NSW EDUCATION STANDARDS AUTHORITY

2017 | HIGHER SCHOOL CERTIFICATE EXAMINATION

IMPORTANT: This resource was developed to support a previous version of the syllabus. It may contain content that differs from the current syllabus.

Biology

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black pen
- Draw diagrams using pencil
- NESA approved calculators may be used

Total marks: 100

Section I – 75 marks (pages 2–20)

This section has two parts, Part A and Part B

Part A – 20 marks

- Attempt Questions 1–20
- Allow about 35 minutes for this part

Part B – 55 marks

- Attempt Questions 21–31
- Allow about 1 hour and 40 minutes for this part

Section II – 25 marks (pages 21–31)

- Attempt ONE question from Questions 32–36
- Allow about 45 minutes for this section

Section I
75 marks

Part A – 20 marks
Attempt Questions 1–20
Allow about 35 minutes for this part

Use the multiple-choice answer sheet for Questions 1–20.

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1 What is the name of the process that enables organisms to maintain a relatively stable internal environment?

A. Osmosis

B. Adaptation

C. Homeostasis

D. Active transport

2 Which of the following body systems is involved in detecting and responding to environmental changes?

A. Circulatory

B. Digestive

C. Excretory

D. Nervous

3 Which scientist contributed to our understanding of the immune response?

A. Robert Koch

B. Louis Pasteur

C. Maurice Wilkins

D. Frank Macfarlane Burnet

4 What is the role of lymphocytes in the body?

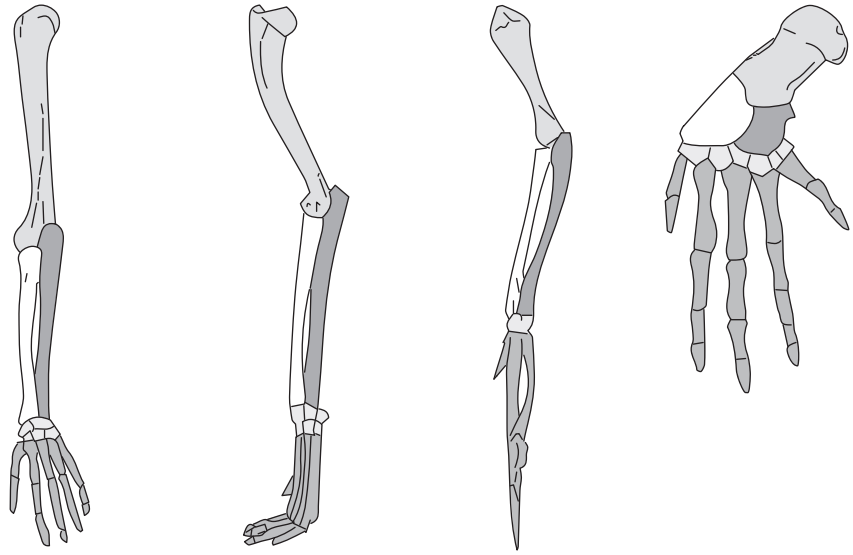
A. They fight infection.

B. They initiate blood clotting.

C. They transport oxygen around the body.

D. They transport carbon dioxide around the body.

5 Four vertebrate forelimbs are shown.



Homology vertebrates, © Волков Владислав Петрович

In which area of study do these forelimbs support the theory of evolution?

A. Biogeography

B. Comparative anatomy

C. Comparative embryology

D. Palaeontology

6 What name is given to the process whereby a white blood cell engulfs a microorganism?

A. Infection

B. Inflammation

C. Phagocytosis

D. Vaccination

7 Which waste product does renal dialysis remove?

A. Urea

B. Urine

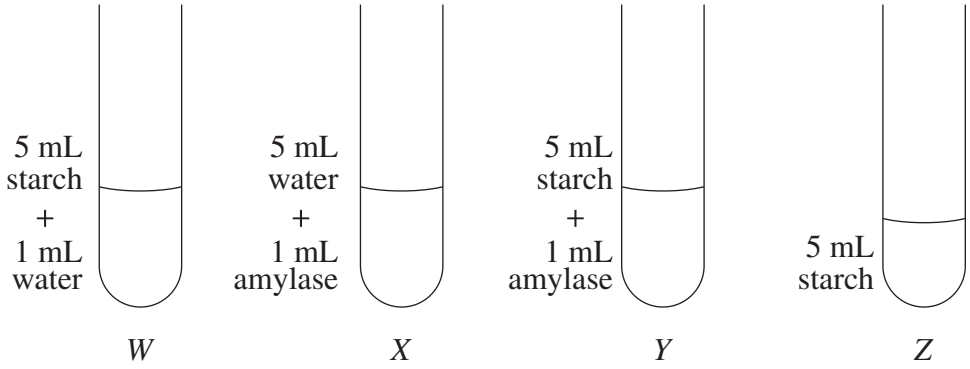
C. Lipids

D. Vitamins

8 Which row of the table shows the effects of dissolving carbon dioxide in water?

	pH	*Acidity*
A.	Increases	Increases
B.	Decreases	Decreases
C.	Decreases	Increases
D.	Increases	Decreases

9 An experiment was planned to investigate the effect of the enzyme, amylase, on starch. The following combination of test tubes was considered.



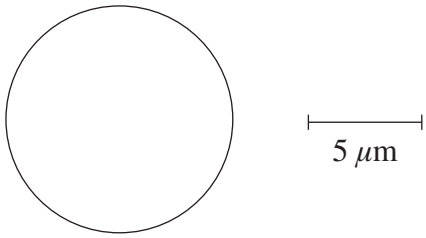
Two drops of iodine will be added to each test tube.

Which combination of test tubes would ensure that the experiment is valid?

	Experiment	*Control*
A.	*Y*	*W*
B.	*Y*	*Z*
C.	*X*	*W*
D.	*X*	*Z*

10 A scaled outline of a cell is shown.

Cell diagram



What is the diameter of the cell?

A. 7 μm

B. 10 μm

C. 12 μm

D. 15 μm

11 A student was asked to complete a table showing whether T cells and B cells have particular characteristics.

Which row did the student complete correctly?

	Characteristic	*T cell*	*B cell*
A.	Produces plasma cells	✓	✓
B.	Produces antibodies that are released in body fluids	✓	✗
C.	Cell surface receptor can recognise a specific antigen	✓	✓
D.	Forms clones once stimulated	✗	✓

12 What is the probability of producing a tall pea plant when a heterozygous tall pea plant is crossed with a homozygous short pea plant?

A. 0%

B. 50%

C. 75%

D. 100%

13 A section of DNA has the following nucleotide sequence.

AGG TCT CAG ATC

What is the nucleotide sequence of the newly-made strand following DNA replication?

A. AGG TCT CAG ATC

B. AGG UCU CAG AUC

C. UCC AGA GUC UAG

D. TCC AGA GTC TAG

14 Which statement correctly describes fungi and protozoans?

A. Fungi and protozoans are unicellular.

B. Fungi and protozoans have chloroplasts.

C. Fungi have a cell wall and protozoans do not.

D. Fungi are procaryotic and protozoans are eucaryotic.

15 A plant breeder crosses two plants of the same species. They are both pure-breeds for flower colour. The colour of the flowers of all the offspring is the same, but different to that of the parents.

What type of inheritance does this result show?

A. Sex-linked

B. Recessive

C. Dominance

D. Co-dominance

16 Which row in the table correctly identifies the features of the named transport mechanism?

	Transport mechanism	*Is energy required?*	*Molecules transported*	*Direction of movement (concentration of transported molecules)*
A.	Diffusion	No	Gases	From low to high
B.	Osmosis	No	Water	From high to low
C.	Active transport	Yes	Ions	From high to low
D.	Passive transport	No	Sugars	From low to high

17 Which feature of DNA was discovered as a result of Rosalind Franklin's work?

A. Double helix shape

B. Long stranded molecule

C. Sugar-phosphate backbone

D. Complementary nucleotides

18 A student used a microscope to estimate the size of blood cells. Two types of cells were observed. The student estimated one type to be about 50% larger than the other.

Which of the following could be used to assess the accuracy of the student's findings?

A. The size of other body cells

B. The sizes of blood cells estimated by other students

C. The expected sizes of blood cells quoted in scientific literature

D. The average size of blood cells from three repetitions of the investigation

19 A zebronkey hybrid is the result of crossing a male zebra which has 44 chromosomes with a female donkey which has 62 chromosomes.

How many chromosomes will the zebronkey have?

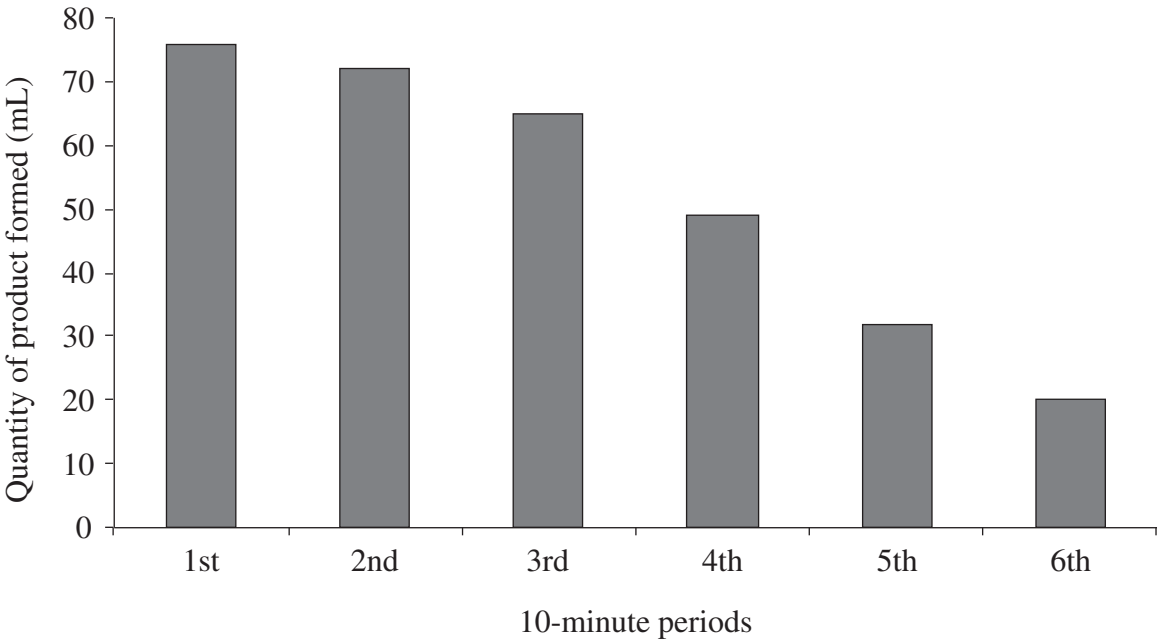
A. 53

B. 75

C. 84

D. 106

20 A student performed a valid enzyme-substrate experiment. At the end of each 10-minute period, the quantity of the gaseous product formed was collected, removed and measured. The graph shows the results of this experiment.



Which of the following statements explains the trend shown in the graph?

A. The rate of enzyme activity is decreasing.

B. The concentration of the product is decreasing.

C. The concentration of the enzyme is decreasing.

D. The concentration of the substrate is decreasing.

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Centre Number

Student Number

Biology

Section I Part B
Answer Booklet

55 marks
Attempt Questions 21–31
Allow about 1 hour and 40 minutes for this part

Instructions

- Write your Centre Number and Student Number at the top of this page.
- Answer the questions in the spaces provided. These spaces provide guidance for the expected length of response.
- Show all relevant working in questions involving calculations.

Please turn over

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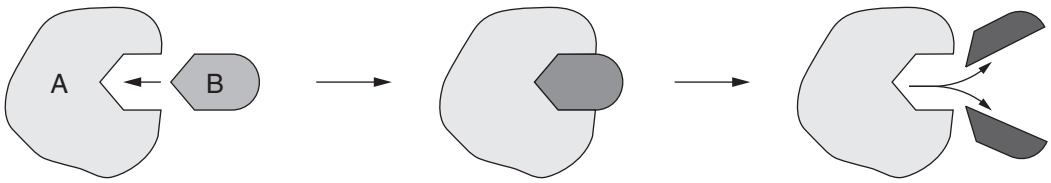
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Question 21 (2 marks)

A model of enzyme activity is shown. **2**



Name the TWO labelled components.

A: .....

B: .....

Question 22 (6 marks)

(a) For each type of disease in the following table, name a specific disease and its cause. **2**

Type of disease	*Name of disease*	*Cause of disease*
Infectious disease		
Non-infectious disease		

(b) Explain how TWO different methods used to treat drinking water reduce the risk of infection. **4**

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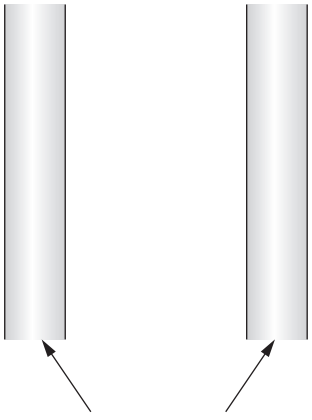
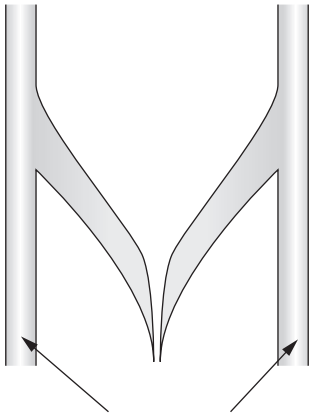
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Question 23 (5 marks)

Complete the table with reference to the two types of blood vessel shown. **5**

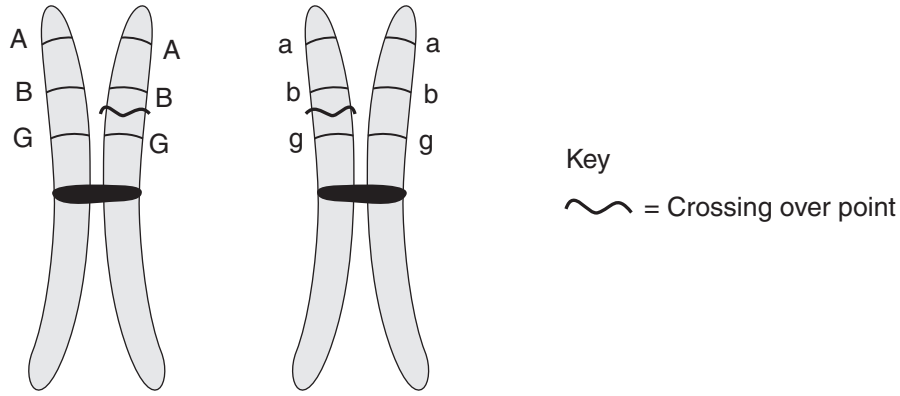
Diagram of vessel	 Muscular wall	 Muscular wall
Name the vessel	.....	.....
Explain how ONE structural feature of the vessel enables it to carry out its function.	....	....

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Question 24 (7 marks)

(a) Three genes are arranged along a homologous pair of chromosomes as shown.



(i) What is the individual's genotype before crossing over occurs? **1**

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(ii) Label, on the diagram below, the alleles after crossing over has occurred. **1**



(b) Explain the effect of independent assortment of chromosomes on the genotype of the offspring. **2**

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Question 24 continues on page 13

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Question 24 (continued)

(c) Explain the role of isolation in the process of evolution. **3**

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End of Question 24

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Question 25 (4 marks)

Explain the difference in the urine concentration of marine fish and freshwater fish. **4**

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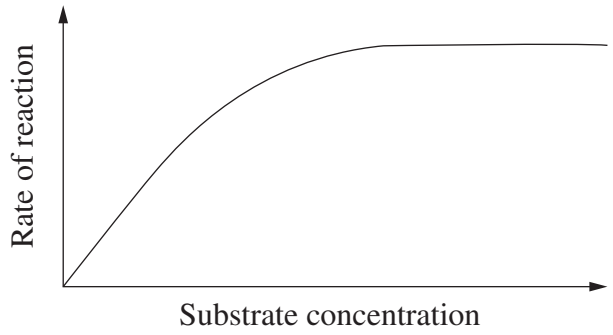
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Question 26 (4 marks)

A controlled experiment was performed to investigate the effect of substrate concentration on the rate of an enzyme-catalysed reaction. Data were collected and are presented in the graph.



(a) What is the independent variable in this experiment? **1**

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(b) Explain the trends shown in the graph. **3**

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Question 27 (5 marks)

(a) Draw labelled diagrams to distinguish between transverse sections of a xylem vessel and a phloem vessel. **2**

(b) Describe the process that transports sugars through a plant. **3**

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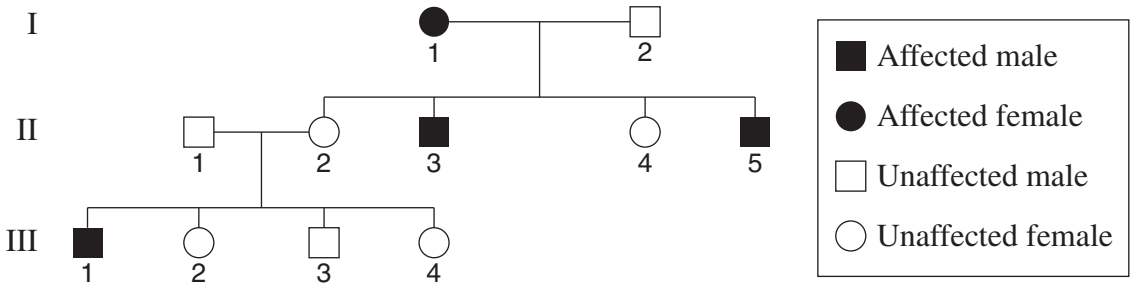
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Question 28 (3 marks)

A pedigree chart of an inherited characteristic is shown. **3**



Subsequent genetic analysis showed I-2 does not have the recessive allele.

Explain the inheritance of this characteristic.

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Question 29 (5 marks)

Justify the change in emphasis from treatment to prevention of a named disease. **5**

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Question 30 (6 marks)

(a) What is the role of ONE type of T lymphocyte in the immune response? **2**

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(b) Explain ONE benefit and ONE limitation of suppressing the immune system in organ transplant patients. **4**

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Question 31 (8 marks)

Assess the importance of the work of Beadle and Tatum to the ability to produce a specific transgenic species. **8**

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Biology

Section II

25 marks
Attempt ONE question from Questions 32–36
Allow about 45 minutes for this section

Answer parts (a)–(e) of one question in the Section II Writing Booklet. Extra writing booklets are available.

Show all relevant working in questions involving calculations.

Pages

Question 32 Communication 22–23

Question 33 Biotechnology 24–25

Question 34 Genetics: The Code Broken? 26–27

Question 35 The Human Story 28–29

Question 36 Biochemistry 30–31

Question 32 — Communication (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) (i) Give an example of a receptor and its stimulus. **2**

(ii) Outline the relationship between the wavelength, frequency and pitch of a sound. **2**

(b) Describe how the lens of the eye changes its shape in order to focus on near and far objects. **3**

(c) (i) Identify the location and function of rhodopsin in the eye. **2**

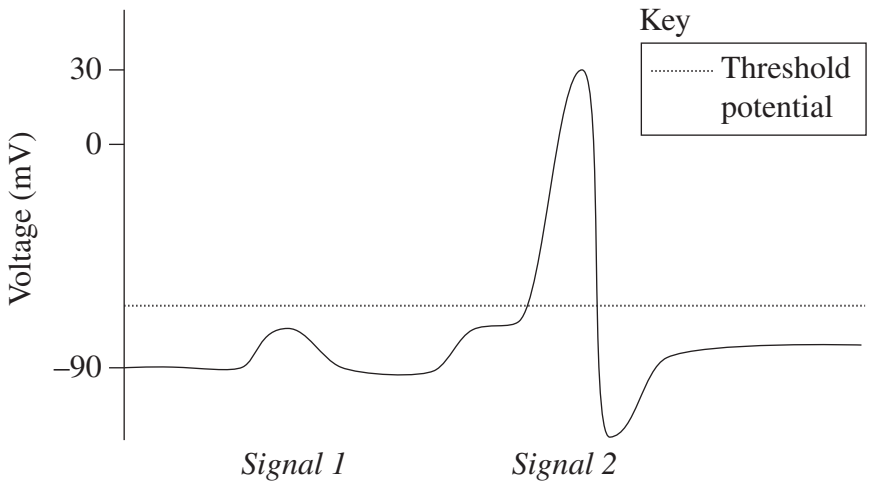
(ii) Contrast the distribution and function of cone cells and rod cells in the human eye. **4**

Question 32 continues on page 23

Question 32 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The graph shows the electrochemical changes in the membrane of a neurone when two signals are detected.



(i) Explain why *Signal 1* does NOT result in the transmission of an impulse. **2**

(ii) Explain the electrochemical changes that would occur in this membrane during *Signal 2*. In your answer, refer to information from the graph. **3**

(e) Assess how our understanding of the path of a soundwave through the ear has led to the development of technologies that assist hearing. **7**

End of Question 32

Question 33 — Biotechnology (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) (i) Name TWO biotechnologies used by an early society. **2**

(ii) What are TWO benefits resulting from artificial selection in a specific plant or animal? **2**

(b) Describe the steps involved in the formation of recombinant DNA. **3**

(c) (i) Outline the differences between DNA and RNA. **2**

(ii) Describe the roles of two types of RNA in protein synthesis. **4**

Question 33 continues on page 25

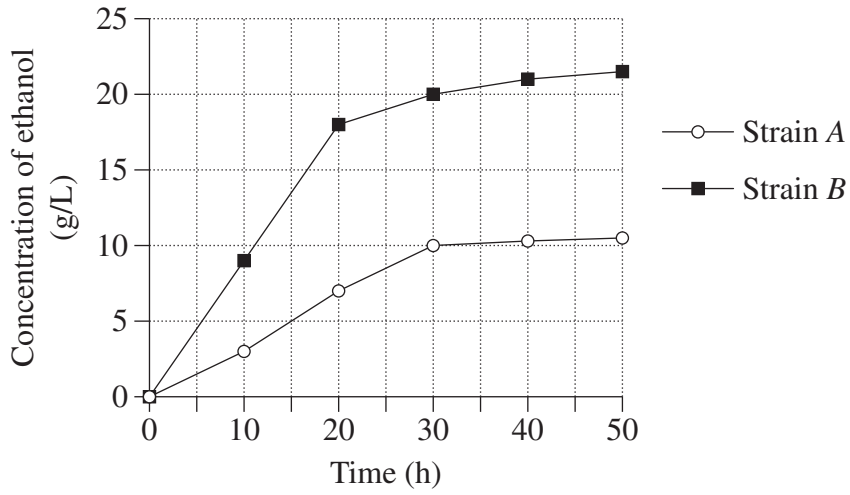
Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The yeast *S. cerevisiae* cannot naturally ferment the sugar xylose. Low value biomass, such as straw and wood fibres, contains up to 20% xylose. *S. cerevisiae* was modified to enable it to produce ethanol from xylose. Information on the two species involved in making the modified *S. cerevisiae* is shown in the table.

Type of organism	*Species*	*Relevant reaction*	*End product*
Bacteria	*Burkholderia cenocepacia*	Utilises xylose in metabolism	Fructose
Yeast	*Saccharomyces cerevisiae*	Utilises fructose in metabolism	Ethanol

(i) Explain why biotechnology was needed to modify *S. cerevisiae*. **2**

Two strains of genetically modified *S. cerevisiae* were produced. The two strains were compared under the same conditions. The results are shown.



(ii) Justify which of these two strains would be better to use to produce commercial quantities of ethanol using low value biomass. In your answer, refer to information from the graph. **3**

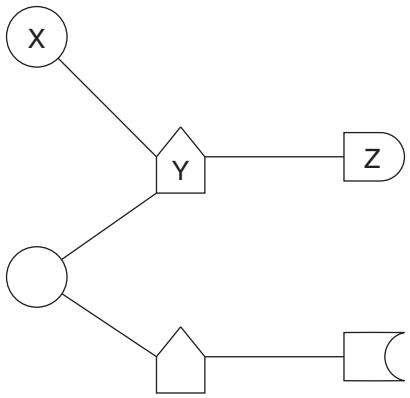
(e) Assess the impact on society of the understanding and application of cell biochemistry. Support your answer with reference to an industrial fermentation process. **7**

End of Question 33

Question 34 — Genetics: The Code Broken? (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) The following is a diagram of nucleotides.



(i) Identify components X and Y. **2**

(ii) Contrast Z in DNA and RNA. **2**

(b) Outline the use of highly variable genes for DNA fingerprinting. **3**

(c) (i) Outline the effect of germ line mutations on species. **2**

(ii) Explain the impact of transposable genetic elements on the genome. **4**

Question 34 continues on page 27

Question 34 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The offspring as a result of a dihybrid cross are shown.

RRTT	RRTt	RrTT	RrTt
RRTt	RRtt	RrTt	Rrtt
RrTT	RrTt	rrTT	rrTt
RrTt	Rrtt	rrTt	rrtt

Key
R = red flowers
r = yellow flowers
T = tall plant
t = dwarf plant

(i) Identify the genotype and the phenotype of the parents. **2**

(ii) Explain how the phenotypic ratio would be different depending on whether two genes are carried on the same chromosome or on two different chromosomes. **3**

(e) Analyse the impact of the Human Genome Project on the development of technologies which benefit society. **7**

End of Question 34

Question 35 — The Human Story (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) (i) Identify TWO features that classify humans as primates. **2**

(ii) Outline how ONE specific feature is used to distinguish between hominids and other primates. **2**

(b) Describe the process of DNA-DNA hybridisation in determining the evolutionary relationship between one primate and another. **3**

(c) (i) What is the difference between *polymorphism* and *clinal gradation*? **2**

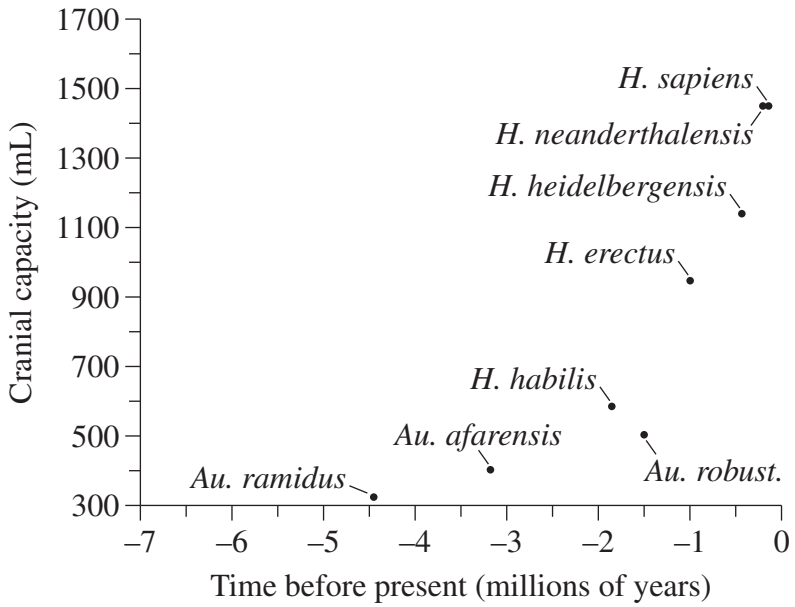
(ii) Explain how polymorphisms have enabled humans to survive in their environment. Use examples in your answer. **4**

Question 35 continues on page 29

Question 35 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The graph shows the evolution of the cranial capacity of different hominid species.



(i) Contrast the change in the cranial capacity of the genus *Australopithecus* with that of the genus *Homo* over time. **2**

(ii) Relate the patterns of migration of genus *Australopithecus* and genus *Homo* to the cranial capacities shown in the graph. **3**

(e) Analyse the impact of modern technologies in the fields of modern medicine and genetic engineering on human evolution. **7**

End of Question 35

Question 36 — Biochemistry (25 marks)

Answer parts (a), (b) and (c) of the question on pages 2–4 of the Section II Writing Booklet. Start each part of the question on a new page.

(a) (i) Identify TWO reasons for studying photosynthesis. **2**

(ii) What are the functions of the products of photosynthesis? **2**

(b) Describe an experiment that could be used to test van Helmont's observation that soil is not primarily responsible for a plant's change in mass. **3**

(c) (i) What is a *radioisotope*? **2**

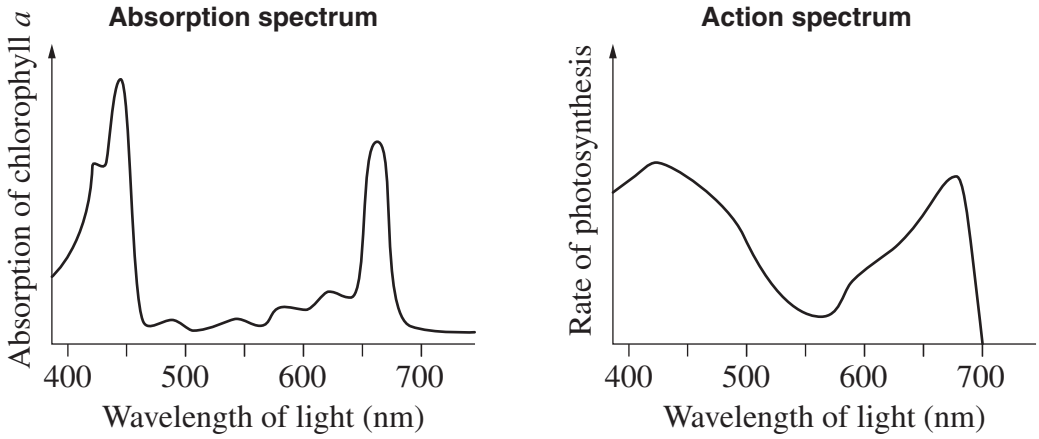
(ii) Explain how TWO named tracers can be incorporated into plants to follow the biochemical pathway of photosynthesis. **4**

Question 36 continues on page 31

Question 36 (continued)

Answer parts (d) and (e) of the question on pages 6–8 of the Section II Writing Booklet. Start each part of the question on a new page.

(d) The graphs show the absorption spectrum of chlorophyll *a* and the action spectrum of a particular plant.



(i) Identify the wavelength ranges of light that are used by this plant for photosynthesis. **2**

(ii) The action spectrum shows two peaks. Explain why the wavelength range of light of each peak is different to the range of the corresponding peak in the absorption spectrum of chlorophyll *a*. **3**

(e) Analyse the impact of the development of the electron microscope on the understanding of chloroplast structure and function. **7**

End of paper

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