Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

S24-3400UA0-1

3400UA0-1

MONDAY, 10 JUNE 2024 – MORNING

BIOLOGY – Unit 1:
Cells, Organ Systems and Ecosystems

HIGHER TIER

1 hour 45 minutes

For Examiner's use only		
Question	**Maximum Mark**	**Mark Awarded**
1.	**8**	
2.	**12**	
3.	**9**	
4.	**7**	
5.	**7**	
6.	**7**	
7.	**11**	
8.	**13**	
9.	**6**	
Total	**80**	

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ADDITIONAL MATERIALS

A calculator and a ruler.

INSTRUCTIONS TO CANDIDATES

Use black ink or black ball-point pen. Do not use gel pen or correction fluid.

You may use a pencil for graphs and diagrams only.

Write your name, centre number and candidate number in the spaces at the top of this page.

Answer **all** questions.

Write your answers in the spaces provided in this booklet. If you run out of space, use the additional page(s) 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.

Question **9** is a quality of extended response (QER) question where your writing skills will be assessed.

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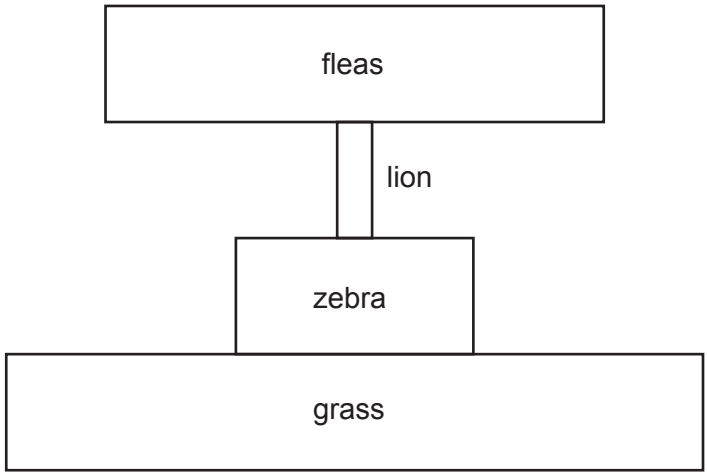
Answer **all** questions.

1. **Image 1** shows a pyramid of numbers in African grassland.

Image 1



(a) (i) State the producer in this pyramid. [1]

.....

(ii) Underline **two** terms from the list below that can be used to describe the zebra. [1]

Producer

Secondary consumer

Carnivore

Herbivore

Primary consumer

(iii) Write the **food chain** that is represented by the pyramid of numbers in **Image 1.** [1]

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(iv) State the source of energy for a food chain. [1]

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(v) State **one** reason why not all of the energy is passed from one stage of the food chain to the next. [1]

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(vi) Suggest why this pyramid of numbers is not pyramid-shaped. [1]

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(vii) **In the space below draw a labelled pyramid of biomass** for the organisms shown in **Image 1**. Your pyramid of biomass does not need to be to scale. [2]

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2. **Image 2.1** shows a fertiliser that is used when growing tomato plants.

Image 2.1

(a) State **three** nutrients that this fertiliser may contain. [3]

1. .....

2. .....

3. .....

(b) Tony grows tomato plants in his greenhouse. He designed an investigation to see if using fertiliser made a difference to the mass of his tomatoes. He grew one tomato plant adding the fertiliser once a week and left one plant without fertiliser. After three months he measured the mass of 10 tomatoes from each plant.

Identify the independent and dependent variables for the investigation. [2]

Independent variable .....

Dependent variable .....

(c) **Table 2.2** shows the results for the experiment.

Table 2.2

Treatment of tomato plants	Mass of each tomato (g)										Mean mass of tomatoes (g)
	1	2	3	4	5	6	7	8	9	10	
With fertiliser	36	33	34	46	37	32	33	34	35	37	35
Without fertiliser	28	30	29	32	30	31	27	28	32	29	.....

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(i) Tony calculated the mean mass of tomatoes grown **with fertiliser** without including an anomalous result.

Circle **the anomalous result** in **Table 2.2.** [1]

(ii) Calculate the mean mass of tomatoes grown **without fertiliser**. **Write your answer** in **Table 2.2 to the nearest whole number.** [2]

Space for working:

(iii) State the conclusion that Tony can make from the results in **Table 2.2**. [1]

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(d) (i) Tony ensured that this investigation was a fair test.
State **one** variable that Tony would have controlled. [1]

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(ii) Each tomato plant produced many tomatoes, from which Tony chose ten.

Suggest why this step in Tony's method could have caused inaccuracies in his results, and what he could have done to improve the investigation. [2]

Reason for inaccuracies

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Suggestion for improvement

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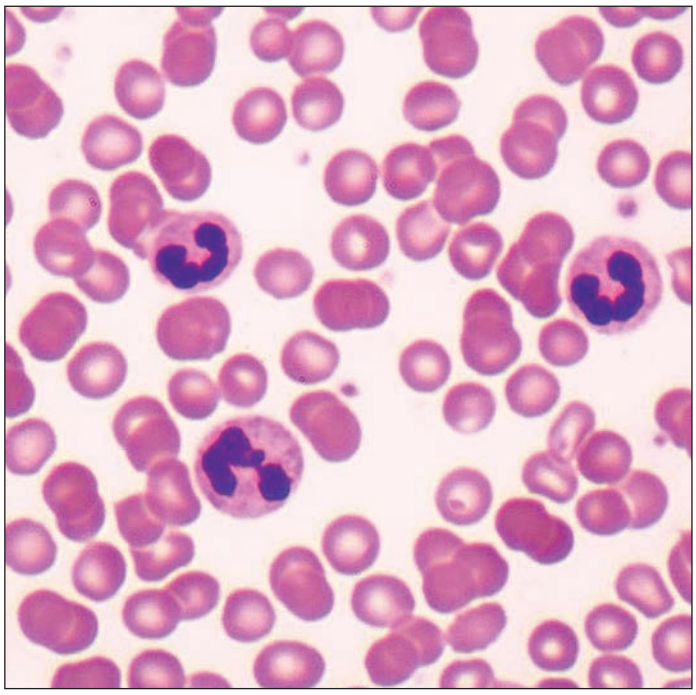
3. **Image 3.1** shows a sample of blood viewed down a light microscope.

Image 3.1



(a) **Draw labelled arrows** on **Image 3.1** to show: [1]

- **one** red blood cell
- **one** white blood cell.

(b) (i) The blood of a human male contains 43 cm^3 of plasma per kg of body mass.
The volume of blood in a human male of mass 62 kg is 4670 cm^3.
Calculate the percentage of plasma in the blood of this male.
Write your answer to two significant figures. [3]

Percentage = ...

(ii) State **one** function of plasma. [1]

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(c) Health professionals can use a full blood count (FBC) to monitor health.
Table 3.2 shows some values from an FBC for three patients, **A**, **B** and **C**.
The normal ranges are also shown.

Table 3.2

	Concentration in blood (a.u.)			
Component of blood	Normal range	Patient A	Patient B	Patient C
Haemoglobin	13.2–14.8	10.9	13.5	13.2
Red blood cells	4.5–5.2	4.4	4.6	5.1
White blood cells	2.0–7.0	5.9	0.4	1.3
Platelets	199.2–292.1	234.4	313.3	42.4

Use **Table 3.2** and your knowledge to explain:

(i) why patient **A** is most likely to suffer low blood oxygen levels; [2]

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(ii) why patient **B** is most at risk of infectious disease. [2]

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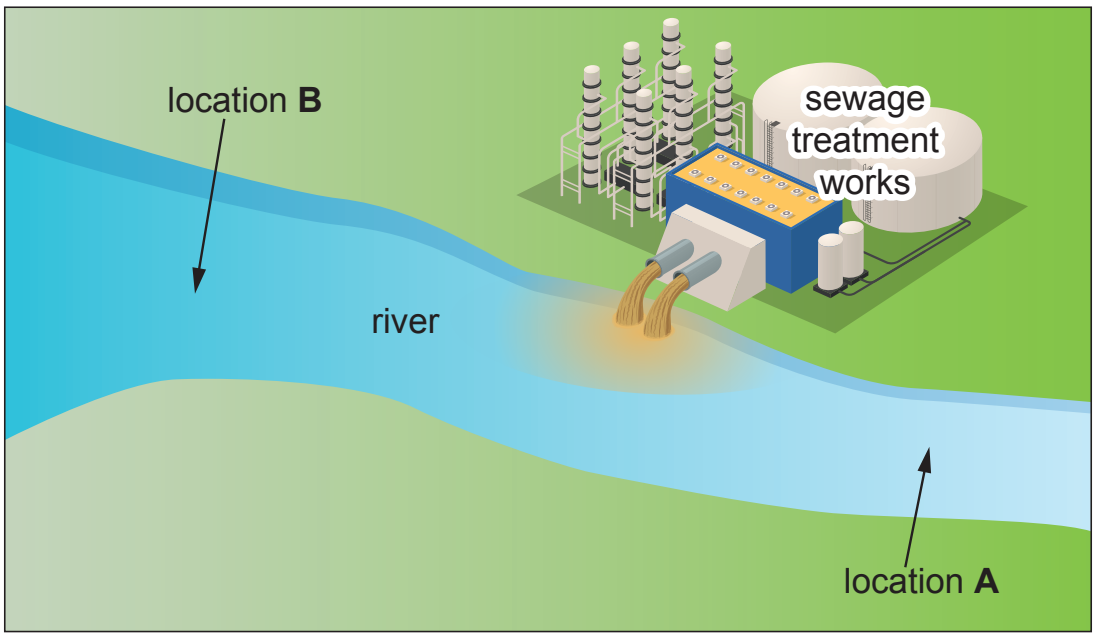
4. In 2022, a report by the Senedd Climate Change Committee noted that during 2020, there were over 105 000 incidents in Wales of untreated sewage being released into streams, rivers and the sea.
Following extreme rainfall, sewage treatment works are allowed to release untreated sewage into streams, rivers and the sea.

Map 4.1 shows a river and the location of a sewage treatment works.

Map 4.1



In June 2020, a survey was carried out in a river at two locations, **A** and **B**, as shown on **Map 4.1**. The number and different types of invertebrates at each location was recorded. **Table 4.2** shows the results of the survey.

Table 4.2

	Number of invertebrates found	
Invertebrates	Location A	Location B
stonefly nymph	55	0
mayfly nymph	12	0
caddisfly larva	2	0
leech	3	0
sludge worm	0	33
rat-tailed maggot	0	27

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Table 4.3 can be used to assess the level of pollution and oxygen concentrations in rivers.

Table 4.3

Invertebrates present	Level of pollution	Oxygen concentration
none	very high	no oxygen
rat-tailed maggot	high	low
sludge worm		
leech	moderate	moderate
blood worm		
caddisfly larva	low	moderate to high
mayfly nymph	none	high
stonefly nymph		

(a) State the scientific term that is used to describe any organisms that can be used to monitor levels of pollution. [1]

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(b) Use **Tables 4.2 and 4.3** to draw conclusions about the **oxygen concentrations** in the river at locations **A** and **B**. [2]

Oxygen concentration at location **A** = ...

Oxygen concentration at location **B** = ...

(c) The release of untreated sewage into streams can result in an algal bloom, which in turn can reduce oxygen levels.
Explain how algal blooms can result in reduced oxygen levels. [4]

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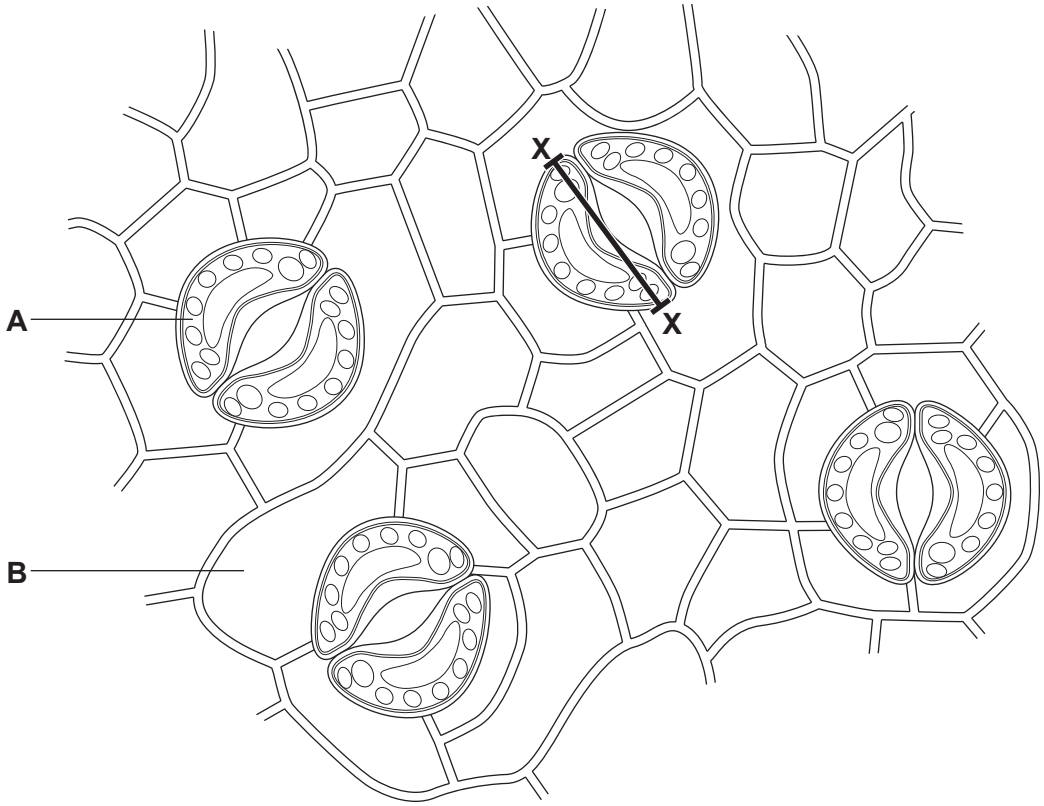
5. **Image 5.1** shows an illustration of part of the lower surface of a leaf from a cress plant.

Image 5.1



(a) (i) State the names of the type of cells labelled **A** and **B** in **Image 5.1**. [2]

A .....

B .....

(ii) Measure the length of line **X**–**X** on **Image 5.1**.

[1]

Length = ... mm

(iii) The actual length of the cell measured by line **X**–**X** on **Image 5.1** is 20 µm. Calculate the magnification of the drawing. [2]

(1 mm = 1000 µm)

Magnification = × .....

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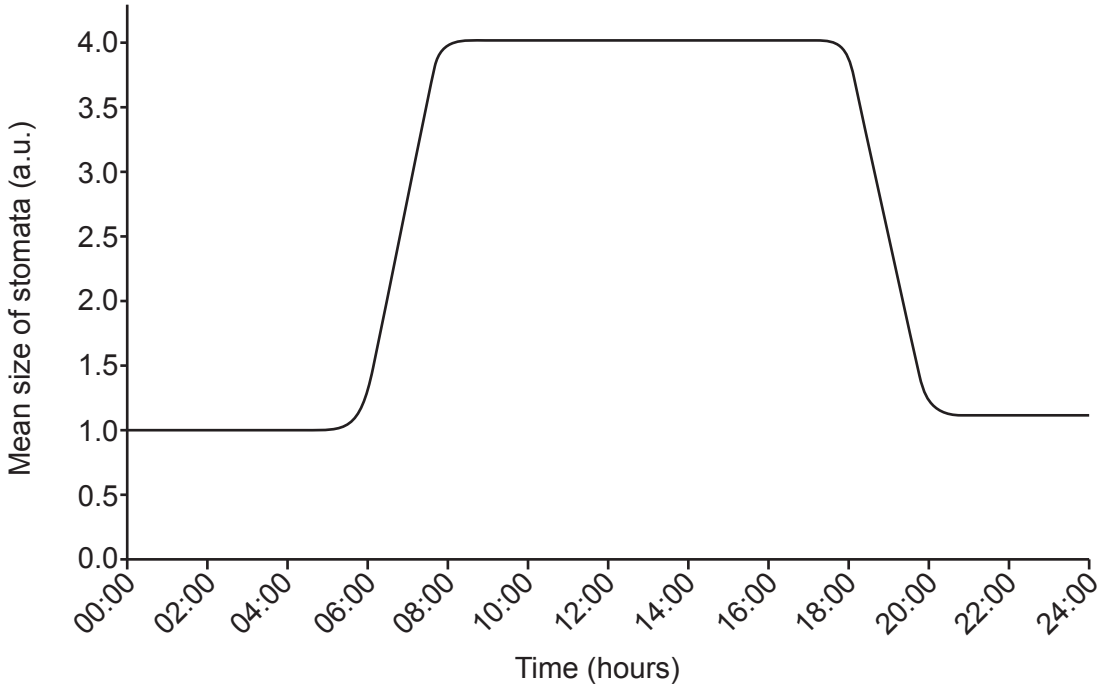
An investigation was carried out into the changes in the mean size of the stomata of a cress plant. The plant was left on a windowsill and the changes were recorded over a 24-hour period. The results are shown in **Graph 5.2**.

Graph 5.2



(b) (i) State **one** conclusion that can be drawn from **Graph 5.2** about when stomata open and close. [1]

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(ii) Explain **one** advantage to plants of being able to change the size of their stomata. [1]

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6. There are two methods of producing ATP in the body:

- aerobic respiration
- anaerobic respiration

However, at the start of exercise, the body will use ATP that is already available in small amounts in muscle cells.

(a) Other than ATP, state the products of aerobic and anaerobic respiration. [3]

Aerobic: ..... and .....

Anaerobic: .....

(b) State why anaerobic respiration is not suitable as a source of energy for continuous exercise. [1]

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(c) **Graph 6.1** shows how the source of ATP for muscle contraction changes over a two-minute period of exercise in an athlete.

Graph 6.1

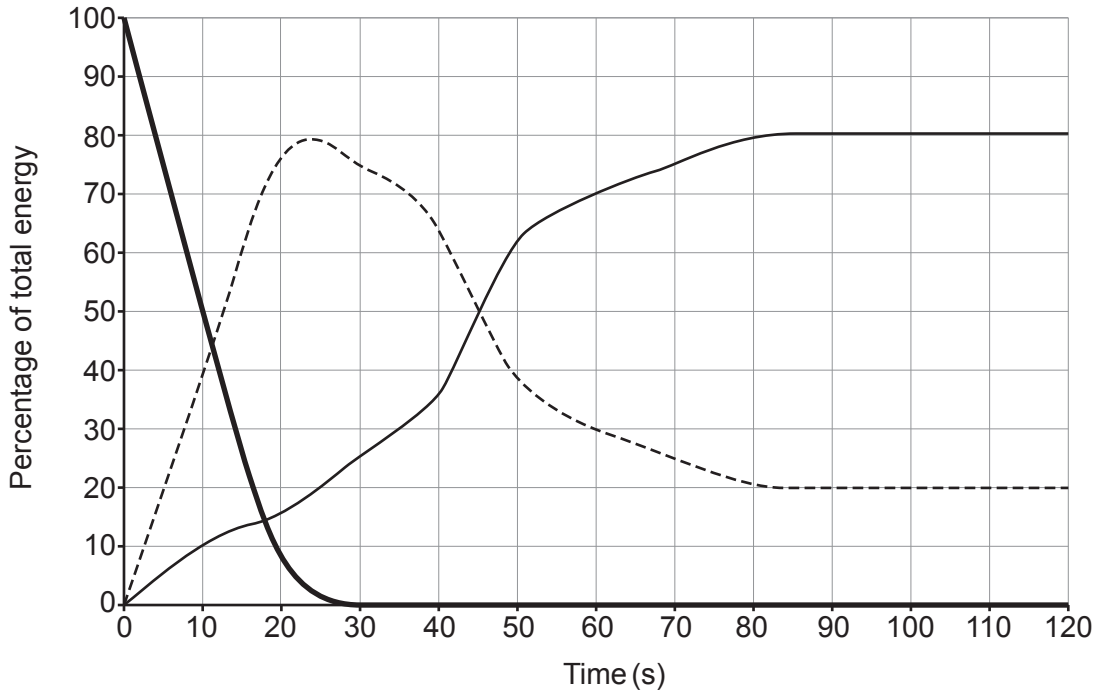

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Table 6.2 shows information about ATP in muscle cells.

Table 6.2

	ATP already available in muscle cells	ATP produced from aerobic respiration	ATP produced from anaerobic respiration
Type of exercise used for	high-intensity exercise	continuous exercise	high-intensity exercise
Duration of ATP source	0–25 seconds	hours	15 seconds–2 minutes
Molecules of ATP produced per molecule of glucose		38	2

(i) Use **Graph 6.1** to suggest why it is important that muscle cells have a small amount of ATP available at the start of exercise. [1]

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(ii) Use the data from **Table 6.2** to compare the efficiency of aerobic and anaerobic respiration. Give the reason for the difference in efficiency. [2]

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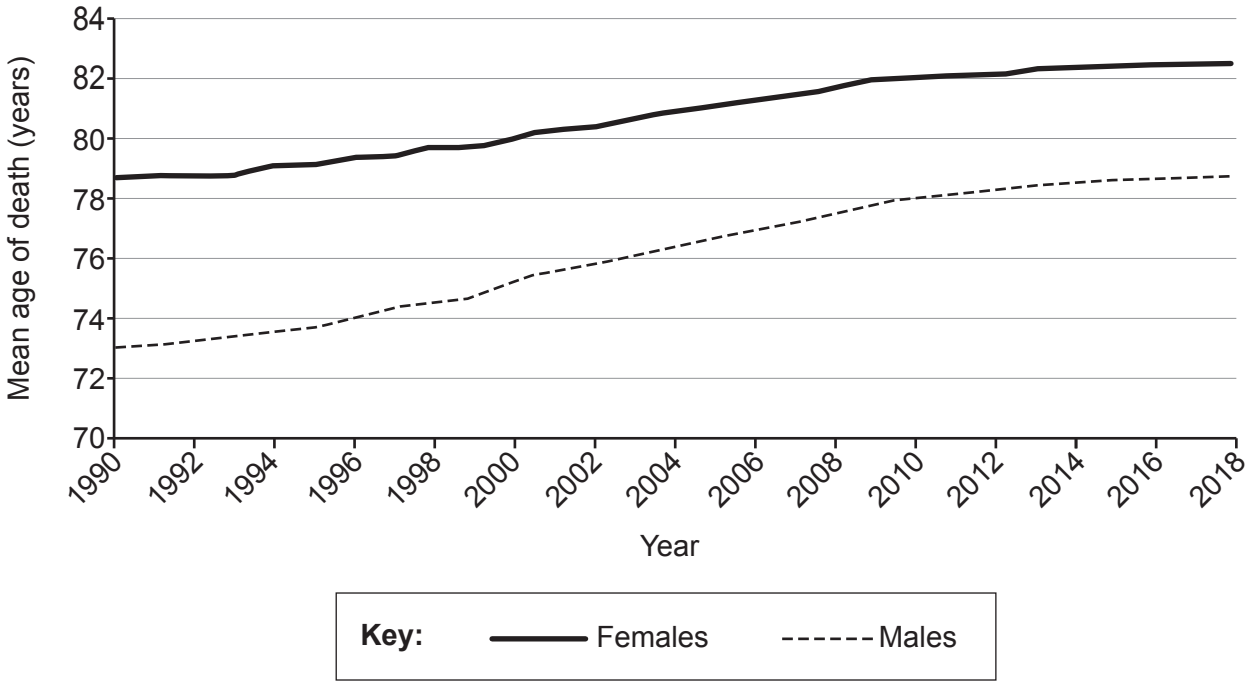
7. **Graph 7.1** shows the mean age of death for the population of Wales between 1990 and 2018.

Graph 7.1



(a) Use **Graph 7.1** to compare the trends in mean age of death for females and males in Wales between 1990 and 2018. [3]

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(b) The mean daily energy intake per person in the UK has increased from 13 000 kJ in 1960 to 14 000 kJ in 2018.
Explain how the change in mean daily energy intake between 1960 and 2018 has had a negative effect on health. [2]

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(c) The Global Burden of Disease Study (GBDS) collects data from more than 7000 researchers in 156 countries. The data records premature deaths and disabilities linked to 350 diseases.
Scientists used the data from the GBDS to model an 'optimal diet'. They claim that following this optimal diet from age 20 would extend average life expectancy by 10 years for females and 13 years for males.
Table 7.2 compares a typical Western diet with the optimal diet.

Table 7.2

Food	Typical Western diet (g)	Optimal diet (g)
Wholegrains	50	225
Vegetables	250	400
Fruit	200	400
Nuts	0	25
Legumes	0	200
Fish	50	200
Refined grains	150	50
Red meat	100	0
Processed meat	50	0
White meat	75	50
Sugar-sweetened drinks	500	0

(i) Suggest how the change in consumption of fruit and vegetables from a typical Western diet to an optimal diet is likely to benefit health. [2]

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(ii) State **two** benefits to health of reducing the consumption of sugar-sweetened drinks. [2]

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(d) Evaluate the strength of the evidence collected by scientists in the GBDS study. [2]

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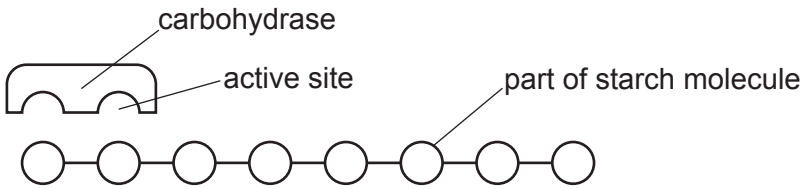
8. **Image 8.1** shows part of a starch molecule and carbohydrase.

Image 8.1



(a) (i) State the name of the model used to explain enzyme action. [1]

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(ii) All enzymes are proteins.
State what determines the shape of the active site of an enzyme. [1]

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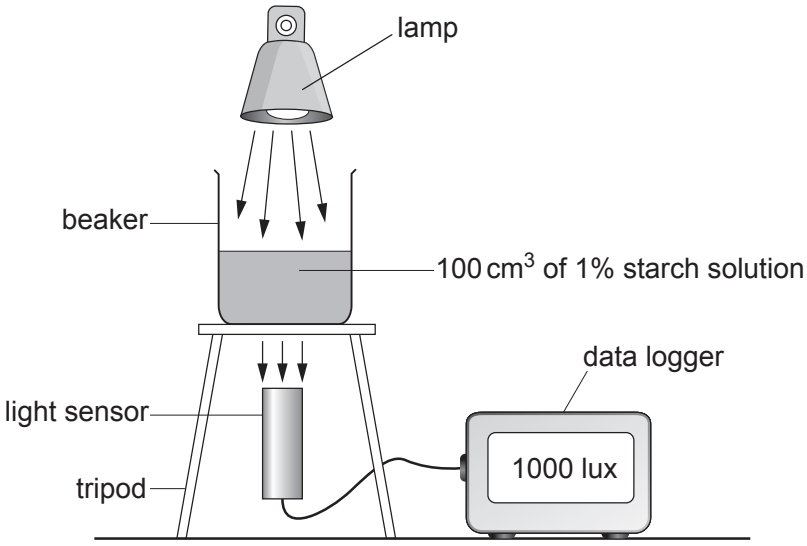
(b) An investigation was carried out to study the rate of digestion of starch by carbohydrase, using a light sensor linked to a data logger. The light sensor detects the intensity of light passing through a solution.
Image 8.2 shows how the investigation was set up.

Image 8.2



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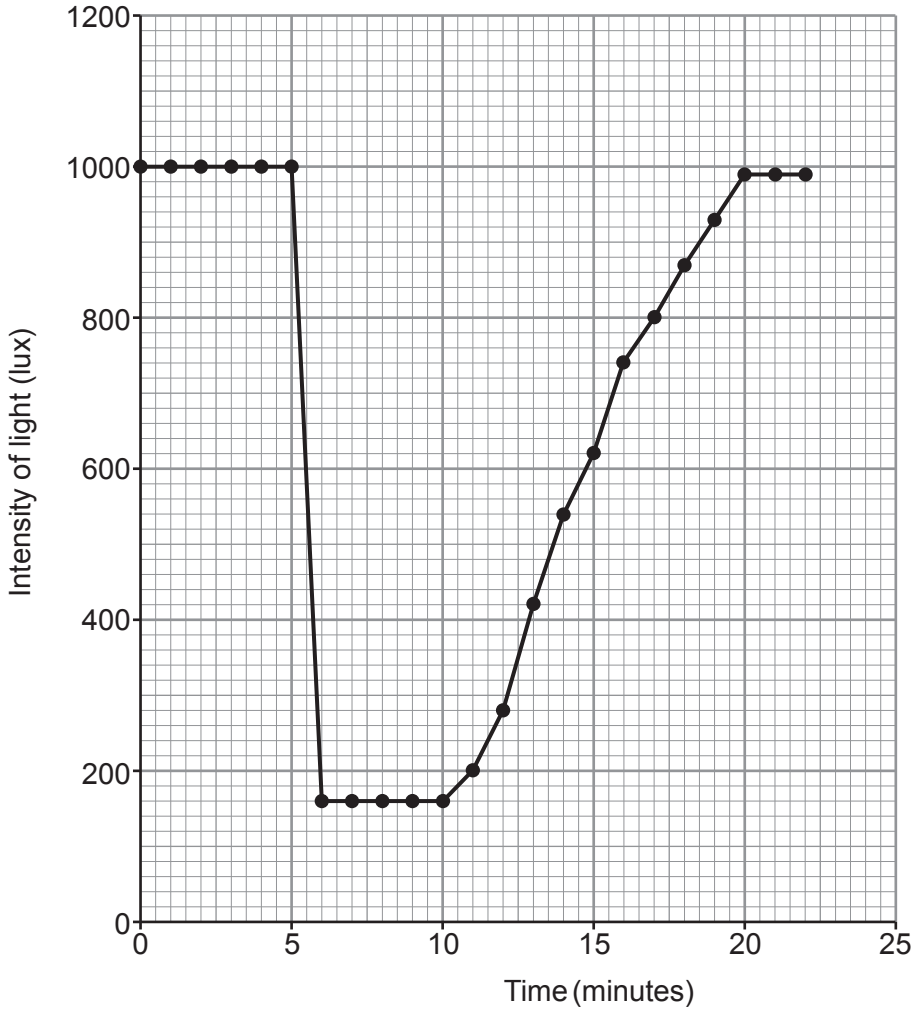
The following method was used.

- A lamp was placed above a beaker containing 100 cm^3 of 1% starch solution.
- A light sensor was placed underneath the beaker and a data logger began recording the light intensity below the beaker.
- At 5 minutes, a few drops of iodine were added to the beaker.
- At 10 minutes, 20 cm^3 of 10% carbohydrase solution was added.

The results of the investigation are shown in **Graph 8.3**.

Graph 8.3



(i) Explain the results between 5 and 6 minutes. [2]

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(ii) Calculate the mean rate of reaction between 10 and 15 minutes, using the following formula. [3]

$$\text{Mean rate of reaction} = \frac{\text{change in light intensity}}{\text{time}}$$

Mean rate of reaction = ... lux/min

(iii) Explain the change in light intensity between 10 and 20 minutes. [3]

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(iv) State **two** controlled variables in this experiment. [2]

1. .....

2. .....

(v) **Draw a line** on **Graph 8.3** to predict the results if the carbohydrase had been boiled and then cooled before being added at 10 minutes. [1]

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9. A class of students observed the following demonstration of water movement through plant cells.

- A fresh potato was cut in half. The halves were labelled **A** and **B**.
- A cavity was cut into each half as shown in **Image 9.1**.
- Concentrated sugar solution was placed in the cavity of **A**.
- The cavity in **B** was left empty.
- **A** and **B** were placed in Petri dishes containing distilled water and left for three hours.

Image 9.1 shows **A** and **B** at the start of the three hours.

Image 9.1

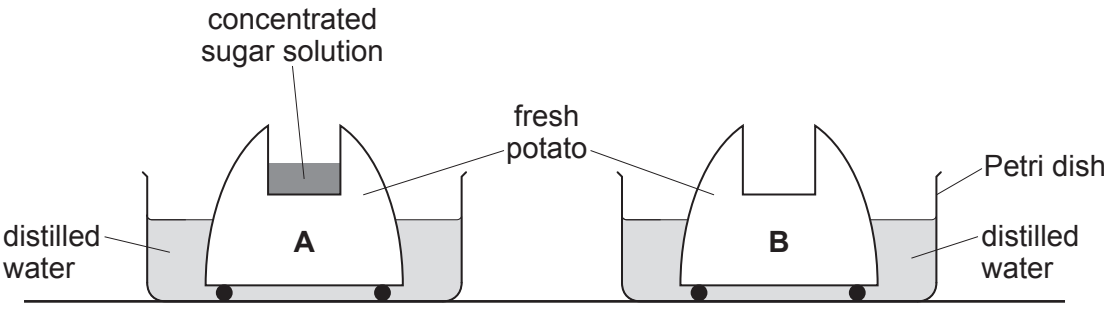
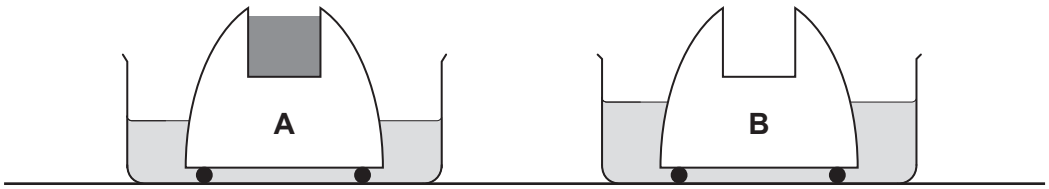


Image 9.2 shows **A** and **B** after three hours.

Image 9.2



Explain the change in the liquid level observed in the cavity of **A** after three hours.
Suggest the purpose of potato **B**. [6 QER]

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Question number	Additional page, if required. Write the question number(s) in the left-hand margin.

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