

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

2006

**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, 11, 15 and 17

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 16–28
- Allow about 1 hour and 45 minutes for this part

Section II Pages 25–31

25 marks

- Attempt ONE question from Questions 29–33
- 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 ↙

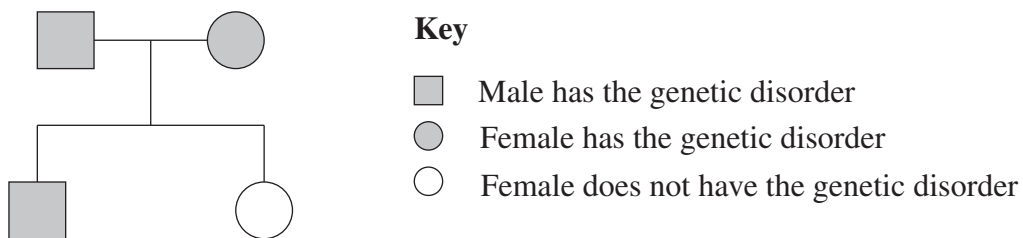
- 1** Which water treatment best reduces the risk of infection by killing pathogens in drinking water?
- (A) Chlorination
 - (B) Filtration
 - (C) Fluoridation
 - (D) Precipitation
- 2** What are the components of DNA?
- (A) Sugars, bases, proteins
 - (B) Sugars, phosphates, bases
 - (C) Phosphates, bases, polypeptides
 - (D) Phosphates, proteins, polypeptides
- 3** Which scientist carried out experiments that led to the development of an understanding of sex linkage?
- (A) Boveri
 - (B) Mendel
 - (C) Morgan
 - (D) Sutton
- 4** Evolutionary relationships between vertebrates can be determined by comparing the amino acid sequence of human haemoglobin with the haemoglobin of other vertebrates.
- Which area of study collects this type of evidence to support the theory of evolution?
- (A) Biochemistry
 - (B) Biogeography
 - (C) Comparative anatomy
 - (D) Comparative embryology

- 5 A student completed a genetics exercise by preparing the Punnett square drawn below. T represents a dominant allele and t represents a recessive allele.

	Parent 1 gametes	
	TT	Tt
Parent 2 gametes	Tt	tt

What were the likely genotypes of the parents?

- (A) Parent 1 was homozygous, Parent 2 was heterozygous.
 (B) Parent 1 was heterozygous, Parent 2 was homozygous.
 (C) Both parents were heterozygous.
 (D) Both parents were homozygous.
- 6 A researcher prepared a pedigree (family tree) to trace a genetic disorder in a family.

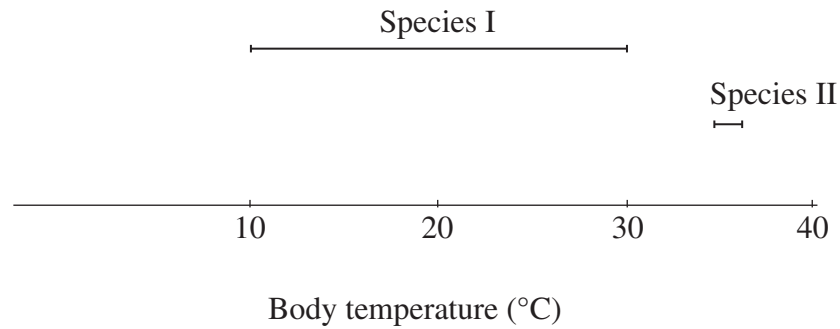


How could the gene that causes the condition best be described?

- (A) Co-dominant
 (B) Dominant
 (C) Recessive
 (D) Sex-linked
- 7 Which alternative correctly identifies the tissues that transport carbohydrates?

	<i>Plant</i>	<i>Animal</i>
(A)	xylem	lymph
(B)	xylem	blood
(C)	phloem	lymph
(D)	phloem	blood

- 8 The ranges of body temperatures of two desert animal species are illustrated.



- What is the best description to account for the range of body temperatures in Species I and Species II?
- (A) Species I is ectothermic; Species II is ectothermic.
 - (B) Species I is ectothermic; Species II is endothermic.
 - (C) Species I is endothermic; Species II is ectothermic.
 - (D) Species I is endothermic; Species II is endothermic.
- 9 What is the role of aldosterone in kidney function?
- (A) Aldosterone acts on the walls of the nephron tubules, changing the permeability of the tubules to react to changes in blood water concentration.
 - (B) Aldosterone is able to detect changes in blood pressure, and causes changes in water reabsorption to return blood pressure to normal.
 - (C) When blood pressure increases, aldosterone is released to increase sodium ion reabsorption rates, which causes less water to be reabsorbed, decreasing blood pressure.
 - (D) When blood pressure decreases, aldosterone is released to increase sodium ion reabsorption rates, which causes more water to be reabsorbed, increasing blood pressure.

- 10** An investigation was carried out where the composition of mammalian blood was compared before and after it had passed through different organs.

Data from one organ showed an increase in both carbon dioxide and digestion product levels, but a decrease in oxygen levels after passing through the organ.

Which organ would produce this result?

- (A) Gall bladder
 - (B) Kidney
 - (C) Pancreas
 - (D) Small intestine
- 11** The movement of materials through a plant occurs by translocation and the transpiration stream.

What is the main difference between these mechanisms?

- (A) Translocation occurs in endotherms, while the transpiration stream occurs in ectotherms.
 - (B) Translocation occurs in xylem tissue, while the transpiration stream occurs in phloem tissue.
 - (C) Translocation involves active transport, while the transpiration stream involves passive transport.
 - (D) Translocation transports respiration products, while the transpiration stream transports photosynthetic products.
- 12** Which two processes are important for the maintenance of health?
- (A) Mitosis and meiosis
 - (B) Mutation and mitosis
 - (C) Mitosis and cell differentiation
 - (D) Meiosis and cell differentiation

13 Allergies are the result of an immune response.

What triggers this response?

- (A) Antigens
- (B) Antidotes
- (C) Antibodies
- (D) Antihistamines

14 Organ transplant patients are given drugs to minimise the rejection of transplanted organs.

How do these drugs work?

- (A) They inhibit the production of enzymes by the transplanted organ that leads to its rejection.
- (B) They suppress the immune response which recognises 'foreign' molecules on the transplanted organs.
- (C) They act as antibiotics so that bacteria are killed before causing infections in transplanted organs.
- (D) They promote the repair of the blood vessel connections between the transplanted organ and the host body.

15 People who lived in the United Kingdom during the 1980s and 1990s are not accepted as blood donors in Australia because they might have eaten beef infected with prions.

Why is this precaution being taken?

- (A) Donated blood might contain prion toxins causing blood poisoning.
- (B) Donated blood might contain prions capable of causing viral infections.
- (C) Donated blood might contain prion DNA that results in prion replication in brain cells.
- (D) Donated blood might contain prions capable of altering protein structure in the brain cells.

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Biology

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Centre Number

Section I (continued)

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Student Number

Part B – 60 marks

Attempt Questions 16–28

Allow about 1 hour and 45 minutes for this part

Answer the questions in the spaces provided.

Question 16 (3 marks) **Marks**

(a) What is *haemoglobin*? **1**

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(b) Describe ONE adaptive advantage of haemoglobin. **2**

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Question 17 (3 marks)

Explain why it is necessary for organisms to remove metabolic waste products. **3**

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 18 (7 marks)

- (a) Name ONE adaptation in an Australian terrestrial plant that assists in minimising water loss. **1**

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- (b) Explain why it is important for plant cells to control water loss. **2**

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- (c) Plant breeders have developed a new variety of terrestrial plant which has one structure that appears to assist in water conservation in hot, dry environments. **4**

Design a first-hand investigation the plant breeder could use to determine if this structure assists in water conservation.

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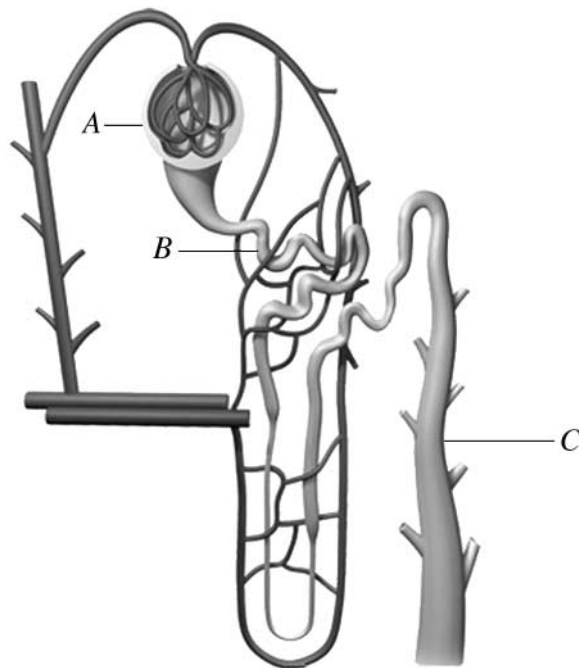
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Question 19 (5 marks)

The diagram shows a representation of a mammalian nephron.



Zygo Media Group, Inc

- (a) Filtration happens at *A*. 1

Name TWO blood components that remain in the blood vessel after filtration.

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- (b) Most reabsorption happens at *B*. 2

Explain why BOTH passive and active transport are needed for this process to occur.

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- (c) ADH (anti-diuretic hormone) acts at *C*. 2

Outline the role of ADH in regulating water balance.

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Question 20 (3 marks)

A student bred a pair of goldfish and noticed that the offspring showed minor differences in appearance. **3**

Explain TWO processes that could result in these differences in appearance.

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Question 21 (4 marks)

(a) Summarise the evidence that led to Beadle and Tatum’s ‘one gene – one protein’ hypothesis. **2**

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(b) Explain why the ‘one gene – one protein’ hypothesis was changed to the ‘one gene – one polypeptide’ hypothesis. **2**

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 22 (8 marks)

- (a) Identify a transgenic species, and state its use. **2**

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- (b) Outline ONE process used to produce a transgenic species. **2**

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- (c) Discuss ONE ethical issue arising from the use of transgenic species. **4**

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Question 23 (4 marks)

In 1926, T H Muller experimented with fruit flies (*Drosophila* sp.) by exposing them to X-rays. He found that their offspring showed new phenotypes not observed in the wild population.

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Explain how the results of these experiments can provide support for Darwin's theory of evolution by natural selection.

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 24 (2 marks)

Black spot is an infectious apple disease that occurs in New Zealand and makes apples unsuitable for sale. **2**

Describe a method to prevent the spread of the disease into Australia.

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Question 25 (3 marks)

Using an example, describe how a disease can be caused by an imbalance of microflora in humans. **3**

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Question 26 (8 marks)

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Warren and Marshall's investigations included:

- using a microscope to look at prepared slides of ulcerated stomach tissues;
- using a flexible endoscope to look into the stomach of patients with stomach ulcers and gastritis (localised or general inflammation of the stomach);
- using staining techniques to determine the possible presence of bacteria in stomach tissue.

In addition, Warren checked that Marshall's stomach contained no *Helicobacter pylori*. Marshall then swallowed a dose of the bacteria, triggering symptoms of gastritis.

Assess the procedures that Warren and Marshall used to identify and confirm their conclusion about the pathogen that caused stomach ulcers and gastritis.

Question 26 continues on page 19

Question 27 (4 marks)

Lactose intolerance is a non-infectious disease found in some humans who cannot digest milk. The causes of non-infectious disease are grouped into three categories. An epidemiological study was undertaken to investigate the cause of lactose intolerance. The study found variation in the occurrence of lactose intolerance in human populations from different parts of the world. Some of the data are shown in the table.

4



Using information from the table, outline how the study could be continued to determine the cause of the disease.

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Question 28 (6 marks)

- (a) A gardener noticed a red and swollen area on his arm that had received a deep scratch from a thorn on a plant. **1**

Identify the most likely human defence adaptation that caused these symptoms.

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- (b) After a number of days, the gardener’s arm remained red and swollen, so he visited his doctor who prescribed an antibiotic to treat the infection. **1**

Why did the doctor prescribe an antibiotic to treat the infection?

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- (c) The gardener should have taken the antibiotic for ten days but stopped after five days because the arm was no longer red or swollen. **4**

Explain how this action by the gardener might lead to antibiotic resistance.

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Biology

Section II

25 marks

Attempt ONE question from Questions 29–33

Allow about 45 minutes for this section

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

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

Question 29 — Communication (25 marks)

- (a) (i) Outline three differences between rods and cones in the retina. **3**
- (ii) Explain their role in human colour blindness. **2**
- (b) (i) Describe the procedure used, and outline the results obtained, when you modelled the process of accommodation. **5**
- (ii) State how using this model increases understanding of accommodation. **1**
- (c) Discuss how advances in hearing and vision technology have assisted people with difficulties in communication. **7**
- (d) A student located the following information about brain damage.

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- (i) Identify the organ that detects light stimuli in humans. **1**
- (ii) Outline ONE piece of evidence that half of the brain is functioning correctly when a human is affected by *visual neglect*. **2**
- (iii) Explain the role of the brain in the coordination of animal behaviour. **4**

Question 30 — Biotechnology (25 marks)

- (a) (i) Outline ONE use of biotechnology in an early society. **3**
- (ii) Explain why the use you outlined in part (a) (i) may be considered an early biotechnology. **2**
- (b) (i) Describe the procedure used, and outline the results obtained, when you demonstrated the fermentation processes in bread or alcohol production. **5**
- (ii) State how using this demonstration increases understanding of fermentation processes. **1**
- (c) Discuss the impact of the development of recombinant DNA technology on applications of biotechnology. **7**
- (d) A student researching the impact of ethical issues on decision-making processes in biotechnology located the following information.

A plant commonly used for animal food was deficient in the amino acid, methionine. The nutritional value of the plant was improved by adding a gene from a different plant species rich in methionine.

However, the gene came from a plant to which some people showed an allergic reaction when exposed to the plant's products. When these people were exposed to the transgenic plant they also showed an allergic reaction.

The transgenic plant was going to be marketed only for animal feed, but the difficulty of keeping animal feed separate from human food during harvesting, transport, and storage became a consideration. It was decided not to ask for approval to market the transgenic plant. It was never approved by the government and was never grown commercially or sold in stores.

- (i) Identify ONE potential benefit of using the transgenic plant. **1**
- (ii) Outline ONE piece of evidence supporting the views of a group opposed to using the transgenic plant. **2**
- (iii) Evaluate decisions relating to the commercial use of cloning or genetically modified organisms. **4**

Adapted from web site 'Transgenic Crops: An Introduction and Resource Guide' By Department of Soil & Crop Sciences, Colorado State University

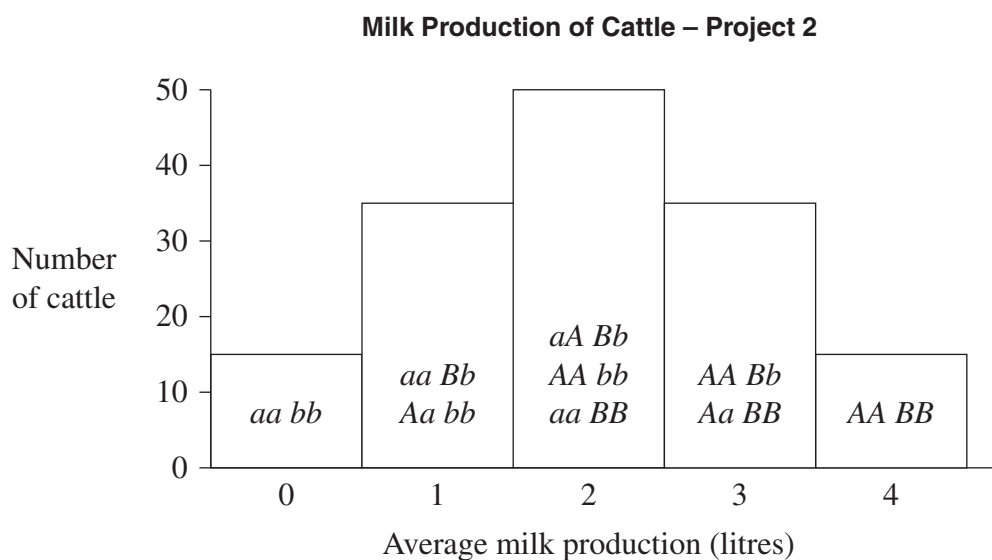
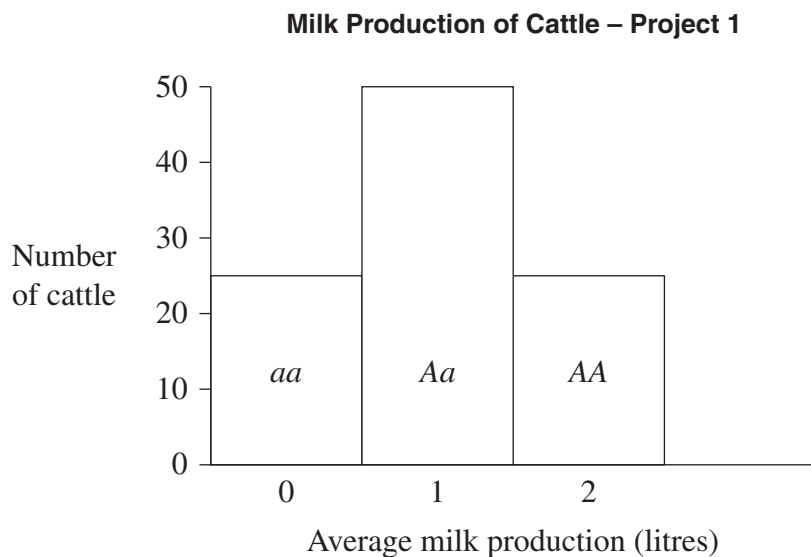
Question 31 — Genetics: The Code Broken? (25 marks)

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| (a) | (i) | Outline THREE differences between somatic and gametic cells. | 3 |
| | (ii) | Explain ONE reason for the differences as outlined in part (a) (i) in terms of their importance in inheritance. | 2 |
| (b) | (i) | Describe the procedure used, and outline the findings obtained, when you processed information on current understanding of gene expression. | 5 |
| | (ii) | State how the findings increased an understanding of gene expression. | 1 |
| (c) | | Discuss how major advances in our knowledge of genetics have changed our understanding of the way genes direct the structure, function and development of an organism. | 7 |

Question 31 continues on page 29

Question 31 (continued)

- (d) A scientist carried out research projects for a farmers' organisation to identify the link between cattle genotype and milk production. The graphs show the average milk production of cattle with different genotypes.

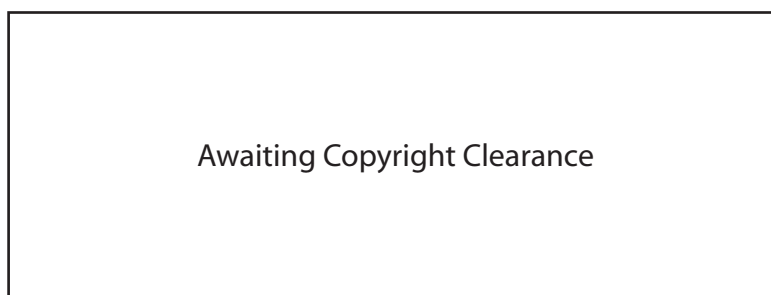


- (i) Identify the cattle genotype that produces the greatest amount of milk. **1**
- (ii) Outline the effect on milk production of cattle having one or more dominant allele. **2**
- (iii) Explain the effect of polygenic inheritance on variability within a trait. **4**

End of Question 31

Question 32 — The Human Story (25 marks)

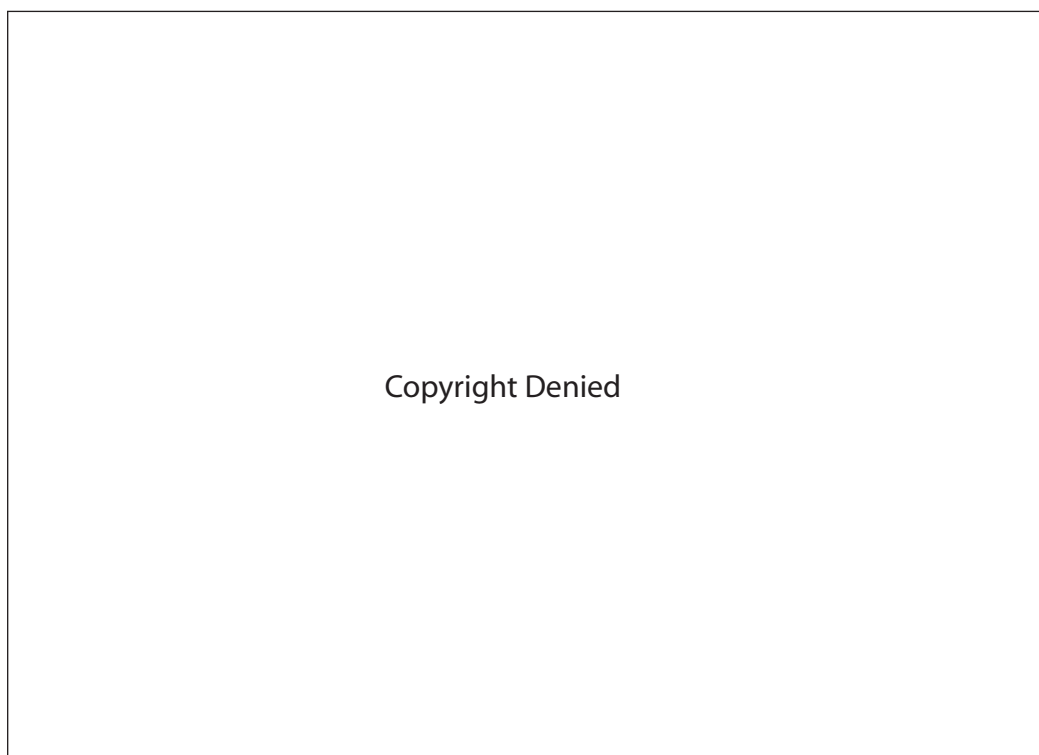
- (a) (i) Name TWO examples of cultural change that occurred as humans developed into efficient hunters in organised cooperative groups. **2**
- (ii) Explain how ONE of the cultural changes named in part (a) (i) has been a feature of human evolution. **3**
- (b) (i) Describe the procedure used, and outline the findings obtained, when you investigated the maternal inheritance of mitochondrial DNA. **5**
- (ii) State the importance of the study of the maternal inheritance of mitochondrial DNA in tracing human evolution. **1**
- (c) Discuss how advances in technology have changed our understanding of the evolutionary relationships between humans and other primates. **7**
- (d) The chart shows the dispersal of the genus *Homo*.



- (i) Identify ONE species of *Homo* thought to be living one million years ago. **1**
- (ii) Outline ONE piece of information to support the hypothesis that *Homo floresiensis* evolved from *Homo erectus*. **2**
- (iii) Based on the information in the chart, assess how the discovery of *Homo floresiensis*, living at the same time as *Homo sapiens*, could be used to support EITHER the ‘Out of Africa’ model OR the ‘Theory of Regional Continuity’ as an explanation for the pattern of human migration and evolution. **4**

Question 33 — Biochemistry (25 marks)

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| (a) | (i) State TWO reasons for studying photosynthesis. | 2 |
| | (ii) Outline the contribution of ONE 17th or 18th century scientist in developing our understanding of photosynthesis. | 3 |
| (b) | (i) Describe the procedure used, and outline the results obtained, when you extracted the mixture of pigments from leaves and examined their absorption spectrum. | 5 |
| | (ii) State how the results have increased an understanding of the role of pigments in photosynthesis. | 1 |
| (c) | Discuss the impact of improvements in microscopy on our understanding of cell structures involved in photosynthesis. | 7 |
| (d) | The diagram shows the Calvin Cycle. | |



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|-------|---|----------|
| (i) | Identify molecule X. | 1 |
| (ii) | State the significance of ATP at (Z) and (Y) in the Calvin Cycle. | 2 |
| (iii) | Assess how knowledge and understanding of the Calvin Cycle has increased with advances in technology. | 4 |

End of paper

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