BOARD OF STUDIES
NEW SOUTH WALES

2007

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, 17 and 19

Total marks – 100

Section I Pages 2–20

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 16–27
- Allow about 1 hour and 45 minutes for this part

Section II Pages 21–31

25 marks

- Attempt ONE question from Questions 28–32
- 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 for Questions 1–15.

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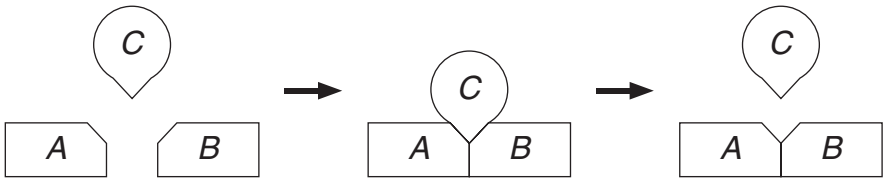
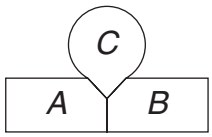
1 The diagram shows one example of enzyme action as demonstrated by the 'Lock and Key' model.



Which part of the diagram represents the substrate?

(A) 

(B) 

(C) 

(D) 

2 Why do cells contain many different enzymes?

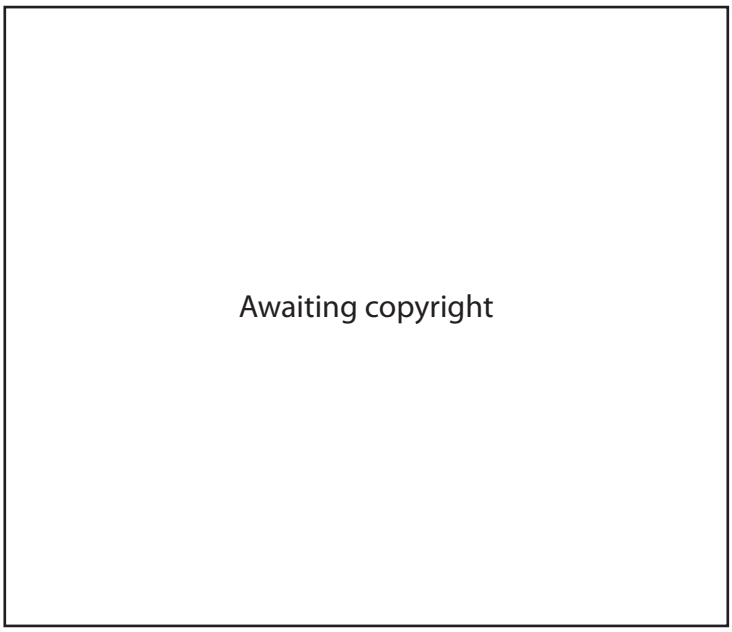
(A) Enzymes are temperature specific.

(B) Enzymes are specific in their action.

(C) Enzymes are sensitive to pH changes.

(D) Enzymes are sensitive to substrate concentration.

3 This is a longitudinal section of plant stem (×200).



What is the name and function of the tissue labelled *W*?

	Name	*Function*
(A)	Xylem	Transports water and mineral ions
(B)	Phloem	Transports water and mineral ions
(C)	Xylem	Transports simple sugars
(D)	Phloem	Transports simple sugars

4 The Wollemi Pine (*Wollemia nobilis*) is easily killed by the fungus *Phythopthera* which lives in the soil. The last small population of Wollemi Pines grows in a remote part of a national park in NSW. Scientists studying this natural population use strategies to prevent the trees becoming infected with *Phythopthera*.

Which procedure would be most effective in preventing the spread of this fungus to the Wollemi Pines?

(A) Inspecting soil samples in the area

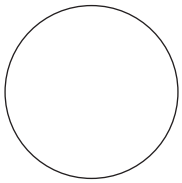
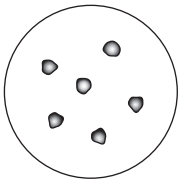
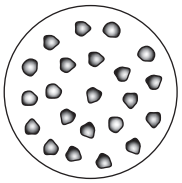
(B) Commercially producing and distributing the Wollemi Pine

(C) Washing soil from scientists' shoes before they walk in the area

(D) Preventing the importation of infected Wollemi Pines into Australia

5 Students performed an investigation to compare the effectiveness of two water treatments for purifying pond water.

Three samples of pond water, *A*, *B* and *C,* were collected and each used to inoculate an agar plate. The plates were incubated at 25°C and examined three days later. The number of visible bacterial colonies on each plate was counted and the results tabulated.

Sample	*A*	*B*	*C*
Treatment	5 grams of pool chlorine per litre of water	Boiling for one minute	No treatment
Number of visible bacterial colonies	0 	6 	22 

What is the dependent variable in this investigation?

(A) The use of a control sample

(B) The number of visible bacterial colonies

(C) The use of sterile agar plates for each sample

(D) Treating the water by boiling or adding pool chlorine

6 Which biological term is best described by ‘engulfing and destruction of bacteria or other foreign bodies’?

(A) Vaccination

(B) Phagocytosis

(C) Antibody production

(D) An inflammation response

7 Which leaf structures are adaptations to assist in the conservation of water?

(A) Central vein, irregular leaf shape

(B) Large air spaces, pointed leaf tip

(C) Spongy mesophyll, vascular bundle

(D) Sunken stomates, thick waxy cuticle

8 Which observations can be used to demonstrate Koch's contribution to understanding the cause of disease?

(A) Polio vaccinations trigger an immune response.

(B) Some mosquitoes carry a pathogen that is often fatal to people.

(C) A lack of vitamin C is found in all people suffering the nutritional disease scurvy.

(D) The bacteria, *Heliobacter pylori*, is present in the stomach of all people diagnosed with stomach ulcers.

9 Current reproductive techniques can be used to alter the genetic composition of a population. Some of these methods were also used in the nineteenth century by Gregor Mendel.

How did Mendel use reproductive techniques in his experiments?

(A) He artificially inseminated the pea plants to achieve wrinkled seeds.

(B) He cloned the pea plants with round seeds to increase their food supply.

(C) He created a transgenic species by mixing tall pea plants and short pea plants.

(D) He artificially pollinated the pea plants to test for different genotypes in the offspring.

10 Which statement best describes the relationship between proteins and polypeptides?

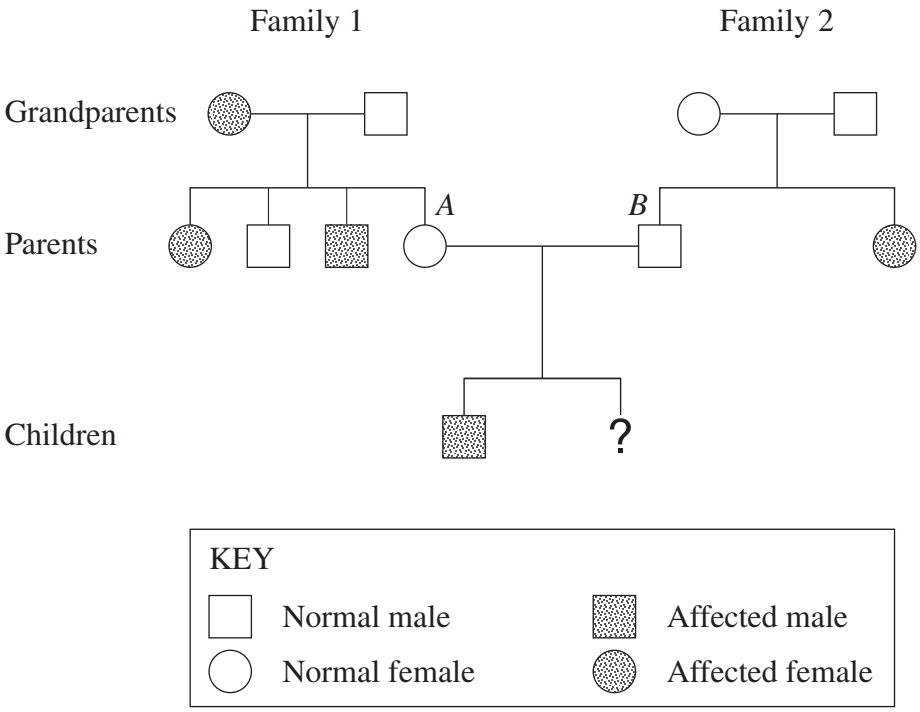
(A) Proteins are composed of polypeptides.

(B) Polypeptides are composed of proteins.

(C) Proteins, unlike polypeptides, are composed of amino acids.

(D) Polypeptides, unlike proteins, are composed of amino acids.

11 The family tree shows the inheritance of a genetic characteristic.



What is the probability that a daughter of parents *A* and *B* would be affected?

(A) 0%

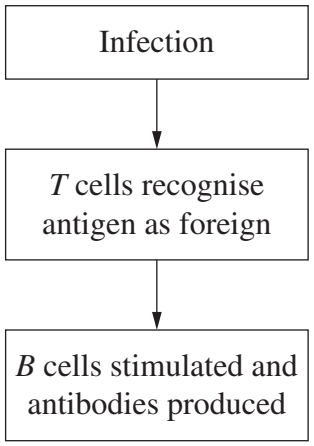
(B) 25%

(C) 50%

(D) 100%

12 Which flowchart correctly shows an interaction between *B* and *T* lymphocytes during an immune response?

(A)



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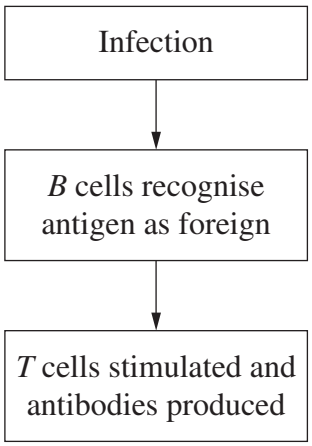
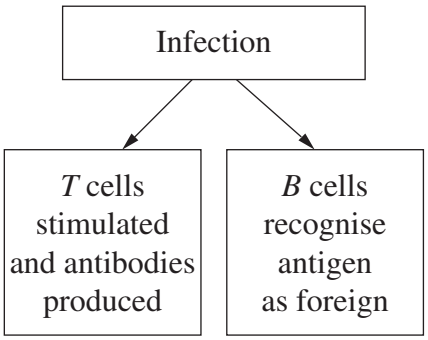
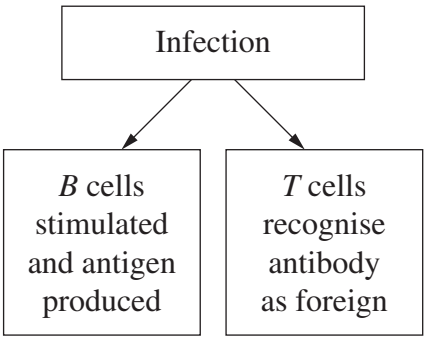


(C)



(D)



13 The effectiveness of a new insecticide was tested on a large population of mosquitoes over a number of breeding cycles. At first the population of mosquitoes was reduced dramatically by the use of the insecticide. After a number of breeding cycles the population then began to increase until the insecticide appeared to have little effect.

How would the Darwin/Wallace theory of evolution by natural selection explain these observations?

(A) Some of the original population were isolated from the insecticide as a control group.

(B) Some of the original population had already reproduced before the insecticide was used.

(C) Some of the original population were resistant to the insecticide and passed this on to their offspring.

(D) Some of the original population adapted to the insecticide and survived to produce offspring.

14 At the end of a marathon race a runner's body is dehydrated.

How does the body control the two hormones, ADH and aldosterone, to help to re-establish normal water balance?

(A) ADH is released and aldosterone is inhibited.

(B) ADH is inhibited and aldosterone is released.

(C) Both ADH and aldosterone are released.

(D) Both ADH and aldosterone are inhibited.

15 How have Walter Sutton and Theodor Boveri contributed to the understanding of inheritance?

(A) By determining the structure of DNA

(B) By improving knowledge of sex linkage

(C) By demonstrating the effect of environment on phenotype

(D) By identifying the importance of chromosomes in inheritance

Centre Number

Student Number

Section I (continued)

Part B – 60 marks
Attempt Questions 16–27
Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

Marks

Question 16 (3 marks)

A student working in a restaurant kitchen is required to wear disposable gloves and hat when preparing food.

(a) Explain how this practice assists in the control of disease. **2**

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(b) Identify another hygiene practice that reduces the risk of infection. **1**

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Marks

Question 17 (3 marks)

Construct a table to distinguish between the environmental conditions experienced by marine and fresh water fish, and the resulting urine production of each fish. **3**

Question 18 (4 marks)

(a) Name a blood product extracted from donated blood and outline how it could be used to restore normal body function. **2**

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(b) Propose TWO reasons why research is needed to develop alternatives to donated blood. **2**

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Marks

Question 19 (6 marks)

(a) Name ONE example of a disease caused by a macro-parasite. **1**

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(b) List TWO features of prions that distinguish them from protozoans. **2**

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(c) Most pathogens must first be transmitted to and enter the human body before they trigger an immune response. **3**

Relate this statement to a named infectious disease you have studied.

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Question 20 (6 marks)

Please turn over

Marks

Question 20 (6 marks)

(a) The table shows that 20% of the bases in a section of double-stranded DNA are adenine (*A*). **3**

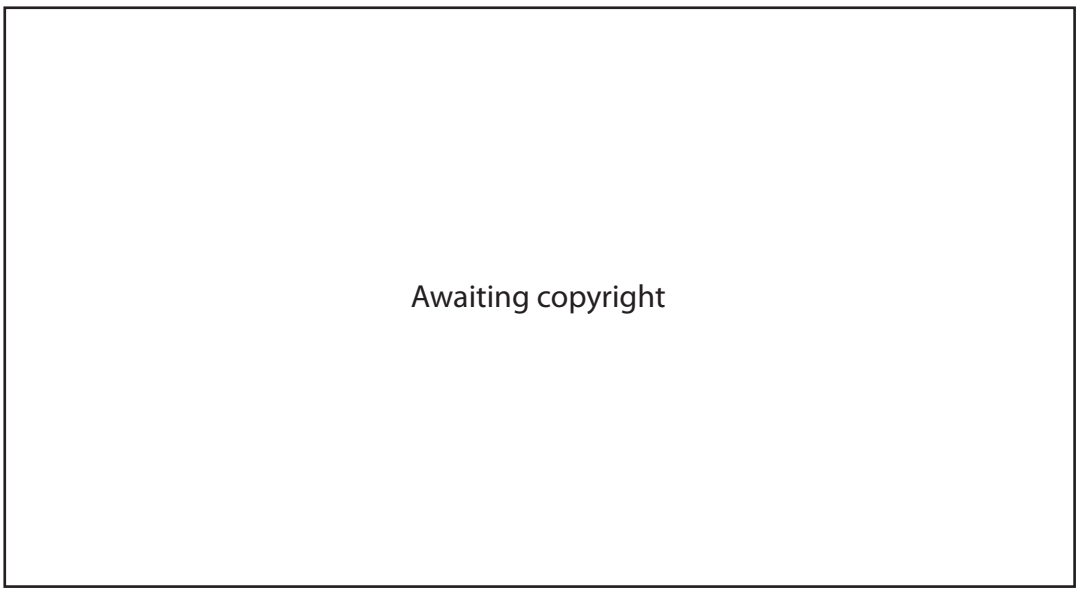
Complete the table below by identifying the other three base types and calculating the percentage of each base type in the section of double-stranded DNA.

Bases	*Percentage* (%)
A	20

(b) Construct a simple flowchart to describe the process of DNA replication. **3**

Marks

Question 21 (6 marks)



(a) Which disease in the table is the most dangerous? Give TWO reasons for your answer. **2**

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(b) Evaluate the effectiveness of a vaccination program for ONE named disease from the table. **4**

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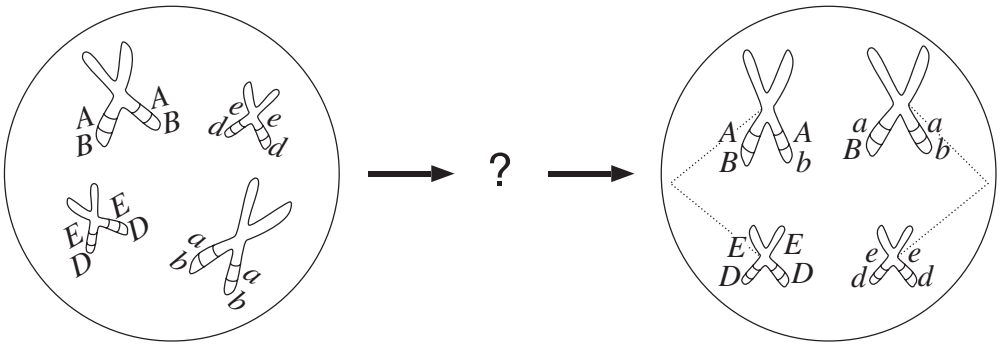
Marks

Question 22 (8 marks)

The diagram shows two steps of the process of meiosis occurring in a cell with four chromosomes.



(a) Describe the behaviour of the chromosomes between the steps shown. **2**

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(b) List FOUR possible combinations of alleles that would be found in the gametes resulting from this process. **2**

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(c) Explain ONE advantage of the process of meiosis to the species. **2**

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(d) Distinguish between the terms *allele* and *gene*. **2**

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Centre Number

Student Number

Section I – Part B (continued)

Marks

Question 23 (4 marks)

Nothofagus gunnii is a deciduous beech tree that grows in Tasmania. When environmental temperatures decrease at the beginning of winter the beech tree drops its leaves. **4**

Design a procedure, using potted beech seedlings, to investigate the temperature at which leaves begin to drop.

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Marks

Question 24 (6 marks)

The flowchart shows the development of technology used to measure oxygen concentration in blood during surgery.

The patient's skin colour is monitored during surgery by a doctor. A bluish colour indicates low levels of oxygen in the blood.

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The pulse oximeter, invented in 1978, is a device that uses red and infra-red light to measure the colour of the blood in arteries. The redder the blood, the higher the oxygen level. The pulse oximeter cannot detect very low oxygen levels and does not work when a patient has no pulse, as in bypass surgery.

↓

The T-Stat oximeter, developed in 2004, uses blue and green light to measure the oxygen level of the blood in capillaries. The T-Stat oximeter can measure very low oxygen levels, even if the patient has no pulse.

(a) Why is it important to monitor oxygen levels in the blood during surgery? **1**

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(b) Explain ONE advantage of the T-Stat oximeter over the pulse oximeter. **2**

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(c) Explain TWO changes in the chemical composition of blood as it moves along a capillary. **3**

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Marks

Question 25 (3 marks)

Epidemiological studies indicate that there is a relationship between smoking and the incidence of lung cancer. **3**

What information would have been gathered to establish this relationship?

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Question 26 (3 marks)

Describe how genes assist in the maintenance of health. **3**

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Marks

Question 27 (8 marks)

Scientists at a climate research unit estimate that global land areas have warmed at an average rate of 0.07°C per decade from 1901 to 2000. **8**

Analyse the possible effects of temperature change on Australian plants and animals with regard to the short-term survival of individuals and long-term survival of species.

Biology

Section II

25 marks
Attempt ONE question from Questions 28–32
Allow about 45 minutes for this section

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

Marks

Question 28 — Communication (25 marks)

(a) (i) Name TWO refractive media in the human eye. **2**

(ii) Explain how a problem with ONE of these media may contribute to poor eyesight or blindness. **3**

(b) (i) Describe an investigation you conducted to distinguish parts of the brain and locate the regions involved in speech, sight and sound perception. **3**

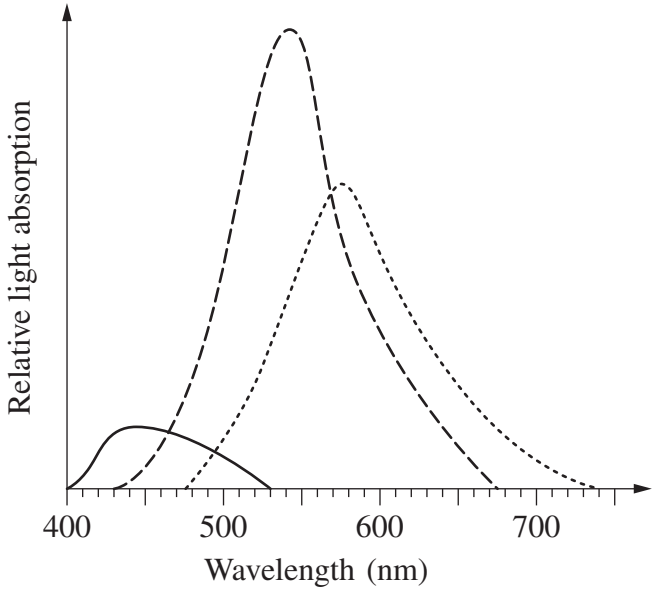
(ii) How would you evaluate the relevance and reliability of the information gathered in this investigation? **3**

(c) Assess how structures in the human body that produce, detect and perceive sound enable effective communication. Include examples of these structures in your answer. **7**

Question 28 continues on page 23

Question 28 (continued)

(d) The graph shows the relative light absorption by cones in the human eye.



KEY

——— Blue pigment cone

– – – – Green pigment cone

-------- Red pigment cone

(i) Estimate the wavelength at which the green pigment cone absorbs most light. **1**

(ii) Describe the pattern of light absorption by the red pigment cone, and suggest why all three pigment cones are necessary for colour vision. **2**

(iii) Explain the relationship between the occurrence of colour vision in animals and their use of colour for communication. Include examples in your answer. **4**

End of Question 28

Marks

Question 29 — Biotechnology (25 marks)

(a) (i) Name TWO organic compounds produced by fermentation techniques developed since the early eighteenth century. **2**

(ii) Explain how the use of ONE of these organic compounds had an impact on society at the time of its introduction. **3**

(b) (i) Describe how you gathered and analysed information to outline the purpose of a current application of transgenic technology. **3**

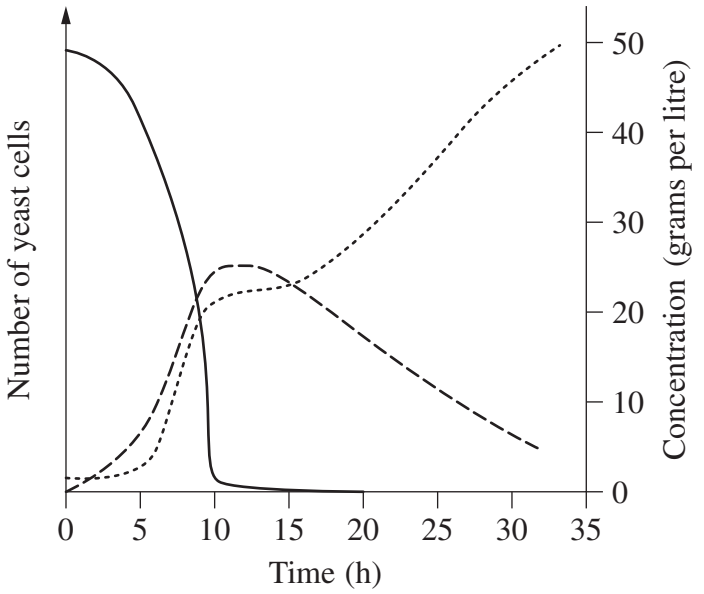
(ii) How would you evaluate the relevance and reliability of the information gathered in this investigation? **3**

(c) Assess the biotechnological processes used in aquaculture. Include examples in your answer. **7**

Question 29 continues on page 25

Question 29 (continued)

(d) The graph shows data recorded during fermentation by yeast cells.



KEY

-------- Number of yeast cells

——— Glucose

– – – – Ethanol

(i) Estimate the time at which ethanol concentration is at its maximum. **1**

(ii) Describe the trend in glucose concentration, and suggest a reason for this change. **2**

(iii) Explain how changes in technology have modified traditional uses of biotechnology. **4**

End of Question 29

Marks

Question 30 — Genetics: The Code Broken? (25 marks)

(a) (i) Name TWO examples of characteristics determined by multiple alleles in an organism other than humans. **2**

(ii) Explain how ONE of these characteristics provides variability in phenotypes. **3**

(b) (i) Describe how you gathered and analysed information to describe the processes used in the cloning of an animal. **3**

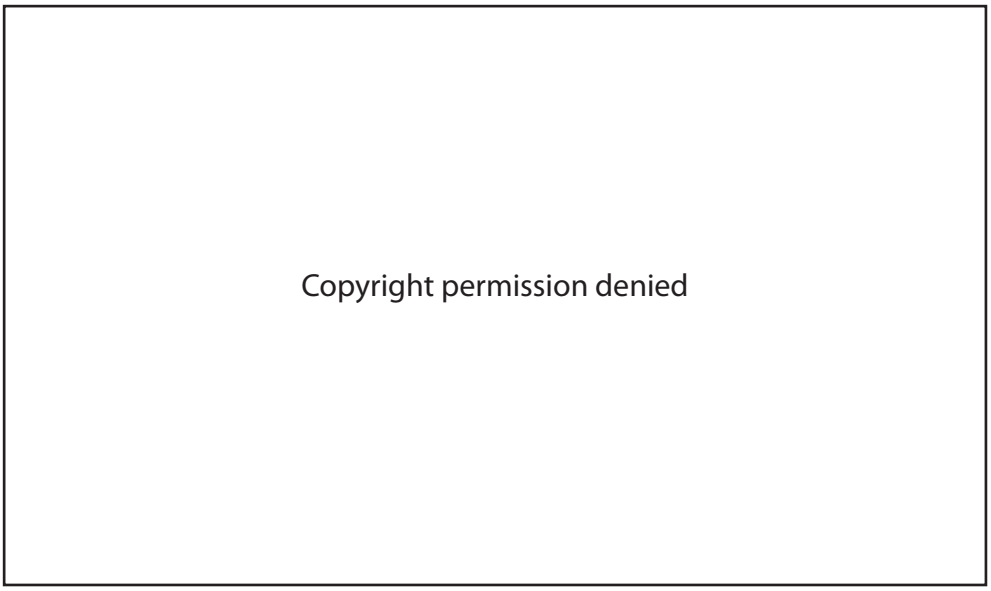
(ii) How would you evaluate the relevance and reliability of the information gathered in this investigation? **3**

(c) Assess how the mapping of the Human Genome and gene therapy assist in managing a genetic disease OR a form of cancer OR AIDS. **7**

Question 30 continues on page 27

Question 30 (continued)

(d) The graph shows maternal age and incidence of Down syndrome (Trisomy 21) births.



(i) Estimate the number of infants with Down syndrome per 1000 births for 40-year-old mothers. **1**

(ii) Describe the trend in the number of Down syndrome births, and define the term *trisomy*. **2**

(iii) Discuss the impact on the genome of transposable genetic elements. **4**

End of Question 30

Marks

Question 31 — The Human Story (25 marks)

(a) (i) Name TWO hominids known from fossil evidence. **2**

(ii) Describe how ONE of these hominids differs from *Homo sapiens*. **3**

(b) (i) Describe how you processed information and used available evidence to assess the contribution of ONE scientist to our increased understanding of human evolution. **3**

(ii) How would you evaluate the relevance and reliability of the information gathered in this investigation? **3**

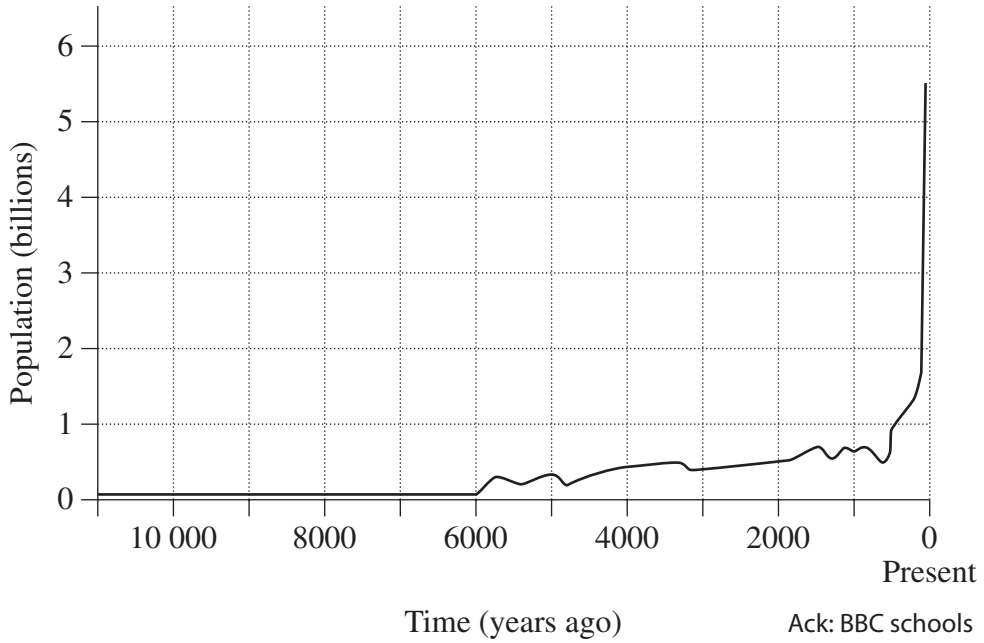
(c) Assess the impact of cultural development throughout human evolution. Include examples in your answer. **7**

Question 31 continues on page 29

Marks

Question 31 (continued)

(d) The graph shows estimated human population for the last 10 000 years.



(i) Estimate the human population 1000 years ago. **1**

(ii) Describe a change in human population numbers over the last 10 000 years, and suggest ONE reason for this change. **2**

(iii) Discuss the potential impact of a modern technology on future human populations. **4**

End of Question 31

Marks

Question 32 — Biochemistry (25 marks)

(a) (i) Name TWO products of photosynthesis. **2**

(ii) Explain how ONE of these products is used in living organisms. **3**

(b) (i) Describe how you gathered and presented information to compare the size, shape and distribution of chloroplasts in different angiosperms. **3**

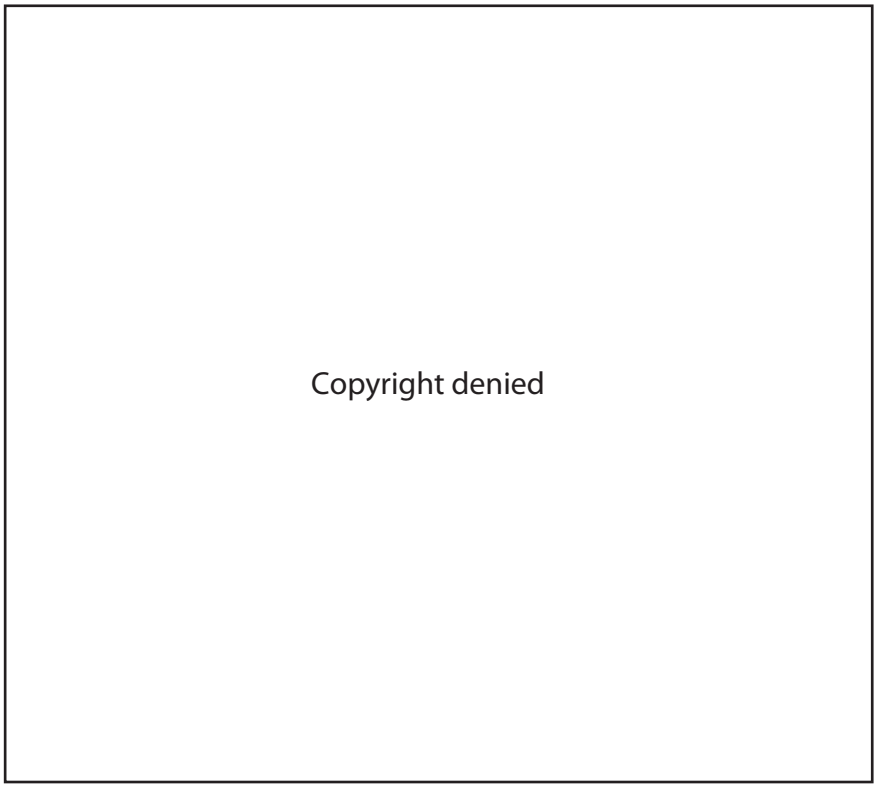
(ii) How would you evaluate the relevance and reliability of the information gathered in this investigation? **3**

(c) Assess the role of isotopes in developing an understanding of photosynthesis. Include examples in your answer. **7**

Question 32 continues on page 31

Question 32 (continued)

(d) The graph shows absorption and action spectra for photosynthesis.



(i) Estimate the wavelength for the maximum rate of photosynthesis. **1**

(ii) Describe the absorption of chlorophyll *a* over the spectrum of visible light, and identify the location within a chloroplast where this occurs. **2**

(iii) Discuss the role of pigments, other than chlorophyll *a*, in photosynthesis. **4**

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