。

R. 与同意_________ 与不同意_________

S. 使那些经验就太晚了。

T. 与同意_________ 与不同意_________
<table>
<thead>
<tr>
<th></th>
<th>情况</th>
<th>没有意见</th>
<th>持有不同意见</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>老师是否考虑学生的需求。</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.</td>
<td>我可以向老师请教问题。</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.</td>
<td>老师用语是否清楚易懂。</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.</td>
<td>课堂上是否容易看清楚及易懂。</td>
<td></td>
<td></td>
</tr>
<tr>
<td>5.</td>
<td>老师对学生的公平评分。</td>
<td></td>
<td></td>
</tr>
<tr>
<td>6.</td>
<td>老师有没有把握好程度及难度的尺度。</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7.</td>
<td>对课程内容引发我对学习的勇气和兴趣。</td>
<td></td>
<td></td>
</tr>
<tr>
<td>8.</td>
<td>老师在考试委员会工作步骤解释得清楚明白。</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
第七部份

说明：以下的意见是一些有关年纪较大的学生经常反映的。这些意见包括多方面的内容，每项意见都有人同意，有人不同意。所以没有绝对或完全的对或错，希望你根据自己的同意或不同意的程度，依下列评分表在各题互相内评分：

+7 极之同意  +1 极之不同意
+6 同意  +2 不同意
+5 指数同意  +3 指数不同意

10. 国语应被采用。
11. 在自由民主的社会下，我们不能适应中国式的传统。
12. 中国传统的价值观在现代不适用。
13. 我们现在的中文教育应采取正确的教授方法，而不是随随便便去翻译。
14. 我们同学之间的交流语言可以成为开发新语言的先河。
15. 当我们与外国人生一接触就开始时，我们不需要固执地用中文，以保持中国人的尊严。
APPENDIX 8

POST-TEST 2 (OPTICS & SOUND)
SECTION A: MULTIPLE CHOICE (32%)

1. If the object distance is halved and the diameter of the hole in a pin-hole camera is doubled, what effect does this produce on the size, brightness and sharpness of the image formed?

<table>
<thead>
<tr>
<th>Size</th>
<th>Brightness</th>
<th>Sharpness</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>doubled</td>
<td>brighter</td>
</tr>
<tr>
<td>B.</td>
<td>doubled</td>
<td>brighter</td>
</tr>
<tr>
<td>C.</td>
<td>doubled</td>
<td>fainter</td>
</tr>
<tr>
<td>D.</td>
<td>halved</td>
<td>brighter</td>
</tr>
<tr>
<td>E.</td>
<td>halved</td>
<td>brighter</td>
</tr>
</tbody>
</table>

2. When the eye is looking at an image in the mirror, the image formed on the retina of the eye is virtual because the image which appears in retina is virtual.

A. True  B. False  C. True  D. True  E. False

3. When an object is put in front of a concave mirror, a real, inverted, magnified image is formed. Find the position of the object.

A. infinity  B. beyond the centre of the curvature  C. on the center of curvature  D. between the focus and the center of curvature  E. between the focus and the pole

4. Which of the following can produce a virtual image of a real object?

I. Plane mirror  II. Concave mirror  III. Convex mirror

A. I only  B. II only  C. I and II only  D. I and III only  E. I, II and III

5. Convex mirrors are more suitable than plane mirrors for use as rear-view mirrors for cars mainly because convex mirrors can give

A. a magnified image  B. a real image  C. a sharper image  D. an undistorted image  E. an image covering a wider angle of view
6. In the figure, the position of the pin has been so adjusted that the pin and its image may be observed with no parallax between them. What is the focal length of the mirror?

A. 10 cm  
B. 20 cm  
C. 25 cm  
D. 40 cm  
E. It cannot be determined from the information given.

7. A straight stick appears to be bent when partly immersed in water. This is due to which of the following?

I. Interference  
II. Reflection  
III. Refraction

A. I only   
B. II only   
C. III only   
D. I and II only   
E. II and III only

8. A man looks vertically down at an object 2 m under water. If the refractive index of water is \( \sqrt{3} \), find the apparent depth.

A. \( \frac{2}{3} \) m  
B. 2 m  
C. \( \frac{2}{\sqrt{3}} \) m  
D. depends on how clear the water is  
E. depends on the distance of the observer above water

9. The path of a ray of light through a glass prism can be calculated if we know......

I. the refracting angle of the prism  
II. angle of incidence in the side of prism  
III. refractive index of the glass

A. III only  
B. I and II only  
C. I and III only  
D. II and III only  
E. All three

10. In the above diagrams, the critical angle of the glass is 42°. Which diagram shows the correct path for the light ray through the prism?

A. I  
B. II  
C. III  
D. IV  
E. V

11. What are the mistakes, if any, in the ray diagram shown above?
A. There is no mistake.
B. There should be one white emergent ray.
C. The red and violet emergent rays should be interchanged.
D. Dispersion of the white light should occur at the first face.
E. The diagram has both the mistakes mentioned in options C and D.

12. A diver at x metres under water looks up at the water surface and observes the sky appears to be a circle. What is the diameter of the circle if the critical angle of water is $\theta$?
A. $2 \times \tan \theta$ metres  
B. $2 \times \sin \theta$ metres  
C. $x \times \tan \theta$ metres  
D. $\frac{x}{\sin \theta}$ metres  
E. Both the mistakes mentioned in options C and D.

13. Which of the points I, II, III and IV can be seen by the fish in the pond as shown in the diagram above?
A. I and II only  
B. I and IV only  
C. I, II and IV only  
D. I, III and IV only  
E. All the points can be seen.

14. Which of the following statements concerning a simple astronomical telescope is/are correct?
I. The first image is always near the focal plane of the objective  
II. The eyepiece is used as a simple magnifying glass to observe the first image  
III. The final image appears to be enlarged
A. I only  
B. II only  
C. III only  
D. II and III only  
E. I, II and III

15. The diagram shows two incoming parallel rays of light which pass through a lens 'L'. The ray XY after passing through the lens will pass through the point
A. I  
B. II  
C. III  
D. IV  
E. V

16. A long needle is viewed through a lens. The needle and its image appear as in Figure 1. When the head is moved to the left, the needle (object) and its image appear as in Figure 2. Which of the following statements is/are correct?
I. The object is more distant than the image.  
II. The image is more distant than the object.  
III. The lens is convex.  
IV. The lens is concave.
A. III only  
B. I and III only  
C. II and III only  
D. I and IV only  
E. II and IV only
17. A pair of rays converge on the point I as shown in the diagram. Which of the following pieces of apparatus, placed along the line MN will displace the convergent point to the right?

- I. a concave lens
- II. a convex lens
- III. a rectangular slab of glass

A. I only  B. II only  C. III only  D. I and III only  E. II and III only

18. In the diagram, the ray between the lenses is parallel to the axis. Only one incident ray and one emergent ray are correctly drawn. Which of the following pairs are the correctly drawn rays?

<table>
<thead>
<tr>
<th>incident ray</th>
<th>emergent ray</th>
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<tr>
<td>I</td>
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<tr>
<td>I</td>
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<tr>
<td>II</td>
<td>IV</td>
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<tr>
<td>II</td>
<td>V</td>
</tr>
<tr>
<td>III</td>
<td>V</td>
</tr>
</tbody>
</table>

19. Which of the following is a property of a sound wave?

- A. It does not require a material medium.
- B. It is an electromagnetic wave.
- C. It is a transverse vibration.
- D. It travels most rapidly in a vacuum.
- E. It is a longitudinal vibration.

20. Sound waves differ from electromagnetic waves in the following respects:

- I. Sound waves can't be refracted.
- II. Sound waves have a greater velocity in a denser medium.
- III. Sound waves can only travel in a gaseous medium.

A. I only  B. II only  C. III only  D. I and II only  E. None of the above

21. A sound wave of frequency f travels in air with a velocity c. Under the same conditions, the velocity of the sound wave of frequency 2f will be

A. \( \frac{1}{2} c \)  B. c  C. 2 c  D. 4 c  E. undetermined

22. Two men A and B stand on a line vertical to and in front of a high wall. The distance between A and the wall is 330 m, between B and the wall is 660 m. When A makes a whistle, B hear the sound first and then the echo from the wall. Let the velocity of sound be 330 m/s, find the length of time between the sound and echo B heard.

A. 0 sec  B. 1 sec  C. 2 sec  D. 3 sec  E. 4 sec
23. With respect to a sound wave,
   I. the pitch depends on frequency
   II. the quality depends on velocity
   III. the loudness depends on amplitude
Which of the above statements is/are correct?
A. I only  B. II only  C. III only
D. I and II only  E. I and III only

24. The quality of the same note produced from different musical instruments depends on
   A. the combination of overtones.
   B. the length of the sound wave.
   C. the energy of the sound wave.
   D. the amplitude of the sound wave.
   E. the density of the medium transmitting the sound.

25. A commonly used method of tuning a sonometer wire into resonance with a tuning fork employs a paper rider.
Which of the following statements is/are true?
   I. the wire vibrates because energy taken from the tuning fork is transferred to the wire and the paper rider.
   II. the position of the rider is unimportant.
   III. the mass of the rider is unimportant.
A. I only  B. I and II only  C. I and III only
D. II and III only  E. I, II and III

26. Which of the following is/are transverse waves?
   I. Light waves
   II. Sound waves
   III. Water waves
A. I only  B. II only  C. I and II only
D. I and III only  E. II and III only

27. Of the following radiations, the one which has nearly the same natures as X-rays is
   A. infra-red  B. ultra-violet  C. visible light
   D. radio wave  E. gamma-ray

28. F.M. broadcasting with a frequency 92 MHz is transmitted by radio Hong Kong every day. The wave length of this broadcasting is approximately.
   A. 0.3 m  B. 186 x 10^14 m  C. 3 x 10^8 m
   D. 3.3 m  E. 1.7 m

29. If the distance between a point source of light and a surface is tripled, the intensity of illumination on the surface will be
   A. triple  B. doubled  C. reduced to 1/9
   D. reduced to 1/3  E. reduced to 1/9
APPENDIX 9

RETEST IN OPTICS & SOUND
1) We can see the image of ourselves in the plane mirror but not on a plane sheet of white paper because

(A) white paper transmitted nearly all the light falling on it.
(B) white paper absorbed all the light falling on it.
(C) light is diffusely reflected from the white paper.
(D) the image formed in white paper is virtual.
(E) the refractive index of white paper is unknown.

2) The rays A & B diverging from a point source P are reflected from a plane mirror M'M'. The reflected rays C & D will now diverge at an angle of

(A) 5° (B) 10° (C) 20° (D) 30° (E) 50°

3) Whenever the centers of the sun, moon and earth are in a straight line (in that order):

I some part of the earth is in the moon's penumbra
II some part of the earth must be in the moon's umbra
III some part on the earth can see a total eclipse of the sun

Which of the above statements is/are true?

(A) I only (B) II only (C) III only
(D) I & II only (E) All three

4) Which of the following mirrors can give an image (real or virtual) of the same size as an object which is not in contact with the mirror?

I concave mirror II convex mirror III plane mirror

(A) I only (B) III only (C) I & II only
(D) I & III only (E) All three

5) In the figure, the position of the pin has been so adjusted that the pin and its image may be observed with no parallax between them. What is the focal length of the mirror?

(A) 12 cm (B) 20 cm (C) 24 cm (D) 40 cm (E) It cannot be determined from the information given.

6) Rays from a point source at U are reflected by a concave mirror M and converge to a point V as shown in the diagram. If we wish to obtain a parallel beam of light after reflection, we could

I move the mirror closer to U
II move the mirror away from U
III keep the source at U and replace M by a suitably chosen concave mirror of shorter focal length

(A) I only (B) II only (C) III only
(D) I & II only (E) II & III only

7) Total internal reflection can occur at a surface of separation between a dense medium X and a rare medium Y only when

I the refractive index for light from X to Y is greater than 1
II the angle of incidence is greater than the critical angle
III the ray travels from X towards Y
7) Which of the above statements is/are correct?

(A) I only  
(B) II only  
(C) I & II only  
(D) II & III only  
(E) All three

8) The angle of incidence of a ray of light on a liquid is 45° and its angle of refraction is 30°. What is the critical angle of the liquid?

(A) 75°  
(B) 60°  
(C) 45°  
(D) 30°  
(E) 15°

9) The diagram shows a thin-walled prism filled with air. The air prism is immersed in water. A ray of light is incident along the line AB. Along which line will the light emerge?

(A) 1  
(B) 2  
(C) 3  
(D) 4  
(E) 5

10) The path of a ray of light through a glass prism can be found if we know:

I. the refractive index of the glass  
II. the refracting angle of the prism  
III. the angle of incidence at one side of the prism

(A) III only  
(B) I & II only  
(C) I & III only  
(D) II & III only  
(E) All three

11) A diver at h metres under water looks up at the water surface and observes the sky appears to be a circle. What is the diameter of the circle if the critical angle of water is C? (in metre)

(A) h tan C  
(B) 2h tan C  
(C) 2h sin C  
(D) h / sin C  
(E) 2h / sin C

12) In the diagrams shown, the critical angle of glass is 42°. Which diagram shows the correct path for the light ray through the prism?

(A)  
(B)  
(C)  
(D)  
(E)  

13) When a lens is placed at M, a real, inverted and magnified image of the illuminated pin is seen on the screen. When the lens is moved to position N, a sharp image of the pin is seen again. This image will be

(A) real, inverted and magnified.  
(B) real, inverted and diminished.  
(C) real, erect and diminished.  
(D) real, erect and magnified.  
(E) virtual, erect and magnified.

14) Two parallel rays of light pass through a box containing a piece of glass and emerge as shown.

I)  
II)  
III)  
IV)  
V)
14) Which of the above pieces of glass could produce this result?
(A) I only (B) III only (C) II or III
(D) I or IV (E) All four

15) When the eye is looking at an image in the mirror, the image formed on the retina of the eye is virtual because the image which appears in the eye is virtual.
(A) True (B) True (C) True (D) False (E) False

16) The diagram shows two incoming parallel rays of light which pass through a lens L. The ray PQ after passing through the lens will pass through the point.
(A) I (B) II (C) III (D) IV (E) V

17) In the diagram, the ray between the lenses is parallel to the axis. Only one incident ray and one emergent ray are correctly drawn. Which of the following pairs are the correctly drawn rays?
Incident Ray Emergent Ray
(A) I (B) I (C) II (D) II (E) III

18) A red disc is placed on a green grass ground and is then illuminated with coloured light given below, which could make the disc indistinguishable from its background?
(A) magenta (B) blue (C) green (D) white (E) red

19) Red and blue filters are placed directly in the path of white light. What is the colour of the light coming through?
(A) black (no light pass through) (B) green (C) yellow (D) white (E) magenta

20) The closed pipe shown is 0.9 m long and contains a stationary sound wave with nodes N and antinodes A at the position shown. The wavelength of the sound is (in m)
(A) 0.15 (B) 0.3 (C) 0.45 (D) 0.6 (E) 0.9

21) Sound waves differ from electromagnetic waves in the following respects:
I Sound waves have a larger velocity in a denser medium
II Sound waves can only travel in a gaseous medium
III Sound waves can't be refracted.
(A) I only (B) II only (C) III only (D) I & II (E) None of the above
22) A sound wave of frequency \( f \) travels in air with a velocity \( C \). Under the same conditions, the velocity of the sound wave of frequency \( 2f \) will be

(A) \( \frac{4}{3} C \)  
(B) \( 2C \)  
(C) \( C \)  
(D) \( \frac{3}{2} C \)  
(E) cannot be determined

23) Two men X & Y stand on a line vertical to and in front of a high wall. The distance between X and the wall is 330 m, between Y and the wall is 660 m. When X makes a whistle, Y hear the sound first and then the echo from the wall. Let the velocity of sound be 330 m/s, find the length of time between the sound and echo Y heard (in sec.)

(A) 4  
(B) 3  
(C) 2  
(D) 1  
(E) 0

24) The diagram shows a disc siren, the pitch emitted by this disc will depend on

I the number of revolutions the disc turns through per second  
II the distance of the whales from the axle of the disc  
III the number of holes in the disc

(A) II only  
(B) I & II only  
(C) I & III only  
(D) II & III only  
(E) All three

25) Two loudspeakers A & B broadcast the same pure note. The sound from loudspeaker A is louder than that from loudspeaker B. The sound waves produced by A

(A) have greater amplitude than those by B  
(B) have longer wavelength than those by B  
(C) have shorter wavelength than those by B  
(D) have higher frequency than those by B  
(E) travel faster than those by B

26) The quality of the same note produced from different musical instruments depends on

(A) the length of the sound wave  
(B) the energy of the sound wave  
(C) the amplitude of the sound wave  
(D) the combination of overtones  
(E) the density of the medium transmitting the sound

27) When the air in a tube closed at one end and open at the other is made to vibrate, it has

(A) a node at the close end  
(B) an antinode at the closed end  
(C) an antinode exactly at the open end  
(D) maximum amplitude halfway along its length  
(E) the frequency of any strongly vibrating tuning fork placed near the open end

28) A sonometer wire emits a note of frequency 300 Hz when under a tension of 2 kgf. If the tension is increased to 8 kgf and the length is kept constant, the frequency of the note becomes (in Hz).

(A) 4800  
(B) 1200  
(C) 600  
(D) 150  
(E) 75

29) A commonly used method of tuning a sonometer wire into resonance with a tuning fork employs a paper rider. Which of the following statements are true?

I the mass of the rider is unimportant  
II the position of the rider is unimportant  
III the wire vibrates because energy taken from the tuning fork is transferred to the wire and the paper rider.

(A) I only  
(B) II only  
(C) III only  
(D) I & II only  
(E) I & III only
30) Sound is produced by pouring water into a resonance tube closed at one end. As the tube fills, it is found that

I  the pitch of the sound produced becomes lower and lower
II the pitch of the sound produced becomes higher and higher
III the velocity of the sound produced remains constant.

(A) I only  (B) II only  (C) I & II only
(D) II & III only  (E) All three

END OF PAPER

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<tr>
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<th>Need</th>
<th>Comprehension</th>
<th>Application</th>
<th>Marking Line</th>
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<td>1</td>
<td>1</td>
<td>9</td>
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<td>Reflection by a cone surface</td>
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<td>Quality of sound</td>
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<td>3</td>
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<tr>
<td>Strings</td>
<td>1</td>
<td>2</td>
<td>1</td>
<td>3</td>
</tr>
</tbody>
</table>

H.B. Wing (B.Sc., M.Ed., Dip.Ed.)
Mr. Au (B.Sc., Dip.Ed.)
1. 针孔照相机的针孔直径加粗，它们成像有什么变化？
- 影响：大小、光度、清晰度有何变化。
- 选项：A. 放大的像；B. 实像；
- C. 反射成像；D. 旁折射像。

<table>
<thead>
<tr>
<th>A</th>
<th>加大</th>
<th>散光</th>
<th>增低</th>
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<tbody>
<tr>
<td>B</td>
<td>变大</td>
<td>影光</td>
<td>不变</td>
</tr>
<tr>
<td>C</td>
<td>变大</td>
<td>散光</td>
<td>减低</td>
</tr>
<tr>
<td>D</td>
<td>变大</td>
<td>散光</td>
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<tr>
<td>E</td>
<td>变大</td>
<td>散光</td>
<td>增低</td>
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</tbody>
</table>

2. 眼注视镜内的像时，视网膜上的成像是虚像。
- 原因：眼睛不在镜框上成像。
- 选项：A. 10cm B. 20cm C. 24cm
- A. 前倾成的正像，且是非折射像。 B. 40cm C. 无法成像或模糊。
- B. 前倾成的正像，且是非折射像。 C. 无法成像或模糊。
- D. 前倾成的正像，且是非折射像。 D. 无法成像或模糊。
- E. 前倾成的正像，且是非折射像。 E. 无法成像或模糊。

3. 下列关于角膜的描述，哪些是正确的？
- A. 具有凹透镜性质。 B. 具有凹透镜性质。 C. 只有凸透镜。
- B. 具有凹透镜性质。 D. 具有凹透镜性质。 E. 只有凹透镜。
- C. 具有透镜性质。 D. 具有透镜性质。 E. 只有透镜。
- D. 具有透镜性质。 E. 具有透镜。

4. 下列说法可否发生？
- A. 光速通过三棱镜的路径。 B. 可以计算出来，但不知道下例。
- C. 入射角不同，出射角不同。 D. 入射角同，出射角不同。
- E. 入射角同，出射角不同。 F. 入射角同，出射角不同。 G. 入射角同，出射角不同。 H. 入射角同，出射角不同。 I. 入射角同，出射角不同。 J. 入射角同，出射角不同。 K. 入射角同，出射角不同。 L. 入射角同，出射角不同。 M. 入射角同，出射角不同。 N. 入射角同，出射角不同。 O. 入射角同，出射角不同。 P. 入射角同，出射角不同。 Q. 入射角同，出射角不同。 R. 入射角同，出射角不同。 S. 入射角同，出射角不同。 T. 入射角同，出射角不同。 U. 入射角同，出射角不同。 V. 入射角同，出射角不同。 W. 入射角同，出射角不同。 X. 入射角同，出射角不同。 Y. 入射角同，出射角不同。 Z. 入射角同，出射角不同。
10. 在图中，玻璃的折射角是42°，那么图中的折射角是正确的。

A. △ B. △ C. △ D. △ E. △

11. 图示中哪一项是正确的？

A. B. C. D. E.

12. 一束光在水中入射角为θ，折射角为η。已知水的折射率为n，求光在水中的波长λ。

A. λ = \frac{c}{n \sin θ} B. λ = \frac{c}{n \sin η} C. λ = \frac{c}{n \sin θ \sin η} D. λ = \frac{c}{n \sin θ \cos η} E. λ = \frac{c}{n \sin θ \sin n}

13. 下列区域中，哪些能看到水下物体？

A. 仅区域 I B. 仅区域 II C. 仅区域 III D. 区域 I 和 III E. 区域 I, II, III 和 IV

14. 下列何种放大会是天文望远镜的观察对象？

A. 仅区域 I B. 仅区域 II C. 仅区域 III D. 区域 I 和 II E. 区域 I, II, III 和 IV

15. 图中所示光学图示表示什么？

A. I, II B. II C. III D. IV E. V

16. 图中所示光学图示表示什么？

A. I, II B. II C. III D. IV E. V
APPENDIX 11

TEACHING SCHEDULE OF MECHANICS
# Teaching Schedule of P.4 Physics (1979)

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<th>Content</th>
<th>Page</th>
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<td>What is force, gravitational force</td>
<td>P.13</td>
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<td>2,3</td>
<td>Centripetal force, Weights of standard masses, Why the weight of a body varies, relation between gravitational force and weight, action and reaction forces, weightlessness, weightlessness in space vehicles, artificial weight in a space station, friction, static friction, sliding friction, coefficient of friction, the nature of friction, friction and brakes, lubrication, air lubrication, further developments.</td>
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<tr>
<td>13/2</td>
<td>4</td>
<td>Discussion of exercise 2, average speed, actual speed, scalar and vector quantities, distance and displacement.</td>
<td>P.21</td>
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<td>Experiment to determine the coefficient of limiting static friction between two solid surfaces, velocity, uniform velocity, acceleration, uniform acceleration.</td>
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<td>Equations of uniformly accelerated motion, velocity-time graph, uniformly accelerated motion represented graphically, velocity from distance-time graph, acceleration from velocity-time graph, worked examples, Galileo Galilei, the simple pendulum experiment to study the simple pendulum, the measurement of g.</td>
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APPENDIX 12

TEST IN MECHANICS

(ANGLO–CHINESE SCHOOL ONLY)
The coefficient of static friction between two solid surfaces in contact depends only on
A. the surface area in contact.
B. the limiting friction between the two surfaces.
C. the normal reaction between the two surfaces.
D. the texture of the surfaces in contact.
E. None of the above

A 5 kg metal is sliding on a horizontal metal surface. Let the coefficient of sliding friction be $\frac{1}{10}$, find the required horizontal force.
A. 0 kg wt
B. $\frac{1}{2}$ kg wt
C. 2 kg wt
D. 5 kg wt
E. 50 kg wt

Which of the following pieces of apparatus measure(s) weight only, and do(es) compare masses?
I. beam balance
II. spring balance
III. Chinese steelyard
A. I only
B. II only
C. III only
D. I and II only
E. II and III only

An object, moving up a smooth inclined plane making an angle $\theta$ with horizontal, decreases its speed from $X$ to $Y$ m/s. What is the distance travelled in this period:
A. $\frac{x^2 - y^2}{2g}$ metres
B. $\frac{x^2 - y^2}{2g \cos \theta}$ metres
C. $\frac{x^2 - y^2}{2g \sin \theta}$ metres
D. $\frac{2(x - y)}{g \sin \theta}$ metres
E. $\frac{(x - y)}{2g}$ metres

A metal sphere on a horizontal plane is given a push so that it quickly runs off the edge of the plane. If air resistance is negligible, what is its vertical displacement downwards in $\frac{1}{2}$ second after it has left the plane? (Acceleration due to gravity = $10 \text{ m s}^{-2}$)
A. 5 m
B. $2\frac{1}{2}$ m
C. 1 m
D. 0 m
E. uncertain, for it does not start with zero velocity

The time of a simple pendulum making small oscillations depends upon
A. the length of the string and the acceleration due to gravity.
B. the mass of the bob and the angle of swing.
C. the mass of the bob and the length of string.
D. the mass of the bob and the acceleration due to gravity.
E. the length of the string and the angle of swing.

Two objects, X of mass 5 g and Y of mass 10 g are projected vertically upwards at the same time with the same velocity of projection. Assuming the air resistance is negligible,
A. Y will come to rest first.
B. X will reach a point higher than Y.
C. both objects have the same potential energy at the highest point.
D. both objects rise with the same retardation.
E. both objects have the same kinetic energy just before getting to the ground.

The period of oscillation of a simple pendulum is 1 second at the surface of the earth. If the acceleration due to gravity at the moon's surface is $\frac{1}{5}$ of that on the earth, what is the period of oscillation when the pendulum is on the moon?
A. $\frac{1}{5}$ second
B. $\frac{1}{15}$ second
C. $\frac{1}{5}$ seconds
D. 5 seconds
E. 25 seconds
If the resultant of all forces acting on a body is zero, the body may be
A. accelerating.
B. decelerating.
C. falling under gravity.
D. moving with uniform velocity.
E. moving along a circular track with uniform speed.

10. A body of mass 10 kg is moving with a velocity of 5 m/s. What is the
force required to stop the body completely in 2 seconds?
A. 1 N  B. 4 N  C. 25 N  D. 50 N  E. 100 N

11. A block of mass 10 kg is put on the floor of a cage. If the whole system
is now falling freely from rest under gravity, what is the magnitude of
the normal reaction between the block and the floor?
A. 0 kgf  B. 10 kgf  C. 970 kgf  D. 980 kgf  E. 990 kgf

12. The weight of a 10 kg object is hanging on a spring balance in an
elevator. When the elevator is
(A) moving up with constant velocity 5 m/s
(B) moving up with constant acceleration 2 m/s².
The reading from the spring balance will be:

(A) 10 kg wt  B. 8 kg wt  C. 10 kg wt  D. 15 kg wt  E. 2 kg wt

13. A lamp of mass 100 g hangs at the end of a light wire. A light string
knotted at the middle of the wire exerts a horizontal pull until the
upper portion of the wire inclines at an angle of 30° to the vertical.
What is the tension of the horizontal string?
A. 0 gf  B. 50 gf  C. 100 gf  D. 100 tan 30° gf  E. 100 tan 60° gf

14. A load W rests on an inclined plane. The coefficient of kinetic friction
is μ. What is the minimum pull F required to keep the body W moving at
steady speed up the plane?
A. W + μW cos θ  B. W sin θ + μW cos θ  C. W sin θ + μW sin θ
D. W sin θ + μW cos θ  E. W + μW sin θ

15. A body of mass 10 g rests on a rough inclined plane at an angle of 30° to
the horizontal. If the body does not move, what is the frictional force
between the body and the inclined plane?
A. 0.5 gf  B. 0.866 gf  C. 5 gf  D. 8.66 gf  E. 10 gf

16. In the diagram, what is the effort required to lift the load?
A. 96 kgf  B. 144 kgf  C. 160 kgf  D. 9.6 kgf  E. 16 kgf
A hinged trapdoor is held in the position shown by the rope. Under these conditions the direction of the force on the hinge will
A. be vertical.
B. be horizontal.
C. be through the C.G. of the trapdoor.
D. be parallel to the rope.
E. cut the rope above the C.G. of the trapdoor.

Which of the following are vectors?
I. Pressure
II. Push or Pull
III. Power
A. I only
B. II only
C. III only
D. I and II only
E. I, II and III

In the above diagram, the moment of the force F about the point A is
A. \( F \times AB \)
B. \( F \times AC \)
C. \( F \times AD \)
D. \( F \times BC \)
E. \( F \times BD \)

When a meter stick is set up as shown, it will be in equilibrium. If the pivot point is moved to the 6 cm point, find the position of E so that the system becomes equilibrium again. (Assume the weight of the meter stick is zero.)
A. 26 cm
B. 34 cm
C. 41 cm
D. 66 cm
E. 76 cm

A uniform metre rule of weight 0.500 N is maintained in equilibrium as shown above. What is the value of the weight X?
A. 0.250 N
B. 1.500 N
C. 4.000 N
D. 4.125 N
E. 4.750 N

The figure represents a uniform lamina with the two shaded portions cut out. The centre of mass of the remaining portion is
A. in the first quadrant.
B. in the second quadrant.
C. in the third quadrant.
D. in the fourth quadrant.
E. outside the large circle.
23. A body of mass \( m \) kilograms is dropped a point \( h \) metres above the ground. When it reaches a point \( x \) metres above the ground, its kinetic energy in joules is \( \frac{1}{2}mgh \) (Acceleration due to gravity = \( g \))

A. \( mgx \)  
B. \( \frac{1}{2}mx^2 \)  
C. \( mgh \)  
D. \( mg(h-x) \)  
E. \( \frac{1}{2}m(h^2-x^2) \)

24. Using the following symbols:

- \( F \) = force exerted  
- \( s \) = distance moved  
- \( t \) = time taken for the force to move through distances  
- \( v \) = velocity of motion  

The power produced by a machine is given by

A. \( Fs \)  
B. \( F/t \)  
C. \( Fv \)  
D. \( F/s \)  
E. \( Ft/v \)

25. The work required to bring a moving object to rest is directly proportional to its

A. velocity  
B. momentum  
C. acceleration  
D. potential energy  
E. kinetic energy

26. When the load is 600 N, the efficiency of the pulley system shown is 50%. This means that

A. 300 N is required to lift the load  
B. 300 N is just able to prevent the load from falling  
C. 400 N is just able to lift the load  
D. 400 N is able to prevent the load from falling  
E. 600 N is just able to lift the load.

27. A load \( L \) is pulled up an inclined plane by a force \( P \). The velocity ratio of this inclined plane is

A. \( \frac{YZ}{XY} \)  
B. \( \frac{XY}{YZ} \)  
C. \( \frac{ZX}{XY} \)  
D. \( \frac{XY}{YZ} \)  
E. \( \frac{XY}{ZZ} \)

28. For a given machine, which of the following depend(s) on the load?

I. Velocity Ratio  
II. Mechanical Advantage  
III. Efficiency

A. I only  
B. II only  
C. I and II only  
D. I and III only  
E. II and III only

29. A wooden block of \( W \) g weight rests on a hinged wooden plane. One end of the plane is raised slowly until the block just begins to slide. If this occurs at angle \( \theta \), which of the following is true?

A. The kinetic coefficient of friction is \( \frac{W \sin \theta}{W \cos \theta} \)  
B. The kinetic coefficient of friction is \( \tan \theta \)  
C. The static coefficient of friction is \( \frac{W \sin \theta}{W \cos \theta} \)  
D. The static coefficient of friction is \( W \cos \theta \)  
E. The static coefficient of friction is \( \tan \theta \)
The acceleration exists when the magnitude and direction of the motion of the body is/are described below.

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<tr>
<td>ii) variable</td>
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A. i only   B. ii only   C. iii only
D. i and ii only  E. ii and iii only

A stone is thrown vertically upwards, at its highest position it has
I. zero velocity
II. no acceleration
III. maximum kinetic energy

Which of the above statements is/are correct?
A. I only   B. II only   C. III only
D. I and II only  E. I and III only

Consider the following, which are correct?
1. Force is that which changes a body's state of rest or uniform motion in a straight line.
2. An object weighs heavier at the equator than at the North Pole.
3. Weights and mass are both constant when an object is raised from sea-level to space.
4. Artificial weight on a space station depends a lot on the speed of rotation of the station.
A. 1 and 2   B. 1 only   C. 1 and 4
D. 3 only   E. 1, 2 and 4

A simple pendulum with a period 1 second on the earth has a period of \( \frac{1}{5} \) second on a certain planet. If the acceleration due to gravity is 9.8 m/sec\(^2\), what is the acceleration due to gravity on the planet?
A. 19.6 m/sec\(^2\)   B. 4.9 m/sec\(^2\)   C. 39.2 m/sec\(^2\)
D. 21.45 m/sec\(^2\)   E. cannot be determined because both the mass and length of the pendulum is not given

When we say that the mechanical advantage of a machine is 15, we mean that
A. the work done by the machine is 15 times the work put into it.
B. the resistance overcome by the machine is 15 times the force applied to it.
C. the load moves through 15 times the distance moved by the effort.
D. the power put into the machine is 15 times that got out of it.
E. the frictional force is 15 times that of the effort.

Two skaters A and B on a small level pond have speeds of 0.9 m/s and 0.6 m/s respectively. They collide head on in a gentle manner and link arms. Both skaters have the same mass. Their common velocity after collision is
A. 0.3 m/s in the original direction of A.
B. 0.3 m/s in the original direction of B.
C. 0.15 m/s in the original direction of A.
D. 0.15 m/s in the original direction of B.
E. none of the above

An inclined plane 10 m long has one end on the ground and the other end on a platform 6 m high. A man of mass 150 kg wishes to push a 90 kg object up this plane. The force of friction is 10 kgf.

The minimum force he must exert is, in kgf, approximately
A. 70   B. 54   C. 64   D. 90   E. 100

In order to hold the object on the plane without letting it slide, the minimum force required is, in kgf, approximately
A. 0   B. 10   C. 44   D. 54   E. 64

The potential energy gained by the object when it is at the top of the plane is, in kgf - m
A. 100   B. 324   C. 540   D. 640   E. 900
39. The efficiency of a machine is defined as
A. load/effort  B. effort/load  C. M.A./Y.R.
D. output/input  E. input/output

40. A bullet of mass m kg and velocity Vm/s is brought to rest in t seconds by a sandbag. The depth penetrated (in metres) is
A. Vm t  B. Vt  C. Vt/2m
D. Vt/2  E. 2tV/m

41. An object whose mass is 100 gm starts from rest and moves with constant acceleration of 20 cm/sec². At the end of 8 sec, its momentum is, in gm-cm/sec.
A. 500  B. 8000  C. 16000
D. 33000  E. 64000

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RESEARCH PROJECT ON

EFFECT OF MEDIUM OF INSTRUCTION UPON STUDENT LEARNING IN MATHEMATICS, SCIENCE AND HISTORY AT FORMS II, III AND IV LEVELS

Second Stage:

Four Lessons on ATOMIC STRUCTURE AND RADIOACTIVITY at Form IV Level

The Chinese University of Hong Kong
School of Education

April 16, 1979
Syllabus and Time Allocation

Atomic Structure and Radioactivity

Lesson One: Atomic Structure (40 minutes)
I. The Atomic Theory
II. Atomic Models
III. Nucleus, Mass Number, Atomic Number

Lesson Two: Isotopes and Radioactivity (25 minutes)
I. Isotopes and Its Chemical Properties
II. Radioactivity and Its Discovery

Assessment One: (15 minutes)
15 multiple-choice questions for Lessons One and Two

Lesson Three: Radiation and Half-Life (40 minutes)
I. alpha, beta and gamma radiations
II. Half-Life and Decay Time
III. Carbon Dating

Lesson Four: Tracer and Atomic Energy in Peaceful Uses (20 minutes)
I. Tracer in Peaceful Uses
II. Atomic Energy in Peaceful Uses

Assessment Two: (20 minutes)
20 multiple-choice questions for Lessons Three and Four
Lesson One: Atomic Structure (40 minutes)

Time Allocation

I. The Atomic Theory

5

The belief that complex substances are composed of simple, elementary components existed in ancient Greece. We know that almost every substance can be broken into smaller parts. About 2500 years ago, a Greek philosopher, Democritus taught that by breaking substances into smaller and smaller parts, one would finally reduce matter to its smallest particles, which could not be broken down any further. These smallest, indivisible particles were called ATOMS.

According to Democritus, atoms, like grains of sand, when packed together could be moulded into any form, so that everything in nature could be built with atoms.

II. Atomic Models

a. J.J. Thomson Model

Atoms had been pictured as small, hard indestructible particles until 1897. When the electron—a negatively charged particle much smaller than the atom, was discovered. In the next year, J.J. Thomson, the English scientist, who discovered the electron, proposed a so called 'plum pudding' model.

In his model, atoms are pictured as small spheres of positively charged matter in which electrons are embedded. (Figure 1). The atom should look somewhat like a snowball with some pebbles or a lump of raisin-studded pudding.

Teacher's Guide

2500 years ago, Democritus taught that by breaking matter into smaller and smaller parts, it may be reduced into its smallest particles—the atoms.

Thomson proposed a plum-pudding model of the atom. He pictured atoms as small spheres of + charged matter in which electrons are embedded.
b. Rutherford-Bohr Model

The Thomson model was soon discarded as it failed to comply with new experimental findings. Thirteen years later, another English scientist, Ernest Rutherford proposed the 'Nucleon Model', (Figure 2) here the atom consists of a nucleus at the center surrounded by electrons, which are negatively charged. His model was later modified by Niels Bohr, a Danish scientist.

Bohr pictured the atom as a miniature solar system. Inside the atom, electrons, like those planets revolving round the sun, are whirling round a tiny positively charged particle called the NUCLEUS. (Figure 3)

c. Our present view

Planets move round the sun in definite orbits but electrons are not. They are whirling round the nucleus with a very high speed, changing their orbits all the time. Because of their rapid motion, it is impossible to find their positions at any instant. The electron can still be found 'somewhere' round the nucleus, but its position can be described only in terms of 'probabilities'.

III. Nucleus, Mass Number and Atomic Number

III-1 The Nucleus

The nucleus, being much smaller than the atom, has a diameter \( \frac{1}{10000} \) part of the diameter of the atom; thus atoms consist largely of empty space. To have some idea of the relative sizes of the nucleus and the atom: if the nucleus were enlarged to the size of a small glass marble, the whole atom would be as big as a giant balloon measuring more than 300 feet across.

Since electrons are much lighter than atoms, (less than one-thousandth part), so that nearly all the mass of the atom is concentrated in the tiny but heavy nucleus.
Scientists found that the nucleus is composed of two kinds of particles—protons and neutrons.

The proton is a positively charged particle, possessing a positive charge equal in magnitude to that of the electron. In a neutral atom, the number of protons is equal to the number of electrons. Its mass is about 2000 times that of an electron.

The neutron does not carry any charge, its mass is the same as the proton. For some atoms, the number of neutrons is equal to the number of protons. But in some heavy atoms, those having large number of protons and neutrons, the number of neutrons is larger than the number of protons.

Protons and neutrons are the component particles of all atomic nuclei. To help in identifying various nuclei, scientists defined two numbers, the atomic number and the mass number.

The number of protons inside the nucleus is called the Atomic Number and is denoted by the symbol Z.

The total number of protons and neutrons is called the Mass Number and is denoted by the symbol A.

Less commonly, the number of neutrons is represented by N, which can be found by using the formula

\[ N = A - Z \]

when A and Z are known.

Examples:
- C atom—6 protons & 6 neutrons in nucleus
  \[ Z = 6, \quad A = 6 + 6 = 12 \]
- Na atom—11 protons and 12 neutrons
  \[ Z = 11, \quad A = 11 + 12 = 23 \]
Symbolic Representation of Nuclei

To represent helium, chemists use the abbreviated symbol: \( \text{He}\). Nuclear physicists are more particular, they represent the nucleus of helium as \( ^4_2\text{He}\) where the top-right no. = mass number and the bottom-left no. = atomic number.

From this symbol, we know at once that there are 4 particles in the nucleus, 2 protons and 2 neutrons.

In general, if \( X \) is the symbol of the element, its nucleus is represented as \( Z^A_X \). The number of component particles are clearly given from the symbol.

Example: \( ^{12}_6\text{C}, ^{23}_11\text{Na}, ^{238}_92\text{U} \)

Examples
Lesson Two: Isotopes and Radioactivity (25 minutes)

I. Isotopes and Its Chemical Properties

I-1 Chemical Properties and Atomic Number

All atoms of an element contain the same number of protons. The chemical properties of an element is determined by the number of electrons in an atom, which is equal to the atomic number of the element.

According to the atomic theory, all atoms of an element should be identical. They should have the same size, mass and structure.

Scientists discovered that an element may consist of several kinds of atoms with different masses. These atoms of the same element have the same number of protons. The various species of an element having different masses are called its ISOTOPES.

I-2 Examples of Isotopes

Ordinary hydrogen atoms have 1 proton in its nucleus. There are also two kinds of hydrogen atoms which have one or two more neutrons respectively in their nuclei. These are called 'heavy hydrogen'. The 3 isotopes are represented by $^1\text{H}$, $^2\text{H}$, $^3\text{H}$.

Chlorine has 2 isotopes: $^{35}\text{Cl}$, $^{37}\text{Cl}$.

Oxygen has 3 isotopes: $^{16}\text{O}$, $^{17}\text{O}$, $^{18}\text{O}$.

Lead has 4 isotopes: $^{204}\text{Pb}$, $^{206}\text{Pb}$, $^{207}\text{Pb}$, $^{208}\text{Pb}$.

Carbon has 3 isotopes: $^{12}\text{C}$, $^{13}\text{C}$, $^{14}\text{C}$.

Isotopes underlined exist in majority abundance, while the ones in brackets have an abundance of less than 1\%.
II. Radioactivity and Its Discovery

II-1 Discovery of Radioactivity

The story happened in a dull, misty day in 1896. A French scientist, Henri Becquerel, placed a uranium salt on a photo plate in a dark drawer. The plate was found to be fogged after development. Clearly the uranium had exposed it even in the dark and through the protective wrapper. This uranium salt possessed some mysterious activity and gave out some radiations that affected the photo plate.

II-2 Basic Knowledge of Radioactivity

Some atoms possess a large number of nucleons in their nucleus. These particles are restless (or unstable) as they are confined in a small region. The jostling particles can have a more easy state (or stable state) by expelling some of their neighboring particles, resulting in the emission of some invisible radiation from the nucleus. These atoms are said to be RADIOACTIVE.

The process of emitting some particles or radiation due to spontaneous splitting (disintegration) is known as DECAY. This will result in a new element which can continue, if possible, this process until a final stable state is attained. A stable state refers to the state at which element can no longer give off radiations.
Lesson Three: Radiation and Half-Life (40 minutes)

1. **alpha, beta and gamma radiations**

   After radioactivity was discovered, hundreds of experiments were performed to study their properties. Scientists soon identified three different kinds of radiations: (i) alpha $\alpha$ radiation, (ii) beta $\beta$ radiation and (iii) gamma $\gamma$ rays.

---

I-1. **alpha $\alpha$ radiation**

   Alpha radiation is found to be groups of particles having 2 protons and 2 neutrons in each group. Since the helium nucleus is also composed of 2 protons and 2 neutrons, alpha particles are sometimes stated as He nuclei. Due to the 2 protons present, alpha particles are positively charged. When an alpha particle is emitted, the process can be represented symbolically by:

   $$ Z^A_X \rightarrow Z - 2 \ ^4_2 \text{He} (\alpha \text{-particle}) $$

   Where $X$ is the element to emit the $\alpha$ particle, generally called the mother nuclide, and $Y$ is the residual element called the daughter nuclide.

   Note that the mother nuclide after emitting an alpha particle has its atomic number decreased by 2 and its mass number less by 4. (Emission of 2 p and 2 n)

   Example: $^{226}_{86}\text{Ra} \rightarrow ^{222}_{84}\text{Rn} + ^4_2\text{He}^4$ (alpha particle)

---

I-2. **beta $\beta$ radiation**

   Beta radiation consists of electrons. These electrons are not orbital electrons. This is simply due to the change of a neutron into a proton and an electron.

   $$ n \rightarrow p + e (\beta \text{-particle}) $$

   The electron is emitted as the beta particle, the equation is given by

   $$ Z^A_X \rightarrow Z + 1^A_Y + -1^0_e (\beta \text{-particle}) $$

---
The residual daughter nuclide has an atomic number of \( Z + 1 \), due to 1 proton more. The mass number \( A \) has not changed as the total number of nucleons is unchanged.

Example: \( ^{6}_{0}^{14} \text{Cl} \rightarrow ^{7}_{1}^{14} \text{N} + \text{e}^{-} \)

I-3 \( \gamma \)-rays

The radiation does not carry any charge. It has a nature similar to that of light but its energy is millions of times larger. They possess wave properties -- can be reflected or refracted. (diffract or interfere with each other as well)

The radiation travels with the speed of light.

II. Half-Life

II-1 Introduction

From lesson 1, we know that unstable atomic nuclei are radioactive. These nuclei may decay, or break up by itself to form more stable nuclei with the emission of radiation.

The breaking up process occurs randomly. We cannot tell which nucleus will decay in a particular time. But it is true that more nuclei will break up if more unstable atoms are present.

II-2 Half-Life (\( T_{1/2} \))

Some radioactive samples need a long period to be converted to the stable ones and some need a few seconds. As an indication of the activity or the power of still being active, we measure the time required for half of the unstable nuclei to be converted to the stable ones.

This is the half-life of the radioactive element.

Example: Radon, a radioactive gas whose \( T_{1/2} \) is 4 days, if we start with 256 atoms of radon, in 4 days time, \( \frac{256}{2} = 128 \) atoms will be changed, leaving 128 atoms of unstable radon atoms. In 4 more days, \( \frac{128}{2} = 64 \) atoms are again decayed, leaving 64 atoms still active; In a total period of 16 days, 16 atoms of radon still remain active.
Different elements have different half-lives, some may be very long and some very short. Here are some examples:

<table>
<thead>
<tr>
<th>Element</th>
<th>Half-life</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uranium 238</td>
<td>4.5 billion years</td>
</tr>
<tr>
<td>Carbon 14</td>
<td>5600 years</td>
</tr>
<tr>
<td>Radium 226</td>
<td>1620 years</td>
</tr>
<tr>
<td>Polonium 214</td>
<td>$10^{-4}$ second</td>
</tr>
</tbody>
</table>

From the graph, we see that the number of survivors becomes smaller as time passes, but it may never become zero. This is another way of saying that we cannot assign any 'definite' lifetime in which all of the original atoms for a sample will have decayed.

The decay law is a result of statistical analysis, and it is applicable to a sample containing a large number of radioactive nuclei.

III. Carbon Dating

Archeologists, people who study ancient relics, always have interest to determine the age of bones or rocks dug from ancient tombs. If the age of a piece of ancient bone can be found, historians can obtain more information about the cultural development at that time.

The common method of dating makes use of Carbon-14, a radioactive isotope of Carbon-12, which exists naturally in very minute amounts. The half-life of Carbon-14 is about 5600 years.

All living organisms, plants or animals, take in Carbon-14 along with carbon-12 from the surroundings. When the organism dies, there is no longer any intake of Carbon-14 isotopes, and those that remain break down slowly. By measurement of the amount of Carbon-14 present in a specimen, the length of time elapsed since the organism's death can be found.

C-14, a radioactive isotope of C-12, having $T_1$ of 5600 years, is the element used for dating.

Measurement of the amount of the remaining C-14 helps the dating of the specimen's age.
Lesson Four: Tracer and Atomic Energy in Peaceful Uses

Introduction
Many people nowadays still have a belief that radiations can only do harm to living things. This could possibly be due to the vast destructive power from atomic bombs.

Though it is undeniable that radiations can be harmful to body tissues and cells, but it can also become helpful under careful control and usage. The most popular application is in the generation of electrical power.

There are other applications in radiotherapy—the treatment of cancer patients with radiation to kill cancerous cells, archeological dating as described in last lesson and to serve as tracers in medical and industrial researches.

I. Tracer in Peaceful Uses

I-1 Principle
A score of artificial radioactive isotopes (radioisotopes) are available today for use in industry and medicine. An important aspect of their usefulness is that they can be traced; a detector of radiation will easily tell their presence anywhere, even in amounts too small to be visible or found by simple means.

I-2 Medical Applications
Radioisotopes are of greatest value in the diagnosis of human disorders. They help in many cases where X-rays fall short. For example, radioactive sodium, in the form of a salt solution, is injected in the patient's arm. The isotope is picked up by the blood stream and transported to the heart. The position of the isotope can then be located by a detector. This offers a valuable means in the recognition of diseases of the heart or the circulatory system.
I-3 Industrial Applications

Tracing small amounts of matter is helpful in all kinds of research in industry. In oil refineries, radioisotopes can be used to trace oil along the pipelines. By adding a few tracer atoms to the oil, batches of different grades of oil can be labelled like letters and followed. Hidden leaks are easily discovered, they are betrayed by the presence of radioactivity outside the pipes.

II. Atomic Energy in Peaceful Uses

In reactions concerning nuclides, energy may be absorbed or released. The energy absorbed or released in a nuclear reaction is a million or more than the amount of energy involved in an ordinary chemical reaction. Hence this property has made the reactions important in industrial and military applications.

Fission—the heavy metal uranium is a mixture of 2 isotopes of which $^{235}\text{U}$, Uranium-235, is the most important. Some atoms of U-235 decay naturally, emitting high-speed neutrons.

When one of these neutrons hits the nucleus of a neighboring U-235 atom, it may break into two nearly equal radioactive nuclei, $^{144}\text{Ba}$ and $^{90}\text{Kr}$, together with two or more neutrons.

$$92^{235}_0\text{U}^1 + 0_n^1 \rightarrow 56^{144}_{25}\text{Ba} + 36^{90}_{36}\text{Kr} + 2_0^1$$

The breaking up process results in the liberation of a great amount of energy in the form of heat. The neutrons emitted in the reaction may split other U-235 nuclei, and so a chain reaction is set up, resulting in a continuous liberation of energy.

The energy released is used to heat up circulating cold water into steam, which is used to generate electricity after passing some mechanical devices.
教學語言與
中二、中三、中四數．理．史三科
學習效果之研究

第二階段：
中四級「原子結構和放射性」
的四課教學設計

香港中文大學 教育學院
一九七九年四月十六日
課程及時間分配

原子結構及放射現象

第一章：原子結構（40分）
工. 原子理論
工. 原子模型
五. 原子核. 質量數. 原子序數

第二章：同位素及放射現象（25分）
工. 同位素及其它化學特性
五. 放射現象及其發現經過

評鑑測驗：第一回（15分）
15題多項選擇題（關於第一章及第二章之內容）

第三章：輻射及半衰期
工. α, β和γ輻射
工. 半衰期及衰減時間
五. 碳-14定年法

第四章：示蹤劑及原子能之和平用途
工. 示蹤劑的應用
五. 原子能之和平用途

評鑑測驗：第二回（20分）
20題多項選擇題（關於第三章及第四章之內容）
第一题：原子结构（40分）

【材料】

【图示】

图一

5. 古希腊人相信万物由不可分的物质组成。公元前四世纪，德谟克利特提出宇宙由原子组成。我们相信，宇宙是由最小的物质组成。原子是物质的不可再分的组成部分。物体由原子组成，原子构成物体。物体的性质由原子的性质决定。原子是不可再分的最小单位，原子之间存在作用力。力的相互作用使得原子能够组合成物体，物体的性质由原子的性质决定。物体的性质由原子的性质决定。

图二

II. 原子模型

甲：汤姆逊（Thomson）原子模型

乙：卢瑟福（Rutherford）原子模型

丙：波尔（Bohr）原子模型

图三

图三示意图

图示说明：

1. 原子由原子核和电子组成。
2. 原子核位于原子中心，由质子和中子组成。
3. 电子绕原子核运动，形成电子云。
4. 原子的能量状态由量子数决定。
5. 原子的化学性质由核外电子的排布决定。
五. 罗瑟福—波尔模型

20世纪初，原子模型因未被新实验结果所证实，不久便被放弃。1913年，另一位英国科学家卢瑟福（Rutherford）提出了一个新的原子模型，称为"原子核模型"（见图二）。

根据这一模型，原子核中有一个核心，而那些带电的电子则分布在核外。不久丹麦的科学家玻尔（Bohr）进一步修改了他提出的原子核模型，称为"波尔模型"（见图三）。

根据玻尔的描述，电子绕着原子中心的核心，不停地回转。这颗沉重、带正电的粒子叫做"原子核"（Nucleus）。（见图三）

四. 近代的看法

太阳系的行星是绕着一定的轨道围绕太阳进行。行星以极高速度运行，但其方向不断改变的轨道，使得行星的运动就形成了一个螺旋。科学家至今也没有找到这样有规律的运转。

位置，根据最新的发现，行星的轨道是无规律的，无法通过简单的模型来描述。
### 三. 原子核，質量數，和原子序數

#### 一. 原子核

- 原子核是一種由原子核內的粒子，它們的總質量為
- 原子核是一種由原子核內的小但帶有正電的粒子
- 原子核的一小部分為小但帶有正電的粒子
- 原子核的質量之和差不多為原子核之
- 原子核的質量約佔原子核之
- 原子核的質量約佔原子核之
- 原子核的質量約佔原子核之

#### 二. 質量數

- 質量數是原子核的質量的整數，它是在原子核之
- 質量數是原子核的質量的整數，它是在原子核之
- 質量數是原子核的質量的整數，它是在原子核之
- 質量數是原子核的質量的整數，它是在原子核之
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- 質量數是原子核的質量的整數，它是在原子核之

#### 三. 原子序數

- 原子序數是原子核中的粒子，它是在原子核之
- 原子序數是原子核中的粒子，它是在原子核之
- 原子序數是原子核中的粒子，它是在原子核之
- 原子序數是原子核中的粒子，它是在原子核之
- 原子序數是原子核中的粒子，它是在原子核之
- 原子序數是原子核中的粒子，它是在原子核之
### 三. 原子核的表示方法

<table>
<thead>
<tr>
<th>符号</th>
<th>数字</th>
<th>代表意义</th>
</tr>
</thead>
<tbody>
<tr>
<td>He</td>
<td>2</td>
<td>氦原子核</td>
</tr>
<tr>
<td>U</td>
<td>238</td>
<td>钋原子核</td>
</tr>
<tr>
<td>C</td>
<td>12</td>
<td>碳原子核</td>
</tr>
<tr>
<td>Na</td>
<td>22</td>
<td>钠原子核</td>
</tr>
</tbody>
</table>

利用这一表示方法，我们一看即可立刻知道原子核的质子数。其中的质子数即核子数。
放射现象和其实验研究

一、放射现象

在1895年，德国科学家拉克尔发现放射现象。他在实验中发现一个特殊的物质——放射性物质，它能发出一种看不见的辐射。这种辐射称为“射线”。这些射线能穿过空气，但无法穿透固体物质。

二、放射现象的实验

1. 有些放射物质能自行发生放射现象，它们在化学反应中会发出放射性物质。
2. 放射性物质的放射性是通过原子核的衰变过程产生的。
3. 放射性物质的放射性可以被用来进行放射性测量。

三、放射现象的应用

放射性物质在医疗、工业、科研等领域有着广泛的用途。例如，它可以用来杀死癌细胞，也可以用来检测地下资源的分布。
### 三价不同的辐射

#### 1. 自然放射现象被发现之后，科学家的不断努力，终于分别三种不同的辐射，称为

- α 辐射 (或 α 粒子)
- β 辐射 (或 β 粒子)
- γ 辐射 (或 γ 射线)

#### 2. α 粒子

5. 科学家发现，在一个 α 粒子衰变时共有四个粒子，其中两个是 α 粒子。我们称这是

- α 粒子
- α 粒子

### 五价不同的辐射

#### 1. α 粒子

放射性元素（如镭）的衰变，可以表示为

\[ {\alpha} \rightarrow {\text{原子核}} + 2 \text{He} \]

在该式中，X 是放射的 α 粒子的原子核，Y 是射出的 α 粒子的残余核，而 Z 是 α 粒子的原子序数。

#### 2. β 粒子

### 五价不同的辐射

#### 1. β 粒子

放射性元素（如镭）的衰变，可以表示为

\[ {\beta} \rightarrow {\text{原子核}} + 2 \text{He} \]

在该式中，X 是放射的 β 粒子的原子核，Y 是射出的 β 粒子的残余核，而 Z 是 β 粒子的原子序数。
放射性

放射性指某些原子核不稳定，会自发地放出粒子或射线，从而转变为另一种原子核的过程。放射性物质的半衰期是指其放射性强度衰减到原来一半的时间。放射性物质在进行放射性衰变时，会放出α射线、β射线、γ射线等。

放射性在医学、考古学、地学等领域有着广泛的应用。例如，在医学中，放射性同位素可以用于诊断和治疗疾病；在考古学中，放射性碳测年法用于测定古生物和古人类的年代。

放射性物质的危险性很大，因此在使用时需要特别小心。放射性物质的处理和储存需要按规定进行。

放射性的影响

放射性物质对人类和环境的影响很大。放射性物质会释放出高能量的射线，对生物体造成严重的伤害，甚至可能导致基因突变，从而影响生物的生存。

在工业生产和科研活动中，放射性物质的使用是不可避免的。然而，放射性物质的使用必须严格遵守相关法规和标准，以减少对人体和环境的影响。
不同元素的半衰期有很大的差别，有些很长，有些却很短。例如：

<table>
<thead>
<tr>
<th>元素</th>
<th>半衰期</th>
</tr>
</thead>
<tbody>
<tr>
<td>钚-238</td>
<td>4.5 亿年</td>
</tr>
<tr>
<td>碳-14</td>
<td>5,600 年</td>
</tr>
<tr>
<td>镭-226</td>
<td>1,600 年</td>
</tr>
<tr>
<td>钋-210</td>
<td>10^{-4} 秒（万分之一秒）</td>
</tr>
</tbody>
</table>

由此图中我们可以知道随着时间的流逝，留下未变的原子越来越少，但如果我们是大自然，便会根据元素的放射性衰变规律，逐渐消散。
碳-14定年法 (

碳-14是碳的一种稳定同位素。在自然界的碳循环中，所有生物通过光合作用消耗碳，当死亡后，剩下的碳-14会逐渐衰变成其他元素。因此，可以通过测量样本中碳-14的比例来计算它的年代。

| 其中较通行的是碳-14 (Carbon-14) 定年法。 | 碳-14 (C\text{14}) 是在中子和

| 碳-14是碳的一种稳定同位素。 | 一种放射性同位素。

| 碳-14代表的衰变期为5600年。 | 碳-14是半衰期的

| 碳循环中的生物体如植物和动物都会不断摄入碳-14。 | 通过计算样本中碳-14的比例来确定它的年代。

| 植物或动物死亡后，其体内碳-14的含量会逐渐减少。 | 可以推算出样本距今的年代。
第四章：示踪剂和原子能的应用（20分）

教师导引

3.

在今天，很多人对辐射感到害怕，认为辐射对身体是有害的。这种观念可能因为原子能或核能的一些破坏力太强有关。

然而，辐射对身体的某些组织和细胞会产生损害，但在适当的控制和引导下，辐射也有建设性的用途，如推动机械工程产生动力。

放射性元素：其他重要的应用，如放射性治疗。利用放射性同位素在体内外治疗癌症的病人。另一方面，利用放射性同位素研究古代文物年代的测定。

8.1. 示踪剂（Tracers）的用途

I-1. 原理：

人造放射性同位素，在工业和医学方面有重大的用途。其基本原理是在放射性同位素探测器上显示该元素的踪迹。

I-2. 医学上应用

放射性同位素对诊断人体疾病有重大价值。通过使放射性同位素进入病人的体内，通过放射性同位素在体内的探测，可以发现病变部位。

I-3. 工程上应用

示踪剂在工程上也有重要应用。例如示踪剂在工程上显示示踪元素在管中的流动情况，显示出示踪剂在管中的流动。

检测示踪剂在管道中的流动情况，如在油箱或管道中，示踪剂在管道中流动。

检测示踪剂在油中或水中流动，示踪剂在油中的流动。

示踪剂在管道中的流动，如在水或油中。示踪剂在管道中的流动，如在水或油中。
二、原子能的和平用途

核反应

铀235的裂变反应

铀235核裂变时，产生裂变碎片和中子，释放出大量的能量。这些中子可以引起更多铀235核裂变，导致链式反应（Chain Reaction），从而产生连续的能量释放。

铀235核裂变的反应方程式：

\[ ^{235}\text{U} + n \rightarrow ^{92}\text{Zr} + ^{141}\text{Kr} + 3n \]

大量的能量可以用来发电。

核反应释放出的能量可以用来发电。
APPENDIX 14

TEST IN ATOMIC PHYSICS
Assessment One (15 minutes)

1. The basic idea of the Rutherford-Bohr Model is that
   (1) the atom has some positively charged matter.
   (2) the atom is formed by a cloud of electrons.
   (3) the nucleus has electrons inside.
   (4) the atom has a structure similar to that of the solar system.
   (5) the electrons are moving in changing orbits.

2. According to J.J. Thomson,
   (1) atoms cannot be divided into smaller parts.
   (2) an atom is a neutral sphere consisting of some positively charged matter with electrons embedded in it.
   (3) inside an atom, there will be a nucleus with electrons all around.
   (4) electrons are located inside the nucleus.
   (5) alpha particles come out from the nucleus.

3. The number of protons in the nucleus of an atom is called
   (1) the mass number
   (2) the atomic number
   (3) the isotope number
   (4) the ionization number
   (5) the nuclear weight

4. The smallest unit of the element that can exist by itself and retain the same quality as the element is called a/an
   (1) atom
   (2) molecule
   (3) elementary particle
   (4) electron
   (5) nucleus

5. Uranium was first discovered as a radioactive element by observing its action in
   (1) affecting a covered photographic plate.
   (2) producing counts on a detector.
   (3) making tracks in a cloud chamber.
   (4) exploding a bomb.
   (5) speeding up a chemical reaction.

6. Refer to Figure 1, a representation of Bohr Atom.

6. X and Y are respectively
   (1) proton and neutron.
   (2) electron and proton.
   (3) nucleus and electron.
   (4) electron and nucleus.
   (5) neutron and electron.

7. X is composed of
   (1) protons only
   (2) neutrons only
   (3) protons and neutrons
   (4) neutrons and electrons
   (5) protons, neutrons and electrons
8. An electron from a hydrogen atom
   (1) is identical to an electron from another hydrogen atom.
   (2) has a greater mass than an electron from an oxygen atom.
   (3) is larger than an electron from a helium atom.
   (4) has a greater charge than an electron from a nitrogen atom.
   (5) is lighter than an electron from a chlorine atom.

9. The weakness of the J.J. Thomson Model is that
   (1) the total charge of electrons is incorrect.
   (2) the size of the atoms is incorrect.
   (3) the shape of the atom is incorrect.
   (4) each electron is surrounded by about the same amount of
   the other matter.
   (5) the number of electrons is equal to the number of the other
   particles.

10. Using the common convention, the element $^{21}_{21}X$ has
    (1) 21 protons and 66 electrons
    (2) 21 neutrons and 45 protons
    (3) 21 neutrons and 24 protons
    (4) 21 protons and 45 neutrons
    (5) 21 protons and 24 neutrons

11. The following table shows four nuclei P, Q, R and S with their
    mass numbers and atomic numbers:

    | Nucleus | Mass Number | Atomic Number |
    |---------|-------------|---------------|
    | I       | P           | 20            | 9             |
    | II      | Q           | 20            | 10            |
    | III     | R           | 21            | 11            |
    | IV      | S           | 22            | 10            |

    Which of the above is/are the isotope(s) of an element having
    a mass number 20 and an atomic number 10?
    (1) I, III and IV only
    (2) I and III only
    (3) II and IV only
    (4) I and IV only
    (5) III and IV only

12. A beam passes between two parallel plates is deflected as shown.
    From the picture, we can tell that the beam is composed of
    (1) electrons
    (2) protons
    (3) neutrons
    (4) gamma particles
    (5) alpha particles

13. When a very fast moving proton P approaches a stationary nucleus S,
    the path of P is likely to be
    (1) I
    (2) II
    (3) III
    (4) IV
    (5) V
14. An improvement of the Rutherford-Bohr Model over the J.J. Thomson Model and a weakness of the Rutherford-Bohr Model are that

1. the size of an atom is bigger but electrons and nucleus are not distinguishable.
2. electrons and nucleus are distinguishable but electrons are moving around the nucleus in fixed orbits.
3. the size of an atom is smaller but electrons are moving around the nucleus in fixed orbits.
4. electrons and nucleus are distinguishable but electrons are moving around the nucleus in changing orbits.
5. electrons and nucleus are distinguishable but electrons are moving around the nucleus in fixed orbits.

15. A beam of particles passes through a magnetic field. If the magnetic field is decreased to a low intensity, no apparent deflection or changes of the beam can be observed. If the magnetic field is increased to a very high intensity, the beam is widened to a small degree but still goes in the same direction. The above information indicates that the beam is composed of

1. neutrons only
2. alpha and beta particles
3. neutrons and a great number of electrons and protons
4. neutrons and a small number of electrons and protons
5. gamma particles
1. The symbol $^2_6^4\text{He}$ may be used for an α-particle because
   (1) it has 2 electrons and 4 nucleons.
   (2) it has 2 protons and 4 neutrons.
   (3) it has 2 neutrons and 4 protons.
   (4) it has 2 protons and 2 neutrons.
   (5) it has 2 electrons and 2 protons.

2. Biologists are trying to find out more about the metabolism of plants and animals through the use of
   (1) high-energy particle accelerators.
   (2) radio-isotopic tracers.
   (3) high power microscope.
   (4) X-rays.
   (5) α-decay.

3. Of the three common types of radiations, namely alpha, beta, and gamma, from radioactive sources, electric charge is carried by
   (1) β and γ only.
   (2) α and γ only.
   (3) α and β only.
   (4) β only.
   (5) α only.

4. The main reason why a neutron will penetrate a nucleus more readily than a proton is that the neutron is
   (1) slightly more massive.
   (2) moving faster.
   (3) moving slower.
   (4) uncharged.
   (5) unaffected by nuclear forces.

5. All EXCEPT ONE of the following statements are true. Which one is the exception?
   (1) Radioactivity is a natural characteristic of some elements.
   (2) Radioactivity isotopes can be produced artificially in the laboratory.
   (3) Radioactive isotopes decay by the emission of particles from the nuclei.
   (4) All isotopes are radioactive.
   (5) There is a wide variety of decay rates for radioactive elements.

6. When the nucleus $^{231}_{91}\text{Pa}$ becomes $^{227}_{93}\text{Ac}$, it has undergone
   (1) an α-decay.
   (2) a β-decay.
   (3) a γ-decay.
   (4) a collision with neutrons.
   (5) a capture of 1 neutron and then a release of 1 proton.

7. A radioactive atom emits a β-particle. What happens to the mass number of the atom?
   (1) It increases by 1.
   (2) It remains unchanged.
   (3) It decreases by 1.
   (4) It decreases by 2.
   (5) It decreases by 4.
8. The half-life of a certain radioactive isotope is 3 seconds. Starting with \( N \) active atoms:

I. there will be \( N/8 \) active atoms remained after 9 seconds
II. there will be \( N/16 \) active atoms remained after 18 seconds
III. three-quarters of the active atoms will have decayed after 6 seconds
IV. there will be \( N/32 \) active atoms remaining after 21 seconds

Which of the above statements is/are correct?

(1) I only
(2) II only
(3) III only
(4) I, II and IV only
(5) I, II, III and IV

9. An unstable element \( X \) decays into a stable element \( Y \) with a half-life of 3 days. On 1st March, a piece of \( X \) has a mass of 10 g. What will be the masses of \( X \) and \( Y \) 6 days later?

<table>
<thead>
<tr>
<th>Mass of ( X )</th>
<th>Mass of ( Y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>5 g</td>
<td>5 g</td>
</tr>
<tr>
<td>10 g</td>
<td>0 g</td>
</tr>
<tr>
<td>0 g</td>
<td>10 g</td>
</tr>
<tr>
<td>2.5 g</td>
<td>7.5 g</td>
</tr>
<tr>
<td>7.5 g</td>
<td>2.5 g</td>
</tr>
</tbody>
</table>

10. When a chain reaction takes place in \( U^{235} \), each nucleus breaks into two parts during fission and also releases

(1) one neutron and one proton
(2) one proton
(3) one neutron
(4) more than 1 neutron
(5) more than 1 proton

11. The age of an old tree is found by burning the tree ashes and counting the number of radioactive \( C^{14} \) nuclei detected to be 8 millions. From the decay graph of \( C^{14} \) given on the left, the age of the old tree being tested is found to be

(1) 5,600 years
(2) 11,200 years
(3) 16,800 years
(4) 22,400 years
(5) 28,000 years

12. Some radioactive isotopes have to be injected into a patient's vein to investigate his blood circulation. In the list of radio-isotopes given, choose the one you think is the most suitable

(1) \( X \) of half-life 10 seconds
(2) \( Y \) of half-life 1 hour
(3) \( Z \) of half-life 10 days
(4) \( P \) of half-life 1 year
(5) \( Q \) of half-life 10 years
13. An atom with mass number $A$ and atomic number $Z$ decays in three stages by the emission of an $\alpha$-particle, a $\beta$-particle and a second $\beta$-particle. It then becomes an isotope of the same element with mass number

1. unchanged
2. equals $A - 1$
3. equals $A - 2$
4. equals $A - 3$
5. equals $A - 4$

14. Which of the following might be the products of the fission of a nucleus of $^{235}_{92}U$ after the nucleus has absorbed a neutron?

1. $^{16}_0e + ^2_0He + ^9_5Fr$ (where $^1_0e$ represents an electron and $^0_1n$ represents a neutron).
2. $^{82}_{32}Se + 5^2_{16}He + 7^0_0n$
3. $^{4}_1H + ^9_3Np$ (where $^1_1H$ represents a proton)
4. $^2_4He + ^90_{27}Th$ (where $^2_4He$ represents a helium nucleus)
5. $^{38}_{18}Sr + ^4_{20}He + ^6_{0}n$

15. Imagine that a new isotope of lithium (Li) with atomic number 3 and mass number 5 has been discovered among the radiations emitted from radioactive plutonium (Pu). Which one of the following nuclear equations correctly describe its emission from a $^{239}_{94}Pu$ nucleus?

1. $^{94}_{94}Pu \rightarrow ^{16}_{0}e + ^2_{0}He + ^9_5Fr$ (where $^1_0e$ represents an electron and $^0_1n$ represents a neutron).
2. $^{94}_{94}Pu \rightarrow ^3_{1}Li + ^9_5Fr$
3. $^{94}_{94}Pu \rightarrow ^3_{1}Li + ^9_5Fr$
4. $^{94}_{94}Pu \rightarrow ^5_{2}Li + ^89_3Ac$
5. $^{94}_{94}Pu \rightarrow ^5_{2}Li + ^9_5Fr$

Questions 16 - 17

A radium source that emits $\alpha$, $\beta$ and $\gamma$ radiations simultaneously is put in an evacuated box. The radiation coming from the small lead cavity then forms a narrow beam which passes between two charged metal plates as shown in the diagram. When the photographic plate is developed, 3 spots labelled P, Q and R are obtained.

16. Which are the radiations responsible for each of the spots?

<table>
<thead>
<tr>
<th>Spot P</th>
<th>Spot Q</th>
<th>Spot R</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\alpha$</td>
<td>$\beta$</td>
<td>$\gamma$</td>
</tr>
<tr>
<td>$\beta$</td>
<td>$\gamma$</td>
<td>$\beta$</td>
</tr>
<tr>
<td>$\gamma$</td>
<td>$\alpha$</td>
<td>$\beta$</td>
</tr>
<tr>
<td>$\beta$</td>
<td>$\alpha$</td>
<td>$\gamma$</td>
</tr>
</tbody>
</table>
17. If more positive charge is put on the positive plate and more negative charge on the negative plate, what will happen to the spots?

<table>
<thead>
<tr>
<th>Spot P</th>
<th>Spot Q</th>
<th>Spot R</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) shifts more to the right</td>
<td>shifts more to the right</td>
<td>shifts more to the right</td>
</tr>
<tr>
<td>(2) shifts slightly to the right</td>
<td>remains unchanged</td>
<td>shifts slightly to the left</td>
</tr>
<tr>
<td>(3) shifts more to the left</td>
<td>remains unchanged</td>
<td>shifts more to the right</td>
</tr>
<tr>
<td>(4) shifts slightly to the right</td>
<td>shifts to the right</td>
<td>shifts more to the right</td>
</tr>
<tr>
<td>(5) shifts more to the left</td>
<td>shifts to the right</td>
<td>shifts slightly to the left</td>
</tr>
</tbody>
</table>

Questions 18 - 19

An analogy has been drawn between the decay rate in a radioactive decay and the flow of water through the system. In a radioactive sample, the decay rate (i.e., the rate of breaking down of unstable atoms) is proportional to the number of unstable atoms present. Similarly, the rate of water flow is also proportional to the height of the water level above the outlet.

![Diagram](image)

The diagrams above show tanks of different cross-sectional areas and are all drained by identical capillary tubes.

18. The half-life period of the water in tank Q would be

I. half of the time spent by a water molecule inside Q's capillary tube
II. the time taken for the water level to fall to half of its original value
III. half of the time required to drain all the water in the tank

(1) Only I is correct
(2) Only II is correct
(3) Only III is correct
(4) Only I and III are correct
(5) Only II and III are correct

19. In this analogy, the height of the water level corresponds to the number of unstable atoms, while the rate of water flow corresponds to the rate of decay. This analogy is not a good analogy because

I. the half-life of the tanks are different even if the initial heights of the water levels are the same
II. the half-life of the tank does not only depend on the height of the initial water level but also on the cross-sectional area
III. the capillary tube where the water flows out is too small so that the half-life is too long.

Which of the above reasons is/are correct?

(1) I only
(2) II only
(3) II and III only
(4) I and II only
(5) III only
20. Which of the following processes do you think will be most effective if some radioactive isotopes are used as means of investigation?

I. The investigation of water flow in a river
II. The research on mineral absorption in a plant
III. The investigation of traffic congestion in a bell-way.

Which of the above statements is/are correct?

(1) I only
(2) II only
(3) I and II only
(4) II and III only
(5) I, II and III only.
測驗一：第一、第二課（15分鐘）

1. 原子模型

   (1) 原子中有一些帶正電的物質
   (2) 原子是由一團電子組成
   (3) 原子的構造類似我們的太陽系
   (4) 原子核內藏有全部電子
   (5) 電子在原子核外的軌道行走

2. 原子模型

   (1) 原子是不可分割的微粒
   (2) 原子是一個中和的球體，由一些帶正電的物質組成，而電子則圍繞在其中
   (3) 原子內有一顆被電子包圍的原子核
   (4) 電子是在原子核內
   (5) α—粒子是從原子核中射出來的

3. 原子核內質子的數目被稱為

   (1) 質量數
   (2) 原子序數
   (3) 同位素數
   (4) 游離數
   (5) 核子重量

4. 最小而仍能保留其元素之特性的粒子稱為

   (1) 原子
   (2) 分子
   (3) 基本粒子
   (4) 電子
   (5) 核子

5. 科學家發現铀具有放射性，最初他們發現铀能以

   (1) 原子
   (2) 原子
   (3) 原子
   (4) 原子
   (5) 原子

   (2) 使放射計時器出現讀數
   (3) 在雲霧室中產生霧跡
   (4) 發生核爆
   (5) 加速化學作用
6-7 参照圖一，其代表一個波爾模型的原子图一

6. 圖中所示，X和Y分別代表
   (1) 質子和中子
   (2) 電子和質子
   (3) 原子核和電子
   (4) 電子和原子核
   (5) 中子和電子

7. 圖中之X是由何種粒子組成?
   (1) 質子和電子
   (2) 電子和中子
   (3) 質子和中子
   (4) 中子和電子
   (5) 質子、中子和電子

8. 氫原子中的電子
   (1) 與另一氫原子中的電子本質上是相同的
   (2) 其質量應大於氧原子中的電子
   (3) 其體積應大於氧原子中的電子
   (4) 所帶的情荷應比氧原子中的電子所帶者為多
   (5) 其重量應較氧原子中的電子為輕

9. 湯姆遜原子模型之弱點是
   (1) 全部電子的總電荷是不正確的
   (2) 原子的大小是不正確的
   (3) 原子的形狀是不正確的
   (4) 每一駐電子是由均數量相同的其他物質環繞著
   (5) 電子的數目是等於其他粒子的數目
10. 根據慣用的符號表示某元素 X，共有
(1) 21 鎂質子和 66 鎂中子
(2) 21 鎂中子和 45 鎂質子
(3) 21 鎂中子和 24 鎂質子
(4) 21 鎂質子和 45 鎂中子
(5) 21 鎂質子和 24 鎂中子

11. 下列為四個不同的原子核 P, Q, R 和 S 及其質量數和原子序數．

<table>
<thead>
<tr>
<th>原子核</th>
<th>質量數</th>
<th>原子序數</th>
</tr>
</thead>
<tbody>
<tr>
<td>P</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>Q</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>R</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>S</td>
<td>22</td>
<td>10</td>
</tr>
</tbody>
</table>

現有一元素 X，其質量數為 20 及原子序數為 10．試找出以上哪些原子核 X 元素是 X 的同位素？

(1) 試用 I, Ⅱ和 Ⅲ
(2) 試用 I 和 Ⅲ
(3) 試用 Ⅱ和 Ⅲ
(4) 試用 I 和 Ⅱ
(5) 試用 Ⅲ和 Ⅲ

12. 一束粒子射線通過兩塊帶電的板時，其轉向如圖示．這束粒子應是

(1) 電子
(2) 質子
(3) 中子
(4) 原子核
(5) α - 粒子

13. 當一粒高能移動的質子 P 接近一個停留不動的原子核 S 時，P 應循圖中那一路往移動？

(1) I
(2) Ⅱ
(3) Ⅲ
(4) Ⅱ
(5) Ⅲ
14. 廣德福—波爾模型與湯姆遜模型改進的一個地方及廣德福—波爾模型的一個弱點是
(1) 原子的體積較大, 但電子與原子核分不開.
(2) 電子與原子核分開, 但電子繞原子核在固定的軌道上移動.
(3) 原子的體積較小, 但電子繞原子核在固定的軌道上移動.
(4) 電子與原子核分開, 但電子繞原子核在不固定的軌道上移動.
(5) 電子與原子核分開, 但電子繞原子核在固定的軌道上移動.

15. 一束粒子通過磁場, 若磁場的強度降低至很低, 我們觀察不到這束粒子產生偏向或其他的變化. 若磁場的強度升至很高, 這束粒子作有限度的擴大, 並仍舊依照同樣的方向前進, 基於以上的情況, 這束粒子是由下列那些粒子組成?
(1) 為中子
(2) α 和 β 粒子
(3) 中子及數量很少的電子和質子
(4) 中子及數量很少的電子和質子
(5) γ 粒子
測試二：第三第四課（80分鐘）

1. 4\(^4\)He 來代表\(\alpha\)粒子的原因是因為
   (1) 它有兩粒質子和四粒核子
   (2) 它有兩粒中子和四粒質子
   (3) 它有兩粒中子和四粒質子
   (4) 它有兩粒中子和四粒質子
   (5) 它有兩粒中子和四粒質子

2. 為了研究更多有關動態的新陳代謝作用，生物學家便應用
   (1) 高速粒子加速器
   (2) 伽利略射線同位素示蹤劑
   (3) 高倍顯微鏡
   (4) X-射線
   (5) X-衰變

3. 當放射性物質發出的放射有\(\alpha\), \(\beta\)和\(\gamma\)三種。電荷是由那一種或幾種攝射傳遞？
   (1) 只有\(\beta\)和\(\gamma\)兩種
   (2) 只有\(\alpha\)和\(\gamma\)兩種
   (3) 只有\(\alpha\)和\(\beta\)兩種
   (4) 只有\(\alpha\)一種
   (5) 只有\(\beta\)一種

4. 中子和質子更容易進入原子核內的原因是因為中子
   (1) 質量較小
   (2) 移動較快
   (3) 移動較慢
   (4) 沒有意電荷
   (5) 不受核外電荷影響

5. 下列各項中那一項不正確？
   (1) 放射性是某些元素的特質
   (2) 放射性同位素可在實驗室由人工製造
   (3) 常放射性同位素衰變後子由原子核內射出
   (4) 世上所有的同位素都具有放射性
   (5) 放射性元素有各種差異很大的放射率
6. 如要使原子核 $^{19}_{P}^{31}$ 变为 $^{27}_{A}^{31} A^{12}$，$^{31}_{P}^{31}$ 常经途径
(1) $\alpha$ - 衰变
(2) $\beta$ - 衰变
(3) $\gamma$ - 衰变
(4) 前中子碰核
(5) 吸收核 - 核中子后再放出 - 粒光子

7. 放射性原子放出 - 粒 $\beta$ - 核后，其半衰期数
(1) 数值增多
(2) 保持不变
(3) 数值减小
(4) 数值减少
(5) 数值减小

8. 某放射性元素的半衰期是三年，若这个元素最初有 $N$ 个活性原子，设

<table>
<thead>
<tr>
<th>时间</th>
<th>活性原子数</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>$N$</td>
</tr>
<tr>
<td>9 个月</td>
<td>$N/2$</td>
</tr>
<tr>
<td>18 个月</td>
<td>$N/4$</td>
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上述哪一种情况是正确的？
(1) 现象 I
(2) 现象 II
(3) 现象 III
(4) 现象 I、II 和 III
(5) 现象 II 和 III

9. 一个不稳定的元素 $X$ 衰变而另一个稳定的元素 $Y$，$X$ 之半衰期为三年，在三月一日，一块元素 $X$ 的质量为 10 克。经过六天后，$X$ 和 $Y$ 的质量分别为

<table>
<thead>
<tr>
<th>元素</th>
<th>质量</th>
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<tbody>
<tr>
<td>$X$</td>
<td>5 克</td>
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<tr>
<td>$Y$</td>
<td>5 克</td>
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(2) 10 克 0 克
(3) 0 克 10 克
(4) 2.5 克 7.5 克
(5) 7.5 克 2.5 克
10. 鈾铀 $^{38}U$ 發生裂變反應時，其原子核分裂為兩部份，並放出
(1) 一粒中子和一粒質子
(2) 一粒質子
(3) 一粒中子
(4) 多於一粒中子
(5) 少於一粒質子

11. 一棵老樹的年輪可以探測放射性元素碳$^{14}$（$^{14}C$）的衰變數量。每千百萬年裡，$^{14}C$ 的原子核會因核反應而減少。從下列碳$^{14}$的衰變圖中，這棵樹的年輪是
(1) 5,600 年
(2) 11,800 年
(3) 16,800 年
(4) 22,400 年
(5) 28,000 年

12. 為了探測人體內血液的流動狀態，醫生可將某些放射性同位素注射入病人体內。下列哪一種同位素最適合運用？
(1) 半衰期為十微秒之$^{41}Ag$元素
(2) 半衰期為一秒之$^{22}$Na元素
(3) 半衰期為十小時之$^{137}Ba$元素
(4) 半衰期為十天之$^{85}Sr$元素
(5) 半衰期為十週之$^{90}Sr$元素
13. 一個質子數為\( A \)和原子序數為\( Z \)的原子接連經過了三次變化：第一次射出一樁\( \alpha \)粒子，第二次射出一樁\( \beta \)粒子，第三次再射出一樁\( \gamma \)粒子。衰變後，產生了一個相同質量的同位素，其質子數為

(1) 不變
(2) 等於 \( A+1 \)
(3) 等於 \( A+2 \)
(4) 等於 \( A-1 \)
(5) 等於 \( A+4 \)

14. 一個核\( _{92}^{235}\text{U} \)的原子核吸收了一樁中子後發生裂變，下列哪一項是裂變後可能產生的結果？

(1) \( 2^1 + _2^4\text{He} + _{92}^{232}\text{U} \)
(2) \( _{82}^{208}\text{Pb} + 5 + _2^4\text{He} + 7 \text{e}' \)
(3) \( _1^0\text{e} + _{93}^{238}\text{Np} \)
(4) \( _1^0\text{e} + _{94}^{239}\text{Th} \)

(5) \( _{38}^{86}\text{Sr} + 4\text{e}' + _{10}^{19}\text{Ne} + 6 \text{e}' \)

\( \text{\( \hat{e} \)：\( _1^0\text{e} \)為電子，\( \text{e}' \)為中子) \)

15. 假設從放射性元素鈾\( (\text{plutonium}) \)射出的輻射中發現原子序數為\( 3 \)和質量數為\( 5 \)而屬於鈾系（\text{lithium}) 的一種新同位素。下列那一種核子反應式能正確地表示從\( _{94}^{239}\text{Pu} \)原子核中射出的放射現象？

(1) \( _{94}^{239}\text{Pu} \rightarrow _3^5\text{Li} + _{94}^{239}\text{Pu} \)
(2) \( _{94}^{239}\text{Pu} \rightarrow _3^5\text{Li} + _{95}^{242}\text{K} \)
(3) \( _{94}^{239}\text{Pu} \rightarrow _3^5\text{Li} + _{94}^{239}\text{Pu} \)
(4) \( _{94}^{239}\text{Pu} \rightarrow _3^5\text{Li} + _{91}^{236}\text{Ac} \)
(5) \( _{94}^{239}\text{Pu} \rightarrow _5^5\text{Li} + _{93}^{234}\text{Pu} \)
16. 這三處斑點分別由何種輻射激發產生？

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<th>Q</th>
<th>R</th>
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<td>(1)</td>
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<td>β</td>
<td>R</td>
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<td>(2)</td>
<td>x</td>
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<td>(3)</td>
<td>β</td>
<td>β</td>
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<td>(4)</td>
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<td>(5)</td>
<td>β</td>
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17. 若我們增加伽瑪全衰能度，理論上會又更多正電荷，戴荷正電的一片會選哪片電？這些三處斑點會有何變化？

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<td>(1)</td>
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<td>稍偏右</td>
<td>更偏右</td>
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<tr>
<td>(2)</td>
<td>指偏左</td>
<td>不變</td>
<td>指偏左</td>
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<td>(3)</td>
<td>指偏左</td>
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<td>指偏左</td>
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<td>(4)</td>
<td>更偏左</td>
<td>指偏右</td>
<td>更偏右</td>
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<tr>
<td>(5)</td>
<td>指偏左</td>
<td>不變</td>
<td>指偏左</td>
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18-19. 我們每一個水流接觸到達水位處會發生放射性衰變。衰變率為不穩定原子的分裂速率。一個放射性衰變率要決定其存在不穩定原子的數目成正比。因此，水流速度越高，水位較高的水位高度成正比。

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以上各圖乃為三個不同接觸面之水箱，各有一同等的細水管接在其出水處。

18. 水種 A 與水的半衰期為 
工. 水分子在水箱 A 的細水管內逗留時間之一半 
工. 水箱 B 水位降至原本水位高度的一半所需時間之一半

對於上述之解釋，以下何者是對的？
(1) 物質工是對的。
(2) 物質工和工是對的。
(3) 物質工和工是對的。
(4) 物質工和工是對的。
(5) 物質工和工是對的。

19. 就這個比喻而言，水位高度相鄰於不穩定原子的数目並
且水流速率相鄰於衰變率。這個比喻並不破滅。其原因是 
工. 水箱 B 水位的高度若相同，水箱的半衰期皆不一樣
工. 水箱 C 的半衰期不等於由原来的水位高度去決定，亦要由水箱的接觸面大小去決定。

且水箱 A 和 B 的細水管太細，因而水管的半衰期便太長了。

對於上述的三個解釋，下列那一項是正確的？
(1) 均有工
(2) 均有工和工
(3) 均有工和工
(4) 均有工和工
(5) 均有工
若使用放射性同位素作研究的工具，你认为下列哪项或哪项最具有效性？

工. 研究河水之流动
甲. 研究植物对矿物质之吸收
乙. 研究上班时交通之塞

(1) 仅 (甲) 有效
(2) 仅 (乙) 有效
(3) 仅 (甲) 和 (乙) 有效
(4) 仅 (甲) 或 (乙) 有效
(5) 工, 甲, 乙, 和 甲
ENGLISH TEST I
LISTENING COMPREHENSION

Time—40 minutes

In this section of the test, you will have an opportunity to demonstrate your ability to understand spoken English. There are three parts to this section, with special directions for each part.

PART A

DIRECTIONS: There are two kinds of problems in Part A. One kind is answering a short question; the other is understanding a short statement. These questions and statements will be spoken just one time. They will not be written out for you, so you will have to listen carefully in order to understand what the speaker says.

When you hear a question, read the four possible answers in your test book and decide which one would be the best answer to the question you have heard. Then, on your answer sheet, find the number of the problem and fill in (blacken) the space that corresponds to the letter of the answer you have chosen.

Look at Example I.

Sample Answer

You will hear: When did Tom come here?

You will read: (A) By taxi. (B) Yes, he did. (C) To study history. (D) Last night.

The best answer to the question, "When did Tom come here?" is (D), "Last night." Therefore, you should choose answer (D).

Then you hear a statement, read the four sentences in your test book and decide which one best gives the meaning of the statement you have heard. Then, on your answer sheet, find the number of the problem and mark your answer.

Look at Example II.

Sample Answer

You will hear: James relaxed with a sigh of relief when he heard the news.

You will read: (A) The news was very disappointing. (B) The news made James very sad. (C) The news was better than expected. (D) The news made James extremely nervous.

Sentence (C), "The news was better than expected," is closest in meaning to the sentence "James relaxed with a sigh of relief when he heard the news." Therefore you should choose answer (C).

PART A

1. (A) He's studying. (B) He spends more time teaching. (C) He studies longer than I do. (D) I study more time than he does.

2. (A) Henry's a baker. (B) Henry's a drummer. (C) Henry's at the door. (D) Henry's a batter.

3. (A) She is a banker. (B) She is a merchant. (C) She is a teacher. (D) She is a chemist.

4. (A) The magazines are in the basket. (B) The magazines are on the floor. (C) The magazines are on the table. (D) This is about furniture.
5. (A) I like monkeys but not lions.
    (B) I like cats but not lions.
    (C) I like lions but not cats.
    (D) I like lions but not monkeys.

6. (A) It’s only eleven o’clock.
    (B) It’s time for lunch.
    (C) Our lunch time is ten o’clock.
    (D) I’m hungry but it’s too early for lunch.

7. (A) The blue car is not worth buying.
    (B) The green car is expensive.
    (C) Both cars are expensive.
    (D) The green car is cheaper than the blue car.

8. (A) She arrived at 11:00.
    (B) She arrived at 11:30.
    (C) She arrived at 12:00.
    (D) She arrived at 12:30.

9. (A) The two girls are standing there.
    (B) They’re not relatives.
    (C) The two girls are relatives.
    (D) They are sisters.

10. (A) Dorothy was late for the train.
     (B) Dorothy was trying to catch the train.
     (C) The train had left before Dorothy came.
     (D) Dorothy made them late for the train.

11. (A) Bob always makes girls nervous.
     (B) The girls before Bob are always nervous.
     (C) Girls always make Bob nervous.
     (D) Both the girl and Bob are nervous.

12. (A) We’re on diet.
     (B) We eat more than we usually do.
     (C) We don’t eat very much, for we take vitamin pills.
     (D) It is important to care for the balance of our diet.

13. (A) Ten days ago, the people were trying to leave the town.
     (B) The flood made fifty families homeless.
     (C) I was by the river ten days ago.
     (D) The river was situated near the town.

14. (A) They went on honeymoon right away.
     (B) They did go on honeymoon immediately after their wedding.
     (C) They spent a week having honeymoon.
     (D) They went on their honeymoon a week after their wedding.

15. (A) Jean was too busy to go shopping.
     (B) Jean’s sister has no time to buy dresses.
     (C) Jean and her sister have a lot of time to spend.
     (D) Jean wasn’t a good buyer of dresses like her sister.

16. (A) The monkey made fun of Laura.
     (B) Laura’s monkey couldn’t dance.
     (C) Her monkey made funny faces.
     (D) The monkey danced and laughed.

17. (A) She decides to stop smoking, because cigarettes are harmful.
     (B) She’s afraid of gaining weight if she quits smoking.
     (C) She doesn’t like to gain weight.
     (D) She’s not aware of the consequences of smoking.

18. (A) Mr. Scott didn’t come.
     (B) Mr. Scott attended the meeting.
     (C) Mr. Scott almost attended all meetings.
     (D) Mr. Scott was late for the meeting.

19. (A) Nobody was missing.
     (B) Several people were missing.
     (C) One person couldn’t be found.
     (D) Several people couldn’t be found.
20. (A) He left after he got all the answers.
(B) He left as soon as he asked him all the questions.
(C) Nobody answers Eddie's questions.
(D) He left after he answered all the questions.

PART B

DIRECTIONS: In Part B you will hear fifteen short conversations between two speakers. At the end of each conversation, a third voice will ask a question about what was said. The question will be spoken just one time. After you hear a conversation and the question about it, read the four possible answers and decide which one would be the best answer to the question you have heard. Then, on your answer sheet, find the number of the problem and mark your answer.

Look at Example 1:

You will hear:

(man) Hello, Mary. This is Mr. Smith at the office. Is Bill feeling any better today?

(woman) Oh, yes, Mr. Smith. He's feeling much better now. But the doctor says he'll have to stay in bed until Monday.

(third voice) Where is Bill now?

You will read: (A) At the office. (B) On his way to work. (C) Home in bed. (D) Away on vacation.

From the conversation, we know that Bill is sick and will have to remain in bed until Monday. The best answer, then, is (C), "Home in bed." Therefore, you should choose answer (C).

PART B

21. (A) At the department store
(B) At the church
(C) In the garden
(D) At the grocery

22. (A) He doesn't have any money to buy the lamp
(B) He has a lot of money to buy the lamp
(C) If he lends her money, she will buy the lamp
(D) If she lends him money, he can buy the lamp

23. (A) Repairman
(B) Taxi driver
(C) Salesman
(D) Car dealer

24. (A) 10 A.M.
(B) 12 A.M.
(C) 2 P.M.
(D) 4 P.M.

25. (A) He's going to find an apartment
(B) He's helping his brother look for an apartment
(C) He already found an apartment
(D) He's looking for an apartment with a girl.

26. (A) The big parties are more impersonal than small ones.
(B) She likes big parties better
(C) She likes small parties
(D) The party is nonsense.

27. (A) He is satisfied with driving from his home to work
(B) The distance is about 20 miles
(C) The road is good but there's a lot of traffic
(D) He lives very far from his work.
28. (A) The temperature dropped below freezing  
(B) It was mild until the early winter last year  
(C) It was very cold  
(D) It was very hot during summer time.

29. (A) 50¢  
(B) $2.00  
(C) $2.50  
(D) $3.00

30. (A) $19,500  
(B) $22,000  
(C) $25,000  
(D) $40,000

31. (A) The story was sold.  
(B) The movie was a hit.  
(C) Reading books is more entertaining.  
(D) The photographer was good.

32. (A) Children have already left for their grandmother's home  
(B) Children will leave for their grandmother's home  
(C) Children will leave for their grandmother's after school  
(D) Children will play with their grandmother in the school.

33. (A) She's careless  
(B) She likes George very much  
(C) She's not concerned with George's health  
(D) She doesn't care what George said.

34. (A) He hears well  
(B) He hears poorly  
(C) He's deaf  
(D) He's dead.

35. (A) There's another cat  
(B) He never lessons the dog  
(C) She has mistaken it for his dog  
(D) The dog likes to walk on the leash.

PART C

36. (A) Declined  
(B) Depleted  
(C) Limited  
(D) Unlimited.

37. (A) Because it is important for food resources  
(B) Because the food fisherries are to be exhausted  
(C) Because the food biologist insisted on it  
(D) Because fishes are fewer than Indian Tigers.

38. (A) Europe and Asia  
(B) The whole world  
(C) Asia and America  
(D) America.

39. (A) The land and the air  
(B) Important species for conservation  
(C) Indian Tigers and the American Eagle  
(D) The Siberian Tiger.

40. (A) The Indian Tiger and the American Eagle are important  
(B) None of the great sea fisheries are to be exhausted  
(C) Fish supply has no effects on people  
(D) Sea resources are important to people.

41. (A) The resources of the sea were unlimited  
(B) The threats to animals and birds  
(C) Sea resources will continue as important food supplies  
(D) We must love fishes.
42. (A) Paris
   (B) Copenhagen
   (C) New York
   (D) London.

43. (A) 1
   (B) 2
   (C) 3
   (D) Never.

44. (A) London and Paris
   (B) U.S.A.
   (C) Paris
   (D) Paris and Copenhagen.

45. (A) The Natural Gas Company
   (B) Fuel Shortage
   (C) The Gas Industries
   (D) A warm winter.

46. (A) It was very cold
   (B) It had snows
   (C) It was a little cold
   (D) It was unusually warm.

47. (A) Curiosity about canned sea food
   (B) Sincerity and Persuasion
   (C) Anger about canned sea food
   (D) Ordering canned sea food.

48. (A) Toxic and poison
   (B) A clear crystalline substance
   (C) Chips of glass
   (D) Sea food.

49. (A) Boil them in water
   (B) Boil them in warm vinegar
   (C) Throw them away
   (D) Eat them.

50. (A) Complain to the Federal Food and Drug Administration
   (B) Ask for refunding of your money from the canner
   (C) Place them in vinegar for a few minutes
   (D) Let the particles dissolve.
1. "Elizabeth borrowed the book a month ago."
   "Then she should _____ it by now."
   (A) to finish   (B) have finished
   (C) finish        (D) had finished

2. "Are those men in the blue uniforms policemen?"
   "Oh, no; they're _____"
   (A) bus drivers   (B) buses drivers
   (C) bus driver    (D) buses driver

3. "I'm very tired."
   "We really should stop _____ and go to bed."
   (A) to study   (B) from studying
   (C) of studying  (D) studying

4. "I like Mary's parents very much."
   "_____"
   (A) So I do   (B) I do so
   (C) So do I    (D) I do so

5. "That's a beautiful table cloth."
   "Yes, but it's not _____ for this table."
   (A) nearly enough long   (B) nearly so long
   (C) nearly long enough  (D) so nearly long

6. "How did you get your car out of the ditch?"
   "_____ it."
   (A) Push   (B) Having pushed
   (C) From pushing  (D) By pushing

7. "I got twenty-five problems wrong on that maths test last week."
   "Well, take your time on this one and you'll probably make _____ mistakes."
   (A) not much (B) fewer           (D) very little
   (C) lesser

8. "How many from your team entered the contest?"
   "_____ but one."
   (A) All   (B) Any
   (C) Some    (D) Many

9. "I can't see the blackboard very well."
   "Perhaps you need _____ "
   (A) to examine your eyes   (B) to have your eyes examined
   (C) to have examined your eyes  (D) to be examined your eyes

10. "I like your new typewriter very much."
    "I bought it because it was _____ yours."
    (A) like    (B) similar of
    (C) like as    (D) as

11. "Will the committee meet during vacation?"
    "No, I suggested that a meeting _____ at some other time."
    (A) holds     (B) is holding
    (C) be held    (D) hold
12. "How did Carl get the nickname of 'Quacker'?"
   "Because he ____ ducks when he was a child."
   (A) had been imitating  (B) has imitated
   (C) was imitating  (D) used to imitate.

13. "Wasn't Joan supposed to be here by now?"
   "Don't worry. She'll be here ____ twenty minutes."
   (A) by at least  (B) around
   (C) at nearly  (D) in about

14. "I wonder how old Mrs. Clark is."
   "She won't tell her age, and ____.
   (A) so won't her sister  (B) her sister won't, too
   (C) neither will her sister  (D) either won't her sister

15. "Mr. Smith said we could ride to Miami with him."
   "Are you going to take advantage ____ his offer?"
   (A) of  (B) with
   (C) by  (D) to

16. "Can't you have more meat?"
   "No, thanks. I've had ____ enough already."
   (A) beyond  (B) more than
   (C) greater than  (D) plenty

17. "Where would your grandfather live if he retired?"
   "He'd have a little place beside the water if he ____ it."
   (A) could have afforded  (B) would afford
   (C) could afford  (D) would have afforded

18. "Will the child recover?"
   "Right now, there's no way ____ ."
   (A) for knowing  (B) to have known
   (C) of knowing  (D) to be known

19. "Do you want to see my driver's license or my passport?"
   "Ch, ____ ."
   (A) either does well  (B) either one will do
   (C) each one is good  (D) each will be fine

20. "Have you gone to see the doctor?"
   "No, but ____ ."
   (A) I go  (B) I'm going to see
   (C) I go to see  (D) I'm going to /

21. "Is Dave about ready?"
   "Yes, he's ____ ."
   (A) finished dressing nearly  (B) finishing nearly dressing
   (C) nearly finished dressing  (D) nearly finishing dressing

22. "I like toast very much."
   "That's good, because ____ is dry."
   (A) the most of the bread  (B) almost whole of the bread
   (C) the nearly all bread  (D) almost all the bread
23. "I can't imagine how they could put on that play in high school."
"They chose the best scenes, ___ out everything that was unsuitable."
(A) and were left (B) left
(C) and leave (D) leaving

24. "Mr. Wilson is expected back at noon."
"Would you have him ___ then, please?"
(A) calling me (B) call me
(C) to calling me (D) called me

25. "Jack plays the piano beautifully."
"Yes, he's ___ here."
(A) the most talented of any students
(B) the more talented student than any other
(C) more talented than any other student
(D) most talented of students

26. "Are you sure there's nothing wrong with this radio?"
"Well, all of the parts seem to be ___.
(A) in working order (B) in order of working
(C) in work order (D) in order of work

27. "The Calhouns have just moved into a larger apartment."
"Did they have to buy ___ for it?"
(A) many new furniture (B) much new furniture
(C) many new furnitures (D) much new furnitures

28. "What did you say about the lawnmower?"
"I objected to ___.
(A) its price so high (B) it has such a high price
(C) its high price (D) it is high priced

29. "Were you ever able to give the Johnsons the message?"
"Yes, I finally succeeded ___ by phone."
(A) to reaching them (B) of reaching them
(C) to reach them (D) in reaching them

30. "What excuse did John offer for his rudeness at the committee meeting?"
"He didn't even mention it ___ explain it."
(A) let alone (B) and even not
(C) or not (D) as opposed to

31. "The Ryans watch television all the time."
"___ do the Tuckers."
(A) So (B) Either
(C) Neither (D) Also

32. "I can't understand what Peirce says."
"I know. That's because he speaks ___ English."
(A) a little (B) such small
(C) so little (D) very small
33. "I'm sorry. Were you speaking to me?"
   "Yes, I was. Would you please _____ in this room?"
   (A) not to smoke     (B) not smoke
   (C) no smoking       (D) no smoke

34. "Did you call Mr. Jackson?"
   "No, because he said he would rather not _____ disturbed this morning."
   (A) to be              (B) being
   (C) be                (D) been

35. "Do you know Edward Wilson?"
   "The name sounds familiar, but I don't remember _____ him."
   (A) that I meet       (B) meeting
   (C) to meet           (D) of meeting

36. "Did your club dance turn out well?"
   "Yes. We made a _____ profit."
   (A) five-hundred-dollar (B) five-hundred-dollars
   (C) five-hundreds-dollar (D) five-hundreds-dollars

37. "What's the matter with that picture on the wall?"
   "It needs _____ ."
   (A) straightening     (B) to be straightening
   (C) straightened      (D) straighten

38. "The market won't be open tonight."
   "If I _____ , I wouldn't have bothered to drive over here."
   (A) know              (B) known
   (C) would know        (D) had known

39. "Do you have a dictionary?"
   "No, but I wish I _____ ."
   (A) have              (B) did
   (C) do                (D) have had

40. "Michael left for California this morning."
   "Oh, I thought he _____ until next week."
   (A) won't be going    (B) isn't going
   (C) wasn't going      (D) hadn't been going
FORM ^

ENGLISH TEST III

Time - 15 minutes

1. He was the only ____ of the plane crash.
   (A) possessor (B) relic (C) survivor (D) finale
2. To repair or improve the appearance of something is to fix it ____.
   (A) cut (B) off (C) up (D) over
3. He ____ for stepping on Mary's foot.
   (A) admonished (B) apologized (C) ridiculed (D) humiliated
4. Because of a ____ engagement, Jean couldn't attend the party.
   (A) premature (B) prolific (C) prescribed (D) prior
5. The leaders decided to organize ____ in order to arouse the members of
   their party.
   (A) a rally (B) sensation (C) convey (D) an exercise
6. His ____ and experience make him an excellent person for this job.
   (A) competence (B) complacency (C) compensation (D) compunction
7. A new kind of machine made the old one ____.
   (A) outright (B) obstructed (C) outlandish (D) obsolete
8. To ask someone for help is to turn ____ him.
   (A) to (B) for (C) on (D) by
9. The balloon was ____ with air.
   (A) injected (B) infused (C) instilled (D) inflated
10. We can't understand Uncle George, for he always ____ whatever he says.
    (A) masters (B) molests (C) numbles (D) muzzles
11. To assist someone with something is to help him ____.
    (A) around (B) on (C) over (D) out
12. Mr. Robinson was very grateful and thanked us ____ though we had really
    done very little.
    (A) eminently (B) profusely (C) arrogantly (D) complacently
13. He used the stick as a ____ to keep the window open.
    (A) prop (B) slot (C) curb (D) plug
14. The vase ____ on the edge of the table, then fell to the floor with a
    crash.
    (A) wobbled (B) wheedled (C) wallowed (D) waddled
15. You haven't really answered the question, for what you said is not ____.
    (A) eligible (B) pertinent (C) provident (D) expeditious

PART B

16. not real
    (A) imaginary (B) incredible (C) insensible (D) unanimous
17. the state of being unoccupied, emptiness
    (A) seclusion (B) exile (C) vacancy (D) recess
18. a part of something
    (A) capsule (B) covenant (C) symptom (D) segment
19. to make sad
    (A) distort (B) deplore (C) depress (D) disdain
20. according to the law  
(A) conspicuous (B) temperate (C) sympathetic (D) legitimate

21. rapid movement back and forth  
(D) vibration (B) acceleration (C) emotion (D) versatility

22. the center or central part  
(A) cube (B) core (C) cult (D) core

23. warm and close friendship  
(A) pitty (B) frenzy (C) intimacy (D) enmity

24. to free someone from blame or guilt  
(A) absolve (B) exonerate (C) disengage (D) unfetter

25. to confuse  
(A) focus (B) bewilder (C) infect (D) accost

26. to describe or depict  
(A) survey (B) portray (C) behold (D) observe

27. useless, ineffectual  
(A) brazen (B) slugging (C) dire (D) futile

28. to bring back, to rescue  
(A) recede (B) retrieve (C) retrench (D) rescind

29. to pretend  
(A) feign (B) fuse (C) foil (D) fume

30. to pretend  
(A) feign (B) fuse (C) foil (D) fume

31. difficult to control  
(A) unbiased (B) uncanny (C) ungainly (D) unruly

32. a beginner  
(A) novice (B) nominee (C) novice (D) notary

33. to force  
(A) coerce (B) abash (C) efface (D) succumb

34. frankness of expression, sincerity  
(A) conviction (B) candor (C) innuendo (D) intimation

35. to demand certain conditions  
(A) excrete (B) invoke (C) postulate (D) stipulate

36. to explain, to make clear  
(A) elucidate (B) inculcate (C) infiltrate (D) explicate

37. a distressing or unfortunate situation  
(A) hazard (B) guise (C) plight (D) blotch

38. returning from time to time  
(A) repentant (B) recurrent (C) recessive (D) repugnant

39. an unexpected shock  
(A) clang (B) blast (C) jolt (D) snap

40. insignificant, worthless  
(A) paltry (B) minimum (C) stunted (D) compact

END OF PAPER
In 1686 a minister admitted that many people in New England wanted to see stage plays in spite of the strong opposition of the influential Puritan church. Interest in the drama grew slowly and unsteadily in America, but it persisted. By 1800, Thomas Bullfinch had designed an exquisite theater for Boston with rooms for dances, card games, and teas. Throughout the nineteenth century, playhouses were established in cities along the East Coast from New York to Charleston, South Carolina. Also, as people moved westward to settle new areas, temporary theaters were built in the young towns. In Columbus, Ohio, trees that were growing on a Monday would become timber for a theater by the following Thursday. In Natchez, Mississippi, a theater was built in a graveyard, and the audience could see bones beneath the stage. Shows were often presented in taverns and other public buildings.

Serious drama did not flourish very far from the East Coast, however. Many talented actors traveled around the country, but they could offer only light entertainment because travel was difficult and not much scenery or equipment could be carried over the rough western roads. But dramatic activity was so popular that a native form of light entertainment developed. In fact, even the humorous tale came to be presented theatrically, as the storyteller relied upon appearance, gesture, and manner of speaking for his dramatic effect.

1. According to the passage, a theater in Natchez was built in a
   (A) church      (B) tavern         (C) forest         (D) graveyard

2. Thomas Bullfinch was most probably
   (A) an actor     (B) an architect (C) a minister (D) a builder

3. According to the passage, most of the development of the theater took place
   (A) before 1700   (B) between 1700 and 1800
   (C) between 1800 and 1900 (D) after 1900

4. Which of the following factors contributed to the particular kind of native entertainment that developed?
   (A) The scarcity of good actors who would travel
   (B) The lack of popular interest in serious drama
   (C) Difficult traveling conditions in the American West
   (D) Opposition of the Puritan church to serious drama

5. The passage states that the theatrical productions of the American West developed in the form of
   (A) light entertainment  (B) humorous tales
   (C) casual songs         (D) serious drama

6. The author suggests that the Puritan church
   (A) could not prevent the building of theaters
   (B) tolerated only skilled actors
   (C) used the drama for religious purposes
   (D) could not discourage interest in the drama

7. The presence of rooms for dances, card games, and teas in the Boston theater shows that
   (A) other entertainment was more important than the plays
   (B) the church had a great deal of influence
   (C) the theater building was elaborate
   (D) Boston was an up-to-date city
The gorilla, called fiendishly fierce on the basis of reports from hunters and observers of captive animals, turns out to be quite agreeable in his own domain, according to zoologist George B. Schaller. Every ape is aware of his status in the group, says Dr. Schaller, so "there is rarely any strife beyond the occasional bickering which is apt to occur even among the most congenial companions." Averaging fewer than twenty animals, the gorilla social group always is dominated by a silver-backed older male, and members of the group seem to like their benevolent dictator. On down the line, males dominate females and female domicate juveniles. The social exchange is close and affectionate, "much like that of a happy human family with a polygamous mating system," Dr. Schaller observes.

As a captive, the gorilla has been described as introverted and phlegmatic. Dr. Schaller observed a range of emotions from hesitation and uneasiness to curiosity, boldness, and annoyance. Like humans, gorillas bite their lips when uncertain and frown when annoyed. The young throw tantrums when thwarted and, like human infants, are intensely curious. Dr. Duane Rumbaugh, who recently observed and tested a baby gorilla through its first year, found the animal attentive and persevering and judged that its exploratory behaviour equalled that of human infants.

8. Dr. Schaller reports that within the gorilla's social group
(A) each member knows who is more and who is less important
(B) there is strife when leadership is contested within the group
(C) each member has a chance to obtain the position of leader
(D) status is determined by the number of female and juvenile followers each male has

9. An interesting observation concerning gorillas is that
(A) their behaviour is just like that of human babies
(B) their emotions are more intense and erratic than man's
(C) they exhibit a range of emotions very similar to man's
(D) they more often exhibit uncertainty, annoyance, and curiosity than do men

10. In line 17, "thwarted" could be replaced correctly by
(A) hungry
(B) frustrated
(C) angry
(D) tired

11. According to the passage, within the gorilla social group, decisions are made by
(A) a group of the oldest males
(B) a consensus among the males
(C) one of the older males
(D) the strongest among the males

12. It appears that keeping a grown gorilla in captivity has the effect of
(A) behave like a human infant, frowning and having tantrums
(B) curious, attentive, and persevering
(C) less lively and less interested in things around him
(D) imitate adult humans

13. According to the author, in their natural habitat, gorillas are
(A) fiendishly fierce
(B) careful to fight only with members of their own social group
(C) more aggressive than members of their own social group
(D) likely to indulge in minor quarreling but are amiable on the whole

14. Apparently Dr. Shaller's work was important because he
(A) observed gorillas in situations that were natural to them
(B) discovered that gorillas are very much like human beings
(C) observed gorillas over a long period and found that they are just like human infants
(D) discovered that gorillas maintain a closeknit, well-organised social group
In the Mormon company, bugles sounded each morning at five. Two hours were allowed for breakfast and prayers. During the day, the company traveled in a close file, most of the men trudging beside the wagons, carrying weapons that were loaded and clearly visible. At night, the wagons were drawn into a tight circle — or a semicircle if the company camped on a river bank. Usually, the animals were pastured within the circle to keep them from roaming and falling prey to thieves. The men would retire for prayers by groups at eight-thirty, and they were expected to be settled by nine. Fifty of them had been appointed as guards, with twelve of these standing duty each half-night. At one time, while they were crossing the prairies, in Indian country, the company drove five wagons abreast.

24. How were the Mormons awakened each morning?
(A) By their appointed guards  (B) By light from the rising sun
(C) By a kind of trumpet  (D) By the calls of birds

25. The Mormons placed their wagons in a circle or a semicircle at night because this arrangement
(A) was a quick and convenient way to make camp
(B) helped to shelter the party from wind and rain
(C) was the most appropriate setting for their devotions
(D) gave them a kind of barricade or fort for protection

26. What seems to have been the Mormons' chief worry as they traveled?
(A) Hostile attacks  (B) God's displeasure
(C) Running out of food  (D) Losing their way

27. Which of the following adjectives would NOT describe the Mormons in the passage?
(A) Devout  (B) Disciplined
(C) Wary  (D) Helpless

28. In line 11, "prairies" could be correctly replaced by
(A) riverbeds  (B) flat, open lands
(C) deep valleys  (D) border territory

29. We can infer from the passage that, by carrying their weapons, the Mormon men hoped to
(A) prevent them from being stolen
(B) fight fatigue more easily
(C) discourage possible enemies
(D) travel faster

30. When they pastured their animals, what did the Mormons do with them?
(A) Gave them food and rest  (B) Provided them with shelter from the elements
(C) Allowed them to wander freely about  (D) Slaughtered and cooked them

31. When the eleven buffalo were added to the larder, they were added to the
(A) company's herd of animals  (B) hunting records of the men who brought them in
(C) company's store of food  (D) cooking pot
Every human being, no matter what he is doing, gives off body heat. The usual problem is how to dispose of it. But the designers of the Johnstown campus of the University of Pittsburgh set themselves the opposite problem - how to collect body heat. They have designed a collection system which utilizes not only body heat, but the heat given off by such objects as light bulbs and refrigerators as well. The system works so well that no conventional fuel is needed to make the campus's six buildings comfortable.

Some parts of most modern buildings - theaters and offices as well as classrooms - are more than amply heated by people and lights and sometimes must be air-conditioned even in winter. The technique of saving heat and redistributing it is called "heat recovery." A few modern buildings recover heat, but the University's system is the first to recover heat from some buildings and re-use it in others.

Along the way, Pitt has learned a great deal about some of its heat producers. The harder a student studies, the more heat his body gives off. Male students emit more heat than female students, and the larger a student, the more heat he produces. It is tempting to conclude that the hottest prospect for the Johnstown campus would be a hard-working, overweight male genius.

15. Until recently, body heat has caused problems because it:
   (A) was difficult to collect
   (B) came in a variety of forms
   (C) was difficult to get rid of
   (D) tended to be absorbed by physical objects

16. Which of the following is true of the heating system of the Johnstown campus?
   (A) The heat is supplied by human bodies only.
   (B) The heat is supplied by both human bodies and other heat-emitting objects.
   (C) The heat is supplied by both human bodies and conventional fuel.
   (D) The heat is supplied by human bodies, other heat-emitting objects, and conventional fuel.

17. At the Johnstown campus, how many of the buildings are heated entirely by the heat collection system?
   (A) none
   (B) Two
   (C) Four
   (D) Six

18. In line 7, "conventional" most nearly means
   (A) ordinary
   (B) powerful
   (C) electrical
   (D) extra

19. In line 10, "amply" most nearly means
   (A) partly
   (B) overly
   (C) warmly
   (D) adequately

20. The phrase "even in winter" (line 11) most nearly means
   (A) if the winter is especially warm
   (B) during all of the year except the winter
   (C) in the winter as well as in other seasons
   (D) during the evenings in the winter

21. In line 12, "heat recovery" refers to a
   (A) method of concealing the source of heat
   (B) special form of air conditioning
   (C) supplementary hot water system
   (D) way of reclaiming and re-using heat

22. According to the passage, which of the following would produce the LEAST amount of heat?
   (A) A fat female who studies hard
   (B) A thin female who does not study
   (C) A fat male who does not study
   (D) A thin male who studies hard

23. In line 19, the "hottest prospect" means the
   (A) most intelligent student
   (B) most desirable student
   (C) most diligent student
   (D) most obese student
1. It is often easier to select the best tool for a particular job than to use them correctly.

2. When a person accepts a dinner invitation, you are expected to arrive on time.

3. Today, divorce is no longer regarded as a disgrace, as a tragedy, or even as a failure.

4. Absurdly is one of the most prominent themes of twentieth-century European drama.

5. If the parents had attended the meeting, they could have discussed the problems with the principal himself.

6. It may be said that in some countries each of the citizens help to decide government policy.

7. When our neighbor's grandson caught his finger in the car door, he did not cry even though it must have hurt him a great deal.

8. The lawyer, Ben Burstine, he represented his case so successfully that the jury came to its decision within a short time.

9. A visit to the chateau includes sampling the wine, discussing its merits, and then, if you are fortunate, to have a chat with the marquis.

10. It may not have been the worse blizzard in history, but I do not want to be out in another one like it.

11. Japan has experienced a remarkable economic growing in the past decade.

12. He generally expresses himself more forceful than any of the members of the opposite party.

13. As a result from hearing the radio announcement, Craig has written to offer himself as a member of the panel for next week.

14. It is surprising that Marquesne is such a fine writer, for he has not read only a few books other than his own.

15. There are many organizations which sole purpose is to help mentally retarded children.
16. Waiting for a plane to take off from an airport can often take so long as the trip itself. 
   A  B  C  D

17. Paul had just returned home and began to read the paper when his sister called to say she had arrived at the station. 
   A  B  C  D

18. It has been estimated that the efforts of a mere one per cent of its total population moves the world forward. 
   A  B  C  D

19. The columnist feels sure that who wins the election will have the support of both parties. 
   A  B  C  D

20. Because he was greatly troubled by conscience, Hamlet was incapable to kill the king. 
   A  B  C  D

21. Neither Russia nor the United States have been able to discover a mutually satisfactory plan for gradual disarmament. 
   A  B  C  D

22. The specific gravity of a gas is the numerical ratio of its density with the density of a standard of reference, usually air. 
   A  B  C  D

23. Seldom in Western civilization has one man been successful in more intellectual pursuits as Leonardo. 
   A  B  C  D

24. Far too many owners of color television sets have had a difficult time to find qualified repairmen. 
   A  B  C  D

25. Aside from the resolution to have more ecumenical conferences, the most accomplishment of the group was that it met at all. 
   A  B  C  D

26. There is always a gap between what we say and _______. 
   A) whatever we do  B) what we do  C) that which is done  D) that done

27. A good administrator must know _______. 
   A) to be firm  B) to have firmness  C) the way of firmness  D) how to be firm

28. In a period of inflation, the value of money drops as _______. 
   A) prices rise  B) prices go the other way  C) up go the prices  D) prices arise

29. Because there was little heat in the bedroom, Evan was cold _______. 
   A) much through the night  B) most of the night  C) many parts of the night  D) the majority part of the night

30. The hikers needed to walk faster to _______. 
   A) arrive by their destination in time  B) reach their destination on time  C) reach at their destination in time  D) arrive their destination on time
31. The purpose of the research had a different meaning for them than __________.
   (A) ours  (B) for ours it had  (C) with us  (D) it did for us

32. It is one thing to accuse a person of a certain crime, but __________.
   (A) proving it is different (B) how to give proof is no easy (C) when to prove it is difficult (D) to prove it is quite another matter

33. The party continued through __________.
   (A) the whole of the night (B) nearly whole of the night (C) almost of the night (D) most of the night

34. Synthetic fabrics are particularly valuable in making __________.
   (A) unheavy clothing for summers  (B) clothes wearing light in summer  (C) light clothes of the summertime  (D) lightweight summer clothing

35. According to Xenophon, Socrates believed that __________.
   (A) what a man does is also able for a woman to do  (B) a man's abilities can be the same with a woman (C) a woman can do the same thing as a man  (D) the same things between man and woman can be done equally

36. Nineteen people were already dead, __________.
   (A) seven of who  (B) seven being teenagers  (C) teenagers were seven  (D) among seven wore teenagers

37. Accustomed to climbing trees, __________.
   (A) I had no difficulty reaching the top  (B) reaching the top was not hard to me  (C) the top was not difficult for me to reach  (D) to reach the top was not a problem

38. The harder they worked, __________.
   (A) they seemed to do less (B) the less they seemed to do  (C) they were doing less  (D) they did less

39. In order to be a good scientist, __________.
   (A) mathematics is urgent  (B) one should have the mathematics  (C) one must understand mathematics  (D) mathematics is important to be understood

40. Mary had spent __________ studying.
   (A) the whole day  (B) all during the day  (C) altogether a day  (D) entirely a day

END OF WRITING ABILITY
APPENDIX 16

SCORES OF INDIVIDUAL STUDENTS
**Guideline for Reading the Scores**

Each student's scores were printed in two lines with their student number at the beginning of the first line and the end of the second line. The numbers between the student numbers were the scores. The following example would help to read the scores (taking the first student as example).

<table>
<thead>
<tr>
<th>First line</th>
<th>Second line</th>
</tr>
</thead>
<tbody>
<tr>
<td>101 Student number</td>
<td>29 Socioeconomic status</td>
</tr>
<tr>
<td>5.5 Pretest (with correction formula 1a)</td>
<td>12 Motivational intensity in physics</td>
</tr>
<tr>
<td>34 Mathematical reasoning</td>
<td>27 Desire to learn physics</td>
</tr>
<tr>
<td>37 Abstract reasoning</td>
<td>63 Study habit in physics</td>
</tr>
<tr>
<td>40 Mechanical reasoning</td>
<td>82 Teaching performance</td>
</tr>
<tr>
<td>36 Spatial reasoning</td>
<td>75 Self concept of academic ability</td>
</tr>
<tr>
<td>40 Chinese verbal reasoning</td>
<td>24 Student's knowledge of English</td>
</tr>
<tr>
<td>37 Chinese language usage</td>
<td>8 Motivational intensity in English</td>
</tr>
<tr>
<td>38 English language usage</td>
<td>38 Attitude to life in Hong Kong</td>
</tr>
<tr>
<td>38 English verbal reasoning</td>
<td>55 Authoritarianism</td>
</tr>
<tr>
<td>23 Listening comprehension</td>
<td>30 Anomie</td>
</tr>
<tr>
<td>22 English structure</td>
<td>14 Rating of English skills</td>
</tr>
<tr>
<td>17 Vocabulary</td>
<td>7 Parents' knowledge of English</td>
</tr>
<tr>
<td>15 Reading comprehension</td>
<td>30 Orientation toward English</td>
</tr>
<tr>
<td>17 Writing ability</td>
<td>27 Attitude to English as a medium</td>
</tr>
<tr>
<td>22 Post-test (good items)</td>
<td>19 Attitude toward foreign language</td>
</tr>
<tr>
<td>24 Retest</td>
<td>100 Attitude to Eng. speaker</td>
</tr>
<tr>
<td>55 Term examination in English</td>
<td>14 Parental encouragement</td>
</tr>
<tr>
<td>21 Mechanics</td>
<td>15 Desire to learn English</td>
</tr>
<tr>
<td>21 Atomic physics (with error)</td>
<td>85 Study habit in English</td>
</tr>
<tr>
<td></td>
<td>8 Reading habit</td>
</tr>
<tr>
<td></td>
<td>16 Ethnocentrism</td>
</tr>
<tr>
<td></td>
<td>33 Cultural allegiance</td>
</tr>
<tr>
<td></td>
<td>22 Atomic physics (no error)</td>
</tr>
<tr>
<td></td>
<td>101 Student number</td>
</tr>
</tbody>
</table>
APPENDIX 17

DISCUSSION ABOUT ITEM DELETION IN SOME SCALES
As shown in Table 3.2, the following scales have some of the items deleted during data analysis. Their content validities are re-examined here to ensure that the original purpose of the individual scales remains unaffected.

Item 7 of Desire to Learn Physics (See Appendix 6, Set III, No. 49)
This item asks about the same kind of things as in item 1. Deleting this item does not affect the content at all.

Item 5, 20, 21 of Study Habits in Physics (See Appendix 6, Set III, No. 53, 73, 74)
Item 5 concerns daydreaming during studying. It is not too related to the purpose of the scale. Item 20 concerns the relation between the amount of study time and accomplishment. Since students spent not too much time in studying physics as indicated in item 23, the present item is not too relevant as originally planned. Item 21 concerns where the students sit in the classroom. Since seats are assigned by the teachers, there is no direct relation with study habit.

Item 6 of Orientation Toward English (See Appendix 6, Set I, No. 49)
This item was not too relevant since half of the subjects were from the Chinese middle school which did not require all their students to pass in English in order to graduate.

Item 4 & 7 of Desire to Learn English (See Appendix 6, Set II, No. 17, 20)
Since students at grade 10 level are usually not proficient enough in English, only very few of them will read English newspaper or magazines unless they are forced to do so. Hence item 4 is not too relevant to the scale. Item 7 has approximately the same content as item 6. Deleting this item does not affect the content validity at all.

Item 1 of Reading Habit (See Appendix 6, Set II, No. 46)
Since this scale aims at finding the comparison between how much English or Chinese the students choose, the first item is not related with the scale at all.
Item 4 of Ethnocentrism (See Appendix 6, Set III, No. 104)
Since the scale concerns the attitude towards Chinese and Western culture, while item 4 deals with modern and traditional translations which is not too relevant, so it was deleted.
APPENDIX 18

ITEM INTERCORRELATION MATRIX FOR SCALES HAVING LOW RELIABILITIES
The following is a list of item correlations of those scales having low reliabilities (internal consistency).

(A) **Orientation Toward English**

<table>
<thead>
<tr>
<th>Item No.</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
</tr>
</thead>
<tbody>
<tr>
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(B) **Desire to Learn English**

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(C) **Attitude Toward Foreign Language**

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(D) **Ethnocentrism**

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APPENDIX 19

INTERCORRELATION MATRIX FOR SIGNIFICANT VARIABLES
IN PREDICTING PHYSICS ACHIEVEMENT & ENGLISH PROFICIENCY
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APPENDIX 20

Intercorrelation Matrix for the Aptitude Scores
Correlation Matrix of the Aptitude Scores for the Two Schools Together

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Correlation Matrix of the Aptitude Scores for the A C S only

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APPENDIX 1  Pretest
APPENDIX 2  Content Analysis of Pretest
APPENDIX 3  Chinese Translation of Pretest
APPENDIX 4  Teaching Schedule of Optics
APPENDIX 5  Teaching Material in Optics
APPENDIX 6  Questionnaire
APPENDIX 7  Chinese Translation of the Questionnaire
APPENDIX 8  Optics Posttest 2
APPENDIX 9  Retest in Optics
APPENDIX 10  Chinese Translation of Optics Posttest 2
APPENDIX 11  Teaching Schedule of Mechanics
APPENDIX 12  Test in Mechanics
APPENDIX 13  Lesson Plan in Atomic Physics
APPENDIX 14  Test in Atomic Physics
APPENDIX 15  English Proficiency Test Battery
APPENDIX 16  Scores of Individual Students
APPENDIX 17  Discussion about Item Deletion in Some Scales
APPENDIX 18  Item Intercorrelation Matrix for Scale Having Low Reliabilities
APPENDIX 19  Item Intercorrelation Matrix for Significant Variables in Predicting Physics Achievement and English Proficiency
APPENDIX 20  Intercorrelation Matrix for the Aptitude Scores
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</table>
A1. Whenever the centres of the sun, moon and earth are in a straight line (in that order):
   I. some part of the earth must be in the moon's umbra
   II. there is a total eclipse of the sun visible from somewhere on the earth
   III. part of the earth is in the moon's penumbra

Which of the above statements is/are true?
A. I only  B. II only  C. III only  D. I and II only  E. I, II and III

A2. The effect of increasing the diameter of the pinhole in the pinhole camera is
A. increased  B. increased  C. increased  D. increased  E. increased
A. sharper  B. sharper  C. sharper  D. sharper  E. sharper
A. reduced  B. reduced  C. reduced  D. reduced  E. reduced
A. blurred  B. blurred  C. blurred  D. blurred  E. blurred

A3. We can see the image of ourselves in the plane mirror but not on a plane sheet of white paper because
A. white paper absorbed all the light energy falling on it.
B. white paper is too rough to give regular reflection.
C. white paper transmitted nearly all the light falling on it.
D. the coefficient of white paper is unknown.
E. the image formed in white paper is virtual.

A4. The rays H and K diverging from a point source S are reflected from a plane mirror MM'. The reflected rays X and Y will now diverge at an angle of
A. 75°  B. 15°  C. 30°  D. 40°  E. 75°

A5. Which of the following mirrors can give an image (real or virtual) of the same size as an object which is not in contact with the mirror?
I. plane mirror
II. convex mirror
III. concave mirror
A. I only  B. III only  C. I and II only  D. I and III only  E. I, II and III

A6. If an object is placed 20 cm from a convex mirror of focal length 20 cm, the image formed by the mirror will be
A. magnified.
B. real and inverted.
C. diminished and upright.
D. between the object and the mirror.
E. at infinity.
A7. (i) 

The above diagrams show a parallel beam of light entering from one medium to another. Which of the beams will emerge as converging rays in the above 3 cases.

A. i only
B. ii only
C. iii only
D. i and ii
E. i and iii

Rays from a point source at S are reflected by a concave mirror M and converge to a point F as shown in the diagram above. If we wish to obtain a parallel beam of light after reflection we could

A. I only
B. II only
C. III only
D. I and III only
E. II and III only

A9. When a beam of monochromatic yellow light pass from air to glass, there must be a change in the...

i. speed at which the light travels
ii. direction of propagation of the light wave
iii. frequency of the light wave

A. i
B. ii
C. iii
D. ii and iii
E. i, ii and iii

A10. Total internal reflection can occur at a surface of separation between a dense medium A and a rare medium B only when

I. the ray travels from A towards B
II. the angle of incidence is greater than the critical angle
III. the refractive index for light travelling from A to B is greater than 1

Which of the above statements is/are correct?

A. I only
B. II only
C. I, II only
D. II, III only
E. I, II and III

A11. 

A ray of light coming from point O in a clear liquid approaches the surface, as shown by ray OQ making an angle with the normal which is less than the critical angle. After meeting the surface, the ray will continue along the path or paths

A. OX only
B. OX only
C. OZ only
D. OX and OZ
E. OX and OQ

Cont'd.
A black spot at X inside a block of glass is observed from the point Y. The image of X appears to be
A. between W and Z.
B. between Z and X.
C. at X.
D. between X and V.
E. between V and Y.

A13. The angle of incidence of a ray of light on a liquid is 45° and its angle of refraction is 30°. What is the critical angle for the liquid?
A. 15°
B. 22.5°
C. 30°
D. 60°
E. 75°

A14. The fish in the above diagram will appear to the observer to be
I. shorter than it actually is
II. longer than it actually is
III. nearer to the observer
IV. further away from the observer
A. I only
B. III only
C. I and III only
D. I and IV only
E. II and IV only

A15. The diagram shows a thin-walled prism filled with air. The air prism is immersed in water. A ray of light is incident along the line PQ. Along which line the direction of the light emerges ...
A. 1
B. 3
C. 5
D. 4
E. 2

A16. Which of the following give optical instrument use concave lens as the eye-piece?
A. Compound microscope
B. prism monocular
C. prism binocular
D. terrestrial telescope

A17. An object is placed between a concave lens and its focal point. What is the nature of the image produced?
A. Magnified, virtual and erect
B. Magnified, real and inverted
C. Diminished, real and inverted
D. Diminished, virtual and erect
E. No image is produced by the arrangement

Cont'd
A18. With a lens at X, a real, inverted and magnified image of the illuminated pin is seen on the screen. When the lens is moved to position Y, an image of the pin is seen again. This image will be

A. real, inverted and diminished
B. real, inverted and magnified
C. real, erect and magnified
D. real, erect and diminished
E. virtual, erect and magnified

A19. A parallel beam of rays after passing through a converging lens L converges to a point F. If the lens is now completely surrounded by a clear liquid having the same refractive index as the lens, you would expect the beam to

A. converge to the point X.
B. converge to the point F as before.
C. converge to the point Y.
D. emerge as a parallel beam.
E. diverge from the point Z.

A20. A real image I of an object is formed by a convex lens, located at a distance of 25 cm from the lens. If a plane mirror inclined at 45° in the axis of the lens is placed at a distance of 15 cm from it, as shown in the diagram above. What will be the nature and position of the final image formed.

A. real, 10 cm below the axis of the lens.
B. real, 15 cm below the axis of the lens.
C. virtual, 15 cm below the axis of the lens.
D. virtual, 15 cm above the axis of the lens.
E. virtual, 10 cm above the axis of the lens.

A21. Two parallel rays of light pass through a box containing a piece of glass and emerge as shown.

\[(\text{I}) \quad (\text{II}) \quad (\text{III}) \quad (\text{IV})\]

Which of the above pieces of glass could produce this result?

A. I only
B. II only
C. III only
D. IV only
E. either II or IV

Cont'd
A22. Short-sight can be corrected by using a suitable concave lens BECAUSE the image seen through a concave lens appears to be closer than the object.

A. True  True (correct explanation)
B. True  True (irrelevant or wrong explanation)
C. True  False
D. False  True
E. False  False

A23. The reason why a rainbow has several colours is that
A. the refractive indices for colours in white light are not quite identical.
B. all of the colours in sunlight have the same refractive index.
C. the different colours in sunlight have travelled from the sun at the same velocity.
D. the different colours in sunlight have travelled from the sun at different velocity.
E. the critical angle for different colours is always the same, regardless of the colour.

A24. A red disc is placed on a green grass ground and is then illuminated with coloured light given below, which could make the disc indistinguishable from its background ...

A. red  B. white
C. green  D. blue
E. magenta

A25. Red and blue filters are placed directly in the path of white light. What is the colour of the light coming through?
A. magenta
B. white
C. yellow
D. green
E. black (no light pass through)

A26. Which of the following will affect the velocity of sound in air?
I. the frequency of sound
II. the loudness of sound
III. the temperature of the air

A. I only
B. II only
C. III only
D. I, II and III
E. none of the above

A27. Which of the following will occur at a displacement node of the longitudinal wave set up in an air column?
A. Maximum variation in pressure and maximum displacement of air particles
B. Maximum variation in pressure but no displacement of air particles
C. Moderate variation in pressure and moderate displacement of air particles
D. No change in pressure but maximum displacement of air particles
E. No change in pressure and no change in displacement of the air particles.

A28. The closed pipe shown is 0.9 m long and contains a stationary sound wave with nodes N and antinodes A at the position shown. The wave length of the sound is

A. 0.9 m  B. 0.6 m
C. 0.45 m  D. 0.3 m
E. 0.15 m

Cont'd
The velocity of sound in air is \(340 \text{ m/s}\). An electronic whistle, situated \(30\) m from a vertical wall, sounds sharply from \(t = 0\) s to \(t = 0.4\) s only. A sound recorder (which draws an amplitude-time graph) is started at the same moment as the whistle. The graph obtained is:

![Graph](image)

A loudspeaker is emitting sound waves of frequency 500 Hz towards a solid wall. On moving a microphone between the loudspeaker and the wall, it is found that there are positions of maximum loudness at regular spaced intervals of 0.3 m. We can deduce from this that the wavelength of the note is

- A. 0.3 m
- B. 0.6 m
- C. 0.66 m
- D. 1.2 m
- E. impossible to calculate

The above diagram shows a disc siren; the pitch emitted by this disc will depend on

- I. the number of holes in the disc
- II. the distance of the holes from the axis of the disc
- III. the number of revolutions the disc turns through per second

- A. II only
- B. I and II only
- C. I, II and III only
- D. I and III only
- E. I, II and III

Two loudspeakers X and Y broadcast the same pure note. The sound from loudspeaker X is louder than that from loudspeaker Y. The sound waves produced by X

- A. have higher frequency than those by Y
- B. have longer wavelength than those by Y
- C. have shorter wavelength than those by Y
- D. have greater amplitude than those by Y
- E. travel faster than those by Y

With respect to a sound wave,

- I. the pitch depends on frequency
- II. the quality depends on velocity
- III. the loudness depends on amplitude

Which of the above statements is/are correct?

- A. I only
- B. II only
- C. III only
- D. I and II only
- E. I and III only

Cont'd
A34. A note sounded on a violin is richer in harmonics than the same note produced by a tuning fork because a violin sets more air in vibration than a tuning fork.

A. True True (Correct explanation)
B. True True (Wrong or irrelevant explanation)
C. True False
D. False True
E. False False

A35. When the air in a tube closed at one end and open at the other is made to vibrate, it has:
A. an antinode at the closed end
B. an antinode exactly at the open end
C. maximum amplitude halfway along its length
D. the frequency of any strongly vibrating tuning fork placed near the open end
E. a node at the closed end

A36. The sound in air caused by the vibrating string must...

i. have the same frequency as the stationary wave
ii. have the same wavelength as the stationary wave
iii. also be a stationary wave

Which of the above statements is/are correct?
A. 1
B. 2
C. 3
D. 1 and 2 only
E. all

A37. Sound is produced by pouring water into a resonance tube closed at one end. As the tube fills, it is found that:

I. the velocity of the sound produced remains constant
II. the pitch of the sound produced becomes lower and lower
III. the pitch of the sound produced becomes higher and higher

A. I only
B. II only
C. III only
D. I and II only
E. I and III only

A38. A sonometer wire emits a note of frequency 300 Hz when under a tension of 2 kgf. If the tension is increased to 8 kgf and the length is kept constant, the frequency of the note becomes...

A. 75 Hz
B. 150 Hz
C. 600 Hz
D. 1200 Hz
E. 4800 Hz

A39. An open tube A has a diameter twice that of another open tube B, but the fundamental length of A is only half of B. Neglecting the end correction, frequency of the sound emitted by A will be...

A. 4 times that emitted by B
B. 2 times that emitted by B
C. same as B
D. a quarter of that emitted by B
E. half of that emitted by B

A40. As in the figure, the column of air in the glass tube is resonating with vibrating tuning fork of unknown frequency. If the level is gradually reduced by a distance 1 metre, resonance occurs again. From the above results only, which of the following can be determined?

i. frequency of the sound emitted by fork
ii. wavelength of the sound emitted by fork
iii. velocity of sound in water

A. i only
B. ii only
C. iii only
D. i and ii only
E. all
Appendix 2
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# Teaching Schedule of F.4 Physics (1978)

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<tr>
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<td>1</td>
<td>Rays and beams of light, the pinhole camera.</td>
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<td>2,3</td>
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<td>Principal focus, mirrors of large aperture, the focal length of a spherical mirror, construction of ray diagrams, image formed by a concave mirror</td>
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<tr>
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<td>14</td>
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<td>256-258</td>
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19/1/18. Questionnaire 1

4/9/18. Pretest (30 min)

6/9/18. 1st lesson General Discussion
2nd Q. - Ray & beams of light
picture camera

8/9/18. 1

12/9/18. Parallels to How the eye see an image
in a plane mirror

19/9/18. Images formed in two mirrors incline
at 90°. sundial

[Two expl.]
1) Images in a plane mirror
2) Images formed in two mirrors

19/9/18. Parallels. Incidental mirror, diffuse reflection, rotation of mirror
(omitted Ch. 21, except Ex)

21/9/18. How the eye see images, explanation of exercise

Verify it (i=1, and the position
of the image).

Several special points:
1) Demonstration of parallels.
2) Why will these images produce outside
a mirror is.

12-6.

19/3/18. 2

19/3/18. 7-3.
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<td>Ch. 22. P. 250-254 (image formed by a convex mirror)</td>
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<td>(Some difficulty on Fig. 248)</td>
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<td>27/8/78</td>
<td>Ch. 23. Parabolic mirror, reflecting telescope, ref. to measure focal</td>
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<td>length (ii) image of a far object (viii) ( \frac{1}{a} + \frac{1}{b} = \frac{1}{f} )</td>
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<td>5/10/78</td>
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<td>Ch. 23. Refraction, laws, index, reversibility of light (P. 265)</td>
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<tr>
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<td>Total Internal Reflection, Fish's eye mirror</td>
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<td>17/10</td>
<td>Discussion of test, exception: total internal refraction by prism</td>
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<td>6/11</td>
<td>Defect of vision, compound microscopes, angular magnitudes, telescope, example</td>
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<td>8/11</td>
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<tr>
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<td>Newton's test, spectrometer, resolution of color, colors of object in white light</td>
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<td>Rainbow, appearance of color object in colored light</td>
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<td>18/11</td>
<td>Discussion of test</td>
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<tr>
<td>20/11</td>
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<tr>
<td>22/11</td>
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<td>21/11</td>
<td>Factors which affect the velocity of sound → echo</td>
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<td>Schelon Echs → end of chapter</td>
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<td>4/12</td>
<td>Exercise, sketch standing wave, soundmeter</td>
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<td>Except with Sonometer &amp; Jeswerman tubing</td>
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16/3 p. 66 - 73
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25/2 Power → Kinetic energy
26/3 Internal Combustion engine, worked examples
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<td>17-18</td>
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<td>P.264-269  Ch.23</td>
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<td>Total internal reflection, critical angle, relation between critical angle and refractive index, the fish's eye view.</td>
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<td>Test on Ch.21 and 22</td>
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<td>Discussion of test, experiment to measure the critical angle and refractive index of a prism.</td>
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<td>P.349-355</td>
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<td></td>
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</tbody>
</table>

Text: A.F. Abbot Ordinary level Physics (2nd ed.)
Heinemann Educational Books.
物理测验 A

1. 每当太阳、地球依次同在一直线上时：
   I. 地球上某些地区必定位于月球的背影区上
   II. 地球上某些地区可看到由金突的景象
   III. 地球上某些地区位于月球的半影区上
   阅读上述叙述正确
   A. 只有 I B. 只有 II C. 只有 III D. 只有 I II E. I II III

2. 增加针孔照相机的针孔直径会有什么影响？
   像的亮度 像的清晰度
   A. 增大 减少 B. 减少 增加 C. 增大 增大 D. 减少 减少 E. 增大 减少

3. 我们可用平面镜中看到自己的像，但不能在白纸上看到自己的像的原因是
   A. 白纸不能反射所有落在其上面的光
   B. 白纸处于镜面附近，反射光线不能到达白纸
   C. 白纸各处厚度不同，无法拍到在它上面的光
   D. 白纸的倒像未知
   E. 白纸上的成像是虚像

4. 

5. 下列何者会使底片产生一个大小相同的正立或倒立，该圆物并不由镜面接触者。
   I. 平面镜
   II. 凸镜
   III. 凹镜
   A. 只有 I B. 只有 II C. 只有 III D. 只有 I II E. I II III

6. 将一实物置于距镜 20 cm 处，镜前距镜面 20 cm，则其成像特点是
   A. 放大的像 B. 缩小的像 C. 等大的像 D. 位置无变化 E. 位置无变化

7. 

8. 如图中由点光源 S 所发的光照射到平面镜 MM' 上，反射光线与反射光线，则反射光线通过点 F
   I. 与 F 重叠
   II. 与 F 直线
   III. 过 F 而向 S
   IV. 近 S 而远离 F
   V. 远离 S 而近 F
   A. 只有 I B. 只有 II C. 只有 III D. 只有 I II E. 只有 I III
9. 当一条线段从水里伸入玻璃时，下列哪一项会产生改变？
A. 会改变方向
B. 会改变长度
C. 会改变颜色
D. 会改变厚度
E. 会改变速度

10. 一个反射现象中，光路依序为
A. 光线自A进入B
B. 光线自B进入A
C. 光线自C进入D
D. 光线自D进入C
E. 光线自E进入F

11. 一个自光源O发出的光线穿过透明的空气进入液体后，会改变方向。若入射角为45°，折射角为30°，则该光波在液体中的速度为
A. 1.5
B. 2.0
C. 2.5
D. 3.0
E. 3.5

12. 有一黑点位于玻璃容器内，观察者自Y点观察，黑点位于
A. W点
B. X点
C. Z点
D. Y点
E. 以上皆非

13. 光线向液体进入空气，入射角是45°，折射角是30°，则该单质体的折射率是
A. 1.5
B. 2.0
C. 2.5
D. 3.0
E. 3.5

14. 观察者之眼

15. 图中之三面镜由聚光片制成，反射成像于水中。图中哪个点是成像点？
A. P点
B. Q点
C. R点
D. S点
E. T点

16. 下列三种光学仪器中，何者是用凹透镜制成的镜片？
A. 恒星光度镜
B. 翼镜
C. 普通凹镜
D. 圆面透镜
E. 平面镜

17. 客物置于凹透镜前其焦点间，焦点性质是
A. 扩大、倒立、虚像
B. 压缩、倒立、实像
C. 扩大、正立、实像
D. 压缩、正立、虚像
E. 扩大、正立、虚像
21. 两平行光穿越一盒，盒中放下列光学装置之一：

Ⅰ Ⅱ Ⅲ Ⅳ Ⅴ

上述哪盒可产生圆中的结果？
A. 只有 I  B. 只有 II  C. 只有 III
D. 只有 II  E. II 或 IV

22. 近视可用下列哪一种镜片矫正？
因为通过显微镜所观察到的像较实物为近
A. 前视光学的镜片 B. 后视光学的镜片
c. 前视光学的镜片 D. 平光片
E. 自已自选

23. 有红光和紫光的单色光是
A. 紫光波长较短 B. 紫光波长较长
c. 紫光波长较短 D. 电波
E. 电波

24. 一红光照射在绿草上，以下哪一句可辨认出？
A. 红 B. 白 C. 绿
D. 蓝 E. 品红

25. 平行光通过红、蓝透过镜片，其出射光线的颜色是
A. 品红 B. 白 C. 黄 D. 绿
E. 绿 (黄光单出)
26. 下列哪项对听觉产生影响？

A. 只有高工 E. 只有丙
B. 只有乙
C. 只有甲
D. 甲、乙、丙

27. 某工在噪声下工作，其听力损害情况为

A. 乙>甲>丙
B. 丙>乙>甲
C. 丙>甲>乙
D. 乙>丙>甲

Ⅰ. 下列哪项属于噪声？

A. 雷声
B. 汽车发动机声
C. 电话声
D. 机器轰鸣声

Ⅱ. 下列哪项不属于噪声控制措施？

A. 消声
B. 吸声
C. 隔声
D. 干燥

28. 噪声的强度与频率有关，噪声的强度与频率的关系为

A. 随频率的增加而增加
B. 随频率的增加而降低
C. 与频率无关
D. 不确定
34. 小提琴的声波频率比大提琴高，频率的不正确，因为小提琴频率音符有些空洞，频率的正确，A. 前者，B. 后者，C. 两者，D. 前者中错误，E. 两者中错误。

35. 朝气蓬勃，另一端开口，其中气柱的振动，形成音波。

36. 34. 振动而传播能量的声波，A. 由方向改变传播相同，B. 同轴同轴传播，C. 只有同轴，D. 有同轴，E. 全部。

37. 8% 的注于一端封闭的一气管中，在倾注过程中，内能变化的？

38. 38. 质量音速不变，频率是 300 Hz，其发生变化，变化应该是，A. 75 Hz，B. 150 Hz，C. 600 Hz，D. 1200 Hz，E. 1800 Hz。
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**Library: Macro "P2" Defined From "JON:MACLIB(7500)"**

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**Library: Macro "SUB1" Defined From "JON:MACLIB(10700)"**
1. A thin converging lens of focal length 5 cm forms a virtual image twice as large as the object. Calculate the distance of the object from the lens and draw a ray diagram to scale showing how the image is formed.

2. A small object is viewed through a diverging lens (concave lens) held close to the eye. An image 2 cm long is formed 30 cm from the lens whose focal length is 40 cm. Find the position of the object and its size.

3. ABC is a triangular prism made of glass of refractive index \( \mu \) in which the angle A is 50°. A ray of light is incident on the face as shown. Calculate the angle of emergence and the angle of deviation of light.

4. There is a particle inside a rectangular transparent block. The apparent depth of the particle is 8 cm if viewed on the side AB. The apparent depth is 6 cm if viewed on the side CD. Find the refractive index of the block and the distance \( x \) shown in the diagram.

5. a) State the reason of long sight and the method of correction.
    b) Write down the structural differences and similarities between the eye and the camera.
1. A thin converging lens of focal length 4 cm forms a real image twice as large as the object. Calculate the distance of the object from the lens and draw a ray diagram to scale showing how the image is formed.

2. A small object is viewed through a diverging lens (concave lens) held closed to the eye. An image 1.5 cm long is formed 25 cm from the lens whose focal length is 40 cm. Find the position of the object and its size.

3. ABC is a triangular prism, made of glass of refractive index 1.5, in which the angle A is 30° and the angle B is 60°. A ray of light is incident on the face AB with an angle of incidence 30° as the diagram shown. Calculate the angle of emergence and the angle of deviation.

4. A glass cube of length 15 cm on each side has a small bubble inside it. If observe this bubble on one face, the apparent depth is 6 cm. If observe it on the opposite face, the apparent depth is 4 cm. Find the distance between the bubble and the first face, and the refractive index of glass also.

5. Copy the following table on the answer sheet, fill in suitable words.

<table>
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<tr>
<th>Object Position</th>
<th>Proportions of Image</th>
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<tr>
<td></td>
<td>Position</td>
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<tr>
<td>Concave mirror</td>
<td>infinity</td>
</tr>
<tr>
<td>Plane mirror</td>
<td>in front of mirror</td>
</tr>
<tr>
<td>Convex mirror</td>
<td>infinity</td>
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</tbody>
</table>
F. 4. Physics Answer I

1) Let object distance be \( u \), making use of the Real in Positive convention, then \( u = 2a \), \( f = 4 \text{ cm} \). Substitute in lens formula:
\[
\frac{1}{v} + \frac{1}{f} = \frac{1}{u}
\]
so \( \frac{1}{u} + \frac{1}{2u} = \frac{1}{4} \Rightarrow u = 6 \text{ cm} \) & \( v = 12 \text{ cm} \).
Answer: image is on opposite side of the lens, and the object is 6 cm from the lens.

2) Let object distance be \( u \), making use of the Real in Positive convention, then \( u = 25 \text{ cm} \) (virtual), \( f = -40 \text{ cm} \). From lens formula:
\[
\frac{1}{u} + \frac{1}{25} = \frac{1}{40}
\]
\( u = 66.7 \text{ cm} \).
Let the height of object be \( h \), then \( \frac{\text{size of image}}{\text{size of object}} = \frac{15}{u} \) \( \Rightarrow \frac{15}{-25} = \frac{15}{66.7} \) \( \Rightarrow x = 4.3 \).
Answer: object is on the same side of the image, at a distance of 66.7 cm from the lens, and of a height of 4 cm.

3) The diagram shows how the light ray passes through the prism. Making use of the law of refraction:
\[
\sin 30^\circ \times \frac{1.5}{1} \Rightarrow x = 19.5^\circ
\]
\[
\sin 10^\circ \times \frac{1.5}{1} \Rightarrow r = 15^\circ
\]
Angle of deviation \( \alpha = (30^\circ - x) + (r - y) = 15^\circ \).

4) Let the bubble be a distance \( x \) away from face AB. Making use of the formula: real depth = refractive index of water when the object is immersed / refractive index of water when the object is not.
Let the refractive index of glass be \( n \), then
\[
\frac{x}{6} = \frac{1}{15} \quad (1)
\]
When the observer looks at the bubble through face DC, then
\[
\frac{15 - x}{4} = \frac{n}{1} \quad (2)
\]
Solving (1) & (2), \( \frac{x}{6} = \frac{15 - x}{4} \Rightarrow x = 9 \); \( \frac{n}{6} = n \Rightarrow n = 1.5 \).

<table>
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<td>real</td>
<td>diminished</td>
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<td>Plane mirror</td>
<td>in front of mirror</td>
<td>real</td>
<td>unchanged</td>
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<tr>
<td>Convex mirror</td>
<td>behind the mirror</td>
<td>virtual</td>
<td>magnified</td>
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</table>
F.4. Physics Example II

1. Two plane mirrors making 45° with each other are shown in the diagram. A point source of light is placed between the two mirrors. Following the scale shown in the diagram, construct ray diagrams to show how light is first reflected by mirror 1 and then mirror 2 to form an image. Find the position of the image also. (Two rays are required.)

2. A concave mirror of radius of curvature 40 cm forms a sharply focused image of a small object on a screen placed at a distance of 80 cm from the mirror. Calculate (a) the position of the object (b) the magnification.

3. An object is placed on and perpendicular to the axis of a convex mirror of focal length 8 cm. The object is at a distance of 15 cm away from the mirror. Find, by accurate drawing, the position of the image and its nature.

(SOLUTION)

2) Let object distance be \( u \),

Green: \( v = 80 \text{ cm} \), \( R = 40 \text{ cm} \)

Using the mirror formula, Read by Parabola convention:

\[
\frac{1}{u} + \frac{1}{v} = \frac{1}{f} \Rightarrow \frac{1}{v} + \frac{1}{-8} = \frac{1}{8}
\]

\( u = 26.7 \text{ cm} \)

Magnification: \( m = \frac{|v|}{|u|} = \frac{80}{26.7} = 3 \)

Answer: The object is placed 26.7 cm in front of the concave mirror. Magnification = 3.

3) The image formed is 3.2 cm behind the mirror. A virtual, erect, diminished image. (The numerical answer may differ slightly).
F.4 optics test 1

1) A small object is placed on the principal axis of a convex mirror of focal length 10 cm and the object is 1.5 cm from the mirror. Find by calculation, the position and nature of the image.

2) A concave spherical mirror of radius of curvature 20 cm forms an erect image 40 cm from the mirror. Find the position and size of the object and show with a scaled diagram how the image is formed.

3) A man is standing in a room of area 6x6 m², height 3 m. The diagram shown is a cross section of the room. A large mirror PO of height 1.2 m is hanged on the middle of wall CD. If the observer wants to see the whole image of wall AB in the mirror PO, find the furthest position of the observer from the mirror. (i.e., find x & y in the diagram)

4) An optical pin of length 10 cm is placed in front of a convex mirror of focal length 20 cm. Find the position of the image. If the optical pin is placed such that it lies on the principal axis with its head 50 cm [distance from the mirror (its tail is 10 cm further away from the mirror)], find the length of the image. (Note: not the height of the image!)

5) As shown in the diagram, PA & AB are two plane mirrors placed perpendicular to each other with AB lying 30° with the horizon. Pole AB of length 2 cm is placed perpendicular to the horizon. Draw this diagram on your answer sheet with exact scale. Construct a ray diagram to show how the light from AB would reflected from AB, then PA to form an image. Find the position of the image also.
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SELF-REPORT FORM FOR INSTRUCTORS

To be completed and retained by the instructor

This self-report form is for your own use. If you fill it out at the time your students are filling out the Student Instructional Report, you will have the opportunity to compare your own perceptions with those of your students when you receive the SIR Report.

Respond to each item according to how you would describe this course, your teaching, or the students enrolled. The items parallel those in the student form, with those asking for student background information left out.

SECTION I Items 1-20. Directions: Circle the number that represents the response closest to your opinion.

NA (0) = Not Applicable or don't know. The statement does not apply to this course or your teaching, or you simply are not able to give a knowledgeable response.
SA (1) = Strongly Agree. You strongly agree with the statement as it applies to this course or your teaching.
A (2) = Agree. You agree more than you disagree with the statement as it applies to this course or your teaching.
D (3) = Disagree. You disagree more than you agree with the statement as it applies to this course or your teaching.
SD (4) = Strongly Disagree. You strongly disagree with the statement as it applies to this course or your teaching.

1. I feel my objectives for the course have been made clear to students .................................................. 0 1 2 3 4
2. There has been considerable agreement between the announced objectives of the course and what is being taught ............................................................... 0 1 2 3 4
3. I feel that I have been using class time well ...................... 0 1 2 3 4
4. I have been readily available for consultation with students ............ 0 1 2 3 4
5. I feel I knew when students didn't understand the material ........ 0 1 2 3 4
6. Lectures were repetitive of what was in the textbook(s) .................. 0 1 2 3 4
7. I encourage students to think for themselves in this course .......... 0 1 2 3 4
8. I have been genuinely concerned about whether students learn and I try to be actively helpful ................................................................. 0 1 2 3 4
9. I made a point of adding helpful comments on student's papers or exams 0 1 2 3 4
10. I have been raising challenging questions or problems for discussion .. 0 1 2 3 4
11. In this class, students were free to ask questions or express their opinions ..................................... 0 1 2 3 4
12. I think that I have been well-prepared for each class .................. 0 1 2 3 4
13. I have informed students of how they would be evaluated in the course. 0 1 2 3 4
14. I have summarized or emphasized major points of lectures or discussions 0 1 2 3 4
15. I feel that students' interest in the subject area has been stimulated by this course ........................................ 0 1 2 3 4
16. The scope of the course has been too limited; not enough material has been covered ................................. 0 1 2 3 4
17. Examinations reflected the important aspects of the course ............ 0 1 2 3 4
18. Students seem to be putting a good deal of effort into this course ... 0 1 2 3 4
19. I feel that I have been open to other viewpoints ........................................ 0 1 2 3 4
20. I feel that I am accomplishing my objectives for the course at this point ........................................ 0 1 2 3 4

SECTION II Items 21-25. Directions: Circle one response number for each question.

21. For the students enrolled, the level of difficulty of this course is:
1 Very elementary
2 Somewhat elementary
3 About right
4 Somewhat difficult
5 Very difficult

22. In my opinion the work load for this course in relation to other courses of equal credit is probably:
1 Much lighter
2 Lighter
3 About the same
4 Heavier
5 Much heavier

23. For the students enrolled, the pace at which the material in this course is being covered is:
1 Very slow
2 Somewhat slow
3 Just about right
4 Somewhat fast
5 Very fast

24. I have been using examples and illustrations to help clarify the material of this course:
1 Frequently
2 Occasionally
3 Seldom
4 Never

25. Was class size satisfactory for the method of conducting the class?
1 Yes, most of the time
2 No, class was too large
3 No, class was too small
4 It didn't make any difference on way or the other

SECTION III Items 32-39. (Item numbers correspond to SIR answer sheet)
Directions: Circle one response number for each question.

32. Overall, I would rate the textbook(s) ................................................................. 0 1 2 3 4 5
33. Overall, I would rate the supplementary readings .............................................. 0 1 2 3 4 5
34. Overall, I would rate the quality of the exams ................................................ 0 1 2 3 4 5
35. I would rate the general quality of the lectures ............................................. 0 1 2 3 4 5
36. I would rate the overall value of class discussions ........................................ 0 1 2 3 4 5
37. Overall, I would rate the laboratories ............................................................... 0 1 2 3 4 5
38. I would rate the overall value of this course to the students as ..................... 0 1 2 3 4 5
39. How effective do you think you have been as a teacher compared to other instructors you know or have known ......................................................... 0 1 2 3 4 5
Appendice 7
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第1部分
請回答下列問題:

1) 年齡 ______

2) 居住地區 ______

3) 你在家裏說甚麼方言？ ______

4) 出生地點（如非本地出生者，請詳述國家、省份和縣名）

5) 何時到港？ ______

6) 父親職業 ______

7) 你預計將來從事何種職業？

8) 你記得升中試的成績嗎？要是記得，請填寫下列的空格：
   (a) 中文 ______
   (b) 英文 ______
   (c) 數學 ______
   (d) 總成績 ______

9) 你現在所就讀的學校是否你升中試的首三個志願之一？是 ______ 否 ______

10) 與別人相比之下，你的家庭總收入怎樣？（照你自己看法）
    (a) 貧窮
    (b) 中下
    (c) 中等
    (d) 中上
    (e) 富有

(第4頁)
1. 在下列各物中，请你将家里拥有的圈出：
(a) 電視
(b) 電話
(c) 私家車
(d) 浴缸
(e) 琴棋
(f) 洗衣機
(g) 彩色電視
(h) 音响器材
(i) 冷氣機

2. 你家裏有佣人沒有？
(a) 有
(b) 沒有

3. 你曾有過私家補習老師嗎？
(a) 有
(b) 沒有

4. 你有自己個人的睡房嗎？
(a) 有
(b) 沒有

5. 你的家人會否間中離港到外地渡假？（澳門和廣東省除外）
(a) 有
(b) 沒有

6. 你母親嘗試過上大學沒有？
(a) 有
(b) 沒有

7. 你母親接過學長上學院沒有？
(a) 有
(b) 沒有

(第二頁)
18) 你父親讀過中學沒有？
   (a) 有
   (b) 沒有

19) 你父親讀過專上學院沒有？
   (a) 有
   (b) 沒有

20) 你家裏有多少書籍？（雜誌報刊不計在內）
   (a) 一百本以下
   (b) 一百至五百本
   (c) 五百本以上

第二部份
請在下列各題中選擇最適合你的答案

21) 你的父親跟你說英語否？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 經常

22) 你的父母有否教你學習英文？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 經常

23) 你何時開始學英文？
   (a) 幼兒班或之前
   (b) 幼稚園
   (c) 一年級
   (d) 二年級
   (e) 三年級或以上

(第三頁)
25. 你曾否讀過英文小學？
   (a) 曾，由一年級起
   (b) 曾，由三年級起
   (c) 曾，由五年級起
   (d) 曾，由六年級起
   (e) 沒有

26. 你讀小學時期的英文程度怎樣？
   (a) 很差
   (b) 中下
   (c) 中等
   (d) 中上
   (e) 很好

27. 你在中學過去幾年的英文程度怎樣？
   (a) 很差
   (b) 中下
   (c) 中等
   (d) 中上
   (e) 很好

28. 除了上英文課外，你有用英文發問或回答問題否？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 差不多全部

29. 在上課的時候，你是否跟同學說英語？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 差不多全部

30. 下課後，你是否跟同學說英語？
   (a) 很少
   (b) 偶然
   (c) 有時
   (d) 很多時
   (e) 差不多全部
30. 當你寫信給朋友時，你通常會用何種語文？
   (A) 中文
   (B) 主要是中文，間中用些英文
   (C) 半中半英
   (D) 主要是英文，間中用些中文
   (E) 英文

31. 當你看西片時，你會否看中文字幕？
   (A) 很少
   (B) 偶然
   (C) 有時
   (D) 很多時
   (E) 經常

32. 你有否收聽英文電台？
   (A) 很少
   (B) 偶然
   (C) 有時
   (D) 很多時
   (E) 經常

33. 你有否收看英文電視台？
   (A) 很少
   (B) 偶然
   (C) 有時
   (D) 很多時
   (E) 經常

第三部分
請在下列各題中選擇最適合你的答案

34. 你的父母用英語跟朋友交談否？
   (A) 從不
   (B) 有時
   (C) 很多時
   (D) 常常

(第五頁)
35) 你的父母在工作時需否應用英語？
   (a) 不需要
   (b) 有時
   (c) 很多時
   (d) 常常

36) 你的父母閱讀英文書、報、雜誌嗎？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常

37) 你的父母寫英文信嗎？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常

38) 你的父母收看英文電視節目嗎？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常

39) 你的父母收聽英文電台嗎？
   (a) 從不
   (b) 有時
   (c) 很多時
   (d) 常常

40) 當你用英文做功課時，若遇到困難，你的父母能在語言方面幫助你嗎？
   (a) 不能
   (b) 有時
   (c) 很多時
   (d) 常常

(第六頁)
第四部份

下面是八個人通常學習英文的理由，請細軟每一個理由，然後按下面的尺度表示你的看法：

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41) 學習英文會幫助我更明白說英語的人及他們的生活方式。

42) 它讓我更容易在一些說英語的人中結交一些好朋友。

43) 它能讓我有英國人的想法及表現。

44) 它讓我能與更多不同的人有交往及傾談。

45) 我認為學習英文能幫助我將來找到一份好的工作。

46) 一個人要在社會上獲得一些名聲，他最少應懂得一種外國語言。

47) 我認為除非一個人能流利地運用英文，他不能真正算為受過教育。

48) 我需要學習英文才能中學畢業。

(第七頁)
這問卷的用意是測量不同的人對一些題目或觀念的看法。測量方面是請你將該題目或觀念放置在下列一個描述性尺度的適當位置上，正確的答案因人而異，最重要的是你個人對這些題目或觀念的感受。有時你或許以為你已見過同一個尺度，但實際並非這樣，故此請你作答時不要前後參閱尺度上的項目，而只就該題作一獨立的決定。

請迅速的選擇答案，不要為個別的項目猶疑，我們所需要知道的是你的第一個印象—即時的反應！

你對「採用英文作為中學各科的教學語言」的看法如何？

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<td>57) 困難</td>
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(第八頁)
第六部份
請在下列各題中選擇最適合你的答案

58. 纔然學校沒有規定，我們仍會選讀外國語文。
   (a) 必定會
   (b) 大概會
   (c) 有可能
   (d) 大概不會
   (e) 必定不會

59. 我喜歡觀看沒有中文字幕的外國電影。
   (a) 絕不喜歡
   (b) 不大喜歡
   (c) 有時喜歡
   (d) 頗喜歡
   (e) 十分喜歡

60. 我們很多外交上的困難是由於缺乏外文知識所造成的。
   (a) 非常同意
   (b) 同意
   (c) 不能決定
   (d) 不同意
   (e) 非常不同意

61. 我要閱讀外國文學的原著。
   (a) 非常同意
   (b) 同意
   (c) 不能決定
   (d) 不同意
   (e) 非常不同意

62. 我渴望能說一口流利的外文。
   (a) 十分渴望
   (b) 頗渴望
   (c) 有時渴望
   (d) 不大渴望
   (e) 絕不渴望

(第九頁)
63) 要是移居外地，縱然中文已很夠用，
(a) 我會一定會
(b) 不會
(c) 概念
(d) 不一定會
(e) 一定

64) 比較上來說，雖然香港雖遠，但學習外文仍是很重要的。
(a) 非常同意
(b) 同意
(c) 不同意
(d) 不同意
(e) 絕不同意

第七部分
以下是一些見解，有很多人同意，亦有不少人不同意，因為各人的觀點不同，故此沒有標準的答案。請你將下列看法填入每題前的空格上。
+1：略微同意
+2：同意
+3：十分同意
-1：不甚同意
-2：不同意
-3：十分不同意

65) 移居香港而又能說英語的外國人對香港社會的繁榮有很大的貢獻。

66) 我愈想了解說英語的外國人時，我愈希望我能說他們的語言。

67) 說英語的外國人在政治和哲學方面都是很民主的。

68) 在說英語的外國人中有很多傑出的藝術家和作家。

69) 說英語的外國人將西方的生活方式帶進我們的社會，對改進我們的生活方式有很大貢獻。

(第十頁)
71) — 說英文的外國人對宗教信仰的信心成了現代社會的推動力。
72) — 說英文的外國人有充分理由為他們自己的種族和傳統而驕傲。
73) — 要是香港失去了說英文的外國人的影響，這將會是一個很大的損失。
74) — 在香港，說英文的外國人比較中國人更有禮貌。
75) — 我們可以從說英文的外國人中學到更好的烹飪、服侍和款待的方法。
76) — 說英文的外國人是可靠的。
77) — 中國孩子在與說英文的外國孩子嬉戲時可以學到很多有價值的東西。
78) — 說英文的外國人對陌生人很慷慨和熱誠。
79) — 香港的中國人應加倍努力去認識更多說英文的外國人。
80) — 強迫說英文的外國人完全中國化是不對的。
81) — 要是我選擇，我寧可離開香港住在一个說英文的地方。
82) — 要是有更多說英文的外國人選到香港香港會成為一個更好的城市。
83) — 說英文的外國人在適應中國人的生活方式上表現了很大的諒解。
84) — 一般來說，香港的工業每每受雇用了說英文的外國人而得到益處。
85) — 說英文的外國人是率直和誠實的。
86) — 說英文的外國人容易信任別人。
87) 說英語的外國人對困苦中的人富同情心。
88) 說英語的外國人是有原則的人，他們尋求積極有意義的人生。
89) 說英語的外國人是知識份子，我們可以在他們的知識和經驗上得到很大的益處。
90) 說英語的外國人有高尚的道德水平，應該為別國人所做效。
91) 說英語的外國人真正關心香港的中國人，他們渴望與中國人學習和聽取中國人的意見。
92) 說英語的外國人誠懇地投身在香港及她的問題上，他們捨己地為香港的進步而努力。
93) 說英語的外國人真誠地將香港當為自己的家，他們非常關心香港的前途。
94) 說英語的外國人很小心的避免表現出自己是個‘萬事通’，他們仔細查整個事情始末之後才表達自己的看法及提議。
95) 說英語的外國人對香港的中國人平等看待。

（完）
請細讀下面各題，並指出最適合你的答案：

1) 以英文科來說，與其他同學比較，我認為我：
   (a) 不如大部份同學那麼用功
   (b) 跟大部份同學一樣用功
   (c) 較大部份同學用功

2) 如果學校內沒有教授英文，我
   (a) 會自學英文
   (b) 會在日常場合裏學會英文（即和閱讀英文書報，
       偶爾會說英語等等。）
   (c) 會設法在別處上英文課
   (d) 不是以上任何一項（說明）

3) 天主動地去思考上英文課時學到的東西
   (a) 永不
   (b) 偶一為之
   (c) 經常如此

4) 平均來說，我每天在家溫習英文（包括所有英文家課）
   的時間為：
   (a) 小於十五分鐘
   (b) 十五分鐘至一小時
   (c) 一小時以上

5) 眾所周知，顯然地說，我
   (a) 唯有靠運氣或機智才會及格，因為我做了很少工夫
   (b) 只做少許的工夫，得過且過便算
   (c) 還要努力學英文
   (d) 不是以上任何一項（說明）

6) 畢業後，我打算
   (a) 不會（想我所學過的英文
   (b) 會，並用英文
   (c) 會，並用英文
   (d) 不是以上任何一項（說明）

7) 與其他學科比較，我
   (a) 較少用工夫在英文科上
   (b) 英文的工夫 Ritual
   (c) 較多用功學習英文
第三部份
請指出最適合的答案。

14) 請在下面各格中填上数字，以表示在各科目中你最喜歡的科目。
英文是你最喜歡的科目

15) 有英文作業時，你是會：
( ) 要待到其他功課都做完才去做
( ) 會先做完這門課
( ) 不會做任何一項（說明）

16) 上英文堂時，你是會：
( ) 感到十分煩惱
( ) 對於英文有興趣
( ) 要先連自己留心聽講
( ) 完全投入

17) 如果你有機會而且英文程度又足夠，你會閱讀英文書籍
( ) 永不
( ) 偶爾
( ) 頗為
( ) 完全
3) 温習英文片刻後，你覺自己：
(a) 每每想起其他事情
(b) 發生興趣去完成它
(c) 對該課課題極感興趣

4) 如果有機會去改變校內教授英文的方法，你會
(a) 減少課程
(b) 保留原有課程
(c) 增加課程

二) 你認為英文
(a) 不應列入數學範圍內
(b) 應給予有意學英文的學生
(c) 應給予所有中學生

2) 你認為學習英文是
(a) 絕不有趣
(b) 跟大多數科目一樣，不見得特別有趣
(c) 非常有趣

第四部份
請指出最適合的答案：
21) 無論我是否喜歡英文，都會用功以爭取好成績，
(a) 甚少
(b) 偶然
(c) 有時
(d) 時常
(e) 幾乎常常如此

22) 學習英文，數天或數週後，我的興趣就會消失。
(a) 甚少
(b) 偶然
(c) 有時
(d) 時常
(e) 幾乎常常如此

24) 我未經了解就死記文法上的規則等
(a) 甚少
(b) 偶然
(c) 有時
(d) 時常
(e) 幾乎常常如此
25) 當我因某种無法避免的原因必須功課落後時，我
不跟英文老師提點也會補做功課
(a) 甚少
(b) 偶然
(c) 有時
(d) 常常
(e) 常常常常如此

26) 當我溫習時，因想及約會將來的計劃等等就不能集中
精神在英文課本上。
(a) 甚少
(b) 偶然
(c) 有時
(d) 常常
(e) 常常常常如此

27) 虽然功課沉悶，我仍然到時去做完。
(a) 甚少
(b) 偶然
(c) 有時
(d) 常常
(e) 常常常常如此

28) 我把所有英文筆記放在一起，細心地排列好。
(a) 甚少
(b) 偶然
(c) 有時
(d) 常常
(e) 常常常常如此

29) 當我遇上英文難題時，我會找老師商談
(a) 甚少
(b) 偶然
(c) 有時
(d) 常常
(e) 常常常常如此

30) 我將我讀書的地方收拾整齊，不會讓閒置或分離
精神的物品諸如圖畫、信件等。
(a) 甚少
(b) 偶然
(c) 有時
(d) 常常
(e) 常常常常如此
31) 我需要很长的时间才能安定下来阅读
(a) 极少
(b) 偶然
(c) 有时
(d) 每天
(e) 平时常常如此

32) 每当我坐下阅读时，我就会觉得非常疲倦、烦躁或慵懒欲睡，以致不能好好阅读
(a) 极少
(b) 偶然
(c) 有时
(d) 每天
(e) 平时常常如此

33) 在短时间内阅读时，我常常感到头痛。
(a) 极少
(b) 偶然
(c) 有时
(d) 每天
(e) 平时常常如此

34) 读完几页英文后，我没法记得刚刚读过的东西
(a) 极少
(b) 偶然
(c) 有时
(d) 每天
(e) 平时常常如此

35) 我浪费太多时间去阅读和做笔记，导致影响睡眠。
(a) 极少
(b) 偶然
(c) 有时
(d) 每天
(e) 平时常常如此

36) 学习情况是毫无系统，未做计划的多数在功课到期要
(a) 极少
(b) 偶然
(c) 有时
(d) 每天
(e) 平时常常如此
37) 我利用校内没有课的时间来温习以减轻晚上的工作。
   (a) 基少
   (b) 偶然
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此

38) 我準時交英文的功課。
   (a) 基少
   (b) 偶然
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此

39) 做家課時我喜歡把收音機開著。
   (a) 基少
   (b) 偶然
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此

40) 當我閱讀一篇指定要讀的文章時我間歇地停下來細想文章內提及過的要點。
   (a) 基少
   (b) 偶然
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此

41) 照時間比例來算我所完成的似乎很少。
   (a) 基少
   (b) 偶然
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此

42) 我喜歡坐在課室後面。
   (a) 基少
   (b) 偶然
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此

43) 對我來說，溫習時若不成功就算失敗要看我的心境如何。
   (a) 基少
   (b) 偶然
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此
44) 每次溫習英文之前我都先定下目標，確定溫習範圍
   (a) 艱少
   (b) 偶爾
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此

45) 我每天都規律地工作以確保自己能按時完成功課
   (a) 艱少
   (b) 偶然
   (c) 有時
   (d) 時常
   (e) 幾乎常常如此

第五部分
請指出最適合的答案
46) 平均來說，你每天用多少時間閱讀與功課無關的書籍？
   (a) 十分鐘以下
   (b) 十五分鐘至半小時
   (c) 半小時以上

47) 空閒時你喜歡讀甚麼書？
   (a) 中文
   (b) 無特別偏好
   (c) 英文

48) 你喜歡讀甚麼報紙？
   (a) 中文
   (b) 無特別偏好
   (c) 英文

49) 你喜歡讀甚麼雜誌？
   (a) 中文
   (b) 無特別偏好
   (c) 英文

50) 如果你兼有中英文版的“讀者文摘”，你會先讀那一本？
   (a) 中文
   (b) 無特別偏好
   (c) 英文

51) 通常你讀那一種文字會較為快速？
   (a) 中文
   (b) 相同速度（指中英文）
   (c) 英文
第六部份

此問題的目的是測量一些問題及觀念對不同的人有何意義。請將答案填入表格中。你自己的意見正確的答案正是你自己的意見。有些時候，你會覺得某一項目似乎是不適當的，但你可能又思考過。因此請勿將此項目改變。你會怎樣答覆類似的項目，請再思考。”

請盡速作答，不要為個別項目疑慮。我們所需要的是你對各項目的第一個印象及即時的感覺。

你對於香港的生活有何感受？

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第七部份

說明：以下的評語是一些與你年紀相似的年輕人經常使用的評語，這些評語包括多方面的問題，而你對其中的評語都有人同意，亦有人不同意，所以沒有全對或全錯的答案。你必須根據你自己同意或不同意的程度，依下列方式在各題左欄內評分：

+7 極力同意
+6 同意
+5 稍微同意
+4 不同意
+3 稍微不同意
+2 不同意
+1 極力不同意
6) 人性既然如此，就永遠都有競爭與衝突。
7) 如果一個人的體格、習慣和承受能力都不好的話，難望顯得傑出。
8) 人不必自詡地高人一等，強者和弱者。
9) 一個對父母沒有感恩，不知感謝及不尊重人的人，世上沒有對的東西比他更為卑劣了。
10) 真正的中國生活方式是這浮誇的消逝，需要努力才能改變保存下來。
11) 現在愈來愈多人對別人的私事看得很開。
12) 如果人人都少談諸多做事，各人的生活都會較好了。
13) 大部份人都不知道我們的生活是受到不少暗地裏搞陰謀及推行的陰謀所控制。

請人選答

以下是一些見解，如您有同意此見解者，請在下面的包括選出您最能代表您的見解所屬的選項上畫圈。

75) 15) 在今日香港，公職人士其實不是關心一般人的問題。
76) 16) 香港是目前最良善的居住地方。
77) 17) 世界的情況既然如此，學生要計劃將來的事業是恐怕霧的一回事。
78) 18) 無論某些人士怎麼做，一般的有責任實在是無論如何，也沒有特別好處。
79) 19) 這個世代，任何人都不十分清楚有誰可以信任。

評選最適合您的答案

80) 20) 我閱讀英文
   (A) 完全
   (B) 少少
   (C) 頗好
   (D) 瞭解

81) 21) 我讀英文
   (A) 完全
   (B) 少少
   (C) 頗好
   (D) 瞭解
59) 我寫英文
(a) 全不
(b) 少少
(c) 頗好
(d) 流利
60) 我母親說英文
(a) 全不
(b) 少少
(c) 頗好
(d) 流利
61) 我父親寫英文
(a) 全不
(b) 少少
(c) 頗好
(d) 流利
62) 我父親講英文
(a) 全不
(b) 少少
(c) 頗好
(d) 流利
問卷三

第二部分 個人能力的表現

1. 以你的知己比較，你如何評估你的學習能力？
   a) 我是最好的
   b) 我是中等之上
   c) 我是中等
   d) 我是中等之下
   e) 我是最差的

2. 與同班同學比較，你如何評估你的學習能力？
   a) 我是最好的
   b) 我是中等之上
   c) 我是中等
   d) 我是中等之下
   e) 我是最差的

3. 在中學裏，你認為你在班上成績屬何等級？
   a) 最好的一級
   b) 中等之上
   c) 中等
   d) 中等之下
   e) 最差的一級

4. 你認為你有沒有能力修完大學學位？
   a) 有
   b) 有，但數學有
   c) 不能肯定
   d) 否

5. 在大學裏，你認為你在班上成績屬何等級？
   a) 最好的一級
   b) 中等之上
   c) 中等
   d) 中等之下
   e) 最差的一級
6. 是或否，你认为大学教授，念完大学
   是辛苦的。你认为你有能力完成这些高
   校课程吗？
   ① 非常可能
   ② 可能
   ③ 不能肯定
   ④ 不可能
   ⑤ 多数不可能

7. 指出你认为别人如何评估你的成绩。按照你
   本人的意见，你认为自己的成绩有多好？
   ① 我的成绩总是差
   ② 我的成绩最好
   ③ 我的成绩属中等
   ④ 我的成绩属中等之下
   ⑤ 我的成绩差于中等

8. 你认为你可以取得什么等级的学分？
   ① 多数是A级
   ② 多数是B级
   ③ 多数是C级
   ④ 多数是D级
   ⑤ 多数是E级

下列的问题，不是你父母回答的，如果你
   你父母跟你一同生活，或者你
   同住的家庭所答，看图出答案要答：

9. 你认为你的学习能力与父母的学业成绩相
   比较，你愿意你父母在
   ① 职业上
   ② 中等之
   ③ 中等之下
   ④ 职业上
10. 你認為你父母會說你
A. 在中學的學習成績
B. 在中學的學習成績
C. 在中學的學習成績
D. 在中學的學習成績
E. 在中學的學習成績

11. 你認為你父母會說「你有能力上大學嗎？」
A. 會
B. 不會
C. 不知
D. 肯
E. 否

12. 要求大學教學
A. 頗
B. 頗
C. 頗
D. 不
E. 之

13. 你認為你父母會說你
A. 多數是 A 級
B. 多數是 B 級
C. 多數是 C 級
D. 多數是 D 級
E. 多數是 E 級

14. 假設你在校內最要好的朋友回答下列問題時，回答是由這位朋友回答的：
A. 能
B. 不能
C. 不知
D. 肯
E. 否

你認為你父母會說你
A. 在大學的學習成績
B. 在大學的學習成績
C. 在大學的學習成績
D. 在大學的學習成績
E. 在大學的學習成績

你認為你父母會說「你有能力上大學嗎？」
A. 會
B. 不會
C. 不知
D. 肯
E. 否

你認為你父母會說你
A. 多數是 A 級
B. 多數是 B 級
C. 多數是 C 級
D. 多數是 D 級
E. 多數是 E 級

你認為你父母會說「你有能力上大學嗎？」
A. 會
B. 不會
C. 不知
D. 肯
E. 否
5. 你曾經學過“華語”嗎？
(a) 沒有
(b) 比上
(c) 上
(d) 中
(e) 其他

6. 你認為你朋友常說你有什麼能力？
(a) 好
(b) 中
(c) 不足
(d) 其他

7. 你認為你對“華語”有什麼程度？
(a) 很好
(b) 好
(c) 中
(d) 不好
(e) 不足

8. 你認為你朋友說你很隨和？
(a) 是
(b) 否
(c) 不足
(d) 沒有
(e) 其他

9. 你認為你朋友會說你一般可以取悅什麼？
(a) 朋友
(b) 數字
(c) 經濟
(d) 其他
(e) 任務
想想看我所喜欢的老师一定不是你的老师。回答下列问题时，答案是由这位老师所为的。

1. 跟其他同学的学生比较：你认为你老师在
  a) 善于学习
  b) 中等
  c) 善于学习
  d) 最差

2. 在学校里：你认为老师是你的能力提升到大学吗？
   a) 肯定
   b) 没有肯定
   c) 多数肯定
   d) 少数肯定

3. 我觉得老师是你的能力提升到大学吗？
   a) 可能
   b) 不可能
   c) 不可能
   d) 没有
23. 你認為誰會統領你一般可以接受什麼等級的教育？
   ( ) 多數是A級
   ( ) 多數是B級
   ( ) 多數是C級
   ( ) 多數是D級
   ( ) 多數是E級

第二部份
以下是你在一些問題中所反應的意見，分別記錄與本項目有關的意見

+3 同意
+2 不懷疑
+1 不同意
-3 同意
-2 不懷疑
-1 不同意

大家也同意的西方人比較中國人較為

3. 食物的西方人相比較起來家庭生活

2. 中國人較重視家庭的

1. 西方人相比較起來中國人更重視

0. 西方人相比較起來中國人更重視

-1. 西方人相比較起來中國人更重視

-2. 西方人相比較起來中國人更重視

-3. 西方人相比較起來中國人更重視
第三部分

表自上而下的逐级顺序是

(1) 要求乙方提供一份详细报告，包括计划、预算及相应的时间表。
(2) 乙方必须按照合同规定的时间和地点，完成相关工作。
(3) 乙方应确保所有工作按照合同要求的标准执行。
(4) 合同执行过程中，乙方应随时向甲方提交工作进展报告。
(5) 合同执行过程中，甲方有权对乙方的工作进行监督和检查。

48. 如果有关方面没有根据协议规定
   (1) 严格遵守协议中有关物理方面的规定。
   (2) 各方应按照协议规定的时间和地点，完成相关工作。
   (3) 各方应确保所有工作按照协议要求的标准执行。
   (4) 协议执行过程中，各方应随时向有关方面提交工作进展报告。
   (5) 协议执行过程中，有关方面有权对各方的工作进行监督和检查。

49. 甲方或乙方在协议上物理或化学方面的规定
   (1) 严格遵守协议中有关物理方面的规定。
   (2) 各方应按照协议规定的时间和地点，完成相关工作。
   (3) 各方应确保所有工作按照协议要求的标准执行。
   (4) 协议执行过程中，各方应随时向有关方面提交工作进展报告。
   (5) 协议执行过程中，有关方面有权对各方的工作进行监督和检查。

50. 本协议自签字之日起生效。
39. 什么季节您最愿意去出去游玩？
A. 春天
B. 夏天
C. 秋天
D. 冬天

40. 以下哪些食物你认为有助于健康？
A. 蔬菜
B. 水果
C. 鱼肉
D. 蛋糕

41. 下列运动你最喜欢哪一种？
A. 跑步
B. 游泳
C. 篮球
D. 羽毛球

42. 下列哪一种植物你认为最美丽？
A. 向日葵
B. 玫瑰
C. 荷花
D. 菊花

43. 你喜欢哪种颜色？
A. 红色
B. 蓝色
C. 绿色
D. 黄色

44. 你喜欢哪种音乐？
A. 古典音乐
B. 流行音乐
C. 乡村音乐
D. 摇滚音乐

45. 你最喜欢的动物是什么？
A. 狗
B. 猫
C. 马
D. 鱼

46. 你认为什么样的家庭是最幸福的？
A. 有钱的
B. 有爱的
C. 有权力的
D. 有地位的

47. 你喜欢哪种运动？
A. 足球
B. 篮球
C. 乒乓球
D. 游泳

48. 你认为哪种职业最有发展前景？
A. 医生
B. 教师
C. 电子产品工程师
D. 律师

49. 你认为哪种食物最好吃？
A. 美食
B. 自制
C. 快餐
D. 传统

50. 你认为哪种艺术形式最吸引你？
A. 电影
B. 音乐
C. 舞蹈
D. 绘画
46. 如果你選擇熱而不顯著程度又是何等，你會考慮讀更多關於物理的書籍嗎？
   a) 不會
   b) 或許
   c) 希望
   d) 完全不會

47. 當你讀物理書時，你會想念自己
   a) 丹丹想及其他事情
   b) 有些地方會放棄
   c) 讀的時候連深感興趣

如果你會推薦書，改進校本教材物理的方
   a) 讀法
   b) 懷念
   c) 改進
   d) 增加

48. 你對物理
   a) 預習
   b) 應該
   c) 應該
   d) 你

49. 你覺得學物理是
   a) 完全不
   b) 具備
   c) 不像同類
   d) 非常有趣

50. 工程來說，你每個星期用多少時間閱讀教
   a) 以外的物理書？
B

1. 請在下方填寫您的答案：

( ) 二十至六十分
( ) 一至二小時
( ) 二小時以上

2. 你最喜歡什麼類型的運動？
( ) 球類
( ) 活力訓練
( ) 有氧訓練
( ) 永不運動

此年齡段的運動方式您是否適合？
( ) 比較適合
( ) 不適合
( ) 要

第三節 目前最佳的運動方式：

1. 若您是否有喜歡的運動，您是否會用於休息時進行？
( ) 是
( ) 否
( ) 不會
( ) 偶爾
( ) 很多

2. 每次運動的持續時間：
( ) 二十至六十分
( ) 一至二小時
( ) 二小時以上

3. 您對運動的態度是什麼？
( ) 比較熱烈
( ) 比較冷淡
( ) 有時
( ) 常常
略表本经了解就足论事内名词、定义
0. 我受
1. 好
2. 有时
3. 等

当我用教理课出避无可的按由以故可识名，
4. 我不可
5. 有时
6. 有时
7. 等于

略查我恩带物理等。因想及约案，特求杨计
0. 我
1. 有时
2. 有时
3. 等于

约带

略查我受理智慧，我仍想坚持做教它。
0. 我
1. 有时
2. 有时
3. 等于

略查我所教理的集记仅在一切，细心
4. 我是上司的理想部下，我会对上司直说——
   a) 是 b) 不 c) 不一定 d) 无从下
5. 你对公司的产品有深入了解吗?
   a) 是 b) 不 c) 不一定 d) 无从下
6. 我是上司的理想部下，我会对上司直说——
   a) 是 b) 不 c) 不一定 d) 无从下
7. 你对公司的产品有深入了解吗?
   a) 是 b) 不 c) 不一定 d) 无从下
8. 我是上司的理想部下，我会对上司直说——
   a) 是 b) 不 c) 不一定 d) 无从下
9. 你对公司的产品有深入了解吗?
   a) 是 b) 不 c) 不一定 d) 无从下
10. 我是上司的理想部下，我会对上司直说——
    a) 是 b) 不 c) 不一定 d) 无从下
15. 總結我對物理的預習，我反覆去記的問題有

a. 戴手套
b. 維持力

16. 我很喜歡在課後去閱讀物理課本，但課本有些難懂，以致影響學習。

a. 常常如此
b. 有時如此
c. 常常如此

17. 我很少在課後做練習，因為課本和課堂上所學的不相符合。

a. 常常如此
b. 有時如此
c. 常常如此

18. 我利用校內的其他時間來溫習。以

a. 習題
b. 課本

19. 我在課堂上也努力地回答問題。

a. 常常如此
b. 有時如此
c. 常常如此

7.19. 敢去後，我喜歡在收音機裏
(1) 高唱
(2) 有時唱
(3)

7.21. 我們在睡覺時把電燈關上，但實在是感到
(1) 安靜
(2) 有時安靜
(3)

7.22. 我們在閱讀一卷指定的書時，我常常
(1) 感到
(2) 有時感到
(3) 當手不常如此

7.23. 我們在上課時的表現，我們時常
(1) 魅力
(2) 有時有魅力
(3)

7.24. 我們在上課時的表現，我們時常
(1) 講
(2) 有時講
(3) 常常如此
7. 我每天除了课外用三小时或以上的时间来做温习。
   a) 是
   b) 有时
   c) 有时
   d) 几乎每天都如此

7. 每天在睡觉之前，我都会定下目标。
   a) 是
   b) 有时
   c) 有时
   d) 几乎每天都如此

8. 每天我都检视自己在学业中完成或未完成的。
   a) 是
   b) 有时
   c) 有时
   d) 几乎每天都如此

第九部分

在最近的考试中，每题或多道选择题显示出你对下列哪一种（物理）概念的理解可用下列比例尺来表示：

<table>
<thead>
<tr>
<th>极高同意</th>
<th>同意</th>
<th>稍微同意</th>
<th>不同意/完全不同意</th>
</tr>
</thead>
<tbody>
<tr>
<td>非常同意</td>
<td>不同意</td>
<td>不同意</td>
<td>高</td>
</tr>
</tbody>
</table>

11. 我因其他数学课，我感觉学得较少。
   a) 极高同意 _______ 同意 _______ 稍微同意 _______ 不同意/完全不同意

12. 同学的帮助很有用。
   a) 极高同意 _______ 同意 _______ 稍微同意 _______ 不同意/完全不同意
1. 教师善是好的。
   您与同意 __________ 您与不同意

2. 老师在课上表扬一些进步的学生。
   您与同意 __________ 您与不同意

3. 您希望老师关心您的学习。
   您与同意 __________ 您与不同意

4. 大致上这门课程让您满意。
   您与同意 __________ 您与不同意

5. 您认为这门课程太难。
   您与同意 __________ 您与不同意

6. 您认为老师能否培养学生发展新观念及改善。
   您与同意 __________ 您与不同意

7. 您觉得这门课程教学太快。
   您与同意 __________ 您与不同意

8. 您是否觉得家庭可以了明授课。
   您与同意 __________ 您与不同意

9. 大致上课程组织得很好。
   您与同意 __________ 您与不同意

10. 您对教师对您的课程解释满意。
    您与同意 __________ 您与不同意

11. 这些课程太难了。
    您与同意 __________ 您与不同意
对老师毫不关心学生的需求。
极不同意

我不可以和老师请教问题。
极不同意

我对老师的教学效果没有太大好感。
极不同意

黑板上的字不容易看清，或者有遮挡。
极不同意

我对教师评分不公。
极不同意

我觉得老师缺乏教学的激情。
极不同意

我没有动力去上课，也不觉得有趣。
极不同意

我对教学内容感到厌烦，工作步骤解释得不清楚。
极不同意
第七部分

说明：以下的意见是一些对你有影响的事情。这些意见包括多面的问题：每面意见都有人同意，有人不同意，所以没有绝对的对与错的答案，希望你自己同意或不同意的程度，依下列讨论题在答题栏内评分：

+7 非常同意  +1 完全不同意
+6 同意       +2 不同意
+5 趋于同意    +3 趋于不同意

101. 团体意识如何

102. 在四围这复杂的世界下，我们将不会

103. 中国传统的价值观念不适用于现代生活。

104. 我们应慎重地采用英文名言的直接译法，而不是逐字逐句地翻译。

105. 我们日常中英文混合语言可能会成为听话者的生词。

106. 当我们与外国人在一起时，说话往往”，

我们需用国语是用中文，以保持中国人的表现。
<table>
<thead>
<tr>
<th>Line</th>
<th>Column</th>
<th>Code</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>717</td>
<td>32</td>
<td>+SET PR = ' ]12ri3 '</td>
<td>DEFINED PR</td>
</tr>
<tr>
<td>717</td>
<td>32</td>
<td>+SET LR = ' ]LR13 '</td>
<td>DEFINED LR</td>
</tr>
<tr>
<td>717</td>
<td>32</td>
<td>+GO</td>
<td>GO</td>
</tr>
<tr>
<td>729</td>
<td>32</td>
<td>+SET PR = ' ]12ri2 '</td>
<td>DEFINED PR</td>
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SECTION A: MULTIPLE CHOICE (32%)

1. If the object distance is halved and the diameter of the hole in a pinhole camera is doubled, what effect does this produce on the size, brightness and sharpness of the image formed?

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</tr>
<tr>
<td>C.</td>
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<td>fainter</td>
</tr>
<tr>
<td>D.</td>
<td>halved</td>
<td>brighter</td>
</tr>
<tr>
<td>E.</td>
<td>halved</td>
<td>brighter</td>
</tr>
</tbody>
</table>

2. When the eye is looking at an image in the mirror, the image formed on the retina of the eye is virtual because the image which appears in retina is virtual.

   | A. True True  (correct explanation) |
   | B. True True  (wrong or irrelevant explanation) |
   | C. True False |
   | D. False True |
   | E. False False |

3. When an object is put in front of a concave mirror, a real, inverted, magnified image is formed. Find the position of the object.

   | A. infinity |
   | B. beyond the centre of the curvature |
   | C. on the center of curvature |
   | D. between the focus and the center of curvature |
   | E. between the focus and the pole |

4. Which of the following can produce a virtual image of a real object?

   I. Plane mirror
   II. Concave mirror
   III. Convex mirror

   | A. I only |
   | B. II only |
   | C. I and II only |
   | D. I and III only |
   | E. I, II and III |

5. Convex mirrors are more suitable than plane mirrors for use as rear-view mirrors for cars mainly because convex mirrors can give

   | A. a magnified image |
   | B. a real image |
   | C. a sharper image |
   | D. an undistorted image |
   | E. an image covering a wider angle of view |
In the figure, the position of the pin has been so adjusted that the pin and its image may be observed with no parallax between them. What is the focal length of the mirror?

A. 10 cm  
B. 20 cm  
C. 30 cm  
D. 40 cm  
E. It cannot be determined from the information given.

7. A straight stick appears to be bent when partly immersed in water. This is due to which of the following?
   I. Interference  
   II. Reflection  
   III. Refraction  
A. I only  
B. II only  
C. III only  
D. I and II only  
E. II and III only

8. A man looks vertically down at an object 2 m under water. If the refractive index of water is $\frac{4}{3}$, find the apparent depth.
   A. $\frac{3}{4}$ m  
   B. 2 m  
   C. $\frac{9}{2}$ m  
   D. depends on how clear the water is  
   E. depends on the distance of the observer above water

9. The path of a ray of light through a glass prism can be calculated if we know:
   I. the refracting angle of the prism  
   II. angle of incidence in the side of prism  
   III. refractive index of the glass  
A. III only  
B. I and II only  
C. I and III only  
D. II and III only  
E. All three

10. In the above diagrams, the critical angle of the glass is $42^\circ$. Which diagram shows the correct path for the light ray through the prism?
   A. I  
   B. II  
   C. III  
   D. IV  
   E. V

11. What are the mistakes, if any, in the ray diagram shown above?
12. A diver at $x$ metres under water looks up at the water surface and observes the sky appears to be a circle. What is the diameter of the circle if the critical angle of water is $\theta$?

A. $2x \tan \theta$ metres  
B. $2x \sin \theta$ metres  
C. $x \tan \theta$ metres  
D. $\frac{x}{\sin \theta}$ metres  
E. $\frac{2x}{\sin \theta}$ metres

13. Which of the points I, II, III and IV can be seen by the fish in the pond as shown in the diagram above?

A. I and II only  
B. I and IV only  
C. I, II and IV only  
D. I, III and IV only  
E. All the points can be seen.

14. Which of the following statements concerning a simple astronomical telescope is/are correct?

I. the first image is always near the focal plane of the objective
II. the eye-lens is used as a simple magnifying glass to observe the first image
III. the final image appears to be enlarged

A. I only  
B. II only  
C. III only  
D. II and III only  
E. I, II and III

The diagram shows two incoming parallel rays of light which pass through a lens 'L'. The ray XY after passing through the lens will pass through the point

A. I  
B. II  
C. III  
D. IV  
E. V

16. A long needle is viewed through a lens. The needle and its image appear as in Figure 1. When the head is moved to the left, the needle (object) and its image appear as in Figure 2.

Which of the following statements is/are correct?

I. The object is more distant than the image. 
II. The image is more distant than the object. 
III. The lens is convex. 
IV. The lens is concave.

A. III only  
B. I and III only  
C. II and III only  
D. I and IV only  
E. II and IV only
17. A pair of rays converge on the point I as shown in the diagram. Which of
the following pieces of apparatus, placed along the line MN will displace
the convergent point to the right?

I. a concave lens
II. a convex lens
III. a rectangular slab of glass.
A. I only   B. II only
C. III only  D. I and III only

18. In the diagram, the ray between the lenses is parallel to the axis. Only
one incident ray and one emergent ray are correctly drawn. Which of the
following pairs are the correctly drawn rays?

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<th>Incident Ray</th>
<th>Emergent Ray</th>
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<td>IV</td>
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<tr>
<td>II</td>
<td>V</td>
</tr>
<tr>
<td>III</td>
<td>VI</td>
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</tbody>
</table>

19. Which of the following is a property of a sound wave?

A. It does not require a material medium.
B. It is an electromagnetic wave.
C. It is a transverse vibration.
D. It travels most rapidly in a vacuum.
E. It is a longitudinal vibration.

20. Sound waves differ from electromagnetic waves in the following respects:

I. Sound waves can’t be refracted.
II. Sound waves have a greater velocity in a denser medium.
III. Sound waves can only travel in a gaseous medium.
A. I only  B. II only  C. III only
D. I and II only  E. None of the above

21. A sound wave of frequency f travels in air with a velocity c. Under the
same conditions, the velocity of the sound wave of frequency 2f will be
A. \(\frac{c}{2}\)  B. c  C. 2c
D. 4c  E. undetermined

22. Two men A and B stand on a line vertical to and in front of a high wall.
The distance between A and the wall is 330 m, between B and the wall is
660 m. When A makes a whistle, B hear the sound first and then the echo
from the wall. Let the velocity of sound be 330 m/s, find the length of
time between the sound and echo B heard.
A. 0 sec   B. 1 sec  C. 2 sec
D. 3 sec  E. 4 sec
23. With respect to a sound wave, 
   I. the pitch depends on frequency 
   II. the quality depends on velocity 
   III. the loudness depends on amplitude
Which of the above statements is/are correct?
   A. I only  B. II only  C. III only
   D. I and II only  E. I and III only

24. The quality of the same note produced from different musical instruments depends on
   A. the combination of overtones. 
   B. the length of the sound wave. 
   C. the energy of the sound wave. 
   D. the amplitude of the sound wave. 
   E. the density of the medium transmitting the sound.

25. A commonly used method of tuning a sonometer wire into resonance with a tuning fork employs a paper rider.
Which of the following statements is/are true?
   I. the wire vibrates because energy taken from the tuning fork is transferred to the wire and the paper rider.
   II. the position of the rider is unimportant.
   III. the mass of the rider is unimportant.
   A. I only  B. I and II only  C. I and III only
   D. II and III only  E. I, II and III

26. Which of the following is/are transverse waves?
   I. Light waves 
   II. Sound waves 
   III. Water waves
   A. I only  B. II only  C. I and II only
   D. I and III only  E. II and III only

27. Of the following radiations, the one which has nearly the same natures as X-rays is
   A. infra-red  B. ultra-violet  C. visible light
   D. radio wave  E. gamma-ray

28. F.M. broadcasting with a frequency 92 MHz is transmitted by radio Hong Kong every day. The wave length of this broadcasting is approximately.
   A. 0.3 m  B. \(186 \times 10^{-4}\) m  C. \(3 \times 10^8\) m
   D. 3.3 m  E. 1.7 m

29. If the distance between a point source of light and a surface is tripled, the intensity of illumination on the surface will be
   A. triple  B. doubled  C. reduced to \(1/3\)
   D. reduced to \(3/4\)  E. reduced to \(1/9\)
The diagram represents the pattern of water waves observed when an obstacle is placed in a ripple tank. Which of the following physical phenomena does the diagram illustrate?

A. Reflection
B. Refraction
C. Dispersion
D. Diffraction with interference
E. Diffraction without interference

31. Which of the following is used to measure the internal diameter of a pipe?

A. a metre
B. a vernier
C. a micrometer screw gauge
D. a measuring cylinder
E. slide calipers

32. Which statements are correct about a burette?

1. It should be read at a position right angle to it.
2. The zero mark is at the bottom.
3. There is only one division on the burette.
4. It can be used to run out small quantities of liquid repeatedly.

A. 1, 2 and 4  B. 1 only  C. 1, 2 and 3  D. 1 and 4  E. None of the above combinations.

SECTION B: LONG QUESTION (68%)

1. Describe fully the apparatus used, how it is set up, and the precautions which are taken, in order to obtain an accurate value for the focal length of a concave spherical mirror. Show how the observations made are used to give the final result.

A concave spherical mirror has a focal length of 10 centimetres. Where must an object be placed in order to produce a real magnified image three times as tall as the object?

How far, and in what direction, does the object need to be moved to produce a virtual image three times as tall as the object?

2. Distinguish between a real image and a virtual image. Give ray diagrams to show how a converging lens can form (a) a real image, and (b) a virtual image, of a small object. Label each diagram clearly and mark the positions of the principal foci of the lens.

If the focal length of a camera lens is 10 cm how far away from the film must the lens be set in order to photograph an object 100 cm away from the lens?

State and explain one way of controlling the light energy falling on the film in a camera.
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1) We can see the image of ourselves in the plane mirror but not on a plane sheet of white paper because

(A) white paper transmitted nearly all the light falling on it.
(B) white paper absorbed all the light falling on it.
(C) light is diffusely reflected from the white paper.
(D) the image formed in white paper is virtual.
(E) the refractive index of white paper is unknown.

2) The rays A & B diverging from a point source P are reflected from a plane mirror MM'. The reflected rays C & D will now diverge at an angle of

(A) 5°  (B) 10°  (C) 20°  (D) 30°  (E) 50°

3) Whenever the centers of the sun, moon and earth are in a straight line (in that order):

I some part of the earth is in the moon's penumbra
II some part of the earth must be in the moon's umbra
III some part on the earth can see a total eclipse of the sun

Which of the above statements is/are true?

(I) I only.
(B) I & II only
(C) II only
(D) III only
(E) All three

4) Which of the following mirrors can give an image (real or virtual) of the same size as an object which is not in contact with the mirror?

I concave mirror
II convex mirror
III plane mirror

(A) I only;
(B) III only
(C) I & II only
(D) I & III only
(E) All three

5) In the figure, the position of the pin has been so adjusted that the pin and its image may be observed with no parallax between them. What is the focal length of the mirror?

(A) 12 cm  (B) 20 cm  (C) 24 cm  (D) 40 cm
(E) It cannot be determined from the information given.

6) Rays from a point source at U are reflected by a concave mirror M and converge to a point V as shown in the diagram. If we wish to obtain a parallel beam of light after reflection, we could

I move the mirror closer to U
II move the mirror away from U
III keep the source at U and replace M by a suitably chosen concave mirror of shorter focal length

(A) I only
(B) II only
(C) III only
(D) I & II only
(E) II & III only

7) Total internal reflection can occur at a surface of separation between a dense medium X and a rare medium Y only when

I the refractive index for light from X to Y is greater than 1
II the angle of incidence is greater than the critical angle
III the ray travels from X towards Y
7) Which of the above statements is/are correct?
   (A) I only   (B) II only   (C) I & II only
   (D) II & III only   (E) All three

8) The angle of incidence of a ray of light on a liquid is 45° and its angle of refraction is 30°. What is the critical angle of the liquid?
   (A) 75°   (B) 60°   (C) 45°   (D) 30°   (E) 15°

9) The diagram shows a thin-walled prism filled with air. The air prism is immersed in water. A ray of light is incident along the line AB. Along which line will the light emerge?
   (A) 1   (B) 2   (C) 3   (D) 4   (E) 5

10) The path of a ray of light through a glass prism can be found if we know:
   I. the refractive index of the glass
   II. the refracting angle of the prism
   III. the angle of incidence at one side of the prism
   (A) III only   (B) I & II only   (C) I & III only
   (D) II & III only   (E) All three

11) A diver at h metres under water looks up at the water surface and observes the sky appears to be a circle. What is the diameter of the circle if the critical angle of water is C? (in metre)
   (A) h tan C   (B) 2h tan C   (C) 2h sin C
   (D) h sin C   (E) 2h sin C

12) In the diagrams shown, the critical angle of glass is 42°. Which diagram shows the correct path for the light ray through the prism?
   (A)   (B)   (C)   (D)   (E)

13) When a lens is placed at M, a real, inverted and magnified image of the illuminated pin is seen on the screen. When the lens is moved to position N, a sharp image of the pin is seen again. This image will be
   (A) real, inverted and magnified.   (B) real, inverted and diminished.
   (C) real, erect and diminished.   (D) real, erect and magnified.
   (E) virtual, erect and magnified.

14) Two parallel rays of light pass through a box containing a piece of glass and emerge as shown.
   (I)   (II)   (III)   (IV)   (V)
14) Which of the above pieces of glass could produce this result?

(A) I only  (B) III only  (C) II or III  (D) I or IV  (E) All four

15) When the eye is looking at an image in the mirror, the image formed on the retina of the eye is virtual because the image which appears in the eye is virtual.

(A) True  (B) True  (C) True  (D) False  (E) False

The diagram shows two incoming parallel rays of light which pass through a lens L. The ray PQ after passing through the lens will pass through the point.

(A) I  (B) II  (C) III  (D) IV  (E) V

In the diagram, the ray between the lenses is parallel to the axis. Only one incident ray and one emergent ray are correctly drawn. Which of the following pairs are the correctly drawn rays?

<table>
<thead>
<tr>
<th>Incident Ray</th>
<th>Emergent Ray</th>
</tr>
</thead>
<tbody>
<tr>
<td>(A) I</td>
<td>V</td>
</tr>
<tr>
<td>(B) I</td>
<td>V</td>
</tr>
<tr>
<td>(C) II</td>
<td>IV</td>
</tr>
<tr>
<td>(D) II</td>
<td>V</td>
</tr>
<tr>
<td>(E) III</td>
<td>V</td>
</tr>
</tbody>
</table>

18) A red disc is placed on a green grass ground and is then illuminated with coloured light given below, which could make the disc indistinguishable from its background?

(A) magenta  (B) blue  (C) green  (D) white  (E) red

19) Red and blue filters are placed directly in the path of white light. What is the colour of the light coming through?

(A) black (no light pass through)  (B) green  (C) yellow  (D) white  (E) magenta

20) The closed pipe shown is 0.9 m long and contains a stationary sound wave with nodes N and antinodes A at the position shown. The wavelength of the sound is (in m)

(A) 0.15  (B) 0.3  (C) 0.45  (D) 0.6  (E) 0.9

21) Sound waves differ from electromagnetic waves in the following respects:

I Sound waves have a larger velocity in a denser medium
II Sound waves can only travel in a gaseous medium
III Sound waves can't be refracted.

(A) I only  (B) II only  (C) III only  (D) I & II  (E) None of the above
22) A sound wave of frequency \( f \) travels in air with a velocity \( C \). Under the same conditions, the velocity of the sound wave of frequency \( 2f \) will be

(A) \( \frac{4}{3} C \)  
(B) \( \frac{2}{3} C \)  
(C) \( \frac{C}{3} \)  
(D) \( \frac{1}{3} C \)  
(E) cannot be determined

23) Two men \( X \) & \( Y \) stand on a line vertical to and in front of a high wall. The distance between \( X \) and the wall is 330 m, between \( Y \) and the wall is 660 m. When \( X \) makes a whistle, \( Y \) hear the sound first and then the echo from the wall. Let the velocity of sound be 330 m/s, find the length of time between the sound and echo \( Y \) heard (in sec.)

(A) 4  
(B) 3  
(C) 2  
(D) 1  
(E) 0

24) The diagram shows a disc siren, the pitch emitted by this disc will depend on

I the number of revolutions the disc turns through per second  
II the distance of the whales from the axle of the disc  
III the number of holes in the disc.

(A) II only  
(B) I & II only  
(C) I & III only  
(D) II & III only  
(E) All three

25) Two loudspeakers \( A \) & \( B \) broadcast the same pure note. The sound from loudspeaker \( A \) is louder than that from loudspeaker \( B \). The sound waves produced by \( A \)

(A) have greater amplitude than those by \( B \)  
(B) have longer wavelength than those by \( B \)  
(C) have shorter wavelength than those by \( B \)  
(D) have higher frequency than those by \( B \)  
(E) travel faster than those by \( B \)

26) The quality of the same note produced from different musical instruments depends on

(A) the length of the sound wave.  
(B) the energy of the sound wave.  
(C) the amplitude of the sound wave.  
(D) the combination of overtones.  
(E) the density of the medium transmitting the sound.

27) When the air in a tube closed at one end and open at the other is made to vibrate, it has

(A) a node at the close end.  
(B) an antinode at the closed end.  
(C) an antinode exactly at the open end.  
(D) maximum amplitude halfway along its length.  
(E) the frequency of any strongly vibrating tuning fork placed near the open end.

28) A sonometer wire emits a note of frequency 300 Hz when under a tension of 2 kgf. If the tension is increased to 8 kgf and the length is kept constant, the frequency of the note becomes (in Hz).

(A) 4800  
(B) 1200  
(C) 600  
(D) 150  
(E) 75

29) A commonly used method of tuning a sonometer wire into resonance with a tuning fork employs a paper rider. Which of the following statements is/are true?

I the mass of the rider is unimportant  
II the position of the rider is unimportant  
III the wire vibrates because energy taken from the tuning fork is transferred to the wire and the paper rider.

(A) I only  
(B) II only  
(C) III only  
(D) I & II only  
(E) I & III only
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<thead>
<tr>
<th>Line</th>
<th>Column</th>
<th>Instruction</th>
<th>Definition</th>
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</tr>
<tr>
<td>1093</td>
<td>49</td>
<td>+GO</td>
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</tr>
</tbody>
</table>
1. 针孔照相机的针孔直径和像的大小、光度及清晰度有何影响？
   - 加倍 软化 減低
   - 加倍 風光 不变
   - 加倍 加强 減低
   - 減半 風光 不变
   - 減半 加强 增高

2. 眼注视像内的像时，视细胞的反应是：
   - 有倒立缩小的像
   - 有正立缩小的像
   - 有倒立放大的像
   - 有正立放大的像
   - 有正立缩小的像

3. 物放于镜前，得一倒立放大之实像，则该物应在________
   - 无限远端
   - 曲率中心以外
   - 曲率中心点
   - 焦点与镜面之间

4. 下列何者可产生虚像之虚像？
   - 可以计算出来，如知道下列
   - A. 透镜 ABC 镜正
   - B. 只有 I
   - C. 只有 II
   - D. 只有 ABC
   - E. I Ⅱ A Ⅲ

5. 光线通过三棱镜之路径
   - 由于光可被反射，如知道下列
   - A. 只有 I
   - B. 只有 II
   - C. 只有 II
   - D. 只有 III
   - E. I Ⅱ A Ⅲ

6. 因中子射
   - 有正立缩小的像
   - 有正立放大的像
   - 有正立缩小的像

7. 下列何者可能存在？
   - 一支直棒在水平方向弯曲
   - 下列何者可以？
   - A. 有工 B. 只有 II C. 只有 III

8. 某人垂直射入水中 2 米深
   - 一物在水中折射率
   - 李的焦深
   - A. 1.5 m B. 2 m C. 2.5 m
   - D. 因水之澄清度而定
   - E. 与观察者和水面高度有关
### Question 10

In the figure, the angle of incidence is $42^\circ$.

Which angle in the figure is the correct angle of incidence?

- A. $\angle A$
- B. $\angle B$
- C. $\angle C$
- D. $\angle D$
- E. $\angle E$

**Solution:**
- Correct answer: **E**

### Question 11

In the figure, which of the following is incorrect?

- A. $\angle A$
- B. $\angle B$
- C. $\angle C$
- D. $\angle D$
- E. $\angle E$

**Solution:**
- Incorrect answer: **C**

### Question 12

A light source is in water at a depth of $x$ meters. Which of the following expressions correctly represents the angle of incidence?

- A. $2x \tan \theta$
- B. $2x \sin \theta$
- C. $x \tan \theta$
- D. $x \sin \theta$
- E. $\frac{2x}{\sin \theta}$

**Solution:**
- Correct answer: **E**

### Question 13

Under which of the conditions can the light of the sun be seen from the water?

- A. Only condition I
- B. Only condition II
- C. Only conditions I and II
- D. All conditions I, II, III, and IV
- E. None of the above

**Solution:**
- Correct answer: **D**

### Question 14

Which of the following lenses are used in telescopes?

- A. Only lens A
- B. Only lens B
- C. Only lens C
- D. Both lens A and B

**Solution:**
- Correct answer: **D**
17. 下列哪一不等於原子序數之和，則元素逐漸移
向左方？
A. Li C vs. C  B. 2c  D. 4c.
T. 同素異形之正三氧化成
Ⅲ. 長方體玻璃塊，
(1) 只有Ⅰ C. 只有Ⅲ D. 只有Ⅰ及Ⅲ.
(2) A. 只有Ⅱ C. 只有Ⅲ D. 只有Ⅰ及Ⅲ.
B. 入射線
C. II
D. III
E. III

18. 下列何者是波的性質？
A. 它無需介質 B. 它是电磁波
C. 它是横向波動 D. 它是傳播最快
E. 它受振動波長

19. 下列何者是音波的性質？
A. 它無需介質 B. 它是电磁波
C. 它是橫向波動 D. 它是傳播最快
E. 它受振動波長

20. 水波(3)被鐵板沒有聽到時不同
A. 声波可被折射
B. 波長較長
C. 頻率較高
D. 声波波長
E. 頻率較高

21. 声波能度為 f，其節律是 c.
若在同一情況中，频率2倍，波長
(1) D. 2f  B. 2c  C. 4c
(2) A. 不常見

22. 甲乙兩球面相同一高堵，乙
(1) A. 乙在橋頭 B. 乙在橋尾
(2) A. 乙在橋頭 B. 乙在橋尾

23. 以下何者正確？
I. 波動與頻率有關
II. 波動與聲度有關
III. 波動與震幅有關
A. 只有I B. 只有II C. 只有III D. 只有I及II E. 只有III

24. 下列何者為生物學的
A. 符合音波的特性
B. 符合波的特性
C. 符合聲波的特性
D. 符合光波的特性
E. 符合位移的特性

25. 下列何者為物理學的
A. 符合光波的特性
B. 符合波的特性
C. 符合聲波的特性
D. 符合光波的特性
E. 符合位移的特性
2638  129  +SET LR = ' )LRI3 '  DEFINED [LR]  GO
2638  129  +GO  DEFINED [LR]  GO

2661  121  +SET PR = ' )LRI3 '  DEFINED [PR]
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2682  122  +GO  DEFINED [LR]  GO

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2847  128  +GO  DEFINED [LR]  GO

2853  128  +FOOTNOTE LEAVING 2 LINES  FOOTNOTE
2854  123  Usually, more than 90% of students stay in the same
2855  128  secondary school for five years.
2856  128  [footend]  GO
### Teaching Schedule of F.4 Physics (1979)

<table>
<thead>
<tr>
<th>Date</th>
<th>Period</th>
<th>Content</th>
</tr>
</thead>
<tbody>
<tr>
<td>7/2</td>
<td>1</td>
<td>What is force, gravitational force</td>
</tr>
<tr>
<td>9/2</td>
<td>2,3</td>
<td>Centripetal force, Weights of standard masses, Why the weight of a body varies, relation between gravitational force and weight, action and reaction forces, weightlessness, weightlessness in space vehicles, artificial weight in a space station, friction, static friction, sliding friction, coefficient of friction, the nature of friction, friction and brakes, lubrication, air lubrication, further developments.</td>
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<tr>
<td>13/2</td>
<td>4</td>
<td>Discussion of exercise 2, average speed, actual speed, scalar and vector quantities, distance and displacement.</td>
</tr>
<tr>
<td>15/2</td>
<td>5,6</td>
<td>Experiment to determine the coefficient of limiting static friction between two solid surfaces, velocity, uniform velocity, acceleration, uniform acceleration.</td>
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<td>19/2</td>
<td>7,8</td>
<td>Equations of uniformly accelerated motion, velocity-time graph, uniformly accelerated motion represented graphically, velocity from distance-time graph, acceleration from velocity-time graph, worked examples, Galileo Galilei, the simple pendulum experiment to study the simple pendulum, the measurement of g.</td>
</tr>
<tr>
<td>21/2</td>
<td>9</td>
<td>Distance moved by a freely falling body related to time of fall, to measure g by use of a centisecond timer, discussion of exercise 3.</td>
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<tr>
<td>23/2</td>
<td>10,11</td>
<td>Newton's first law of motion, momentum, Newton's second law of motion, weight of a body expressed in newtons, to calibrate a spring balance in newtons, use of a calibrated spring balance, can a spring balance be used to measure mass as well as weight, weight of a body in a lift.</td>
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<td>27/2</td>
<td>12</td>
<td>Newton's third law of motion, law of the conservation of momentum, to verify the conservation of momentum for interacting bodies moving in the same straight line, rocket propulsion jet engines.</td>
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<td>Worked examples, discussion of exercise 4.</td>
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<td>14,15</td>
<td>Experiments with an elementary force and motion cart, addition of displacement, polygon of vectors, resultant force, equilibriant, worked examples.</td>
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<td>16,17</td>
<td>Resolution of forces, worked examples, addition of velocities, the parallelogram rule for adding vectors, the ferryman's problem, three forces in equilibrium, experiments to verify the parallelogram of forces and the triangle of forces.</td>
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<td>Principle of moments, resultant moment, experiments to verify the principle of moment and to find the weight of an object.</td>
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<td>Parallel forces, couples, to study parallel forces in equilibrium, centre of gravity, the plumbline.</td>
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<td>16/3</td>
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<td>Experiments to locate centre of gravity by a balancing method and by means of a plumbline, centre of gravity of a stool or tripod, to find the mass of an object by means of a metre rule, principle of the beam balance, to measure the mass of a metre rule by using a single known mass, the steelyard, stable, unstable and neutral equilibrium.</td>
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<td>20/3</td>
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<td>Worked examples, discussion of exercise 6.</td>
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<td>22/3</td>
<td>25,26</td>
<td>Work, energy, mechanical energy, interchange of energy between potential energy and kinetic energy, internal energy, transfer of energy from one kind to another, heat energy, the sun as a source of energy, the uranium bomb, the conservation of energy and mass, thermonuclear energy.</td>
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<td>23/3</td>
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<td>Power and its unit, to measure personal power, kinetic energy.</td>
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<td>26/3</td>
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<td>Internal combustion engines, worked examples, discussion of exercise 7.</td>
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<tr>
<td>28/3</td>
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<td>The lever, mechanical advantage, mechanical advantage of a lever, pulleys, the single fixed pulley, the single moving pulley, direction of tension in a string.</td>
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<td>The block and tackle, velocity ratio, work done by a machine, efficiency, relation between M.A., V.R., and efficiency, the inclined plane, the screw, experiments to determine the M.A., V.R. and efficiency of a block and tackle system, then an inclined plane.</td>
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<td>2/4</td>
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<td>Wheel and axle principle, gears, the hydraulic press.</td>
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<td>3/4</td>
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<td>Discussion of exercise 8.</td>
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Cheung, P.W. *Practical Physics (Third edition)*
Hung Fung Book Co.
Appendix 12
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Answer all 69 items in the M.C. answer sheets. Each carries equal marks.

1. The coefficient of static friction between two solid surfaces in contact depends on
   A. the surface area in contact.
   B. the limiting friction between the two surfaces.
   C. the normal reaction between the two surfaces.
   D. the texture of the surfaces in contact.
   E. None of the above.

2. A 5 kg metal is sliding on a horizontal metal surface. Let the coefficient of sliding friction be \( \mu_s = 0.34 \), find the required horizontal force.
   A. 0 kg wt
   B. 0.5 kg wt
   C. 2 kg wt
   D. 5 kg wt
   E. 50 kg wt

3. The bob of a pendulum consists of a light but not weightless cylindrical tube full of oil. As the oil leaks away from the tube, the periodic time of the oscillating pendulum
   A. remains unchanged.
   B. increases.
   C. decreases.
   D. increases and then decreases.
   E. decreases and then increases.

4. Which of the following pieces of apparatus measure(s) weight only, and does compare masses?
   I. beam balance
   II. spring balance
   III. Chinese steelyard
   A. I only
   B. II only
   C. III only
   D. I and II only
   E. II and III only

5. Two particles are allowed to fall freely from the same point, one of which is released a short time before the other. Neglecting the resistance of air, which of the following statements are correct?
   (1) they undergo the same acceleration
   (2) their velocities always differ by the same amount
   (3) their distance of separation is always the same
   A. (1) and (2) only
   B. (1) and (3) only
   C. (2) and (3) only
   D. None of the above

6. An object passing a mark with a velocity of \( y \) m s\(^{-1}\) eastward is subjected to a constant acceleration of \( a \) m s\(^{-2}\) in a westward direction. How long will it take to return to the same mark?
   A. \( \frac{y^2}{a} \) seconds
   B. \( \frac{2y}{a} \) seconds
   C. \( \frac{y^2}{2a} \) seconds
   D. \( \frac{2y}{a} \) seconds
   E. \( \frac{y^2}{2} \) seconds

7. A stone is thrown vertically upwards, at its highest position it has
   I. zero velocity
   II. no acceleration
   III. maximum kinetic energy
   Which of the above statements is/are correct?
   A. I only
   B. II only
   C. III only
   D. I and II only
   E. I and III only
An object, moving up a smooth inclined plane making an angle $\theta$ with horizontal, decreases its speed from $X$ to $Y$ m/s. What is the distance travelled in this period?

- $P. \frac{x^2 - y^2}{2g}$ metres
- $Q. \frac{x^2 - y^2}{2g \cos \theta}$ metres
- $R. \frac{x^2 - y^2}{2g \sin \theta}$ metres
- $T. \frac{(x - y)}{2g \sin \theta}$ metres

A horizontal force is applied to an object resting on a smooth horizontal surface. The relationship between the force and the time of application of this force is represented by the graph above. Which of the following "velocity time" graphs correctly illustrates the motion of the object under this force?

- $P.$
- $Q.$
- $R.$
- $S.$
- $T.$

The acceleration exists when the magnitude and direction of the motion of the body is/are described below.

<table>
<thead>
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<th>Magnitude of Velocity</th>
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<td>i) constant</td>
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<tr>
<td>ii) variable</td>
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<tr>
<td>iii) variable</td>
<td>variable</td>
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- $P.$ i only
- $Q.$ ii only
- $R.$ iii only
- $S.$ i and ii only
- $T.$ ii and iii only

A metal sphere on a horizontal plane is given a push so that it quickly runs off the edge of the plane. If air resistance is negligible, what is its vertical displacement downwards in $\frac{1}{2}$ second after it has left the plane? (Acceleration due to gravity $= 10 \text{ m s}^{-2}$)

- $A. 5 \text{ m}$
- $B. 2\frac{1}{2} \text{ m}$
- $C. 7 \frac{1}{2} \text{ m}$
- $D. 0 \text{ m}$
- $E. \text{ uncertain, for it does not start with zero velocity}$

The time of a simple pendulum making small oscillations depends upon

- $A.$ the length of the string and the acceleration due to gravity.
- $B.$ the mass of the bob and the angle of swing.
- $C.$ the mass of the bob and the length of string.
- $D.$ the mass of the bob and the acceleration due to gravity.
- $E.$ the length of the string and the angle of swing.
Two objects, X of mass 5 g and Y of mass 10 g are projected vertically upwards at the same time with the same velocity of projection. Assuming the air resistance is negligible,

A. Y will come to rest first.
B. X will reach a point higher than Y.
C. both objects have the same potential energy at the highest point.
D. both objects rise with the same retardation.
E. both objects have the same kinetic energy just before getting to the ground.

The period of oscillation of a simple pendulum is 1 second at the surface of the earth. If the acceleration due to gravity at the moon's surface is 1/5 that of on the earth, what is the period of oscillation when the pendulum is on the moon?

A. 1/5 second  B. 1/15 second  C. 15 seconds  D. 5 seconds  E. 25 seconds

If a stationary object explodes, breaking into three unequal fragments,

A. velocity of the fragments are equal.
B. velocity of the fragments are proportional to their mass.
C. the velocity of the fragments are coplanar.
D. the fragments fly off along the same straight line.
E. there is no definite route regarding the velocity of the fragments.

A car of mass M is travelling at a velocity V. If now a braking force is applied, the minimum stopping distance will depend on

i the coefficient of friction between the tyres and the road
ii velocity of the car
iii mass of the car

P. i only  Q. ii only  R. i and ii only
S. i and iii only  T. i, ii and iii

If the resultant of all forces acting on a body is zero, the body may be

P. accelerating.
Q. decelerating.
R. falling under gravity.
S. moving with uniform velocity.
T. moving along a circular track with uniform speed.

A body of mass 10 kg is moving with a velocity of 5 m/s. What is the force required to stop the body completely in 2 seconds?

P. 1 N  Q. 4 N  R. 25 N  S. 50 N  T. 100 N

A ball of mass 1 kg is dropped on a hard surface and bounces. If its speed is 20 m/s just before impact and 16 m/s immediately after impact, its change in momentum is

P. 36 kg m/s  Q. 20 kg m/s  R. 16 kg m/s
S. 4 kg m/s  T. 0 kg m/s

Which of the following is an effect, or are effects, due to a force acting on a body?

I the body changes in shape
II the body moves with a constant acceleration in a straight line
III the body moves with a constant velocity in a straight line

P. I only  Q. II only  R. III only
S. I and II only  T. I and III only

A block of mass 10 kg is put on the floor of a cage. If the whole system is now falling freely from rest under gravity, what is the magnitude of the normal reaction between the block and the floor?

A. 0 kgf  B. 10 kgf  C. 970 kgf  D. 980 kgf  E. 990 kgf
The two identical spring balances X and Y, each of mass 40 g and 600 g, are suspended as shown in the diagram. The readings of X and Y are

A. $\frac{640}{600}$ g  $\frac{600}{600}$ g
B. $\frac{600}{600}$ g  $\frac{600}{600}$ g
C. $\frac{340}{300}$ g  $\frac{300}{300}$ g
D. $\frac{320}{320}$ g  $\frac{320}{320}$ g
E. $\frac{300}{300}$ g  $\frac{300}{300}$ g

The weight of a 10 kg object is hanging on a spring balance in an elevator. When the elevator is

A. moving up with constant velocity 5 m/s
B. moving up with constant acceleration 2 m/s².

The reading from the spring balance will be:

(A) 10 kg wt 10 kg wt
(B) 15 kg wt 10 kg wt

Forces act as shown at a point P. The effect of these forces is to cause the point P to

A. remain stationary.
B. move at constant velocity in direction of Z.
C. move at constant velocity in direction opposite to Z.
D. accelerate in direction opposite to Z.
E. accelerate in direction Z.

A man walks 1 km due west and then 3 km due south. His displacement from the starting point is

A. 2 km $30°$ W of S
B. 2 km $60°$ W of S
C. 1 + 3 km $30°$ W of S
D. 1 + 3 km $60°$ W of S

An object is resting on a rough plane inclined at an acute angle $\theta$ to the horizontal. As the angle $\theta$ gradually increases the frictional force experienced by the object BEFORE it begins to slide will be directly proportional to

$F \cdot \frac{1}{\sin \theta}$

A. $\frac{1}{\sin \theta}$
B. $\frac{1}{\cos \theta}$
C. $\frac{1}{\tan \theta}$
D. $\frac{1}{\sec \theta}$

The above diagram shows the magnitude and direction of three coplanar forces acting at a point O. The resultant of these three forces will

P. lie in the 1st quadrant
Q. lie in the 2nd quadrant
R. lie in the 3rd quadrant
S. lie in the 4th quadrant
T. be zero
28. Which of the following is a vector quantity?


A lamp of mass 100 g hangs at the end of a light wire. A light string knotted at the middle of the wire exerts a horizontal pull until the upper portion of the wire inclines at an angle of 30° to the vertical. What is the tension of the horizontal string?

P. 0 gf  Q. 50 gf  R. 100 gf
S. 100 tan 30° gf  T. 100 tan 60° gf

A load W rests on an inclined plane. The coefficient of kinetic friction is μ. What is the minimum pull F required to keep the body W moving at steady speed up the plane?

P. W + MW cos θ  Q. W(sin θ + cos θ)
S. W sin θ + μW sin θ  T. W cos θ + μW sin θ

A man walks 1 km due west and then 3 km due south. His displacement from the starting point is

A. 2 km 30° W of S  B. 2 km 60° W of S
C. 1 + 3 km 30° W of S  D. 1 + 3 km 60° W of S

32. Which of the following quantities are vectors?

I. speed  II. velocity  III. fluid pressure  IV. force  V. potential energy

A. I and II only  B. II and III only
C. II, III and IV only  D. II, IV and V only
E. III, IV and V only

A wooden block of W g weight rests on a hinged wooden plane. One end of the plane is raised slowly until the block just begins to slide. If this occurs at angle θ, which of the following is true?

A. The kinetic coefficient of friction is W sin θ  B. The kinetic coefficient of friction is tan θ
C. The static coefficient of friction is W sin θ  D. The static coefficient of friction is W cos θ
E. The static coefficient of friction is tan θ

A body of mass 10 g rests on a rough inclined plane at an angle of 30° to the horizontal. If the body does not move, what is the frictional force between the body and the inclined plane?

A. 0.5 gf  B. 0.866 gf  C. 5 gf
D. 5.66 gf  E. 10 gf
A hinged trapdoor is held in the position shown by the rope. Under these conditions the direction of the force on the hinge will

A. be vertical.
B. be horizontal.
C. be directed through the C.G. of the trapdoor.
D. be parallel to the rope.

Which of the following are vectors?

I Pressure
II Push or Pull
III Power

P. I only
Q. II only
R. III only
S. I and II only
T. I, II and III

In the above diagram, the moment of the force F about the point A is

P. F x AB
Q. F x AC
R. F x AD
S. F x BC
T. F x BD

When a meter stick is set up as shown, it will be in equilibrium. If the pivot point is moved to the 6 cm point, find the position of E so that the system becomes equilibrium again. (Assume the weight of the meter stick is zero.)

P. 28 cm
Q. 34 cm
R. 41 cm
S. 66 cm
T. 76 cm

Two equal and opposite forces F acts on a rod XYZ as shown in the above. Find the total moment due to this parallel forces is

P. greatest above the point X.
Q. greatest above the point Y.
R. greatest above the point Z.
S. the same about the points X, Y and Z only.
T. the same about any points.

A couple is defined as two parallel forces which are

P. equal and acting in the same direction.
Q. equal but acting in the opposite directions.
R. unequal and acting in the same direction.
S. unequal but acting in the opposing directions.
T. None of the above
41. A uniform rod weighs 60 g and is 120 cm long. It is supported on a pivot X which presses upwards with a force of 140 gf. At the 80 cm mark the rod passes through a slot in a fixed metal plate. Weights hang from the ends of rod as shown.

The force exerted by the rod on the metal plate is

A. 0 B. 40 gf upwards C. 50 gf downwards D. 60 gf upwards E. 65 gf upwards

42. The suspended rod is a uniform metre stick of mass 100 g in both figures. In each case the rod is in equilibrium. Suspended weights are indicated in grams. The type of equilibrium to be found in each figure

Figure 1: A. stable B. neutral C. unstable
Figure 2: A. stable B. neutral C. unstable

43. In the diagram, what is the effort required to lift the load?

A. 96 kgf B. 144 kgf C. 160 kgf D. 9.6 kgf E. 16 kgf

44. A beam balance with unequal arms is used to measure the mass of an object. When the object is placed in the right-hand pan, the weighing is \( W_1 \). When in the left-hand pan, the weighing is \( W_2 \). What is the mass of the object?

A. \( W_1 \) B. \( W_2 \) C. \( W_1 \times W_2 \) D. \( (W_1 \times W_2)^{1/2} \) E. \( \frac{1}{2}(W_1 + W_2) \)

45. Fig. I, II and III show a U-shaped lamina in equilibrium when supported on a knife-edge in three different ways. The type of equilibrium to be found in each figure is

Figure I: A. stable B. unstable C. neutral
Figure II: A. neutral B. stable C. unstable
Figure III: A. neutral B. stable C. neutral
46. In Fig. I, a graduated uniform steel rod 40 cm long hangs suspended from two wires A and B, the tension in each wire being 1 kgf. In Fig. II, when the mass M kgf is hung from the same rod at a certain position, the tension in wire A becomes 2 kgf and the tension in wire B becomes 2 1/2 kgf. What is the mass M and its position on the rod?

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<td>4.5 kg</td>
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0.29

0.01

A uniform metre rule of weight 0.500 N is maintained in equilibrium as shown above. What is the value of the weight X?

P. 0.250 N  Q. 1.500 N  R. 4.000 N  S. 4.125 N  T. 4.750 N

0.11

The figure represents a uniform lamina with the two shaded portions cut out. The centre of the mass of the remaining portion is

P. in the first quadrant.  Q. in the second quadrant.
R. in the third quadrant.  S. in the fourth quadrant.
T. outside the large circle.

0.17

A particle of mass m kg is given a push so that it leaves the table with a velocity of \( v = \text{m s}^{-1} \) as shown in the above diagram. The energy the particle possesses at a point x metres above the ground is

P. \( \frac{1}{2}mv^2 \) joules  Q. \( \frac{1}{2}mv^2 + mgx \) joules
R. \( \frac{1}{2}mv^2 + mg(h - x) \) joules  S. \( \frac{1}{2}mv^2 + mgh \) joules
T. \( mg(h - x) \) joules

50. A body of mass 10 kg is moving with a velocity of 5 m s\(^{-1}\). What is its kinetic energy?

P. 25 J  Q. 50 J  R. 100 J  S. 125 J  T. 250 J
51. During the motion, a simple pendulum, the work done by the tension in the string is

A. directly proportional to the amplitude of swing.
B. inversely proportional to the amplitude of swing.
C. Zero
D. directly proportional to the length of the pendulum.
E. directly proportional to the mass of the bob.

52. Two bodies X and Y of masses 1 kg and \( \frac{4}{3} \) kg respectively are connected by a loose string as shown in the above diagram. X is moving with a velocity of 10 m s\(^{-1}\) in the direction indicated when Y is at rest. What is the final kinetic energy of the whole system when the string becomes taut?

A. 50 J  B. 40 J  C. 10 J  D. 8 J  E. 0 J

53. A body of mass \( m \) kilograms is dropped a point h metres above the ground. When it reaches a point x metres above the ground, its kinetic energy in joules is (Acceleration due to gravity = g)

A. \( mgx \)  B. \( \frac{1}{2} mx^2 \)  C. \( mgh \)  D. \( mg(h - x) \)  E. \( \frac{1}{2} m(h^2 - x^2) \)

54. The kinetic energy possessed by a moving body is directly proportional to

A. its velocity.  B. its acceleration.  C. its displacement.  D. its potential energy.  E. None of the above

55. A constant force \( F \) in the direction shown, is applied to a body whilst the body moves from H to K. KJ is a construction line. The work done by force \( F \) is

A. \( F \times HJ \)  B. \( F \times HK \)  C. \( F \times KJ \)  D. \( F \times (KJ + KJ) \)  E. impossible to calculate from the information given

56. Using the following symbols:

- \( F \): force exerted
- \( s \): distance moved
- \( t \): time taken for the force to move through distances
- \( v \): velocity of motion

The power produced by a machine is given by

- \( P = Fs \)  Q. \( F/t \)  R. \( Fv \)  S. \( F/s \)  T. \( Ft/v \)

57. Unit kinetic energy is the work done

A. per second in bringing to rest a body of mass 2 units
B. per second in bringing to rest a body of mass 2 units moving at unit velocity
C. in bringing a moving body of unit mass to rest
D. in bringing to rest a body of unit mass moving at unit velocity
E. in bringing to rest a body of mass 2 units moving at unit velocity
The work required to bring a moving object to rest is directly proportional to its

P. velocity
Q. momentum
S. potential energy
T. kinetic energy
R. acceleration

When the load is 600 N, the efficiency of the pulley system shown is 50%. This means that

F. 300 N is required to lift the load
G. 300 N is just able to prevent the load from falling
H. 400 N is just able to lift the load
S. 400 N is just able to prevent the load from falling
T. 600 N is just able to lift the load.

Three simple machines are shown as above, their velocity ratio when arranged in ascending order will be:

P. I, II, III
Q. II, III, I
S. II, III, I
T. III, II, I

A load L is pulled up as inclined plane by a force P. The velocity ratio of this inclined plane is

A. \( \frac{YZ}{XY} \)
B. \( \frac{XZ}{XY} \)
C. \( \frac{XZ}{XZ} \)
D. \( \frac{XY}{YX} \)
E. \( \frac{XY}{XZ} \)

Which of the following statement concerning a single string 'block and tackle' pulley system is correct?

A. Efficiency of the machine always increases as the number of pulleys in the machine increases
B. Efficiency will be 100% if the pulleys are frictionless
S. Efficiency increases with load
D. The mechanical advantage of the machine always equals its velocity ratio
E. The energy output is always greater than the energy input.
For a given machine, which of the following depend(s) on the load?

I. Velocity Ratio
II. Mechanical Advantage
III. Efficiency

A. I only  B. II only  C. I and II only  D. I and III only

The diagram shows a movable pulley resting on a rope. What is the velocity ratio of the system?

A. $2 \sec \theta$  B. $\sec \theta$  C. $2 \cos \theta$  D. $\cos 2\theta$  E. $2 \sin \theta$

A hydraulic press consists of two circular cylinders of radii 1 cm and 10 cm. The smaller cylinder is operated by a lever of velocity ratio 2. What is the velocity ratio of the whole press?

A. 5  B. 20  C. 50  D. 100

Which of the following machines is likely to have the greatest efficiency?

P. screw jack  Q. pulley system  R. inclined plane  S. wheel and axle  T. beam balance

The diagram shows a hydraulic press in which $A_1$ and $A_2$ are the cross-sectional areas of the small and large pistons respectively.

I. This machine turns a small pressure at $A_1$ into a large pressure at $A_2$.
II. It has a velocity ratio of $A_2/A_1$.
III. It may attain an efficiency of 100%.

A. I only  B. II only  C. I and II only  D. II and III only  E. I, II and III

When we say that the mechanical advantage of a machine is 15, we mean that

F. the work done by the machine is 15 times the work put into it.
G. the resistance overcome by the machine is 15 times the force applied to it.
H. the load moves through 15 times the distance moved by the effort.
I. the power put into the machine is 15 times that got out of it.
J. the frictional force is 15 times that of the effort.

What is the velocity ratio of the above windlass?

A. $4/5$  B. $5/4$  C. $3/2$  D. $5/2$
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Library: MACRO "P4" DEFINED FROM "JON:MACLIB(S129)"
RESEARCH PROJECT

ON

EFFECT OF MEDIUM OF INSTRUCTION UPON

STUDENT LEARNING IN MATHEMATICS, SCIENCE

AND HISTORY AT FORMS II, III AND IV LEVELS

Second Stage:

Four Lessons on ATOMIC STRUCTURE AND RADIOACTIVITY

at Form IV Level

The Chinese University of Hong Kong

School of Education

April 16, 1979
Syllabus and Time Allocation

Atomic Structure and Radioactivity

Lesson One: Atomic Structure (40 minutes)
   I. The Atomic Theory
   II. Atomic Models
   III. Nucleus, Mass Number, Atomic Number

Lesson Two: Isotopes and Radioactivity (25 minutes)
   I. Isotopes and Its Chemical Properties
   II. Radioactivity and Its Discovery

Assessment One: (15 minutes)
   15 multiple-choice questions for Lessons One and Two

Lesson Three: Radiation and Half-Life (40 minutes)
   I. alpha, beta and gamma radiations
   II. Half-Life and Decay Time
   III. Carbon Dating

Lesson Four: Tracer and Atomic Energy in Peaceful Uses (20 minutes)
   I. Tracer in Peaceful Uses
   II. Atomic Energy in Peaceful Uses

Assessment Two: (20 minutes)
   20 multiple-choice questions for Lessons Three and Four
Lesson One: Atomic Structure (40 minutes)

Time Allocation
(min.)

I. The Atomic Theory

5

The belief that complex substances are composed of simple, elementary components existed in ancient Greece. We know that almost every substance can be broken into smaller parts. About 2500 years ago, a Greek philosopher, Democritus taught that by breaking substances into smaller and smaller parts, one would finally reduce matter to its smallest particles, which could not be broken down any further. These smallest, indivisible particles were called ATOMS.

According to Democritus, atoms, like grains of sand, when packed together could be moulded into any form, so that everything in nature could be built with atoms.

II. Atomic Models

a. J.J. Thomson Model

Atoms had been pictured as small, hard indestructible particles until 1897. When the electron—a negatively charged particle much smaller than the atom, was discovered. In the next year, J.J. Thomson, the English scientist, who discovered the electron, proposed a so called 'plum pudding' model.

In his model, atoms are pictured as small spheres of positively charged matter in which electrons are embedded. (Figure 1). The atom should look somewhat like a snowball with some pebbles or a lump of raisin-studded pudding.
b. Rutherford-Bohr Model

The Thomson model was soon discarded as it failed to comply with new experimental findings. Thirteen years later, another English scientist, Ernest Rutherford proposed the 'Nucleon Model', (Figure 2) where the atom consists of a nucleus at the center surrounded by electrons which are negatively charged. His model was later modified by Niels Bohr, a Danish scientist.

Bohr pictured the atom as a miniature solar system. Inside the atom, electrons, like those planets revolving round the sun, are whirling round a tiny positively charged particle called the NUCLEUS. (Figure 3)

c. Our present view

Planets move round the sun in definite orbits but electrons are not. They are whirling round the nucleus with a very high speed, changing their orbits all the time. Because of their rapid motion, it is impossible to find their positions at any instant. The electron can still be found 'somewhere' round the nucleus, but its position can be described only in terms of 'probabilities'.

III. Nucleus, Mass Number and Atomic Number

III-1 The Nucleus

The nucleus, being much smaller than the atom, has a diameter \( \frac{1}{10000} \) part of the diameter of the atom; thus atoms consist largely of empty space. To have some idea of the relative sizes of the nucleus and the atom: if the nucleus were enlarged to the size of a small glass marble, the whole atom would be as big as a giant balloon measuring more than 300 feet across.

Since electrons are much lighter than atoms, (less than one-thousandth part), so that nearly all the mass of the atom is concentrated in the tiny but heavy nucleus.
5 Scientists found that the nucleus is composed of two kinds of particles—protons and neutrons.

The proton is a positively charged particle, possessing a positive charge equal in magnitude to that of the electron. In a neutral atom, the number of protons is equal to the number of electrons. Its mass is about 2000 times that of an electron.

The neutron does not carry any charge, its mass is the same as the proton. For some atoms, the number of neutrons is equal to the number of protons. But in some heavy atoms, those having large number of protons and neutrons, the number of neutrons is larger than the number of protons.

5 Protons and neutrons are the component particles of all atomic nuclei. To help in identifying various nuclei, scientists defined two numbers, the atomic number and the mass number.

The number of protons inside the nucleus is called the Atomic Number and is denoted by the symbol Z.

The total number of protons and neutrons is called the Mass Number and is denoted by the symbol A.

Less commonly, the number of neutrons is represented by N, which can be found by using the formula

\[ N = A - Z \]

when A and Z are known.

Examples: C atom—6 protons & 6 neutrons in nucleus

\[ Z = 6, \quad A = 6 + 6 = 12 \]

Na atom—11 protons and 12 neutrons

\[ Z = 11, \quad A = 11 + 12 = 23 \]
To represent helium, chemists use the abbreviated symbol: He. Nuclear physicists are more particular, they represent the nucleus of helium as \(^4\text{He}\) where the top-right no. = mass number and the bottom-left no. = atomic number.

From this symbol, we know at once that there are 4 particles in the nucleus, 2 protons and 2 neutrons.

In general, if \(X\) is the symbol of the element, its nucleus is represented as \(\_Z^AX\). The number of component particles are clearly given from the symbol.

Example: \(\_6^{12}\text{C} \), \(\_11^{23}\text{Na} \), \(\_92^{238}\text{U} \)
Lesson Two: Isotopes and Radioactivity (25 minutes)

I. Isotopes and Its Chemical Properties

I-1 Chemical Properties and Atomic Number

All atoms of an element contain the same number of protons. The chemical properties of an element is determined by the number of electrons in an atom, which is equal to the atomic number of the element.

According to the atomic theory, all atoms of an element should be identical. They should have the same size, mass and structure.

Scientists discovered that an element may consist of several kinds of atoms with different masses. These atoms of the same element have the same number of neutrons. The various species of an element having different masses are called its ISOTOPES.

I-2 Examples of Isotopes

Ordinary hydrogen atoms have 1 proton in its nucleus. There are also two kinds of hydrogen atoms which have one more neutron respectively in their nuclei. These are called 'heavy hydrogen'. The 3 isotopes are represented by $\text{H}^1$, $\text{H}^2$, $\text{H}^3$.

Chlorine has 2 isotopes: $^{35}\text{Cl}$, $^{37}\text{Cl}$.

Oxygen has 3 isotopes: $^{16}\text{O}$, $^{17}\text{O}$, $^{18}\text{O}$.

Lead has 4 isotopes: $^{204}\text{Pb}$, $^{206}\text{Pb}$, $^{207}\text{Pb}$, $^{208}\text{Pb}$.

Carbon has 3 isotopes: $^{12}\text{C}$, $^{13}\text{C}$, $^{14}\text{C}$.

Isotopes underlined exist in majority abundance, while the ones in brackets have an abundance of less than 1%.
II. Radioactivity and Its Discovery

II-1 Discovery of Radioactivity

The story happened in a dull, misty day in 1896. A French scientist, Henri Becquerel, placed a uranium salt on a photo plate in a dark drawer. The plate was found to be fogged after development.

Clearly the uranium had exposed it even in the dark and through the protective wrapper. This uranium salt possessed some mysterious activity and gave out some radiations that affected the photo plate.

II-2 Basic Knowledge of Radioactivity

Some atoms possess a large number of nucleons in their nucleus. These particles are restless (or unstable) as they are confined in a small region.

The jostling particles can have a more easy state (or stable state) by expelling some of their neighboring particles, resulting in the emission of some invisible radiation from the nucleus. Those atoms are said to be RADIOACTIVE.

The process of emitting some particles or radiation due to spontaneous splitting (disintegration) is known as DECAY. This will result in a new element which can continue, if possible, this process until a final stable state is attained. A stable state refers to the state at which elements can no longer give off radiations.
Lesson Three: Radiation and Half-Life (40 minutes)

I. alpha, beta and gamma radiations

1. After radioactivity was discovered, hundreds of experiments were performed to study their properties. Scientists soon identified three different kinds of radiations: (i) alpha \( \alpha \) radiation, (ii) beta \( \beta \) radiation and (iii) gamma \( \gamma \) rays.

2. **Alpha \( \alpha \) radiation**

   Alpha radiation is found to be groups of particles having 2 protons and 2 neutrons in each group. Since the helium nucleus is also composed of 2 protons and 2 neutrons, alpha particles are sometimes stated as He nuclei. Due to the 2 protons present, alpha particles are positively charged. When an alpha particle is emitted, the process can be represented symbolically by:

   \[
   2X^A \rightarrow Z-2^A-4 + ^2\text{He}^4(\alpha - \text{particle})
   \]

   Where \( X \) is the element to emit the \( \alpha \) particle, generally called the mother nuclide, and \( Y \) is the residual element called the daughter nuclide.

   Note that the mother nuclide after emitting an alpha particle has its atomic number decreased by 2 and the mass number less by 4. (Emission of 2 p and 2 n)

   Example: \( ^{226}_{86}\text{Ra} \rightarrow ^{222}_{84}\text{Rn} + ^2\text{He}^4(\alpha - \text{particle}) \)

3. **Beta \( \beta \) radiation**

   Beta radiation consists of electrons. These electrons are not orbital electrons. This is simply due to the change of a neutron into a proton and an electron.

   \[
   n \rightarrow p + e^- (\beta - \text{particle})
   \]

   The electron is emitted as the beta particle, the equation is given by

   \[
   2X^A \rightarrow Z+1^A + _{-1}^0e (\beta - \text{particle})
   \]
The residual daughter nuclide has an atomic number of $Z + 1$, due to 1 proton more. The mass number $A$ has not changed as the total number of nucleons is unchanged.

Example: $^{14}_6\text{He} \rightarrow \gamma^{14}_0 + \beta_1^0$

I-3 gamma rays

The radiation does not carry any charge. It has a nature similar to that of light but its energy is millions of times larger. They possess wave properties -- can be reflected or refracted. (diffract or interfere with each other as well) The radiation travels with the speed of light.

II. Half-Life

II-1 Introduction

From lesson 1, we know that unstable atomic nuclei are radioactive. These nuclei may decay, or break up by itself to form more stable nuclei with the emission of radiation.

The breaking up process occurs randomly. We cannot tell which nucleus will decay in a particular time. But it is true that more nuclei will break up if more unstable atoms are present.

II-2 Half-Life ($T_\frac{1}{2}$)

Some radioactive samples need a long period to be converted to the stable ones and some need a few seconds. As an indication of the activity or the power of still being active, we measure the time required for half of the total number of radioactive nuclei original present to be changed. This is the half-life of the radioactive element.

Example: Radon, a radioactive gas whose $T_\frac{1}{2}$ is 4 days, if we start with 256 atoms of radon, in 4 days time, $\frac{256}{2} = 128$ atoms will be changed, leaving 128 atoms of unstable radon atoms.

in 4 more days, $\frac{128}{2} = 64$ atoms are again decayed, leaving 64 atoms still active;

In a total period of 16 days, 16 atoms of radon still remain active.
Different elements have different half-lives, some may be very long and some very short. Here are some examples:

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</thead>
<tbody>
<tr>
<td>Uranium 238</td>
<td>4.5 billion years</td>
</tr>
<tr>
<td>Carbon 14</td>
<td>5600 years</td>
</tr>
<tr>
<td>Radium 226</td>
<td>1620 years</td>
</tr>
<tr>
<td>Polonium 214</td>
<td>$10^{-4}$ second</td>
</tr>
</tbody>
</table>

From the graph, we see that the number of survivors becomes smaller as time passes, but it may never become zero. This is another way of saying that we cannot assign any 'definite' life time in which all of the original atoms for a sample will have decayed.

The decay law is a result of statistical analysis, and it is applicable to a sample containing a large number of radioactive nuclei.

III. Carbon Dating

Archeologists, people who study ancient relics, always have interest to determine the age of bones or rocks dug from ancient tombs. If the age of a piece of ancient bone can be found, historians can obtain more information about the cultural development at that time.

The common method of dating makes use of Carbon-14, a radioactive isotope of Carbon-12, which exists naturally in very minute amounts. The half-life of Carbon-14 is about 5600 years.

All living organisms, plants or animals, takes in Carbon-14 along with carbon-12 from the surroundings. When the organism dies, there is no longer any intake of Carbon-14 isotopes, and those that remain break down slowly. By measurement of the amount of Carbon-14 present in a specimen, the length of time elapsed since the organism's death can be found.
Lesson Four: Tracer and Atomic Energy in Peaceful Uses

Introduction

Many people nowadays still have a belief that radiations can only do harm to living things. This could possibly be due to the vast destructive power from atomic bombs.

Though it is undeniable that radiations can be harmful to body tissues and cells, but it can also become helpful under careful control and usage. The most popular application is in the generation of electrical power.

There are other applications in radiotherapy—the treatment of cancer patients with radiation to kill cancerous cells, archeological dating as described in last lesson and to serve as tracers in medical and industrial researches.

I. Tracer in Peaceful Uses

I-1 Principle

A score of artificial radioactive isotopes (radioisotopes) are available today for use in industry and medicine. An important aspect of their usefulness is that they can be traced; a detector of radiation will easily tell their presence anywhere, even in amounts too small to be visible or found by simple means.

I-2 Medical Applications

Radioisotopes are of greatest value in the diagnosis of human disorders. They help in many cases where X-rays fall short. For example, radioactive sodium, in the form of a salt solution, is injected in the patient's arm. The isotope is picked up by the bloodstream and transported to the heart. The position of the isotope can then be located by a detector. This offers a valuable means in the recognition of diseases of the heart or the circulatory system.
I-3 Industrial Applications

Tracing small amounts of matter is helpful in all kinds of research in industry. In oil refineries, radioisotopes can be used to trace oil along the pipelines. By adding a few tracer-atoms to the oil, batches of different grades of oil can be labelled like letters and followed. Hidden leaks are easily discovered, they are betrayed by the presence of radioactivity outside the pipes.

II. Atomic Energy in Peaceful Uses

In reactions concerning nuclides, energy may be absorbed or released. The energy absorbed or released in a nuclear reaction is a million or more than the amount of energy involved in an ordinary chemical reaction. Hence this property has made the reactions important in industrial and military applications.

Fission— the heavy metal uranium is a mixture of 2 isotopes of which 92U235, Uranium-235, is the most important. Some atoms of U-235 decay naturally, emitting high-speed neutrons.

When one of these neutrons hits the nucleus of a neighboring U-235 atom, it may break into two nearly equal radioactive nuclei, Ba144 and Kr90, together with two or more neutrons.

\[ 92U^{235} + 0^{1\text{n}} \rightarrow 56Ba^{144} + 36Kr^{90} + 2 0^{1\text{n}} \]

The breaking up process results in the liberation of a great amount of energy in the form of heat. The neutrons emitted in the reaction may split other U-235 nuclei, and so a chain reaction is set up, resulting in a continuous liberation of energy.

The energy released is used to heat up circulating cold water into steam, which is used to generate electricity after passing some mechanical devices.
教學語言與
中二、中三、中四數、理、史三科
學習效果之研究

第二階段：
中四级「原子結構和放射性」
的四課教學設計

香港中文大學教育學院
一九七九年四月十六日
課程及時間分配

原子結構及放射現象

第一章：原子結構（40分）
  1. 原子理論
  2. 原子模型
  3. 原子核、質量數、原子序數

第二章：同位素及放射現象（25分）
  1. 同位素及其他化學特性
  2. 放射現象及其發現經過

評鑑測驗：第一回（15分）
  15題多項選擇題（關於第一章及第二章之內容）

第三章：輻射及半衰期
  1. α、β和γ輻射
  2. 半衰期與衰變時間
  3. 碳-14定年法

第四章：示蹤劑及原子能之和平用途
  1. 示蹤劑的應用
  2. 原子能之和平用途

評鑑測驗：第二回（20分）
  20題多項選擇題（關於第三章及第四章之內容）
5. 近代的看法

| 太阳系的行星是沿着一定的轨道环绕太阳运行 | 它们以极高速度环绕太阳运行。行星的轨道是近似圆形的。
| 太阳系的行星是沿着一定的轨道环绕太阳运行 | 星子以极高速度环绕太阳。这些行星的轨道是近似圆形的。

根据波尔的描述，电子绕核作圆周运动。
第二課：原子結構（40分）

一. 原子理論

電子原子模型

湯姆遜（Thomson）原子模型

湯姆遜（Thomson）於1904年提出一模型，稱為“湯姆遜模型”（Thomson model）。

他在研究電子時，發現電子的質量不等於任何一種原子的質量，而似乎是一種介質，它們的質量與原子的質量相似。

原子由電子和原子核組成，電子在外圍圍繞原子核旋轉。

原子模型

原子模型可以簡單地描述為一個電子在原子核周圍旋轉的模型。

原子模型示意圖

湯姆遜原子模型中，電子在外圍圍繞原子核旋轉，而原子核則位於電子的中心，形成一種類似於小行星帶的模型。

原子結構示意图

電子在外圍圍繞原子核旋轉的模型，可以簡化為一個電子在原子核周圍旋轉的模型。
# 原子核

## 一、原子核

原子核是原子的中心部分，由质子和中子组成。质子带正电荷，中子不带电。质子和中子的总数称为原子序数（Z）。

<table>
<thead>
<tr>
<th>原子核</th>
<th>质子数</th>
<th>中子数</th>
<th>原子序数</th>
</tr>
</thead>
<tbody>
<tr>
<td>氢</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>氦</td>
<td>2</td>
<td>2</td>
<td>2</td>
</tr>
<tr>
<td>氯</td>
<td>17</td>
<td>17</td>
<td>17</td>
</tr>
</tbody>
</table>

## 二、原子核的粒子—质子（proton）和中子（neutron）

<table>
<thead>
<tr>
<th>粒子名称</th>
<th>质量</th>
<th>电荷</th>
</tr>
</thead>
<tbody>
<tr>
<td>质子</td>
<td>约为电子的1836倍</td>
<td>+1</td>
</tr>
<tr>
<td>中子</td>
<td>约为电子的1836倍</td>
<td>0</td>
</tr>
</tbody>
</table>

## 三、质量数（Mass Number）

质量数是原子核的质子数和中子数之和。

<table>
<thead>
<tr>
<th>原子符号</th>
<th>质子数</th>
<th>中子数</th>
<th>质量数</th>
</tr>
</thead>
<tbody>
<tr>
<td>H</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td>He</td>
<td>2</td>
<td>2</td>
<td>4</td>
</tr>
<tr>
<td>Cl</td>
<td>17</td>
<td>17</td>
<td>34</td>
</tr>
</tbody>
</table>

## 四、原子序数

原子序数是元素在周期表中的位置。

<table>
<thead>
<tr>
<th>元素名称</th>
<th>原子序数</th>
</tr>
</thead>
<tbody>
<tr>
<td>氢</td>
<td>1</td>
</tr>
<tr>
<td>氦</td>
<td>2</td>
</tr>
<tr>
<td>氯</td>
<td>17</td>
</tr>
</tbody>
</table>

## 五、核外电子

核外电子围绕原子核运行，共有2个。电子的质量几乎可以忽略不计。

<table>
<thead>
<tr>
<th>元素名称</th>
<th>电子数</th>
</tr>
</thead>
<tbody>
<tr>
<td>氢</td>
<td>1</td>
</tr>
<tr>
<td>氦</td>
<td>2</td>
</tr>
<tr>
<td>氯</td>
<td>17</td>
</tr>
</tbody>
</table>
### 預備知識的表示方法

<table>
<thead>
<tr>
<th>預備知識</th>
<th>表示方法</th>
</tr>
</thead>
<tbody>
<tr>
<td>核子物理學家常常用一套特別的符號來代表不同</td>
<td>( X )</td>
</tr>
<tr>
<td>例: 氦的原子核可寫成</td>
<td>( ^2\text{He} )</td>
</tr>
</tbody>
</table>

例:

- (Helium)的原子核共有四顆核子，其中兩顆是中子，兩顆是質子。
- 當然，如果\( X \)是某元素的化學符號，它的原子核可以
- 用\( ^{A}\text{X} \)表示。（\( A \)是原子量）
- 現在的原子核有質子和中子的数目一下子就便能
- 計算出來。

例:

- \( ^{92}\text{U}, ^{12}\text{C}, ^{23}\text{Na} \)
第二章：同位素、半衰期

I. 同位素（Isotope）

I-1 化学性质与质子序数的关系

一个元素中所有的原子都必须拥有相同的质子数，元素的化学性质完全取决于质子数。

一个原子中除了质子数必须相同外，中子数可能不同，因此同位素存在。

例如，氧原子有三种同位素：
- O
- O
- O

I-2 同位素的例子

大多数的原子核中只有一颗质子，另外还有少数的原子核中存在一颗或多颗中子。

氧（Oxygen）有三种同位素：
- O
- O
- O

氯（Chlorine）亦有两种同位素：
- Cl
- Cl

硫（Sulfur）亦有两种同位素：
- S
- S

放射性同位素

放射性同位素指的是具有放射性的同位素。它们的半衰期较短，而且容易测量。

放射性同位素用于医学、地质学、考古学等领域。它们在医学上用于诊断和治疗疾病，在地质学中用于确定岩石的年龄，在考古学中用于确定文物的年代。
放射现象和其发现过程

在1896年，法国科学家贝克勒尔（Becquerel）发现\( ^{238}\text{U} \) 再放射性会发出射线（radioactivity），他在一个密闭的小盒子中放置一\( ^{238}\text{U} \) 液体，然后把盒子放在一个黑色的照射下，盒子上的放射性物质被一个放射性物质的检测器检测到，发现该物质被一种未知的射线所照射。

放射现象的解释

有些原子核不稳定，放射出放射性粒子（如\( ^{238}\text{U} \)），这些原子核在衰变过程中会辐射出射线。这些射线包括：
- \( ^{238}\text{U} \) 
- \( ^{238}\text{U} \) 
- \( ^{238}\text{U} \)

这些射线具有放射性，原子核在放射过程中会释放出能量。放射性原子核会通过\( ^{238}\text{U} \) 
- \( ^{238}\text{U} \) 
- \( ^{238}\text{U} \) 的方式，原子核在衰变的过程中也会放射出射线。

放射性原子核的衰变

原子核的衰变是放射性的本性，衰变的模型包括：
- 衰变（\( \alpha \) 衰变）
- 衰变（\( \beta \) 衰变）
- 衰变（\( \gamma \) 衰变）

在放射性物质中，\( ^{238}\text{U} \) 
- 衰变（\( \alpha \) 衰变）
- 衰变（\( \beta \) 衰变）
- 衰变（\( \gamma \) 衰变）
第三章 粒射的性质和衰期 (40分)

I 三种不同的粒射

1. 自然放射现象被发现以来，科学家的不断努力，终于分别出了三种不同的放射性。

(1) X 粒射 (或 X - 粒射)
(2) β 粒射 (或 β - 粒射)
(3) γ 粒射 (或 γ - 粒射)

I - 1 X - 粒射

5. 科学家发现，在一颗 X - 粒射的原子核中，其中两颗是中子和两颗是质子。我们知道了

(Heisenberg) 的原子核，亦是由两颗中子和两颗质子

组成，因此，X - 粒射本质上是一颗元素的原子核。由于它是由两颗中子，所以是带有反射的。

当一个原子核发射出一个外层电子时，我们程序

的反应则可由下列反应式来表示，

\[ X + \text{He} ^{4} \rightarrow Y + Z ^{2} + Z _{2} + Z _{2} \]

在公式中：X 是放射性元素的原子核，而 Y

(γ - 粒射) 是原子核 (Daughter nucleus)

Y 是该原子核的放射性后代。而 Z 是放射性element

Z 为粒子 (子原子核) (Daughter nucleus)

萤时原子核放射了一颗 X - 粒子之后，它的原子核即

以同质素浓度，而其质量则减少 4 (即为质子)

3. Z 质子核被 X 粒子束轰击

例：\[ ^{226}_{88} \text{Ra} ^{22} \rightarrow ^{222}_{84} \text{Rn} ^{2} + \text{He} ^{4} \]

I - 2 β - 粒子

5. β 粒射是原子核中中子数多于质子数，这些中子在不足，就产生

电子。电子是原子核中其中有一子变成一颗质

子和一电子。然后被射出核外，形成 β - 粒射。

成质子中子中子的质子。
<table>
<thead>
<tr>
<th>時間 (分)</th>
<th>教師專注</th>
</tr>
</thead>
</table>
| 3        | 放射性射線。放射性射線是在原子核的核結構中，由核內的穩定和不穩定的原子核在衰變過程中放射出的射線。這包括α射線、β射線和γ射線。放射性射線對人體有極大的危險。放射性射線的強度隨距離的增加而減小。

3.1 放射性射線的種類和特性

- α射線：由氦原子核放射出的粒子，速度低，穿透能力弱，容易被物質吸收。
- β射線：高速電子流，能量高，穿透力強。
- γ射線：高能量光子，穿透力強，不易吸收。

3.2 放射性射線的測量

放射性射線的強度可以用射線計測器來測量。射線計測器可以測量射線的強度和方向。

3.3 放射性射線的應用

放射性射線在醫療、工業和科研中有着廣泛的應用。例如，γ射線在殺菌、工業探傷和醫學治療等方面有着重要的作用。

15. 半衰期的意義

半衰期是放射性物質放射性減弱到原數量一半所需要的时间。半衰期的長短決定了一個放射性物質的放射性強弱。

<table>
<thead>
<tr>
<th>半衰期 (放射性物質的放射性減弱到原數量一半所需要的时间)</th>
<th>放射性物質的放射性減弱情況</th>
</tr>
</thead>
<tbody>
<tr>
<td>1/2</td>
<td>放射性物質的放射性減弱到原數量一半</td>
</tr>
</tbody>
</table>

例如，一個放射性物質的半衰期是5天，那麼這個放射性物質在5天後就只剩下一半的放射性。
氡(Rn)是一种放射性的气体，其半衰期为4天。如果起始有256个氡的原子，经过四天之后，只有 $256 \div 2 = 128$ 个原子还存在。再过四天，共有 $128 \div 2 = 64$ 个原子还存在，剩下64个不稳定的原子。如果再经过十六天之后，只剩下16个不稳定的原子，剩下的原子就留了下来。

不同元素的半衰期有很大的差别，有些很长，有些却很短。例如：

<table>
<thead>
<tr>
<th>元素</th>
<th>半衰期</th>
</tr>
</thead>
<tbody>
<tr>
<td>钋</td>
<td>238 (Uranium 238) 4.5 亿年</td>
</tr>
<tr>
<td>碳</td>
<td>14 (Carbon 14) 5,600 年</td>
</tr>
<tr>
<td>钷</td>
<td>226 (Radium 226) 1,620 年</td>
</tr>
<tr>
<td>钝</td>
<td>212 (Polumium 212) $10^{-4}$ 秒（万分之一秒）</td>
</tr>
</tbody>
</table>

随著时间的流逝，不稳定原子会逐渐衰变，剩下来的原子越来越多。
碳-14年代测定法（Carbon Dating）

碳-14年代测定法是根据碳-14的放射性衰变来测定样品的年代。

科学原理：碳-14是一种放射性同位素，存在于自然界中。生物在生长过程中会吸收碳-14。当生物死亡后，碳-14开始衰变，其半衰期约为5730年。通过测量样品中碳-14的剩余量，可以计算出样品的年代。

碳-14的半衰期为5730年，这意味着每经过5730年，样品中碳-14的剩余量会减少一半。因此，通过测量样品中碳-14的剩余量，可以计算出样品的年代。

碳-14年代测定法广泛应用于考古学、地质学、生物学等领域。
第四章：示踪剂和放射性元素的应用（20分）

引言
在今天，很多人对辐射感到害怕，认为辐射对身体有害，这个观念可能因原子能的破坏能力强而有误。

不可否认，辐射对人体的组织和细胞会产生伤害，但在适当的控制和利用下，辐射也会有建设性的用途，如推动核电站来产生电力。

放射性同位素有许多用途，如放射性同位素在工业和医学方面有重大的用途，其特点是放射能以探测器显示该等元素。

示踪剂（Tracers）的用途

I.1 原理
人类放射性同位素在工业和医学方面有重大的用途，其特点是放射能以探测器显示该等元素。

I.2 医学应用
放射性同位素对诊断人体疾病有重大价值，且使诊断及治疗的病变能解决。如放射性同位素（如磷）、放射性同位素能被注射入病变的体内，随血液循环至心脏。该等同位素的位置由探测器指示出来，这对诊断心脏病或其它循环系统疾病提供有用的资料。

I.3 工业应用
示踪剂在工业上应用有极大帮助。如在输送石油工业上，放射性同位素能作显示，如输送油管中石油流动的情况。正如带有同位素的石油输送，任何油管的泄漏裂痕也可以由放射能的放射性同位素而侦察出来。
II. 原子核的和平用途

在核子反应过程中，大量的能量会被吸收或放出。在该等反应所涉及之能量比普通化学反应所需的多达百万倍以上。因此原核反应在工业和军事上的应用日益重要。

核子分裂

在能量反应中，铀-235在所有同位素中，$^{235}\text{U}$，称为铀-235的最重轻。若$^{235}\text{U}$在本身自生裂变中放出高速中子，$^{235}\text{U}$核

相反应的$^{235}\text{U}$原子核会经过裂变而崩解，放出放射性核子$^{35}\text{C}r$和$^{90}\text{Kr}$，且放出两个或更多中子，

$$^{235}\text{U} + n \rightarrow ^{56}\text{Fe} + ^{90}\text{Kr} + 2n$$

铀-235核子崩解除产生放射性核子和中子外，还以链式反应放出大量能量。而中子也可使其他铀-235核子崩解，导至一連鎖反应（Chain Reaction），令能量能够连续地放出。

放出大量能量被用来蒸汽在环热交换器，成为蒸汽，这些蒸汽就推动发电机而产生电力。

核子反应涉及大量能源。

铀-235衰变可放出高速中子。

中子撞击其他铀-235原子，使其分裂并放出大量子。

大量的能量以能量的方式在裂变中放出。

链式裂变是链式反应（Chain Reaction）。

放出之能量能用于发电子。
During the study (Section 3.5), one student in the CS group dropped out from school.

Since not all the students sat for the S.S.E.E., only 126 students (85 of ACS and 41 of CS group) possessed results on choice of school and S.S.E.E.
1. The basic idea of the Rutherford-Bohr Model is that
(1) the atom has some positively charged matter.
(2) the atom is formed by a cloud of electrons.
(3) the nucleus has electrons inside.
(4) the atom has a structure similar to that of the solar system.
(5) the electrons are moving in changing orbits.

2. According to J.J. Thomson,
(1) atoms cannot be divided into smaller parts.
(2) an atom is a neutral sphere consisting of some positively charged matter with electrons embedded in it.
(3) inside an atom, there will be a nucleus with electrons all around.
(4) electrons are located inside the nucleus.
(5) alpha particles come out from the nucleus.

3. The number of protons in the nucleus of an atom is called
(1) the mass number
(2) the atomic number
(3) the isotope number
(4) the ionization number
(5) the nuclear weight.

4. The smallest unit of the element that can exist by itself and retain the same quality as the element is called a/an
✓atom
(2) molecule
(3) elementary particle
(4) electron
(5) nucleus

5. Uranium was first discovered as a radioactive element by observing its action in
(1) affecting a covered photographic plate.
(2) producing counts on a detector.
(3) making tracks in a cloud chamber.
(4) exploding a bomb.
(5) speeding up a chemical reaction.

6. - 7 refer to Figure 1, a representation of Bohr Atom.

6. X and Y are respectively
(1) proton and neutron.
(2) electron and proton.
(3) nucleus and electron.
(4) electron and nucleus.
(5) neutron and electron.

7. X is composed of
(1) protons only
(2) neutrons only
(3) protons and neutrons
(4) neutrons and electrons
(5) protons, neutrons and electrons.
8. An electron from a hydrogen atom
   (1) is identical to an electron from another hydrogen atom.
   (2) has a greater mass than an electron from an oxygen atom.
   (3) is larger than an electron from a helium atom.
   (4) has a greater charge than an electron from a nitrogen atom.
   (5) is lighter than an electron from a chlorine atom.

9. The weakness of the J.J. Thomson Model is that
   (1) the total charge of electrons is incorrect.
   (2) the size of the atoms is incorrect.
   (3) the shape of the atom is incorrect.
   (4) each electron is surrounded by about the same amount of
       the other matter.
   (5) the number of electrons is equal to the number of the other
       particles.

10. Using the common convention, the element $^{21}_{X}$ has
    (1) 21 protons and 66 electrons
    (2) 21 neutrons and 45 protons
    (3) 21 neutrons and 24 protons
    (4) 21 protons and 45 neutrons
    (5) 21 protons and 24 neutrons

11. The following table shows four nuclei P, Q, R and S with their
    mass numbers and atomic numbers:

    | Nucleus | Mass Number | Atomic Number |
    |---------|-------------|---------------|
    | I. P    | 20          | 9             |
    | II. Q   | 20          | 10            |
    | III. R  | 21          | 10            |
    | IV. S   | 22          | 10            |

    Which of the above is/are the isotope(s) of an element having
    a mass number 20 and an atomic number 10?
    (1) I, III and IV only
    (2) I and III only
    (3) II and IV only
    (4) I and IV only
    (5) III and IV only

12. A beam passes between two parallel plates is deflected as shown.
    From the picture, we can tell that the beam is composed of
    (1) electrons
    (2) protons
    (3) neutrons
    (4) gamma particles
    (5) alpha particles

13. When a very fast moving proton P approaches a stationary nucleus S,
    the path of P is likely to be
    (1) I
    (2) II
    (3) III
    (4) IV
    (5) V
1. The symbol $^{2}_{4}He$ may be used for an alpha-particle, because
   (1) it has 2 electrons and 4 nucleons
   (2) it has 2 protons and 4 neutrons
   (3) it has 2 neutrons and 2 protons
   (4) it has 2 protons and 2 neutrons
   (5) it has 2 electrons and 2 protons

2. Biologists are trying to find out more about the metabolism of plants and animals through the use of
   (1) high-energy particle accelerators
   (2) radio-isotopic tracers
   (3) high power microscope
   (4) X-rays
   (5) a decay

3. Of the three common types of radiations, namely alpha, beta and gamma, from radioactive sources, electric charge is carried by
   (1) $\beta$ and $\gamma$ only
   (2) $\alpha$ and $\gamma$ only
   (3) $\alpha$ and $\beta$ only
   (4) $\beta$ only
   (5) $\alpha$ only

4. The main reason why a neutron will penetrate a nucleus more readily than a proton is that the neutron is
   (1) slightly more massive
   (2) moving faster
   (3) moving slower
   (4) unaffected by nuclear forces

5. All EXCEPT ONE of the following statements are true. Which one is the exception?
   (1) Radioactivity is a natural characteristic of some elements
   (2) Radioactive isotopes can be produced artificially in the laboratory
   (3) Radioactive isotopes decay by the emission of particles from the nucleus
   (4) All isotopes are radioactive
   (5) There is a wide variety of decay rates for radioactive elements

6. When the nucleus $^{231}_{93}Pa$ becomes $^{227}_{91}Ac$, it has undergone
   (1) an $\alpha$-decay
   (2) a $\beta$-decay
   (3) a $\gamma$-decay
   (4) a collision with neutrons
   (5) a capture of 1 neutron and then a release of 1 proton

7. A radioactive atom emits a $\beta$-particle. What happens to the mass number of the atom?
   (1) It increases by 1
   (2) It remains unchanged
   (3) It decreases by 1
   (4) It decreases by 2
   (5) It decreases by 4
8. The half-life of a certain radioactive isotope is 3 seconds. Starting with \( N \) active atoms,

I. there will be \( N/8 \) active atoms remained after 9 seconds
II. there will be \( N/16 \) active atoms remained after 18 seconds
III. three-quarters of the active atoms will have decayed after 6 seconds
IV. there will be \( N/32 \) active atoms remaining after 21 seconds

Which of the above statements is/are correct?

(1) I only
(2) II only
(3) III only
(4) I, II and IV only
(5) I, II, III and IV

9. An unstable element \( X \) decays into a stable element \( Y \) with a half-life of 3 days. On 1st March, a piece of \( X \) has a mass of 10 g. What will be the masses of \( X \) and \( Y \) 6 days later?

<table>
<thead>
<tr>
<th>Mass of ( X )</th>
<th>Mass of ( Y )</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 5 g</td>
<td>5 g</td>
</tr>
<tr>
<td>(2) 10 g</td>
<td>0 g</td>
</tr>
<tr>
<td>(3) 0 g</td>
<td>10 g</td>
</tr>
<tr>
<td>(4) 2.5 g</td>
<td>7.5 g</td>
</tr>
<tr>
<td>(5) 7.5 g</td>
<td>2.5 g</td>
</tr>
</tbody>
</table>

10. When a chain reaction takes place in \( ^{235}\text{U} \), each nucleus breaks into two parts during fission and also releases

(1) one neutron and one proton
(2) one proton
(3) one neutron
(4) more than 1 neutron
(5) more than 1 proton

11. The age of an old tree is found by burning the tree ashes and counting the number of radioactive \( ^{14}\text{C} \) nuclei detected to be 8 millions. From the decay graph of \( ^{14}\text{C} \) given on the left, the age of the old tree being tested is found to be

(1) 5,600 years
(2) 11,200 years
(3) 16,800 years
(4) 22,400 years
(5) 2,800 years

12. Some radioactive isotopes have to be injected into a patient's vein to investigate his blood circulation. In the list of radioactive isotopes given, choose the one you think is the most suitable

(1) \( X \) of half-life 10 seconds
(2) \( Y \) of half-life 1 hour
(3) \( Z \) of half-life 10 days
(4) \( P \) of half-life 1 year
(5) \( Q \) of half-life 10 years
13. An atom with mass number \( A \) and atomic number \( Z \) decays in three stages by the emission of an \( \alpha \)-particle, a \( \beta \)-particle and a second \( \beta \)-particle. It then becomes an isotope of the same element with mass number

- (1) unchanged
- (2) equals \( A - 1 \)
- (3) equals \( A - 2 \)
- (4) equals \( A - 3 \)
- (5) equals \( A - 4 \)

14. Which of the following might be the products of the fission of a nucleus of \( ^{235}_{92}U \) after the nucleus has absorbed a neutron?

(1) \( ^{1}_{0}e + ^{232}_{90}Pa + ^{5}_{0}He \)
(2) \( ^{1}_{0}e + ^{209}_{82}Pb + ^{0}_{1}n \)
(3) \( ^{1}_{0}e + ^{236}_{94}Np + ^{0}_{1}n \)
(4) \( ^{1}_{0}e + ^{140}_{60}Ba + ^{45}_{0}Xe + ^{0}_{1}n \)
(5) \( ^{1}_{0}e + ^{140}_{60}Ba + ^{45}_{0}Xe + ^{0}_{1}n \)

15. Imagine that a new isotope of lithium (Li) with atomic number 3 and mass number 5 has been discovered among the radiations emitted from radioactive plutonium (Pu). Which one of the following nuclear equations correctly describes its emission from a \( ^{239}_{94}Pu \) nucleus?

(1) \( ^{94}_{239}Pu \to ^{234}_{94}Pa + ^{5}_{3}Li \)
(2) \( ^{94}_{239}Pu \to ^{234}_{94}Pa + ^{5}_{3}Li \)
(3) \( ^{94}_{239}Pu \to ^{234}_{94}Pa + ^{5}_{3}Li \)
(4) \( ^{94}_{239}Pu \to ^{234}_{94}Pa + ^{5}_{3}Li \)
(5) \( ^{94}_{239}Pu \to ^{234}_{94}Pa + ^{5}_{3}Li \)

Questions 16 - 17

A radium source that emits \( \alpha \), \( \beta \) and \( \gamma \) radiations simultaneously is put in an evacuated box. The radiation coming from the small lead cavity then forms a narrow beam which passes between two charged metal plates, as shown in the diagram. When the photographic plate is developed, 3 spots labelled P, Q and R are obtained.

16. Which are the radiations responsible for each of the spots?

<table>
<thead>
<tr>
<th>Spot P</th>
<th>Spot Q</th>
<th>Spot R</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) ( \alpha )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
</tr>
<tr>
<td>(2) ( \alpha )</td>
<td>( \beta )</td>
<td>( \gamma )</td>
</tr>
<tr>
<td>(3) ( \beta )</td>
<td>( \gamma )</td>
<td>( \alpha )</td>
</tr>
<tr>
<td>(4) ( \gamma )</td>
<td>( \beta )</td>
<td>( \alpha )</td>
</tr>
<tr>
<td>(5) ( \gamma )</td>
<td>( \beta )</td>
<td>( \alpha )</td>
</tr>
</tbody>
</table>
17. If more positive charge is put on the positive plate and more negative charge on the negative plate, what will happen to the spots?

<table>
<thead>
<tr>
<th>Spot P</th>
<th>Spot Q</th>
<th>Spot R</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) shifts more to the right</td>
<td>shifts to the left</td>
<td>shifts more to the right</td>
</tr>
<tr>
<td>(2) shifts slightly to the right</td>
<td>remains unchanged</td>
<td>shifts slightly to the left</td>
</tr>
<tr>
<td>(3) shifts more to the left</td>
<td>remains unchanged</td>
<td>shifts more to the right</td>
</tr>
<tr>
<td>(4) shifts slightly to the right</td>
<td>shifts to the right</td>
<td>shifts more to the right</td>
</tr>
<tr>
<td>(5) shifts more to the left</td>
<td>shifts to the right</td>
<td>shifts slightly to the left</td>
</tr>
</tbody>
</table>

Questions 18 - 19

An analogy has been drawn between the decay rate in a radioactive decay and the flow of water through the system. In a radioactive sample, the decay rate (i.e., the rate of breaking down of unstable atoms) is proportional to the number of unstable atoms present. Similarly, the rate of water flow is also proportional to the height of the water level above the outlet.

The diagrams above show tanks of different cross-sectional areas and are all drained by identical capillary tubes.

18. The half-life period of the water in tank Q would be

I. half of the time spent by a water molecule inside Q's capillary tube
II. the time taken for the water level to fall to half of its original value
III. half of the time required to drain all the water in the tank

(1) Only I is correct
(2) Only II is correct
(3) Only III is correct
(4) Only I and II are correct
(5) Only II and III are correct

19. In this analogy, the height of the water level corresponds to the number of unstable atoms, while the rate of water flow corresponds to the rate of decay. This analogy is not a good analogy because

I. the half-life of the tanks are different even if the initial heights of the water levels are the same
II. the half-life of the tank does not only depend on the height of the initial water level but also on the cross-sectional area
III. the capillary tube where the water flows out is too small so that the half-life is too long.

Which of the above reasons is/are correct?

(1) I only
(2) II only
(3) II and III only
(4) I and II only
(5) III only
測驗一：第一、第二課（15分鐘）

1. 庫倫福—波爾（Rutherford—Bohr）原子模型最特別的地方是：
   (1) 原子中有一些帶正電的物質
   (2) 原子是由一圍電子組成
   (3) 原子的構造類似我們的太陽系
   (4) 原子核內藏有全部電子
   (5) 電子是依照不固定的軌道行走

2. 根據湯姆遜（Thomson）原子模型對原子的描繪
   (1) 原子是不可分割的個體
   (2) 原子是一個中和的球體，由一些帶正電的物質組成
     而電子則埋藏在其中
   (3) 原子內有一顆被電子包圍的原子核
   (4) 電子是埋藏在原子核內
   (5) 由一粒子是從原子核中射出來的

3. 原子核內質子的數目被稱為
   (1) 質量數
   (2) 原子序數
   (3) 同位素數目
   (4) 氧離數
   (5) 核子重量

4. 最細小而仍能保留其元素之特異的粒子稱為
   (1) 原子
   (2) 分子
   (3) 基本粒子
   (4) 電子
   (5) 異子

5. 科學家發現鈾具有放射性，最初他們發現鈾能夠
   (1) 使一塊包裝着不爆炸的威光中威光
   (2) 使輻射計器出現讀數
   (3) 在雲霧室中產生霧旋
   (4) 發生核爆
   (5) 加速化學作用
6-7 參照圖一，其代表一個波爾模型的原子

6. 圖中所示，x 和 y 分別代表
(1) 質子和中子
(2) 電子和質子
(3) 原子核和電子
(4) 電子和原子核
(5) 中子和電子

7. 圖中之 x 為何種粒子組成？
(1) 為有質子
(2) 為有中子
(3) 為質子和中子
(4) 為中子和電子
(5) 為質子、中子和電子

8. 氫原子中的電子
(1) 與另一氫原子中的電子本質上是相同的
(2) 其質量應大於氧原子中的電子
(3) 其體積應大於氧原子中的電子
(4) 所帶的電荷應比氧原子中的電子所帶者為多
(5) 其重量應較氧原子中的電子為輕

9. 湯姆遜原子模型之弱點是
(1) 全部電子的總電荷是不正確的
(2) 原子的大小是不正確的
(3) 原子的形狀是不正確的
(4) 每一粒電子是由約數量相同的其他物質環繞著
(5) 電子的數目是等於其他粒子的數目
10. 根據慣常的符號表示某元素 "X" 共有
(1) 21 粒質子和 66 粒電子
(2) 21 粒中子和 45 粒質子
(3) 21 粒中子和 34 粒質子
(4) 21 粒質子和 45 粒中子
(5) 21 粒質子和 24 粒中子

11. 下列為四個不同的原子核 P, Q, R 和 S 及其質量數和原子序數

<table>
<thead>
<tr>
<th>原子核</th>
<th>質量數</th>
<th>原子序數</th>
</tr>
</thead>
<tbody>
<tr>
<td>I</td>
<td>20</td>
<td>9</td>
</tr>
<tr>
<td>II</td>
<td>20</td>
<td>10</td>
</tr>
<tr>
<td>III</td>
<td>21</td>
<td>10</td>
</tr>
<tr>
<td>IV</td>
<td>22</td>
<td>10</td>
</tr>
</tbody>
</table>

現有一元素 "X"，其質量數為 20 及原子序數為 10。試找出以上那些原子核之元素是 "X" 的同位素？
(1) 多為 I, III 和 IV
(2) 多為 I 和 III
(3) 多為 III 和 IV
(4) 多為 I 和 IV
(5) 多為 III 和 IV

12. 一束粒子射線通過兩塊帶電的板時，其折射如圖示，這束粒子應是
(1) 電子
(2) 質子
(3) 中子
(4) γ 粒子
(5) μ 粒子

13. 當一粒高速移動的質子 P 接近一個停留不動的原子核 S 時，P 應循圖中那一路徑移動？
(1) I
(2) II
(3) III
(4) IV
(5) V
測驗二：第三、第四課（80分鐘）

1. 以$^2\text{He}$來代表α粒子的原因是因為
   (1) 它有兩個電子和四粒核粒子
   (2) 它有兩粒質子和四粒中子
   (3) 它有兩粒中子和四粒質子
   (4) 它有兩粒質子和兩粒中子
   (5) 它有兩粒電子和兩粒質子

2. 為了研究更多有關動植物的新陳代謝作用，生物學家便應用
   (1) 高能粒子加速器
   (2) 電磁放射性同位素示蹤劑
   (3) 高倍顯微鏡
   (4) X-射線
   (5) γ-蒸發

3. 從放射性物質發出的輻射有α、β和γ三種。電荷是由哪一種或幾種輻射傳遞?
   (1) 只有β和γ兩種
   (2) 只有α和γ兩種
   (3) 只有α和β兩種
   (4) 只有β一種
   (5) 只有α一種

4. 中子較質子更容易穿入原子核內的原因是因為中子
   (1) 數量較多
   (2) 移動較快
   (3) 移動較慢
   (4) 無電荷
   (5) 不受核子引力影響

5. 下列各項中那一項不正確？
   (1) 放射性是某些元素的特質
   (2) 放射性同位素可在實驗室由人工製造
   (3) 當放射性同位素衰變時，粒子由原子核內射出
   (4) 世上所有的同位素都具有放射性
   (5) 放射性元素有各種差異很大的放射率
6. 如要使原子核 $^{231}_{91}Pr$ 变为 $^{9}_{4}Ar$，$^{231}_{91}Pr$ 需经一过程
   (1) $\alpha$ - 衰变
   (2) $\beta$ - 衰变
   (3) $\gamma$ - 衰变
   (4) 前子中子碰撞
   (5) 先吸收一中子后在放出一中子质子

7. 放射性原子放出一粒 $\beta$ - 粒子后，其质量数
   (1) 质前增多 1
   (2) 保持不变
   (3) 质前减少 1
   (4) 质前减少 2
   (5) 质前减少 4

8. 某放射性元素的半衰期是三秒，若这个元素最初有 $N$ 倍活性原子，则
   工 9秒后余下 $N/8$ 倍活性原子
   工 18秒后余下 $N/16$ 倍活性原子
   工 6秒后余下 $N/4$ 倍活性原子
   工 21秒后余下 $N/32$ 倍活性原子
   上述三种或哪几种情形是正确的？
   (1) 只有工
   (2) 只有工
   (3) 只有工
   (4) 只有工和工
   (5) 工、工、工和工

9. 一个不稳定的元素 $X$ 衰变为另一稳定的元素 $Y$，$X$ 之半衰期为三日。在三月一日，一块元素 $X$ 的质量为 10 克，经过六天后，$X$ 和 $Y$ 的质量分别为

<table>
<thead>
<tr>
<th>元素 $X$</th>
<th>元素 $Y$</th>
</tr>
</thead>
<tbody>
<tr>
<td>(1) 5 克</td>
<td>5 克</td>
</tr>
<tr>
<td>(2) 10 克</td>
<td>0 克</td>
</tr>
<tr>
<td>(3) 0 克</td>
<td>10 克</td>
</tr>
<tr>
<td>(4) 2.5 克</td>
<td>7.5 克</td>
</tr>
<tr>
<td>(5) 7.5 克</td>
<td>2.5 克</td>
</tr>
</tbody>
</table>
10. 當铀 $^{235}\text{U}$ 發生領反應時，其原子核分裂為兩部份，並放出
(1) 一粒中子和一粒質子
(2) 一粒質子
(3) 一粒中子
(4) 多於一粒中子
(5) 多於一粒質子

11. 一棵老樹的年齡可經燒樹炭和計算放射性元素碳-14（$^{14}\text{C}$）的原子核數目查出。今發現這棵樹共有八百萬個碳-14的原子核。從下列碳-14的衰變圖中這棵樹的年齡為
(1) 5,600年
(2) 11,200年
(3) 16,800年
(4) 22,400年
(5) 28,000年

12. 為了探測人體內血液的流動狀態，醫生可將某些放射性同位素注射入病人的體內。下列哪一種同位素最適合選用？
(1) 半衰期為十分之一之 $\times$ 元素
(2) 半衰期為二小時之 $\times$ 元素
(3) 半衰期為十日之 $\times$ 元素
(4) 半衰期為一年之 $\times$ 元素
(5) 半衰期為十年之 $\times$ 元素
13. 一個質量數為 A 和原子序數為 Z 的原子經過了三次衰變：第一次射出一粒 α-粒子，第二次射出一粒 β- 粒子，第三次再射出一粒 β- 粒子。衰變後，產生了一個相同元素的同位素，其質量數為
(1) 不變
(2) 等於 A - 1
(3) 等於 A - 2
(4) 等於 A - 3
(5) 等於 A - 4

14. 一個鈾 $^{235}_{92}$ 的原子核吸收了一粒中子後，發生核子分裂。下列那一項是分裂後可能產生的結果？
(1) $^1_0 \text{C} + _2^4 \text{He} + _{91}^{232} \text{Pa}$
(2) $^2_8 \text{Pb} + _5^5 \text{He} + 7 \alpha'$
(3) $^1_0 \text{C} + _{93}^{236} \text{Np}$
(4) $^2_2 \text{He} + _{90}^{232} \text{Th}$
(5) $^{38}_{36} \text{Sr} + _{45}^{140} \text{Xe} + 6 \alpha'$

解：$\text{C}^0$ 為電子，$\alpha'$ 為中子

15. 假設從放射性元素鈾 (plutonium) 射出的輻射線中發現有原子序數為 3 和質量數為 5 而屬於元素鋰 (lithium) 的一種新同位素。下列那一項核反應式能正確地表示該 $^{239}_{94} \text{Pu}$ 原子核衰變的放射現象？
(1) $^{239}_{94} \text{Pu} \rightarrow _3^7 \text{Li} + _{91}^{234} \text{Pa}$
(2) $^{239}_{94} \text{Pu} \rightarrow _3^7 \text{Li} + ^{97}_{97} \text{Bk}$
(3) $^{239}_{94} \text{Pu} \rightarrow _3^7 \text{Li} + ^{91}_{91} \text{Pa}
(4) $^{239}_{94} \text{Pu} \rightarrow _3^7 \text{Li} + ^{94}_{89} \text{Ac}$
(5) $^{239}_{94} \text{Pu} \rightarrow _5^7 \text{Li}^{3} + _{91}^{234} \text{Pa}$
16-17 參選下圖，銅可同時射出 \( \alpha \), \( \beta \) 和 \( \gamma \) 三種輻射線。現把一銅粒放在一個真空之密閉箱內，如圖所示銅射線從一細小的銅孔放出，形成一狹長射束，再通過兩塊薄紙的金屬板中間。當兩先後暴影後，我們發覺了三處有斑點，以 \( P, Q \) 及 \( R \) 為記。 

16. 這三處斑點分別由何種輻射線產生？

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<td>(5)</td>
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17. 若我們增加兩塊金屬板上的電荷，使銅正電的一片有更多正電和銅負電的一片有更多負電，這三處斑點會有何變化？

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18-19列举下图，我们以一个水流逻辑的水柱代表放射性衰变衰变率。衰变率乃为不稳定原子之分裂速率，一个放射性物质之衰变率是与其存在之不稳定原子之数目成正比。同样，理由水流速度也与高于水流出口处的水柱高度成正比。

| P |  | Q |  | R |

以上各图乃为三个不同横切面之水箱，各有一同等的细水管接在其出水处。

18. 水箱Q内水的半衰期为
(1) 水分子在接上水箱Q的细水管内逗留时间之一半
(2) 水箱内水位降至原来水柱高度的一半所需时间
(3) 水箱内全部的水流出所需时间之一半
对于上述之解释，
(1) 有(2) 是对的。
(2) 有(2) 是对的。
(3) 有(2) 是对的。
(4) 有(1) 和(2) 是对的。
(5) 有(1) 和(3) 是对的。

19. 以这个比喻看来，水柱高度相随于不稳定的原子的数目，并且水流速率相随于衰变率。这个比喻虽不科学，但其原因是
(1) 既然各水柱的原水高度都是一样，各水箱的半衰期可不一样。
(2) 水箱的半衰期不单由原来的水柱高度去决定，亦要由水箱的横切面大小去决定。
(3) 由于水柱流出箱外的细水管粗细，因而水柱的半衰期便太长了。
对于上述的三个解释，下列那一项是正确的？
(1) 有(1)
(2) 有(2)
(3) 有(1) 和(2)
(4) 有(1) 和(3)
(5) 有(3)
Appendix 15

\[ \text{Equation 1} \]

\[ \text{Equation 2} \]

\[ \text{Equation 3} \]

\[ \text{Equation 4} \]

\[ \text{Equation 5} \]
For S.S.E.E. results, students received classification grades 1, 2, 3, etc., as an indication of their standard in that subject area. A smaller grade number means a better result (grade 1 is the best) in that subject area. (Note this fact in Table 4.1).

Details of the program can be obtained from the Computer Centre, the University of British Columbia.

The cutoff value, corresponding roughly to the value of F1,60 at the 0.05 level of significance, was used in the analysis. All variables associated with F-value less than the cutoff value of 4.00 were not entered into the equation.

Independent variables not listed in Table 4.1 indicated that they were not significant in explaining a substantial variance of physics achievement.
In this section of the test, you will have an opportunity to demonstrate your ability to understand spoken English. There are three parts to this section, with special directions for each part.

PART A

DIRECTIONS: There are two kinds of problems in Part A. One kind is answering a short question; the other is understanding a short statement. These questions and statements will be spoken just one time. They will not be written out for you, so you will have to listen carefully in order to understand what the speaker says.

When you hear a question, read the four possible answers in your test book and decide which one would be the best answer to the question you have heard. Then, on your answer sheet, find the number of the problem and fill in (blacken) the space that corresponds to the letter of the answer you have chosen.

Look at Example I.

Sample Answer

You will hear: When did Tom come here?

(A) (B) (C) (D)

You will read: (A) By taxi.
(B) Yes, he did.
(C) To study history.
(D) Last night.

The best answer to the question, "When did Tom come here?" is (D), "Last night." Therefore, you should choose answer (D).

Then you hear a statement, read the four sentences in your test book and decide which one best gives the meaning of the statement you have heard. Then, on your answer sheet, find the number of the problem and mark your answer.

Look at Example II.

Sample Answer

You will hear: James relaxed with a sigh of relief when he heard the news.

(A) (B) (C) (D)

You will read: (A) The news was very disappointing.
(B) The news made James very sad.
(C) The news was better than expected.
(D) The news made James extremely nervous.

Sentence (C), "The news was better than expected," is closest in meaning to the sentence "James relaxed with a sigh of relief when he heard the news." Therefore you should choose answer (C).

PART A

1. (A) He's studying.
   (B) He spends more time teaching.
   (C) He studies longer than I do.
   (D) I study more time than he does.

2. (A) Henry's a baker.
   (B) Henry's a drummer.
   (C) Henry's at the door.
   (D) Henry's a batter.

3. (A) She is a banker.
   (B) She is a merchant.
   (C) She is a teacher.
   (D) She is a chemist.

4. (A) The magazines are in the basket.
   (B) The magazines are on the floor.
   (C) The magazines are on the table.
   (D) This is about furniture.
5. (A) I like monkeys but not lions.
(B) I like cats but not lions.
(C) I like lions but not cats.
(D) I like lions but not monkeys.

6. (A) It's only eleven o'clock.
(B) It's time for lunch.
(C) Our lunch time is ten o'clock.
(D) I'm hungry but it's too early for lunch.

7. (A) The blue car is not worth buying.
(B) The green car is expensive.
(C) Both cars are expensive.
(D) The green car is cheaper than the blue car.

8. (A) She arrived at 11:00.
(B) She arrived at 11:30.
(C) She arrived at 12:00.
(D) She arrived at 12:30.

9. (A) The two girls are standing there.
(B) They're not relatives.
(C) The two girls are relatives.
(D) They are sisters.

10. (A) Dorothy was late for the train.
(B) Dorothy was trying to catch the train.
(C) The train had left before Dorothy came.
(D) Dorothy made them late for the train.

11. (A) Bob always makes girls nervous.
(B) The girls before Bob are always nervous.
(C) Girls always make Bob nervous.
(D) Both the girl and Bob are nervous.

12. (A) We're on diet.
(B) We eat more than we usually do.
(C) We don't eat very much, for we take vitamin pills.
(D) It is important to care for the balance of our diet.

13. (A) Ten days ago, the people were trying to leave the town.
(B) The flood made fifty families homeless.
(C) I was by the river ten days ago.
(D) The river was situated near the town.

14. (A) They went on honeymoon right away.
(B) They did go on honeymoon immediately after their wedding.
(C) They spent a week having honeymoon.
(D) They went on their honeymoon a week after their wedding.

15. (A) Jean was too busy to go shopping.
(B) Jean's sister has no time to buy dresses.
(C) Jean and her sister have a lot of time to spend.
(D) Jean wasn't a good buyer of dresses like her sister.

16. (A) The monkey made fun of Laura.
(B) Laura's monkey couldn't dance.
(C) Her monkey made funny faces.
(D) The monkey danced and laughed.

17. (A) She decides to stop smoking, because cigarettes are harmful.
(B) She's afraid of gaining weight if she quits smoking.
(C) She doesn't like to gain weight.
(D) She's not aware of the consequences of smoking.

18. (A) Mr. Scott didn't come.
(B) Mr. Scott attended the meeting.
(C) Mr. Scott almost attended all meetings.
(D) Mr. Scott was late for the meeting.

19. (A) Nobody was missing.
(B) Several people were missing.
(C) One person couldn't be found.
(D) Several people couldn't be found.
20. (A) He left after he got all the answers.
(B) He left as soon as he asked him all the questions.
(C) Nobody answers Eddie's questions.
(D) He left after he answered all the questions.

PART B

DIRECTIONS: In Part B you will hear fifteen short conversations between two speakers. At the end of each conversation, a third voice will ask a question about what was said. The question will be spoken just one time. After you hear a conversation and the question about it, read the four possible answers and decide which one would be the best answer to the question you have heard. Then, on your answer sheet, find the number of the problem and mark your answer.

You will hear:

(men) Hello, Mary. This is Mr. Smith at the office. Is Bill feeling any better today?

(woman) Oh, yes, Mr. Smith. He's feeling much better now. But the doctor says he'll have to stay in bed until Monday.

(third voice) Where is Bill now?

You will read:

(A) At the office.
(B) On his way to work.
(C) Home in bed.
(D) Away on vacation.

Sample Answer

(A) (B) (C) (D)

From the conversation, we know that Bill is sick and will have to remain in bed until Monday. The best answer, then, is (C), "Home in bed." Therefore, you should choose answer (C).

PART B

21. (A) At the department store
(B) At the church
(C) In the garden
(D) At the grocery

22. (A) He doesn't have any money to buy the lamp
(B) He has a lot of money to buy the lamp
(C) If he lends her money, she will buy the lamp
(D) If she lends him money, he can buy the lamp.

23. (A) Repairman
(B) Taxi driver
(C) Salesman
(D) Car dealer.

24. (A) 10 A.M.
(B) 12 A.M.
(C) 2 P.M.
(D) 4 P.M.

25. (A) He's going to find an apartment
(B) He's helping his brother look for an apartment
(C) He already found an apartment
(D) He's looking for an apartment with a girl.

26. (A) The big parties are more impersonal than small ones.
(B) She likes big parties better
(C) She likes small parties
(D) The party is nonsense.

27. (A) He is satisfied with driving from his home to work
(B) The distance is about 20 miles
(C) The road is good but there's a lot of traffic
(D) He lives very far from his work.
28. (A) The temperature dropped below freezing  
    (B) It was mildly cold in the early winter last year  
    (C) It was very cold  
    (D) It was very cold during X'mas time.

29. (A) 50¢  
    (B) $2.00  
    (C) $2.50  
    (D) $3.00

30. (A) $19,500  
    (B) $20,000  
    (C) $25,000  
    (D) $40,000

31. (A) The story was good  
    (B) The movie was good  
    (C) Reading novels is more entertaining  
    (D) The photography was good.

32. (A) Children have already left for their grandmother's home  
    (B) Children will leave for their grandmother's home  
    (C) Children will leave for their grandmother's after school  
    (D) Children will play with their grandmother in the school.

33. (A) She's careless  
    (B) She likes George very much  
    (C) She's not concerned with George's health  
    (D) She doesn't care what George said.

34. (A) He hears well  
    (B) He hears poorly  
    (C) He's deaf  
    (D) He's dead.

35. (A) There's another cat  
    (B) He never loosens the dog  
    (C) She has mistaken it for his dog  
    (D) The dog likes to walk on the leash.

36. (A) Declined  
    (B) Depleted  
    (C) Limited  
    (D) Unlimited.

37. (A) Because it is important for food resources  
    (B) Because the great fisheries are to be exhausted  
    (C) Because the noted biologist insisted on it  
    (D) Because fishes are fewer than Indian Tigers.

38. (A) Europe and Asia  
    (B) The whole world  
    (C) Asia and America  
    (D) America.

39. (A) The land and the air  
    (B) Important species for conservation  
    (C) Indian Tigers and the American Eagle  
    (D) The African Elephant.

40. (A) The Indian Tiger and the American Eagle are important  
    (B) None of the great sea fisheries are to be exhausted  
    (C) Fish supply has no effects on people  
    (D) Sea resources are important to people.

41. (A) The resources of the sea were unlimited  
    (B) The threats to Animals and Birds  
    (C) Sea resources will continue as important food supplies  
    (D) We must love fishes.
42. (A) Paris  
    (B) Copenhagen  
    (C) New York  
    (D) London.

43. (A) 1  
    (B) 2  
    (C) 3  
    (D) Never.

44. (A) London and Paris  
    (B) U.S.A.  
    (C) Paris  
    (D) Paris and Copenhagen.

45. (A) The Natural Gas Company  
    (B) Fuel Shortage  
    (C) The Gas Industries  
    (D) A warm winter.

46. (A) It was very cold  
    (B) It had snows  
    (C) It was a little cold  
    (D) It was unusually warm.

47. (A) Curiosity about canned sea food  
    (B) Sincerity and Persuasion  
    (C) Anger about canned sea food  
    (D) Ordering canned sea food.

48. (A) Toxic and poison  
    (B) A clear crystalline substance  
    (C) Chips of glass  
    (D) Sea food.

49. (A) Boil them in water  
    (B) Boil them in warm vinegar  
    (C) Throw them away  
    (D) Eat them.

50. (A) Complain to the Federal Food and Drug Administration  
    (B) Ask for refunding of your money from the canner  
    (C) Place them in vinegar for a few minutes  
    (D) Let the particles dissolve.

END OF THE LISTENING COMPREHENSION
1. "Elizabeth borrowed the book a month ago."
   "Then she should _____ it by now."
   (A) to finish (B) have finished
   (C) finish (D) had finished

2. "Are those men in the blue uniforms policemen?"
   "Oh, no; they're _____."
   (A) bus drivers (B) buses drivers
   (C) bus driver (D) buses driver

3. "I'm very tired."
   "We really should stop _____ and go to bed."
   (A) to study (B) from studying
   (C) of studying (D) studying

4. "I like Mary's parents very much."
   "_____ ."
   (A) So I do (B) I so do
   (C) So do I (D) I do so

5. "That's a beautiful table cloth."
   "Yes, but it's not _____ for this table."
   (A) nearly enough long (B) nearly so long
   (C) nearly long enough (D) so nearly long

6. "How did you get your car out of the ditch?"
   "_____ it."
   (A) Push (B) Having pushed
   (C) From pushing (D) By pushing

7. "I got twenty-five problems wrong on that maths test last week."
   "Well, take your time on this one and you'll probably make _____ mistakes."
   (A) not much (B) fewer
   (C) lesser (D) very little

8. "How many from your team entered the contest?"
   "_____ but one."
   (A) All (B) Any
   (C) Some (D) Many

9. "I can't see the blackboard very well."
   "Perhaps you need _____ ."
   (A) to examine your eyes (B) to have your eyes examined
   (C) to have examined your eyes (D) to be examined your eyes

10. "I like your new typewriter very much."
    "I bought it because it was _____ yours."
    (A) like (B) similar of
    (C) like as (D) as

11. "Will the committee meet during vacation?"
    "No, I suggested that a meeting _____ at some other time."
    (A) holds (B) is holding
    (C) be held (D) hold
12. "How did Carl get the nickname of 'Quacker'?
   "Because he ___ ducks when he was a child."
   (A) had been imitating  (B) has-imitated
   (C) was imitating          (D) used to imitate

13. "Wasn't Joan supposed to be here by now?"
   "Don't worry. She'll be here ___ twenty minutes."
   (A) by at least  (B) around
   (C) at nearly    (D) in about

14. "I wonder how old Mrs. Clark is."
   "She won't tell her age, and ___.
   (A) so won't her sister  (B) her sister won't, too
   (C) neither will her sister  (D) either won't her sister

15. "Mr. Smith said we could ride to Miami with him."
   "Are you going to take advantage ___ his offer?"
   (A) of  (B) with
   (C) by  (D) to

16. "Don't you have more meat?"
   "No, thanks. I've had ___ enough already."
   (A) beyond  (B) more than
   (C) greater than  (D) plenty

17. "Where would your grandfather live if he retired?"
   "He'd have a little place beside the water if he ___ it."
   (A) could have afforded  (B) would afford
   (C) could afford          (D) would have afforded

18. "Will the child recover?"
   "Right now, there's no way ___.
   (A) for knowing  (B) to have known
   (C) of knowing  (D) to be known

19. "Do you want to see my driver's license or my passport?"
   "Oh, ___".
   (A) either does well  (B) either one will do
   (C) each one is good  (D) each will be fine

20. "Have you gone to see the doctor?"
   "No, but ___.
   (A) I go  (B) I'm going to see
   (C) I go to see  (D) I'm going to

21. "Is Dave about ready?"
   "Yes, he's ___.
   (A) finished dressing nearly  (B) finishing nearly dressing
   (C) nearly finished dressing  (D) nearly finishing dressing

22. "That's good, because ___ is dry."
   (A) the most of the bread  (B) almost whole of the bread
   (C) the nearly all bread  (D) almost all the bread
23. "I can't imagine how they could put on that play in high school."
"They chose the best scenes, ____ out everything that was unsuitable."
(A) and were left (B) left
(C) and leave (D) leaving

24. "Mr. Wilson is expected back at noon."
"Would you have him ____ then, please?"
(A) calling me (B) call me
(C) to calling me (D) called me

25. "Jack plays the piano beautifully."
"Yes, he's ____ here."
(A) the most talented of any students
(B) the more talented student than any other
(C) more talented than any other student
(D) most talented of students

26. "Are you sure there's nothing wrong with this radio?"
"Well, all of the parts seem to be ____.
(A) in working order (B) in order of working
(C) in work order (D) in order of work

27. "The Calhouns have just moved into a larger apartment."
"Did they have to buy ____ for it?"
(A) many new furniture (B) much new furniture
(C) many new furnitures (D) much new furnitures

28. "What did you say about the lawnmower?"
"I objected to ____.
(A) its price so high (B) it has such a high price
(C) its high price (D) it is high priced

29. "Were you ever able to give the Johnsons the message?"
"Yes, I finally succeeded ____ by phone."
(A) to reaching them (B) of reaching them
(C) to reach them (D) in reaching them

30. "What excuse did John offer for his rudeness at the committee meeting?"
"He didn't even mention it ____ explain it.
(A) let alone (B) and even not
(C) or not (D) as opposed to

31. "The Ryans watch television all the time."
"____ do the Tuckers."
(A) So (B) Either
(C) Neither (D) Also

32. "I can't understand what Pierre says."
"I know. That's because he speaks ____ English."
(A) a little (B) such small
(C) so little (D) very small
33. "I'm sorry. Were you speaking to me?"
   "Yes, I was. Would you please ___ in this room?"
   (A) not to smoke (B) not smoke
   (C) no smoking (D) no smoke

34. "Did you call Mr. Jackson?"
   "No, because he said he would rather not ___ disturbed this morning."
   (A) to be (B) being
   (C) be (D) been

35. "Do you know Edward Wilson?"
   "The name sounds familiar, but I don't remember ___ him."
   (A) that I meet (B) meeting
   (C) to meet (D) of meeting

36. "Did your club dance turn out well?"
   "Yes. We made a ___ profit."
   (A) five-hundred-dollar (B) five-hundred-dollars
   (C) five-hundreds-dollar (D) five-hundreds-dollars

37. "What's the matter with that picture on the wall?"
   "It needs ___ ."
   (A) straightening (B) to be straightening
   (C) straightened (D) straighten

38. "The market won't be open tonight."
   "If I ___ , I wouldn't have bothered to drive over here."
   (A) know (B) known
   (C) would know (D) had known

39. "Do you have a dictionary?"
   "No, but I wish I ___ ."
   (A) have (B) did
   (C) do (D) have had

40. "Michael left for California this morning."
   "Oh, I thought he ___ until next week."
   (A) won't be going (B) isn't going
   (C) wasn't going (D) hadn't been going

END OF PAPER
1. He was the only ____ of the plane crash.
   (A) possessor (B) relic (C) survivor (D) finale

2. To repair or improve the appearance of something is to fix it ____.
   (A) out (B) off (C) up (D) over

3. He ____ for stepping on Mary's foot.
   (A) admonished (B) apologized (C) ridiculed (D) humiliated

4. Because of a ____ engagement, Jean couldn't attend the party.
   (A) premature (B) prolific (C) prescribed (D) prior

5. The leaders decided to organize ____ in order to arouse the members of
   their party.
   (A) a rally (B) a sensation (C) a convoy (D) an exercise

6. His ____ and experience make him an excellent person for this job.
   (A) competence (B) complacency (C) compensation (D) compunction

7. A new kind of machine made the old one ____.
   (A) outright (B) obstructed (C) outlandish (D) obsolete

8. To ask someone for help is to turn ____ him.
   (A) to (B) for (C) on (D) by

9. The balloon was ____ with air.
   (A) injected (B) infused (C) instilled (D) inflated

10. We can't understand Uncle George, for he always ____ whatever he says.
    (A) masters (B) molests (C) numbles (D) muzzles

11. To assist someone with something is to help him ____.
    (A) around (B) on (C) over (D) out

12. Mr. Robinson was very grateful and thanked us _____, though we had really
    done very little.
    (A) eminently (B) profusely (C) arrogantly (D) complacently

13. He used the stick as a ____ to keep the window open.
    (A) prop (B) slot (C) curb (D) plug

14. The vase ____ on the edge of the table, then fell to the floor with a
    crash.
    (A) wobbled (B) wheeled (C) walloped (D) waddled

15. You haven't really answered the question, for what you said is not ____.
    (A) eligible (B) pertinent (C) provident (D) expeditious

   PART B

16. not real
    (A) imaginary (B) incredible (C) insensible (D) unanimous

17. the state of being unoccupied, emptiness
    (A) seclusion (B) exile (C) vacancy (D) recess

18. a part of something
    (A) capsule (B) covenant (C) symptom (D) segment

19. to make sad
    (A) distort (B) deplore (C) depress (D) disdain
20. according to the law
   (A) conspicuous  (B) temperate  (C) sympathetic  (D) legitimate

21. rapid movement back and forth
   (A) vibration  (B) acceleration  (C) commotion  (D) versatility

22. the center or central part
   (A) cube  (B) cove  (C) core  (D) cult

23. warm and close friendship
   (A) piety  (B) frenzy  (C) intimacy  (D) enmity

24. to free someone from blame or guilt
   (A) absolve  (B) exasperate  (C) disengage  (D) unfetter

25. to confuse
   (A) focus  (B) bewilder  (C) infect  (D) accost

26. to describe or depict
   (A) survey  (B) portray  (C) behold  (D) observe

27. useless, ineffectual
   (A) brazen  (B) sluggish  (C) dire  (D) futile

28. to bring back, to rescue
   (A) recede  (B) retrieve  (C) retrench  (D) rescind

29. to pretend
   (A) feign  (B) fuse  (C) foil  (D) fume

30. very ugly or frightening
   (A) sullen  (B) dismal  (C) hideous  (D) gloomy

31. difficult to control
   (A) unbiased  (B) uncanny  (C) ungainly  (D) unruly

32. a beginner
   (A) nomad  (B) nominee  (C) novice  (D) notary

33. to force
   (A) coerce  (B) abash  (C) efface  (D) succumb

34. frankness of expression, sincerity
   (A) conviction  (B) candor  (C) innuendo  (D) intimation

35. to demand certain conditions
   (A) excrete  (B) invoke  (C) postulate  (D) stipulate

36. to explain, to make clear
   (A) elucidate  (B) incalculate  (C) infiltrate  (D) expostulate

37. a distressing or unfortunate situation
   (A) hazard  (B) guise  (C) plight  (D) blotch

38. returning from time to time
   (A) repentant  (B) recurrent  (C) recessive  (D) repugnant

39. an unexpected shock
   (A) clang  (B) blast  (C) jolt  (D) snap

40. insignificant, worthless
   (A) paltry  (B) minimum  (C) stunted  (D) compact

END OF PAPER
In 1686 a minister admitted that many people in New England wanted to see stage plays in spite of the strong opposition of the influential Puritan church. Interest in the drama grew slowly and steadily in America, but it persisted. By 1800, Thomas Bullfinch had designed an exquisite theater for Boston with rooms for dances, card games, and teas. Throughout the nineteenth century, playhouses were established in cities along the East Coast from New York to Charleston, South Carolina. Also, as people moved westward to settle new areas, temporary theaters were built in the young towns. In Columbus, Ohio, trees that were growing on a Monday would become timber for a theater by the following Thursday. In Natchez, Mississippi, a theater was built in a graveyard, and the audience could see bones beneath the stage. Shows were often presented in taverns and other public buildings.

Serious drama did not flourish very far from the East Coast, however. Many talented actors traveled around the country, but they could offer only light entertainment because travel was difficult and not much scenery or equipment could be carried over the rough western roads. But dramatic activity was so popular that a native form of light entertainment developed. In fact, even the humorous tale came to be presented theatrically, as the storyteller relied upon appearance, gesture, and manner of speaking for his dramatic effect.

1. According to the passage, a theater in Natchez was built in a
   (A) church (B) tavern (C) forest (D) graveyard

2. Thomas Bullfinch was most probably
   (A) an actor (B) an architect (C) a minister (D) a builder

3. According to the passage, most of the development of the theater took place
   (A) before 1700 (B) between 1700 and 1800 (C) between 1800 and 1900 (D) after 1900

4. Which of the following factors contributed to the particular kind of native entertainment that developed?
   (A) The scarcity of good actors who would travel
   (B) The lack of popular interest in serious drama
   (C) Difficult traveling conditions in the American West
   (D) Opposition of the Puritan church to serious drama

5. The passage states that the theatrical productions of the American West developed in the form of
   (A) light entertainment (B) humorous tales (C) casual songs (D) serious drama

6. The author suggests that the Puritan church
   (A) could not prevent the building of theaters (B) tolerated only skilled actors
   (C) used the drama for religious purposes (D) could not discourage interest in the drama

7. The presence of rooms for dances, card games, and teas in the Boston theater shows that
   (A) other entertainment was more important than the plays (B) the church had a great deal of influence
   (C) the theater building was elaborate (D) Boston was an up-to-date city
The gorilla, called fiendishly fierce on the basis of reports from hunters and observers of captive animals, turns out to be quite agreeable in his own domain, according to zoologist George B. Schaller. Every ape is aware of his status in the group, says Dr. Schaller, so "there is rarely any strife beyond the occasional bickering which is apt to occur even among the most congenial companions." Averaging fewer than twenty animals, the gorilla social group always is dominated by a silver-backed older male, and members of the group seem to like their benevolent dictator. Down the line, males dominate females and females dominate juveniles. The social exchange is close and affectionate, "much like that of a happy human family with a polygamous mating system," Dr. Schaller observes.

As a captive, the gorilla has been described as introverted and phlegmatic. Dr. Schaller observed a range of emotions from hesitation and uneasiness to curiosity, boldness, and annoyance. Like humans, gorillas bite their lips when uncertain and frown when annoyed. The young throw tantrums when thwarted and, like human infants, are intensely curious. Dr. Diane Rumbaugh, who recently observed and tested a baby gorilla through its first year, found the animal attentive and persevering and judged that its exploratory behaviour equalled that of human infants.

8. Dr. Schaller reports that within the gorilla's social group
   (A) each member knows who is more and who is less important
   (B) there is strife when leadership is contested within the group
   (C) each member has a chance to obtain the position of leader
   (D) status is determined by the number of female and juvenile followers each male has

9. An interesting observation concerning gorillas is that
   (A) their behaviour is just like that of human babies
   (B) their emotions are more intense and erratic than man's
   (C) they exhibit a range of emotions very similar to man's
   (D) they more often exhibit uncertainty, annoyance, and curiosity than do men

10. In line 17, "thwarted" could be replaced correctly by
    (A) hungry  (B) frustrated  (C) angry  (D) tired

11. According to the passage, within the gorilla social group, decisions are made by
    (A) a group of the oldest males  (B) a consensus among the males
    (C) one of the older males  (D) the strongest among the males

12. It appears that keeping a grown gorilla in captivity has the effect of making him
    (A) behave like a human infant, frowning and having tantrums
    (B) curious, attentive, and persevering
    (C) less lively and less interested in things around him
    (D) imitate adult humans

13. According to the author, in their natural habitat gorillas are
    (A) fiendishly fierce
    (B) careful to fight only with members of their own social group
    (C) more aggressive than are members of their own social group
    (D) likely to indulge in minor quarreling but are amiable on the whole

14. Apparently Dr. Schaller's work was important because he
    (A) he observed gorillas in situations that were natural to them
    (B) discovered that gorillas are very much like human beings
    (C) observed gorillas over a long period and found that they are just like human infants
    (D) discovered that gorillas maintain a closeknit, well-organized social group
Every human being, no matter what he is doing, gives off body heat. The usual problem is how to dispose of it. But the designers of the Johnstown campus of the University of Pittsburgh set themselves the opposite problem - how to collect body heat. They have designed a collection system which utilizes not only body heat, but the heat given off by such objects as light bulbs and refrigerators as well. The system works so well that no conventional fuel is needed to make the campus's six buildings comfortable.

Some parts of most modern buildings - theaters and offices as well as classrooms -- are more than amply heated by people and lights and sometimes must be air-conditioned even in winter. The technique of saving heat and redistributing it is called "heat recovery." A few modern buildings recover heat, but the University's system is the first to recover heat from some buildings and re-use it in others.

Along the way, Pitt has learned a great deal about some of its heat producers. The harder a student studies, the more heat his body gives off. Male students emit more heat than female students, and the larger a student, the more heat he produces. It is tempting to conclude that the hottest prospect for the Johnstown campus would be a hard-working, overweight male genius.

15. Until recently, body heat has caused problems because it
(A) was difficult to collect
(B) came in a variety of forms
(C) was difficult to get rid of
(D) tended to be absorbed by physical objects

16. Which of the following is true of the heating system of the Johnstown campus?
(A) The heat is supplied by human bodies only.
(B) The heat is supplied by both human bodies and other heat-emitting objects.
(C) The heat is supplied by both human bodies and conventional fuel.
(D) The heat is supplied by human bodies, other heat-emitting objects, and conventional fuel.

17. At the Johnstown campus, how many of the buildings are heated entirely by the heat collection system?
(A) none (B) Two (C) Four (D) Six

18. In line 7, "conventional" most nearly means
(A) ordinary (B) powerful (C) electrical (D) extra

19. In line 10, "amply" most nearly means
(A) partly (B) overly (C) warmly (D) adequately

20. The phrase "even in winter" (line 11) most nearly means
(A) if the winter is especially warm (B) during all of the year except the winter (C) in the winter as well as in other seasons (D) during the evenings in the winter

21. In line 12, "heat recovery" refers to a
(A) method of concealing the source of heat (B) special form of air conditioning (C) supplementary hot water system (D) way of reclaiming and re-using heat

22. According to the passage, which of the following would produce the LEAST amount of heat?
(A) A fat female who studies hard (B) A thin female who does not study (C) A fat male who does not study (D) A thin male who studies hard

23. In line 19, the "hottest prospect" means the
(A) most intelligent student (B) most desirable student (C) most diligent student (D) most obese student
In the Mormon company, bugles sounded each morning at five. Two hours were allowed for breakfast and prayers. During the day the company traveled in a close file, most of the men trudging beside the wagons, carrying weapons that were loaded and clearly visible. At night the wagons were drawn into a tight circle -- or a semicircle if the company camped on a river bank. Usually the animals were pastured within the circle to keep them from roaming and falling prey to thieves. The men would retire for prayers by groups at eight-thirty, and they were expected to be settled by nine. Fifty of them had been appointed as guards, with twelve of these standing duty each half-night. At one time, while they were crossing the prairies, in Indian country, the company drove five wagons abreast.

The Mormons sighted their first buffalo at the head of Grand Island on April 30. Hunters from the camp rode after them and succeeded in bringing down eleven, which were added to the larder.

24. How were the Mormons awakened each morning?
(A) By their appointed guards (B) By light from the rising sun
(C) By a kind of trumpet (D) By the calls of birds

25. The Mormons placed their wagons in a circle or a semicircle at night because this arrangement
(A) was a quick and convenient way to make camp
(B) helped to shelter the party from wind and rain
(C) was the most appropriate setting for their devotions
(D) gave them a kind of barricade or fort for protection

26. What seems to have been the Mormons' chief worry as they traveled?
(A) Hostile attacks (B) God's displeasure
(C) Running out of food (D) Losing their way

27. Which of the following adjectives would NOT describe the Mormons in the passage?
(A) Devout (B) Disciplined
(C) Wary (D) Helpless

28. In line 11, "prairies" could be correctly replaced by
(A) riverbeds (B) flat, open lands
(C) deep valleys (D) border territory

29. We can infer from the passage that, by carrying their weapons, the Mormon men hoped to
(A) prevent them from being stolen (B) fight fatigue more easily
(C) discourage possible enemies (D) travel faster

30. When they pastured their animals, what did the Mormons do with them?
(A) Gave them food and rest (B) Provided them with shelter from the elements
(C) Allowed them to wander freely about (D) Slaughtered and cooked them

31. When the eleven buffalo were added to the larder, they were added to the
(A) company's herd of animals (B) hunting records of the men who brought them in
(C) company's store of food (D) cooking pot
PART A

1. It is often easier to select the best tool for a particular job than to use them correctly.

2. When a person accepts a dinner invitation, you are expected to arrive on time.

3. Today, divorce is no longer regarded as a disgrace, as a tragedy, or even as a failure.

4. Absurdly is one of the most prominent themes of twentieth-century European drama.

5. If the parents had gone to the meeting, they could have discussed the problems with the principal himself.

6. It may be said that in some countries each of the citizens help to decide government policy.

7. When our neighbor's grandson caught his finger in the car door, he did not cry even though it must have hurt him a great deal.

8. The lawyer, Ben Burstine, he presented his case so successfully that the jury came to its decision within a short time.

9. A visit to the chateau includes sampling the wine, discussing its merits, and then, if you are fortunate, to have a chat with the marquis.

10. It may not have been the worse blizzard in history, but I do not want to be out in another one like it.

11. Japan has experienced a remarkable economic growing in the past decade.

12. He generally expresses himself more forceful than any of the members of the opposite party.

13. As a result from hearing the radio announcement, Craig has written to offer himself as a member of the panel for next week.

14. It is surprising that Marquesne is such a fine writer, for he has not read only a few books other than his own.

15. There are many organizations which sole purpose is to help mentally retarded children.
16. Waiting for a plane to take off from an airport can often take so long as the trip itself.

17. Paul had just returned home and began to read the paper when his sister called to say she had arrived at the station.

18. It has been estimated that the efforts of a more one per cent of its total population moves the world forward.

19. The columnist feels sure that who wins the election will have the support of both parties.

20. Because he was greatly troubled by his conscience, Hamlet was incapable to kill the king.

21. Neither Russia nor the United States have been able to discover a mutually satisfactory plan for gradual disarmament.

22. The specific gravity of a gas is the numerical ratio of its density with the density of a standard of reference, usually air.

23. Seldom in Western civilization has one man been successful in more intellectual pursuits as Leonardo.

24. Far too many owners of color television sets have had a difficult time to find qualified repairmen.

25. Aside from the resolution to have more ecumenical conferences, the most accomplishment of the group was that it met at all.

PART B

26. There is always a gap between what we say and ________.
   (A) whatever we do  (B) what we do  (C) that which is done  (D) that done

27. A good administrator must know ________.
   (A) to be firm  (B) to have firmness  (C) the way of firmness  (D) how to be firm

28. In a period of inflation, the value of money drops as ________.
   (A) prices rise  (B) prices go the other way  (C) up go the prices  (D) prices arise

29. Because there was little heat in the bedroom, Evan was cold ________.
   (A) much through the night  (B) most of the night  (C) many parts of the night  (D) the majority part of the night

30. The hikers needed to walk faster to ________.
   (A) arrive by their destination in time  (B) reach their destination on time  (C) reach at their destination in time  (D) arrive their destination on time
31. The purpose of the research had a different meaning for them than _____.
   (A) ours   (B) for ours it had
   (C) with us (D) it did for us

32. It is one thing to accuse a person of a certain crime, but ________.
   (A) proving it is different (B) how to give proof is no easy
   (C) when to prove it is difficult (D) to prove it is quite another
      matter

33. The party continued through ________.
   (A) the whole of the night   (B) nearly whole of the night
   (C) almost of the night      (D) most of the night

34. Synthetic fabrics are particularly valuable in making ________.
   (A) unheavy clothing for summers (B) clothes wearing light in summer
   (C) light clothes of the summertime (D) lightweight summer clothing

35. According to Xenophon, Socrates believed that ________.
   (A) what a man does is also able for a woman to do
   (B) a man's abilities can be the same with a woman
   (C) a woman can do the same thing as a man
   (D) the same things between man and woman can be done equally

36. Nineteen people were already dead, ________.
   (A) seven of whom were teenagers (B) seven being teenagers
   (C) teenagers were seven      (D) among seven were teenagers

37. Accustomed to climbing trees, ________.
   (A) I had no difficulty reaching the top
   (B) reaching the top was not hard to me
   (C) the top was not difficult for me to reach
   (D) to reach the top was not a problem

38. The harder they worked, ________.
   (A) they seemed to do less (B) the less they seemed to do
   (C) they were doing less      (D) they did less

39. In order to be a good scientist, ________.
   (A) mathematics is urgent
   (B) one should have the mathematics
   (C) one must understand mathematics
   (D) mathematics is important to be understood

40. Mary had spent ________ studying.
   (A) the whole day   (B) all during the day
   (C) altogether a day (D) entirely a day
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*e.g. "C" is the correct answer*
### Correlation Matrix for Total Sample

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**Log Determinant of T** = 24.0150146

**Determinant of T** = **************

**Lambda** = 0.9279304

**F1** = 3.0000000

**F2** = 172.0000000

**For Test of H2, F =** 4.4529104

**Execution Terminated** 13:17:20  **T=0.2 RC=0**  $0.92$