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1998 HIGHER SCHOOL CERTIFICATE EXAMINATION REPORT

GENERAL SCIENCE 2 UNIT

The number of candidates presenting for the examination in General Science has remained fairly stable over the past three years, as shown in the following table.

Year	Candidature
1998	1988
1997	1996
1996	1998

General comments

As in all examinations, candidates needed to read the questions very carefully to enable them to interpret what was required in their answers. Too often there was evidence that candidates had attempted to answer a question other than the one that was asked. Where explanations or descriptions were required, answers were frequently marred by poor expression. Diagrams were of mixed quality; some candidates used well-drawn and labelled diagrams in their answers, however, students should practise not only drawing and labelling diagrams carefully but also identifying and interpreting the key terms in a question such as, ‘state’, ‘name’, ‘list’, ‘describe’, ‘explain’, ‘draw a diagram’.

Several questions were phrased in the negative, for example Questions 3 and 13 in Part A, Question 25 (c) in Part B, and Question 29 (b) (ii) in Part C, and these proved difficult for some candidates. Answering this type of question should also be practised by candidates in their preparation for the examination.

Section I — Core

Part A

Multiple-choice questions

The following table gives the percentage of the candidature correctly answering each question.

Questions 1 – 15 Mean = 9.06

Question	Correct Answer	Percentage Correct
1	D	65.53
2	A	63.80
3	B	35.08
4	D	63.09
5	B	69.70
6	D	83.15
7	A	56.36
8	A	22.45

Question	Correct Answer	Percentage Correct
9	C	56.98
10	A	78.82
11	C	58.91
12	C	82.84
13	B	38.65
14	D	85.13
15	B	45.62

For all questions except Question 8, the correct answer was chosen more frequently than any of the alternatives.

For Questions 3, 8, 13, and 15, the correct answer was chosen by less than 50% of the candidature.

In Question 3 (relating to the rotation of Earth on its axis) approximately 30% of the candidates chose alternative C and a similar proportion chose alternative D (apparent movement of the stars and Moon, respectively, across the night sky).

In Question 8 (relating to the properties of cotton and wool) approximately 38% of the candidates chose alternative C (cotton is a good insulator of heat, wool conducts heat) and approximately 24% chose alternative D (wool fibres increase in strength when wet, cotton fibres become elastic when wet).

In Question 13 (relating to the Theory of Evolution by Natural Selection) approximately 20% of the candidates chose each of the incorrect alternatives (A, C, and D).

In Question 15, (relating to Copernicus' and Kepler's models of the solar system) the most popular distractor was C (all planets move in epicycles).

Part B

Mean = 16.73

Questions 16 – 20 Mean = 8.68

Questions 21 – 25 Mean = 8.05

Question 16

(a) Very few candidates were able to explain why the apparent shape of the Moon changes over a period of two weeks. Many used diagrams, but generally these tended to be of poor quality. Some candidates tried to explain the phases by stating that the amount of sunlight reaching the Moon varies.

(b) Candidates generally confused terminology, some simply stating that the Moon rotated, rather than that it revolved around or orbited the Earth. Candidates indicated that they had conducted some of the relevant fieldwork but were unable to account for their observations.

(c) This part was reasonably well answered, with candidates being able to describe the location of the Sun at full Moon. There was some confusion with eclipses.

On the whole this was the most poorly answered question in Part B.

Question 17

This question was the best-answered question in Part B.

(a) The majority of candidates were able to identify the special condition found in space craft as being ‘low gravity’ or ‘weightlessness’. Some candidates did not read the question properly and interpreted it to mean a condition of the astronaut eg. muscles becoming atrophied.

(b) (i) and (ii) The use of straps/belts/harnesses was well explained by candidates.

Some, however, attempted to describe a training environment on Earth rather than in space.

Question 18

(a) This question was well answered. The better candidates linked each characteristic with primate lifestyle eg. binocular vision helps primates judge distance as they swing from branch to branch and opposable thumbs enable them to grasp branches. Poorer candidates gave answers such as ‘better focusing of binocular vision’.

(b) Generally this was not well answered. A large number of candidates gave hominid characteristics rather than primate characteristics eg. high forehead, non-protruding jaw, arched feet, foramen magnum at the base of the skull rather than at the back of the skull, S-shaped spine, wide pelvis. Some gave vertebrate characteristics such as pentadactyl limb. The better candidates gave larger brain, flattened nails, extended care of young, or reduced snout as answers.

Question 19

(a) Candidates were required to give two properties of a given metal that have made it useful in modern society. In a significant number of cases, candidates gave one property correctly and then gave a use for it rather than a second property. Many could describe a property but their vocabulary was limited and they did not use terms such as ‘ductile’ and ‘malleable’.

(b) This was not done well, as candidates did not specify the metals to which they were referring in their answers. It was apparent, though, that some candidates had a good knowledge of the activity series of metals.

(c) This part was also not answered well. Candidates confused ‘melting point’ with ‘boiling point’. They postulated the difference between the melting points of copper and iron as being the reason why they could not be alloyed. The better candidates were able to explain that the reason copper and iron could not be alloyed was because the very high temperature required could not be achieved with the available technology.

Question 20

(a)(i) and (ii) Both parts were well answered, though some candidates gave metals and ores not associated with iron eg bauxite/aluminium.

(b) The better candidates stated carbon reduction, gave a word equation showing the removal of oxygen by the formation of carbon dioxide, or stated that carbon is used as a fuel. Poor answers included statements such as ‘carbon was mixed to promote the reaction’.

(c) The purpose of Step Two in the reaction was well explained by using terms such as to purify, remove impurities, refine, remove earthy materials. Poorer candidates failed to associate limestone with the change of impure iron to pure iron.

Question 21

(a) Most candidates were able to identify an advantage of one of the natural polymers – wool, cotton, or rubber. Some confused the terms, ‘insulator’ and ‘conductor’, when referring to wool, saying, eg Wool is a conductor because it keeps you warm.

(b) Most candidates could identify an advantage such as strength, or low cost, of a synthetic polymer that can replace the natural polymer named.

(c) In drawing a labelled diagram of a polymer, candidates often:

- did not clearly show the links between the monomers
- did not show a structure that obviously continued past what was drawn
- where labels were used, confused the words ‘monomer’ and ‘polymer’.

Students would benefit from practice in transposing text information into drawings.

Question 22

(a) Candidates readily identified a reason for using thermoplastic polymers from the stimulus article provided in the question.

(b) Most candidates could identify two properties of plastics. Some, however, gave a property that was given in the article. A careful reading of the question would have shown that properties mentioned in the article were not to be used in their answers.

(c) Candidates readily identified the advantage of using new materials over recycled polymers.

Students would benefit from practice in differentiating between a use of a plastic and a property of a plastic eg. made into chairs vs easily moulded, flexible. As in previous years, the properties of a polymer, its uses, and advantages were often confused.

It should be noted that in Questions 19, 21, and 22 candidates were required to distinguish between properties of materials and uses of materials. This, as in 1997, was not well done by a significant proportion of the candidature.

Question 23

This question was generally not well answered by candidates.

(a) In designing an experiment to test the hypothesis that 'removing the tails caused future generations of lambs to be born without a tail', the more able candidates showed a clear description of the test including:

- docking of tail and subsequent breeding, and
- some aspect of good scientific method eg repetition through many/several generations or a large sample or mention of a control group

(b) Most candidates could not explain that some lambs are born without a tail as a result of a mutation. This is a source of variation upon which Natural Selection works. Although many candidates understood that Fred was testing Lamarck's theory, they went on to explain the absence of a tail in Lamarckian terms rather than as a source of variation due to mutation.

Question 24

(a) The majority of candidates understood that an optical telescope is best located in high places or space because the atmosphere distorts light waves OR because city lights interfere with observations of light waves received from space. A major misconception was that placing the telescope in space or in high places brings it significantly closer to the objects being viewed.

(b) (i) Many candidates were unable to identify photograph B as being that of a radio telescope.

(b) (ii) Explanations of why radio telescopes need not be located in high places were poor. Many candidates believed radio telescopes detect sound waves. This may be an area that needs to be addressed in class.

Question 25

Here candidates were asked to analyse the diagram showing primate evolutionary relationships.

The most common incorrect response was to give two dates - one when gibbons diverged from other apes, and one when gorillas diverged from the human/chimpanzee line.

Candidates could readily identify examples of primates that are classified as apes.

Answers to this question showed that candidates have a good knowledge of why chimpanzees are not classified as humans.

The most common mistake occurred when candidates did not make it clear whether they were referring to specific human or primate characteristics in their answers.

In comparing the characteristics of chimpanzees and humans, candidates needed to link the characteristic to the name of the organism to which they were referring, eg ‘They have an S-shaped spine’ would have been better expressed as ‘Humans have an S-shaped spine’.

Candidates would benefit from practising the skill of analysing diagrams using a variety of focus questions.

A sample marking scheme and some annotated responses for Question 25 are given below.

(a) 22-24 million years

(b) Any of: Gibbon, Orang-utan, Gorilla, Chimpanzee, Human

(c) Any human characteristic not shared by chimpanzees eg:

Humans have larger brain capacity

Humans are bipedal

Humans have ‘S’-shaped spine

Humans do not have opposable toes

Humans have more advanced tool use

Answers to Question 25

Candidate 1		(3 marks)
a)	23 million years	1
b)	Chimpanzee, gorilla, orang-utan, gibbon and humans	1
c)	Chimp's brain capacity is less than humans (Humans have a larger brain capacity than chimps)	1

Candidate 2		(2 marks)
a)	gorilla – 12 million years ago gibbons – 23 million years ago	0 [1]
b)	humans, chimps	1
c)	Chimps are not bipedal	1

Candidate 3		(1 mark)
a)	between 20 – 25 million years ago	0 [2]
b)	orang-utan, gibbon, gorilla	1
c)	they have opposable thumbs	0 [3]

Candidate 4		(0 marks)
a)	between 12 – 23 million years ago	0 [4]
b)	old world monkeys	0 [5]
c)	they have an 'S'-shaped spine	0 [6]

Notes

1 This is a response that would answer a question such as 'When did gorillas and chimpanzees diverge from the human/chimpanzee line?'

2 This response shows too broad a range. Students using a ruler to extend a line down to the horizontal axis were able to give an accurate response.

3 This response gives a general primate characteristic rather than a distinguishing characteristic between humans and chimpanzees.

4 The diagram is showing divergence as a series of discrete events in time. This response shows 2 discrete events occurring over a large range in time.

5 This response does not name an ape.

6 Many students responded by thinking of and naming an appropriate human characteristic. This response did not identify the organism and, by inference from the question, the student incorrectly named a chimpanzee characteristic.

Part C

Mean = 15.83

Questions 26 – 28 Mean = 8.56

Questions 29 – 31 Mean = 7.27

Question 26

This question was generally answered well.

(a) This question required candidates to read a table and understand the concepts of ‘rising’ and ‘setting’ times of astronomical bodies. A compass direction or compass bearing was required and the majority of candidates answered this question correctly.

(b) One reason showing why the term ‘morning star’ is a misleading description of Venus was required. The better candidates pointed out that Venus is a planet and that it is also visible at night. On the whole, this question was answered well.

(c) An explanation of two ways of distinguishing between planets and their background stars was required. Some good explanations included discussion of retrograde motion, ecliptical planes, and planets showing a disk shape.

The main problems in answers to this question occurred when candidates failed to identify clearly whether their answers referred to stars or planets, or showing ‘how’ planets moved in relation to the background stars.

Some candidates simply gave one-word answers such as ‘brightness’.

Question 27

This question was the best answered in Part C.

(a) This part of the question was answered well by the majority of candidates. It involved reading an experimental procedure and interpreting a diagram of results in order to provide two conclusions. The major error in this part of the question occurred when candidates gave observations based on the stimulus material rather than conclusions. Another common error was confusing the term ‘resistance’ with ‘antibiotic’.

(b) The question asked for one necessary safety precaution when carrying out experiments on bacterial growth. Some candidates gave trivial answers such as ‘be careful’.

(c) The key words in this part were ‘immunity’, ‘resistance’, ‘mutations’, ‘new diseases’. These were included very frequently in answers, in which they were linked to the concept of the development of new antibiotics. A common error was stating that the ‘body’, rather than ‘the strain’ of bacteria, was becoming immune to the antibiotic. Candidates needed to state ‘in order to control new diseases’, or ‘new strains of bacteria are developing’.

(d) This question was answered well, with candidates being able to give one contribution of antibiotics to modern society. The most common answers were: ‘to improve public health’, ‘increase life expectancy’, and ‘help fight disease’. A common misconception was that antibiotics could combat viruses and viral infections.

Question 28

(a) This question was poorly answered. Candidates had difficulties in clearly describing a method for obtaining a random sample of the community for a survey.

(b) This was generally answered well. Poorer answers just described the scientific discovery instead of describing the 'impact' of the specific discovery. The list of discoveries given in the question focused candidates' answers; few, however, based their answers on a different discovery from those listed.

(c) (i) and (ii) These parts of the question were answered satisfactorily, with candidates being able to provide arguments in support of why scientists should and should not be held accountable for their discoveries.

Question 29

(a) Some candidates interpreted 'evolutionary relationship' as a physical and/or cultural trend and a significant number interpreted 'draw a diagram' as meaning 'draw a sketch'. Consequently, such candidates provided sketches that showed some of the trends as physical changes and/or cultural changes from early to modern times. Many candidates, however, were able to represent an acceptable evolutionary relationship of known species of humans.

(b) (i) This was a difficult question and very few candidates were able to provide a description of a piece of fossil evidence that could be used to identify the remains of one specific species.

(b) (ii) In most cases this question was interpreted as referring to a part of human culture that the specific species HAD rather than a part of human culture that this species did NOT have. This highlights the need for candidates to read questions carefully.

Question 30

(a) Most candidates were able to draw an accurate family tree from the experimental data and shade or code it appropriately. Nearly all candidates demonstrated the ability to use a key to accompany the pedigree, but some failed to identify clearly the individuals or the gender of family members. On the whole, this part of the question was very well done.

(b) A large proportion of the candidature was able to identify and describe the concept of how two parents who are heterozygous for a dominant phenotype can produce a homozygous recessive offspring.

(c) Although part (b) was well answered, and many candidates could accurately use a punnet square to predict expected phenotypes, a significant number failed to use correct genotypes for the parents and consequently gave incorrect ratios in the offspring.

A sample Marking scheme and sample annotated responses are given below.

(a) Correct family relationships — 1 mark

Shading with key or labels for eye colour — 1 mark

Name or key of one family member to identify others — 1 mark

(b) Description of one piece of evidence, eg: — 1 mark

Mum and Dad have brown, yet Susie has blue eyes.

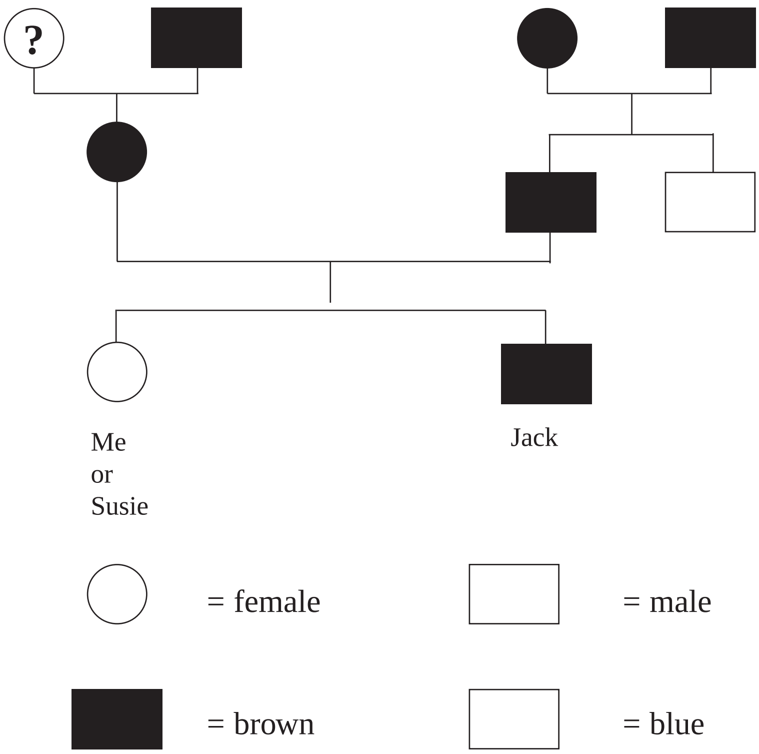
or Dad's parents have brown eyes yet Dad's brother has blue eyes.

or an explanation for how blue eyes skip a generation.

(c) 25% or 1/4 or correct working of the correct punnet square — 1 mark

Sample 1

(a)



………… 3

(b) Evidence   Mum and Dad have brown eyes yet Susie has blue eyes ………… 1

(c) Bb x Bb

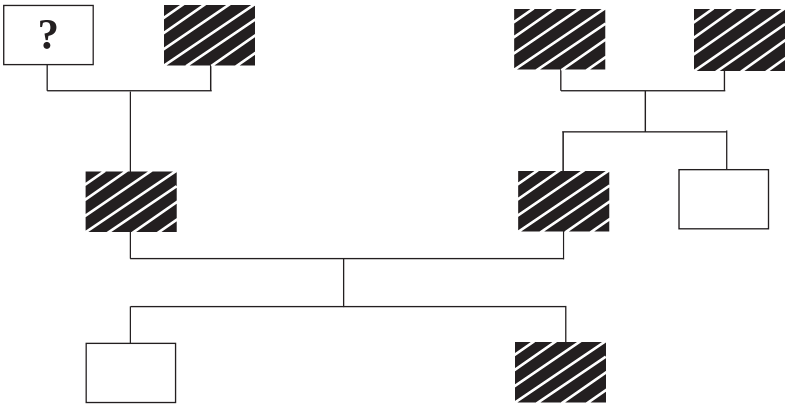
Mum

Dad	B	b
B	BB	Bb
b	Bb	bb

chance: 25% chance of another blue-eyed child. ………… 1

Sample 2

(a)



= brown * No labelling and/or gender shown

= blue 2

(b) Mum and Dad have brown eyes yet Susie has blue eyes. 1

(c) Bb x Bb

Mum

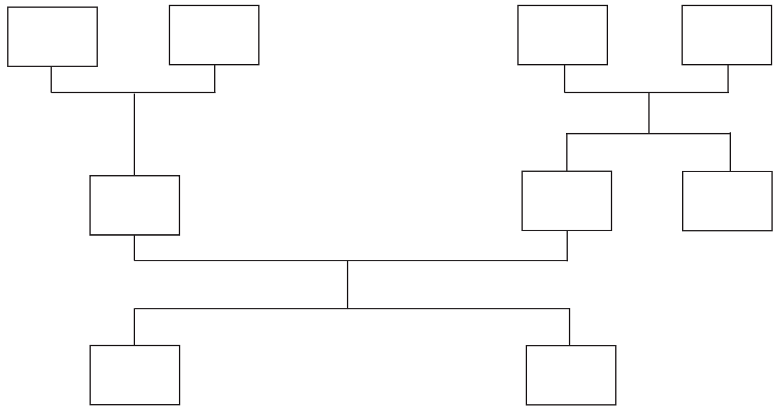
Dad

	B	b
B	BB	Bb
b	Bb	bb

Chance: 25% chance of another blue-eyed child. 1

Sample 3

(a)



* No shading with key

* No labelling and/or gender shown. 1

(b) Mum and Dad have brown eyes yet Susie has blue eyes. 1

(c)

Mum

Dad

	B	B
B	BB	BB
b	Bb	Bb

Chance: 50% chance of a blue-eyed child. 0

*Incorrect genotype for one parent and incorrect explanation of genotype to give incorrect chance of phenotype.

Question 31

This question was, on the whole, the most poorly answered question in Part C.

(a) Many candidates could produce an appropriate equation for the efficiency of a simple machine, however, a significant number could not substitute the necessary data into such an equation to arrive at a correct answer.

(b) The majority of candidates could state the First Law of Thermodynamics in some form.

(c) This question was reasonably well answered, with candidates recognising the effect of friction and/or heat loss on the efficiency of an engine.

(d) This question was also reasonably well answered, with candidates being able to suggest an appropriate method for making a machine more efficient.

While a significant number of candidates were unable to provide a correct answer in part (a), some, including some who had as an answer >100% efficiency, showed good examination technique and went on to answer the other parts correctly.

Section II — Electives

Mean for the Electives = 12.26

General comments

As in 1997, a common set of marking guidelines was developed for all the elective questions and each candidate's script was independently marked by two markers.

The following comments apply to all of the electives, but, where appropriate, specific references to elements of particular electives have been included.

Most of the candidature was well prepared and responded to the questions with detailed and well-sequenced answers. The structure given in the questions was adhered to by the candidates and specific practical experiences relevant to each elective were cited.

Candidates could recount specific and appropriate scientific procedures or processes to illustrate the specific scientific method. There was a better understanding than in the past of the difference between an experiment and an investigation, and candidates chose appropriate practical experiences for parts (a) and (b).

Candidates, this year, displayed a better understanding of terminology appropriate to the elective studied. They were able to discuss thoroughly the information learned during the study of their elective. Use of appropriate labelled diagrams and tables has increased and these enhanced candidates' responses in all sections of the elective questions.

It should be stressed to students that it is imperative for them to read the entire question prior to commencing their answers, and to plan their answers in order to give the best response.

Several candidates attempted more than one elective, generally giving very cursory answers in each case. Candidates should be encouraged to attempt only the elective question for which they have studied, as answers without evidence of sufficient depth of understanding tend to earn few marks.

The following table gives the proportion of the candidature attempting each elective.

Question	% of Candidature
32	7.7
33	5.7
34	15.5
35	4.6
36	7.7

Question	% of Candidature
37	10.4
38	7.7
39	9.1
40	6.6
41	25.0

Part (a) **6 marks**

The better candidates gave clear descriptions of an entire experiment and many referred to the purpose, procedure, and results of each. These answers referred to an experiment relevant to the elective that had been studied and often included well-labelled diagrams that were used to illustrate the procedure or results.

The better candidates identified relevant experimental design factors that were either varied or kept constant. Poorer candidates described the experiment, but failed to identify these factors. A significant number described experiments in which there were two or more variables.

In general, there was a weakness in stating an appropriate conclusion, with many candidates giving conclusions that did not relate to the aim or were simply restatements of the results.

Part (a) Scientific experiments usually involve observing how something reacts under different conditions. In designing an experiment, it is best that only ONE factor is allowed to vary, while other factors are kept constant.

Q	Elective	Comment
32	Colour	Many candidates described demonstrations or investigations of colour mixing or dispersion rather than an experiment as was required.
33	Metals in the Service of People	Most candidates were able to describe an appropriate experiment.
34	Optics	Most candidates reported on activities involving lenses or mirrors. The better responses indicated the factors that were kept constant and identified a single variable in their experiments.
35	Petroleum and its Compounds	Many candidates referred to cracking or distillation, and failed to identify a relevant variable in those experiments.
36	Physiology of the Senses	Candidates who described an investigation, instead of an experiment, in many cases failed to identify a variable.
37	Reproduction in Animals and Plants	Many candidates described demonstrations or investigations rather than an experiment as was required.
38	The Insects	A number of candidates reported on studies of the effect of environmental conditions on insect behaviour. Of concern was the number of candidates who reported on experiments to develop insect immunity to insecticides.
39	The Science of Food Technology	Generally, this question was well–answered by candidates, especially in the area of food preservation.
40	The Scientific Basis of Photography	This question was handled well by candidates who, this year, answered the question with reference to experiments rather than investigations. The better candidates identified the link between exposure, aperture, and shutter speed.
41	Water	There was a great variety of relevant experiments and the question was well answered. Some candidates reported on very basic demonstrations eg boiling water, and failed to identify a variable or to reach a valid conclusion.

Part (b) **7 marks**

The better candidates gave clear descriptions of an investigation that used scientific equipment or procedures, including in their answers an indication of the purpose of the investigation. They also described the use of the equipment rather than simply listing it. This was often achieved through the use of labelled diagrams.

The concept of an experimental control was well understood. The majority of candidates who had conducted an investigation without using a control were able to explain why a control was not necessary.

Many candidates referred, inappropriately, to problems linked to human error rather than problems linked to experimental design. Results were given in great detail and were well explained. Tables and diagrams were frequently used.

A small but significant number of candidates repeated the experiment described in part (a).

Part (b) Laboratory work relies on scientific equipment or procedures to improve our understanding. Many experimental procedures require the use of a control.

Q	**Elective**	**Comment**
32	Colour	Most candidates gave appropriate responses.
33	Metals in the Service of People	Most candidates gave appropriate responses, reporting on a variety of investigations.
34	Optics	Most candidates reported on activities involving lenses or mirrors. The use of labelled diagrams was excellent.
35	Petroleum and its Compounds	Many candidates reported on testing the properties of the products of cracking or distillation. However, the identification of a control was poorly done.
36	Physiology of the Senses	Most candidates gave appropriate responses. Dissections were very common and many candidates were able to explain why they did not need to use a control.
37	Reproduction in Animals and Plants	Most candidates gave appropriate responses; dissections and studies of life cycles were common.
38	The Insects	While many candidates responded with investigations of life cycles, a number gave poor responses that described collecting and classification.
39	The Science of Food Technology	Many candidates responded well, describing investigations relating to food preservation.
40	The Scientific Basis of Photography	Most candidates gave appropriate responses, reporting on a variety of investigations.
41	Water	There was a great variety of relevant investigations and the question was well answered. Candidates who described very basic investigations to part (a) often repeated the investigation in part (b) with minor modifications.

Part (c) **6 marks**

Candidates were required to explain the meaning of two given terms and to provide explanations for two additional terms they would have encountered in their study of the elective. Most candidates were able to give clear and succinct answers; they were able to list two additional terms and often explained them well, using diagrams to enhance the explanations.

Poorer candidates listed terms that were not appropriate to study at this level or to the depth implied by the study of an elective.

Q	Elective	Comment
32	Colour	'Camouflage' was well explained. Candidates had difficulty in explaining 'absorption'.
33	Metals in the Service of People	Electrolysis was poorly explained. Incorrectly labelled diagrams were common. Corrosion was also poorly explained.
34	Optics	'Angle of incidence' was well explained, often with the use of diagrams. 'Polarisation' was poorly understood and not explained well.
35	Petroleum and its Compounds	Candidates had difficulty in explaining 'distillation'. 'Impervious' was also poorly explained.
36	Physiology of the Senses	Candidates had difficulty in explaining 'receptors'. The term 'synapse' was poorly explained.
37	Reproduction in Animals and Plants	'Pollination' was often confused with fertilisation. 'Asexual' was well explained.
38	The Insects	'Thorax' was well explained. 'Biological success' was generally poorly understood.
39	The Science of Food Technology	'Pickling' was well explained. 'Decay' was poorly explained. Candidates often described the appearance of decaying food.
40	The Scientific Basis of Photography	Some candidates gave detailed explanations of 'fixer'. 'Shutter speed' was well explained.
41	Water	'Solvent' was well explained. 'Surface tension' was poorly explained.

Part (d) **6 marks**

Most candidates were able to give clear answers and frequently used diagrams in their explanations.

Contrary to the instructions in the paper a number of candidates chose items that were referred to in parts (a), (b), and (c). Some candidates also chose items that were of limited relevance to the focus of the question.

Q	Elective	Question Focus	Comment
32	Colour	Perception of colour	Many candidates described information that was not linked to a study of perception of colour.
33	Metals in the Service of People	Properties of metals compared with the properties of alternative materials	This was a well answered section of this elective.
34	Optics	Modern developments in optics	This was well answered, with appropriate use of diagrams.
35	Petroleum and its Compounds	The production of other chemicals from petroleum and their uses	Many candidates repeated information discussed in other parts of the question.
36	Physiology of the Senses	The structure and function of the main sense organs	This was well answered, with extensive use of diagrams.
37	Reproduction in Animals and Plants	Evolutionary trends in methods of reproduction	Many candidates correctly described evolutionary trends in reproduction.
38	The Insects	The behaviour and communication of insects that live in communities	A significant number of candidates responded with lengthy answers that lacked relevant material.
39	The Science of Food Technology	Physical and chemical effects of cooking on food	Some candidates gave very basic answers that lacked specific detail. Some, however, gave outstanding, detailed answers.
40	The Scientific Basis of Photography	Structure and working of a simple camera	This was very well answered by the majority of candidates.
41	Water	Effects of water on the Earth's crust	Most candidates answered this part well. However, a number of candidates gave lengthy elaborate answers of limited relevance to the question.

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