

HSC Trial Examination 2004

Biology

This paper must be kept under strict security and may only be used on or after the morning of Friday 13 August, 2004, as specified in the NEAP Examination Timetable

General Instructions

Reading time 5 minutes.

Working time 3 hours.

Board-approved calculators may be used.

Write using blue or black pen.

Draw diagrams using pencil.

Total marks 100

Section I Pages 2–17

Total marks 75

This section has two parts, Part A and Part B

Part A — 15 marks

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

Part B — 60 marks

- Attempt Questions 16–29.
- Allow about 1 hour and 45 minutes for this part

Section II Pages 18–27

Total marks 25

- Attempt ONE question from Questions 30–34.
- Allow about 45 minutes for this section.

Students are reminded that this is a trial examination only and cannot in any way guarantee the content or the format of the 2004 Biology Higher School Certificate examination.

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1. Identify Louis Pasteur's main contribution to our understanding of disease?
- (A) The discovery that micro-organisms were able to generate spontaneously.
 (B) The discovery of antibiotics in controlling bacterial growth.
 (C) That vaccinations help prevent the spread of disease.
 (D) That microbes were responsible for the transmission of diseases.

2. The table below shows smoking prevalence by education level between 1980 and 1995.

Educational level	Male %					Female %				
	1980	1983	1986	1989	1992	1980	1983	1986	1989	1992
I	44	41	37	35	34	31	31	29	28	25
II	44	41	39	37	32	32	32	32	29	28
III	31	28	29	26	27	27	27	26	26	24
IV	n/a	n/a	18	21	18	n/a	n/a	18	17	14

Note: Educational level attained:

I: less than or equal to Year 9

II: years 10 and 11

III: year 12 or more (not university graduate)

IV: university graduate

not applicable – this education level not distinguished from Level III in the earlier surveys

Source: Hill et al, Hill and White, Hill and Gray, Hill, Hill et al.

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From the data presented in the above table, what is the best conclusion that could be made?

- (A) Increasing education levels are associated with increasing smoking prevalence.
 (B) Increasing education levels are associated with decreasing smoking prevalence.
 (C) The younger a person starts smoking the more likely they are to continue smoking into adulthood.
 (D) Education programs have been responsible for the decline in smoking rates.

- 3.

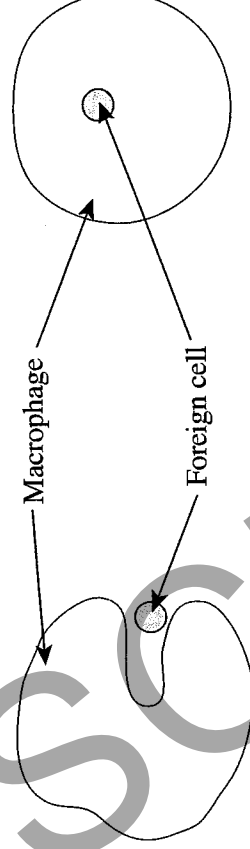
Choose which of the following cells/molecules are components of the immune response.

- (A) Erythrocytes (red blood cells) and leucocytes (white blood cells).
 (B) T-cells and prions.
 (C) T-cells and B-cells.
 (D) Erythrocytes and macrophages.

4. Diseases may be caused by an imbalance of the microflora in humans. Identify which of the following diseases may be caused by a microflora imbalance.

(A) Candidiasis (thrush)
 (B) Diphtheria
 (C) Down Syndrome
 (D) Malaria

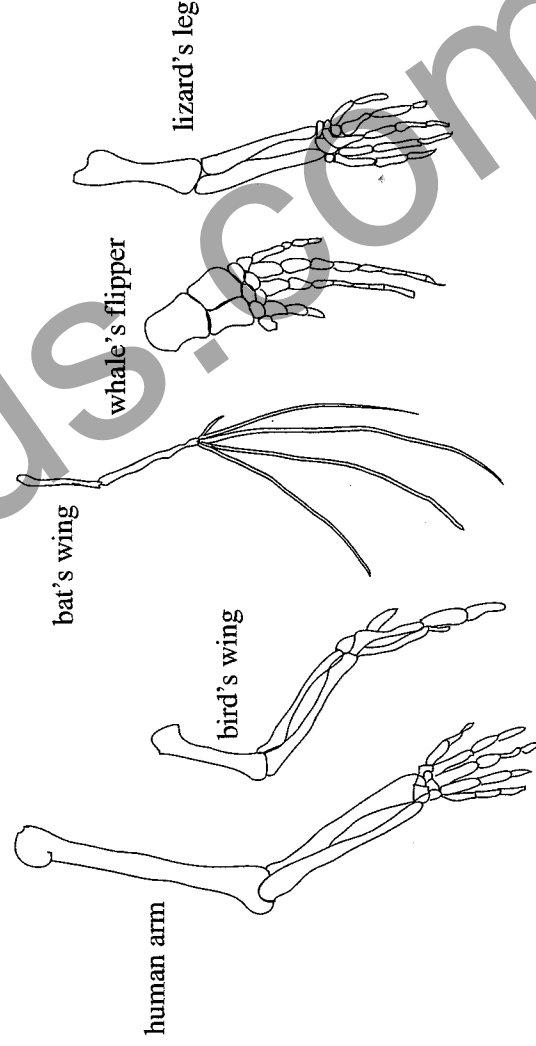
5. The following diagram shows a process that occurs as part of our defence system against invading cells.



Which of the following would be most correct for the above process?

Process	Function
(A) Phagocytosis	Present an antigen to a T-cell or B-cell site.
(B) Digestion	Enzymes break down food molecules to be easily absorbed.
(C) Antibody production	Antibodies attack antigens to form an antibody/antigen complex.
(D) Immunisation	Vaccine molecules attack foreign cells.

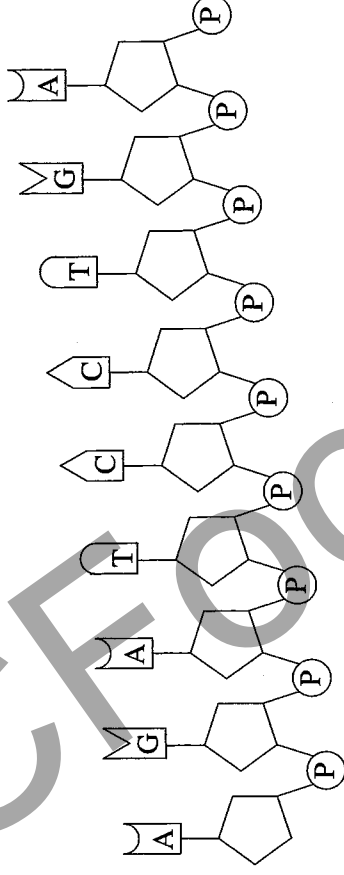
6. The diagram below shows the forelimbs of several different vertebrates.



Identify the form of evidence shown in the above diagram.

(A) Evidence for evolution from palaeontology.
 (B) Transitional forms in limbs of vertebrates.
 (C) Comparative embryology.
 (D) Evidence for evolution from homologous structures.

7. Feather colour in budgerigars is controlled by a single gene. The dominant condition gives green-coloured body feathers while the recessive condition results in blue-coloured body feathers.
- A budgerigar breeder has purchased a pair of green budgerigars in order to boost the overall genetic viability of his breeding stock. However, he needs to know whether the birds are heterozygous or homozygous before he can begin using them in his breeding program.
- In order to prove whether the green birds are heterozygous or homozygous, which of the following test crosses should the breeder undertake?
- The green birds should be crossed with each other.
 - The green birds should be crossed with known homozygous blue birds.
 - The green birds should be crossed with known homozygous green birds.
 - The green birds should be crossed with known heterozygous green birds.
8. The diagram below represents a single strand of DNA ready for protein synthesis.

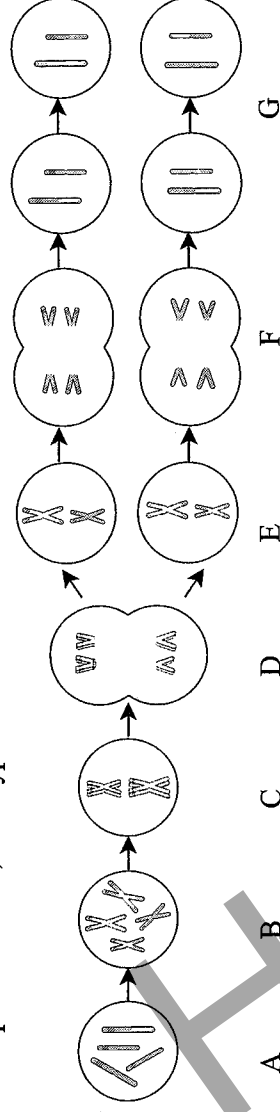


Reading the DNA from left to right, what will be the correct mRNA sequence for this section of DNA?

- T-C-T-A-G-G-A-C-T
- A-G-A-U-C-C-U-G-A
- A-G-A-T-C-C-T-G-A
- U-C-U-A-G-G-A-C-U

9. Which of the following statements most accurately describes Beadle and Tatum's 'one gene – one enzyme' hypothesis?
- There is only one type of gene in cells that codes for enzymes.
 - There exists a one-to-one relationship between a gene and the enzyme produced by that gene.
 - Enzymes only act when stimulated by their corresponding gene.
 - If a gene is changed by radiation, the enzyme produced by that gene can still be produced.

10. In the process below, what type of cell is G?

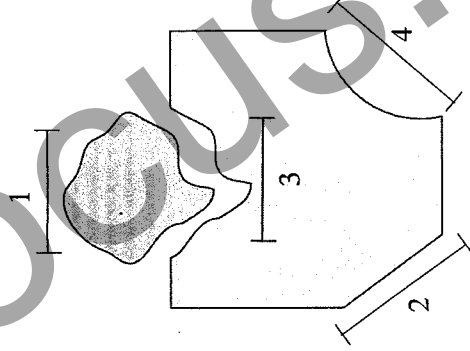


- (A) gamete
(B) zygote
(C) diploid
(D) homologous

11. Which of the following statements is NOT an adaptation of plants to reduce water loss?

- (A) Leaves hanging vertically.
(B) Small needle-like leaves.
(C) Shiny leaves.
(D) Large surface area to volume ratio.

12. The diagram below shows an enzyme and a substrate. Which number correctly identifies the active site?

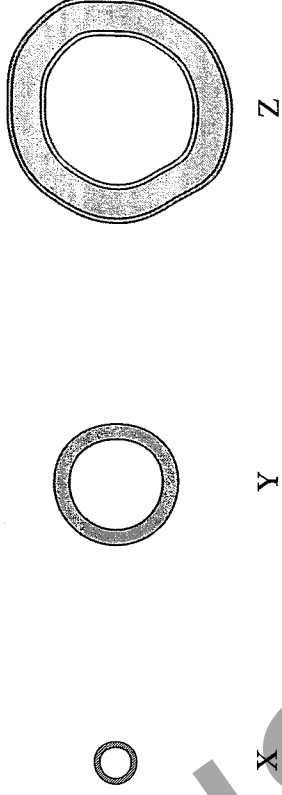


- (A) 1
(B) 2
(C) 3
(D) 4

13. As a marathon runner begins to run, her breathing rate increases and she gets red in the face. The skin all over her body gets more and more red the longer she continues to run. Which of the following statements could account for the redness of her skin?

- (A) The blood vessels near the surface of the runner's skin have dilated to increase the amount of heat radiated from the skin and to therefore cool the body.
(B) Since she is running, the marathon runner's heart rate has increased, pushing more blood near the surface of the skin.
(C) The blood vessels near the surface of the skin have constricted to reduce blood flow to the skin.
(D) As the runner is getting hotter the longer she runs, she becomes redder.

14. The diagram below represents the three types of blood vessels in the human body.



Choose the statement below which best describes the function of Y.

- (A) Is composed of three layers – an outer layer of connective tissue, a layer of elastic fibres and smooth muscle and an inner endothelial layer.
- (B) Transports blood at high pressure away from the heart.
- (C) Has valves to allow blood to flow only one way – towards the heart.
- (D) Has very thin walls to allow transfer of materials to and from the cells that surround this blood vessel.

15. The following graph shows a person's water consumption on a cool day.



This person is producing large amounts of dilute urine. Which statement is an accurate description of the level and effect of ADH (anti-diuretic hormone) in this person after drinking so much water?

- (A) There will be less ADH secreted, causing the kidney collecting duct to be more permeable to water.
- (B) There will be less ADH secreted, causing the kidney collecting duct to be less permeable to water.
- (C) There will be more ADH secreted, causing the kidney collecting duct to be more permeable to water.
- (D) There will be more ADH secreted, causing the kidney collecting duct to be less permeable to water.

Part B

Total marks 60

Attempt Questions 16–29.

Allow about 1 hour and 45 minutes for this part.

Answer Part B questions in the spaces provided.

Show all relevant working in questions that require calculations.

Marks

Question 16 (3 marks)

Using an example, outline how cell differentiation and specialisation assist in the maintenance of health. 3

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Question 17 (4 marks)

A gardener pruning a rose bush accidentally pricks their finger on a thorn. The thorn breaks off, staying embedded in the skin and causing blood to flow from the wound.

Identify two defence adaptations that would occur within the gardener's body and for each describe how they would respond to the invasion. 4

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Question 18 (4 marks)

Our understanding of what causes a particular disease and how it can be prevented often involves research and discoveries by scientists over many years. An example of such a disease is malaria. Drugs have often been used to treat malaria, but with mixed success.

The following table outlines the history of treatment by antimalarial drugs.

<i>Drug</i>	<i>History</i>
Quinine	Used for more than three centuries. Until the 1930's was the only effective agent for the treatment of malaria. Presently used for severe cases due to the undesirable side effects.
Atebrin	Used in the Second World War. No longer used due to side effects.
Chloroquine	Used in the 1940's, but no longer effective due to resistance in most strains of malaria.
Proguanil	First synthesised in 1946. Drug destroys malarial parasite and is still used.
Malarone	Released in Australia in 1998 as a combination drug. Still effective, but expensive to produce.
Maloprim	No longer used due to resistance.
Fansidar	Combination drug no longer recommended due to resistance and serious side effects.
Mefloquine	First introduced in 1971. Decline in its use due to resistance and undesirable side effects including acute brain syndrome.
Halofantrin	Introduced in the 1980's. Resistance to the drug is increasing, plus undesirable side effects including neuropsychiatric disturbances.

Discuss how the historical developments associated with the treatment of malaria improves our understanding of the cause and prevention of malaria.

4

Question 19 (8 marks)

8

The following statement was reported on ABC radio on the 23rd April 2003 regarding the outbreak of SARS (Severe Acute Respiratory Syndrome).

“The threat of an outbreak of SARS in Australia has led State Governments to list the disease under the Public Health Act. That means that police can be used to compel suspected victims into testing, treatment or quarantine.”

Discuss the role of quarantine in preventing an outbreak of SARS in Australia and the shift in emphasis from treatment and control to management and prevention of the disease.

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Question 20 (3 marks)

Marks

- (a) Name ONE species that can be used as an example of how an environmental change can lead to changes in a species. **1**

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- (b) Explain how this species has changed as the result of changes in its environment. **2**

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Question 21 (3 marks)

In translating the mRNA sequence to amino acids, several of the amino acids can be coded for by multiple codons. For instance, the mRNA sequences of UUA, UUG, CUU, CUC, CUA, and CUG all code for the amino acid leucine; the mRNA sequences of GUU, GUC, GUA, and GUG all code for the amino acid valine; and the mRNA sequences of GGU, GGC, GGA, and GGG all code for the amino acid glycine.

- (a) Given the mRNA codons listed above, name the four bases that make up mRNA. **1**

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- (b) Describe the effect that the existence of multiple codons has on point mutations in nucleic acids. **2**

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Question 22 (3 marks)

Gregor Mendel and Charles Darwin made their respective contributions to genetics and evolutionary theory at about the same time. Darwin's *The Origin of Species* was published in 1859, while Mendel's paper outlining his work with pea plants was published in 1866.

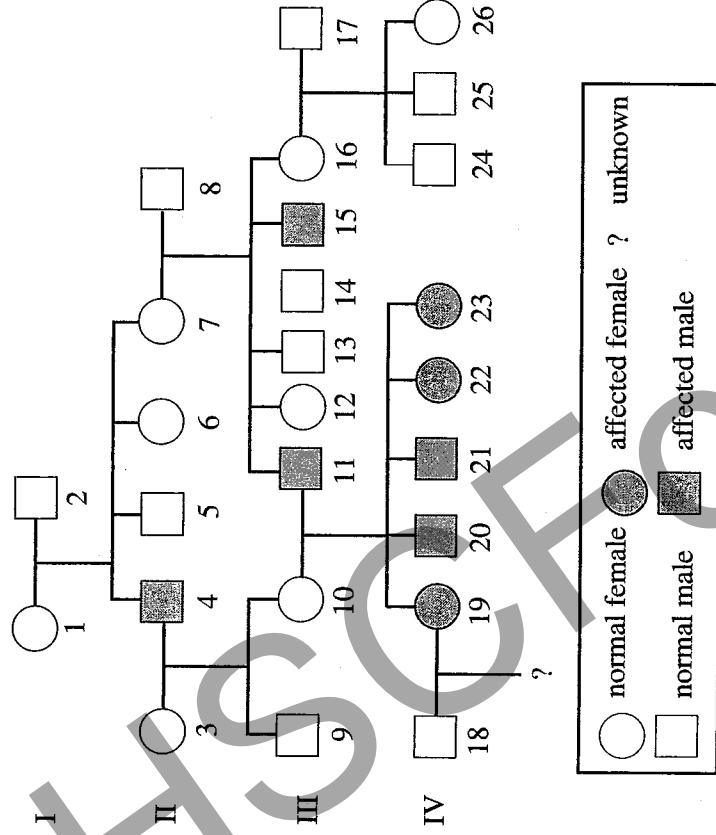
3 Compare the responses of the scientific community to the publishing of Darwin's and of Mendel's work and propose reasons for significant differences in the responses.

ASCFO

Question 23 (4 marks)

Marks

The pedigree below traces the occurrence of a sex-linked genetic trait through a family over four generations.



- (a) By referring to examples from the pedigree, explain why many cultures have laws that restrict intermarriage between close family members. 2

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- (b) Predict the chances of individuals 18 and 19 having a child that is: 1
- (i) an affected male. 1

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(ii) an affected female. 1

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Question 24 (8 marks)

Modern genetic engineering techniques have the potential to transform society in a variety of ways.

- (a) Outline the processes used to produce a transgenic species.

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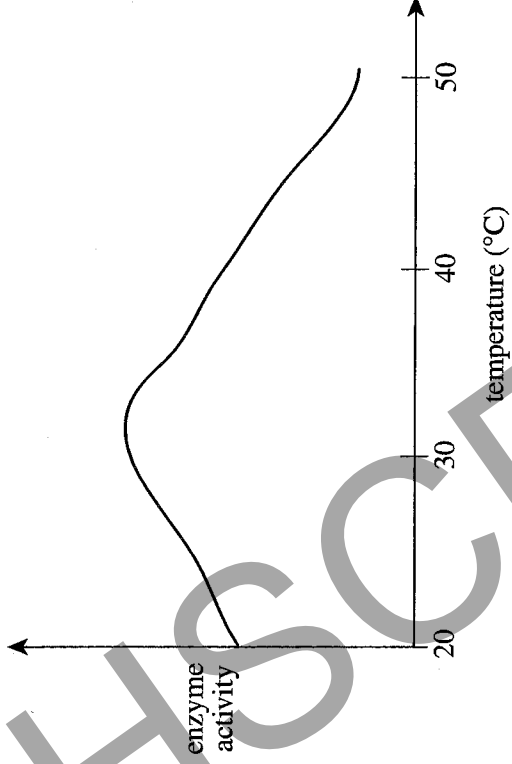
- (b) Discuss some of the ethical and biodiversity issues arising from the development and use of transgenic species.

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Question 25 (4 marks)

Marks

The following graph shows an enzyme (rennin) catalysing a substrate. The temperature increases from 20°C to 50°C over 20 minutes.



- (a) State the temperature that you consider optimum for this enzyme in terms of activity. 1

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- (b) Name another factor that can affect enzyme activity. 1

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- (c) Describe what may be happening to the enzyme's structure above 45°C. 2

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Question 26 (5 Marks)

- (a) Describe an investigation that you carried out to estimate the size of red and white blood cells.

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- (b) Explain the adaptive advantage of the haemoglobin contained in red blood cells.

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Question 27 (4 Marks)

Compare the structure and function of xylem and phloem vessels in plants.

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Question 28 (3 Marks)**Marks**

Outline how hormone replacement therapy (HRT) can help people who cannot secrete aldosterone. **3**

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Question 29 (4 Marks)

Outline how the body detects and then reacts to a change in lower ambient temperature. **4**

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Section II

Total 25 Marks

Attempt ONE question from Questions 30–34.

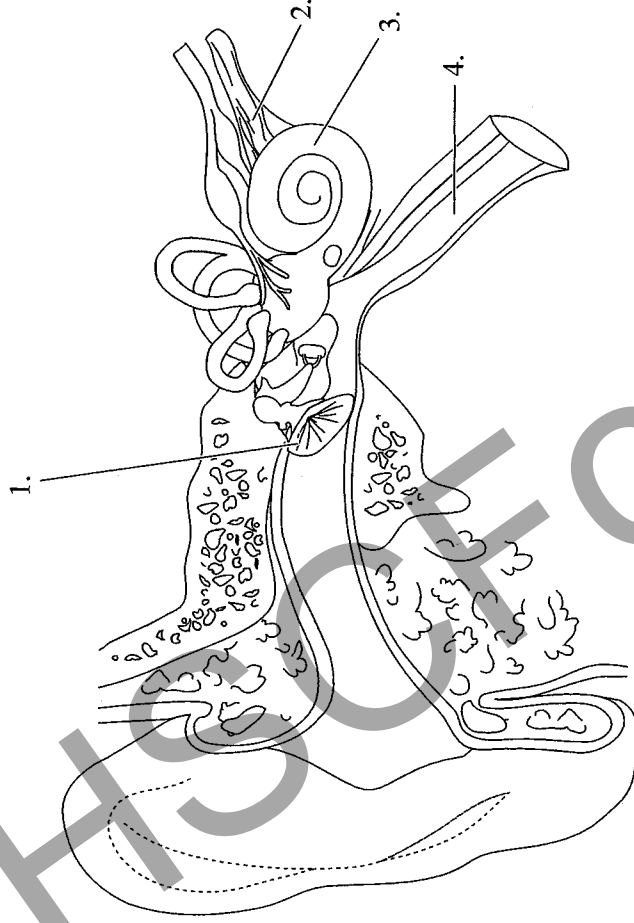
Allow about 45 minutes for this section.

Answer the question in a writing booklet. Extra writing booklets are available.

Question 30	Communication	19
Question 31	Biotechnology	21
Question 32	Genetics – The Code Broken?	22
Question 33	The Human Story	23
Question 34	Biochemistry	26

Question 30 — Communication (25 marks)**Marks**

- (a) Explain how depth perception can be achieved.
- (b) The following is a diagram of the human ear.

2

- (i) In your answer book, clearly identify the following structures:

2

1.

2.

DO NOT PUT ANSWER HERE

3.

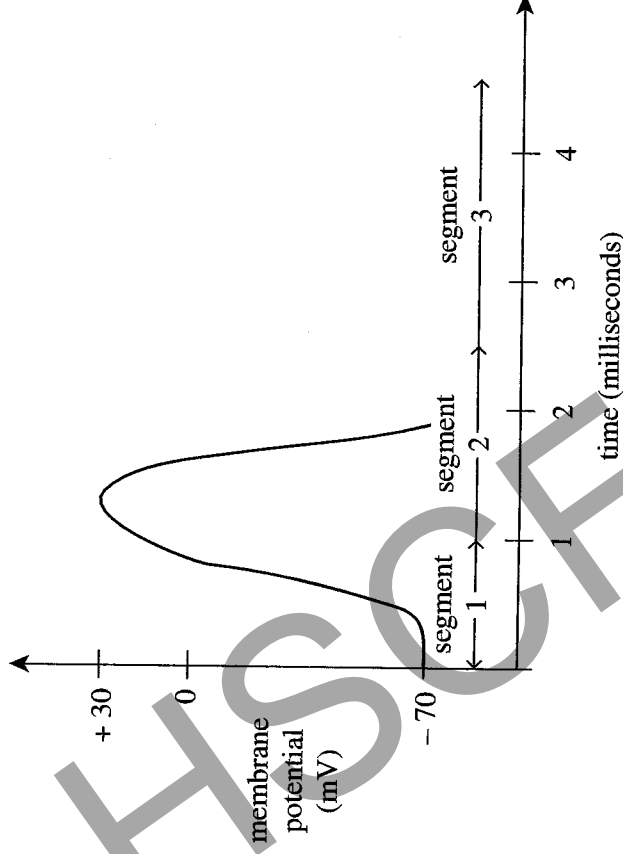
4.

- (ii) If structure 1 was damaged, identify and evaluate a current technology that could be used to assist that person in hearing. Include the limitations of this technology in your evaluation.

4

Question 30 (Continued)

- (c) The following graph represents a typical action potential.



- (i) Considering the net movement of potassium and sodium ions, in the following table give the direction (in or out) for each ion in the segment indicated. (Draw a table in your answer book with your correct response.) 3

Segment	Sodium	Potassium
1	DO NOT	
2	PUT	
3	ANSWER HERE	

- (ii) Explain why not all stimuli generate an action potential. 2

- (d) The genes that control the production of photoreceptors are quite similar among different animals, yet the structure of the eye amongst these animals varies quite significantly.

- (i) Compare the nature and functioning of photoreceptor cells in a mammal, an insect and another different invertebrate. 3

- (ii) Outline the role of rhodopsin in rods. 2

- (e) The Fred Hollows Foundation works with blindness prevention agencies in more than 29 countries to establish the mechanisms to treat and prevent avoidable blindness. 7

Describe a technology that could be used to prevent blindness resulting from cataracts and discuss the implication of this technology for society. Compare this technology to technologies that would be used to correct myopia and hyperopia.