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HSC Trial Examination 2005

Biology

This paper must be kept under strict security and may only be used on or after the morning of Friday 12 August, 2005 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 examination 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 18–23

Total marks 25

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

Students are advised that this is a trial examination only and cannot in any way guarantee the content or the format of the 2005 HSC Biology Examination.

1. Which of the following statements is a reason for the maintenance of water levels within a cell?

(A) Cells may take in or lose large amounts of water if the concentration, both inside and outside the cell, is not maintained.

(B) Cells need to take in water; therefore the concentration within the cell must be maintained.

(C) Cells must excrete wastes to maintain an equal concentration with their surroundings.

(D) Isotonic cells neither gain nor lose water.

2. Blood travels around the human body with a number of substances dissolved in it. Which of the following correctly describes the substance and its form in the blood?

	Substance	*Form in blood*
(A)	oxygen	hydrogen carbonate ions
(B)	waste nitrogenous material	oxyhaemoglobin
(C)	salts	as ions in the plasma
(D)	oxygen	urea

3. Which of the following correctly identifies where active transport occurs in the nephron?

(A) the glomerulus

(B) the collecting duct

(C) the Bowman's capsule

(D) the tubule or loop of Henle

4. Which of the following is a factor that can affect the function of an enzyme?

(A) light

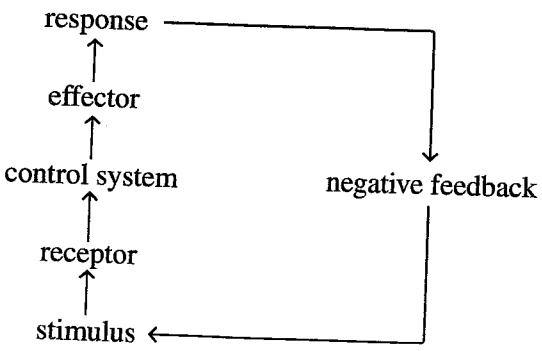
(B) pH

(C) concentration of solvent

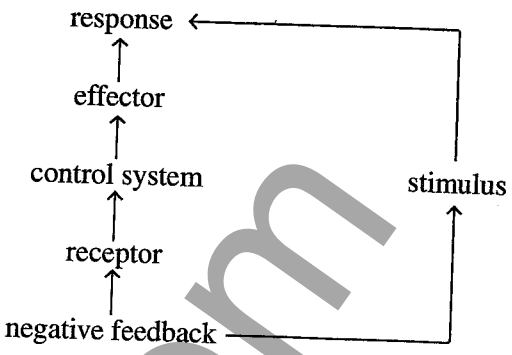
(D) pressure

5. Which of the following most correctly represents a feedback mechanism?

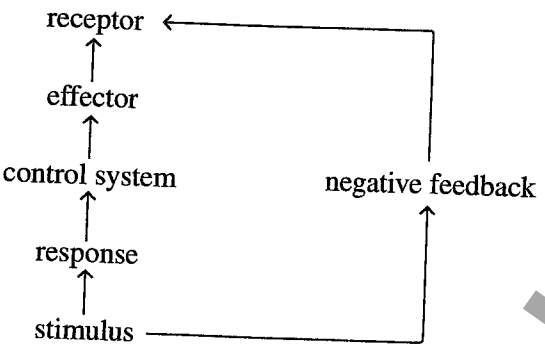
(A)



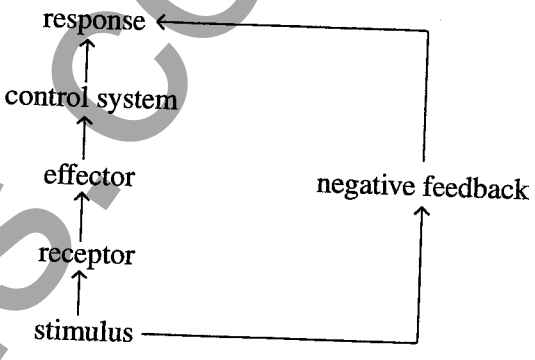
(B)



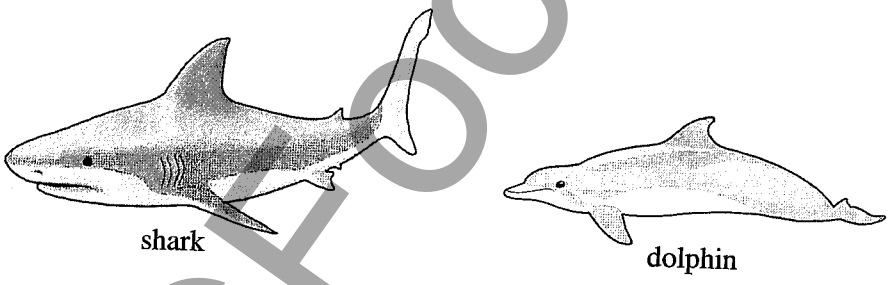
(C)



(D)



6. The diagram below shows a shark (a fish) and a dolphin (a mammal).



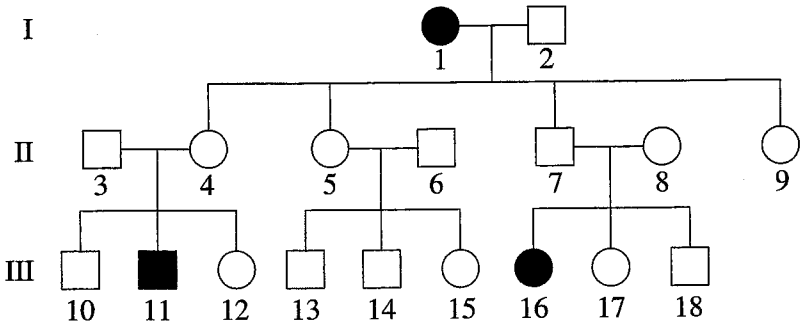
The organisms above are an example of

(A) mutations within a species.
(B) biogeography.
(C) enantiostasis.
(D) convergent evolution.

7. A black male rabbit mates with a white female rabbit and all their offspring are black. From this information, it can be concluded that

(A) black fur colour is dominant over white fur colour in rabbits and it is a sex-linked trait.
(B) white fur colour is dominant over black fur colour in rabbits, but both alleles are co-dominant in the offspring.
(C) the white fur colour in the female is due to a one-off mutation.
(D) black fur colour is dominant over white fur colour and the male was likely homozygous.

8. The pedigree below shows the inheritance of a type of albinism in humans. The production of normal pigmentation is dominant to the albinism allele. Individuals in the pedigree that exhibit albinism are shaded.



The genotype of individuals 3, 4, and 11, respectively, are

(A) aa, aa, Aa.
(B) Aa, aa, aa.
(C) Aa, Aa, aa.
(D) AA, aa, Aa.

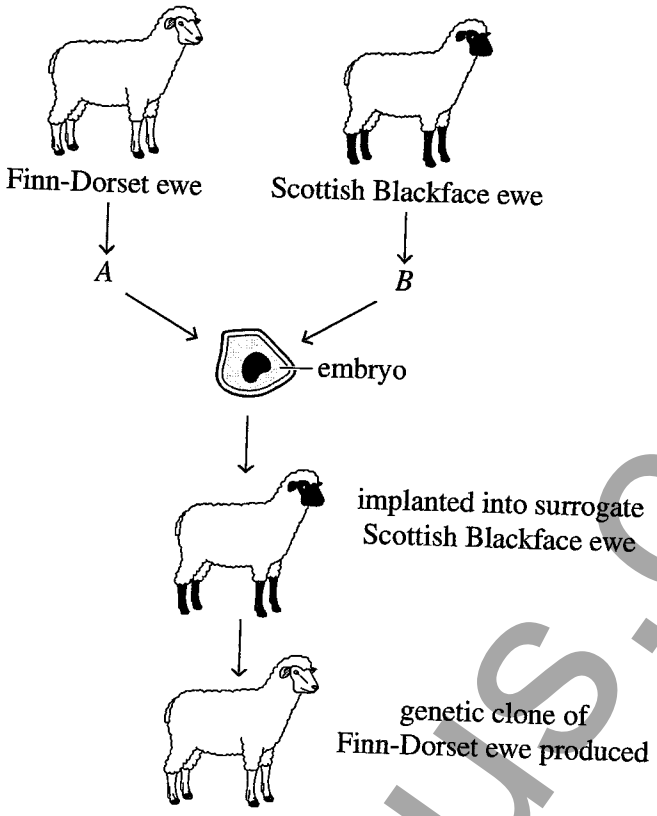
9. The steps below summarise the process of protein synthesis.

DNA
↓
DNA is transcribed to mRNA
↓
mRNA leaves nucleus
↓
A
↓
tRNA attaches specific amino acid to polypeptide chain

The missing step labelled *A* takes place

(A) just outside the nucleus.
(B) at the ribosome.
(C) on the chromosomes.
(D) inside the nucleus.

10. The diagram below shows a process called nuclear transfer. This process could be used to clone sheep.



From the information in the diagram, it is possible to conclude that the missing items *A* and *B* are, respectively

(A) the donor nucleus and an enucleated unfertilised egg.
(B) the donor nucleus and a fertilised egg.
(C) sperm and unfertilised egg.
(D) an enucleated unfertilised egg and the donor nucleus.

11. What is the name of the scientist whose work enables the identification of the organism that causes a particular infectious disease?

(A) Louis Pasteur
(B) Walter Sutton
(C) MacFarlane Burnet
(D) Robert Koch

12. Late in 2004, a tsunami devastated the islands and coasts of many countries around the Indian Ocean, causing considerable loss of life. During the relief operations that followed the disaster, many doctors expressed concern about the spread of bacterial diseases such as cholera and typhoid.
What was the main reason for their concern?

(A) Difficulties with providing adequate food and shelter.
(B) Contamination of potential drinking water by human and other waste.
(C) The poor resistance to pathogens of the people in the area.
(D) Transmission of pathogens from dead bodies in the area.

13. Which statement describes the main reason an organ transplant triggers an immune response in a patient?

(A) The proteins in the transplanted organ are different from the proteins in the patient's body.

(B) The transplant introduces additional bacteria into the patient's body.

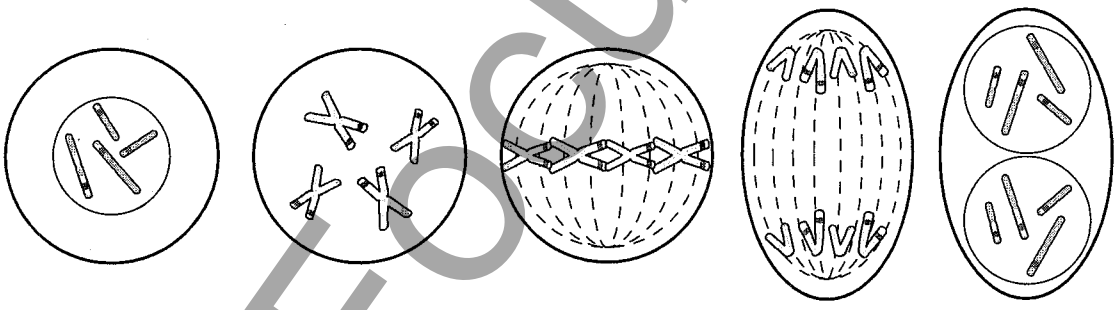
(C) Following the transplant, the patient is put on a course of immunosuppressive drugs.

(D) Interaction between B and T cells increases phagocytosis and inflammation.

14. Which of the following correctly shows the difference between an antibody and an antibiotic?

	Antibody	*Antibiotic*
(A)	Protein produced by B cells	Molecule that triggers an immune response
(B)	Substance used to manage an infectious disease	Protein produced by B cells
(C)	Protein produced by B cells	Substance used to manage an infectious disease
(D)	Molecule that triggers an immune response	Substance used to manage an infectious disease

15. The following sequence of diagrams illustrates a process that commonly occurs in healthy cells. If the process is adversely affected, the disease cancer may result.



Which of the following correctly identifies the name of the process illustrated and associated problems that may result in the development of cancer?

	Process	*Problems that may result in cancer developing*
(A)	Mitosis	Crossing over and differentiation do not occur
(B)	Mitosis	Cells divide too rapidly and differentiation does not occur
(C)	Meiosis	Cells divide too slowly and gametes are not formed
(D)	Crossing-over	Chromosomes fail to rejoin

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)

Describe the change in the composition of blood as it passes through the lungs in the human body. **3**

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Question 17 (3 marks)

Complete the table below to compare the structure of arteries, veins and capillaries. Draw a diagram and write a brief description of each type of blood vessel in the relevant space. **3**

Blood vessel	*Diagram*	*Description of structure*
Artery		
Vein		
Capillary		

Marks

Question 18 (3 marks)

Outline a current technology to allow the measurement of oxygen saturation in the blood. **3**

Question 19 (8 marks)

A biologist wanted to compare the conditions under which two different enzymes were active in reducing starch to sugar. One of the conditions tested was the effect of pH on enzyme activity. The results of this investigation are shown below.

	Amount of product at (mL)			
	pH 4	*pH 6*	*pH 8*	*pH 10*
Enzyme A	2	3.4	2	1.1
Enzyme B	4	2.2	2.0	0.7

Provide an aim, materials, procedure and conclusion for this experiment. **8**

Marks

Marks

Question 20 (3 marks)

Explain why a cell must constantly remove wastes for continued metabolic activity. **3**

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Question 21 (3 marks)

DNA hybridisation is one technique from biochemistry that can be used to support evolutionary theory.

(a) Explain how DNA hybridisation can be used to distinguish between two closely related species and two distantly related species. **2**

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(b) Outline one other way biochemistry can be used as evidence for evolutionary theory. **1**

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Marks

Question 22 (6 marks)

As part of the discovery of the structure of DNA, the American scientist Erwin Chargaff researched the ratios of the different DNA nucleotides found in various organisms. His results are summarised in the table below.

DNA source	*DNA composition (approx. %)*			
	A	*C*	*G*	*T*
yeast	32	17	18	33
bacteria	16	34	36	14
ox thymus	30	18	24	28
ox spleen	30	18	24	29
human sperm	30	19	19	32

(a) Account for the ratios of nucleotides as found by Chargaff's research. **2**

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(b) With the knowledge gained by Chargaff's research, it was not much longer before scientists worked out the structure of the DNA molecule.

Explain how Chargaff's research would have aided in deciphering the structure of the DNA molecule. **2**

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(c) Outline how the structure of the DNA molecule facilitates the process by which DNA replication occurs. **2**

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Marks

Question 23 (6 marks)

As part of your study of this course, you were required to learn the contributions of various scientists to their fields of research. For each scientist listed below, describe their contributions to the understanding of genetics and inheritance.

Include a reference to the name of the organism each used in their research.

(a) Theodor Boveri **3**

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(b) Thomas Hunt Morgan **3**

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Question 24 (5 marks) **Marks**

"The technology of gene manipulation is simply a collection of techniques for manipulating DNA."

With reference to a named example, describe a process used to produce a transgenic species and provide reasons for its use. **5**

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Question 25 (3 marks)

(a) Name a disease caused by a protozoan. **1**

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(b) Outline **two** structural differences between a protozoan and a bacterium. **2**

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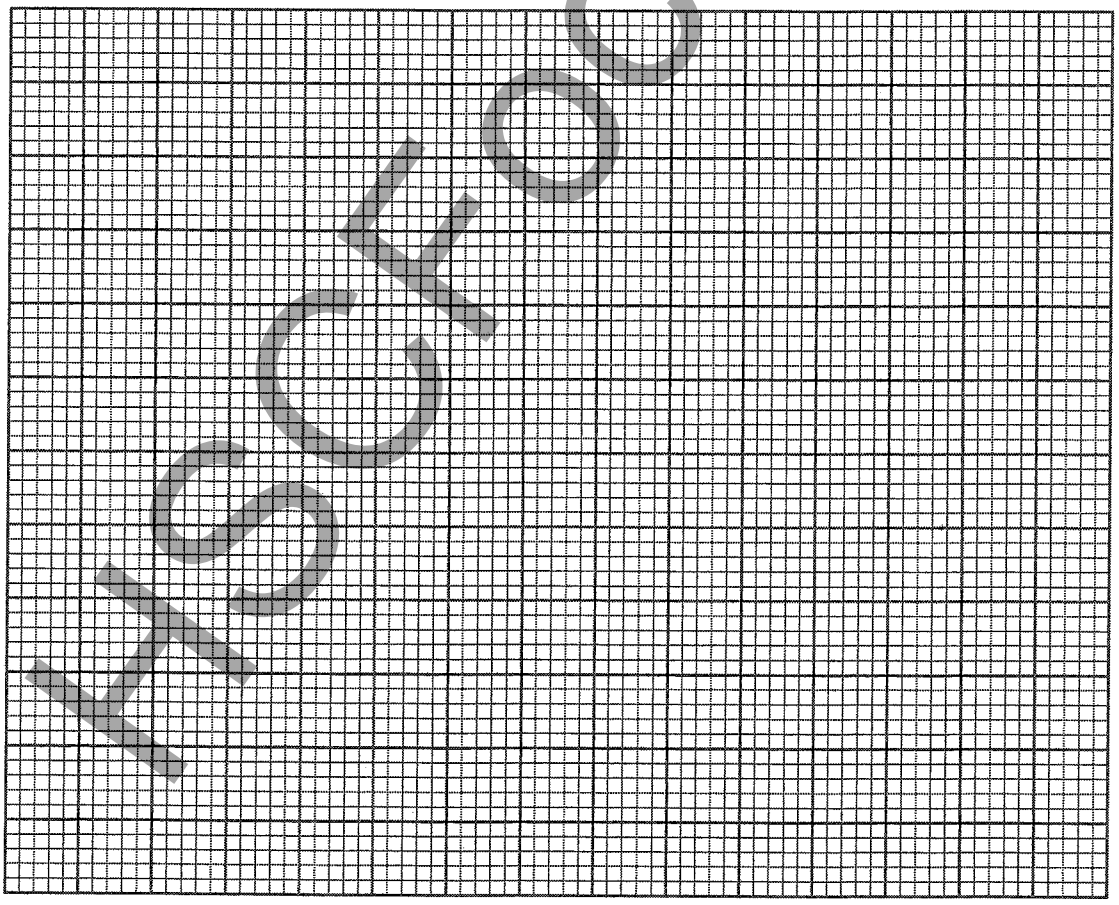
Marks

Question 26 (6 marks)

The information in the table below shows the incidence of melanoma of the skin in NSW for the period 1993–2002.

	Incidence rate of melanoma per 100,000 population	
Year	*Males*	*Females*
1993	54	36
1994	51	34
1995	53	32
1996	53	34
1997	57	37
1998	54	35
1999	56	35
2000	54	35
2001	58	37
2002	61	36

(a) Construct the most appropriate graph for the information on the grid provided below. **5**



1

Question 26 continues on page 16

(b) Clarify why it is difficult to extrapolate information about the possible incidence of melanoma in the year 2003 from the graph you have drawn. **Marks**

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Question 27 (3 marks)

Contrast the roles of **two** types of T lymphocytes found in the human body. **3**

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Question 28 (4 marks)

The following is an extract from a press release, issued by a medical institute, entitled 'Emerging Microbial Threats to Health in the Twenty-first Century'.

Infectious diseases continue to be a serious burden around the world, in developing and industrialised countries alike... National borders offer trivial impediments to such threats, especially in the highly interconnected and readily traversed 'global village' of our time.

Discuss this statement with particular reference to strategies designed to prevent the spread of disease. **4**

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Marks

Question 29 (4 marks)

Lupin is a pulse crop primarily produced for stockfeed. *Colletotrichum lupini* is a fungus that causes a serious disease in lupin.

A series of controlled experiments was carried out to assess the effect of exposure to dry heat on *Colletotrichum lupini* infection in lupin seed. Four replicate seed lots of 250 seeds were used for each time period and temperature.

The results of one of these experiments, concerning the effect of up to eight days exposure to different temperatures on infection in lupin seed, appear in the table below.

Temperature (°C)	*Duration of exposure (days)*	*Seeds infected (%)*
Untreated (control)	7	3.8
50	7	3.8
60	1	3.8
60	7	1.0
65	1	1.7
65	7	0.0
70	1	1.3
70	7	0.0

(a) Name the pathogen referred to in the experiment described above. **1**

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(b) Outline the most efficient way to treat lupin seeds to prevent infection by this fungus. **1**

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(c) Assess the reliability and importance of the data gathered. **2**

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Marks

Question 30 — Communication (25 marks)

(a) (i) Identify the relationship between frequency and the pitch of a sound. **1**

(ii) Compare the structure(s) used by a named animal to produce sound with the structure(s) used by humans for the same purpose. **3**

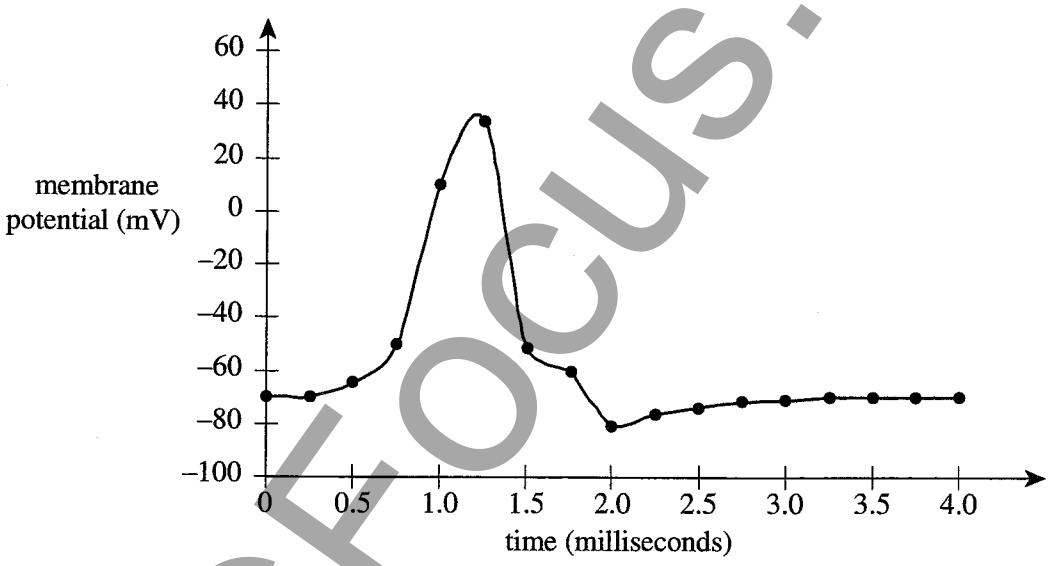
(b) During your study of this topic, you performed a first-hand investigation of a mammalian eye to gather first-hand data to relate structure to function.

(i) Describe the method you used to investigate the interior of the eye, including the means by which you minimised hazards and disposed of waste materials. **4**

(ii) Identify **two** structures you examined in the eye's interior. Relate the anatomy of each structure to its function. **2**

(c) Discuss the benefits and limitations of **two** different technologies that have been designed to improve human hearing. **7**

(d) The graph below represents a typical action potential.



Changes in membrane potential with time.

(i) Describe what is meant by 'action potential'. **2**

(ii) For the action potential represented in the graph, determine the values of the resting potential and the time taken to reach the threshold. **2**

(iii) Using light falling on the retina as an example, explain why not all stimuli generate an action potential and the consequences of this. **4**