

DUNMAN SECONDARY SCHOOL

CANDIDATE
NAME

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CLASS

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INDEX
NUMBER

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PRELIMINARY EXAMINATION 2025 SECONDARY 4 EXPRESS

BIOLOGY

Paper 2

6093/02

28 August 2025
1 hour 45 minutes

Candidates answer on the Question Paper.
No Additional Materials are required.

READ THESE INSTRUCTIONS FIRST

Write your name, class and index number on all the work you hand in.
Write in dark blue or black pen.
You may use an HB pencil for any diagrams, graphs or rough working.
Do not use staples, paper clips, glue or correction fluid.

Section A

Answer **all** questions.

Write your answers in the spaces provided on the Question Paper.

Section B

Answer all the questions, the last question is in the form either/or.

Write your answers in the spaces provided on the Question Paper.

The use of an approved scientific calculator is expected, where appropriate.
The number of marks is given in brackets [] at the end of each question or part question.

Section A

Answer **all** questions.

- 1 (a) The phloem is used to transport sucrose and amino acids in plants. Aphids are used to investigate how plants transport sucrose. Fig. 1.1 shows an aphid with its mouthparts inserted into a leaf to feed on the liquid in the phloem.



Fig. 1.1

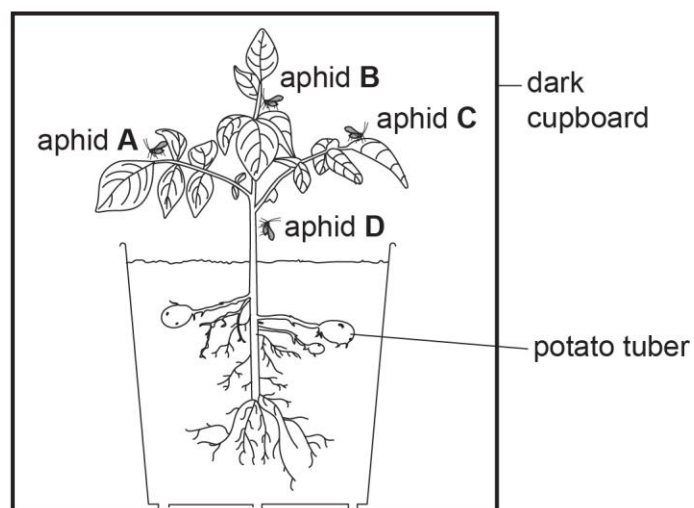


Fig. 1.2

A potato plant was put in a dark cupboard for several days. Four aphids, **A**, **B**, **C** and **D**, were then placed on the plant in the dark cupboard as shown in Fig. 1.2. Immediately after the aphids were placed on the plant it was observed that:

- all the aphids ingested the same volume of liquid from the phloem.
- aphid **D** ingested the highest concentration of sucrose.

Explain why aphid **D** ingested the highest concentration of sucrose.

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..... [3]

- (b) Fig. 1.3 shows some cells on the surface of a leaf from a plant.

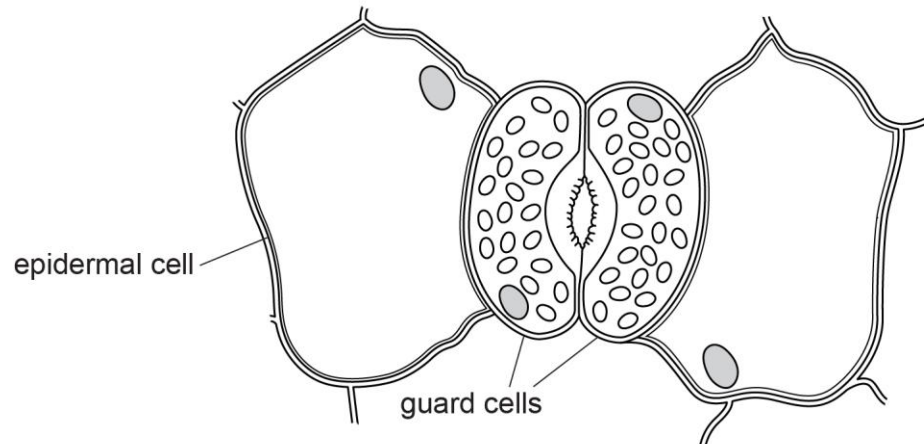


Fig. 1.3

State **two** differences, visible in Fig. 1.3 between guard cells and epidermal cells.

1

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2

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[2]

- (c) The potato plant has purple flowers that are usually insect-pollinated. After pollination the seeds formed can grow into new plants.

Explain why these plants may show features different from the parent plants.

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..... [2]

[Total: 7]

- 2 Fig. 2.1 and Fig. 2.2 are diagrams of transverse sections of the human heart during different stages of the cardiac cycle. The sections pass through the heart at a level that is just above the valves.

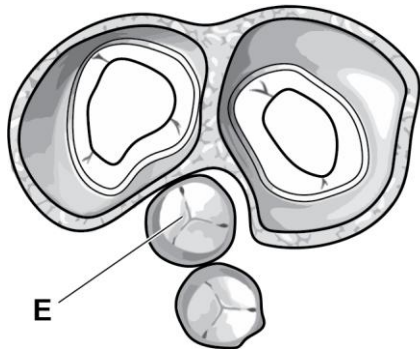


Fig. 2.1

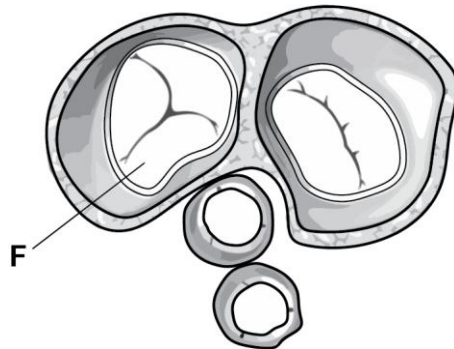


Fig. 2.2

- (a) (i) Name valve **E** on Fig. 2.1 and valve **F** on Fig. 2.2.

E

F [2]

- (ii) With reference to the chambers of the heart and the main blood vessels, describe the flow of blood through the heart that occurs when the transverse section of the heart appears as shown in Fig. 2.1.

.....

 [2]

- (b) Identify the stage of the cardiac cycle shown in Fig. 2.2.

Give a reason for your answer.

stage of cardiac cycle

reason

.....
 [2]

- (c) Fig. 2.3 shows the heart of a man with coronary heart disease (CHD).

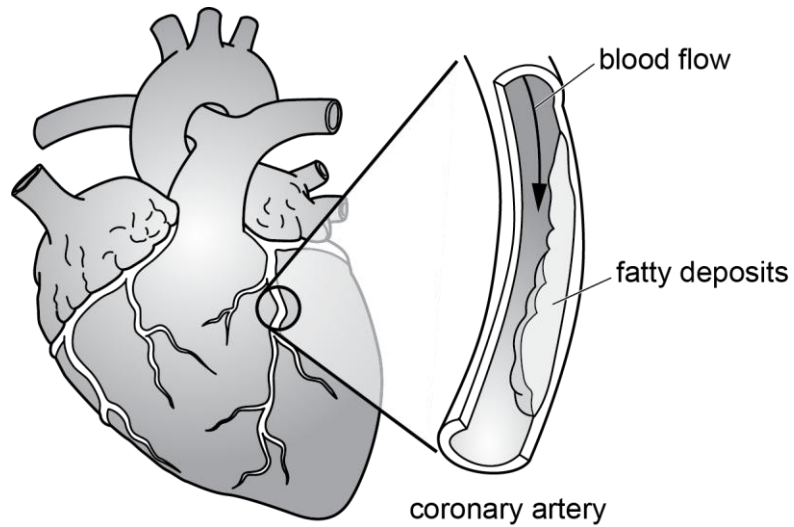


Fig. 2.3

The heart needs to respond to extra demands during strenuous exercise.

Explain why, during strenuous exercise, the heart of a person with CHD would not respond as efficiently as the heart of a healthy person.

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..... [3]

[Total: 9]

- 3 Soya beans and beef are both good sources of protein. Table 3.1 shows the nutritional content of products made from soya and beef.

Table 3.1

product	nutritional content per 100 g of product			
	energy kJ	protein / g	saturated fat / g	fibre / g
corned beef	905	26.9	12.1	0.0
soya sausages	1128	19.0	2.1	2.0

- (a) Explain **two** reasons why soya sausages may be healthier than corned beef in a regular diet.

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..... [4]

- (b) An average adult man needs 0.8 g of protein per kilogram of body weight daily.

Calculate the mass of soya beans an 80 kg man needs to eat to meet the protein requirement.
Show your working.

[2]

- (c) Corned beef is produced from cattle that have been fed on soya beans.

Explain why it is more energy efficient for humans to eat soya products as a source of protein than corned beef.

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..... [3]

[Total: 9]

- 4 PTC is a bitter tasting chemical that some humans can taste while others cannot. This is controlled by a single gene with a pair of alleles. Fig. 4.1 shows the inheritance of the ability to taste PTC in a family.

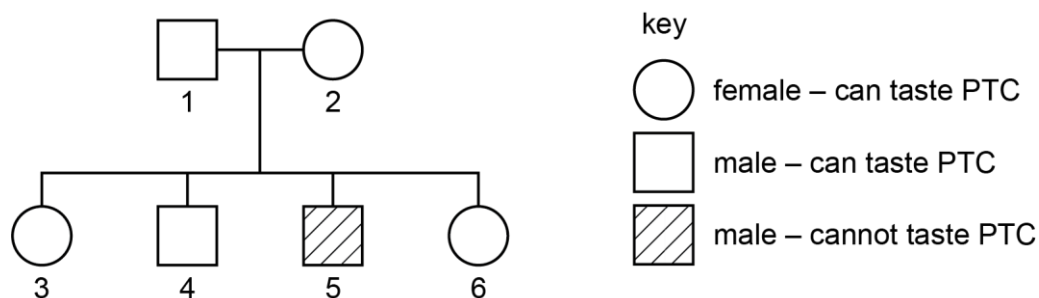


Fig. 4.1

- (a) (i) The allele for tasting PTC is dominant to the allele for not tasting PTC.
State evidence shown in Fig. 4.1 that supports this fact.
-
-
- [2]
- (ii) Use the symbols **T** for the dominant allele and **t** for the recessive allele to state the genotypes for individuals 2 and 5.
- individual 2
- individual 5 [1]
- (iii) What are the **two** possible genotypes for individual 3?
- [1]

- (b) A scientist was pouring powdered PTC into a bottle. A small amount of the powder accidentally blew into the air. A short time later another scientist working in the same room said that she had a bitter taste in her mouth from the powder in the air.

Describe, with reference to named components of the nervous system, the nervous pathway that led to the scientist detecting that the powder tasted bitter.

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[Total: 8]

- 5 Two groups of healthy volunteers participated in a study on the effect of thermoregulation in a room at 38 °C and 50% relative humidity. One group was kept at rest while the other group was asked to run on a treadmill set at constant speed for 45 min. The results of the study are shown in Fig. 5.1.

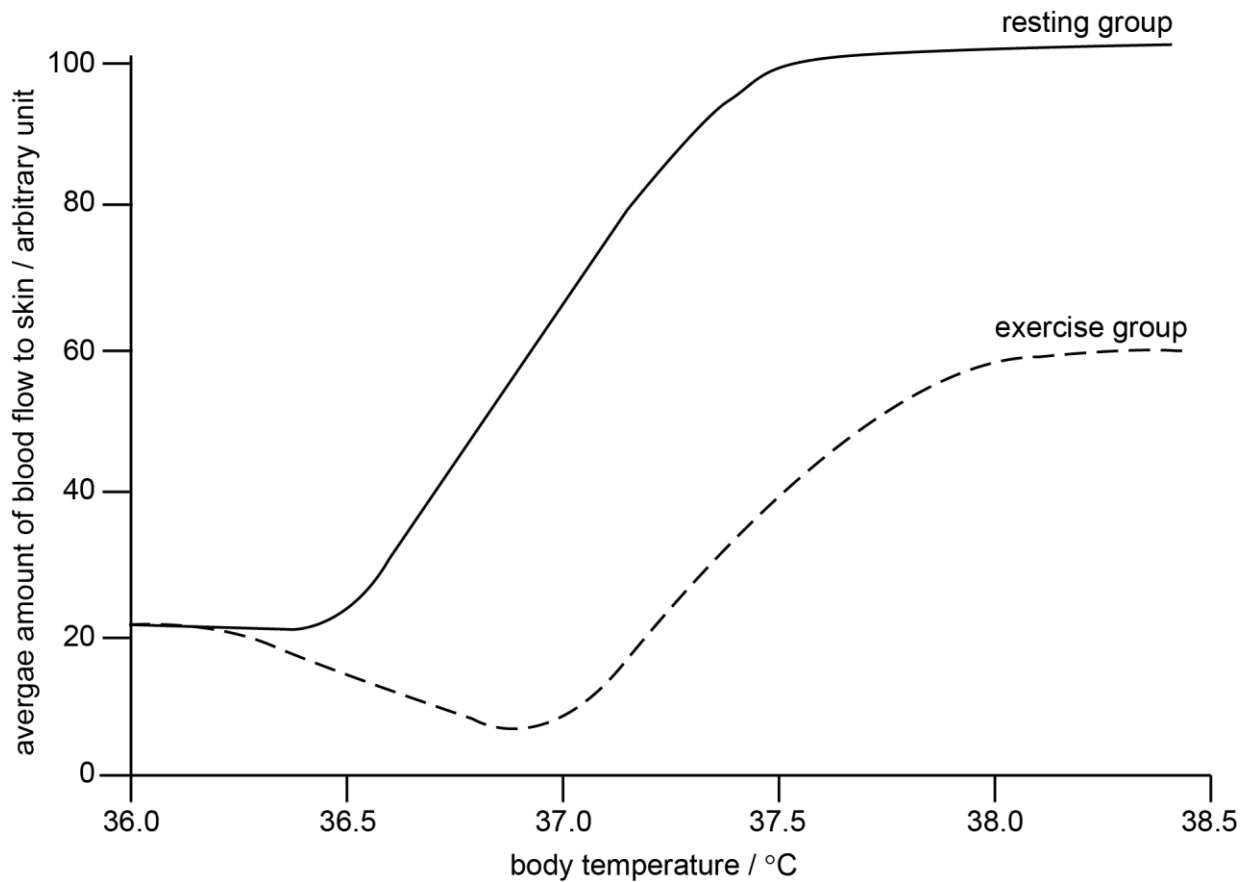


Fig. 5.1

- (a) Describe the process leading to an increase in blood flow to the skin of the resting group.

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[4]

- (b) (i) With reference to the curve of the exercise group, describe the volume of blood flow and the condition of the arterioles leading to the skin surface when the body temperature increased from 36 °C to 37 °C.

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..... [2]

- (ii) Suggest the reason for the change in (b)(i) to the exercise group?

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..... [2]

- (c) Apart from the change in (b)(i), state two other differences in how skin blood flow changes in thermoregulation for the two groups.

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..... [2]

[Total: 10]

- 6 A healthy kidney controls the excretion of urea and other metabolic waste products from the blood. Fig. 6.1 shows a kidney tubule and associated blood vessels. The arrows show the direction of blood flow.

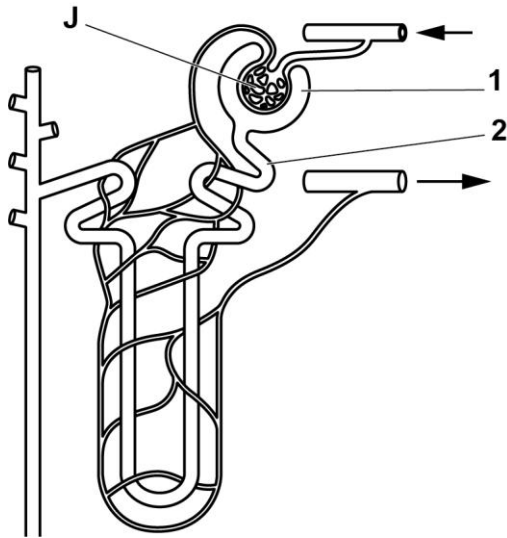


Fig. 6.1

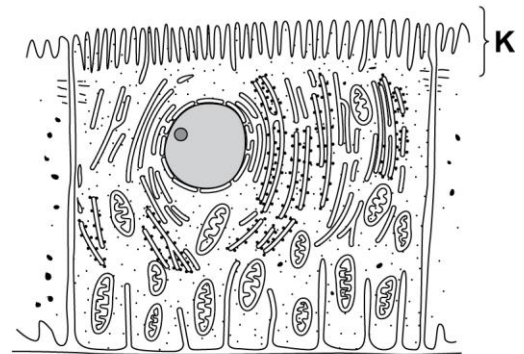


Fig. 6.2

- (a) (i) Define *excretion*.

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 [1]

- (ii) Describe how structure J is adapted for urine formation.

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 [2]

- (iii) Fig. 6.2 is a vertical section through a cell from the lining of region 2 of the tubule. Explain the importance of structure K on the surface of the cells lining region 2.

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 [1]

- (b) When the kidneys fail, urea needs to be removed by dialysis. For patients who are unable to travel for hemodialysis, peritoneal dialysis is an alternative way to remove urea. Fig. 6.3 shows peritoneal dialysis in a patient with kidney failure.

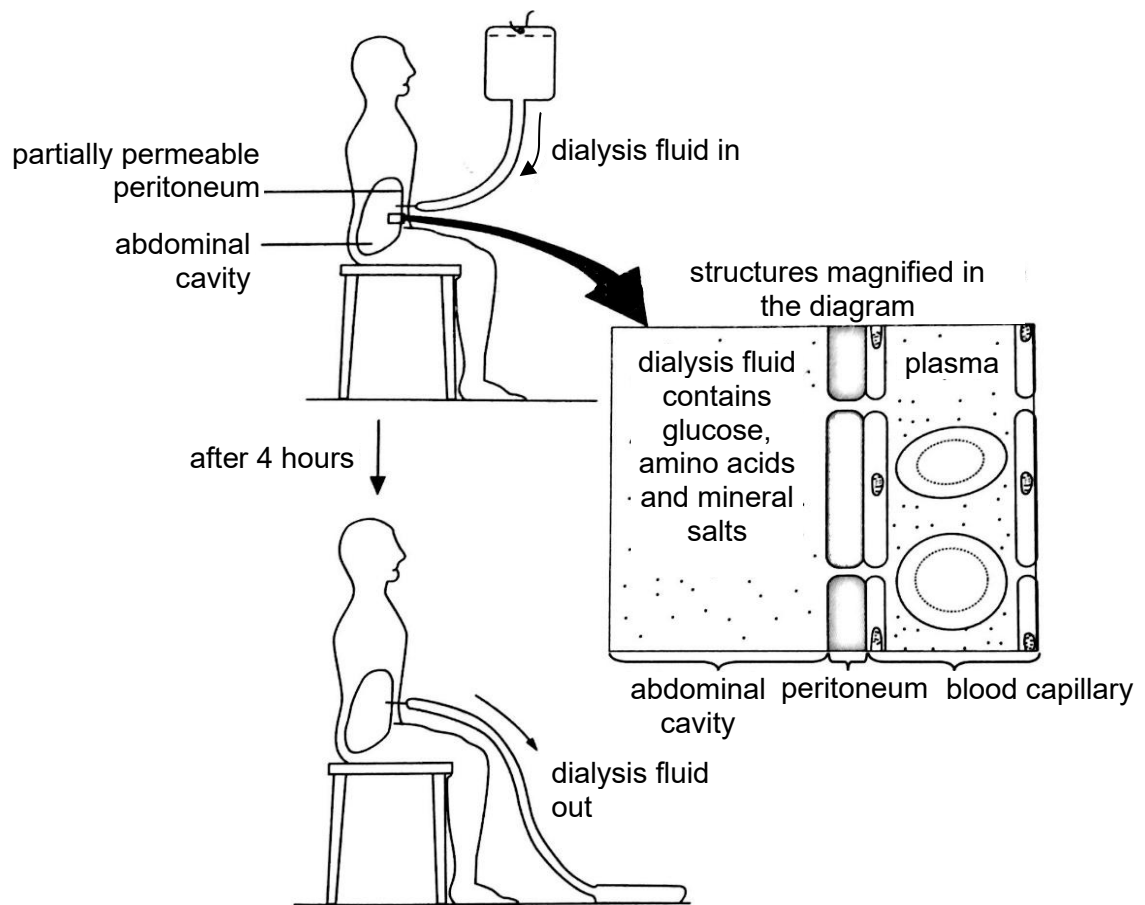


Fig. 6.3

- (i) Explain how nitrogenous waste is removed from blood in this method of dialysis.

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 [1]

- (ii) Explain why it is important for the patient to avoid a high protein diet.

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 [2]

- (iii) Patients undergoing peritoneal dialysis will have to go through this process three to five times daily as compared to once every two to three days for hemodialysis.

Suggest and explain why there is a difference in frequency of treatment between peritoneal dialysis and hemodialysis.

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..... [3]

[Total: 10]

7 Enzymes are proteins. Fig. 7.1 shows the stages involved in protein synthesis.

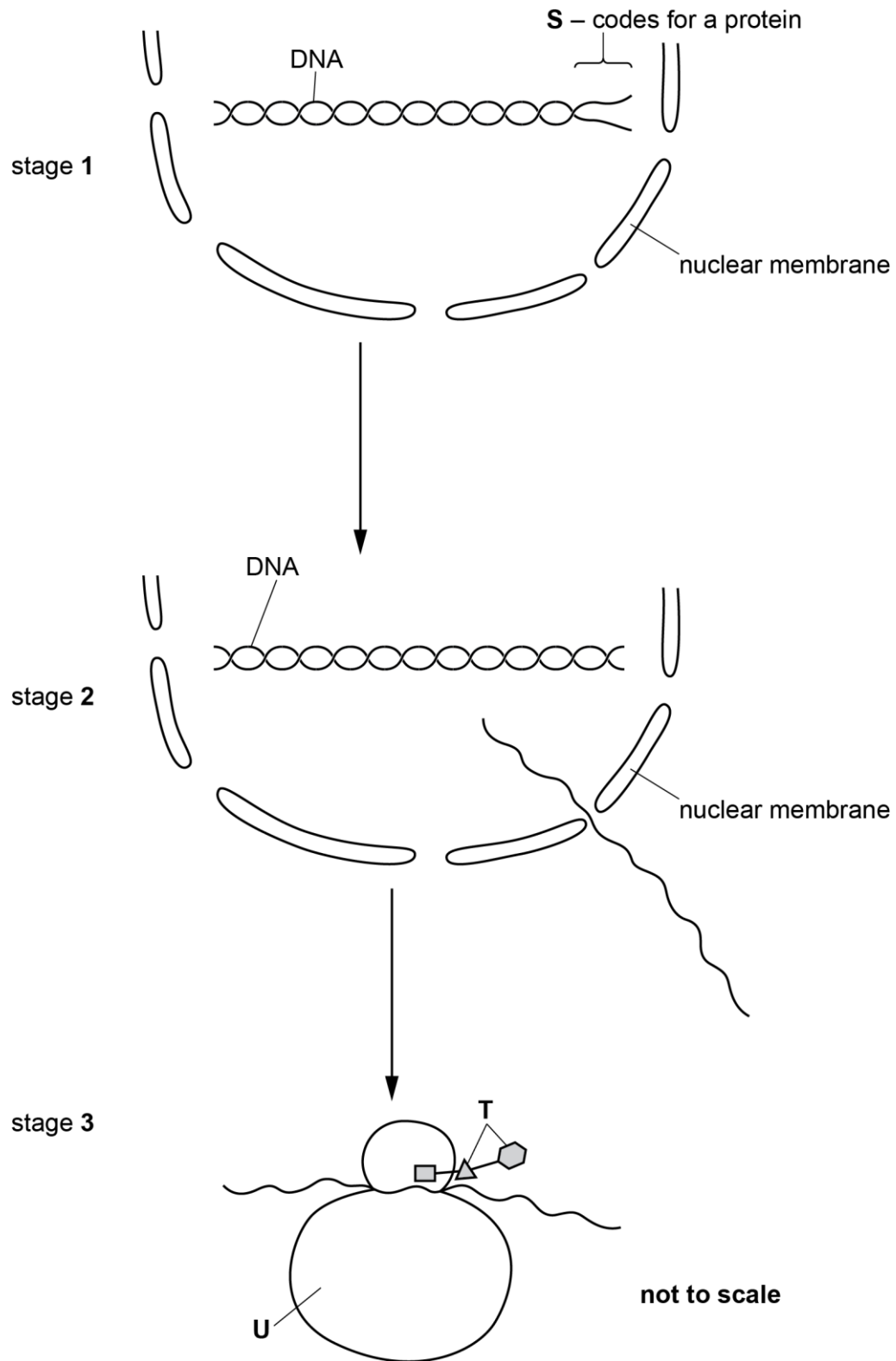


Fig. 7.1

- (a) Describe the events that occur during stage **1**, **2** and **3** of protein synthesis in Fig. 7.1.

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..... [4]

- (b) The shape of a protein is very important for its function.
Explain why a gene mutation can affect the function of an enzyme.

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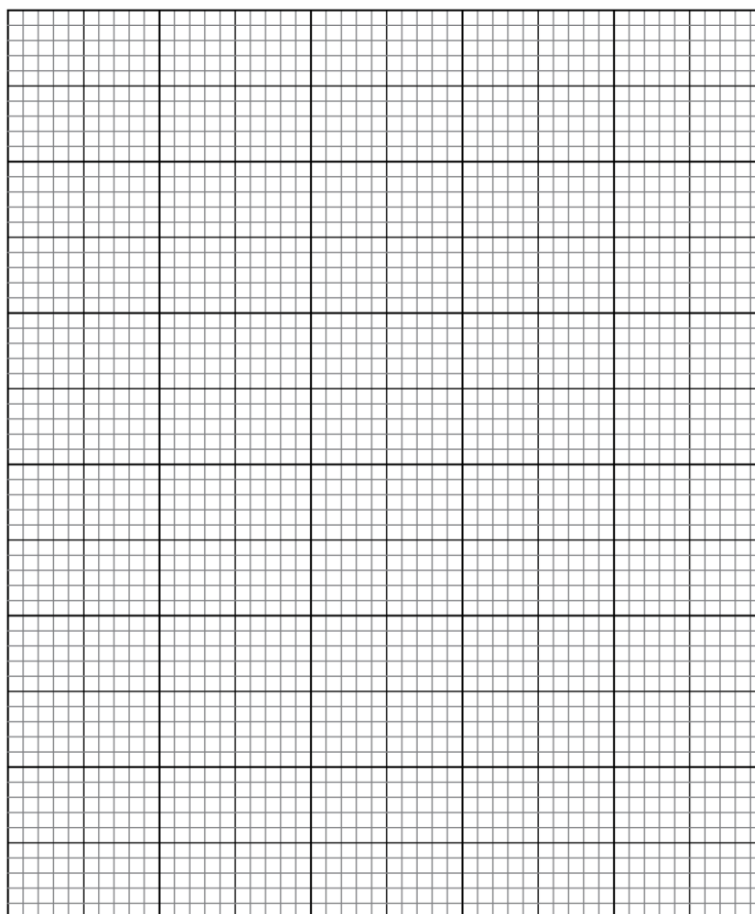
[Total: 7]

- 8 Some fruits contain protease enzymes. These enzymes can denature the proteins in milk, causing the milk to clot. The effect of pH on the activity of the protease enzyme in fruit extract was investigated. The results are shown in Table 8.1.

Table 8.1

pH	protease activity / $\mu\text{mol min}^{-1} \text{mg}^{-1}$
2	0.00
4	5.50
6	15.00
8	29.00
10	7.00

- (a) Plot a graph of the data in Table 8.1 on the grid below.



[4]

- (b) Describe the effect of pH on the activity of the protease.

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..... [2]

- (c) Use your graph to estimate the protease activity at pH 5. Mark this point on your graph and rewrite the value below.

protease activity at pH 5 = [2]

- (d) Enzymes are involved in the milk clotting process. A water bath was used to keep the temperature constant, at 30 °C, for each test.

Suggest why it is important to keep the temperature constant.

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..... [2]

[Total: 10]

Candidate Name:	Class:	Index No:
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Section B

Answer **one** question from this section.

- 9 (a) Fig. 9.1 shows the percentage of bacteria from human faeces that are resistant to antibiotics in relation to the quantities of antibiotics used in each of a number of years over a period of forty years.

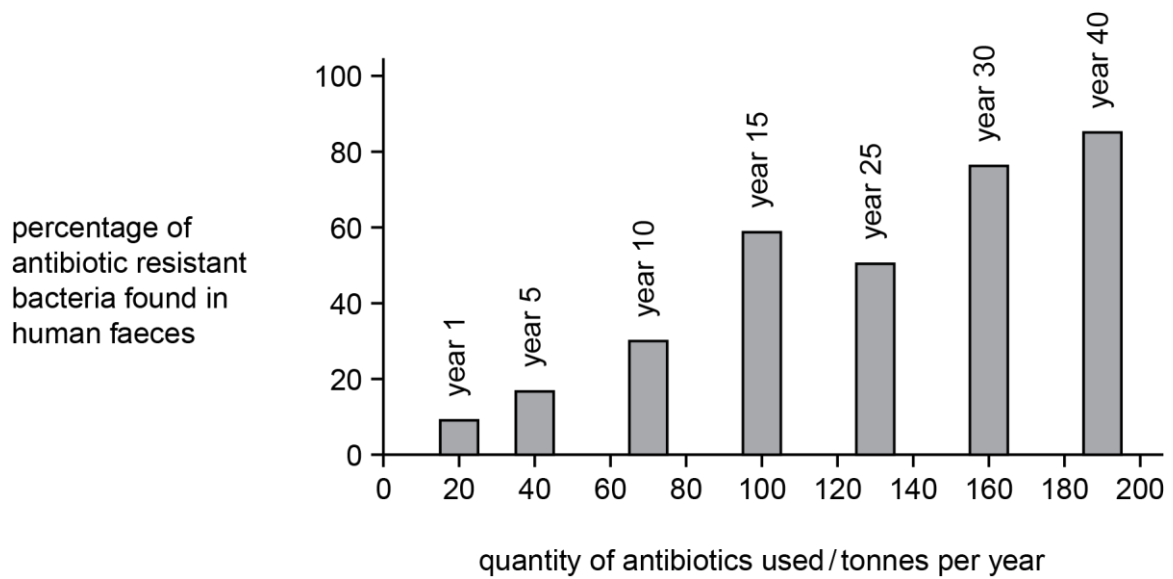


Fig. 9.1

- (i) With reference to Fig. 9.1, describe the relationship between the quantity of antibiotics used and antibiotic resistance during this 40-year period.

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..... [3]

- (ii) Explain the relationship between the percentage of resistant bacteria and the quantity of antibiotics used.

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- (b) Antibiotics are used to treat human diseases. Many bacteria have become resistant to antibiotics and some antibiotics can no longer be used to treat certain diseases.

Describe how the problem of antibiotic resistance can be limited.

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..... [3]

[Total: 10]

- 10 (a) Scientists investigated the effect of deforestation on a river. The river flows through a forest, part of which has been deforested. Fig. 10.1 shows the changes in nitrate concentration and the biodiversity of animals in the river as it flows through the forest.

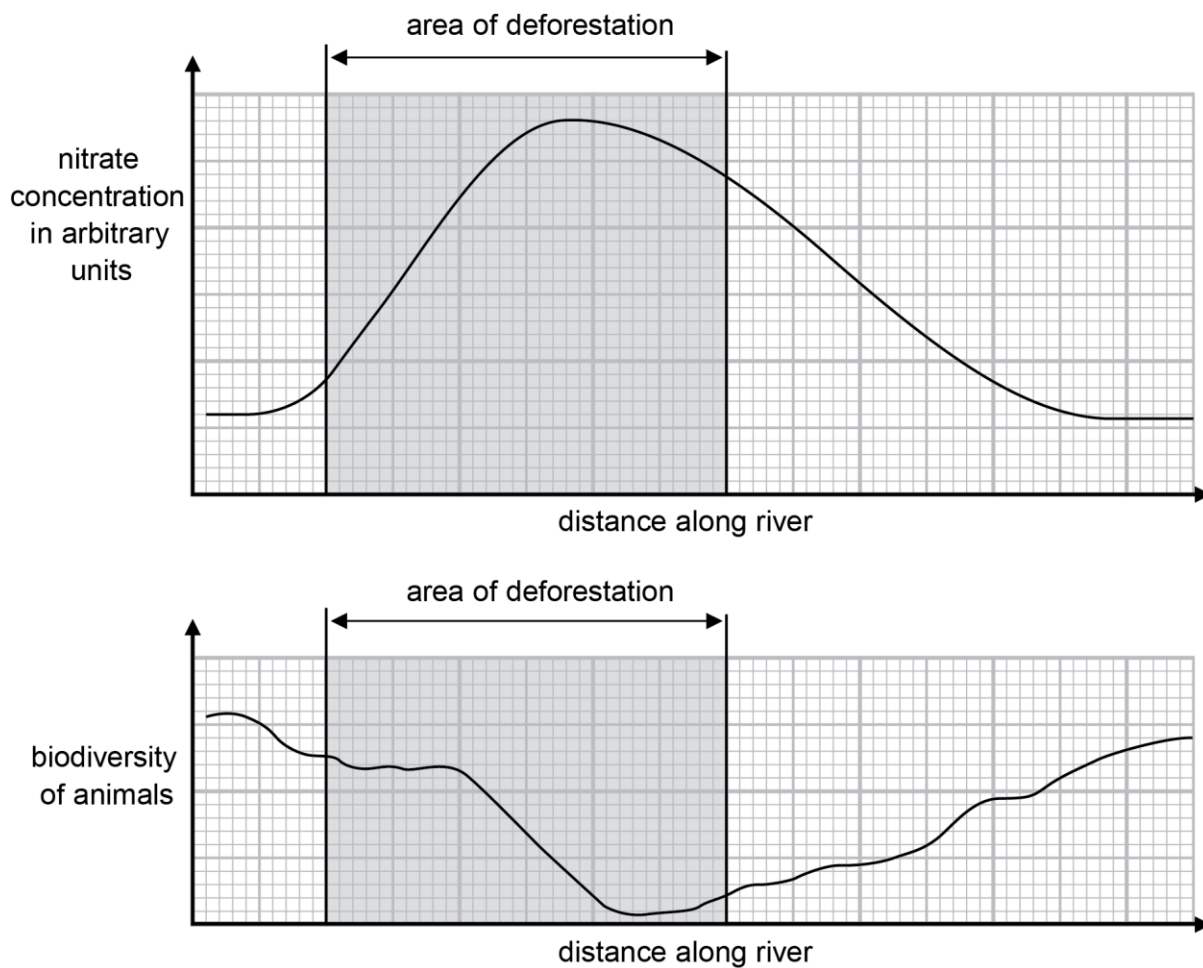


Fig. 10.1

- (i) The number of different animal species living in the river was recorded as a measure of the biodiversity of animals.

Explain why this may not be a complete measure of biodiversity.

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..... [1]

- (ii) Explain the change in the biodiversity of animals along the river with reference to Fig. 10.1.

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..... [4]

- (b) Plastic waste can now be found in increasing quantities in water bodies all over the world. State **two** effects of non-biodegradable plastic waste on river ecosystems.

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..... [2]

- (c) Every year, more species of animals and plants become extinct. How could the conservation of animal and plant species be of benefit to mankind?

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..... [3]

[Total: 10]

