



2004
FORM VI
TRIAL HSC EXAMINATION

Biology

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
- Write your student number at the top of each page Part B
- Hand in ALL sections of your examination paper in one bundle

Total marks (100)

Section I Pages 2 - 24

This section has two parts, Part A and Part B

Part A

Total marks (10)

- Attempt ALL Questions
- Allow about 20 minutes for this Part

Part B

Total marks (65)

- Attempt ALL Questions
- Allow about 1 hour and 55 minutes for this Part

Section II Pages 25 - 30

Total marks (25)

- Attempt ONE Question from Questions 26 - 30
- Allow about 45 minutes for this Section

CHECKLIST

Each boy should have the following:

| | |
|--------------------------------|--|
| 1 Question Paper | |
| 1 Multiple Choice Answer Sheet | |
| 1 4-page Writing Booklet | |

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|---------|----------|
| TWD - 1 | BHC - 2 |
| GPW - 3 | HCKM - 4 |

Part A**Total marks (10)****Attempt ALL Questions****Allow about 15 minutes for this Part**

Use the multiple-choice Answer Sheet.

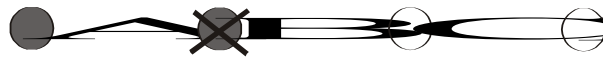
Select the alternative A, B, C or D that best answers the question. Fill the response circle completely.

Sample $2 + 4 =$

(A) 2 (B) 6 (C) 8 (D) 9



If you think you have made a mistake, put a cross through the incorrect answer and fill in the new answer.

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

- 1 Which of the following statements is correct about the excretion of waste through the kidneys?
- (A) The urine excreted by terrestrial insects is dilute.
 - (B) The concentration of urine excreted by fresh water fish is very dilute.
 - (C) The urine produced by marine fish is very dilute because they are constantly drinking water.
 - (D) Urine secreted by desert dwelling mammals is generally very dilute, as they need to conserve water.
- 2 Which of the following carries blood at low pressure and with low oxygen?
- (A) An artery
 - (B) A lymph vessel
 - (C) A vein
 - (D) A capillary
- 3 As blood moves around the body its chemical composition changes. In which of the following organs would you expect the blood's oxyhaemoglobin to increase?
- (A) Lungs
 - (B) Heart
 - (C) Kidneys
 - (D) Stomach
- 4 What is the main difference between active and passive transport?
- (A) Active transport is diffusion and passive transport is osmosis.
 - (B) Active transport only occurs in the kidney and passive transport occurs throughout the body.
 - (C) Active transport involves the blood and circulation and passive transport occurs in cells.
 - (D) Active transport requires the input of energy and passive transport requires no additional energy input.

- 5 *Grevillea gaudichaudii* is a natural hybrid between *G. acanthifolia* and *G. laurifolia* occurring in the Blue Mountains near Sydney. Populations of this hybrid show a gradation of characteristics ranging from forms closely resembling *G. acanthifolia* to those closely resembling *G. laurifolia*.

In the future, *G. gaudichaudii* will be regarded as a completely separate and distinct species if which of the following occurs?

- (A) Its population eventually contains only identical individuals.
(B) The parent plants become extinct.
(C) It loses its capacity to be pollinated from adjoining populations of either parent species.
(D) It ceases to interbreed with either parent species and produce fertile offspring.
- 6 In tigers, the allele for normal skin pigmentation (N) is dominant over the allele for albinism (n). An albino female mates with a male tiger that is not an albino, even though his father is. They have a female cub with normal skin pigmentation. Which of the following genotypes describes the female albino tiger, her male mate and their female offspring?
- (A) NN nn Nn
(B) nn NN Nn
(C) Nn NN nn
(D) nn Nn Nn
- 7 The human blood cell is structurally suited to its function because of which of the following?
- (A) It contains haemoglobin which can form a complex with oxygen.
(B) Its disc shape reduces surface area.
(C) It contains enzymes to digest foreign bodies that enter the blood.
(D) It doesn't contain a nucleus which allows more haemoglobin to be packed into the cell.
- 8 "Survival of the fittest" is a term for the process of natural selection as proposed by Charles Darwin. The word 'fittest' is best described by which of the following statements?
- (A) The 'fittest' organism can find and obtain most food, either by predation or by adequate storage.
(B) The 'fittest' organism can survive all changes due to their dominance.
(C) The 'fittest' organisms can produce the largest number of surviving offspring.
(D) The 'fittest' organism can survive harsh environmental conditions by migration or other means.

- 9** The sequence TTA CGA represents a coding strand of a DNA molecule. The corresponding sequences on the other strand of DNA would be best represented by which of the following sequences?
- (A) AAT GCU
 - (B) AAT CCA
 - (C) AAT CGA
 - (D) AAT GCT
- 10** A photo micrograph of a dividing cell from a mouse showed 19 homologous pairs of chromosomes. How many chromosomes would the haploid gametes produced by this mouse contain?
- (A) 38 chromosomes
 - (B) 76 chromosomes
 - (C) 19 chromosomes
 - (D) 10 chromosomes in the male gamete and 9 chromosomes in the female gamete

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Part B
Total marks (65)
Attempt ALL Questions
Allow about 1 hour and 55 minutes for this Part

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Answer the questions in the spaces provided
Show all relevant working in questions involving calculations

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Question 11 (2 marks)

Identify the role of enzymes in metabolism.

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Question 12 (4 marks)

(a) Draw and label a scaled diagram of a white blood cell.

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(b) What are two differences you could observe if you compared a red blood cell and a white blood cell?

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Question 13 (4 marks)

Using a **named** plant found in an estuarine environment, describe a process it uses for salt concentration regulation. Explain why it is essential for estuarine organisms to maintain appropriate salt concentrations in their body.

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Question 14 (5 marks)

The red kangaroo (*Macropus rufus*) is one of the main species of native mammal found in the inland parts of the continent. Air temperature in this environment may fall below 0°C in winter and reach as high as 45°C during the day in summer. Surface water for drinking is often scarce and rainfall unpredictable.

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For a desert mammal, such as the red kangaroo, describe both a physiological and a behavioural response to a change in ambient temperature and explain how each response assists with temperature regulation. In your answer you should discuss the importance of homeostasis.

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Question 16 (4 marks)

- (a) Define the term mutagen. **1**

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- (b) State one example of a mutagen. **1**

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- (c) Describe one piece of evidence which scientists have developed to support the hypothesis that radiation could cause mutations. **2**

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Question 17 (3 marks)

Distinguish between an allele and a gene, giving specific examples in your answer.

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Question 18 (3 marks)

In the space below, draw a simple labelled diagram to illustrate the process of DNA replication.

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Question 19 (4 marks)

State one important use of models in Biology. Illustrate your answer using a specific example of a model you have used.

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Question 20 (3 marks)

In humans, the inheritance of colour blindness is sex-linked.

- (a) Define the term sex-linkage. **1**

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- (b) A colour blind female and a non-colour blind male have a son and a daughter. Using appropriate symbols, show the genetic possibilities for all four of these individuals. **2**

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Question 21 (2 marks)

Both the Kiwi and the recently extinct Moa of New Zealand are examples of flightless birds called ratites.

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For many years, comparative anatomy studies suggested that the two groups were quite closely related. Recently, however, biochemical analysis of the DNA of the two groups suggest that they are not as closely related as first thought, and that the Kiwi is actually more closely related to the Emu of Australia.

Explain how DNA analysis of the Moa and the Kiwi can be used to show evolutionary relationships between them and other ratites.

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Question 22 (6 marks)

Discuss a modern example of natural selection.

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Question 23 (2 marks)

Describe the difference between graduated and punctuated evolution.

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Question 24 (4 marks)

Discuss the accuracy of this statement:

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“genotype determines phenotype.”

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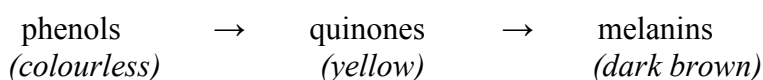
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Question 25 (13 marks)

When many fruits and vegetables are peeled, they turn brown on exposure to air. This browning is caused by a group of **enzymes** called *phenol oxidases*. These enzymes catalyse the relatively slow conversion of naturally occurring colourless phenols to yellow quinones which are then oxidised to dark brown melanins when exposed to the air.



In this experiment the phenol is called catechol and the enzyme is found in the apple extract.

The following are results from a pupil's experiment investigating the browning of apple tissue.

| Volume of contents of tube (mL) | | | | | | |
|---------------------------------|--------------------------|-------------------------------|------------------|-------------|---------------|--------------|
| Tube number | Catechol (colourless) | Apple extract (colourless) | Buffer (pH 7) | Dilute acid | Dilute alkali | appearance* |
| 1 | 2 | - | 5 | - | - | colourless |
| 2 | 2 | 2 | 3 | - | - | dark brown |
| 3 | 2 | 2 | - | 3 | - | colourless |
| 4 | 2 | 2 | - | - | 3 | yellow/brown |
| 5 | - | 2 | 5 | - | - | colourless |
| 6 | 2 | 2** | 3 | - | - | colourless |

* = appearance of tube contents after 10 minutes at room temperature

** = apple extract had been thoroughly boiled before being added to tube 6

- (a) What evidence from these results indicates that the substance in apple extract which causes browning is an enzyme (*catechol oxidase*)? **1**

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Question 25 continued on page 22

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Question 25 (continued)

- (b) From these results, what is the optimum pH range (acid, neutral or alkali) of the enzyme catechol oxidase? Give a reason for your choice using the data in the table. **3**

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- (c) Suggest **two** ways in which apples can be prevented from turning brown after they are peeled. Justify your suggestions by referring to the information provided for this experiment. **3**

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Question 25 continued on page 23

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Question 25 (continued)

(d) Identify three variables that have been kept constant. **3**

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(e) Explain the purpose of tubes 1 and 5. **3**

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Section II**Total marks (25)****Attempt ONE Question from Questions 26 - 30****Allow about 45 minutes for this Section**

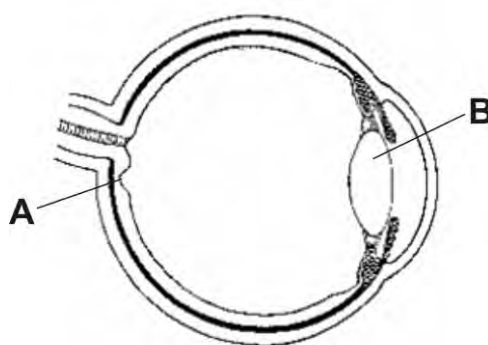
Answer the question in a writing booklet. Extra writing booklets are available.

| | Pages |
|--------------------|--|
| Question 26 | Communication29 |
| Question 27 | Biotechnology |
| Question 28 | Genetics - The Code Broken?31 |
| Question 29 | The Human Story |
| Question 30 | Biochemistry |

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

- (a) (i) Outline the function of the cornea in the eye. **1**
- (ii) Two structures are labelled in the diagram of the eye shown below. State one function for each labelled structure. **2**



- (b) (i) There are new techniques for the treatment of cataracts being developed all the time. Describe how you would gather information on this topic and how you would assess its reliability. **2**
- (ii) Describe the relationship between the wavelength, frequency and the pitch of a sound. **2**
- (c) In your study of vision you performed a first-hand investigation of a pig's eye. Describe the procedure you followed, the results you observed and any safety considerations. **5**
- (d) (i) Outline and compare the detection of vibrations by insects, fish and mammals. **3**
- (ii) Compare the range of frequencies detected by humans as sound and compare this with the other mammals giving possible reasons for the differences. **4**
- (e) Vision and hearing can be impaired both by defects in the sense organs themselves and by damage to the brain. Using specific examples discuss this statement. In your answer include information which demonstrates your understanding of the role of the nervous system in vision and hearing. **6**

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

- (a) (i) Define what is meant by *polygenic inheritance*. **1**
- (ii) Describe one example of *polygenic inheritance*. **1**
- (b) Describe how it is possible for a female with blood type A and a male with blood type B to have children with four different blood types. (*show all working*) **3**
- (c) In a certain flowering plant, the allele for red colour (R) is dominant over the allele for white colour (r); and the allele for long stem (L) is dominant over the allele for short stem (l). **4**

In an experiment, hundreds of heterozygous plants which produce long stem red flowers were crossed with hundreds of plants which produce short stem white flowers.

Approximately equal ratios of four different phenotypes of offspring were expected according to simple Mendelian principles. However, 90% of the offspring had either long stem red flowers or short stem white flowers; only a small number (10%) had long stem white flowers or short stem red flowers.

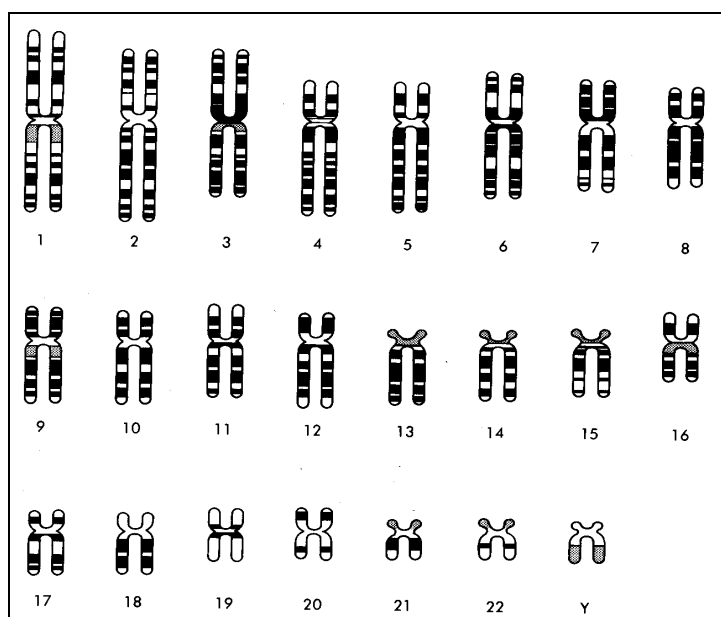
| Phenotype | Expected % | Actual % |
|------------------|------------|----------|
| long stem red | 25 | 45 |
| long stem white | 25 | 5 |
| short stem red | 25 | 5 |
| short stem white | 25 | 45 |

Carefully explain the discrepancy between the expected results and the actual results of this experiment. (*sample size was sufficiently large to reduce statistical errors*)

Question 28 continued on page 30

Question 28 (continued)

- (d) The following diagram (karyotype) shows the chromosomes found in a human cell arranged for ease of identification.



- (i) Should the term *diploid* or *haploid* be used to correctly describe the number of chromosomes shown in this karyotype? Explain your choice. 1
- (ii) From which specific type of human cell was this karyotype obtained? State two reasons for your answer. 2
- (iii) If one of these chromosomes was damaged, would that type of mutation be considered *germ line* or *somatic*? Explain your answer, including a discussion of the consequences of that type of mutation. 3
- (e) Using a specific named example, describe the current use of gene therapy to manage disease. 4
- (f) Outline the procedure to produce recombinant DNA and discuss one current successful application of this technology. 6