

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

2001

**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, 13 and 15

Total marks – 100

Section I Pages 2–17

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 19–25

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.

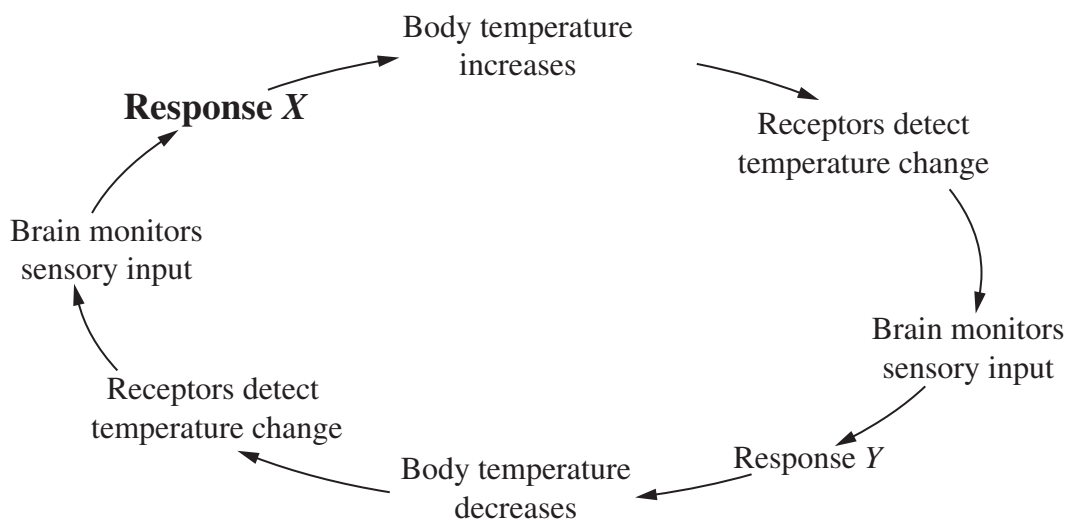
A B C D
correct ↙

- 1 The Australian hopping mouse, *Notomys alexis*, is a desert animal. It produces urine that is very concentrated.

Why is this an advantage for the animal?

- (A) It needs to conserve water.
 - (B) It is nocturnal and only drinks at dusk.
 - (C) It has a high intake of salt in its specialised diet.
 - (D) It needs to excrete large amounts of water to survive.
- 2 What is the role of ADH (vasopressin)?
- (A) It increases the amount of water reabsorbed in the kidney.
 - (B) It increases the amount of sugar reabsorbed in the kidney.
 - (C) It decreases the amount of water reabsorbed in the kidney.
 - (D) It decreases the amount of sugar reabsorbed in the kidney.

- 3 The flowchart represents one example of homeostasis in an endotherm.



Which of the following does Response X represent in this cycle?

- (A) Increased rate of sweat production
- (B) Increased rate of urine production
- (C) Decreased rate of sweat production
- (D) Decreased rate of urine production

- 4 Four students were asked to design a first-hand investigation to determine the effect of pH on the activity of an enzyme.

Their designs of the investigation are shown in the tables.

Design A

<i>Tube number</i>	<i>Contents</i>	<i>pH</i>	<i>Temp. (°C)</i>
1	E	3	20
2	E	7	20
3	E	12	20
4	S	3	20
5	S	7	20
6	S	12	20

Design B

<i>Tube number</i>	<i>Contents</i>	<i>pH</i>	<i>Temp. (°C)</i>
1	E + S	3	20
2	E + S	7	20
3	E + S	12	20
4	S	3	20
5	S	7	20
6	S	12	20

Design C

<i>Tube number</i>	<i>Contents</i>	<i>pH</i>	<i>Temp. (°C)</i>
1	E + S	3	10
2	E + S	7	20
3	E + S	12	30
4	S	3	10
5	S	7	20
6	S	12	30

Design D

<i>Tube number</i>	<i>Contents</i>	<i>pH</i>	<i>Temp. (°C)</i>
1	E + S	7	10
2	E + S	7	20
3	E + S	7	30
4	S	7	10
5	S	7	20
6	S	7	30

Key: E = enzyme S = substrate

Which investigation is the most appropriate?

- (A) Design A
- (B) Design B
- (C) Design C
- (D) Design D

- 5 The sweet taste of freshly-picked corn is due to the high sugar content in the kernels. Enzyme action converts about 50% of the sugar to starch within one day of picking. To preserve its sweetness, the freshly-picked corn is immersed in boiling water for a few minutes, then cooled.

Which of the following explains why the boiled corn kernels remain sweet?

- (A) Boiling destroys the sugar molecules so that they cannot be converted into starch.
 - (B) Boiling inactivates the enzyme responsible for converting sugar into starch.
 - (C) Boiling kills a fungus on the corn that is needed to convert sugar into starch.
 - (D) Boiling activates the enzyme that converts starch into sugar.
- 6 Fossil evidence indicates that the Australian environment in the past supported a large and diverse range of megafauna. The megafauna has now been displaced by a variety of smaller marsupials.

What is the best explanation for this?

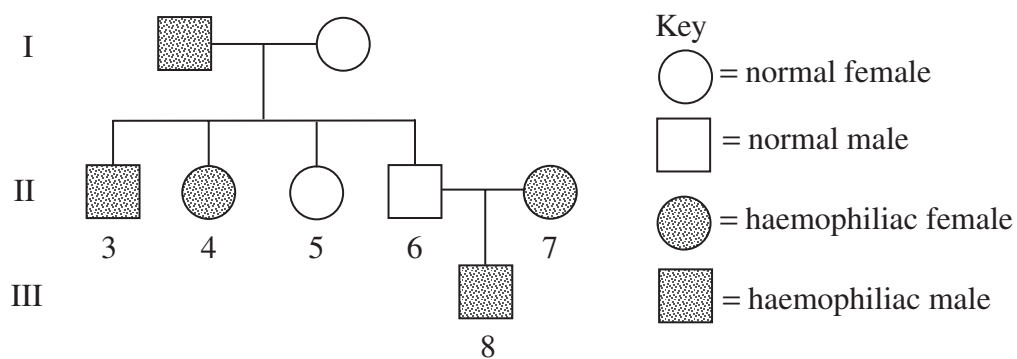
- (A) Smaller marsupials coped with climatic changes, and survived.
 - (B) Larger marsupials reduced in size so as to cope better with climatic changes.
 - (C) A meteorite collision caused a mass extinction of the megafauna.
 - (D) Introduced plant species were not a suitable food for the megafauna.
- 7 Which of the following is true of a mutation that produces an allele that is dominant?
- (A) It would be expected to cause death.
 - (B) It would be expected to spread more quickly through a population than a recessive mutation.
 - (C) It could give an observable phenotype in a heterozygous genotype.
 - (D) It could give an observable phenotype only in a homozygous genotype.

- 8 In 1940, Beadle and Tatum developed the *one gene–one protein* hypothesis. This has now been modified to the *one gene–one polypeptide* hypothesis.

Why was this modification needed?

- (A) All proteins are comprised of more than one type of polypeptide.
 (B) Most proteins are comprised of more than one copy of the same polypeptide.
 (C) Many proteins are comprised of more than one polypeptide that may be the same or different.
 (D) The number of polypeptides in proteins is always the same as the number of genes specifying those polypeptides.
- 9 Haemophilia is a human disease in which the blood of an affected individual does not clot. The disease is known to be caused by a sex-linked recessive allele.

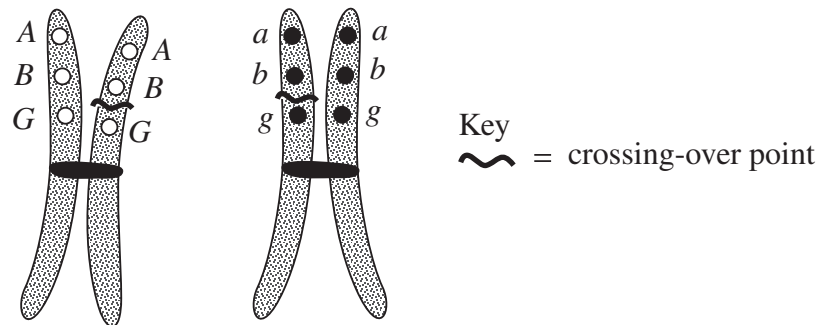
The family pedigree shows the pattern of inheritance of this disease in a family.



If X^h is the allele for haemophilia and X^n is the allele for normal clotting, what is the genotype of individual 5?

- (A) X^hX^h
 (B) X^hX^n
 (C) X^nX^n
 (D) X^nY

- 10 The diagram represents one pair of homologous chromosomes during meiosis. Crossing-over occurs and random segregation takes place.



What genotypes are produced?

- (A) ABG , abG , ABg , abg
 (B) ABG , aBG , Abg , abg
 (C) ABG , ABG , abg , abg
 (D) ABG , aBg , Abg , abg
- 11 If campers have to drink water from a creek, which is the best way of making the water safe to drink?
- (A) Boil the water for five minutes.
 (B) Filter the water through a clean shirt.
 (C) Collect the water and let it stand in a clean container.
 (D) Expose the water to the sun's ultraviolet rays for two hours.
- 12 Overseas equestrian competitors brought their horses to Australia for the Sydney 2000 Olympic Games.

Why were the horses quarantined for a period of time before the Olympic Games began?

- (A) To acclimatise them to Australian conditions
 (B) To make sure that no horse diseases spread to the spectators
 (C) To make sure that the horses did not contract Australian diseases
 (D) To make sure that the horses did not have an infectious disease

- 13** What is a possible immune response to a pathogen?
- (A) T lymphocytes produce antibodies.
 - (B) T helper lymphocytes are activated.
 - (C) B lymphocytes produce antigens.
 - (D) B lymphocytes phagocytose the pathogen.
- 14** How does immunisation against diseases such as diphtheria and polio limit the spread of these infectious diseases?
- (A) Immunisation kills the relevant pathogens.
 - (B) Immunisation suppresses or reduces the immune response and associated inflammation.
 - (C) Immunisation strengthens first-line defence barriers and prevents the entry of the relevant pathogens into the body.
 - (D) Immunisation reduces the multiplication of the relevant pathogens in immunised hosts and this reduces the chance of other people becoming infected.
- 15** Eight sick animals were found to be suffering from the same symptoms. Blood tests showed that they were infected with the same type of bacterium.

Which of the following strategies would be the best to determine if this particular type of bacterium is the cause of the disease?

- (A) Find other animals with the same symptoms. Attempt to isolate the same type of bacterium from their blood.
- (B) Inject blood from animals with the symptoms into suitable host individuals. If they develop the same symptoms, this proves that this type of bacterium caused the disease.
- (C) Use bacteria cultured from the blood of the animals with these symptoms to infect suitable host individuals. If they develop the disease, attempt to isolate the same type of bacterium from their blood.
- (D) Treat all eight animals with an antibiotic known to kill this type of bacterium. They will recover if this type of bacterium is the cause of the disease.

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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.

Marks

Question 16 (4 marks)

Genetically modified food on menu

Australians are growing more accepting of genetically modified (GM) food, a federal agency survey has found.

This survey found that 44 per cent of Australians now believe GM food would become more widely accepted and less risky in the next few years.

An earlier survey revealed that people thought the risks outweighed the benefits, but that the situation would change.

- (a) State ONE opinion held by Australians about genetically modified food, according to this article. 1

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- (b) Justify ONE piece of information you would need in order to determine the validity of the survey results. 3

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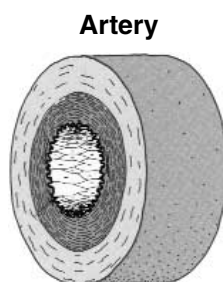
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Question 17 (3 marks)

- (a) Label, on the diagram, ONE structural feature of the artery shown. 1



- (b) How does the labelled feature relate to the artery's function? 2

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Question 18 (5 marks)

- (a) Name TWO products extracted from donated blood, and state their uses. 4

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- (b) Propose ONE reason why scientists have now begun to develop artificial blood. 1

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 19 (6 marks)

In your Biology course, you performed a first-hand investigation to gather information about structures in plants that assist in the conservation of water.

- (a) Describe the procedure you followed. **4**

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- (b) Identify TWO safe work practices needed during this investigation. **2**

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Question 20 (7 marks)

Name ONE example of an Australian endothermic animal and ONE example of an Australian ectothermic animal, and summarise their responses to the following environmental changes. Give your answer in the form of a table.

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Change 1: The ambient temperature rises well above the average daily temperature range.

Change 2: The ambient temperature drops well below the average daily temperature range.

Endothermic animal:

Ectothermic animal:

Question 21 (4 marks)

Sutton, Boveri and Morgan worked in the field of genetics.

4

Describe the contribution made by TWO of these scientists to the understanding of the chromosomal nature of inheritance.

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 22 (6 marks)

- (a) Cloning is a technique that could be used to increase numbers in an endangered species. What effect would cloning have on the genetic diversity of the species? **2**

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- (b) Explain TWO possible evolutionary effects of a disease entering an endangered population containing some cloned individuals. **4**

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Question 23 (3 marks)

In twelfth-century China, people seeking protection from smallpox removed scabs from people mildly scarred from the disease. These scabs were then ground and inhaled as powder. Similarly, in the seventeenth century, an Englishwoman, Mary Montagu, injected bits of smallpox scabs into healthy children to protect them from the disease.

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In the light of our current knowledge about the immune response, explain why these practices were successful.

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Question 24 (4 marks)

Explain the relationship between the cause and ONE symptom of ONE named non-infectious disease.

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Centre Number

Section I – Part B (continued)

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Student Number

Marks

Question 25 (3 marks)

Antibiotics are drugs widely used in most industrialised societies. They are used to treat bacterial infections, are added to animal feed, and have been included in plastic products such as sandwich bags.

3

Explain TWO possible effects of this widespread use of antibiotics on the likely spread of disease in the future.

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Question 26 (3 marks)

When a body organ is transplanted from one person to another, the immune system of the recipient is triggered.

(a) Patients who have an organ transplant are given drugs to suppress their immune response. State the reason for this.

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(b) Explain a possible consequence for the general health of organ transplant patients as a result of suppressing the immune system.

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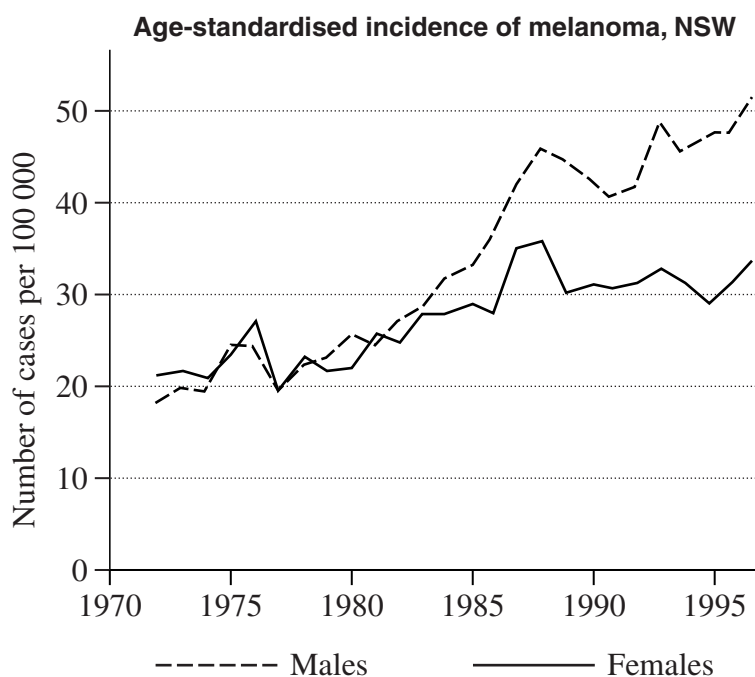
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Question 27 (4 marks)

Epidemiological studies have demonstrated a relationship between ultraviolet radiation exposure and the development of melanoma, a type of skin cancer.

4

The graph shows the rate of occurrence of melanoma in males and females between 1972 and 1997.



A student studying the graph made the following statement.

‘The incidence of melanoma will continue to increase beyond 1997 at a greater rate in males than in females.’

Analyse the data in the graph to assess the validity of this statement.

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Biology

Section II

25 marks

Attempt ONE question from Questions 29–33

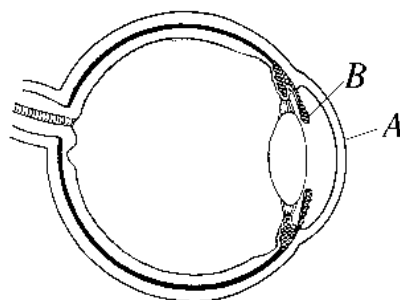
Allow about 45 minutes for this section

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

	Pages
Question 29 Communication	20
Question 30 Biotechnology	21–22
Question 31 Genetics – The Code Broken?	23
Question 32 The Human Story	24
Question 33 Biochemistry	25

Question 29 — Communication (25 marks)

- (a) (i) Where are photoreceptor cells located in the eye? **1**
- (ii) State ONE function for each of the structures labelled in the diagram below. **2**



- (b) (i) How would you gather information on the structures used by animals to produce sound? **2**
- (ii) How would you assess that the information you collected was relevant and reliable? **2**

(c) Describe ways in which technology can be used to overcome the effects of cataracts. **5**

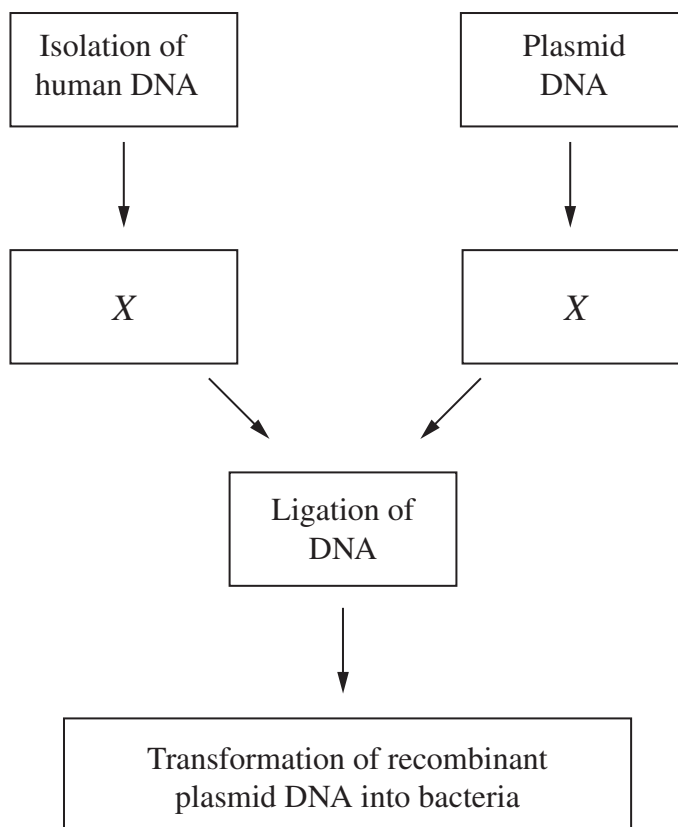
(d) In your study of Communication, you performed a first-hand investigation to model the process of accommodation. **6**

Justify the procedure used and the conclusions drawn.

(e) Evaluate the appropriateness of TWO devices designed to assist people with different types of hearing impairment. **7**

Question 30 — Biotechnology (25 marks)

(a) The flowchart shows the major steps in the production of recombinant DNA.



- (i) Name the process labelled X. 1
 - (ii) Outline the process of *ligation of DNA*. 2
- (b)
- (i) How would you gather information on an ancient use of aquaculture? 2
 - (ii) How would you assess that the information you collected was relevant and reliable? 2

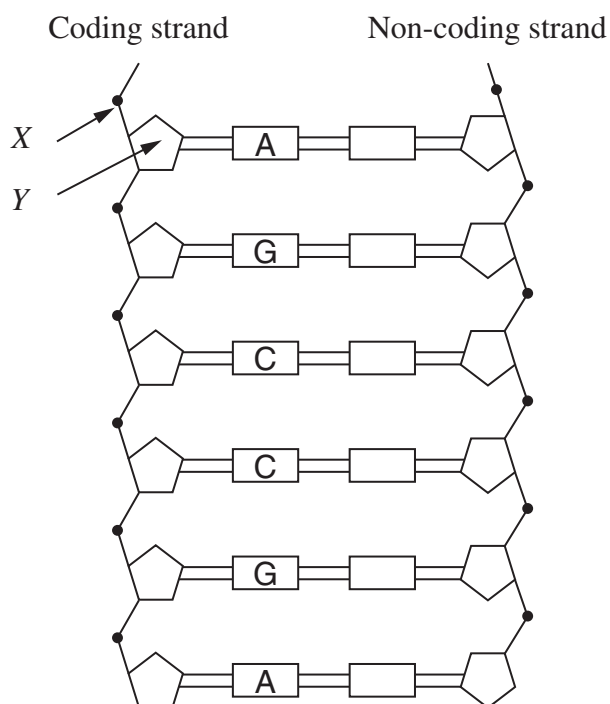
Question 30 continues on page 22

	Marks
Question 30 (continued)	
(c) Explain how changes in technology and scientific knowledge have modified traditional uses of biotechnology.	5
(d) In your study of Biotechnology, you performed a first-hand investigation of the use of the fermentation process in bread or alcohol production. Justify the procedure used and the conclusions drawn.	6
(e) Assess the efficiency of ONE modern application of biotechnology that you have studied.	7

End of Question 30

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

(a) The diagram shows a simplified model of a DNA molecule.



- (i) Identify structures *X* and *Y*. 2
- (ii) What is the base sequence for the non-coding strand? 1

- (b) (i) How would you gather information on the processes used in tissue culture or animal cloning? 2
- (ii) How would you assess that the information you collected was relevant and reliable? 2

- (c) Discuss the role of public education in preventing cancers. 5

- (d) In your study of Genetics – The Code Broken?, you performed a first-hand investigation to model the processes involved in meiosis that relate to linkage. 6

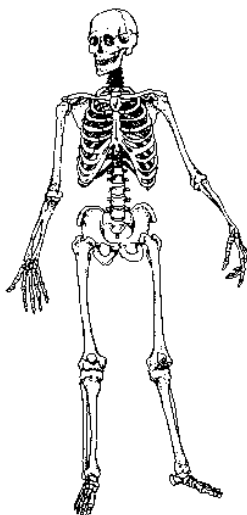
Justify the procedure used and the conclusions drawn.

- (e) Explain why the aims of the Human Genome Project could NOT be achieved by studying linkage maps. 7

Question 32 — The Human Story (25 marks)

- (a) (i) Identify ONE feature that can be used to classify humans as mammals. **1**
- (ii) The diagram shows a *Homo sapiens* skeleton. **2**

Homo sapiens skeleton



State TWO structural differences between this skeleton and the skeleton of *Australopithecus afarensis*.

- (b) (i) How would you gather information about the use of radiometric data to date material collected from a fossil site? **2**
- (ii) How would you assess that the information you collected was relevant and reliable? **2**

- (c) Analyse the evolutionary significance of the phenotypes displayed in ONE example of polymorphism in humans. **5**

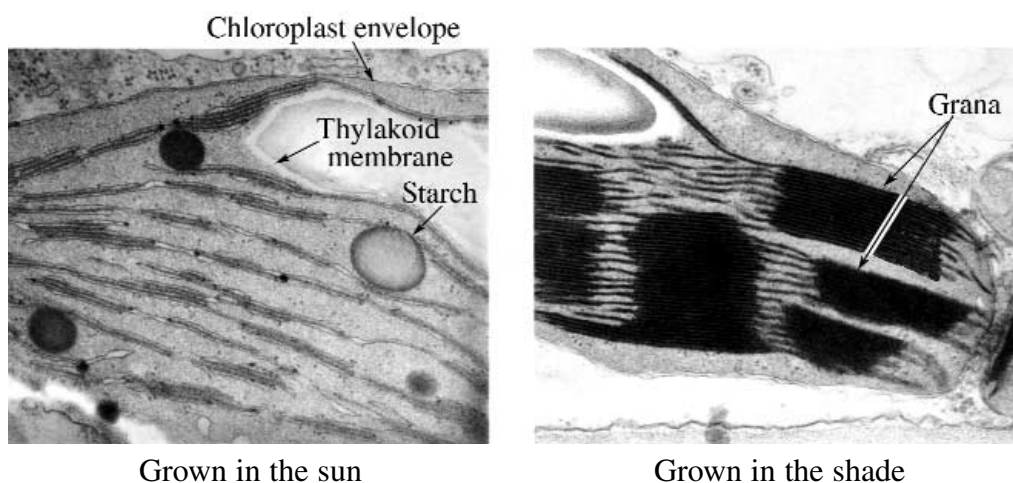
- (d) In your study of The Human Story, you performed an investigation to analyse the similarities and differences between prosimians, monkeys, apes and humans. **6**

By referring to TWO features of these primates, outline the information you gathered to perform this analysis, and justify the conclusions drawn from this information.

- (e) What would you predict will be the main factors affecting human biological evolution in the next one hundred years? Justify your predictions. **7**

Question 33 — Biochemistry (25 marks)

- (a) (i) What energy transformation is involved in photosynthesis? 1
- (ii) Describe the major function of photosystem II. 2
- (b) (i) How would you gather information on the potential uses of photosynthesis in replacing materials presently obtained from other non-renewable resources? 2
- (ii) How would you assess that the information you collected was relevant and reliable? 2
- (c) The diagrams show two electron micrographs of chloroplasts in the leaves of the rainforest plants *Alocasia macrorrhiza*, one grown in the sun and the other in the shade. 5



With reference to the electron micrographs, explain how the development of the electron microscope has led to a greater understanding of the structure and function of chloroplasts.

- (d) In your study of Biochemistry, you performed a first-hand investigation to confirm the production of oxygen in photosynthesis. 6
- Justify the procedure used and the conclusions drawn.
- (e) Explain, using examples, how radioactive tracers can be incorporated into plants to follow a biochemical pathway such as photosynthesis. 7

End of paper

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