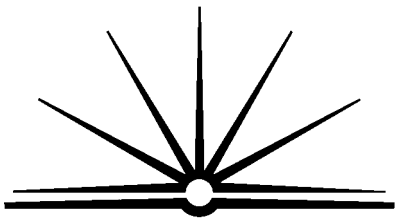

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1999 HSC

Biology

Enhanced Examination Report

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1999 HSC Biology Enhanced Examination Report

Introduction

In 1999 a total of 15 252 candidates sat for the HSC Biology examination. This was an increase from 1998.

General Comments

In general, the standard of the candidates' responses was consistent with trends observed in previous years. The majority of responses showed good examination preparation in both Core and Elective sections. However, there is still a significant number of candidates who demonstrated a lack of understanding of biological terminology and a confusion in the use of the language of Biology.

Of particular concern this year was the difficulty many candidates experienced with graphing — both in interpreting data represented graphically and in converting data into a graph. Candidates should show competence in the use of the language used in the syllabus. To be successful in Biology, a candidate must understand the content of the course and be able to communicate that information clearly and concisely using appropriate and recognisable terms.

Samples of some of the marking schemes are provided in this examination report, as are examples of candidate responses that gained a range of marks available. For each elective question, a section has the marking scheme reproduced. This is done to provide teachers and candidates with the opportunity to read the types of responses that candidates give and to see how the available marks are awarded. These are not model answers — they are typical responses produced under examination conditions and may contain errors. The marking schemes provided are simplified forms of the schemes used in the marking operation.

2 Unit

Section I – The Core

PART A

Candidates were generally able to score well across the multiple-choice questions. The following table gives the percentages of candidates selecting the correct alternative for the multiple-choice questions. The questions that only a small percentage of candidates answered correctly generally indicated an inability to interpret graphs. It is important for candidates to be well prepared in skills as well as content.

Question	Correct Response	% of Candidature
1	C	77.34
2	A	56.29
3	C	72.52
4	B	48.50
5	D	90.85
6	C	88.34
7	A	73.89
8	A	79.29
9	B	27.65
10	B	25.00
11	D	48.96
12	A	67.69
13	D	20.65
14	D	42.86
15	C	67.64

PART B

Question 16

(a) Most candidates could transfer the data from the table and construct a graph. Care should be taken to ensure that the scales are continuous and even, that each axis is labelled including units and that each point is correctly plotted (ie accepted graphing skills).

(b) Most candidates could describe the relationship between the age of the mother and the occurrence of Down Syndrome in their babies. Some candidates did not point out that the rate dramatically increases after the age of 35 years for the mother.

Question 17

In part (a) many candidates did not correctly describe the function of the swim bladder as altering the density of the fish or as a hydrostatic organ. Candidates overall did not distinguish well between the 'function' in part (a) and the advantage in part (b). A number of candidates restated the information given in the question in their response to (a) but gave no further information. Similarly in part (c) some candidates restated the question, ie 'to remain submerged in water' as the purpose of wearing a weighted belt, without offering any further information.

The marking scheme and a range of candidate responses for Question 17 follow:

(a)	Alters the density of the fish/a hydrostatic organ/store of oxygen for use in cellular respiration.	1 mark
	Allows fish to regulate buoyancy.	$\frac{1}{2}$ mark
	(additional $\frac{1}{2}$ mark awarded if the size of the swim bladder was mentioned and a description of how it functions)	
(b)	Maintain depth/changing depth/conserving energy	1 mark
(c)	Water provides buoyancy/air in lungs provides buoyancy/layers of fat cause buoyancy	$\frac{1}{2}$ mark
	Wearing weights changes human density/no adaptations for a buoyant medium.	$\frac{1}{2}$ mark

Example of a response scoring 3 marks

(a)	The function of a swim bladder in an aquatic environment is to enable the fish to alter its density.	1 mark
(b)	The advantage of the swim bladder for the fish is that it enables the fish to change depth in the water.	1 mark
(c)	Since the water provides buoyancy, humans need a weighted belt to change their density in order to remain submerged.	1 mark

Example of a response scoring 2 marks

(a)	Fish need a swim bladder in order to give them buoyancy in an aquatic environment.	$\frac{1}{2}$ mark
(b)	A swim bladder allows fish to maintain its depth in the water.	1 mark
(c)	The air in the lungs of humans provides buoyancy and they need a weighted belt to keep them submerged.	$\frac{1}{2}$ mark

Example of a response scoring 1 mark

(a)	A swim bladder allows a fish to regulate its buoyancy in an aquatic environment.	$\frac{1}{2}$ mark
(b)	The advantage of the swim bladder for the fish is that it does not have to worry about floating.	0 mark
(c)	Humans are not adapted to the buoyancy of water.	$\frac{1}{2}$ mark

Question 18

This question was generally well answered. A large proportion of the candidates scored full marks. Some candidates used general terms rather than precise biological terms, resulting in some answers being ambiguous and failing to score full marks. Some candidates were unfamiliar with the term 'alimentary canal' — this part of the question was frequently answered in terms of the respiratory system.

In sections (a), (b) and (c), $\frac{1}{2}$ mark was awarded for naming a *feature* of the point of entry which provides protection against invasion by pathogens and $\frac{1}{2}$ mark for the *explanation* of how it provides that protection. To gain $\frac{1}{2}$ mark for the explanation, the correct feature had to be given. In (c), acidic pH or low pH needed to be specified – pH on its own was not sufficient to score.

Example of a response scoring 3 marks

(a)	An intact skin surface prevents entry of pathogens.	1 mark
(b)	Acid secretions in the stomach kill pathogens.	1 mark
(c)	Mutualistic bacteria which line the surface inhibit the growth of pathogens.	1 mark

Example of a response scoring 2 marks

(a)	Sweat is slightly acidic. This kills pathogens.	1 mark
(b)	Contains cilia which move pathogens to the mouth to be expelled.	0 mark
(c)	The process of urination flushes pathogens from the body.	1 mark

Example of a response scoring 1 mark

(a)	Skin is the outer layer which stops the invasion of pathogens.	0 mark
(b)	Vomiting expels pathogens from the body.	1 mark
(c)	pH of the urogenital tract kills pathogens	0 mark

Question 19

There was a wide range of responses to this question. In (a) many candidates showed a poor understanding of osmosis and its implications for water balance. In (b) some candidates appeared unfamiliar with the term 'abiotic', and many were unable to make a clear comparison between the freshwater pool and the sea in terms of these characteristics. Many candidates merely gave a description of the abiotic factor in one of the environments with no comparisons.

Question 20

Many candidates were unable to *name* a fossil that they had examined. Candidates were able to describe a difference between a fossil and a present day form but found it more difficult to describe a similarity.

Candidates generally answered part (a) well, giving an adequate explanation of how the study of fossils and present day forms supports the theory of evolution.

Question 21

Candidates generally answered part (a) well. Their knowledge of asexual reproduction was sound. Many were able to identify sexual reproduction in part (b), but did not clearly explain why. Some candidates did not identify natural selection but suggested the presence of a mate to guard the nest as a reason for survival.

A common mistake made by many candidates in part (c) was to repeat the question in their answer – suggesting that populations would be similar as they contain the same genes. The term 'parthenogenesis' (which was stimulus material only) confused many candidates.

Question 22

Candidates were generally able to apply the immune response to this question. Part (a) was well answered with most candidates being aware of the role of phagocytes. In (b), many candidates missed the concept of B lymphocytes developing/changing into/forming plasma cells or memory cells. There was also the usual confusion of antigens and antibodies. In part (c), the range of accepted functions was very broad and candidates generally achieved well. Candidates needed to link functions to specific T cells. Many candidates were able to name types of T cells and the general role of T cells, but few were able to link each type of T cell with a function.

Question 23

In part (a) candidates were generally able to apply turgidity to the situation appropriately in part (i). In part (ii), candidates often wrote about turgidity of plant cells in water where cells are iso-osmotic. There was a wide range of answers related to turgidity, indicating a lack of understanding in this part. Some candidates mentioned flotation devices (and gained 1 mark), but did not explain how they aided in the support of aquatic plants for the additional mark. In Part (b) candidates used plant characteristics to answer about animals, eg cell walls, turgidity. Candidates missed the point of hard skeletons. Some interpreted it as bony skeletons and answered incorrectly using cartilaginous skeletons. Some used examples of animals without legs, eg snakes/whales. Some candidates correctly referred to hydrostatic skeletons in animals such as annelids, which are supported by internal water pressure (1 mark) against the outer muscular wall (1 mark).

Question 24

Candidates should choose clear, well-expressed examples related to each of the factors of evolution in the question. It is important to relate the explanation given to the example and to state how it provides evidence for evolution.

The marking scheme for Question 24 follows:

(a)	a named example of a biochemical similarity and an explanation of how it supports evolutionary theory	1 mark
(b)	a named example of an homologous structure and an explanation of how it supports evolutionary theory	1 mark
(c)	an example relating to the age of the earth and an explanation of evidence of enough time for evolution to have occurred	1 mark

An example of a response scoring 3 marks

(a)	Biochemical similarities, such as blood proteins, which are present in a range of animals, indicate evidence of common ancestry.	1 mark
(b)	An homologous structure such as the pentadactyl (5 fingered) limb among land vertebrates is support for the existence of a common ancestor.	1 mark
(c)	The age of the earth has been estimated at 5000 million years. This indicates that there has been enough time available for the slow process of evolution to have taken place.	1 mark

An example of a response scoring 2 marks

(a) Blood proteins in man and chimpanzees are chemically very similar, providing evidence that they separated very recently from a common ancestor. 1 mark

(b) The forelimbs of vertebrates are similar providing evidence that they were once alike. 0 mark

(c) Radiometric dating of the rocks of the earth show that it is old enough for evolution to have occurred. 1 mark

An example of a response scoring 1 mark

(a) Chemical similarities are found among many animals and show that evolution must have taken place. 0 mark

(b) The pentadactyl limb of vertebrates shows that they have evolved from a common ancestor. 1 mark

(c) The earth is very old and this shows that animals changed. 0 mark

Question 25

(a) Most candidates were able to score a mark in this section. Some candidates gave the name and symptoms of an infectious disease and forfeited the mark. Other candidates gave the symptom of a disease rather than the name of a disease.

(b) This section required candidates to explain methods of control or eradication for their chosen disease, rather than simply give details of the cause. Candidates who answered 'no' and 'because it is not possible' were not able to demonstrate their knowledge.

(c) This was a difficult question for many candidates. Lists of symptoms for the specified disease alone scored no marks. Well-explained effects on various groups of the population scored well.

PART C

Question 26

(a) (ii) Many candidates gave the cause only. The correct biological name gained the mark. Many candidates gave inaccurate and/or confused historical development without linking to the cause. The better candidates gave a sequence of dates/scientists and events linking to the named causative agent.

(b) (i) There were many general answers. Few gave genus and species.

(ii) Approximately half of the candidates answered the question well. Many candidates did not draw a life cycle of their named parasite; others omitted the human host. The varieties of worms and flukes were poorly and incorrectly presented.

(iii) This part was generally well done. Poorer candidates listed features only.

(iv) The majority of candidates answered this well.

Marking Scheme – Question 26

Question No		Details	Mark
(a)	(i)	No mark	0 mark
	(ii)	Total 1 $\frac{1}{2}$ marks	
		– Cause of disease without linking	$\frac{1}{2}$ mark
		– Historical events contributing to the understanding of the disease (dates, steps, scientists)	$\frac{1}{2}$ mark
		– Linking of historical events with the discovery of the cause of the disease	$\frac{1}{2}$ mark
(b)	(i)	Total $\frac{1}{2}$ mark	
		– Correct biological name of a macroscopic parasite (Genus or full name)	$\frac{1}{2}$ mark
	(ii)	Total 1 mark	
		– Cycle including humans	$\frac{1}{2}$ mark
		– Correct method of egg dispersal from the parasite	$\frac{1}{2}$ mark
		– Correct method of transmission (larva/cyst) from intermediate host to primary host	$\frac{1}{2}$ mark
	(iii)	Total 1 mark	
		– Description of each feature and how it assists survival (one mark for each feature)	1 mark
	(iv)	Total $\frac{1}{2}$ mark	
		Correct specific method of control/treatment if it prevents spread of parasite	$\frac{1}{2}$ mark
		Total	5 marks

Note: If a macroscopic parasite is in correctly named in b (i), mark only b (iii) and b (iv) — maximum 1 $\frac{1}{2}$ marks for part (b).

An example of an answer scoring 5 marks

(a) (i) Malaria

(ii) Pre 18 century — symptoms recorded

1800 Laveran links cause with microorganism

1885 Marchiafara and Celli observe transmission of infected blood transmits malaria

1886 Golgi observes asexual reproduction of protozoan within infected blood

1898 Grassi and Bastianelli suggest Anopheles mosquito as vector

1899 Ross establishes Plasmodium as cause of malaria

(b) (i) Taenia solium (pork tapeworm disease)

(ii)

Secondary host (pigs)		Primary host (man)
Carried to a muscle where embryo develops into a bladderworm	→	Consumption of bladderworms in infected undercooked pork
↑		↓
Embryo burrows through stomach wall and into bloodstream		Attaches to intestinal lining and develops into adult tapeworm
↑		↓
Pigs eat contaminated grass and eggs develop into an embryo	←	Adult release eggs with faeces, which contaminate grass

(iii) Hooks and suckers allow it to attach itself to intestinal lining of host. Large production of eggs increases chance of transmission to other hosts.

(iv) Proper disposal of contaminated sewage to prevent transmission to secondary host — breaks life cycle.

Comment

In each part the question was correctly answered with the candidates scoring maximum marks.

An example of a response scoring 4 marks

(a) (i) Typhoid

(ii) It has been understood for many years that Typhoid is caused by bacteria, Salmonella typhi, and is carried in contaminated food and water.

(b) (i) Fasciola hepatica (Liver fluke)

(ii)

Adult liver fluke in human or sheep	→	Eggs passed out of faeces
↑		↓
Cercaria encyst on watercress or grass		Miricidium larva ingested by snail
↑		↓
Cercaria pass out of snail	←	Snail

(iii) Liverfluke is able to become encysted cercaria which protects it from acidic fluids in human body and can also mimic human/hosts immune system to prevent itself from being attacked.

(iv) If snails were killed off by the use of molluscicide, the eggs could not develop to further become liverflukes to harm humans/sheep.

Comment

Full marks were awarded to all sections of the question except part (a). In part (a) (ii), only $\frac{1}{2}$ mark was awarded since the candidate gave only the cause of the disease without any historical development.

An example of a response scoring 3 marks

(a) (i) Cholera (Vibrio cholerae)

(ii) Epidemics throughout the world
Koch observes the presence of Cholera vibrio in dirty water
Variations in the O antigen are observed amongst infected Japanese workers
Better purification methods result in less cases of the disease

(b) (i) Enterobius vericubrus (threadworm)

(ii)

Migration causes extreme irritation and the humans scratches for relief. Eggs become lodged under fingernails	→	Human who has come into contact with tainted faeces eats food
		↓
		Eggs transport from mouth to stomach and finally intestines with food
		↓
↑		Eggs hatch and threadworm prepares to reproduce
Worms migrate to anus and lay eggs	←	
↑		

(iii) The ability to survive the acidic elements of the intestine. Suckers that allow it to attach to the intestinal lining.

(iv) By practicing strict personal hygiene (not scratching anus or thoroughly washing hands), the parasite can be controlled.

Comment

In part (a)(ii), only $\frac{1}{2}$ mark was awarded for naming the disease cause. In part (b) full marks were awarded in parts (i), (ii) and (iv) but no mark was awarded for part (iii).

An example of a response scoring 2 marks

(a) (i) Gonorrhea

(ii) Due to the invention of the light microscope and the electron microscope, Koch's postulate and being able to culture the disease.

(b) (i) taeniasis — tapeworm

(ii)

Eggs develop into adult — develop hooks and suckers, live in intestine, grow up to 4 — 7 metres	→	Proglottid containing up to 100,000 eggs excreted through the faeces
↑		↓
Eggs infected beef and pork, poorly cooked and eaten by humans		
↑		Cows and pigs eat grass with eggs attached
Eggs develop and enter the bloodstream	←	

(iii) Has suckers and hooks to latch on inside the host
Can adjust to different environments, eg inside cow or pig, then outside a human.

(iv) One method of control is to make sure meat is thoroughly cooked before consumption.

Comment

Part (a) (ii) was too general to receive a mark. In part (b)(i), a biological name was not used. In part (b)(ii) the candidate was not awarded $\frac{1}{2}$ mark for incorrect transmission from the intermediate host. In part (b)(iii), the second response was not awarded the $\frac{1}{2}$ mark.

An example of an answer scoring 1 mark

(a) (i) Bubonic plague

(ii) Since its epidemic in the earlier parts of the century it has been discovered that it is carried in rats and transferred to humans by fleas, being ultimately caused by the bacterium Yersina pestis.

(b) (i) Tapeworm

(ii)

Worm in pig	→	Human eats pig
↑		
Pig comes in contact with human faeces		↓
↑		
Worm or parts of worm removed in human faeces	←	Human has worm

(iii) The long thin segmented body, and strong hooks and suckers on its head enable it to live in the intestines by sucking onto the wall and living in the thin tubes of the intestine.

(iv) The careful consideration of infection when preparing foods (meats) that may be in danger of contamination and extermination by proper preparation.

Comment

Part (a) contained inadequate historical development but listed the cause of the disease scoring a _ mark, while in part (b) (i) a correct biological name was not used. In part (b) (ii), a life cycle was not given scoring 0 marks.

An example of an answer scoring 0 mark

(a) (i) Influenza

(ii) Influenza is a virus

(b) (i) Hydatids

(ii)

Humans developed	→	Dogs young
↑		↓
Cows Sheep	←	Hydatids born

(iii) A host

(iv) To wash hands before eating a meal

Comment

For each part, no answer was specific enough to be awarded a mark.

Question 27

(a) Many candidates failed to distinguish between metabolic rate and the amount of metabolic activity or to appreciate the significance of the term 'relative' with respect to the metabolic rate.

(b) Most candidates recognised the significance of the surface area to volume ratio but many failed to relate the ratio to heat loss or gain. Some referred to surface area instead of surface area to volume ratio.

(c) Many candidates showed a rudimentary understanding of ectothermy but failed to discuss the difference in the energy sources for ectotherms and endotherms. In some answers it was not clear whether the candidate was referring to the stem of the question; they said that, since metabolic rate can be used to show the rate at which animals use energy to maintain their body temperature, it would be impossible to say whether the rate for an ectotherm the size of a mouse would be higher, lower, or the same, because it would depend on the ambient temperature.

(d) Generally, the ways given for ectotherms to regulate body temperature were very superficial and often showed no understanding of the difference, in temperature regulation, between ectotherms and endotherms.

Marking Scheme – Question 27

(a) $\frac{1}{2}$ mark maximum.

smaller body weight – higher metabolic rate **or** big animal – lower metabolic rate.	$\frac{1}{2}$ mark

(b) 1 mark maximum.

big SA:V ratio – higher metabolic rate **or** small SA:V ratio – lower metabolic rate **or** big animal – small SA:V ratio **or** small animal – large SA:V ratio	$\frac{1}{2}$ mark
Indication of connection between SA:V ratio and heat loss or gain.	$\frac{1}{2}$ mark

(c) $1\frac{1}{2}$ marks maximum.

lower	$\frac{1}{2}$ mark
understanding of ectothermy	$\frac{1}{2}$ mark
how ectotherms get the heat needed for metabolism	$\frac{1}{2}$ mark
or	
good explanation of the relationship between the source of heat and metabolism	1 mark
or	
good explanation of why the definition of metabolic rate stated in the question cannot be applied in a predictive way to an ectotherm	$1\frac{1}{2}$ marks

(d) 2 marks maximum.

any two correct ways of regulating body temperature	$\frac{1}{2}$ mark each
qualifying explanation that indicates heat/energy flow	$\frac{1}{2}$ mark each

An example of a response scoring 5 marks

(a) The graph shows that as the size or weight of an animal increases the metabolic rate decreases. Similarly the lower the body weight of the animal the greater the metabolic rate.

(b) The shrew has a very large SA:V ratio due it its small size therefore it needs a high metabolic rate to produce heat as its high SA:V ratio ensures that heat loss is rapid. The elephant however has a comparably smaller SA:V ratio and thus will not lose heat as rapidly. It thus has a lower metabolic rate as it doesn't need to produce heat as readily — it is better able to retain heat.

(c) The metabolic rate of the ectotherm would be lower as it does not need to produce its own heat, ie heat comes from the environment, therefore it does not need to metabolise as rapidly in order to produce body heat.

(d) By directing their body according to the suns rays, eg some lizards in the morning lie flat to expose a greater SA to the sun and thus absorb more heat. At midday, they face their smallest SA to the sun to absorb less heat. Also burrowing during the day or night. Temperatures are more stable underground, eg on the desert surface temperatures may vary from zero to forty but underground varies only by five to ten degrees centigrade.

In each part of the question the candidate correctly addresses the question and provided a good explanation.

An example of a response scoring 4 marks

(a) The higher the body weight the lower the relative metabolic rate. The lower the body weight the higher the relative metabolic rate. As body weight increases relative metabolic rate decreases.

(b) Endotherms with a small SA:V ratio have a low relative metabolic rate. As SA:V ratio increases so does the relative metabolic rate.

(c) Its metabolic rate would be lower than that of a house mouse. Because it uses environmental heat to regulate its body temperature and not metabolic rate, as it is ectothermic and the house mouse is endothermic.

(d) Behavioural — move into and out of the sun throughout the day.

Some have light coloured shiny scales, which reflect the heat to control body temperature and avoid gaining too much heat.

Comment

In part (b) the candidate did not indicate a connection between SA:V ratio and heat loss or gain. Similarly, in part (d) there was no qualifying explanation for one of the regulatory mechanisms.

An example of a response scoring 3 marks

(a) As body weight increases, the relative metabolic rate decreases.

(b) As SA:V ratio decreases the metabolic rate of ectotherms also decreases.

(c) The metabolic rate of an ectotherm would be lower as ectotherms are unable to adjust metabolism to control temperature.

(d) Some ectotherms lay in the sun to increase their body temperatures, adjusting their behaviour to the environmental conditions. Others have a high SA:V ratio to lose heat more readily in hotter seasons.

Comment

Part (a) is satisfactory and receives one mark. In part (b) there is no indication of the connection between the metabolic rate and the SA:V ratio. For part (c) there is no indication that an ectotherm's body temperature depends upon its environment. In part (d) only one regulatory mechanism is satisfactorily described so only one mark is awarded.

An example of a response scoring 2 marks

(a) The higher the body weight of the animal the lower the relative metabolic rate.

(b) The larger the size the lower the SA:V ratio is. This would explain the curve in the graph.

(c) Its relative metabolic rate would be lower as it has further adaptations to control temperature and would usually have a smaller surface area.

(d) (1) They move around, for example they will shiver to create friction, which will warm them up.

(2) They move to a protective area, eg under a tree, inside a building, into a burrow etc.

Comment

Part (a) is satisfactory. Only $\frac{1}{2}$ mark is awarded to part (b) for stating, but not explaining, a link between SA:V ratio and body size. The explanation of part (c) is inadequate; only $\frac{1}{2}$ mark is awarded for correctly indicating a lower metabolic rate. In part (d) only one correct mechanism and no correct explanations are provided – thus receiving $\frac{1}{2}$ mark.

An example of a response scoring 1 mark

(a) Organisms with a higher body weight have a lower metabolic rate.

(b) A shrew is less than a thousand times smaller than an elephant which is why the graph has its shape.

(c) It would be higher; because its temperature is varying. Its metabolic rate would be higher in order to cope with it.

(d) Ectotherms regulate their body temperature through behavioural adaptations such as going into the shade and also through physiological adaptations such as sweating in order to cool down the bodies temperature.

Comment

Only $\frac{1}{2}$ mark is awarded for a correct response in part (a) and a further $\frac{1}{2}$ mark for a correct response without an explanation in part (b).

An example of a response scoring 0 marks

(a) The greater the surface area, the colder the temperature is. Lightweight objects, gain more heat.

(b) Small surface area to volume generates more heat because the circulation is far more greater than for a big surface area.

(c) An ectotherm generates more heat than a house mouse because it has a small surface area.

(d) Ectotherms generate their temperature much more complicatedly because they are more lighter in body mass. This is done by diffusion through the blood cells, which circulates energy to generate heat.

Comment

Answers are either incorrect or do not address the issues and answer the question, so no marks are awarded.

Question 28

(a) Most candidates showed the genotype by using letters, some described the genotype (ie homozygous recessive). Many candidates used odd combinations of letters (ie MF or NM) without clearly specifying what they meant. Despite the clear statements in the question, a large number of candidates assumed the disease to be recessive, sex-linked, or both.

(b) Most candidates indicated the parents correctly, or at least consistently with part (a). While the majority of candidates carried out their calculations correctly a significant number assumed that a 50% chance equalled a 1:2 ratio.

(c) A number of candidates correctly indicated that a ratio is a probability only approached by a large sample. Some indicated mutations as a possible source of deviation. Many candidates demonstrated a poor understanding of the question, referring to carriers and homo/heterozygous parents.

(d) Most candidates correctly indicated that the affected individuals lived long enough to reproduce. A very small number indicated that the disease might offer some immediate genetic advantage to the sufferer.

Marking Scheme – Question 28

(a) $1\frac{1}{2}$ marks

– Correct Genotypes:

1 correct	0 marks
2 correct	$\frac{1}{2}$ mark
3 correct	1 mark
4 correct	$1\frac{1}{2}$ marks

(b) $1\frac{1}{2}$ marks

– Correct parents (according to the question)	$\frac{1}{2}$ mark
– Correct calculations (according to parents set out by candidate)	$\frac{1}{2}$ mark
– Correct ratio (according to candidate's calculations)	$\frac{1}{2}$ mark

(c) 1 mark maximum

Mutation $\frac{1}{2}$ mark

– Mutation with a correct explanation of mechanism and effects 1 mark

– Expected ratio is only a probable outcome (probability) $\frac{1}{2}$ mark

– The chance of each individual is independent of previous outcome $\frac{1}{2}$ mark

– The ratio is generally only approached by a large enough sample 1 mark

(d) 1 mark maximum

– Sufferer procreates/reproduces before death 1 mark

– It could be a middle age/geriatric/old age disorder $\frac{1}{2}$ mark

– The disease confers a genetic advantage to the sufferer $\frac{1}{2}$ mark

– The disease confers an advantage + explanation + particular disease 1 mark

An example of a response scoring 5 marks:

(a) D = diseased, d = normal 1 dd 2 Dd 3 dd 4 Dd $1\frac{1}{2}$ marks

(b) Individuals Dd X dd =

	D	d
d	Dd	dd
d	Dd	dd

Ratio 1:1 $1\frac{1}{2}$ marks

(c) Expected ratios only work with a large number of subjects (people). In the family there is not a large enough sample to ensure adherence to exact ratios. 1 mark

(d) The disease has a long life expectancy. People infected are able to reproduce to pass on the disease before death. 1 mark

Comment

A very good response. Parents and workings are clearly set out, and an excellent explanation is given in part (c), showing a good understanding of probabilities.

An example of a response scoring 4 marks

(a) 1 dd 2 Dd 3 dd 4 Dd $1\frac{1}{2}$ marks

(b) Individuals Dd X dd =

	d	d
D	Dd	dd
d	dd	dd

Ratio 1:3 1 mark

(c) The predicted genotypes affected by the disease could occur in more offspring simply by chance and the genotype for normal may not occur as often as originally predicted. $\frac{1}{2}$ mark

(d) People with the disease reproduce and give birth to offspring with the disease before the disease causes death of the parents. 1 mark

Comment

This is a good response. There is an error in the punnet square (with consequent loss of marks). The marks for the ratio have been awarded because the ratio is consistent with the results obtained in the punnet square. The explanation in part (c) only scored $\frac{1}{2}$ mark because the candidate did not mention that these ratios are generally only achieved by considering a large enough population of individuals.

An example of a response scoring 3 marks

(a) 1 aa 2 Aa 3 aa 4 Aa $1\frac{1}{2}$ marks

(b) 4 = Aa 5 = aa

	A	a
a	Aa	aa
a	Aa	aa

50% of individuals would be affected. $1\frac{1}{2}$ marks

(c) One of the parents was homozygous for the trait therefore all offspring would be effected AA. 0 mark

(d) The disease is dominant over the normal gene and therefore little area for eradication or room for alteration. 0 mark

Comment

As did many others, this candidate answered the first part of the question well but showed poor understanding of the second half. Many candidates seemed to have difficulties in understanding part (c). Here, the candidate seemed to refer to the family in part (b), whereas the question clearly states 'in another family'. The response for part (c) is difficult to interpret.

An example of a response scoring 2 marks

(a) 1 XY (normal) 2 XX' 3 XX 4 X'Y 0 mark

(b) X'Y = affected male XX = unaffected female

	X'	Y
X	X'X	XY
X	X'X	XY

Affected females X'X = 50% ($\frac{1}{2}$)

Unaffected males XY = 50% ($\frac{1}{2}$) $1\frac{1}{2}$ marks

(c) There could be slight genetic variations due to mutations. $\frac{1}{2}$ mark

(d) The allele for the disease is dominant over the normal gene. 0 mark

Comment

The candidate has assumed the disease to be sex-linked (despite its being clearly stated otherwise in the question). Marks have been awarded in part (b) because the candidate used clear keys to indicate what the symbols mean. The candidate correctly pointed out in part (c) that mutations can cause a variation in the expected ratio. The response in part (d) simply repeated what had already been stated in the question.

An example of a response scoring 1 mark

(a) 1 MMm 2 Mmm 3 mm 4 mm — 0 mark

(b)

	M	M
m	Mm	Mm
m	Mm	Mm

All infected, they are all carriers but are not infected themselves. — 1 mark

(c) The other person may be a carrier — 0 mark

(d) It caused from a mutation and cannot be cured because it is a genetic disease — 0 mark

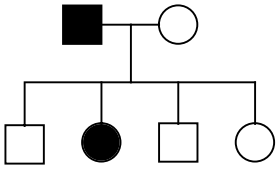
Comment

The candidate has been awarded 1 mark in part (b) because the punnet square has been correctly executed and the ratio is consistent with his/her workings. The candidate seems to imply (wrongly) that the disease is recessive.

An example of a response scoring 0 mark

(a) 1 Mm Normal male 2 Af affected female 3 Nf Normal female 4 Am Affected male — 0 mark

(b)



0 mark

(c) It is a much more present gene within the family and becomes dominant over the other. — 0 mark

(d) Because it is a hereditary disease some one may be carrying it not affected and then pass it on to some one who will then be affected. — 0 mark

Comment

The response indicated little understanding of the topic.

Question 29

(a) A good response recognised that the large SA:V ratio in organism C was sufficient for gaseous exchange. Many candidates could not express this, suggesting difficulty with the concept, and chose instead to nominate an example of a unicellular organism or simply state that C was small. Poor responses stated the organism did not require oxygen for survival and therefore did not need a respiratory surface.

Responses indicated there is confusion between respiration, osmosis and gaseous exchange.

(b) Candidates were required to recognise that folding gave a larger SA, which allowed for greater diffusion of gases. As in (a), responses indicated confusion between respiratory rate and rate of diffusion.

(c) Better responses recognised the significance of moisture to dissolve gases for more rapid diffusion. Most recognised the system is internal for protection or to prevent desiccation. A few mentioned the dense capillary network, but they had to relate this to the impact on diffusion rate or concentration gradient.

(d) There were few problems in this part, with most candidates recognising disadvantages of external gills.

Question 30

This question was generally well answered by the majority of candidates.

(a) Candidates were generally able to present the answer in diagram form as specified. Most candidates displayed a sound knowledge of the concept of crossing-over during meiosis. Candidates scoring full marks were able to show homologous pairs, crossing of chromatids between homologous pairs and the exchange of information because of this crossing-over.

(b) The better candidates had a good understanding of how the process of fertilisation led to variation. The better candidates showed the importance of fusion of the two genetically different gametes in the random process of fertilisation. However, a large number of candidates confused meiosis with fertilisation.

(c) This section was generally well answered, with many candidates able to correctly describe the possible mechanism of evolution that led to the distribution of the Komodo dragon.

Candidates tended to generalise their answers to this section with some confusing Lamarckian and Darwinian theories of evolution. Better candidates were generally able to describe Natural Selection in Isolation.

Question 31

Most candidates were able to basically answer this question using Koch's postulates in part (a), but only a small number were able to correctly separate the two colonies into two separate hosts as the question required and then apply Koch's methods.

In part (b), most candidates were competent in predicting that if it is the same infection then it will be the same bacteria. However, only a small candidature was able to explain that other bacteria may also be present depending on the organism.

Many candidates had difficulty with part (c) of this question. The concept of *prions* as protein molecules and not as viruses, bacteria or fungi was very challenging to many candidates. Consequently, the candidates did not really know why they cannot use Koch's postulates.

Section II – Electives

The Marking scheme and a range of candidate responses for Question 32 parts (f) and (g) follow.

Question 32 The Australian Environment

		Marking criteria	Marks
(a)		Statement of activity 1, eg breeding programs	$\frac{1}{2}$
		Explanation of activity 1, eg boosts numbers	$\frac{1}{2}$
		Statement of activity 2, eg fencing reserved habitat	$\frac{1}{2}$
		Explanation of activity 1, eg reduces predators	$\frac{1}{2}$
(b)	(i)	Name of area	0
	(ii)	1. Name of organism and statement of PATTERN of its distribution and/or abundance, eg *Acmena smithii* distributed in shaded gullies.	$\frac{1}{2}$
		2. Name of another organism and statement of PATTERN of its distribution and/or abundance (organism in 1 & 2 MUST be NAMED or NO mark)	$\frac{1}{2}$
(b)	(iii)	Name of distribution method	$\frac{1}{2}$
		Description of distribution method	$\frac{1}{2}$
		Name of abundance method	$\frac{1}{2}$
		Description of abundance method	$\frac{1}{2}$
	(iv)	TWO factors (abiotic OR biotic) $\frac{1}{2}$ mark each	1
	(v)	Description of effect on distribution and/or abundance, eg *A. smithii* prefer low pH soil. (MUST NAME component or NO MARK.)	1
	(vi)	Idea of CONTROL and TREATMENT group, eg one group of *A. smithii* in low pH, one group in higher pH.	$\frac{1}{2}$
		Idea of controlling other variables, eg same amount of water applied.	$\frac{1}{2}$
(c)		Name of stage 1, eg juvenile	$\frac{1}{2}$
		Effect of abiotic factor A & B on stage 1 ($\frac{1}{2}$ mark each), eg Fire and lack of water reduces numbers of juveniles due to lack of food.	1
		Name of stage 2, eg adult	$\frac{1}{2}$
		Effect of abiotic factor A & B on stage 2 ($\frac{1}{2}$ mark each)	1

(d)	(i)	Quadrat	$\frac{1}{2}$
	(ii)	ONE advantage such as time saving, accurate estimation, minimal disruption to ecosystem.	1
	(iii)	Any TWO problems, eg too few samples, too few organisms, not random, area too small or difficult to calculate. (Idea of inaccuracy must be linked to estimation idea.)	2
	(iv)	Organism is sessile or slow moving.	$\frac{1}{2}$
(e)	(i)	Named plant	$\frac{1}{2}$
		Named animal	$\frac{1}{2}$
		(MUST be INTRODUCED or NO MARK)	
	(ii)	Effect of plant, eg Privet provides for wrens.	1
		Effect of animal, eg Feral cat preys upon small ringtails. (Native organisms must be indicated below Class level.)	1
	(iii)	Effect of plant OR animal, eg Feral cat number is reduced so possum number increases. (Specific name NOT required.)	$\frac{1}{2}$
		Explanation of effect, eg Cat is a predator and reduction in number causes an increase in prey number.	$\frac{1}{2}$
(f)	(i)	ONE human activity, eg fire.	$\frac{1}{2}$
		Increase percentage germination. (NUMBER)	$\frac{1}{2}$
		Increase speed of germination. (RATE/TIME)	$\frac{1}{2}$
	(ii)	Name of Myrtaceae OR Proteaceae (binomial OR specific common name).	$\frac{1}{2}$
		SPECIFIC description of climatic factor, eg High Temperature 30–40°C, Low Rainfall (< 100 mm/year) NOT hot/cold temperature or adequate rainfall.	$\frac{1}{2}$
		Topography, eg mountainous, high altitude, distance above sea level.	$\frac{1}{2}$
(g)		Gondwana concept — joined land masses	1
		NZ split away earlier than Australia or South America.	1
		Any TWO of the following points for 1 MARK each:	$\frac{1}{2}$
		Evidence statement, eg SPECIFIC fossils, jigsaw shape of coasts, distribution of SPECIFIC groups of living organisms	
		or	
		Explanation, eg marsupials found in South America and Australia Indicates that these land masses were once joined, which did not occur in the case of NZ.	$\frac{1}{2}$

(f) (i)

An example of a response scoring 1 $\frac{1}{2}$ marks

The back burning of bushland would increase the number or percentage of seeds germinating and the rate at which the seeds germinated, as indicated by the graph.

An example of a response scoring 1 mark

The back burning of bushland would increase the number or percentage of seeds germinating as indicated by the graph.

An example of a response scoring $\frac{1}{2}$ mark

The back burning of bushland

(f) (ii)

An example of a response scoring 1 $\frac{1}{2}$ marks

The *Acmena smithii* is distributed in areas where the rainfall range is between 500 - 1100 mm of rainfall a year and is mostly found in shaded gullies, valleys and protected sides of hills.

An example of a response scoring 1 mark

The *Acmena smithii* is distributed in areas where the rainfall range is between 500 - 1100 mm of rainfall a year.

An example of a response scoring $\frac{1}{2}$ mark

The *Acmena smithii*.

(g)

An example of a response scoring 3 marks

Originally Australia and South America and New Zealand were part of a large super continent called Gondwanaland. New Zealand separated from Gondwanaland before Australia and South America. This is evidenced by the current distribution of plant species such as *Nothofagus sp*. on parts of the Australian and South American continents and the fact that marsupials can be found in both Australia and South America but not New Zealand.

An example of a response scoring 2 $\frac{1}{2}$ marks

Originally Australia and South America and New Zealand were part of a large super continent called Gondwanaland. New Zealand separated from Gondwanaland before Australia and South America. This is evidenced by the current distribution of plant species such as *Nothofagus sp*. on parts of the Australian and South American continents.

An example of a response scoring 2 marks

Originally Australia and South America and New Zealand were part of a large super continent called Gondwanaland.. This is evidenced by the current distribution of plant species such as *Nothofagus sp*. on parts of the Australian and South American continents and the fact that marsupials can be found in both Australia and South America but not New Zealand.

An example of a response scoring 1 $\frac{1}{2}$ marks

Originally Australia and South America and New Zealand were part of a large super continent called Gondwanaland. This is evidenced by the current distribution of plant species such as *Nothofagus sp*. on parts of the Australian and South American continents.

An example of a response scoring 1 mark

Originally Australia and South America and New Zealand were part of a large super continent called Gondwanaland and the fact that marsupials can be found in both Australia and South America but not New Zealand.

An example of a response scoring $\frac{1}{2}$ mark

This is evidenced by the current distribution of plant species such as *Nothofagus sp*. on parts of the Australian and South American continents.

Question 33 – Structure and Function of Cells and Tissues

Candidates demonstrated a sound knowledge of biochemistry and cell functions. However, some candidates had difficulty in some sections.

Part (a) showed that most candidates had knowledge of photolysis and carbon fixation and were able to identify the links with ATP and NADPH.

In part (b) Krebs and Cytochrome functions were well answered, but very few candidates recognised that glycolysis was the only pathway available to red blood cells.

Most candidates demonstrated a good understanding of enzyme specificity, catalysis and denaturation in part (c). The concept of reversibility was not well answered.

In part (d) candidates had difficulty in interpreting (i) as common features of plant and animal cells and (ii) as general plant cell characteristics and general animal cell characteristics. Section (iii) was well answered with candidates demonstrating good knowledge of specialised plant and animal tissues.

Candidates showed good understanding of unicellular organisms in part (e).

Part (f) was well answered. Candidates drew clear, labelled diagrams of correctly identified mitochondria and chloroplasts.

Most candidates used the stimulus material in part (g) to correctly describe the changes occurring in the meristematic, elongation and differentiation zones.

The marking scheme and a range of candidate responses for Question 33 part (g) follows.

Marking Scheme

Growth of meristem well explained	1 mark
Growth of meristem poorly explained	$\frac{1}{2}$ mark
Elongation well explained	1 mark
Elongation poorly explained	$\frac{1}{2}$ mark
Differentiation well explained	1 mark
Differentiation poorly explained	$\frac{1}{2}$ mark

Question 34 – Control and Coordination

In part (a), a majority of candidates understood the concept of homeostasis in (a) (i) and the difference in speed of action of the two systems in (a) (ii). Many candidates, however, were not skilled in comparing, giving only the hormonal or nervous aspect of the answer. In part (a) (iii) a reasonable number of candidates could select and explain an activity controlled by both systems.

In part (b), a majority of candidates understood the concept of a reflex arc and could apply it to a diagram or flow chart, though some were still confused as to the role of the brain.

The marking scheme for part (b) and a range of responses follow.

(b) receptor → sensory neurone → spinal cord → motor neurone → effector

$\frac{1}{2}$ mark for each component or suitable example thereof

$\frac{1}{2}$ mark for correct direction of impulse

An example of a response scoring 3 marks

stimulus – nail
↓
receptor – skin $\frac{1}{2}$ mark
↓
sensory neurone $\frac{1}{2}$ mark
↓
spinal cord $\frac{1}{2}$ mark
↓
motor neurone $\frac{1}{2}$ mark
↓
effector – muscle in leg $\frac{1}{2}$ mark

add $\frac{1}{2}$ mark for correct direction

An example of a response scoring 1 $\frac{1}{2}$ marks

stimulus
↓
sensory neurone in foot — $\frac{1}{2}$ mark
↓
motor neurone to move foot — $\frac{1}{2}$ mark

add $\frac{1}{2}$ mark for correct direction

An example of a response scoring 0 marks

nail
↓
signal to brain
↓
reflex to foot

In part (c) (i), a significant number of candidates could not distinguish between pituitary and other hormones, but most could identify the target organ for the hormone and its function in (ii). In part (iii), a reasonable number of candidates had some idea of feedback but many did not understand it as being a two-sided process. In part (iv), the majority of candidates saw positive feedback as being a component of negative feedback. In part (v), a reasonable number of candidates could select increase as the correct option. However, the majority of candidates could not adequately explain why this increase should occur.

It should be noted in this elective that the sodium-potassium pump is not the **sole** cause of the action potential — it sets up the conditions that allow the action potential to occur.

(d) In part (d)(i), approximately 30% of candidates thought the interneurone was a sensory neurone, and the terms ‘connector’ or ‘connective’ neurone were popular in certain exam centres.

Many candidates were vague as to the function of the two neurones in part (d)(ii), while question (d)(iii), was fully answered in great detail, out of proportion to the question’s mark weighting, and leading many candidates into revealing erroneous ideas. Section 2 was answered better than section 1.

Approximately 20% said ‘yes’ to part (d) (iv), and many who said ‘no’ could not explain why, beyond ‘because it doesn’t go that way’.

The marking scheme and a range of candidate responses for Question 34 Part (d) follow:

Marking Scheme

(d)	(i)	X labelled correctly and Y labelled correctly	$\frac{1}{2}$ mark
	(ii)	X correct function	$\frac{1}{2}$ mark
		Y correct function	$\frac{1}{2}$ mark
	(iii)	1. Brief explanation	$\frac{1}{2}$ mark
		elaboration	$\frac{1}{2}$ mark

	2. Brief explanation		$\frac{1}{2}$ mark
	elaboration		$\frac{1}{2}$ mark
(iv)	No		0 mark
	Explanation		$\frac{1}{2}$ mark
		Subtotal	4 mark

An example of a response scoring 4 marks

(d) (i)	X motor neurone Y interconnecting neurone		$\frac{1}{2}$ mark
(ii)	X (motor neurone) receives a message from Y and transmits it to the effector, muscle thus bringing about a response		$\frac{1}{2}$ mark
	Y receives a message from a sensory neurone and transmits it to X. The interconnecting neurones are found in the brain and spinal cord		$\frac{1}{2}$ mark
(iii)	1. electrical transmission by an action potential. When the permeability of the dendrite is changed by a neurotransmitter, Na+ ions move into the membrane and K+ ions move out, thus propagating an action potential.		1 mark
	2. chemical transmission ie by a neurotransmitter, eg acetyl choline or noradrenaline		$\frac{1}{2}$ mark
	This neurotransmitter is released by the synaptic knobs at the end of the inter-connecting neurones. It then diffuses across the synapse, and on reaching the motor neurone, causes a change in the permeability of the dendrite, thus propagating an electrical impulse.		$\frac{1}{2}$ mark
(iv)	No. Since there are no synaptic knobs producing neurotransmitter at X, it is unable to propagate an impulse to Y, ie from a motor neurone to an interconnecting neurone. Besides, the neurotransmitter is broken down by enzymes once it reaches X.		$\frac{1}{2}$ mark

An example of a response scoring 2 marks

(d) (i)	X= a motor neurone Y = a interneurone		$\frac{1}{2}$ mark
(ii)	X= sends messages to muscles		0 mark
	Y= pass messages between motor and sensory neurones		$\frac{1}{2}$ mark
(iii)	1. electrochemical transmission		$\frac{1}{2}$ mark
	2. chemical transmission		$\frac{1}{2}$ mark
(iv)	No, because nervous impulses only flow in one direction		0 mark

An example of a response scoring $\frac{1}{2}$ mark

			Marks
(d)	(i)	receptor neurone and interneurone	0
	(ii)	The receptor neurone sends messages from the receptor cells to the interneurone (brain & spinal cord)	0
		which sends messages to the motor neurone to make the reaction	$\frac{1}{2}$
	(iii)	(no response)	0
	(iv)	(no response)	0

Part (e) had more non-attempts than any other section.

Part (e)(i) was well done, but the focus of part (e)(ii) 1 was unclear to many candidates. Sections 2 and 3 were well answered, while 'when, in the life of the plant …' was subject to myriad interpretations, and often no stage was mentioned at all. Candidates who used a table to structure their answers generally fared better than those who did not.

In part (e)(iii), approximately 30% of candidates had no idea of the answer and, of the others, specificity of hormones was better understood than the nature of receptor sites on target organs.

In part (f)(i), candidates were generally good at naming parts of the brain, although some confused cerebrum and cerebellum, and the placement of label R led to reasonable doubt as to whether it was the spinal cord or the medulla oblongata. Less well answered were the functions of each part of the brain, and correct functions were often coupled with incorrect ones, and less able candidates confused the functions of the spinal cord with those of the medulla.

Section (ii) was well answered; however, 'autonomous' was a popular alternative for 'autonomic'.

Question 35 – Classification and the Species Concept

(a) This question asked candidates to show their knowledge of the types of features normally used to classify plants and those which do not make good taxonomic descriptors. Most candidates gave adequate responses to part (i), although some lost marks by giving very general features (eg 'flowers', 'fruits' or 'leaves'). To score maximum marks candidates needed to qualify their responses, such as 'numbers of floral parts' (eg stamens, petals), type of fruit (eg woody) or shape of leaves (eg compound, simple).

In section (ii), there was a limited number of responses, but candidates needed to indicate that features which show considerable variation within a species or at different ages of a plant are considered unsatisfactory for use in classification, such as height, size and colour.

Marking Scheme

Question No		Details	**Mark**	**Max Mark**
(a)	(i)	qualified/distinguishing feature (eg leaf shape) — not taxonomic names — $\frac{1}{2}$ mark each	2	2
		unqualified feature (eg leaf, flower)	0	
	(ii)	features not used (eg height/size, colour, habitat)	1	2
	and/	$\frac{1}{2}$ mark for each		

or	Explanation of suitability of such features	1	
	(both needed to be justified together or individually)		
or	other feature plus justification	1	
	(a) Total		**4**

(b) The candidates' knowledge of the binomial classification system was tested in this section. Only the strict binomial classification was accepted in (i) — genus beginning with an upper case letter and species with lower case. Underlining was not demanded.

Relatedness of organisms was shown in diagram (ii), with organism E being most closely related to organism A because they are in the same genus. Archeobalanidae is the family level of classification (iii). Most candidates scored well in this part.

(b)	(i)	*Hexaminius pope*	$\frac{1}{2}$	1
		Elminius covert	$\frac{1}{2}$	
	(ii)	E	$\frac{1}{2}$	$1\frac{1}{2}$
		same genus	1	
	or	on the same branch	$\frac{1}{2}$	
	(iii)	family	$\frac{1}{2}$	$\frac{1}{2}$
		(b) Total		**3**

(c) In part (i) most candidates listed the taxa in the classification hierarchy in the correct order and indicated that organisms were least alike at the kingdom level.

In part (ii) candidates needed to understand that structural characteristics are most often used in classification as they are easy to observe, usually change very little within species or at different life stages, and can be used to classify dead and fossil organisms. In this section candidates were also asked to illustrate their answer with examples and a number of candidates lost marks for not including these.

The marking scheme and a range of candidate responses for Question 35 part (c) follow.

(c)	(i)	species, genus, family, order, class, phylum, kingdom	1	$1\frac{1}{2}$
		one mistake/misplacement	$\frac{1}{2}$	
		more than one mistake/misplacement	0	
	and	kingdom	$\frac{1}{2}$	
	(ii)	structural/physical characteristics	$\frac{1}{2}$	$2\frac{1}{2}$
		explanation of why	1	
		2 appropriate example(s)	1	
		(c) Total		**4**

An example of a response scoring 3 $\frac{1}{2}$ marks

(c)	(i)	Kingdom, Phylum, Class, Order, Family Genus species	1 mark
		members of kingdom are least alike	$\frac{1}{2}$ mark
	(ii)	structural features are used most often	$\frac{1}{2}$ mark
		as they can be seen easily even in dead specimens	1 mark
		eg number of legs in Arthropods	$\frac{1}{2}$ mark

Comment

The candidate lost $\frac{1}{2}$ mark for using only one example.

An example of a response scoring 1 $\frac{1}{2}$ marks

(c)	(i)	Kingdom, Phylum, Order, Family and species	0 mark
		members of kingdom are least alike	$\frac{1}{2}$ mark
	(ii)	Insects have 3 body parts and no antennae	1 mark

Comment

Two taxa were left out of the classification hierarchy (1 mark). No response was given by the candidate regarding the type of features most often used in classification ($\frac{1}{2}$ mark) or why such features are most often used (1 mark).

(d) The concept of speciation was again tested in this part of the question. The *sympatric* speciation model was eliminated by the wording of the question, which indicated a geographical isolating mechanism (a river) separating population C from populations A and B. Most candidates based their hypotheses around the mechanism of *allopatric speciation*. This is where genetic variation is acted on by natural selection after groups of a single species have become physically (geographically) separated from each other. Because of this, no interbreeding (gene flow) occurs. As there is no gene flow between the groups there is no dilution of any genetic changes produced by different natural selection pressures acting on each group. The groups may become reproductively isolated from each other due to these changes and be recognised as new species.

However, some candidates named and/or discussed various mechanisms of reproductive isolation (eg behavioural isolation, where changes in mating behaviour between groups C and A and B had resulted in each not responding to the other's mating behaviour and their being unable to interbreed).

The syllabus asks candidates to study 'hypotheses to account for speciation' and asks candidates to consider genetic variability, isolating mechanisms and genetic change as being involved in the process of speciation. Marks were awarded to candidates approaching their answers from any of these areas, the better marks being awarded to those who related these mechanisms to the process of speciation.

(d)	(i)	Students can gain marks by using any of the following approaches: named reproductive isolating mechanisms — $\frac{1}{2}$ mark each	$1\frac{1}{2}$	3
		eg behavioural isolation		
	and	explanation for each relating to speciation — $\frac{1}{2}$ mark each	$1\frac{1}{2}$	
		eg different behaviour prevents interbreeding/gene flow		
	or	good explanation of allopatric speciation, including any 3 of geographic isolation (2), cessation of gene flow (2), changes under different natural selection (2), leading to reproductive isolation (2)	3	
	or	naming factors which could contribute to speciation, including: genetic variability, isolation, genetic change/mutation, natural section/different selection agents	$1\frac{1}{2}$	
	and	some explanation of how these may contribute to speciation	$1\frac{1}{2}$	
	Note:	**Marks can be awarded for correct information by a student taking more than one of these approaches, but each idea/concept can only be paid once**		
	(ii)	no physical separation/isolation or equivalent statement/a and b = a cline	1	2
		still have gene flow/interbreeding/reproduction between groups	1	
		mating or breeding/reproduction without indication of it being between groups	0	
		(d) Total		**5**

(e) Candidates were asked in part (i) to indicate why a tick (pictured) would not be classified as an insect, in part (ii) to design a key to key out 3 insects within the Order Hymenoptera (ii), in part (iii) to name another order they had studied and in part (iv) to give a characteristic of that order which distinguished it from the Hymenoptera.

Question No		Details		
(e)	(i)	8 legs/not 6 legs	$\frac{1}{2}$	1
	+/or	2 body parts or sections/ not 3 body parts or sections (segments not accepted)	$\frac{1}{2}$	
	+/or	no antennae	$\frac{1}{2}$	
	(ii)	steps to key out 3 remaining species — $\frac{1}{2}$ mark each	$1\frac{1}{2}$	2

and	correct setting out of key		$\frac{1}{2}$	
	key must be dichotomous, not in branching form, not extended			
(iii)	scientific order name		1	1
	common name		0	
(iv)	any ONE feature distinguishing named or inferred order from Hymenoptera		1	1
		(e) Total		**5**

An example of a response scoring 5 marks

					Marks
(e)	(i)	animal has 4 pairs of legs, not 3 insects have 3 body parts not 2			1
	(ii)	1a	wings present	go to 2	
		1b	wings absent	Insect A	
		2a	insect smaller than 10 mm	go to 3	
		2b	insect larger than 10 mm	Insect B	
		3a	antennae as long as body	Insect D	
		3b	antenna much shorter than body	Insect C	2
	(iii)	Coleoptera			1
	(iv)	have hardened fore wings (elytra) covering membranous hind wings			1

Comment

The candidate gave good responses for all parts of the question, including using measurements given in the diagrams and described antennae in relation to body size, rather than just simply saying ‘small’ or ‘large’.

An example of a response scoring 3 $\frac{1}{2}$ marks

					Marks
(e)	(i)	animal has 8 legs, not 6 has no wings			$\frac{1}{2}$
	(ii)	1a	wings present	go to 2	
		1b	wings absent	Insect A	
		2a	antennae facing forward	go to 3	
		2b	antennae facing back	Insect D	
		3a	has long process off abdomen	Insect C	
		3b	has no long process off abdomen	Insect B	2
	(iii)	Coleoptera			1
	(iv)	chewing mouthparts			0

Comment

The candidate gave only one distinctly insect feature (not all have wings) (i) and gave a feature for the named order which did not distinguish it from the Hymenoptera (iv).

An example of a response scoring 1 $\frac{1}{2}$ marks

					Marks
(e)	(i)	insects have 3 body segments and an exoskeleton			0
	(ii)	1a	wings present	go to 2	
		1b	wings absent	Insect A	
		2a	wings have scales	go to 3	
		2b	wings without scales	Insect C	
		3a	long antennae	Insect D	
		3b	without long antennae	go to 4	
		3c	antennae facing forward	Insect B	$\frac{1}{2}$
	(iii)	Lipidopod — moths			0
	(iv)	long sucking tube for feeding			1

Comment

The candidate gained no marks for part (i) as the main body parts of both insects and arachnids are divided into segments and the exoskeleton is an arthropod feature. The key was not dichotomous, as asked for in the question, and used features (scales) not applicable to the diagrams. Candidates were awarded marks for the description of antennae, but should really avoid using terms such as ‘short’ and ‘long’, with measurements or sizes in relation to body size being more appropriate. The scientific order name was not close enough (Lepidoptera), but a mark for a feature separating the order (inferred from one group of organisms within the order — moths) from Hymenoptera was awarded a mark.

(f) This question was worded in a difficult way but many candidates answered it quite well, indicating that the geographical separation between the islands would prevent gene flow and that any differences in selection pressures exerted by different conditions on the islands would result in the species inhabiting them (either fossil or living) being unlikely to belong to the same species.

Conversely, if the islands were quite close to each other (‘nearby island’), gene flow between them could still occur due to pollinating agents (eg insects, birds), so that they could well be the same species (even although one had died out and was only present as a fossil). This would be more likely if the environmental conditions on the two adjacent islands had not changed much over geological time so that selection pressures were similar on the two islands.

(f)		**Support argument**		1
		geographical isolation or physical separation explained	$\frac{1}{2}$	
	and	therefore unable to interbreed/reproduce between groups	$\frac{1}{2}$	
		mating or breeding/reproduction without indication of it being between groups	0	
	or	have different gene pools	$\frac{1}{2}$	
	or	changed under different natural selection on two islands	1	
		Against argument		1
		not isolated due to nearness of islands/islands once part of same landmass	$\frac{1}{2}$	
	or	available pollinating/dispersal agents/common ancestors on original landmass	$\frac{1}{2}$	
	and	= possible gene flow/pollination/seed dispersal — recently or in past	$\frac{1}{2}$	
	or	same/similar selection on the different islands	1	
	or	same/similar selection on islands as on original landmass	1	
			(f) Total	**2**

(g) In (i) candidates were expected to indicate that physical differences, such as colour or feather patterns, in this instance were not good taxonomic characters to use as they differed within the species (between male and female).

This difficulty would have been overcome by scientists discovering that the two birds were able to breed together under natural conditions to produce fertile offspring (ii).

Many candidates scored well in this question.

(g)	(i)	physical differences, differences in colour, feather patterns etc	$\frac{1}{2}$	$\frac{1}{2}$
		look different	0	
	or	belong to a cline	$\frac{1}{2}$	
	(ii)	– reproduce/breed/mate	$\frac{1}{2}$	$1\frac{1}{2}$
		– to produce fertile offspring	$\frac{1}{2}$	
		– under natural conditions	$\frac{1}{2}$	
	or	same/common gene pool	$1\frac{1}{2}$	
	or	gene pool without common/same	$\frac{1}{2}$	
	or	DNA/Biochemical testing	1	
			(g) Total	**2**

Question 36 – Human Species

Marking Scheme

Part (a) – Total 3 Marks

(i)	1 mark	$\frac{1}{2}$ mark feature, $\frac{1}{2}$ mark adaptation
(ii)	1 mark	$\frac{1}{2}$ mark feature, $\frac{1}{2}$ mark adaptation
(iii)	1 mark	$\frac{1}{2}$ mark feature, $\frac{1}{2}$ mark adaptation

Part (b) – Total 3 Marks

(i)	$1\frac{1}{2}$ marks	$\frac{1}{2}$ mark for each of three mammalian characteristics
(ii)	$1\frac{1}{2}$ marks	$\frac{1}{2}$ mark for each of three primate characteristics

Part (c) – Total 3 Marks

(i)	1 mark	Comparison
(i)	2 marks	$\frac{1}{2}$ mark for each of 2 reasons $\frac{1}{2}$ mark for each of 2 elaborations

Part (d) – Total 3 Marks

(i)	$\frac{1}{2}$ mark	specific human population mentioned
	$\frac{1}{2}$ mark	correct advantage given
(ii)	$\frac{1}{2}$ mark	idea of interbreeding or gene pool mixing
	$\frac{1}{2}$ mark	correct reasoning or example of interbreeding
(iii)	1 mark	two correct characteristics OR examples of characteristic linked to climates correctly

Part (e) – Total 2 Marks

(i)	$\frac{1}{2}$ mark	correct similarity
	$\frac{1}{2}$ mark	explanation of advantage
(ii)	$\frac{1}{2}$ mark	correct difference in characteristic from diagram
	$\frac{1}{2}$ mark	result of difference

Part (f) – Total 3 Marks

(i)	$1\frac{1}{2}$ marks	$\frac{1}{2}$ mark for each correct characteristic of a skull similar to humans
(ii)	$1\frac{1}{2}$ marks	$\frac{1}{2}$ mark for correct justification for each feature

Part (g) – Total 4 Marks

(i)	2 marks	1 mark example of archaeological evidence
		1 mark information evidence may provide
(ii)	2 marks	1 mark limitations of evidence
		1 mark discussion of how/why referring to Aborigines

Part (h) – Total 4 Marks

(i)	$\frac{1}{2}$ mark	Description of biological evolution
	$\frac{1}{2}$ mark	Description of cultural development
	$\frac{1}{2}$ mark	Example of biological evolution
	$\frac{1}{2}$ mark	Example of cultural development
(ii)	1 mark	Example of cultural development
	1 mark	Influence example has had on evolution

Comment

(a)	(i)–(iii)	Most candidates were able to state an identifiable feature for bipedalism from the diagrams. Many candidates had difficulty explaining the adaptation of the feature.
(b)	(i)	Most candidates were able to list three features of mammals that were unique to the group.
	(ii)	The majority of candidates was able to list three primate features that were unique to the group.
(c)	(i)	Most candidates were able to identify a comparison from the graph.
	(ii)	Many candidates could state a reason for the shape of the graph but some had difficulty elaborating on the reason.
(d)	(i)	Most candidates were able to apply the height to weight ratio correctly to the rate of heat loss. Many candidates also translated height to weight ratio as surface area to volume ratio. Some candidates indicated that surface area to volume ratio occurred as a result of humans choosing where they were going to live. Some also interpreted height to weight as gaining or losing weight. Many candidates failed to name a specific human population in their answer.
	(ii)	Many candidates did not use an example when answering this question or confused ‘race’ with ‘culture’. A large number of candidates appeared to answer this question as a prepared answer on polymorphic species and missed the point of the question.

(iii) This section was generally well answered, although many candidates used 'surface area to volume ratio' as another example.

An example of a response scoring 3 marks

			Marks
(d)	(i)	People like the Eskimos would have a lower height to weight ratio. This means they would conserve body heat which would be an advantage for living in cold areas.	1
	(ii)	It is difficult to sustain the concept of race because improved travel has led to more interbreeding between races.	1
	(iii)	Skin colour Being heterozygous for sickle-cell anaemia	1

An example of a response scoring 1 $\frac{1}{2}$ marks

			Marks
(d)	(i)	A population in cooler areas (Eskimos) would have lower surface area to volume ratio. This means they would keep warmer because of their body fat that insulates them from cold air.	$\frac{1}{2}$
	(ii)	It is difficult to maintain the concept of race because of interbreeding.	$\frac{1}{2}$
	(iii)	Surface area to volume ratio Having dark skin provides protection from the sun's damage in equatorial regions.	$\frac{1}{2}$

An example of a response scoring 0 marks

			Marks
(d)	(i)	It would be an advantage to a specific population if you lived in a cold region. Your height to weight ratio would decrease which means you would be warmer because of the smaller surface area to volume ratio.	0
	(ii)	The human species are very polymorphic. This makes it difficult to determine race. For example, a Japanese person and a Chinese person have characteristics that are very similar. Many other groups have different features that make it difficult to sustain race.	0
	(iii)	Dark skin Sickle-cell anaemia	0

(e) (i) This was well answered by most candidates. There were many variations in the spelling of the word 'opposable'.

(ii) This question was more difficult for many candidates. The feature chosen must have been from the diagrams provided, **not** from other knowledge.

(f) Many candidates misinterpreted this question and answered it in terms of evolutionary changes rather than by giving specific characteristics of the 'skull that has been discovered intact'. Candidates who explained the significance of each characteristic scored better than those who gave a general statement as an explanation.

(g) (i) This question was generally well answered. However, a significant number of candidates could not distinguish between archaeological and palaeontological evidence.

(ii) Many candidates demonstrated poor expression in this section. They did not state 'why' there was a limitation in interpreting the evidence. A large number of candidates simply restated the question.

(h) (i) This question was well answered. Candidates should be aware that the terms 'evolution' and 'development' involve some process of change which should be evident in their answers. Also 'speech' was frequently given incorrectly as a cultural development.

(ii) A significant number of candidates were not able to articulate correctly the effect of cultural change on evolution. A smaller number of candidates discussed possible future effects instead of past or present effects.

Question 37 – Genes in Action

In this question a detailed understanding was required to give full descriptions of:

- The roles of DNA, messenger RNA, transfer RNA and ribosomes in protein synthesis
- Types of mutations — point and chromosomal
- Human ABO blood groups and human height inheritance
- Techniques of genetic manipulation through artificial selection and recombinant DNA
- Information needed by genetic counsellors to advise patients
- The relationship between crossing over, % recombination of genes and distance between genes on a chromosome

Descriptions can include fully labelled diagrams as in protein synthesis.

(a) (i) Most candidates showed a good understanding of protein synthesis and answered the question well. Diagrams were well drawn in most instances and were clearly labelled.

Some errors that were observed included:

- not understanding the difference between DNA replication and transcription, eg some answers said mRNA copies the DNA
- confusion about the role of tRNA in the formation of the polypeptides.

(ii) This question was generally not well answered. Many candidates were unable to relate gene structure to protein structure and function.

(b) The question on genetic mutations was well understood and answered. Candidates understood the difference between a base substitution and a base deletion in the genetic code and the effect of each on protein synthesis.

(c) The concept of polygenic inheritance was clear to most candidates. However, some responses failed to clearly distinguish between 'many genes at different loci' and 'many genes or alleles at the same locus'.

(d) Genetic disorders caused by a change in chromosome number were well understood, with both the abnormality and effect on the organism well explained.

(e) This part was generally well answered. Candidates needed to show all their working as well as give a full explanation. Some drew correct punnet squares but failed to explain them. Some candidates could not interpret the table and tried to match the 'baby' with one parent from couple 2.

(f) Some confusion existed with the comparison between recombinant DNA techniques and traditional artificial selection techniques. Each disadvantage and advantage needed to be linked to both genetic manipulation techniques. Some candidates simply defined and described recombinant DNA techniques.

(g) This part was well answered by most candidates. Some confusion was evident between the factual information required by a genetic counsellor and the advice given. Candidates need to outline more than one piece of factual information.

(h) (i) This section was well answered, with the majority of candidates displaying a sound understanding of chromosome maps. Candidates must be precise in the use of the term 'allele'.

(ii) Many candidates were able to explain how linkage can be used to construct chromosome maps. Some candidates confused % recombination of genes with chromosomes. Some used the term 'linkage' but failed to explain how it is used.

Marking Scheme – Question 37

Question			**Mark**	**Max Marks**
37(a)(i)	DNA	Diagram showing DNA as template for formation of mRNA	$\frac{1}{2}$	
		(If no diagram — $\frac{1}{2}$ mark only)		
		or		
		correctly labelled diagram + explanation in labels/text	1	
	mRNA/ ribosomes	mRNA moves to ribosome (or arrows showing it)	$\frac{1}{2}$	3 marks max
		ribosome is site of protein synthesis	$\frac{1}{2}$	
		or		
		indication in diagrammatic form of above	1	
	tRNA	picks up single amino acid from cytoplasm and delivers it to ribosome	$\frac{1}{2}$	
		or		
		has three bases (anticodon) which correspond to bases in the mRNA (codon)		
		or		
		codon/anticodon fit together		
		or		
		(if no diagram 1 mark max)	1	
		correctly labelled diagram or explanation in labels/text		

37(a)(ii)	Enzymes are proteins **or** different genes produce different proteins.	$\frac{1}{2}$	1 mark
	Different proteins control chemical processes to produce a variety of characteristics	1	
37(b)(i)	Point mutation **or** genetic mutation	1	
	or		
	– mutation 1 is a base substitution or a substitution alone	$\frac{1}{2}$	
	– mutation 2 is a base deletion or a frameshift	1	
	Explanation		2 marks
	– mutation 1 adenine replaced by cytosine	$\frac{1}{2}$	
	– mutation 2, adenine (or A) has been removed (C removed)	$\frac{1}{2}$	

An example of a response scoring 2 marks

Mutation 1 — point or base substitution mutation.
Adenine has been replaced by cytosine in second codon.

Mutation 2 — point, base deletion or frameshift mutation.
Adenine has been deleted from second codon.

An example of a response scoring 1 mark

Both 1 and 2 are point mutations, 1 being a base substitution and 2 frameshift mutation.

An example of a response scoring $\frac{1}{2}$ mark

Mutation 1 is a duplication and mutation 2 is a frameshift mutation.

37(b)(ii)	Effects on protein synthesis — mutation 1 (both effect and reason for mark)	$\frac{1}{2}$	
	– no effect as same as coded by changed triplet or different aa coded but effect insignificant in the protein synthesis		
	– some effect on structure and/or function of the protein because mutation codes for different aa		
	– cessation of protein synthesis because mutation codes for a stop codon		1 mark

	Effects on protein synthesis — mutation 2	$\frac{1}{2}$	
	– if mutation near end there may be no effect		
	– synthesis may stop if mutation codes for a stop codon		
	– synthesis continues but structure and/or function altered because of changes to reading frame from deletion onwards.		
37(b)(iii)	Two possible causes, eg		
	UV light / tar / mustard gas gamma rays / acrydine dyes / 5-Bromouracil nitrous acid / high temperatures / hydroxylamine benzene / viruses colchicine	$\frac{1}{2}$	1 mark
	spontaneous — errors in cellular process (must explain)	$\frac{1}{2}$	
37(c)	Polygenic or quantitative trait/inheritance	1	
	Polygenics	$\frac{1}{2}$	2 marks
	– trait controlled by more than one gene pair	1	
	– many genes at different loci		
	– under the influence of many loci		
	– cumulative effect of genes involved		
37(d)(i)	Genetic disorder caused by an abnormal change in chromosome number, eg	$\frac{1}{2}$	2 marks
	Down Syndrome - trisomic 21		
	Patau — trisomic 13		
	Edwards — trisomic 18		
	Turner's X 0		
	Metafemale XXXX OR XXXXX		
	Kleinfelter's - XXY, XXYY or XXXXY or XXXXXY		
	Jacob's — super male		
	super female		
	Trisomy in Datura stramonium		
	polyploidy		

37(d)(ii)	Description of abnormality in chromosome # must link and be correct with condition named in (i), eg trisomy of 21st chromosome for Down Syndrome	1	
37(d)(iii)	One effect which must be correct for named condition	$\frac{1}{2}$	
37(e)	Baby L matches Couple 1	$\frac{1}{2}$	3 marks
	Baby K matches Couple 2	$\frac{1}{2}$	
	Show working in a punnet square or similar — Couple 1	$\frac{1}{2}$	
	Show working in a punnet square or similar — Couple 2	$\frac{1}{2}$	
	Correct explanation for Baby L	$\frac{1}{2}$	
	Correct explanation for Baby K	$\frac{1}{2}$	
37(f)	Describe **two** advantages — must be for recombinant DNA over traditional methods **or** If the advantage is a product/technique use of recombinant DNA that does not exist for artificial selection but no comparison made	1 1 $\frac{1}{2}$	4 marks
	Describe **two** disadvantages — must be for recombinant DNA over traditional methods	1 1	
37(g)	Must mention at least **three** facts	1 1 1 1	3 marks
37(h)(i)	A chromosome map is a diagram showing the order in which known genes occur along a chromosome and their relative distance apart	1	
37(h)(ii)	The frequency (%) of recombination or frequency (%) of crossing over of linked genes indicates the relative distance separating the genes. By comparing % recombination of a number of linked genes, a map showing the position of genes along a chromosome can be produced. AND A quantitative statement/diagram is needed for FULL MARKS If the % recombination between 2 genes on a chromosome is high, the genes are far apart, and if it is low the genes are close together.		3 marks

Question 38 – Human Environmental Impact

Candidates need to ensure that responses are accurate, concise and involve the use of appropriate scientific language. Candidates using general knowledge only, and writing in generalisations, score very few marks in this elective. Candidates may be required to apply their knowledge of this area of the syllabus to new situations in order to provide solutions for environmental problems.

The marking scheme and range of candidate responses for Question 38 (d) follows:

Marking Scheme

Part	Answer	Marks
(d) (i)	Low population/limited gene pool Limited suitable habitat Strong competition from other species	$\frac{1}{2}$ mark each Max 1 mark
(ii)	Remove ivy by hand Use biological control to remove ivy Propagate pines artificially Keep humans out of the area Educate people to prevent releasing exotics Monitor land use upstream Fines for inappropriate activities	1 mark each Max 2 marks
(iii)	Introduction of exotic species Dispersal by humans, other animals, wind. Successful invasion due to: lack of competition, parasites, disease, rapid reproduction, suitable habitat.	$\frac{1}{2}$ mark each Max 1 mark

An example of a response scoring 4 marks

(i) There is competition for light with the ivy, and the pine's gene pool will be limited by its very small population.

(ii) Physically remove all ivy specimens from these habitats. Then limit the use of the area by humans to avoid further invasion by seeds.

Monitor the land use in areas upstream from these waterfalls. This is to try to prevent the accidental release of seeds or cuttings of the ivy.

(iii) There are few species of animals which graze on the ivy. It competes very well because there are not many diseases of ivy in this environment. The ivy is able to grow and reproduce quickly.

An example of a response scoring 3 marks

(i) There are limited numbers and there is a limited habitat that it can survive in. It is threatened by the English ivy.

(iii) Try to grow and farm the pines under controlled conditions so they can be replanted and numbers re-established in the wild.

(ii) Ivy brought into Australia as a garden plant.
Ivy planted in the Blue Mountains.
Able to grow quickly and out of control due to favoured environment and no natural predators to keep it under control.

An example of a response scoring 2 marks

(i) This pine is considered to be an endangered species because it only lives in four south-facing waterfalls in the Blue Mountains.

(ii) The pine should be grown and planted on other south-facing waterfalls. The ivy should be removed by pulling it out by hand.

(iii) When the Blue Mountains was colonised, someone brought the English ivy with them. The ivy grew, the birds ate the seeds, deposited the seeds on the cliff by dropping their faeces, and the ivy grew.

An example of a response scoring 1 mark

(i) It is endangered because it is only surviving in a few small areas.

(ii) By informing the public about the situation. By removing the English ivy.

(iii) It could have been brought from overseas. Its seeds could have dispersed by wind or birds.