GCE AS/A LEVEL

2400U10-1

BIOLOGY – AS UNIT 1

BASIC BIOCHEMISTRY AND CELL ORGANISATION

THURSDAY, 24 MAY 2018 – AFTERNOON

1 hour 30 plus your additional time allowance

Surname _____

Other Names _____

Centre Number _____

Candidate Number 2 _____

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	10	
2.	6	
3.	11	
4.	13	
5.	15	
6.	16	
7.	9	
Total	**80**	

ADDITIONAL MATERIALS

A calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink, black ball-point pen or your usual method.

Write your name, centre number and candidate number in the spaces provided on the front cover.

Answer ALL questions.

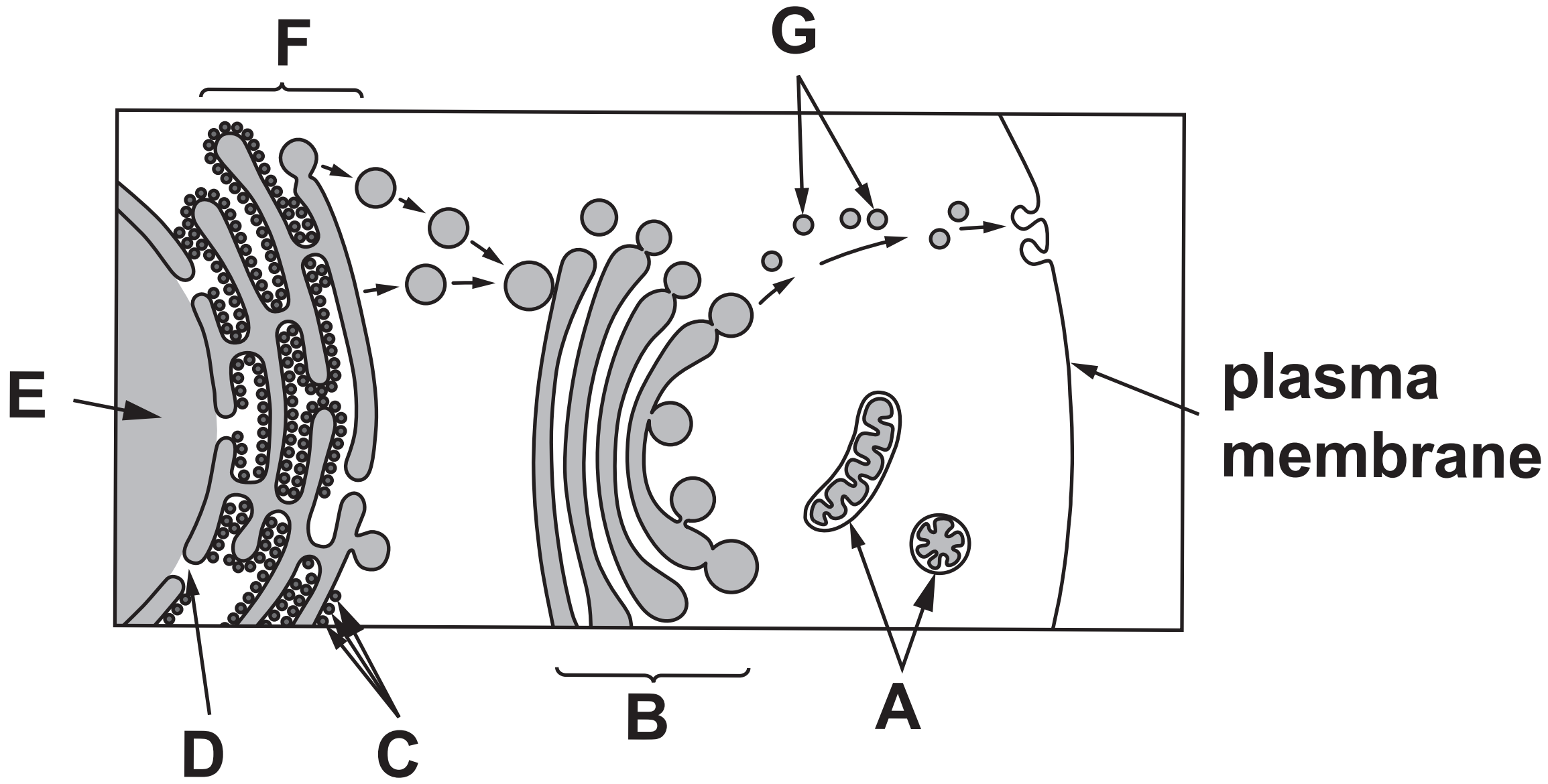
Write your answers in the spaces provided in this booklet. If you run out of space, use the continuation pages at the back of the booklet, taking care to number the question(s) correctly.

INFORMATION FOR CANDIDATES

The number of marks is given in brackets at the end of each question or part-question.

The assessment of the quality of extended response (QER) will take place in question 7.

The quality of written communication will affect the awarding of marks.


F
G
E
plasma
membrane
D
C
B
A

Answer all questions.

1. **The diagram opposite shows part of a cell taken from the pancreas, which is involved in the production of digestive enzymes.**

(a) **Identify the structures labelled A, B, C, D. [2]**

A: _____

B: _____

C: _____

D: _____

1(b) (i) **With reference to the structures labelled C, D and E, describe the sequence of events that lead to the production of digestive enzymes in this cell. [3]**

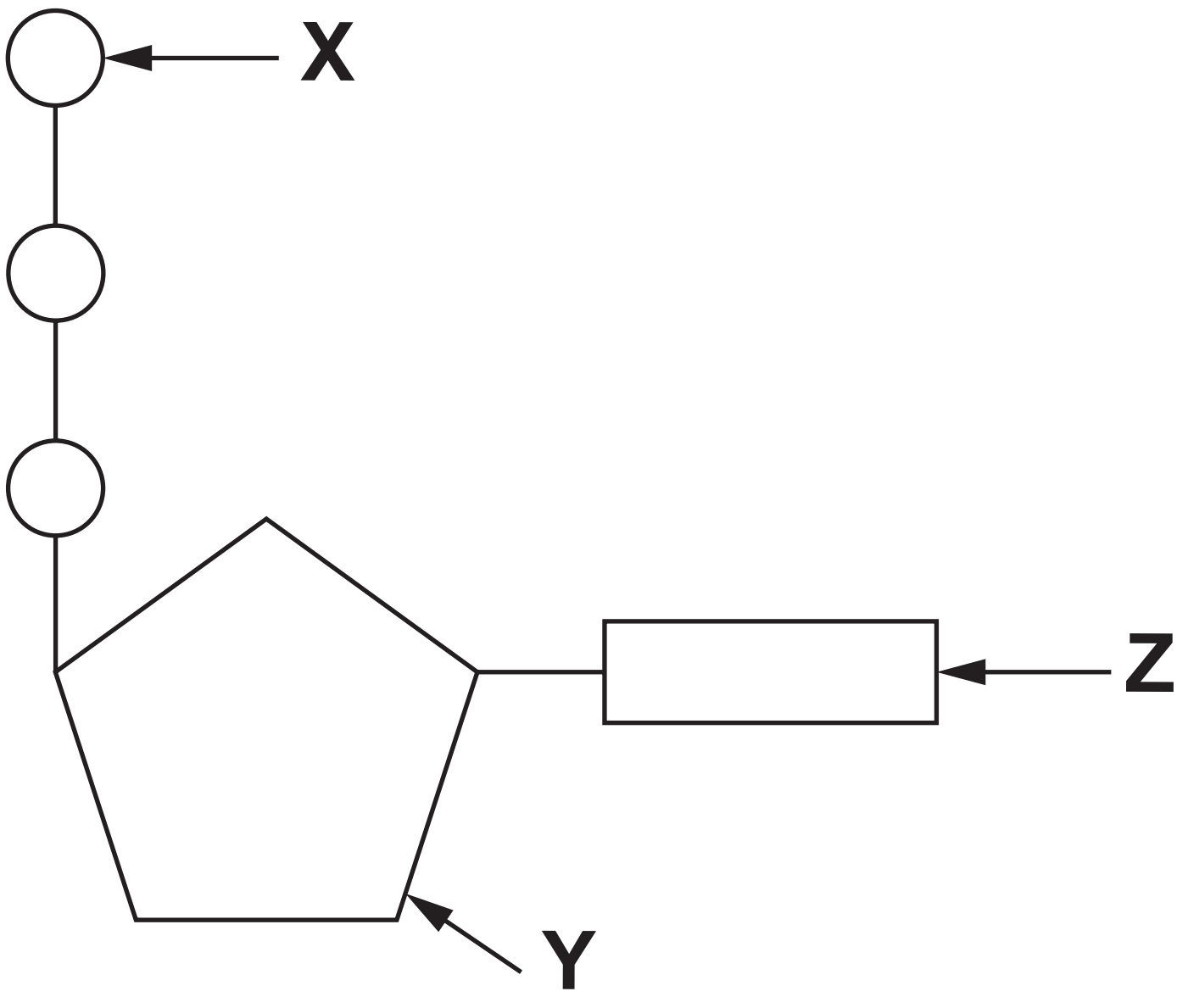
7

1(b) (ii) With reference to the structures B, F and G, describe the sequence of events that lead to the secretion of digestive enzymes from this cell. [3]

9

1(b) (iii) Explain the role of organelle **A** in the production and secretion of digestive enzymes. [2]

2. **The diagram below shows a molecule of ATP which is produced during respiration and is an energy carrier molecule used in cells. When ATP is broken down into ADP and P_i, 30.6 kJ mol^{-1} of energy is released, which can be used for cellular activities.**



2(a) (i) State the names of the parts of the ATP molecule labelled X, Y and Z. [2]

X: _____

Y: _____

Z: _____

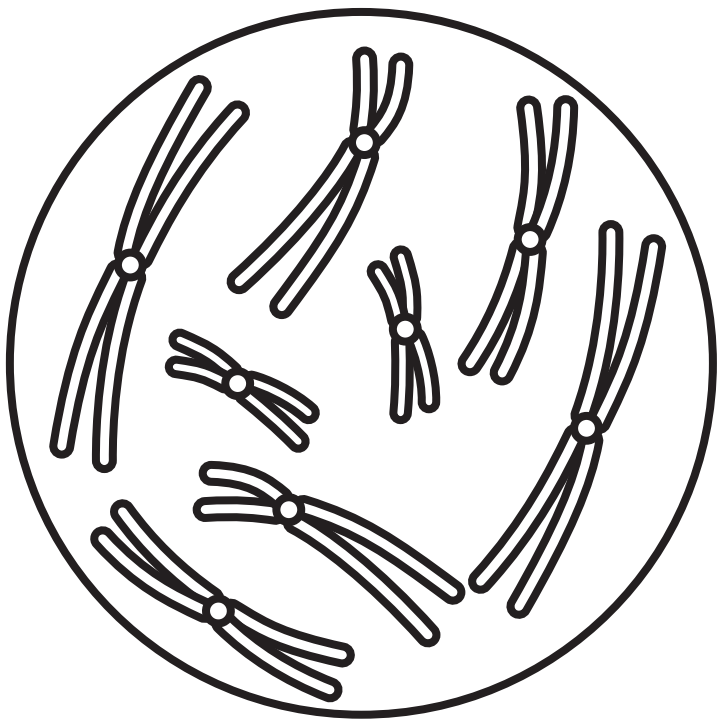
(ii) State TWO uses for the energy released from ATP in a plant cell. [1]

2(b) One mole of glucose releases 2 870 kJ of energy when completely oxidised during aerobic respiration. Synthesis of one mole of ATP from ADP and P_i requires 30.6 kJ of energy.
Calculate the percentage (%) efficiency of respiration if 38 moles of ATP are produced from one mole of glucose. Give your answer to three significant figures. [3]

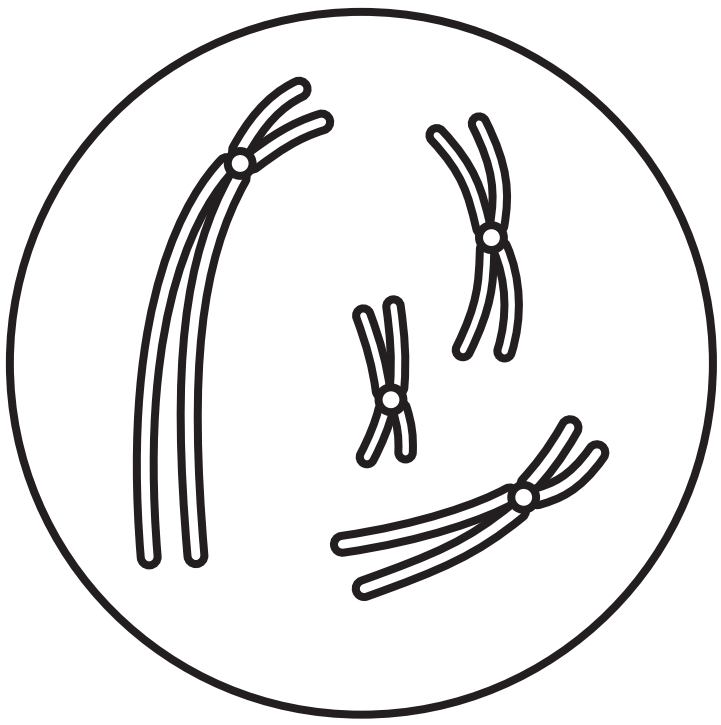
% efficiency = _____

6

H



I



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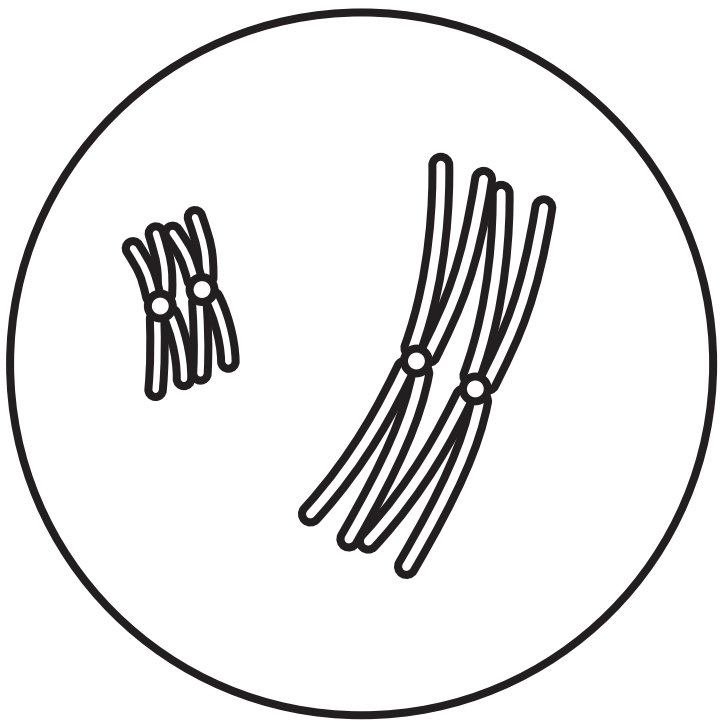

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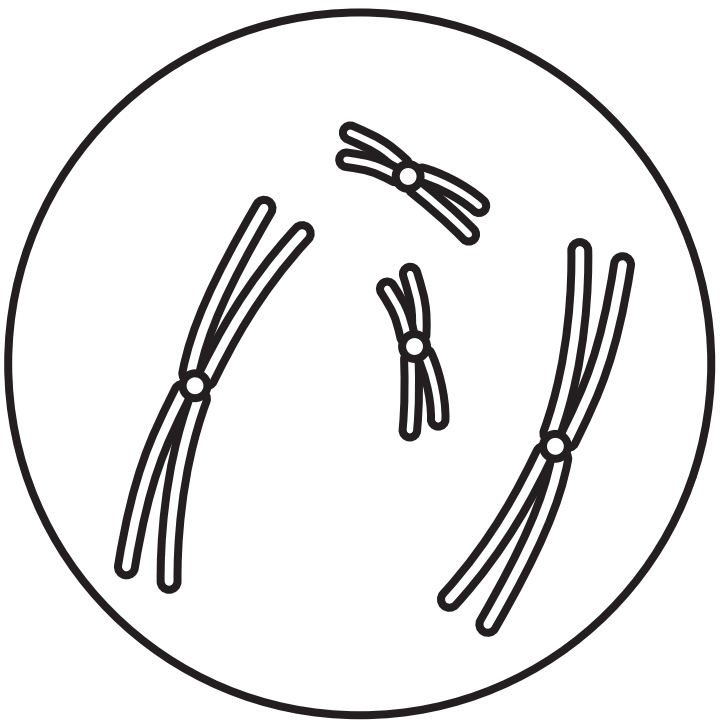
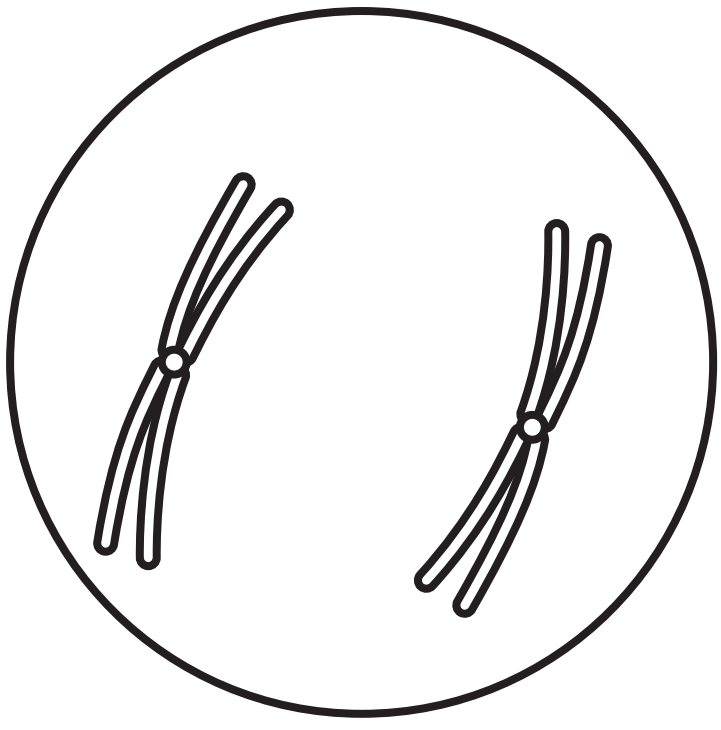
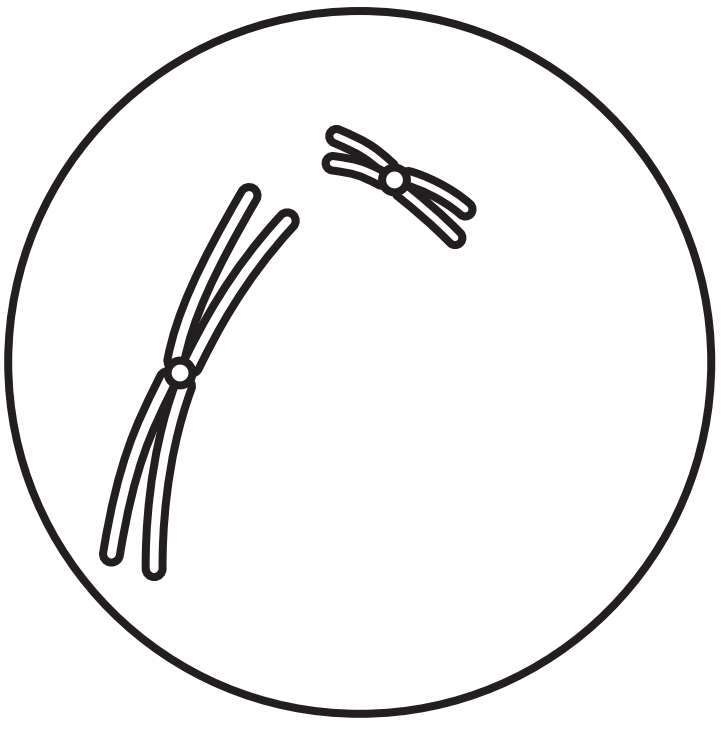


L



M



3. **Spider mites are small invertebrates which are related to spiders and scorpions. One species, *Eutetranychus africanus*, which is native to the island of Mauritius, has very few chromosomes, 2n = 4.**

The diagrams opposite show the chromosomes in some cells undergoing mitosis or meiosis.

(a) **Identify the cells that belong to this species of spider mite. [2]**

female
spider mite

male
spider mite

egg

egg

sperm

male
spider mite

female
spider mite

3(b) The diagram opposite shows the individuals that make up a colony of spider mites. Female spider mites are produced when a male sperm fertilises a female's egg. Male spider mites develop from an unfertilised female egg.

(i) COMPLETE the diagram to state which stages are HAPLOID or DIPLOID. [2]

(ii) What conclusions can be made about the formation of male and female gametes in spider mites?

[2]

16

3(c) (i) **A sample of tissue from the LEG MUSCLE of a young spider mite was analysed. The mass of DNA in some of the cells was 6.8 arbitrary units (au), whilst in other cells it was 3.4 au. Suggest explanations for this difference using your knowledge of the cell cycle. [3]**

3(c) (ii) **The table below shows the percentage of cells, with either 3.4 au or 6.8 au of DNA, in the leg muscle of a young spider mite and an older spider mite.**

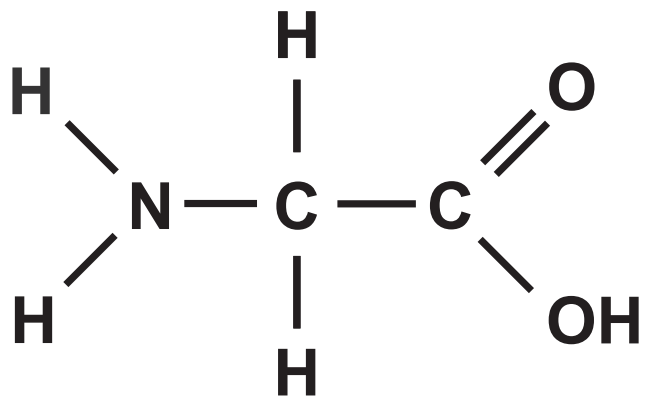
	Percentage of cells	
Mass of DNA in cell /au	**Young spider mite**	**Older spider mite**
6.8	**20**	**5**
3.4	**80**	**95**

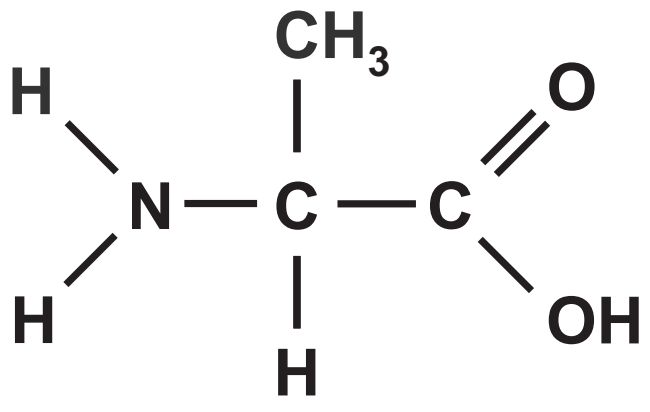
3(c) (ii) **What conclusions can be drawn from the data regarding the significance of mitosis in these spider mites? [2]**

4. β-Bungarotoxin is a neurotoxin found in the venom of Krait snakes. The neurotoxin is a protein that causes muscle paralysis and eventual death.

The diagram opposite shows the structure of two amino acids found within the protein.

4(a) (i) Complete the diagram, to show the products formed when these amino acid molecules are joined by a condensation reaction. [2]



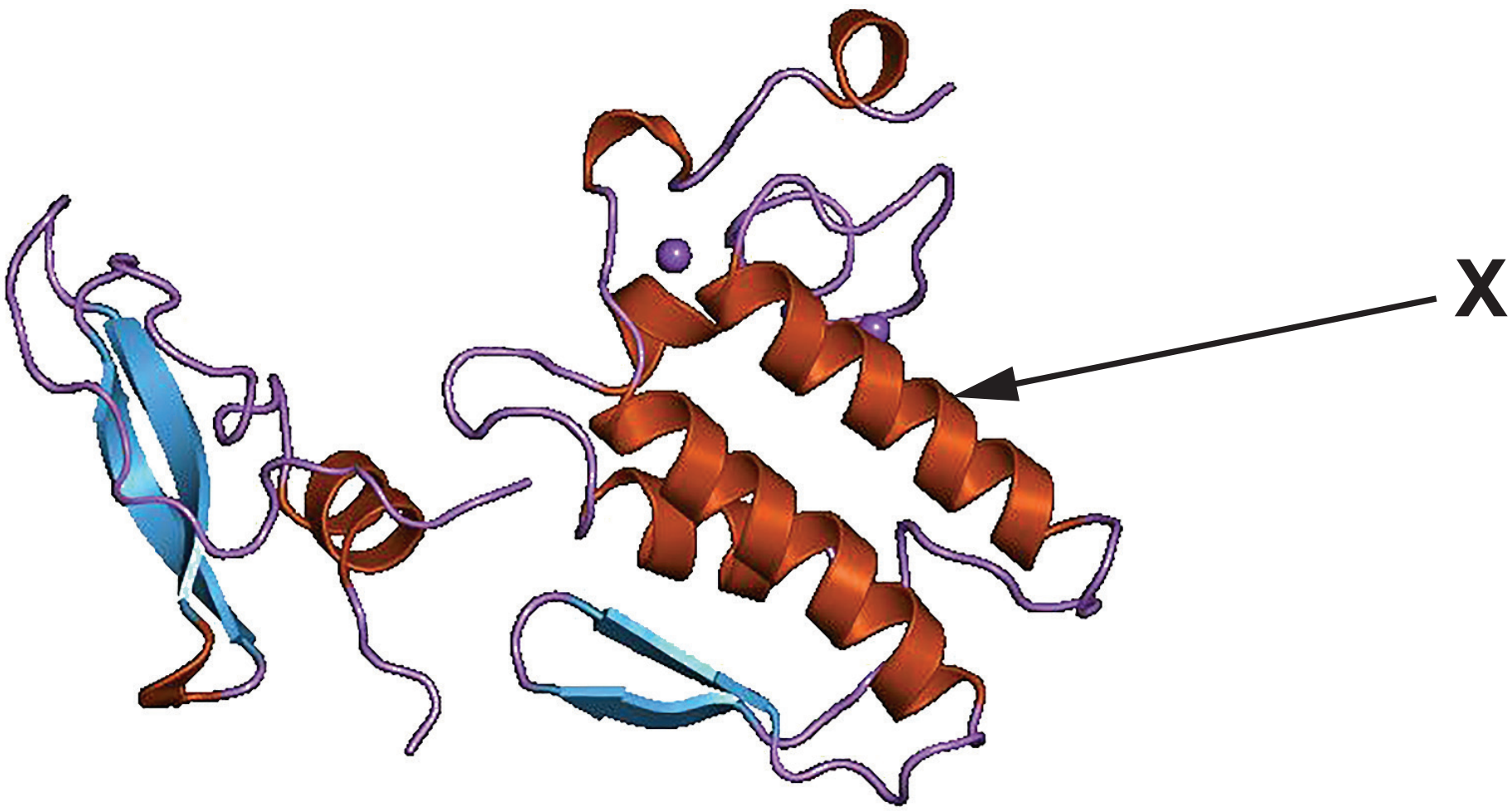


(ii) State the bond formed. [1]

_____

_____

4(b) The diagram below shows the structure of the β-bungarotoxin. The protein is composed of two polypeptide chains.



(i) State the highest level of protein structure exhibited by the β-bungarotoxin. [1]

_____

_____

4(b) (ii) Name the structure labelled X and state how this structure is maintained. [2]

(iii) State the minimum number of genes required to code for the β-bungarotoxin. Explain how you reached this conclusion. [1]

4(c) (i) One polypeptide chain of β-bungarotoxin contains 120 amino acids. State the minimum number of DNA nucleotides that would be required to code for this polypeptide. [1]

(ii) Scientists have isolated, and sequenced, the gene for this polypeptide chain; it was found to contain over 2 000 nucleotides. Scientists have also isolated molecules of mRNA, which code for this polypeptide, and found that some mRNA molecules had a higher molecular mass than the others. What conclusions can be drawn about the production of this polypeptide? [5]

26

13

5. **Nereis virens is a species of marine worm. A student wanted to investigate the effect of a change in solute concentration on these worms. The following method was used.**

- **Collect seawater and thirty worms.**
- **Make a 10% solution of seawater by placing 1 dm^3 of seawater and 9 dm^3 of freshwater into a fish tank.**
- **Record the mass of ten worms and place them into the fish tank of diluted seawater.**
- **Every 15 minutes remove the worms, blot dry, re-weigh and record their mass.**
- **Repeat this process, and after 75 minutes, return the worms to a container of undiluted seawater.**
- **Repeat the experiment a further two times using different worms for each trial.**

5.

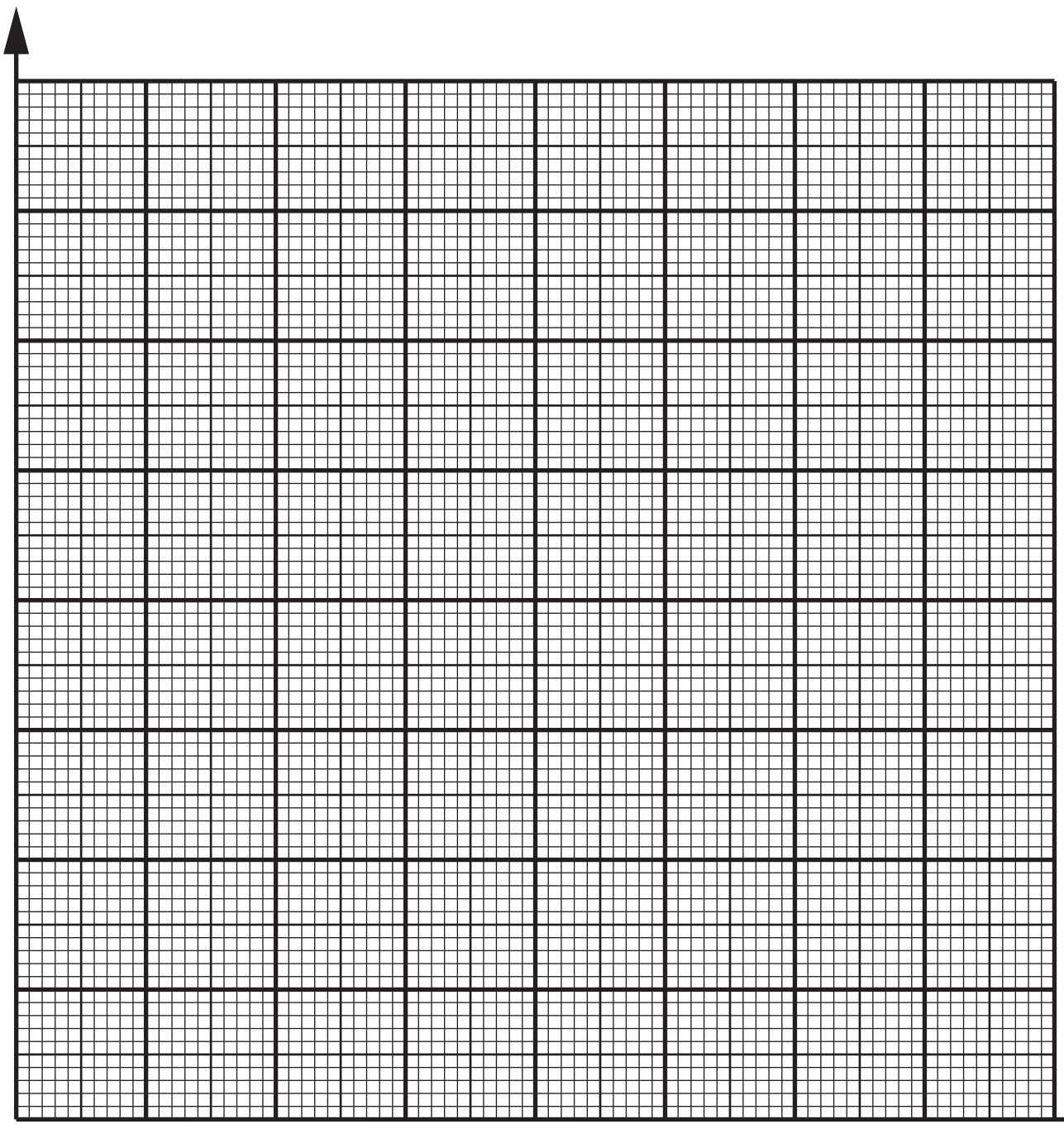
– Calculate the mean percentage change in mass of the worms during the investigation.

The student's results are shown in the table below.

Time / minutes	Mean percentage change in mass / %
0	0
15	15
30	18
45	20
60	22
75	22

5(a) Explain why it was necessary for the student to calculate the percentage change in mass. [2]

Mean change in mass / %

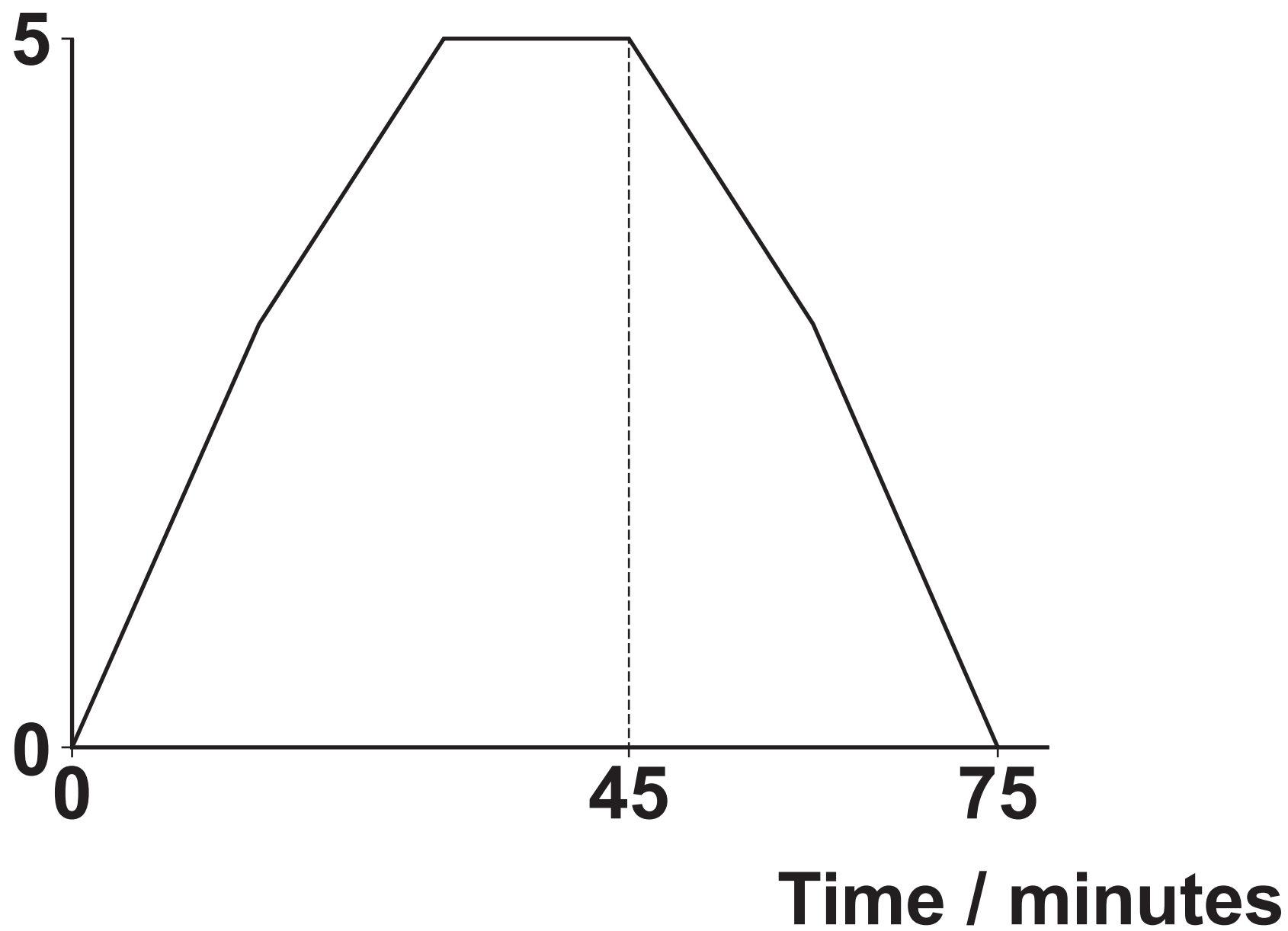


Time / minutes

5(b) (i) **Plot the student's results shown in the table on page 22 on the grid opposite. [3]**

(ii) **Describe and explain the changes in mass of the worms during the experiment. [4]**

31


Mean change in mass / %
5
0
0
45
75
Time / minutes

5(c) **The student decided to repeat the experiment. She collected ten fresh worms, weighed them and placed them in a fish tank containing undiluted seawater. Explain why it was important for the student to carry out this second experiment.**

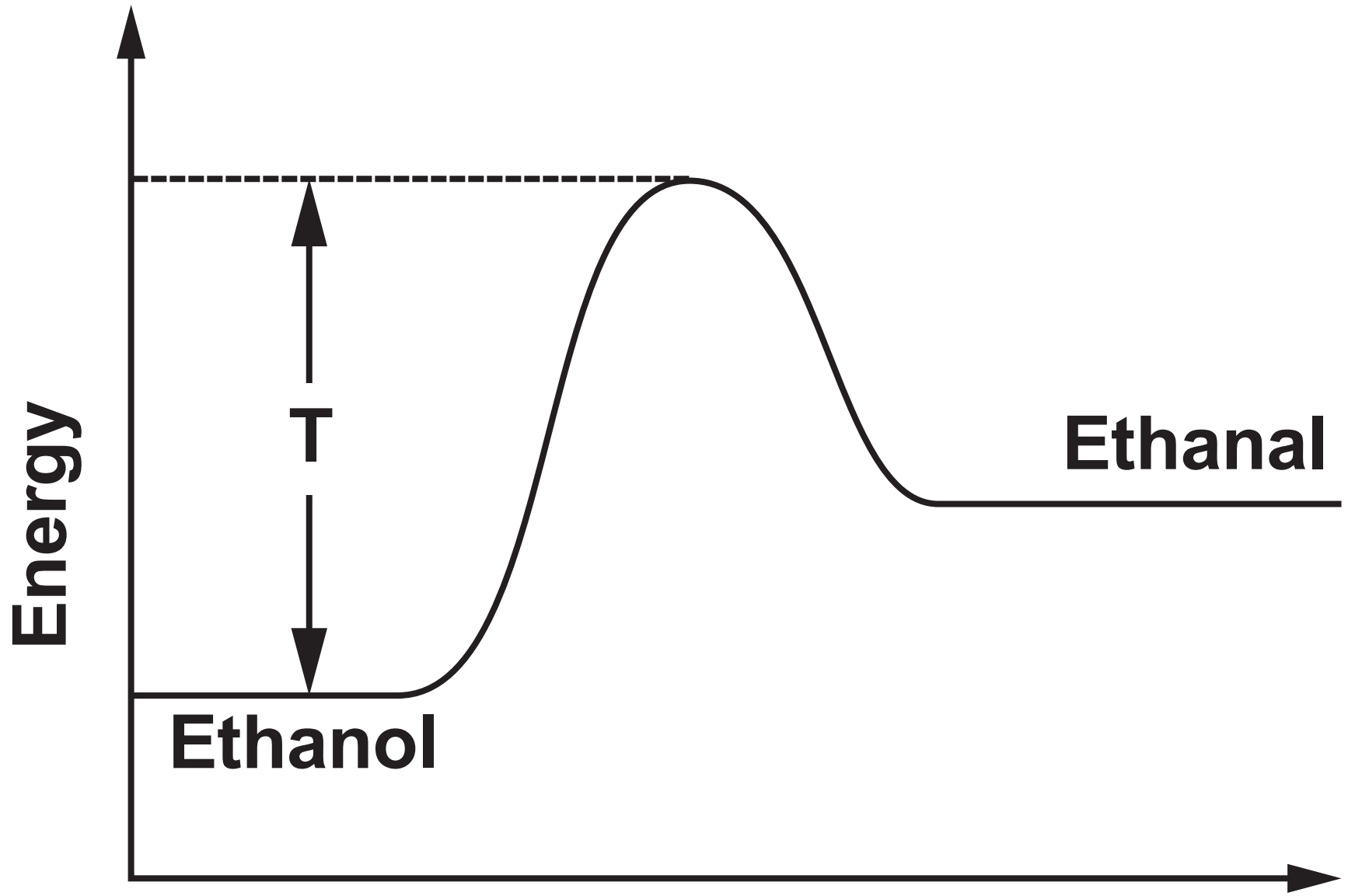
[2]

5(d) A similar experiment was set up with a different species of marine worm, ***Golfingia gouldi***. The results are shown opposite.

(i) Describe how the results for ***Golfingia*** differ from those of ***Nereis***. [2]

5(d) (ii) **Golfingia** can actively pump ions from its cells into the surrounding water. Explain the change in mass of **Golfingia** between 45 and 75 minutes. [2]

15


Energy
T
Ethanol
Ethanal

6. Alcohol dehydrogenase is an enzyme that catalyses the conversion of ethanol into ethanal.

The graph opposite shows the change in energy state when ethanol is converted to ethanal when no enzyme is present.

(a) (i) State what is represented by the region labelled T. [1]

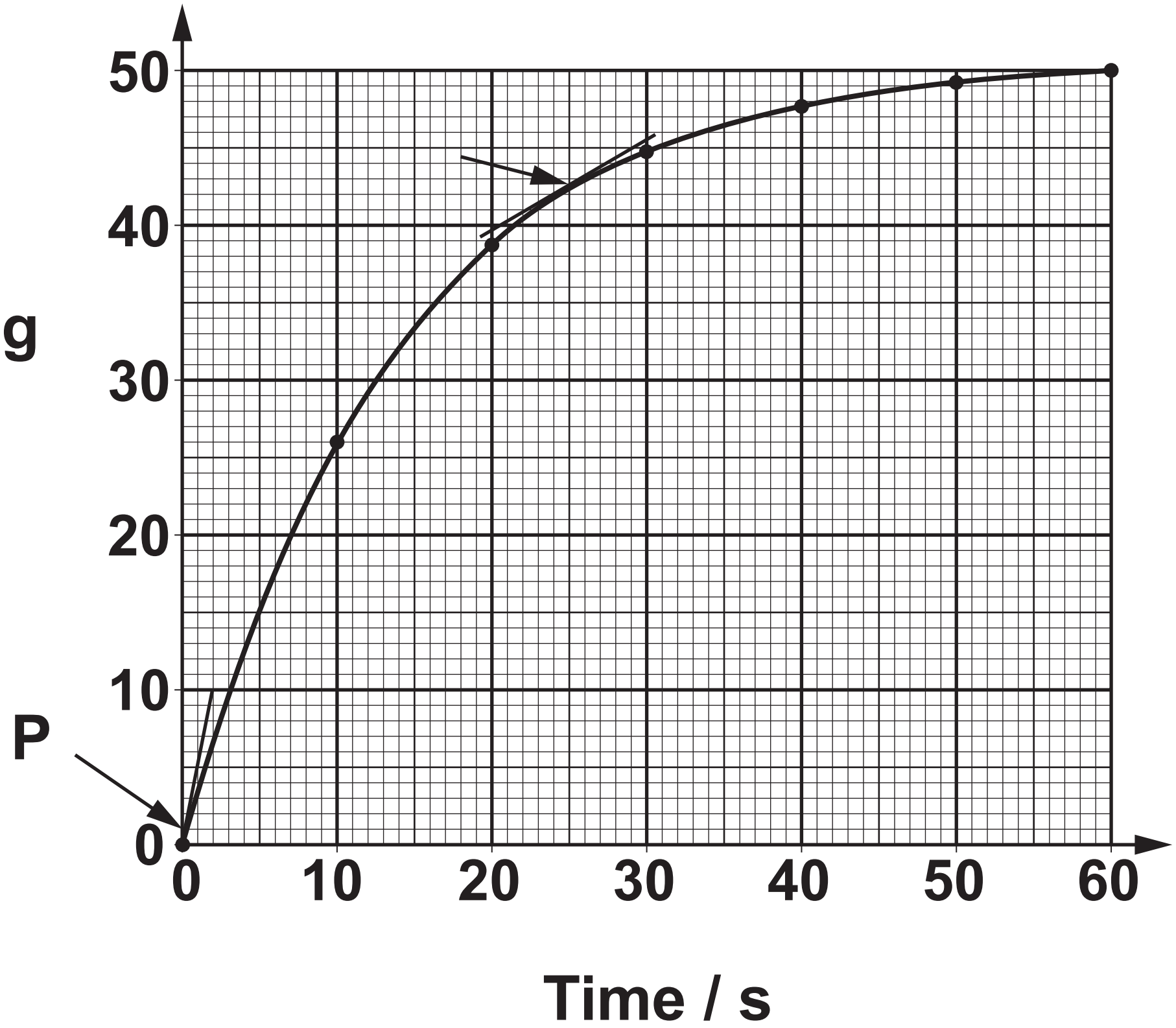
_____

_____

(ii) Draw a curve on the diagram opposite to show the change in energy level when alcohol dehydrogenase is present. [1]

6(b) Describe how alcohol dehydrogenase can catalyse the conversion of ethanol into ethanal.

[3]

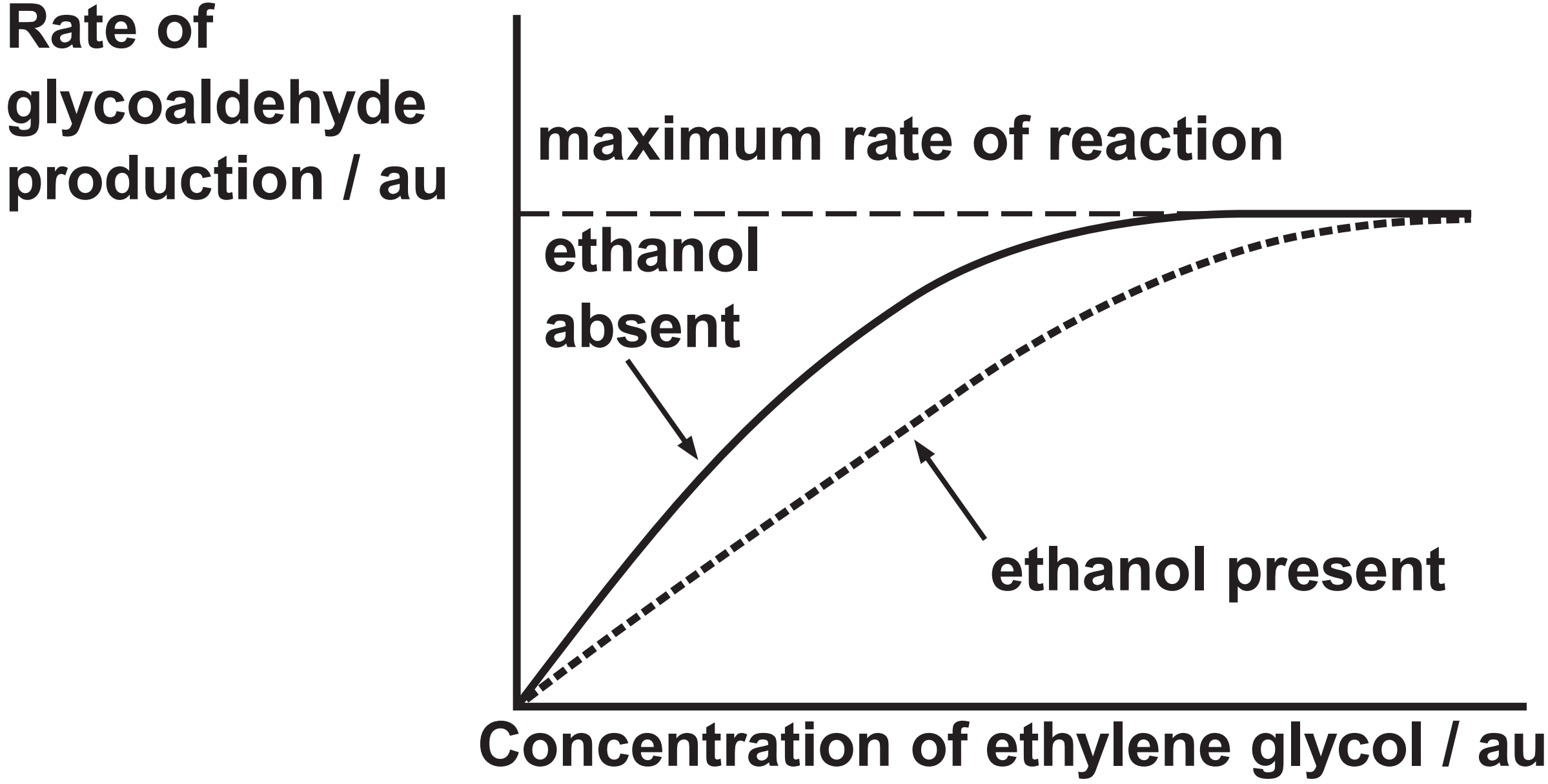

Mass of ethanal / mg
50
40
30
20
10
0
P
0
10
20
30
40
50
60
Time / s

6(c) A fixed mass of ethanol was added to a test tube containing alcohol dehydrogenase and a pH7 buffer solution. The test tube was incubated at 30°C and the mass of ethanal produced over time was recorded. The results are shown opposite.

(i) The rate of reaction at **P** was $5\,mg\,s^{-1}$.
Calculate the rate of reaction at **Q**. [2]

rate = _____ mg s^{-1}

6(c) (ii) What conclusions can be drawn that would account for the difference in rate at P and at Q? [4]


Rate of glycoaldehyde production / au
maximum rate of reaction
ethanol absent
ethanol present
Concentration of ethylene glycol / au

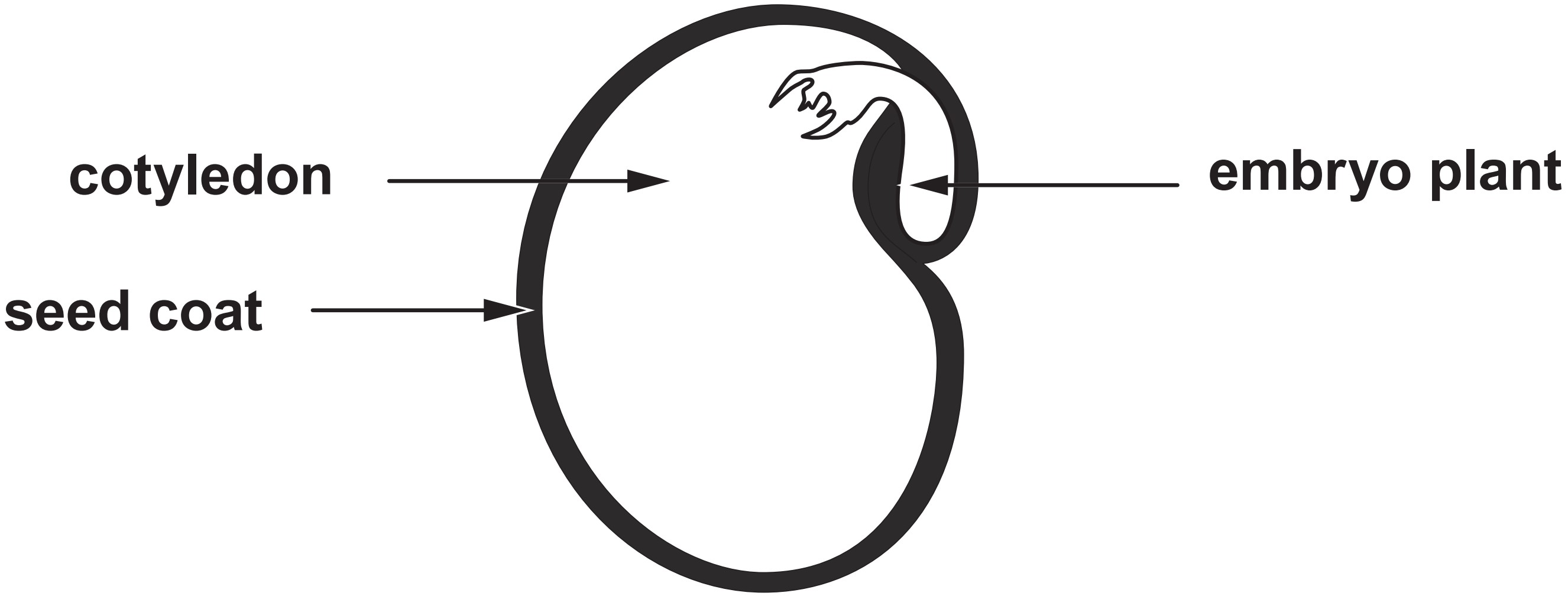
6(d) Ethylene glycol is a colourless, odourless, sweet liquid, commonly found in antifreeze. It is highly toxic if ingested because once inside the body ethylene glycol is converted into glycoaldehyde. This reaction is also catalysed by alcohol dehydrogenase.

Treatment of ethylene glycol poisoning includes giving the patient ethanol, either intravenously or orally.

The graph opposite shows the rate of glycoaldehyde production in the presence, and absence of ethanol.

Use the information provided to explain why this treatment would reduce the effects of ethylene glycol poisoning. [5]

42


cotyledon
seed coat
embryo plant

7. **The diagram opposite shows the generalised structure of a seed.**

The cotyledon contains many organic molecules including starch and triglycerides. Describe the structure of starch and triglycerides and suggest how their structure and properties relate to their function as energy storage molecules. [9 QER]

45

47

48

50

9

END OF PAPER

Rhif y Cwestiwn	Tudalen ychwanegol, os oes ei hangen. Ysgrifennwch rifau'r cwestiynau ar ymyl chwith y dudalen.

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