

Student Number:

2006**HIGHER SCHOOL CERTIFICATE**

Sample Examination Paper

BIOLOGY**General Instructions**

- Reading Time – 5 minutes
- Working Time – 3 hours
- Write using blue or black pen
- Board-approved calculators may be used
- Draw diagrams using pencil
- Write your student number at the top of this page

Total Marks – 100**Section I****75 marks****This section has two parts, Part A and Part B****Part A – 15 marks**

- Attempt Questions 1–15
- Allow about 30 minutes for this section

Part B – 60 marks

- Attempt Questions 16–25
- Allow about 1 hour and 45 minutes for this section

Section II**25 marks**

- Attempt ONE question from Questions 26–30
- Allow about 45 minutes for this section

Directions to school or college

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Section I
75 marks

Allow about 2 hours and 15 minutes for this section

This section has TWO parts

Part A – 15 marks Questions 1–15
Part B – 60 marks Questions 16–25

Part A
15 marks

Select the alternative A, B, C, or D that best answers the question. Fill in the response sheet clearly.

1	X			
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If you think you have made a mistake, blank out the incorrect answer and fill in the new answer.

1	X			X
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If you change your mind and have crossed out what you consider to be the correct answer, then indicate the correct answer by writing the word *correct* and drawing an arrow.

1	X			X
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Correct →

Section I

75 marks

Part A – 15 marks

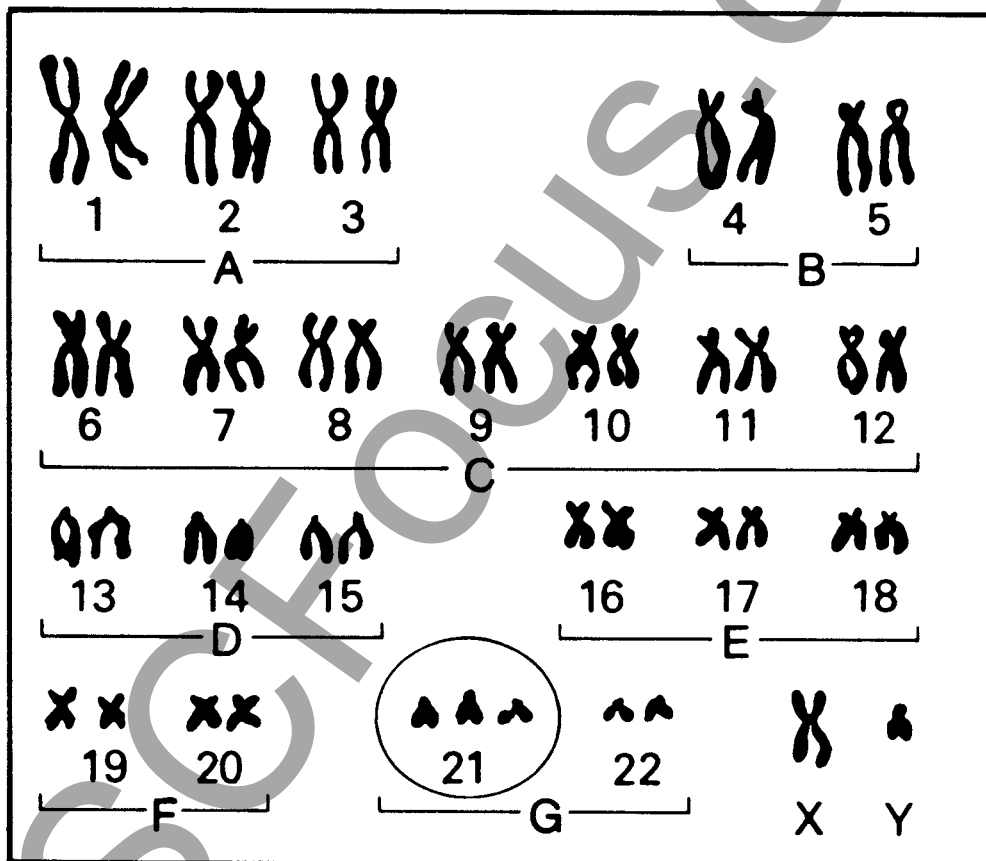
Attempt Questions 1–15

Allow about 30 minutes for this section

Use the multiple choice answer sheet.

- 1 Which of the following is the best definition of the term *homeostasis*?
- A The production of ATP by mitochondria during cellular respiration at a constant rate
 - B The maintenance of a relatively stable external environment by living things
 - C The use of a simple model to describe the specificity of enzymes on substrates
 - D The process by which organisms maintain a relatively stable internal environment
- 2 During your studies you performed a first-hand investigation to demonstrate the effect of dissolved carbon dioxide on the pH of water. What is the effect of increasing the amount of dissolved carbon dioxide on the pH of water?
- A There is no effect.
 - B The pH is increased.
 - C The pH is reduced.
 - D Water does not have a pH so this could not be determined.
- 3 Which of the following is a non-specific defence barrier to prevent entry of pathogens into humans?
- A T cells
 - B Antibodies
 - C B memory cells
 - D Cilia
- 4 Which of the following triggers the immune response?
- A Antigens
 - B Antibodies
 - C Phagocytosis
 - D The lymph system

- 5 Pesticide resistance is a problem affecting farmers who depend upon chemicals to control insect pests. Which of the following would be the result of the increased use of pesticides?
- A New species of pests evolving that are resistant to the pesticides
 - B Genetic resistance in insect pests that is passed on to the next generation
 - C Greater time between applications of the pesticides
 - D The use of pesticides with lower concentrations of chemicals so as not to harm the environment
- 6 The diagram below shows the chromosomal complement (karyotype) of a person with Down Syndrome.



What is this an example of?

- A A non-infectious inherited disease
- B A non-infectious environmental disease
- C An infectious disease caused by a virus
- D A deliberate suppression of the immune system

- 7 The table below contains the names of important scientists and their contributions to science in terms of theories, discoveries and experimental methods. Which alternative (A, B, C or D) correctly matches all scientists with their contributions?

	Darwin	Sutton and Boveri	Pasteur	Koch
A	Evolution	Chromosomal inheritance	Germ theory of disease	Disease Postulates
B	DNA structure	Disease Postulates	Germ theory of disease	Chromosomal inheritance
C	Evolution	DNA structure	Evolution	Germ theory of disease
D	Chromosomal inheritance	Evolution	DNA structure	Disease Postulates

- 8 In a species of plants there are three possible flower colours: red, blue and purple. When plants with red flowers are crossed with plants with purple flowers the resulting offspring have either red flowers or purple flowers. What is this mode of inheritance called?

- A Sex linkage
- B Recessive
- C Codominant
- D Dominant

- 9 The following diagram shows the behaviour of chromosomes during a certain stage of meiosis.



What is the process that is occurring here called?

- A Crossing over
- B Cytokinesis
- C Mitosis
- D Random segregation of chromosomes

- 10** In humans, pattern baldness is sex linked, recessive and carried on the X chromosome. If a carrier female has a child with a normal male, what is the probability that one of their children will have pattern baldness?
- A 0%
 B 25%
 C 50%
 D 100%
- 11** Which of the following alternatives includes all of the factors that are essential for osmosis to occur?
- A A selectively permeable membrane in water
 B A selectively permeable membrane separating solutions of equal concentrations of solutes in water
 C An impermeable membrane separating solutions of unequal concentrations of solutes in water
 D A selectively permeable membrane separating solutions of unequal concentrations of solutes in water
- 12** Mammalian blood contains a substance called haemoglobin. What is the purpose of this substance?
- A Enable oxygen to be carried through the walls of blood vessels to where it is needed
 B Maintain the correct pH of the blood by neutralising the excess carbon dioxide
 C Increase the blood's capacity to carry oxygen
 D Decrease the need for oxygen as it takes its place, particularly at higher altitudes
- 13** Which of the following (A, B, C or D) is a correct comparison of arteries and veins?

	Arteries	Veins
A	Thin, inelastic walls and large diameter tube because of low blood pressure.	Thick, elastic walls and narrow diameter tube to resist the higher blood pressure.
B	Thick, elastic walls and narrow diameter tube to resist the higher blood pressure.	Walls one cell thick to allow for the exchange of materials between blood and surrounding tissues.
C	Valves and a wide diameter tube to allow for the flow of blood to the heart.	Walls one cell thick to allow for the exchange of materials between blood and surrounding tissues.
D	Thick, elastic walls and narrow diameter tube to resist the higher blood pressure.	Valves and a wide diameter tube to allow for the flow of blood to the heart.

- 14** The following passage has some words missing. These words have been replaced with numbers. Which alternative (A, B, C or D) has all of the missing words correctly identified?

Enzymes are ...**1**... . Every reaction and process within a cell (...**2**....) is controlled by a ...**3**.... enzyme.

	1	2	3
A	lipids	metabolism	non-specific
B	proteins	metabolism	specific
C	carbohydrates	respiration	non-specific
D	proteins	digestion	specific

- 15** Which of the following is a correct description of the concentration of gases in blood leaving the heart to go to the body compared to blood entering the heart from the body?

- A A higher concentration of oxygen and a lower concentration of carbon dioxide
- B A higher concentration of carbon dioxide and a lower concentration of oxygen
- C Equally high concentrations of both carbon dioxide and oxygen
- D Equally low concentrations of carbon dioxide and oxygen

Section I (continued)

Part B – 60 marks

Attempt Questions 16–25

Allow about 1 hour and 45 minutes for this section

Answer the questions in the spaces provided.

	Marks
Question 16 (8 marks)	
Temperature has a very large effect upon organisms, for example, it may influence where they live, their daily activity and their metabolism.	
(a) Using examples of organisms, identify the broad range of temperatures over which life is found compared with the narrow limits for individual species.	2
(b) For a named Australian endothermic organism, outline one response to an increase in the ambient temperature and explain how this response assists temperature regulation.	2
(c) During your course of study you had to perform a first-hand investigation to test the effect of increased temperature on the activity of a named enzyme.	
(i) Identify your data sources	1
AND	
(ii) Describe the effect of increasing temperature on the activity of your named enzyme as the temperature is increased from 10°C to 100°C.	1

Marks

- 2

[illegible]

Question 17 (6 marks)

During your course of study you had to analyse information from secondary sources to prepare a case study to show how an environmental change can lead to changes in a species.

- 4

HSC Focus

Marks

- (b) Define the term natural selection. Describe the change in your species brought about by natural selection. 2

[www.dreamtore.com](#)

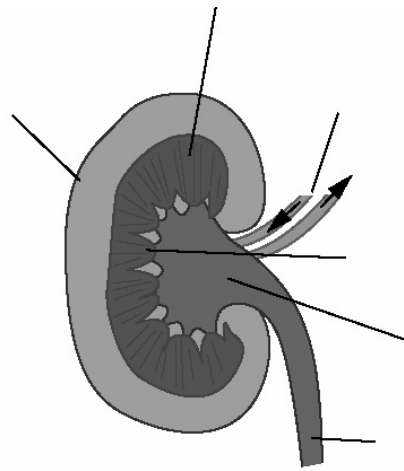
Question 18 (5 marks)

Present information about the occurrence, symptoms, cause, treatment/management of a named non-infectious disease.

HSC Focus

Marks**Question 19** (13 marks)

- (a) In your studies you would have performed a dissection, used a model or visual resource to identify the regions involved in the excretion of waste products by the kidney. The diagram below shows a dissected mammalian kidney.



Label, on the diagram, the two main internal regions of the kidney involved in the excretion of waste products.

2

- (b) Outline the role of the kidney in mammals.

3

- (c) Distinguish between active and passive transport.

1

Marks

- (d) Justify the use of hormone replacement therapy in people who cannot secrete aldosterone.

4

- (e) Outline the role of the hormone ADH.

3

Question 20 (8 marks)

- (a) Using examples, distinguish between the terms 'allele' and 'gene'.

2

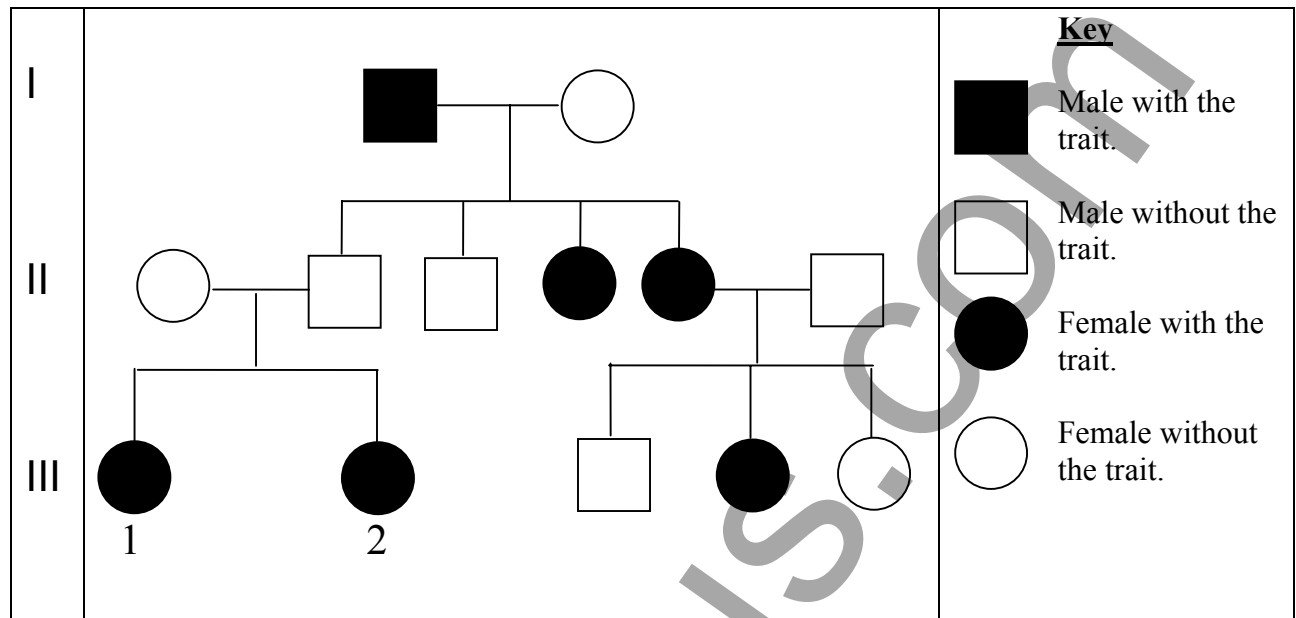
Marks

- (b) A geneticist crossed pure breeding yellow-flowered pea plants with pure breeding white-flowered pea plants. The F1 that were grown from this cross were all yellow.
- (i) Using appropriate symbols, give the genotypes and phenotypes for both of the parents and the F1 from this study. **2**
- (ii) What would be the phenotypes of the F2 if the F1 were self-fertilized and in what ratios would they be present? Show your workings. **4**

Please turn over for Question 21

Question 21 (4 marks)

The diagram below represents the pedigree of a family. It shows the inheritance of a particular trait being studied by geneticists at a hospital clinic.



- (a) Is the trait dominant or recessive? Explain your answer.

2

- (b) What is the probability that the parents of children 1 and 2 in generation III will have another child with the trait? Give your reasoning.

2

Marks

Question 22 (8 marks)

- (a) Define the term ‘transgenic species’. 1

- (b) Outline in detail the steps needed to produce transgenic species. 3

Blank lined paper for writing.

- (c) Discuss two ethical issues arising from the development and use of transgenic species, including an example of a transgenic species and a reason for its use. 4

HSCFOOD

Question 23 (3 marks)

During your study of biology you had to identify data sources, plan and choose equipment or resources to perform a first-hand investigation to identify microbes in food or water.

- (a) Identify two safe work practices you used during this investigation and justify their use.

2

- (b) Identify how you carefully and safely disposed of a named waste material produced during the investigation.

1

Please turn over for Question 24

Marks**Question 24** (3 marks)

Answer the following questions in terms of the infectious disease you have studied.

Name the disease: _____

- (a) Which of the following groups does the cause of the disease fall into: prions, viruses, bacteria, protozoans, fungi or macro-parasites? **1**

- (b) What is the host response to this infectious disease? **1**

- (c) How is the disease transmitted? **1**

Question 25 (2 marks)

Outline the way in which vaccinations prevent infection. **2**

End of Section I

Section II
25 marks

Attempt ONE Question from Questions 26–30
Allow about 45 minutes for this section

Answer the question in a SEPARATE writing booklet

	Pages
Question 26 Communication	19
Question 27 Biotechnology	20
Question 28 Genetics: The Code Broken	21
Question 29 The Human Story	22
Question 30 Biochemistry	23–25

Marks**Question 26 – Communication (25 marks)**

- (a) Justify, using examples, the following statement:
‘Animals that produce vibrations also have organs to detect vibrations’. **4**
- (b) Draw a schematic diagram of the human ear and label the positions of each of the following:
pinna, cochlea, oval window, ear ossicles, auditory nerve, tympanic membrane, round window and the organ of Corti. **4**
- (c) Relate the structure of the tympanic membrane to its function. **2**
- (d) Construct a flowchart showing the pathway from stimulus to response. **1**
- (e) (i) Define the term ‘accommodation’. **1**
(ii) Identify the conditions under which refraction of light occurs. **2**
(iii) During your study of this unit of work you had to perform a first-hand investigation to model the process of accommodation by passing rays of light through convex lenses of different focal lengths.
Justify the use of convex lenses of different focal lengths for this investigation. **3**
- (f) (i) What is the difference between a nerve and a neurone? **1**
(ii) Explain why not all stimuli detected generate an action potential. **2**
(iii) Graphically represent a typical action potential. There is no need for units on either axis but they must be labelled. **3**
- (g) Define myopia and outline how a technology can be used to correct this condition. **2**

End of Question 26

Question 27 – Biotechnology (25 marks)

- (a) Define the term ‘biotechnology’. 2
- (b) Explain why the collection of seeds and breeding of animals with desired characteristics could be described as early biotechnology. 2
- (c) During your study of this unit of work you had to gather and process information from secondary sources to investigate an industrial fermentation process. Use the information that you gathered to answer the following questions.
- (i) Name and describe an industrial fermentation process. Include in your description the micro-organism used in the fermentation process and the products of the fermentation. 5
- (ii) Outline the use of the product of the fermentation process. 1
- (iii) Assess the impact of the use of the fermentation product on society at the time of its introduction. 3
- (d) (i) Define the following terms: recombinant DNA, polymerase and DNA vectors. 3
- (ii) Construct a flow chart for the sequence of events that result in the formation of recombinant DNA. 3
- (e) Explain why different groups in society may have different views about the use of DNA technology. 2
- (f) Cell chemistry has a very important role in biotechnology. One biochemical pathway is the synthesis of proteins in the cell.
- Briefly outline the steps involved in the synthesis of proteins by cells. 3
- (g) Outline the role of transfer RNA. 1

End of Question 27

Marks**Question 28 – Genetics: The Code Broken (25 marks)**

- (a) Distinguish between ‘polygenic inheritance’ and characteristics determined by multiple alleles. Use one example of each to illustrate your answer. **4**
- (b) Amanda has type A blood while her mother has type B blood. What would be the possible genotypes of Amanda, her father and mother? Give your reasons. **5**
- (c) In pea plants, red flowers (R) are dominant to white flowers (r) and green seed pods (G) are dominant to yellow seed pods (g).
What will be the outcome in terms of phenotypes and their ratios of a cross between two plants that are heterozygous for red flowers and heterozygous for green seed pods? No working required.
What is this type of cross called? **4**
- (d) Predict the outcome of the cross described in (c) above if the genes for flower colour and seed pod colour are linked? Explain your answer. **3**
- (e) Describe evidence which indicates the presence of ancestral vertebrate gene homologues in lower animal classes. **2**
- (f) Assess the value of the Human Genome Project. **4**
- (g) The royal families of Europe have been plagued by the disease haemophilia. This is a sex-linked recessive disease that reduces the ability of the person’s blood to clot. When studies of the family tree of royals were done the disease was traced back to Queen Victoria of England. It is thought that there may have been a mutation in an X chromosome that she inherited.
- (i) Is this a germ line or somatic mutation? Explain. **1**
- (ii) Distinguish between germ line and somatic mutations in terms of their effect on species and explain why their effects are different. **2**

End of Question 28

Question 29 – The Human Story (25 marks)

- (a) A scientist has found the partial skeletal remains of what appears to be an ancestor of *Homo sapiens*. State one feature that would that would her to classify the species as each of the following:
- (i) a primate
 - (ii) a hominid and
 - (iii) a member of the genus *Homo*.

3

- (b) ‘A study of a woolly mammoth that died in Siberia several millennia ago has yielded the complete DNA sequence of the creature's mitochondria, the energy factories of the animal's cells. Comparison with the mitochondrial genomes of living elephants indicates that the mammoth is slightly more closely related to the Asian elephant than to the African elephant.’

From ‘Mammoth Finding’ by Sid Perkins, *Science News*, 3 January 2006

- (i) Discuss how DNA–DNA hybridisation can be used to determine relationships between organisms. 4
 - (ii) Previously scientists thought that mammoths were more closely related to the African elephant than to the Asian elephant. This conclusion was based on a comparison of fossils with modern elephants. Outline three difficulties with this. 3
 - (iii) Explain how mitochondrial genomes can be used as a ‘molecular clock’ to trace evolutionary history. 2
- (c) Analyse the purpose and implications of the Human Genome Project. 4
- (d) There has been much debate and many theories put forward about the origin of the different groups or types of people that inhabit the earth.
- (i) Outline the mechanisms that have led to this human diversity. 4
 - (ii) Describe one example of polymorphism in humans that would have evolutionary significance and analyse the evolutionary significance of the phenotypes displayed. 3
- (e) Outline the ‘Out of Africa’ model and provide one piece of evidence in support of this theory. 2

End of Question 29

Marks

Question 30 – Biochemistry (25 marks)

- (a) 'From December 1st through to 11th, 1997, more than 160 nations met in Kyoto, Japan, to negotiate binding limitations on greenhouse gases for the developed nations, pursuant to the objectives of the Framework Convention on Climate Change of 1992. The outcome of the meeting was the Kyoto Protocol, in which the developed nations agreed to limit their greenhouse gas emissions, relative to the levels emitted in 1990. The United States agreed to reduce emissions from 1990 levels by 7 per cent during the period 2008 to 2012.'

Source: *The Energy Information Administration* (www.eia.doe.gov)

In the light of what we now know about the greenhouse effect and greenhouse emissions, justify studying photosynthesis and the importance of reducing carbon dioxide levels.

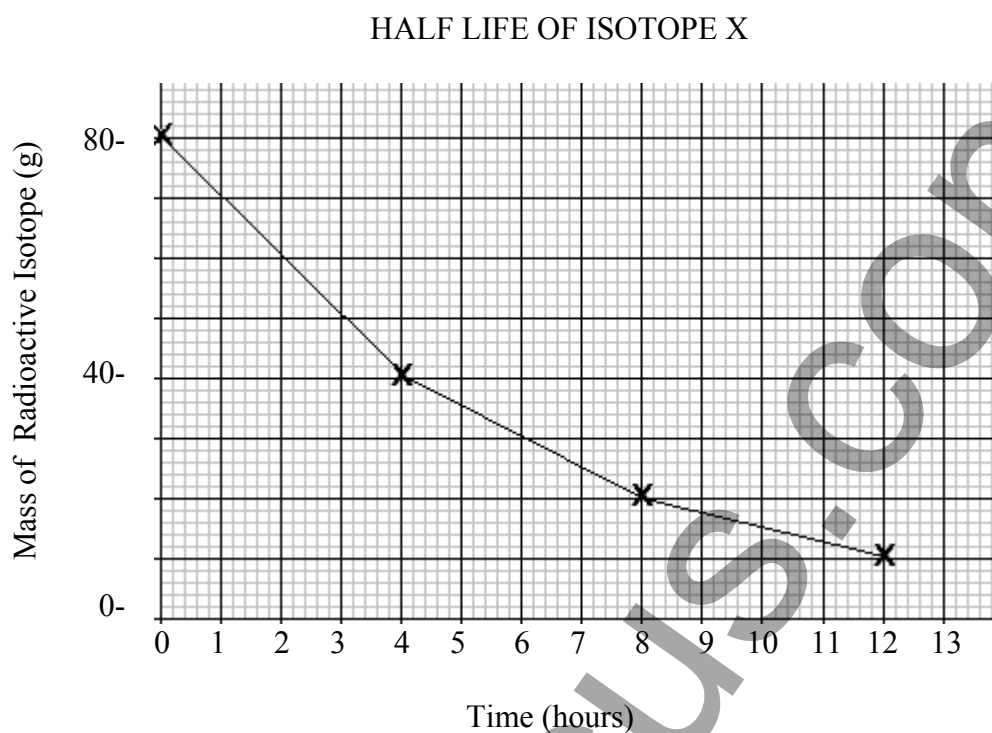
4

- (b) In the 18th century, Ingen-Housz demonstrated the importance of sunlight for oxygen production by plants. Outline the progress that occurred in the understanding of plant growth as a result of this experiment.

2

Question 30 continues on the next page

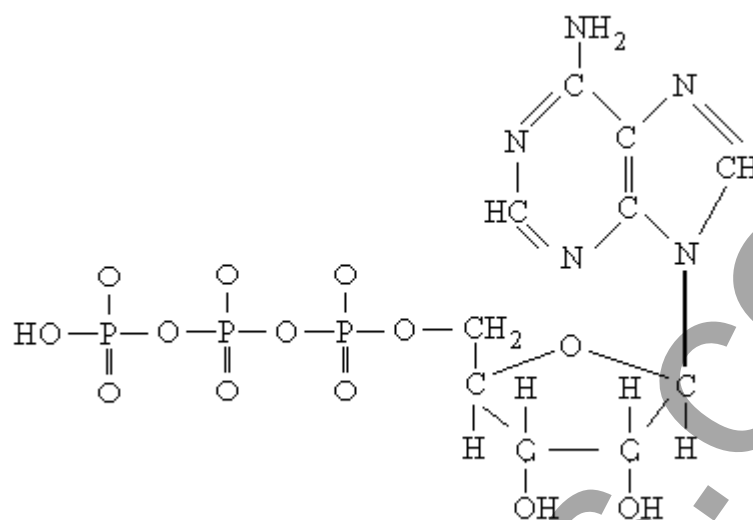
- (c) The diagram below shows the radioactive decay of an isotope over time.



- (i) Discuss the suitability of isotope X for use in plant growth experiments. 2
- (ii) Explain how a named isotope can be used as a radioactive tracer. Describe how this isotope can be incorporated into plants to follow a biochemical pathway, such as photosynthesis. 4
- (d) (i) Draw and label the structure of a chloroplast. 4
- (ii) Identify and explain the location of the sites of light absorption and the site of the Calvin cycle. 3

Marks

- (e) The diagram below shows a biologically important molecule.



- (i) Name the molecule illustrated above. **1**
- (ii) Use a pen/pencil to draw the biologically important part of this molecule. **1**
- (iii) Outline the discovery of the synthesis of this substance in the mid-20th century in terms of the discovery of photophosphorylation in chloroplasts of plants and that its synthesis involves an electron transfer reaction occurring across a membrane. **4**

End of paper

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Section I – Multiple Choice**Answer sheet**

Place an ✕ in the response box for the alternative A, B, C or D that best answers the question.

	A	B	C	D
1				
2				
3				
4				
5				
6				
7				
8				
9				
10				
11				
12				
13				
14				
15				

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Mapping grid

Question	Mark	Content	Outcome	Band
1	1	9.2.1, column 2, dot point 3	H6	2–3
2	1	9.2.2, column 3	H6, H7, H8	1–2
3	1	9.4.4, column 2, dot point 1	H6	1–2
4	1	9.4.4, column 2, dot point 2	H6	1–2
5	1	9.4.7, column 2, dot point 2	H4, H7, H8	2–3
6	1	9.4.6, column 2, dot point 2	H6, H9	1–2
7	1	Various: 9.3.3, column 2, dot point 2, 9.3.1, column 2, dot point 1, 9.4.3, column 2, dot point 1	H1, H4	3–4
8	1	9.3.3, column 3; 9.3.3, column 2, dot point 8	H9	2–3
9	1	9.3.3, column 2, dot point 4	H9	1–2
10	1	9.3.3, column 3, dot point 2	H9	3–4
11	1	Essential knowledge related to 9.2.3, column 2, dot point 4, 5	H6	1–2
12	1	9.2.2, column 2, dot point 2	H6	1–2
13	1	9.2.2, column 2, dot point 3	H6	1–2
14	1	9.2.1, column 2, dot point 1	H6	2–3
15	1	9.2.2, column 2, dot point 4	H6	2–3
16a	2	9.2.1, column 2, dot point 7	H7	3–4
16b	2	9.2.1, column 2, dot point 8	H6, H7	2–3
16c(i)	1	9.1–11.1(a)	H11	2–3
16c(ii)	1	9.2.1, column 3, dot point 1	H6	2–3
16d	2	Essential knowledge related to 9.2.1, column 3, dot point 1	H6	3–4
17a	4	9.3.1, column 3, dot point 2	H2, H7, H10	3–4
17b	2	9.1 H12.4 (e)	H2, H7, H10	3–4
18	5	9.4.6, column 3, dot point 2	H6	3–4
19a	2	9.2.3, column 3, dot point 1	H6	2–3
19b	3	9.2.3, column 2, dot point 3	H6	3–4
19c	1	9.2.3, column 2, dot point 4	H6	2–3
19d	4	9.2.3, column 3, dot point 3	H6, H4, H5, H16	5–6
19e	3	9.2.3, column 2, dot point 6	H6	2–3

Question	Mark	Content	Outcome	Band
20a	2	9.3.2, column 2, dot point 5	H9	3–4
20b(i)	2	9.3.2, column 2, dot point 3, 9.3.2, column 3, dot point 2	H9, H14	3–4
20b(ii)	4	9.3.2, column 2, dot point 3, 9.3.2, column 3, dot point 2	H9, H14	5–6
21a	2	9.3.2, column 3, dot point 1, 9.3.2, column 3, dot point 2	H9, H14	3–4
21b	2	9.3.2, column 3, dot point 2,	H9, H14	3–4
22a	1	9.3.5, column 2, dot point 2	H3, H4, H5, H8, H9, H10	2–3
22b	3	9.3.5, column 2, dot point 2	H3, H4, H5, H8, H9, H10	3–4
22c	4	9.3.5, column 3, dot point 2	H1, H3, H4, H5, H8, H9, H16	5–6
23a	2	9.1–12.1 (c)	H12	2–3
23b	1	9.1–12.1 (d)	H12	1–2
24a	1	9.4.3, column 2, dot point 2 9.4.3, column 3, dot point 1	H6	1–2
24b	1	9.4.3, column 2, dot point 3 9.4.3, column 3, dot point 1	H6	2–3
24c	1	9.4.3, column 3, dot point 1	H6	1–2
25	2	9.4.5, column 2, dot point 3	H6, H16	3–4
26a	4	9.5.6, column 1	H6	5–6
26b	4	9.5.6, column 2, dot point 2 9.1–13.1e	H6, H13	3–4
26c	2	9.5.6, column 3, dot point 1	H6	3–4
26d	1	9.5.1, column 2, dot point 2; 9.1–13.1e	H6, H13	2–3
26e(i)	1	9.5.3, column 2, dot point 3	H6	2–3
26e(ii)	2	9.5.3, column 2, dot point 1	H6	2–3
26e(iii)	3	9.5.3, column 3, dot point 1, 2 9.5.3, column 2, dot point 2,3	H2	3–4
26f(i)	1	9.5.7, column 2, dot point 1	H6	2–3
26f(ii)	2	9.5.7, column 2, dot point 3	H6	2–3
26f(iii)	3	9.5.7, column 3, dot point 3, 9.1–13.1f	H6, H13	3–4

Question	Mark	Content	Outcome	Band
26g	2	9.5.3, column 2, dot point 5	H1, H3, H4	3–4
27a	2	9.6.2, column 1	H1, H6, H3 H8	2–3
27b	2	9.6.1, column 2, dot point 2	H4, H7, H8, H10	2–3
27c(i)	5	9.6.3, column 3, dot point 1	H6 H5	2–3
27c(ii)	1	9.6.3, column 3, dot point 1	H1, H6, H5	2–3
27c(iii)	3	9.6.3, column 3, dot point 1	H1, H6, H4, H5, H16	5–6
27d(i)	3	9.6.5, column 2, dot point 1, 2	H6, H5, H9	3–4
27d(ii)	3	9.6.5, column 3, dot point 2	H6, H9	3–4
27e	2	9.6.7, column 2, dot point 1	H1, H10, H16	3–4
27f	3	9.6.4, column 2, dot point 1	H6	3–4
27g	1	9.6.4, column 2, dot point 1	H6	1–2
28a	4	9.7.2, column 3, dot point 2 9.7.2, column 2, dot point 1	H9	4–5
28b	5	9.7.2, column 3, dot point,	H9, H14	3–4
28c	4	9.7.3, column 2, dot point 2, 9.7.3, column 3, dot point 1	H9, H14	3–4
28d	3	9.7.3, column 2, dot point 3, 9.7.3, column 3, dot point 1	H9, H14	5–6
28e	2	9.7.8, column 2, dot point 3	H10	3–4
28f	4	9.7.4, column 2, dot point 1, 2	H1, H3, H4, H5, H10, H16	3–4
28g(i)	1	9.7.6, column 2, dot point 4,	H9	1–2
28g(ii)	2	9.7.6, column 2, dot point 4	H9	1–2
29a	3	9.8.1, column 2, dot point 3 9.8.1, column 3, dot point 1	H10	1–2
29b(i)	4	9.8.2, column 2, dot point 6 9.8.2, column 3, dot point 2	H3, H5, H9, H10	3–4
29b(ii)	3	9.8.2, column 2, dot point 5	H5, H9, H10	2–3
29b(iii)	2	9.8.2, column 2, dot point 6	H3, H5, H9, H10	3–4
29c	4	9.8.6, column 3, dot point 2	H1, H3, H4, H5, H9, H16	3–4
29d(i)	4	9.8.4, column 2, dot point 1	H7, H9, H10	3–4
29d(ii)	3	9.8.4, column 3, dot point 1	H7, H9, H10	4–5
29e	2	9.8.3, column 2, dot point 3	H10	3–4

Question	Mark	Content	Outcome	Band
30a	4	9.9.1, column 2, dot point 1	H1, H4, H5, H16	5–6
30b	2	9.9.2, column 2, dot point 1	H1, H6, H16	3–4
30c(i)	2	9.9.5, column 2, dot point 3	H6	2–3
30c(ii)	4	9.9.5, column 3	H6, H4	3–4
30d(i)	4	9.9.8, column 3, dot point 1	H6	3–4
30d(ii)	3	9.9.8, column 3, dot point 1	H6	3–4
30e(i)	1	9.9.7	H6	1–2
30e(ii)	1	9.9.7, column 2, dot point 2	H6	1–2
30e(iii)	4	9.9.7, column 2, dot point 3	H1, H2, H6	4–5

Marking Guidelines

The marking guidelines are flexible and markers can, using their professional expertise and judgement, accept and incorporate other correct statements/responses into the marking scheme.

Answers

Section I – Part A

- 1 D
- 2 C
- 3 D
- 4 A
- 5 B
- 6 A
- 7 A
- 8 C
- 9 A
- 10 B
- 11 D
- 12 C
- 13 D
- 14 B
- 15 A

Marking guidelines

Section I – Part B

Question 16(a)

- Life can be found at extremes ranging from -40°C to $+120^{\circ}\text{C}$ but most are found in the -2°C to $+40^{\circ}\text{C}$ range (give relevant examples).
- For each individual species the range is even narrower (use a correct example).

Marking guidelines

Criteria	Marks
• Correctly compares both statements above with correct examples used.	2
• Correctly compares both statements above but incorrect or no examples used.	1

Question 16(b)

Marking guidelines

Criteria	Marks
• Correctly outlines the response for a named Australian endotherm and correct explanation.	2
• Correctly outlines the response for a named Australian endotherm. (No mark for naming an endotherm, but if incorrect then a mark is lost.)	1

Question 16(c)(i)

Marking guidelines

Criteria	Marks
• Identifies at least two correct data sources. ('Sources' is plural, means two.)	1

Question 16(c)(ii)

- As temperature increases from 10°C the activity would increase.
- Until at some point the activity would drop dramatically. This would occur around 50°C .

Marking guidelines

Criteria	Marks
• Correctly gives BOTH statements above.	1

Question 16(d)

1. As temperature increases chemical reactions speed up as molecules move faster/collide at a faster rate.
2. As temperature gets to a certain point the enzyme is denatured and ceases to function.

Marking guidelines

Criteria	Marks
• Correctly gives both statements above as an explanation.	2
• Gives a partial explanation – only one of the statements above.	1

Question 17(a)

Marking guidelines

Criteria	Marks
• Includes each of the following: an outline of what the case study was about, indication of what the environmental change was, how the species investigated had changed.	3–4
• Includes any two of the above.	2
• Includes any one of the above.	1

Question 17(b)

Marking guidelines

Criteria	Marks
• Includes an appropriate definition of natural selection and the correct identification of the change made by natural selection.	2
• Includes any one of the above.	1

Question 18**Marking guidelines**

Criteria	Marks
Includes correct name of a non-infectious disease, description of its occurrence, symptoms, cause, and treatment/management.	5
Includes any four of the above.	4
Includes any three of the above.	3
Includes any two of the above.	2
Includes one of the above.	1

Question 19(a)

No marks for recognition of the diagram as a dissected kidney.

The internal regions involved in the excretion of waste products are the medulla and the cortex. **1 mark each** for the correct identification of the **medulla** and the **cortex**.

Question 19(b)

The kidney does more than just 'filter the blood'. **NO MARKS at all for this statement.** It plays a central role in homeostasis, forming and excreting urine while regulating water and salt concentration in the blood. It maintains the precise balance between waste disposal and the animal's needs for water and salt.

Marking guidelines

Criteria	Marks
- Gives all three statements above OR - Gives a very good description of the role in homeostasis that includes them	3
- Gives any two of the statements above OR - Gives a good description of the role in homeostasis that includes them	2
Includes: - forms/excretes urine OR - regulates water OR - regulates salt	1

Question 19(c)

Marking guidelines

Criteria	Marks
The answer must include the requirement of energy for active transport and not for passive transport.	1

Question 19(d)

Points needed in the answer are:

- the justification is an argument in support of hormone replacement therapy which would be that the disease could be controlled;
- people who cannot secrete aldosterone (Addison's disease) have certain symptoms (which include severe abdominal pain, nausea/vomiting, fatigue/weakness, kidney failure, high urine output with a resulting low blood volume and this can result in heart failure);
- clearly states the role of aldosterone;
- a replacement hormone is used to treat this condition.

Marking guidelines

Criteria	Marks
Gives all four points (above). Includes the justification.	4
Gives any three points (above), with or without the justification.	3
Gives any two points (above), with or without the justification.	2
Gives any point (above).	1

Question 19(e)

- The role of ADH (vasopressin) is to basically control the reabsorption of water in the nephrons.
- The hypothalamus detects fluid levels in the blood and causes the pituitary to release ADH. ADH works by increasing the permeability of the collecting ducts to water, thus allowing more water to be absorbed from the urine into the blood.
- The resulting urine is more concentrated.

Marking guidelines

Criteria	Marks
Statements 1, 2 and 3 above are essential for 3 marks.	3
Includes any two of the statements above, or similar.	2
Includes any one of the statements above, or similar.	1

Question 20(a)

A gene is a section of DNA coding for proteins that expresses itself as the phenotype of an organism. Alleles are alternative forms of a gene, e.g. the gene for height in peas has 2 alleles: tall, T; and short, t.

Marking guidelines

Criteria	Marks
Correctly distinguishes between allele and gene with correct examples.	2
- Correctly distinguishes between allele and gene without correct examples OR - Correctly defines only one of allele or gene with a correct example.	1

Question 20(b)(i)

Correct symbols must be a capital letter for the dominant allele and lower case for the recessive allele. Because all of the F1 were yellow then that is the dominant allele. The matching genotypes and phenotypes are:

Parents – pure breeding yellow	YY
– pure breeding white	yy
F1 – yellow	Yy

Marking guidelines

Criteria	Marks
Gives all of the matching genotypes and phenotypes, as above.	2
- Gives either the matching genotypes and phenotypes of the parents OR - Gives matching genotype and phenotype of the F1.	1

Question 20(b)(ii)

Result is ratio of 3 yellow to 1 white.

Marking guidelines

Criteria	Marks
Gives correct ratio of 3 yellow to 1 white; shows correct working (a Punnett square or other suitable working).	4
- Gives correct answer of ratio of 3 yellow to 1 white; shows working (a Punnett square or other suitable working) but with mistakes - OR - Gives incorrect ratio of yellow to white; shows correct working (a Punnett square or other suitable working) - OR - Gives correct ratio of 3 to 1 but incorrect colours; shows correct working (a Punnett square or other suitable working).	3
- Gives correct ratio of 3 yellow to 1 white but no or incorrect working - OR - Gives partially correct ratio/colours and partially correct working.	2
Gives any part of the answer that may be correct: ratio; colours; or enough of the working.	1

Question 21(a)

The trait is recessive because in generation II it is not expressed in the parents of the two girls III 1 and III 2 but is expressed in the two girls.

Marking guidelines

Criteria	Marks
Correctly states the trait is recessive and gives correct reason as above.	2
Correctly states the trait is recessive but no or an incorrect reason.	1

Question 21(b)

Since neither parent expresses the trait then they must be heterozygous carriers for it. That means that the chance of producing a homozygous individual from a monohybrid cross would be 25%.

Marking guidelines

Criteria	Marks
Gives correct probability and reason (as above).	2
- Gives correct probability OR - Gives correct reason.	1

Question 22(a)**Marking guidelines**

Criteria	Marks
Gives a fully correct definition.	1

Question 22(b)

Identify the gene required. Restriction enzymes are used to cut DNA in specific places.

Ligases are used to repair and strengthen the DNA.

Polymerase chain reaction is used to produce many copies of the recombinant DNA formed by the previous processes.

Once the recombinant DNA is produced there are processes used to insert the DNA into the host species, such as bacteria, viruses, microinjection and gene guns.

Marking guidelines

Criteria	Marks
Includes all of the procedures outlined above.	3
Includes three or four of the procedures outlined above.	2
Includes one or two of the procedures outlined above.	1

Question 22(c)

Ethical issues include the ability to produce transgenic species that may help feed people in places where it is currently hard to grow food or carry genes to make medicines or pesticides; these transgenic species may cause havoc if they escape free into ecosystems or the chemicals they make may harm people.

Marking guidelines

Criteria	Marks
Includes (1) ethical issues for and (2) against, (3) an example of a transgenic species and (4) a reason for its use.	4
Includes only three of the four points needed.	3
Includes only two of the four points needed.	2
Includes only one of the four points needed.	1

Question 23(a)**Marking guidelines**

Criteria	Marks
Identifies and justifies two correct safe work practices identified and correctly justified. The safe work practices must also correctly match the investigation performed	2
One correct safe work practice identified and correctly justified.	1

Question 23(b)**Marking guidelines**

Criteria	Marks
Correctly names waste product (must also correctly match the investigation performed) and the correct disposal method.	1

Question 24(a)**Marking guidelines**

Criteria	Marks
Correctly matches the cause of the disease with the group it belongs to.	1

There is **no mark** awarded for the name of the infectious disease and a mark is not given for (a) if it is not an infectious disease or if it is not named.

Question 24(b)**Marking guidelines**

Criteria	Marks
Gives the correct host response for the named disease.	1

The host response usually consists of the production of antibodies; however, the answer may vary depending on the disease.

Question 24(c)**Marking guidelines**

Criteria	Marks
Gives the correct method of transmission for the named disease.	1

The correct answer depends on the disease but must be fully correct.

Question 25

- An outline of what a vaccination does: the vaccinations introduce antigens into the body.
- B cells are activated to produce large amounts of antibodies and memory B cells that are stored in the lymph system ready for a future attack by the particular pathogen.

Marking guidelines

Criteria	Marks
Includes all of the above.	2
Gives only a partial outline.	1

Section II

Question 26(a)

A justification must include reasons as to why the statement is correct.

Marking guidelines

Criteria	Marks
Gives a fully correct justification with at least two examples.	4
- Gives a fully correct justification with only one example - OR - Gives a good justification with at least two examples.	3
- Gives a good justification with only one example - OR - Gives two examples with no justification.	2
Gives a poor justification or only one example.	1

Question 26(b)

This does not have to be an artistic/realistic drawing, but a schematic representation. However, the diagram must still be easily interpreted so that the labels that are applied can be understood in terms of their positions.

Marking guidelines

Criteria	Marks
A schematic representation easily interpreted with all labels correctly positioned.	4
- A schematic representation easily interpreted with five to seven labels correctly positioned - OR - A poor diagram with all labels correctly positioned.	3
- A schematic representation easily interpreted with three or four labels correctly positioned - OR - A poor diagram, with five to seven labels correct	2
- A poor diagram, with three or four labels correct - OR - A schematic representation, easily interpreted, with one or two labels correctly positioned.	1

Question 26(c)

Structure: the tympanic membrane stretches across the ear canal; thin, taut membrane.

Function: vibrates when sound waves reaches it and transfers mechanical energy into the middle ear

No mark for just stating function or structure.

Marking guidelines

Criteria	Marks
• Correctly states structure and relates this to function, as above.	2
• Poorly relates structure to function.	1

Question 26(d)**Marking guidelines**

Criteria	Marks
• Stimulus → receptor → messenger → effector → response	1

One mark for a fully correct answer – no half marks, nothing less accepted.

Question 26(e)(i)**Marking guidelines**

Criteria	Marks
• Correct definition: accommodation is the ability of the lens to change its shape and bring to focus light from objects at varying distances.	1

Question 26(e)(ii)

Refraction of light occurs when: (1) light passes from one substance to another with different densities and (2) if the path of the light is not at right angles to the interface of the substances.

Marking guidelines

Criteria	Marks
• States both conditions, as above.	2
• States only one of the conditions.	1

Question 26(e)(iii)**Marking guidelines**

Criteria	Marks
- Full justification including: - the eye has a convex lens - it changes focal length to accommodate objects at different distances.	3
Partial justification.	2
Poor justification.	1

Question 26(f)(i)**Marking guidelines**

Criteria	Marks
A nerve is a bundle of axons or neuronal fibres while a neurone is a nerve cell.	1

Question 26(f)(ii)

A neurone will only fire when it reaches the threshold of reaction at which point there is an all or nothing response where the neurone fires at maximum intensity. Unless the neurone is excited enough to reach the threshold of reaction it will not fire.

Marking guidelines

Criteria	Marks
Gives full explanation, similar to above.	2
Gives partial explanation, with only one of the statements above.	1

Question 26 (f)(iii)**Marking guidelines**

Criteria	Marks
Diagram with correctly labelled axes and correctly drawn action potential.	3
- Diagram with correctly labelled axes but partially correctly drawn action potential OR - Diagram with incorrectly labelled axes and correctly drawn action potential.	2

Criteria	Marks
- Diagram with incorrectly labelled axes and partially correctly drawn action potential - OR - Diagram with correctly labelled axes but incorrectly drawn action potential.	1

Question 26(g)**Marking guidelines**

Criteria	Marks
Correctly defines myopia and outlines how technology can be used to correct this condition.	2
- Correctly defines myopia - OR - Outlines how technology can be used to correct this condition.	1

Question 27(a)

Biotechnology is to utilise micro-organisms for specific uses, and to use living organisms to make or modify a product or to improve plants or animals.

Marking guidelines

Criteria	Marks
Gives a complete definition, as above.	2
Gives a partial definition.	1

Question 27(b)

Over time people were controlling the genetic makeup of the plants and animals they were breeding as they chose characteristics that they preferred, particularly after breeding for certain characteristics over many generations.

Marking guidelines

Criteria	Marks
Gives a complete explanation, as above.	2
Gives a partial explanation.	1

Question 27(c)(i)

Answer includes:

- name of an industrial fermentation process
- full description of an industrial fermentation process
- name of the micro-organism used
- products of the fermentation

Marking guidelines

Criteria	Marks
• Includes all of the above.	5
• Includes all of the above BUT with a partial description of an industrial fermentation process, OR • Includes a full description of an industrial fermentation process BUT only two of the other three points.	4
• Includes the name of an industrial fermentation process, the name of the micro-organism used and the products of the fermentation only, OR • Partially describes an industrial fermentation process AND only two of the other three points.	3
• Includes two of: the name of an industrial fermentation process, the name of the micro-organism used, and the products of the fermentation only, OR • Partially describes an industrial fermentation process AND only one of the other three points.	2
• Includes one of: the name of an industrial fermentation process, the name of the micro-organism used, and the products of the fermentation only.	1

Question 27(c)(ii)

Marking guidelines

Criteria	Marks
• Correctly outlines the use of the product of the fermentation process.	1

Question 27(c)(iii)**Marking guidelines**

Criteria	Marks
• Gives a full assessment.	3
• Gives a partial assessment.	2
• Gives a minimal assessment.	1

Question 27(d)(i)

1 mark for each fully correct answer.

Question 27(d)(ii)

The flow chart must contain at least three correct steps, one mark for each correct step.

Marking guidelines

Criteria	Marks
• Includes any three steps in correct order with full information.	3
• Includes any three steps in correct order.	2
• Includes any two steps in correct order.	1

Question 27(e)**Marking guidelines**

Criteria	Marks
• Explains fully, including at least two groups and their different views.	2
• Includes one group and their views fully explained OR • Includes two groups but only one view stated.	1

Question 27(f)

The answer must include an outline of transcription, translation and the polypeptide chains forming a protein.

Marking guidelines

Criteria	Marks
Includes all three steps correctly outlined.	3
- Includes two steps, correctly outlined OR - Includes three steps, partially outlined.	2
- Includes two steps, partially outlined OR - Includes one step, correctly outlined.	1

A diagram/flowchart is acceptable provided the criteria are satisfied.

Question 27(g)

Marking guidelines

Criteria	Marks
Correctly outlines the role of transfer RNA.	1

Question 28(a)

Marking guidelines

Criteria	Marks
Correctly distinguishes between polygenic inheritance and multiple alleles and uses one correct example of each.	4
- Partially correctly distinguishes between polygenic inheritance and multiple alleles and uses one correct example of each OR - Correctly distinguishes between polygenic inheritance and multiple alleles but uses only one correct example.	3
- Correctly distinguishes between polygenic inheritance and multiple alleles with no or incorrect examples OR - Incorrectly distinguishes between polygenic inheritance and multiple alleles but uses one correct example of each or - Partially correctly distinguishes between polygenic inheritance and multiple alleles and uses one correct example only.	2

Criteria	Marks
- Partially correctly distinguishes between polygenic inheritance and multiple alleles with no examples - OR - Includes one correct example only and everything else is incorrect.	1

Question 28(b)

To have type A blood Amanda could be AA or AO BUT because her mother is type B blood, then Amanda could only be AO. To have type B blood her mother can be BB or BO BUT because Amanda does not have a B gene then her mother must be BO so that Amanda inherited the O gene from her mother. Her father must therefore have an A gene to pass on to Amanda and could therefore be AA, AO or AB.

Marking guidelines

Criteria	Marks
Gives fully correct answer as above, with complete, correct explanation.	5
Either one incorrect genotype OR one incorrect explanation.	4
Either two incorrect genotypes OR two incorrect explanations OR one of each.	3
Either three incorrect genotypes OR three incorrect explanations OR any combination of this.	2
Either three incorrect genotypes and one incorrect explanation OR two incorrect of each or any combination of this.	1

Question 28(c)

The two genotypes will be RrGg and RrGg.

This is a dihybrid cross which always produces offspring in the ratio of 9 : 3 : 3 : 1. The outcome of the cross will therefore be:

Nine red plants with red flowers and green pods
 Three red plants with red flowers and yellow pods
 Three white plants with red flowers and green pods
 One white plant with red flowers and yellow pods

The name of this cross is a dihybrid cross.

Marking scheme:

1 mark for the genotypes of both parents.

1 mark for naming this a dihybrid cross.

1 mark for the correct ratio.

1 mark for correctly matching all phenotypes of F1 with ratio.

Marking guidelines

Criteria	Marks
• Gives four correct answers, as above.	4
• Gives three correct answers, as above.	3
• Gives two correct answers, as above.	2
• Gives one correct answer, as above.	1

Question 28(d)

Assuming that the two dominant genes, R and G, are linked on one chromosome and the two recessive genes, r and g, are linked on the other chromosome, then the gametes produced by each parent would be RG and rg. The resulting F1 would have the same ratio as for a monohybrid cross: 3 red, green : 1 white, yellow, not the 9 : 3 : 3 : 1 ratio for a dihybrid cross where the genes are not linked.

Marking guidelines

Criteria	Marks
• Correct prediction and explanation as above.	3
• Correct prediction and partial explanation OR • Fully correct explanation but incorrect prediction.	2
• Correct prediction OR • Partial explanation.	1

Question 28(e)

Homologues regulate the development of an organism. Experiments have confirmed that the homologue gene from an amphibian can regulate the corresponding gene in mammals. A mammal homologue gene can regulate the corresponding gene in insects.

These homologue genes exist in many eukaryotic organisms, vertebrates and invertebrates as well as some fungi and plants. Evidence from biochemistry and molecular biology shows that all cells contain similar amino acids, nucleotides, sugars and fatty acids. Chemical processes such as protein synthesis within cells are also similar.

Marking guidelines

Criteria	Marks
Gives at least two pieces of evidence, described fully.	2
- Gives one piece of evidence, described fully - OR - Gives two pieces of evidence, described partially.	1

Question 28(f)

An assessment would require making a judgement of its value. The HGP has many potential applications and benefits as well as limitations. There would need to be a discussion of these.

Marking guidelines

Criteria	Marks
Gives a full assessment including discussion of at least two limitations and two applications/benefits.	4
- Gives a fair assessment including discussion of at least two limitations and two applications/benefits - OR - Gives a full assessment with a discussion of less than two limitations and two applications/benefits.	3
- Gives a fair assessment with limited discussion of limitations and applications/benefits - OR - No assessment but a discussion of at least two limitations and two applications/benefits.	2
- No assessment but a limited discussion of limitations and applications / benefits - OR - Gives a fair assessment with no discussion of limitations and applications / benefits.	1

Question 28(g)(i)

This is a germ line mutation (no mark for this) because the trait is inherited (one mark for this).

Question 28(g)(ii)

Germ line mutations can be inherited as they are passed on to offspring via sperm or ova. Somatic mutations are in body tissue cells and therefore cannot be inherited. Therefore only germ line mutations can affect a species. Somatic mutations only affect an individual during their lifetime.

Marking guidelines

Criteria	Marks
Fully distinguishes as above, comparing the effect of germ line mutations and somatic mutations, with a correct explanation.	2
- Fully distinguishes as above, comparing the effect of germ line mutations and somatic mutations, but with an incorrect or limited explanation - OR - Gives correct explanation but fails to distinguish their effects.	1

Question 29(a)

1 mark for each correct answer.

Question 29(b)(i)

- DNA is extracted from cells of two different species.
- It is heated and the double strands of DNA separate.
- Restriction enzymes cut the strands into smaller pieces.
- Then the DNA of the two different species is mixed. As the DNA cools, the strands of the different species realign with each other to form double-stranded DNA again, one strand from each species.
- If the DNA is similar then the code will be similar and there will be strong bonds formed between the two strands.
- The mixture is then heated and the temperature required to separate the strands again will indicate how closely related the two species are. The closer two species are the more similar will be their DNA and the more bonds formed between them.

Marking guidelines

Criteria	Marks
A full discussion as above correctly outlining the steps involved in using DNA–DNA hybridisation to determine relationships between organisms.	4
A partial discussion correctly outlining most of the steps involved in using DNA–DNA hybridisation to determine relationships between organisms.	3
A partial discussion correctly outlining some of the steps involved in using DNA–DNA hybridisation to determine relationships between organisms.	2
A limited discussion correctly outlining one of the steps involved in using DNA–DNA hybridisation to determine relationships between organisms.	1

Question 29(b)(ii)

Correct answer includes:

- conflicting dates based on different technologies
- poor fossil record
- different interpretations of the same evidence
- only hard parts rather than whole organism are studied

1 mark each for three difficulties correctly outlined.

Question 29(b)(iii)

Mitochondrial DNA (mtDNA) consists of a single circle of DNA. During fertilisation the female egg cell provides the mitochondria for the new organism. This means that mitochondrial DNA is always passed through the female line. By comparing the mitochondrial DNA from living primates it is possible to evolutionarily separate them based on a constant rate of mutation. So how different the mtDNA is, is an indication of how many years have passed since the two organisms shared a common ancestor.

Marking guidelines

Criteria	Marks
• Gives full explanation as above.	2
• Gives partial explanation.	1

Question 29(c)**Marking guidelines**

Criteria	Marks
• Analyses purpose and at least three implications.	4
• Analyses purpose and at least two implications OR • Gives no analysis of the purpose but analyses three implications.	3
• Analyses purpose and one implication OR • Gives no analysis of the purpose but analyses two implications.	2
• Analyses purpose but no implications OR • Gives no analysis of the purpose but analyses one implication.	1

Question 29(d)(i)

Answer needs to include the following.

- Humans migrated throughout the world in small groups.
- They would have become isolated by barriers, and genetic variations and mutations within these groups were therefore not shared with other groups.
- Genetic variations within each group that increased their chances of surviving and reproducing would become more common in that group.
- Natural selection would have led to differences between groups as they were exposed to different environmental conditions causing regional differences.

Marking guidelines

Criteria	Marks
• Gives a full outline, as above, with four points discussed adequately.	4
• Includes only three of the points, outlined adequately.	3
• Includes only two of the points, outlined adequately.	2
• Includes only one of the points, outlined adequately.	1

Question 29(d)(ii)

For example, body stature in humans shows polymorphism as there is a range of heights (1 mark). In hot equatorial areas a tall thin body stature has a larger surface area to volume ratio for greater heat loss. A short stocky body is found in groups such as the Inuits (Eskimos) who live in cold polar regions. This body shape has a smaller surface area to volume ratio which allows better heat retention. These traits allow each body type to survive better in its environment.

Marking guidelines

Criteria	Marks
• Describes one example of polymorphism and fully analyses the evolutionary significance of the phenotypes displayed.	3
• Describes one example of polymorphism and partially analyses the evolutionary significance of the phenotypes displayed.	2
• Describes one example of polymorphism, with no analysis.	1

Question 29(e)**Marking guidelines**

Criteria	Marks
• Outlines the ‘Out of Africa’ model and gives one piece of evidence in support of the theory.	2
• Outlines the ‘Out of Africa’ model OR gives one piece of evidence in support of the theory.	1

Question 30(a)**Marking guidelines**

Criteria	Marks
• Includes explanation of what the greenhouse effect is, the importance of reducing carbon dioxide levels and a justification for studying photosynthesis.	4
• Includes explanation of either what the greenhouse effect is OR the importance of reducing carbon dioxide levels, and a justification for studying photosynthesis - OR • Includes explanation of what the greenhouse effect is, the importance of reducing carbon dioxide levels and a poor justification for studying photosynthesis.	3
• Includes explanation of what the greenhouse effect is and the importance of reducing carbon dioxide levels but no justification for studying photosynthesis - OR • Includes a justification for studying photosynthesis but does not include an explanation of what the greenhouse effect is or the importance of reducing carbon dioxide levels - OR • Includes EITHER an explanation of what the greenhouse effect is OR the importance of reducing carbon dioxide levels, and a poor justification for studying photosynthesis.	2
• Gives a poor justification for studying photosynthesis - OR • Includes EITHER an explanation of what the greenhouse effect is OR the importance of reducing carbon dioxide levels and no justification for studying photosynthesis.	1

Question 30(b)

Igen-Housz showed that green plants ‘purified air’ only when they were placed in light. This demonstrated the need for light by plants and their effect upon air.

Marking guidelines

Criteria	Marks
• Outlines as above.	2
• Gives partial outline.	1

Question 30(c)(i)

The two statements required are:

- Isotope X would be suitable for use in plant growth experiments because of its short half-life.
- Substances with short half-life can be used in biochemistry as the time that the substance is in the organism will not affect its functioning.

Marking guidelines

Criteria	Marks
• Includes at least two statements in the discussion, as above.	2
• Includes one statement in the discussion.	1

Question 30(c)(ii)

Marking guidelines

Criteria	Marks
• The correct answer must include: a named isotope; an explanation of how it can be used as a radioactive tracer; and a correct description of how this isotope can be incorporated into plants to follow a biochemical pathway.	4
• Includes a named isotope, an explanation of how it can be used as a radioactive tracer and a PARTIALLY correct description of how this isotope can be incorporated into plants to follow a biochemical pathway OR • includes either a named isotope OR an explanation of how it can be used as a radioactive tracer and a correct description of how this isotope can be incorporated into plants to follow a biochemical pathway.	3

Criteria	Marks
- Includes both a named isotope OR an explanation of how it can be used as a radioactive tracer BUT NO correct description of how this isotope can be incorporated into plants to follow a biochemical pathway - OR - Gives only a correct description of how this isotope can be incorporated into plants to follow a biochemical pathway - OR - Includes either a named isotope OR an explanation of how it can be used as a radioactive tracer and a PARTIALLY correct description of how this isotope can be incorporated into plants to follow a biochemical pathway.	2
Includes either a named isotope OR an explanation of how it can be used as a radioactive tracer OR a PARTIALLY correct description of how this isotope can be incorporated into plants to follow a biochemical pathway.	1

Question 30(d)(i)

The diagram should be well drawn and fully recognisable with the following labels: the thylakoid membrane and lumen or space, the grana, the stroma, the inner and outer chloroplast membrane, lamellae joining different grana throughout the stroma.

Marking guidelines

Criteria	Marks
Drawn and fully recognisable diagram, all labels as listed above.	4
- Drawn and mostly recognisable diagram, all labels as listed above - OR - Drawn and fully recognisable diagram, most of the labels as listed above.	3
- Drawn and fully recognisable diagram, two or three of the labels as listed above - OR - Drawn and mostly recognisable diagram, most of the labels as listed above.	2
- Drawn and fully recognisable diagram, one of the labels as listed above - OR - Drawn and mostly recognisable diagram, some of the labels as listed above.	1

Question 30(d)(ii)

Marking guidelines

Criteria	Marks
Identifies and explains locations of the sites of light absorption and the site of the Calvin cycle.	3
- Location of the sites of light absorption and the site of the Calvin cycle identified BUT only one explained - OR - Location of the sites of light absorption and the site of the Calvin cycle only explained NOT correctly located.	2
- Identifies and explains either the location of the sites of light absorption OR the site of the Calvin cycle - OR - Identifies either the location of the sites of light absorption OR the site of the Calvin cycle - OR - Explains one of the sites.	1

Question 30(e)(i)

Marking guidelines

Criteria	Marks
Correct answer is ATP.	1

Question 30(e)(ii)

The energy used by cells is stored in the bonds between the second and third phosphate groups in ATP. The hydrolysis (splitting) of ATP to ADP and P_i releases energy as in the equation $ATP \rightarrow ADP + P_i$.

Marking guidelines

Criteria	Marks
The correct answer would be a circle drawn around the second and third phosphate groups.	1

Question 30(e)(iii)**Marking guidelines**

Criteria	Marks
Gives a complete outline in terms of phosphorylation and electron transfer reaction occurring across a membrane.	4
Gives an adequate outline in terms of phosphorylation and electron transfer reaction occurring across a membrane.	3
Gives a partial outline in terms of phosphorylation and/or electron transfer reaction occurring across a membrane.	2
Gives a minimal outline with very limited correct outline of phosphorylation and/or electron transfer reaction occurring across a membrane.	1