BOARD OF STUDIES
NEW SOUTH WALES

2008

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 21

Total marks – 100

Section I Pages 2–24

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 25–30

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 for Questions 1–15.

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1 Which blood vessels in humans contain structures that allow blood to flow in only one direction?

(A) Arteries

(B) Capillaries

(C) Lymph vessels

(D) Veins

2 Which of the following pathogen types cause diseases that can be treated with antibiotics?

(A) Bacteria

(B) Macro-parasites

(C) Prions

(D) Viruses

3 To protect a farm animal from a plant toxin, a gene for resistance to the toxin was transferred to the farm animal.

Which term best describes this process?

(A) Cloning

(B) Genetic engineering

(C) Artificial pollination

(D) Artificial insemination

4 Which process involves detecting changes from a stable state then counteracting these changes?

(A) Enantiostasis

(B) Homeostasis

(C) Osmosis

(D) Phagocytosis

5 Why are polio vaccinations effective?

(A) They cause an inflammation response resulting in the production of antibodies that engulf the polio virus if it enters the body.

(B) They cause an immune response resulting in the production of cytotoxic (killer) T cells that remain in the blood attacking all viruses that enter the body.

(C) They cause an immune response resulting in the production of memory B cells that provide a rapid response if infected by the polio virus.

(D) They cause an inflammation response resulting in the production of memory T cells that provide a limited response if infected by the polio virus.

6 Some students carried out investigations to determine whether a newly discovered animal was an ectotherm or an endotherm. Each student made one observation and conclusion.

Which is the correct conclusion based on the observation?

	Observation	*Conclusion*
(A)	It was not a mammal.	The animal is an ectotherm.
(B)	Its body temperature was 37°C.	The animal is an endotherm.
(C)	Its temperature was less than the temperature of the cage.	The animal is an endotherm.
(D)	Its temperature and metabolism increased when the cage temperature increased.	The animal is an ectotherm.

7 Which processes result in genetic variation of offspring?

(A) DNA mutation and gamete formation

(B) Cell differentiation and gamete formation

(C) DNA mutation and polypeptide production

(D) Cell differentiation and polypeptide production

8 Some students want to determine if the colour of light affects plant growth.

Which of the following is a suitable hypothesis to be tested by the students?

(A) All plants will grow better in red light.

(B) All plants will grow bigger flowers in sunlight.

(C) Pea plants will grow taller in red light than in blue light.

(D) Pea plants will grow faster than bean plants in coloured light.

9 What is the role of antigens in the body's defence against disease?

(A) They bind to invading pathogens.

(B) They trigger the immune response.

(C) They inactivate invading antibodies.

(D) They suppress the inflammation response.

10 Which scientist improved the understanding of the immune response?

(A) George Beadle

(B) Frank Macfarlane Burnet

(C) Robert Koch

(D) Walter Sutton

11 What finding from the study of comparative embryology supports the theory of evolution?

(A) Embryos are easily fossilised.

(B) The embryos of fish and mammals look very similar.

(C) The dominant chromosomes are passed on to embryos.

(D) Mutation in gametes is common and this leads to different embryos.

12 After an infection was treated with a new drug, inflammation decreased. In a few patients, inflammation returned after one week. In these patients, the pathogens causing the infection were shown to be resistant to the drug.

What conclusion can be drawn from these observations?

(A) These patients developed resistance to the drug.

(B) The decrease in inflammation allowed the pathogens to become resistant to the drug.

(C) The white blood cells were not functioning properly and therefore the inflammation returned.

(D) A few pathogens resistant to the drugs were present at the start of treatment and natural selection increased their numbers.

13 What does mitosis produce to assist in the maintenance of health?

(A) Gametes to ensure reproduction

(B) Polypeptides to ensure cell growth

(C) Prions to protect cells against cancer

(D) Cells to replace those that are damaged

14 What is the most important difference between active and passive transport?

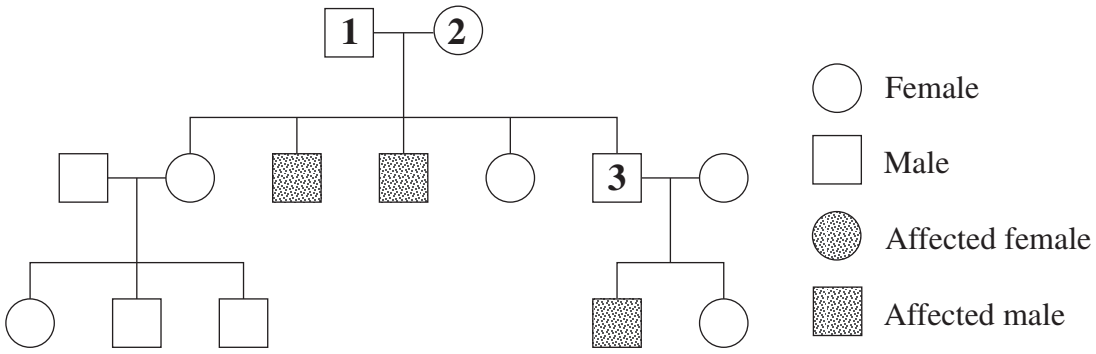
(A) Active transport requires energy input, passive transport does not.

(B) Active transport occurs in animals, passive transport occurs only in plants.

(C) Active transport does not use membranes, passive transport always uses membranes.

(D) Active transport occurs whenever an organism moves, passive transport does not involve movement of the organism.

15 In a particular sex-linked disease, progressive weakening of the muscles and loss of coordination lead to death before the age of five.



Using this pedigree, what is the genotype of the individuals numbered **1**, **2** and **3**?

	Individual 1	*Individual 2*	*Individual 3*
(A)	Normal	Normal	Normal
(B)	Carrier	Normal	Carrier
(C)	Normal	Carrier	Normal
(D)	Normal	Carrier	Carrier

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Centre Number

Student Number

Section I (continued)

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 (3 marks)

A plant species may have red or white flowers. Two red-flowered plants were crossed. Most of the offspring had red flowers, but some had white flowers. **3**

Explain the presence of both red- and white-flowered offspring.

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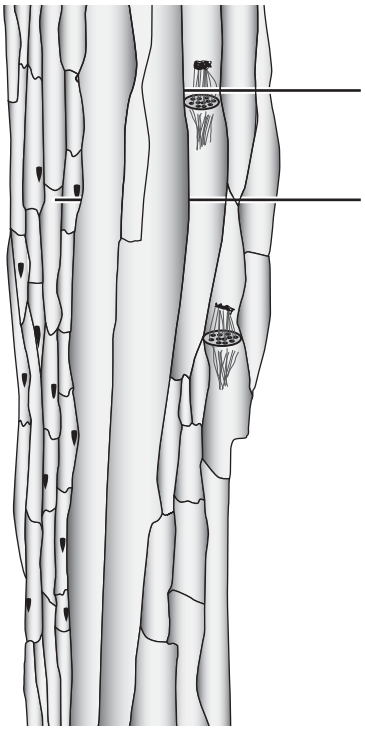
Marks

Question 17 (4 marks)

(a) Label the TWO components of phloem tissue indicated in the diagram. **1**



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(b) Describe ONE theory about the processes responsible for the movement of materials through phloem tissue. **3**

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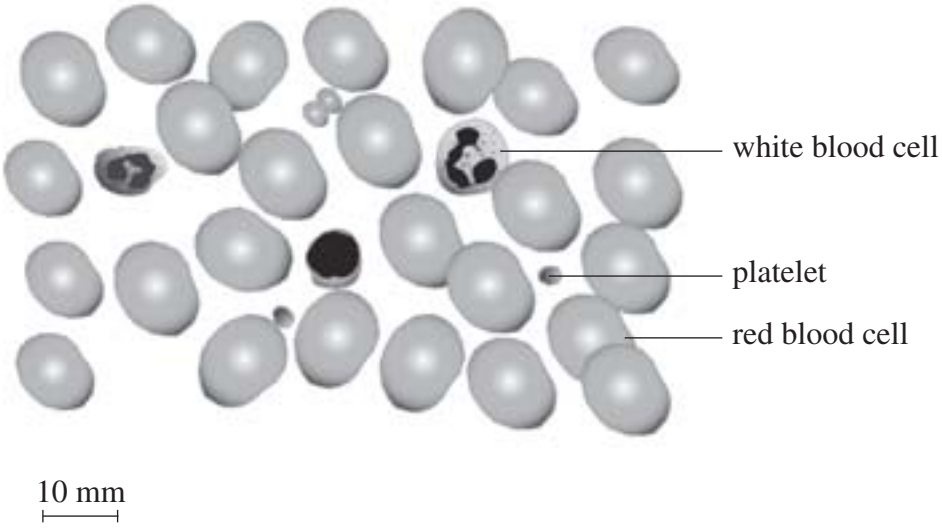
Marks

Question 18 (4 marks)

Using a light microscope, a student looked at a prepared slide of human blood, and drew a scaled diagram.

The diagram shown is a representation of the student's scaled diagram.



(a) Assess the accuracy of the diagram. **3**

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(b) Why is it safer to use prepared slides instead of fresh blood? **1**

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Marks

Question 19 (4 marks)

A new product has been developed to kill pathogens in drinking water. **4**

Design an experiment to test the effectiveness of the product.

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Section I – Part B (continued)

Marks

Question 20 (5 marks)

Describe the occurrence, symptoms, cause and treatment/management of a named non-infectious disease. **5**

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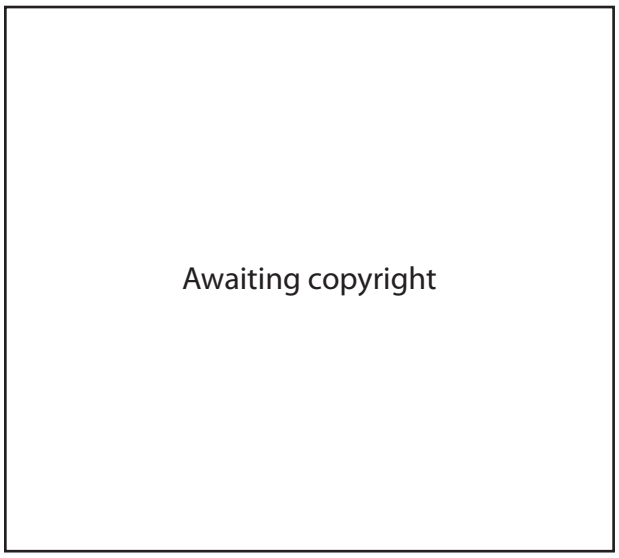
Marks

Question 21 (3 marks)

Both the Australian marsupial bilby and the North American placental jack rabbit are found in hot, dry environments.

Bilby



How would the Darwin/Wallace theory of evolution account for the similarity in ear size? **3**

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Question 22 (5 marks)

Explain how hormone activity maintains water and salt levels in the blood. **5**

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Question 23 (4 marks)

Compare the changes in the chemical composition of blood as it passes through the lungs, the small intestine, and the brain. **4**

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Section I – Part B (continued)

Question 24 (6 marks)

Question 24 (6 marks)

The data in the table are the results from an investigation measuring enzyme activity using different substrate concentrations. The experiment was carried out at pH 9.3 and the temperature was kept constant at 37°C.

Tube number	Substrate concentration (μM)	Enzyme activity (μM/sec/g)
1	0	0
2	5	0.7
3	10	1.7
4	15	2.5
5	20	3.1
6	25	3.4
7	30	3.9
8	35	4.1
9	40	4.2
10	45	4.3

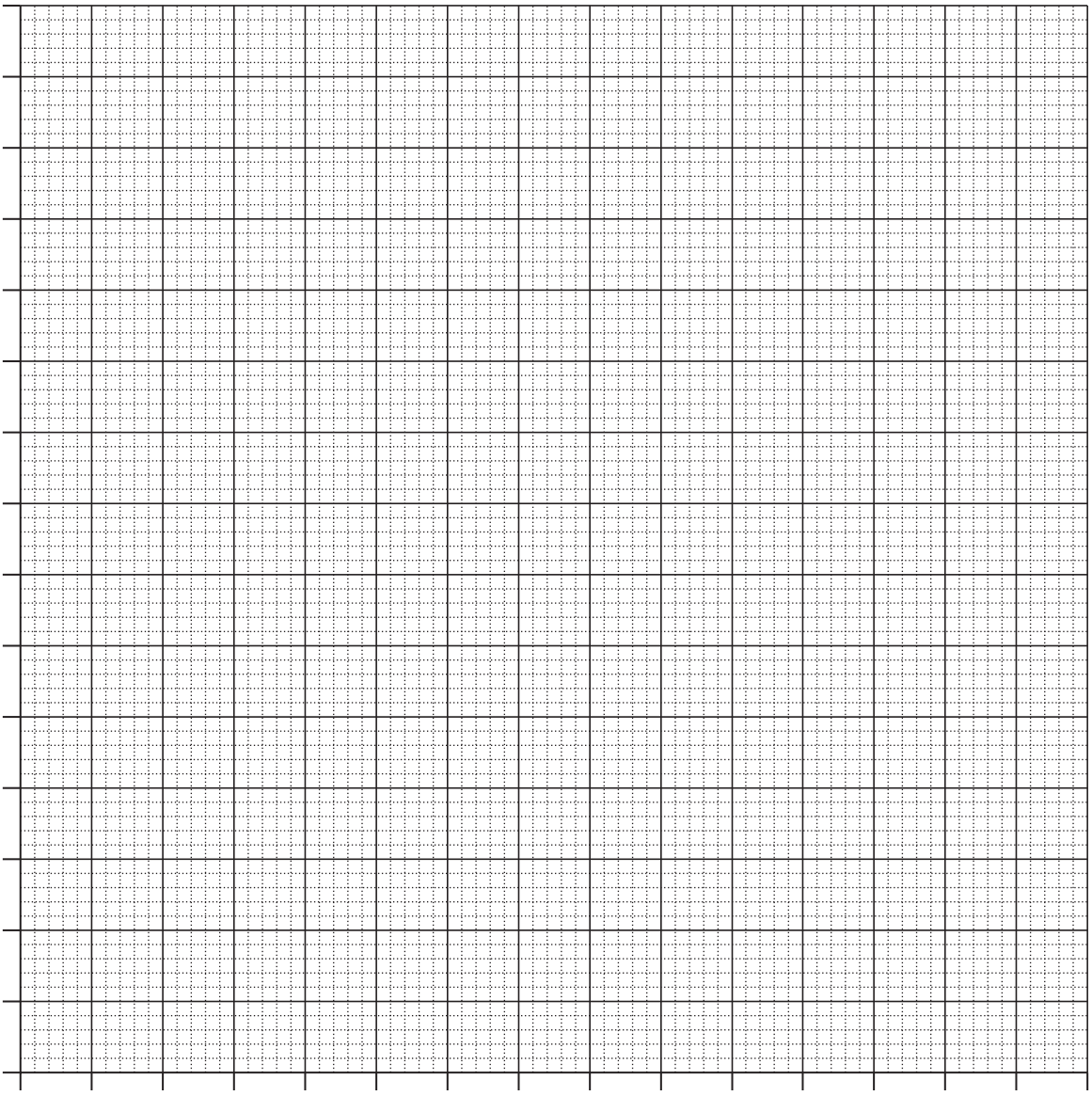
Question 24 continues on page 19

Marks

Question 24 (continued)

An appropriate graph is to be drawn and used to predict the enzyme activity for a substrate concentration of 75 μM.

(a) Use the data to draw an appropriate graph. **4**



(b) Extrapolate your graph and predict what the enzyme activity would be if the substrate concentration were increased to 75 μM. **2**

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End of Question 24

Marks

Question 25 (5 marks)

(a) How could a mutation in DNA affect polypeptide production? **3**

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(b) How could a change in a polypeptide affect cell activity? **2**

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Centre Number

Section I – Part B (continued)

Student Number

Marks

Question 26 (3 marks)

The Tasmanian devil is in danger of becoming extinct due to an infectious disease causing facial tumours. The animals slowly starve and usually die within six months of showing tumours. Populations in the western third of Tasmania currently remain free of this disease. **3**

Justify the steps you would take to ensure that a population of Tasmanian devils remains disease free.

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Marks

Question 27 (8 marks)

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Some recent developments in blood banking

Types of donation

- Plasma donation – during collection, plasma is separated by centrifugation and the other blood components are returned to the donor
- Whole blood donation – after collection, whole blood is centrifuged to separate blood components and the components from different donors are pooled

Storage of blood components

- Some blood components can be frozen for storage
- Some blood components can be refrigerated for up to one month, but this requires additives
  - citrate is used as an anticoagulant
  - glucose is used as a source of nutrients
  - mannitol is used to maintain osmolarity and pH

Safety

- Ensuring that the donor does not get an infection during donation
- Ensuring that the donated blood is not contaminated by testing it for antibodies to particular microbes or for the presence of viral DNA or RNA
- Ensuring that the number of white blood cells is depleted before the blood is given to patients who have a weakened immune system
- Bacterial contamination of platelets is still a problem because they cannot be easily separated by filtration

With reference to the information above, explain how an understanding of biological concepts has led to the development of specific methods in blood banking and the implications for society.

Question 27 continues on page 23

Question 27 (continued)

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End of Question 27

Marks

Question 28 (6 marks)

(a) Explain how ONE named process that occurs during meiosis results in genetic variation. **3**

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(b) Why is genetic variation important in the survival of a species? **3**

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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
Question 32	The Human Story	29
Question 33	Biochemistry	30

Marks

Question 29 — Communication (25 marks)

(a) (i) Name TWO receptors used for communication in humans. **2**

(ii) For ONE receptor, outline the steps in the response to a stimulus. **3**

(b) It was observed that a new insect species had a flat disk on the inner knee of each foreleg. **6**

How could you use a first-hand investigation and information from secondary sources to determine if this structure functions as a tympanic membrane?

(c) People can have problems with communication because of difficulties in the sending, receiving or interpretation of some signals. **7**

How has an increased understanding of the processes of sight and hearing led to improved assistance for people with difficulties in communicating?

(d) Draw and label a diagram showing the path of soundwaves through the external, middle and inner ear. **3**

(e) Describe possible future research to overcome ONE current limitation in cochlear implants. **4**

Marks

Question 30 — Biotechnology (25 marks)

(a) Name TWO organic compounds produced by biotransformation technologies. **2**

(b) Describe ONE use of biotechnology by an early society. **3**

(c) The sourdough process of breadmaking involves retaining some of the dough each time as a "starter" for the next bread mixture. **6**

How could you use a first-hand investigation and information from secondary sources to develop methods to improve this process in order to ensure a consistent bread product?

(d) How have developments in the understanding of modern biotechnological processes led to improvements in treating disease? **7**

(e) Draw and label a diagram showing the sequence of events that result in the formation of recombinant DNA. **3**

(f) Describe ONE possible area of future research based on a current use of recombinant DNA technology. **4**

Marks

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

(a) (i) Describe ONE difference between gene cloning and whole organism cloning. **2**

(ii) Outline the steps that could be taken to verify that a particular animal was a clone. **3**

(b) In a study of Mendelian genetics, small-winged butterflies were crossed with butterflies with normal size wings. **6**

Unexpectedly, one of the offspring had wings twice the normal size.

How could you use a first-hand investigation and information from secondary sources to determine if this is a genetic mutation?

(c) How have knowledge of genetics and genetic mutations affected understanding of human health and disease? **7**

(d) Draw and label a diagram of a method used to produce recombinant DNA. **3**

(e) Describe ONE possible area of future research arising from the limited data obtained from the Human Genome Project. **4**

Marks

Question 32 — The Human Story (25 marks)

(a) Name TWO characteristics of humans that allow them to be classified as primates. **2**

(b) Outline ONE method that could be used to determine the age of fossils. **3**

(c) On a remote island, a whole Hominid skeleton was exposed by a recent landslide. **6**

How could you use a first-hand investigation and information from secondary sources to determine if this is a new *Homo* species?

(d) How have knowledge of cultural development and polymorphism led to an improved understanding of how the human species has adapted to the environment? **7**

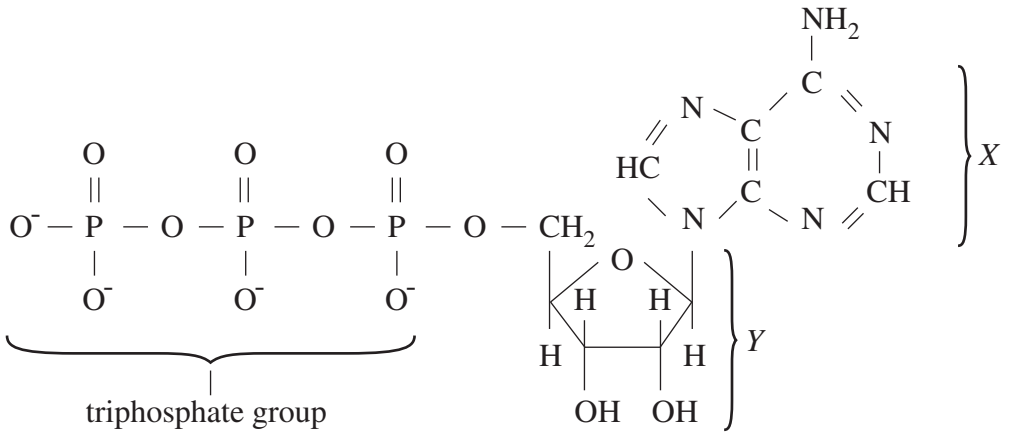
(e) Draw and label a diagram to show the process of DNA-DNA hybridisation that is used to determine relationships between groups of primates. **3**

(f) Describe possible implications of the Human Genome Project on our understanding of human evolution. **4**

Marks

Question 33 — Biochemistry (25 marks)

(a) The structure of the ATP molecule is shown.



(i) Name the TWO components of ATP that are labelled *X* and *Y*. **2**

(ii) Why are the phosphate groups considered to be the biologically important part of the ATP molecule? **3**

(b) A rare plant was discovered on the side of a volcano. This plant excreted pure sulfur at levels that could be used commercially. **6**

More sulfur was produced when the volcano was active and when the atmosphere was deep red.

Based on Van Niel's findings it was thought that this was a photosynthetic reaction.

How could you use a first-hand investigation and information from secondary sources to determine if this is a photosynthetic reaction?

(c) How are developments in technologies and strategies for investigating plant biochemistry related to the development of understanding of photosynthesis? **7**

(d) Draw and label a diagram to trace the main steps in the Calvin cycle. **3**

(e) Describe ONE possible area of future research in photosynthesis to address the continuing need for energy supplies. **4**

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