GENERAL SCIENCE

2 UNIT

In 1996 2057 candidates presented for the 2 Unit General Science examination.

SECTION I : Core

Part A

Multiple Choice Questions

The answers considered to be the most suitable for each of these questions were as follows:

Mean = 9.26				
Approximate percentage choosing each alternative				
Item	**A**	**B**	**C**	**D**
1	5.19	32.04	**59.28***	3.38
2	25.13	35.18	4.85	**34.44***
3	**65.36***	21.41	5.39	7.69
4	27.05	24.40	**46.01***	2.45
5	15.63	**73.15***	10.29	.93
6	12.84	16.41	29.79	**40.81***
7	1.57	**67.91***	29.79	1.81

Mean = 9.26				
Approximate percentage choosing each alternative				
8	**86.75***	2.45	2.30	8.43
9	3.48	**79.72***	3.04	13.72
10	3.72	10.00	**64.82***	21.26
11	12.93	32.63	13.23	**40.72***
12	31.21	5.44	**55.56***	7.74
13	**66.93***	8.04	9.60	15.29
14	**67.56***	12.49	9.95	9.85
15	9.26	**77.46***	1.67	11.51

Part B

General Comments

Most students attempted all of the questions. The standard of handwriting and literacy showed some improvement over the standards in recent years, but students need to practise reading the questions carefully, identifying key words and interpreting the meaning of the questions. Some questions and the responses to them indicated a need to consider current technology and recent research as part of this course.

In order to score higher marks, students are advised to make more frequent use of appropriate scientific terminology and to make specific statements rather than generalisations.

Question 16

(a) Students should carry out more practical work on naked eye astronomy. They need to be
and able to link their observations with theoretical concepts and correct terminology, e.g.
(b) *azimuth, elevation*. Students were able to cite other information satisfactorily, e.g. time, date, phase of the moon.

(c) Not all students were able to draw valid conclusions from their observations.
A large number scored by answering part (c) in part (a).

Question 17

(a) (i) Students were rewarded if they were able to recognise the heliocentric nature of the sixteenth century model and apply the term *epicycles* correctly.
The direction of the motion, e.g. clockwise, anti-clockwise, was irrelevant to the question and scored no marks.

(ii) Most were able to state that the twentieth century model described elliptical orbits.

(b) This required a post-Copernican response, as it was his model which featured in the question.

Question 18

(a) Those who scored well could confidently use terms like *long chains of monomers, covalent bonds, insulators* in describing common features of polymers. They were able to generalise about all polymers, rather than focussing on the properties of specific substances.

(b) There was a wide range of responses, most of which were accepted as being useful properties of wool that make it useful in clothing.

(c) A wide range of synthetic polymers was accepted.

Question 19

(a) Good students understood the concept of genetic engineering and were able to discuss its possibilities, but they were not all able to quote two specific examples that have been beneficial to humans. Some confused genetic engineering with reproductive technology, e.g. IVF, sex determination. Students should be encouraged to research this topic beyond their texts and to incorporate in their responses the latest advances in this area.

(b) Most students could identify a risk involved in research in genetic engineering. The better students were able to phrase their answers in scientific terms.

Question 20

Students generally answered this question well, and were able to recognise the differences between the hands and feet of a lemur and a human. Some related the difference to survival in the environment and were rewarded appropriately.

Question 21

(a) Many candidates had difficulty in placing the objects in order of cultural change.

(b) Responses often failed to show the significance of each of the chosen objects in improving a group's ability to survive.

Students are encouraged to make specific statements in their responses rather than generalisations and to avoid repeating phrases used in the question, especially when space for the response is limited.

Question 22

The better students were able to relate two advantages and two disadvantages of using plastic as a building material. Such students clearly stated the name of a specific synthetic polymer that could be used in windows instead of glass. Many simply stated *plastic.*

Question 23

This question was generally well answered. Students can improve their answers by giving specific information, providing examples or including a scientific rather than a general basis to the response.

In many responses there was obvious misunderstanding regarding the effect of the use of antibiotics on viruses, and the question of acquired resistance in bacteria.

Question 24

(a) Compared with previous years, a pleasing improvement was evident in the level of understanding of the concepts involved in moving a block of wood across a table. There is a need for candidates to use scientific terminology to express clearly the theoretical principles involved in moving the block of wood.

(b) The more able students extracted information from the table accurately, stated the necessary formula and then correctly calculated and expressed the efficiency of the specific method.

Question 25

(a) Generally responses to this question showed little evidence of the fact that candidates understood the issue of accountability in science.

(b) Many students stated generalised outcomes of the poll, having failed to recognise the significance of the question asked. The better candidates were able to identify features associated with the *design* of an opinion poll.

Part C

Question 26

This Core Unit involves the use of models in science and the question relied on the candidates' skill in interpreting a diagram. The better responses here showed that students had seen and discussed a similar diagram.

(a) (i) The better students correctly interpreted the diagram and indicated that it would be day in Sydney in both positions, A and D.

(ii) This question indicated that most candidates could not relate the tilt of the axis and the position of Sydney with the season, Summer.

(b) This was generally a well answered question with a full range of correct responses, one-quarter of a year to 913 days. A number of candidates confused the natural events causing day or night and the year.

(c) Most candidates understood that the seasons were affected if the Earth's axis were not tilted. The better responses then described effects on Sydney correctly - no seasons, equal day and night, climate change. Some answers needed more specific detail.

Question 27

In general, the question was very well answered.

(a) Many candidates understood the statement *tiny wobbles of the stars they orbit* or gave interpretations such as *regular motion of the stars they orbit* which could be obtained from the comprehension passage.

Too many candidates preferred to give answers that attempted to explain the techniques used by astronomers to determine the cause of these wobbles. In doing so, errors were made.

(b) Most candidates could list two reasons for not being able to see the planets. The better responses stated that the planets were too far away or too small or too dim or there was too much light from the associated stars or deficiencies in telescopes, e.g. *they were not powerful enough*.

(c) It was pleasing to find that most candidates were able to distinguish between simply naming a problem and describing it. The better responses described specific problems of the actual journey, e.g. a physiological problem such as muscle wastage due to weightlessness, a better propulsion system would have to be developed so that the long trip could be covered in a shorter time, the length of the trip would be too long for a

person's lifespan, the spacecraft would need to be safe, protected against cosmic rays and/or meteorite bombardment, the travellers would experience psychological problems because of loneliness and boredom, a reliable life-support system would be needed for the supply of oxygen, food and water.

It was also acceptable for the high costs involved in attempting such a journey to be given as well as the suggestions for alternative uses for the money.

Question 28

On the whole this was a very well answered question.

(a) This part was extremely well answered with candidates showing ability to process tabulated information and to interpret diagrams correctly.

(b) This was also well answered. The majority of candidates could state at least one feature correctly.

It was pleasing to see candidates' depth of knowledge of indicative physiological features of primates. The best answers were those which distinguished the primates from other groups, as well as indicating the observable features on Animal II. Good answers included: *opposable thumb and/or toe, forward facing eyes enabling binocular vision, flat face/reduced snout, nails rather than claws.*

(c) Most candidates had little trouble with this question since they possessed a sound knowledge of the distinguishing characteristics of apes. The most commonly given correct answer was: *Apes have no tail*. Other correct responses included increased brain size and arms longer than legs.

Question 29

(a) Here the better responses covered all possible criteria, viz. correct shapes, shading, three layered structure and a consistent linkage pattern.

(b) The majority of the candidates gave the correct response, i.e. the characteristic is recessive. Explanations varied greatly, the two most obvious responses being:

(i) Both parents (second generation) did not exhibit the characteristic, but one of the offsprings (sister) did.

(ii) The characteristic skipped a generation.

The most common error was considering only the mother's side of the family as influencing inheritance of the characteristic.

(c) This part was answered well by most candidates.

Question 30

(a) The majority of candidates answered this well.

(b) Some students named ores that were not mentioned on the diagram.

(c) Many students were unable to describe the functions of the parts or materials represented in the diagram by *X* and *Y*. A number had difficulty in interpreting the diagrams. The letters *X* and *Y* were confused by some who did not restrict their answers to one diagram.

(d) Many confused *property* with *use* or gave very general answers.

Question 31

(a) Many students were able to include the terms *natural selection* and *survival of the fittest* in their answer, but few were able to explain the concept fully in relation to the question asked.

(b) This part was well answered, with most students giving *creationism* and/or *religious beliefs* as their response.

(c) The majority of students experienced great difficulty with this question. Few were able to give evidence of planning a feasible and scientifically designed experiment to support Darwin's theory of evolution.

SECTION II : Electives

Question 32 : Colour (130 candidates)

Mean: 15.14 Standard Deviation: 5.22

On the whole there was a very good use of scientific language as well as evidence of a wide variety of experimentation, both within individual centres and across the State.

(a) The better candidates specifically directed their answer to *living things* rather than to the physics of colour. Their answers revealed a variety of *items* and did not simply elaborate on **one** item of information; the majority tried to include a diagram to support one or more items of information.

(b) In the better answers students described a specific behavioural reaction rather than a structural or physiological adaptation of an organism. Here candidates included a variety of behavioural responses.

(c) The majority of good answers responded correctly to the question by choosing experiments in the areas of *physics* and a *perception of colour* rather than chemistry or behaviour.

(d) The better answers specifically discussed each section of the question, rather than simply recording Aim, Method, Results, Conclusion, which were not required.

Many students incorporated coloured diagrams into their responses. In some cases this enhanced answers; in others it was obvious that the student had insufficient time and, perhaps, should have concentrated on answering the question before *colouring in*.

Question 33 : Metals in the Service of People (136 candidates)

Mean: 14.66 Standard Deviation: 5.19

(a) Most candidates showed a good understanding of common metals (Cu, Al, Fe, Au), viz. their properties and uses. A number of difficulties were discussed, particularly corrosion and change of property by alloying.

(b) Most candidates were able to provide a timeline dating from the use of native metals to simple extraction processes to the development of simple alloys (Bronze Age). A good understanding of the history and uses of metals in early civilisations was apparent. The better candidates related the discovery of metals to their order of use by early civilisations.

(c) The majority of students were well acquainted with experimental work, particularly in relation to extraction processes. Candidates presented their work both scientifically and logically. Their classroom experiments generally related to industrial extraction techniques.

(d) The majority of students had no difficulty in choosing a second experiment, thus showing the diversity of experiments attempted by candidates in this elective. There were few non-attempts as compared with last year. Only a small number of students could answer part (iii) competently, but the majority were able to describe some problems they had encountered or for which they allowed in their experiment.

On the whole this was a good question, although some responses did not extend the students' knowledge beyond the Core and few showed any great depth of understanding.

Question 34 : Optics

Answers here were satisfactory, although only a very small number of candidates attempted this option.

Question 35 : Petroleum and its Compounds (81 candidates)

Mean: 14.85 Standard Deviation: 4.28

(a) This part was generally well done and the better responses showed a logical progression as, in them, candidates examined the three key terms *formation, location* and *extraction.* There was, however, some confusion with the use of the term *extraction,* with some candidates discussing extraction of fuels from petroleum rather than extraction of petroleum from the ground. The best answers included accurate diagrams of geological structures and exploration techniques.

(b) Candidates who explained the process of fractional distillation, catalytic cracking, etc, as well as showing a knowledge of derived products from fractions and not simply from the distillation process, scored the highest marks.

(c) This part was generally well answered. Fractional distillation of crude oil was described in most responses. Those who achieved the best results showed a good understanding of the practical work and could relate the significance of the different boiling points to the fractions recovered. The discriminating factor between responses was the application of the process. Neat, accurate and relevant diagrams enhanced the answers.

(d) Those who could relate their practical experiences to the topic scored the highest marks.

Question 36 : Physiology of the Senses (194 candidates)

Mean: 14.87 Standard Deviation: 4.56

Most of those attempting this question were able to express themselves well and answered the question asked. The number of non-attempts, however, rose in part (d). It is emphasised, again, candidates should be aware of time management when answering any elective question.

(a) This part was answered very well. Diagrams of neurones and the reflex arc were good, while distinctions between sensory and motor neurones, cerebrum, cortex and cerebellum, were well covered. More emphasis was needed on *transmission* of impulse than on *reception*. The better candidates made good use of their knowledge of synapse and the electrochemical nature of the nerve impulse.

(b) Responses here were noteworthy for a good standard of literacy and a good knowledge of scientific terms and the better candidates showed knowledge of disorders of sense organs and medical terms. Concise answers, which included the use of tables and diagrams, scored most highly. The term *malfunction* was interpreted too broadly by some candidates.

(c) This part was generally answered well, although many candidates unnecessarily included *results*. Practical work was evident but the level of response was usually very basic with little use of scientific terms.

(d) The majority of candidates answered the question, but the better answers included tables and diagrams in their results. Many candidates discussed the need to repeat experiments in order to obtain reliable results, but did not explain why results should be averaged or compared.

Question 37 : Reproduction in Animals and Plants (176 candidates)

Mean: 14.2 Standard Deviation: 5.7

(a) Outstanding answers showed both depth and breadth of understanding, indicating wide research of relevant material.

Higher marks were awarded to those who presented clear and relevant diagrams, and to those who used scientific language and terms correctly.

(b) 25% of candidates did not attempt this section, which seems to indicate that the concept of evolutionary trends is not well understood. If this is so, this part of the Syllabus needs to be covered carefully. The better answers described a variety of trends.

(c) Generally the answers to this part were of a high standard and included accurate, relevant, well labelled diagrams.

Although many often confused genetics and evolution with reproduction, the majority could indicate experimental work in relation to plants and animal reproduction.

(d) This section was well answered. Many candidates described experiments on sexual and asexual reproduction in animals and plants under the headings in the question; the use of accurate diagrams enhanced most responses.

Part (iii) did present problems since candidates used controls or multiple trials in experiments in which these were either not relevant or impossible.

Question 38 : The Insects (76 candidates)

Mean: 14.88 Standard Deviation: 6.16

This question examined the elective thoroughly and appeared to cover many aspects of the specific topics of study, although the candidates did not show much in-depth knowledge. Part (c) appeared to be a fair, well worded, obvious choice, while part (d) gave the students freedom to refer to other experimental work covered.

(a) This question was fair for most students, the majority of whom wrote in some detail about the behaviour and communication of a number of types of insects, although few had extensive detail of any specific insect. Some diagrams of insect dances were supplied.

(b) The majority of candidates had a good understanding of the implications of the biological success of insects and its implications for people, listing both positive and negative aspects. Many considered the reasons for this success, linking it to reproduction, survival, resistance, physical features and adaptations.

(c) Even though there was evidence of experimental work here, candidates' findings lacked a scientific conclusion. Their experimental reports were greatly affected by their research, although the majority found such research difficult and confusing. For this reason very few experiments appeared to increase their understanding of the topic.

(d) Candidates with limited knowledge of the topic - The Insects - managed to write up a simple experiment, answering parts (i), (ii) and (v). The majority, however, had little experience in recognising problems and verifying the reliability of their results.

Question 39 : The Science of Food Technology (309 candidates)

Mean: 15.1 Standard Deviation: 4.38

The level of literacy and use of scientific language here were generally satisfactory, although it was obvious that a diverse range of students had chosen this Elective. Some answers were very detailed - more than the question required - while others were very basic and certainly did not indicate the level of study required in an Elective.

(a) The standard of literacy was satisfactory and most candidates were able to list items of information about the methods of food preservation. Many students failed to label clearly the answer to part (a), often including a general discussion of parts (a) and (b) together; very few, however, included diagrams, tables or graphs. Answers in table form often scored higher marks. Some candidates wrote lengthy discussions or described experiments which were unnecessary to score a high mark in this part. Many failed to use scientific language and terms, e.g. *oxidise, denotive, inactivate, enzyme*, and answers here often did not discuss scientific principles.

(b) This part was not as well answered as the previous part. One noteworthy weakness was confusion of *food preservation* and *food packaging*, when answers often drifted from one topic to the other. The standard of literacy was generally satisfactory, although responses were often expressed in general terms, without using scientific terms and principles. Several students merely listed types of packaging without including a description or explanation. Some wrote too much, interpreting the term *report* as needing a long answer; one page or less was sufficient to gain high marks.

(c) This was generally answered very satisfactorily, with the better students answering as directed by the question and so a result was not required. Unfortunately for many the result constituted most of the responses. There was ample evidence that extensive practical work had been undertaken and that students understood the procedures clearly, some, however, related their answers to *means of* preservation rather than to *factors causing deterioration*, etc, while others ignored the *chemical effects of cooking.* Relevant use of tables and diagrams, some excellent, was made by those who gained the highest marks. Again, the best answers reflected specific understanding, rather than saying *Now I understand this topic better*. This experimental section was the better answered of the two choices to this part.

(d) Again, those who answered the parts as directed by the question gained the highest marks. Parts (iii) and (iv) were difficult for many students, a number of whom totally ignored them. Some, because they were asked to describe an experiment they had carried out, simply answered under the headings of Aim, Method, Result, Conclusion. The better students outlined the use of controls and identified specific problems rather than using such answers as *My problem was someone threw my experiment out.* Generally appropriate scientific language was used, although too many students thought bacteria and fungi are the same thing. Again, it was obvious that extensive practical work had been done, although some was very simple and not really relevant.

Many students had certainly covered this topic in great detail, and some tended to include information regardless of whether it was required or not. There was some excellent presentation of experimental work, but a number of students could not relate their practical exercises to a specific topic area, nor did they fully understand the relevance of their practical work.

Question 40 : The Scientific Basis of Photography (221 candidates)

Mean: 14.97 Standard Deviation: 4.7

This question was generally well answered. Most candidates attempted all four sections, although 15% did not attempt part (b). The best responses included very good diagrams and laboratory experience, with each section being fully labelled.

The best responses incorporated clear and correct question labelling and well labelled diagrams, particularly those in pencil and colour. Increased marks were awarded for correct sequencing of procedures and terminology. Poor responses failed to answer all sections of each part of the question or failed to follow the question guidelines.

(a) The best answers gave detailed explanations of items listed and numbered in correct order. Some candidates were confused by the word *list*, being unsure how many items to list and how detailed they should be. The best responses used correct wording and procedural information with labelled diagrams.

(b) Candidates who scored highly showed a clear understanding of the chemistry of the process and did not simply use general terms such as *developer* and *fixer.* The better responses showed alkaline-acid reactions - concentrations, temperatures, times and use-by-date plus safety considerations and contamination problems. Several included cross-sections of film for black and white and colour.

(c) This part on the structure and working of a simple camera was well answered. Most candidates showed a good understanding of the concepts involved and gave evidence of laboratory work. The best responses included detailed explanation of many parts of the camera, as well as neatly labelled diagrams, while poor responses reflected restricted practical work on only *one* aspect, e.g. shutter speed or lenses.

(d) Part (i) was well answered; part (ii) was usually treated as a question on method, while parts (iii) and (iv) were often linked together. The best responses were clearly treated in sections and showed a good understanding of controlled variables and problem analysis. In addition they described distinctly different experiments from those given in parts (a), (b) and (c) of the question, and linked diagrams with their results.

Question 41 : Water (420 candidates)

Mean: 14.18 Standard Deviation: 4.85

(a) Those who scored well listed many ways in which water can affect the crust, and provided relevant information and diagrams about each item. Many candidates did not distinguish between the effects of water on the crust and the effects of water on the animals and plants living on the crust.

(b) Those scoring high marks were able to demonstrate in concise scientific language a good understanding of a broad variety of different problems associated with the shortage of water, e.g. plants, animals, man, loss of livelihood, effects on the economy, effects on the Earth's crust, far-reaching effects within the biosphere. Some candidates wrote about water *storage* rather than water *shortage*.

(c) Candidates who were able to explain how their specific experiment increased their understanding of the topic scored well. It was pleasing to see information presented in tables, well labelled diagrams and flow charts, and also to see that a wide variety of experiments are also being carried out in this topic.

(d) The wide scope and variety of experiments discussed here was very pleasing. Those who realised the significance of reliability and problems in experimental technique and design answered this section well. Some candidates wanted to adhere to the traditional Aim, Method, Results, Conclusion format, and did not identify sections clearly.