

B O A R D O F S T U D I E S
NEW SOUTH WALES

2004

**HIGHER SCHOOL CERTIFICATE
EXAMINATION**

Biology

General Instructions

- Reading time – 5 minutes
- Working time – 3 hours
- Write using black or blue pen
- Draw diagrams using pencil
- Board-approved calculators may be used
- Write your Centre Number and Student Number at the top of pages 9, 13, 15 and 19

Total marks – 100

Section I Pages 2–21

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 part

Part B – 60 marks

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

Section II Pages 23–29

25 marks

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

Section I
75 marks

Part A – 15 marks

Attempt Questions 1–15

Allow about 30 minutes for this part

Use the multiple-choice answer sheet.

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

Sample: $2 + 4 =$ (A) 2 (B) 6 (C) 8 (D) 9
A B C D

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

A B C D

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 as follows.

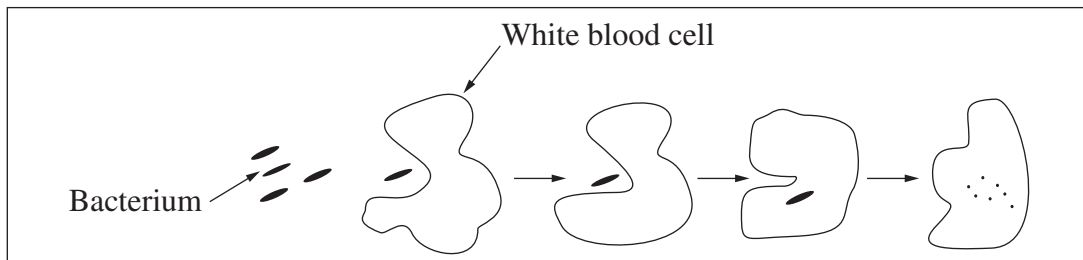
A B C D
correct ↙

- 1 Which of the following statements can be used to describe a pathogen?
- (A) They are all viral.
 - (B) They are all infectious.
 - (C) They are all microscopic.
 - (D) They are all macroparasites.
- 2 Which of the following helps prevent the entry of pathogens into humans?
- (A) Cilia
 - (B) Antigens
 - (C) B lymphocytes
 - (D) Inflammation response
- 3 Recently, hospitals and medical practitioners have warned the community about the spread of severe acute respiratory syndrome (SARS). People were experiencing:
- high temperatures
 - body aches
 - pains similar to that of the flu.

How would you classify these descriptions?

- (A) Controls
 - (B) Symptoms
 - (C) Warnings
 - (D) Methods of transmission
- 4 What is the name of the scientist who identified the role of microbes in decay?
- (A) Macfarlane Burnet
 - (B) Robert Koch
 - (C) Louis Pasteur
 - (D) Ronald Ross

- 5 The diagram below illustrates one process that occurs as part of an immune response.



What process does the diagram illustrate?

- (A) Cytokinesis
 (B) Inflammation
 (C) Osmosis
 (D) Phagocytosis
- 6 Which adaptation assists temperature regulation in plants?
- (A) Large leaves for cooling
 (B) Increased production of seeds
 (C) Movement of glucose to roots
 (D) Evaporation of water from stomates
- 7 Blood travels around the body through arteries, veins and capillaries. Which of the following correctly describes the structure or function of each of these blood vessels?

	<i>Artery</i>	<i>Vein</i>	<i>Capillary</i>
(A)	Always carries oxygenated blood	Always carries deoxygenated blood	Always carries waste products
(B)	Thick muscular walls	Thin walls with valves	Walls one cell thick
(C)	Takes blood to the heart	Thick muscular walls	Takes blood to and from the heart
(D)	Carries blood under high pressure	Carries blood under variable pressure	Thin walls with valves

- 8 Which statement best describes a function of nephrons?
- (A) Filter waste products from the blood
 - (B) Remove carbon dioxide from the blood
 - (C) Collect urine from the blood
 - (D) Remove the waste products directly from the cells in the blood
- 9 Which statement defines homeostasis in multicellular organisms?
- (A) Homeostasis is the process by which cells maintain their internal environment.
 - (B) Homeostasis is the maintenance of the internal and external environment of the organism.
 - (C) Homeostasis is the process by which animals and plants maintain their body temperature.
 - (D) Homeostasis is the maintenance of a constant internal environment of the organism.
- 10 Which of the following sequences most correctly represents the results of a reaction involving an enzyme?

KEY

E Enzyme

*P*₁ Product₁

*P*₂ Product₂

S Substrate

- (A) $P_1 + S \rightarrow P_2 + E$
 - (B) $S + E \rightarrow P_1 + P_2$
 - (C) $P_1 + P_2 + E \rightarrow S + E$
 - (D) $S + E \rightarrow P_1 + P_2 + E$
- 11 Which of the following is the correct base-pairing in DNA?
- (A) G—C, A—T
 - (B) T—U, A—G
 - (C) G—T, A—C
 - (D) G—C, A—U

12 Reproductive technologies focus on the transfer of genetic information.

Which process only involves the transfer of the nucleus?

- (A) Cloning
- (B) Transgenesis
- (C) Artificial pollination
- (D) Artificial insemination

13 In rabbits, black (B) coat colour is dominant over white (b) coat colour.

Which Punnet square correctly represents a cross between a rabbit heterozygous for coat colour and a white rabbit?

(A)

	B	b
B	BB	Bb
b	Bb	bb

(B)

	B	B
b	Bb	Bb
b	Bb	Bb

(C)

	B	b
b	Bb	bb
b	Bb	bb

(D)

	B	b
b	Bb	Bb
b	Bb	Bb

14 Why is accurate replication of DNA important?

- (A) It leads to cell differentiation.
- (B) It maintains genetic information.
- (C) It allows for evolution of the species.
- (D) It enables cells to modify their proteins.

15 'Generally, gametes produced by an organism will not be identical.'

Which of the following does NOT influence this genetic variability of gamete formation?

- (A) Mutation
- (B) Sex linkage
- (C) Independent assortment of alleles
- (D) Crossing over in homologous chromosomes

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Centre Number

Section I (continued)

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Student Number

Part B – 60 marks

Attempt Questions 16–29

Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

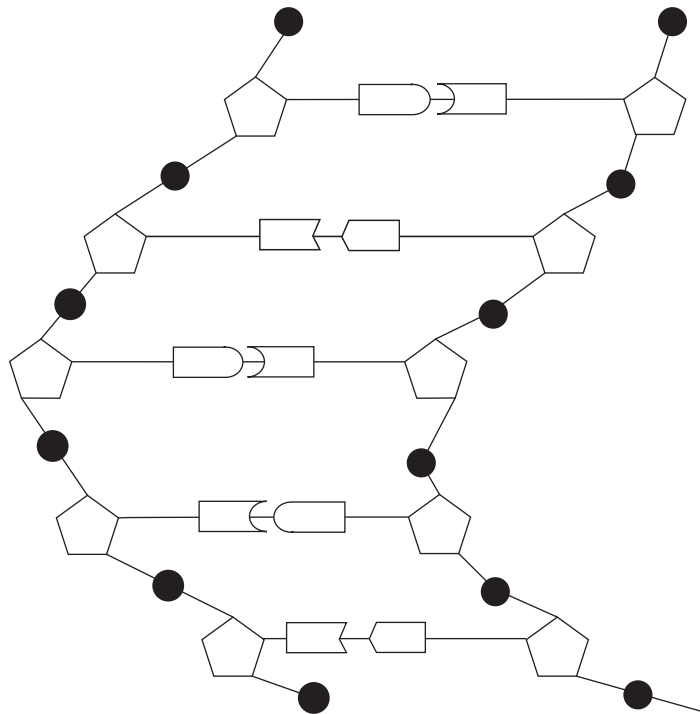
Marks

Question 16 (4 marks)

(a) On the diagram, clearly identify ONE nucleotide by placing a box around it.

1

Structure of portion of a DNA molecule



Senior Biology, RJ King and FM Sullivan, Longman Australia/Pearson Education Australia. Reproduced with permission.

(b) Outline the main steps of DNA replication.

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Question 17 (7 marks)

A plant breeder replicated one of Mendel’s pea plant breeding experiments. The results of the cross between green (G) pods and yellow (g) pods are shown in the table.

<i>Generation</i>	<i>Pod colour</i>	
	<i>Green (G)</i>	<i>Yellow (g)</i>
F_1	632	0
F_2	1560	482

- (a) List all possible genotypes of the F_2 generation. **1**

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- (b) Using your understanding of current genetic thinking, interpret the results of the F_2 cross depicted above. **3**

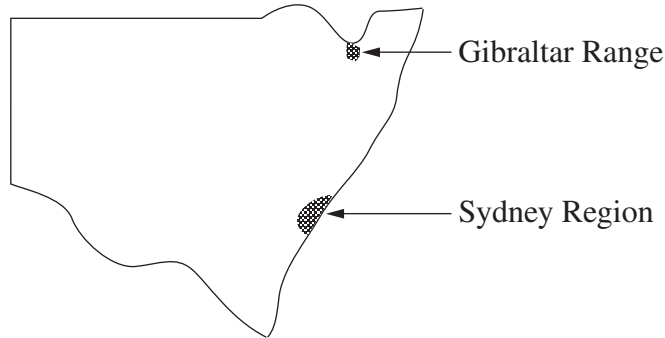
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- (c) Describe the features of TWO experimental techniques used by Mendel that led to his success. **3**

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Question 18 (6 marks)

- (a) A plant species found in the area immediately around Sydney has also been found in a small area in the Gibraltar Range in the far north of NSW. **3**



Map of NSW

Predict what might happen to the TWO populations over the next 5 million years, in terms of Darwin/Wallace's theory of evolution.

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- (b) Justify the use of vertebrate forelimbs as evidence to support the theory of evolution. **3**

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Question 20 (3 marks)

(a) Identify ONE type of *T* lymphocyte. **1**

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(b) Distinguish between the functions of *B* cells and *T* cells. **2**

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Question 21 (3 marks)

The Murray-Darling Basin is the natural habitat of the Murray Cod, a native Australian freshwater fish. **3**

Explain the implications of increased water salinity for the survival of the Murray Cod.

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Question 22 (3 marks)

Public health programs, pesticides and genetic engineering are used to control and/or prevent disease. **3**

Using an example, explain how ONE of these strategies has been used to control or prevent disease within the community.

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 23 (3 marks)

Current theories describe differences in the movement of substances through plants. **3**

Compare the movement of substances in xylem and phloem tissues.

<i>Feature</i>	<i>Xylem</i>	<i>Phloem</i>
Material transported		
Process of movement		
Name of relevant current theory		

Question 24 (3 marks)

Justify continued research into the development of artificial blood. **3**

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Question 25 (6 marks)

(a)

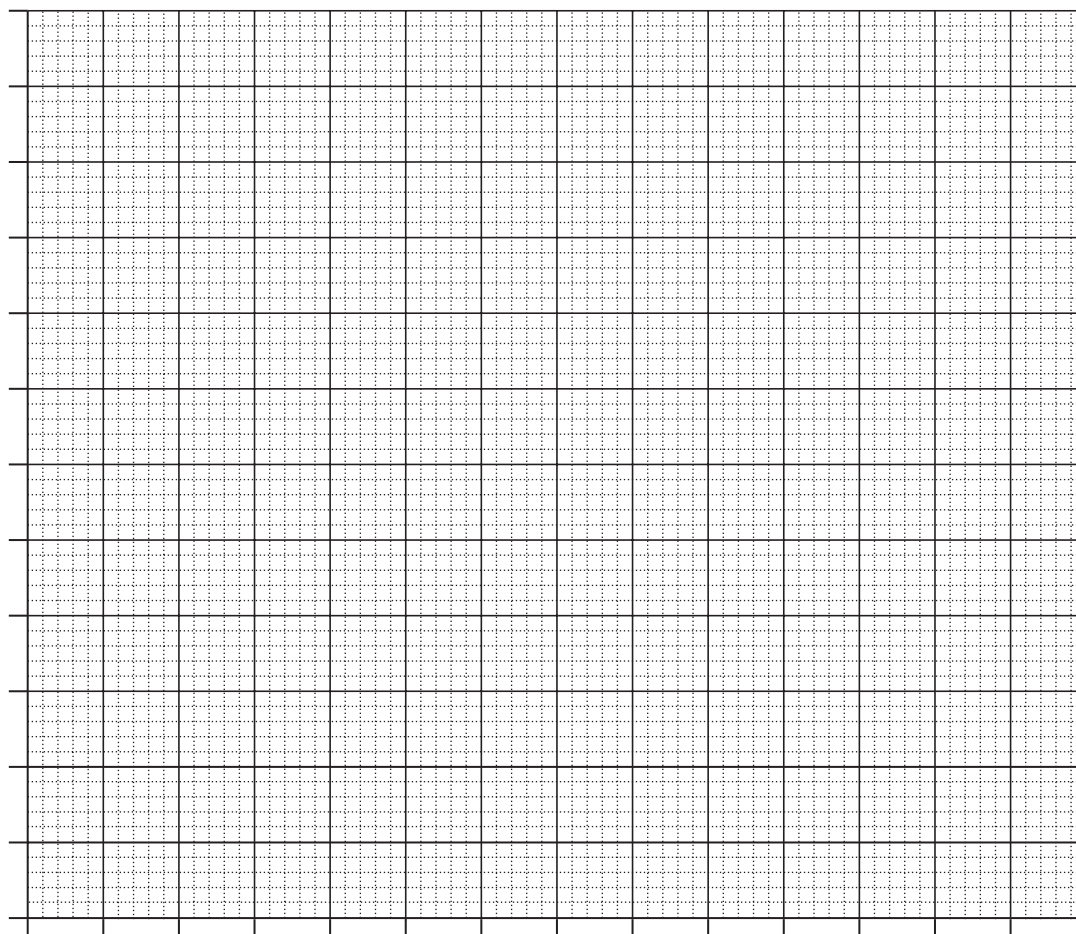
Death due to lung cancer in males and females in Australia

5

<i>Time</i>	<i>Death rate per 100 000 population</i>	
	<i>Males</i>	<i>Females</i>
1994	59	19
1995	56	19
1996	55	19
1997	51	19
1998	52	18
1999	50	19
2000	48	19
2001	47	20

Draw the most appropriate graph for the information, on the grid provided.

Death due to lung cancer



Question 25 continues on page 17

Question 25 (continued)

- (b) Suggest additional data that needs to be gathered before a relationship between smoking and lung cancer can be inferred. 1

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Question 26 (3 marks)

You undertook a first-hand investigation to examine plant shoots and leaves for evidence of pathogens and insect pests. 3

Using the information you gathered, complete the table.

	<i>Plant shoot or plant leaf</i>
Evidence of pathogen	
Evidence of insect pest	
Equipment or procedure used for observation	

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Centre Number

Section I – Part B (continued)

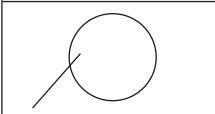
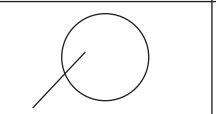
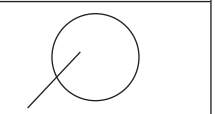
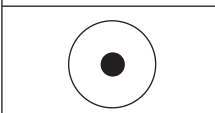
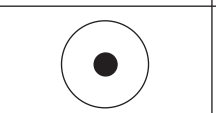
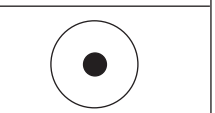
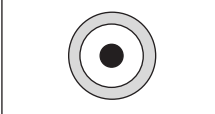

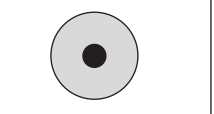
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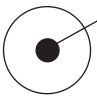
Question 27 (4 marks)

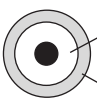
Marks


To study the effect of an antibiotic on three strains of bacteria (*A*, *B*, *C*), agar plates were set up as shown.

	Agar plate 1	Agar plate 2	Agar plate 3
Method			
	Surface covered with bacterium <i>A</i>	Surface covered with bacterium <i>B</i>	Surface covered with bacterium <i>C</i>
			
Incubation 37°C, 48 hours			
Result			

KEY

 Disc of the same antibiotic X placed on each plate

 Clear zone no bacteria

 Bacterial growth

The plates were incubated at 37°C for 48 hours. The diagrams of plates 1, 2 and 3 depict the results.

- (a) Write a conclusion to the experiment. 1

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- (b) Identify ONE safe work practice used to minimise risks associated with handling or identifying microbes. 1

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Question 27 continues on page 20

Question 27 (continued)

- (c) In humans, bacterial infections are often treated with antibiotics. Explain why the complete course of antibiotics should be taken, even if the symptoms of infections have disappeared. 2

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Question 28 (3 marks)

‘All mutations are harmful.’ 3

Discuss this statement.

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Question 29 (8 marks)

A space probe recently returned to Earth from a distant planet, with samples containing bacteria *X*.

8

Biologists are interested in comparing the activity of an enzyme found in bacteria *X* with that found in bacteria *E* from Earth. Both bacteria contain an enzyme that produces a gas as a product of its activity on the same substrate.

	<i>Environmental conditions where bacteria were collected</i>	
	<i>Temperature (°C)</i>	<i>pH</i>
<i>Bacteria X</i>	50–80	5.5–7.5
<i>Bacteria E</i>	37–55	6.5–8.5

State a hypothesis to be tested, and plan an investigation you could carry out to compare the activity of the enzymes found in these TWO bacteria under ONE of these conditions.

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Biology

Section II

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.

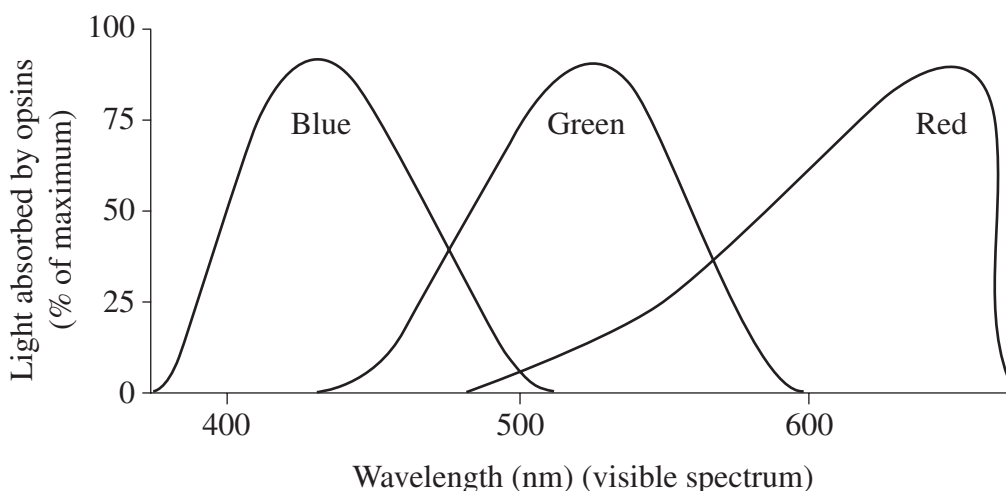
	Pages
Question 30 Communication	24
Question 31 Biotechnology	25
Question 32 Genetics: The Code Broken?	26
Question 33 The Human Story	27–28
Question 34 Biochemistry	29

Question 30 — Communication (25 marks)

- (a) (i) Name the part of the brain involved in perception and interpretation of light and sound. **1**
- (ii) Describe the stimulus-response pathway that is used to respond to stimuli from the external environment. **3**
- (b) During the study of Communication, you undertook an investigation to identify the relationship between wavelength, frequency and pitch of sound.
 - (i) Provide an outline of the method followed in this investigation. **4**
 - (ii) Explain how this investigation increased your understanding of sound. **2**
- (c) A focus of the option Communication was the technologies developed to overcome difficulties associated with the detection of, transmission of and response to stimuli in the environment. **7**

Discuss the impact that these technologies have had on society.

- (d) The graph depicts the relationship between light absorption by colour sensitive pigments (opsins) and wavelength of light.



Biology Options Communication, Glenda Chidrawi and Marilyn Mercer, 2003, McGraw- Hill Australia Pty Ltd, Sydney.


- (i) Explain why the brain is able to interpret a variety of colours. **2**
- (ii) With reference to light absorption of opsins, explain how a person can be colour blind. **2**
- (iii) Describe the use of colour for communication in animals other than humans, and relate this to the occurrence of colour vision in animals. **4**

Question 31 — Biotechnology (25 marks)

- (a) (i) Name an ancient Australian Aboriginal use of biotechnology. **1**
- (ii) Describe how the breeding of animals with desired characteristics may be considered as early biotechnology. **3**
- (b) During the study of Biotechnology, you undertook an investigation to extract DNA from a suitable source.
- (i) Provide an outline of the method followed in this investigation. **4**
- (ii) Outline uses of extracted DNA in biotechnology. **2**
- (c) A focus of the option Biotechnology was an understanding of biotechnological processes and the application of these processes for assisting humans. **7**

Discuss, using named examples, the impact of the application of biotechnology on society.

(d)



Fluorescent fish go on sale

Despite objections from food safety and conservation groups, zebra fish genetically modified to fluoresce red went on sale in several pet stores in Florida last week. ‘They’re selling really well,’ says Steven Feinberg of the Pet Supermarket chain. Each GloFish costs \$4.99, ten times as much as a normal zebra fish, he says.

For this genetically modified fish to be produced, a number of processes would have been used. Gene splicing may have been one of them.

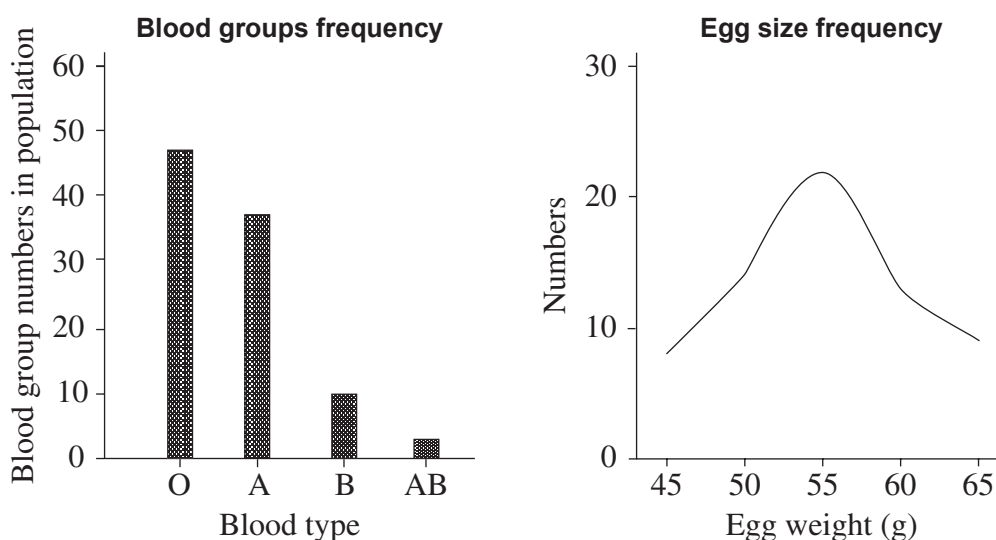
- (i) Outline the process of gene splicing to produce recombinant DNA. **2**
- (ii) Fluorescent zebra fish are able to mate with non-fluorescent fish to produce viable offspring. Propose an impact on the environment if the fluorescent fish are accidentally released. **2**
- (iii) Explain why some groups in society may have different views about the use of DNA technology to produce zebra fish that fluoresce. **4**

Question 32 — Genetics: The Code Broken? (25 marks)

- (a) (i) Name the nitrogen base unique to mRNA. **1**
- (ii) Outline how the information contained in DNA is used to produce a polypeptide. **3**
- (b) During the study of Genetics: The Code Broken?, you undertook an investigation to model linkage.
 - (i) Provide an outline of the method followed when modelling linkage. **4**
 - (ii) Explain how this investigation increased your understanding of linkage. **2**
- (c) A focus of the option Genetics: The Code Broken? included genetic changes that occur as a result of human intervention. **7**

Discuss the impact that genetic change due to human intervention has had on society.

- (d) In two separate experiments, blood groups in humans and egg size in chickens were investigated. The following data were collected and the results graphed.



- (i) Identify the graph that represents polygenic inheritance. **1**
- (ii) Discuss the differences between the graphs, supporting your answer with a description of polygenic and multiple allele inheritance. **4**
- (iii) Using an example, outline the use of highly variable genes for DNA fingerprinting of forensic samples. **3**

Question 33 — The Human Story (25 marks)

- | | | | |
|-----|------|---|----------|
| (a) | (i) | Name the GENUS to which modern humans belong. | 1 |
| | (ii) | Describe THREE primate characteristics of prosimians. | 3 |
| (b) | | During the study of The Human Story, you undertook an investigation to model DNA-DNA hybridisation. | |
| | (i) | Provide an outline of the method followed when modelling DNA-DNA hybridisation. | 4 |
| | (ii) | Explain how this investigation increased your understanding of the use of DNA-DNA hybridisation in possible evolutionary relationships. | 2 |
| (c) | | A focus of the option The Human Story was the use of fossil evidence to support various theories about human evolution. | 7 |

Discuss the impact that modern technologies have on research in this area.

Question 33 continues on page 28

Question 33 (continued)

- (d) The three sets of diagrams below illustrate some anatomical differences between apes and humans.



- (i) Based on the data above, construct a table that describes the anatomical differences between an ape and a human. 4
- (ii) How does the interpretation of the differences in TWO of these anatomical features provide evidence to support human evolution? 4

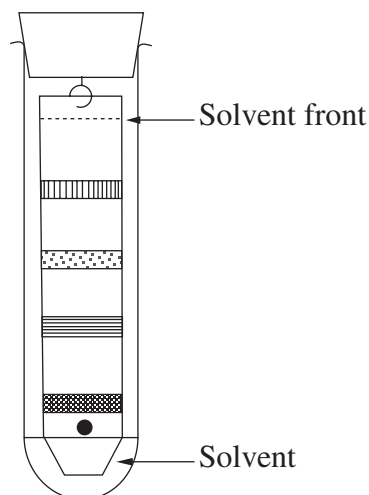
End of Question 33

Question 34 — Biochemistry (25 marks)

- (a) (i) Name the organelle where photosynthesis occurs. **1**
- (ii) Describe the overall process of photosynthesis. **3**
- (b) During the study of Biochemistry, you undertook an investigation to determine the effect of light intensity and temperature on gas production in a pond weed.
- (i) Provide an outline of the method followed in this investigation. **4**
- (ii) Explain how this investigation increased your understanding of photosynthesis. **2**
- (c) A focus of the option Biochemistry includes the study of reactions within living organisms. **7**

Discuss the impact of new technologies on biological research.

- (d) Tswett invented a method for the separation of leaf pigments. The diagram represents possible results of Tswett's work.



Senior Biology, RJ King and FM Sullivan, Longman Australia 1995/Pearson Education Australia. Reproduced with permission.

- (i) Name the method invented, and outline how Tswett would have interpreted the results. **2**
- (ii) Describe the role of chlorophyll in the light reaction. **2**
- (iii) Referring to a named scientist, explain the role of radioactive isotopes in determining our current understanding of photosynthesis. **4**

End of paper

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