Surname	Centre Number	Candidate Number
First name(s)		0

GCSE

3400UA0-1

S23-3400UA0-1

TUESDAY, 13 JUNE 2023 – 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.	**12**	
2.	**8**	
3.	**8**	
4.	**8**	
5.	**9**	
6.	**5**	
7.	**7**	
8.	**8**	
9.	**15**	
Total	**80**	

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ADDITIONAL MATERIALS

In addition to this paper you will require a calculator.

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

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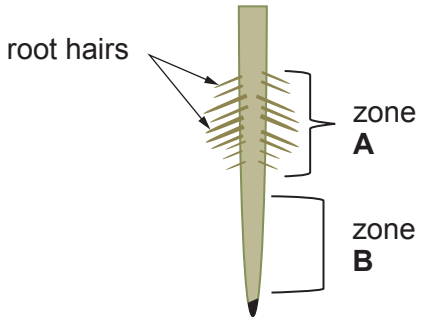
Answer **all** questions.

1. Part of a plant root is shown in **Image 1.1**.

Image 1.1



(a) Explain why water uptake in zone **A** is greater than in zone **B**. [1]

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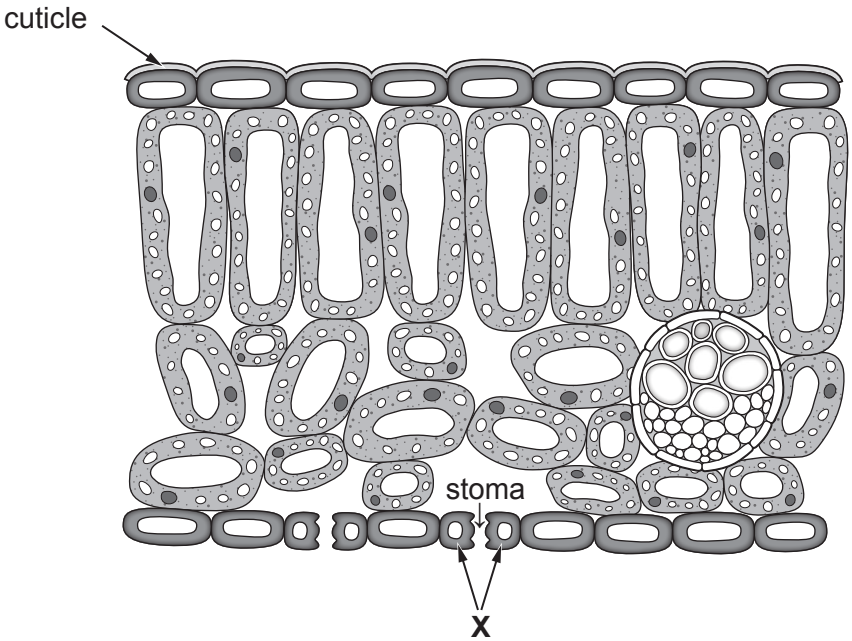
(b) **Image 1.2** represents a section through the leaf of a plant.

Image 1.2



(i) On **Image 1.2**, **draw an arrow** to show the tissue which transports water to all parts of the plant. **Label the arrow with the name of the tissue**. [2]

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(ii) I. Name cells **X** shown in **Image 1.2**. [1]

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II. State how the stoma and cuticle are involved in the control of water loss from a leaf. [2]

Stoma

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Cuticle

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.....

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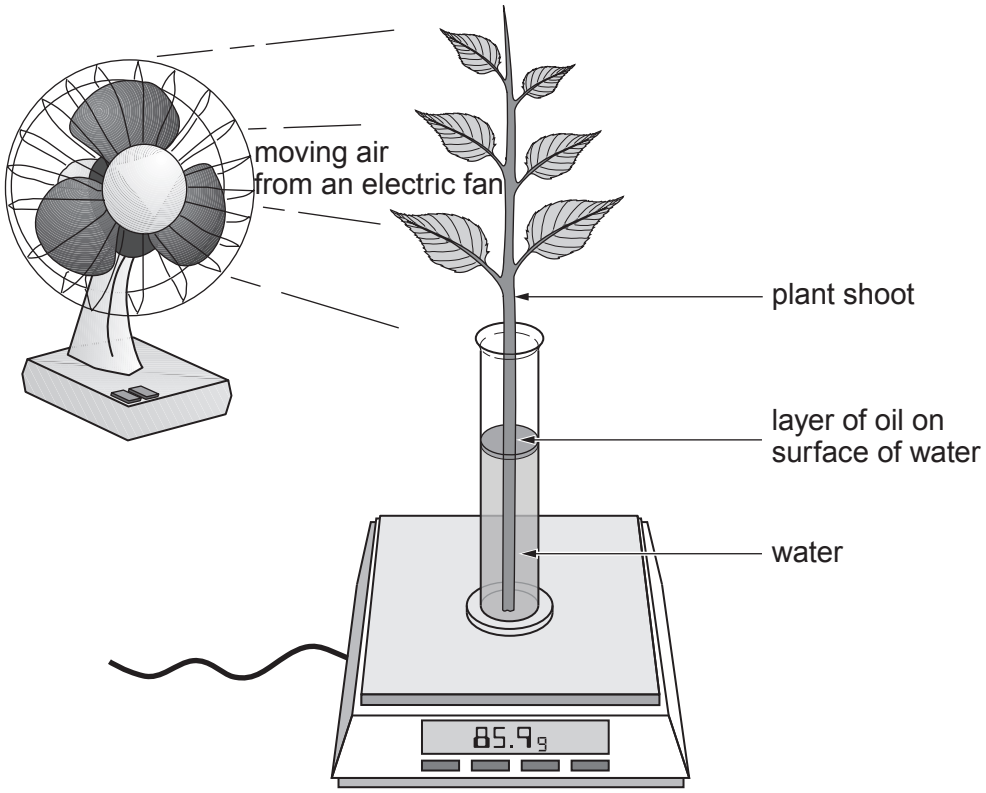
(c) Megan and Rhys investigated the loss of water from a leafy shoot. They used the apparatus shown in **Image 1.3**.

Image 1.3



They recorded the loss of mass after directing moving air, at different speeds, onto the shoot.

(i) State the scientific term for the evaporation of water from the leaves of a plant. [1]

.....

(ii) State **one** way in which Megan and Rhys could ensure that they carried out a fair test. [1]

.....

.....

(iii) State why it was important that the layer of oil was added. [1]

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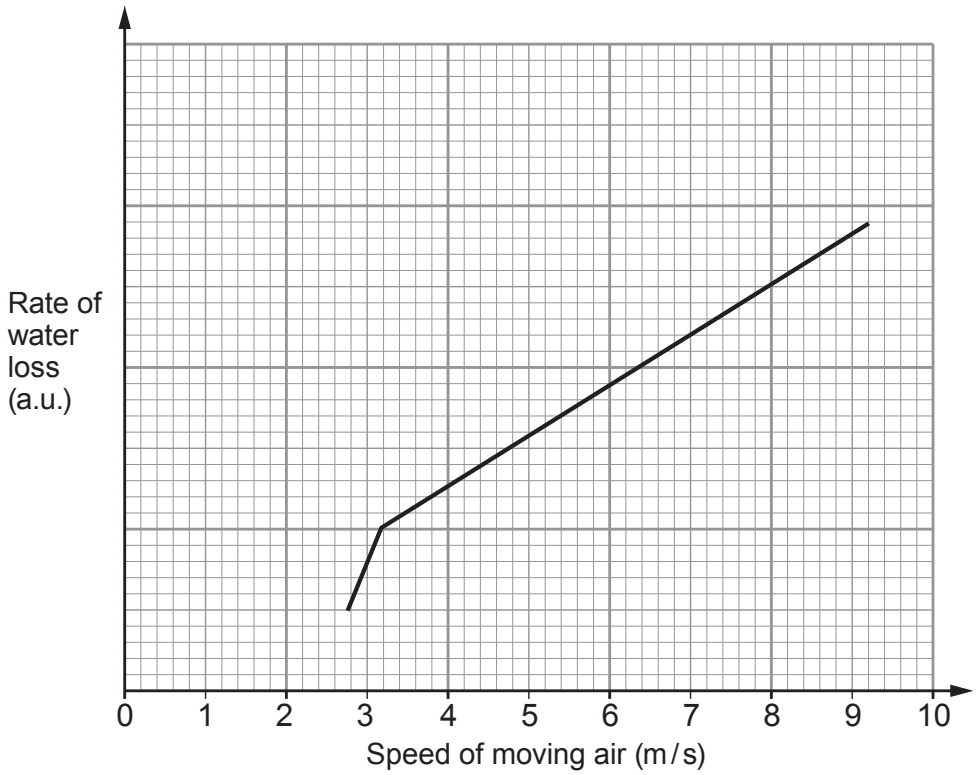
(iv) The results of their investigation are summarised in **Graph 1.4**.

Graph 1.4



I. Describe the effect of increasing the speed of moving air on the rate of water loss. [2]

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II. **Sketch a line on Graph 1.4** to suggest the result you would expect if the **humidity** of the air was increased. [1]

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2. **Image 2.1** shows chickens in two different farming systems.

Image 2.1

Free-range farm Intensive farm

In 1950 chicken was an expensive food and most adults in the UK, on average, ate only 1100 g each year. By 2000 they ate 25 kg per year as intensive farming had made chicken much cheaper.

In intensive farming, large numbers of chickens are reared indoors. Environmental conditions and food supply are constantly controlled. The chickens grow faster than free-range chickens and use less energy as their movement is restricted.

The farmer can monitor the chickens more easily than on a free-range farm. Much less land is used and labour costs are lower but larger amounts of concentrated waste are produced.

(a) (i) Use the information given to calculate the increase in mass in the annual consumption of chicken for a **family of four adults** in the UK between 1950 and 2000. [2]

Increase in mass = ... kg / family / year

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During an investigation, the growth of chickens from different farm systems was compared. The results are shown in **Graph 2.2** and **Tables 2.3** and **2.4**.

Graph 2.2

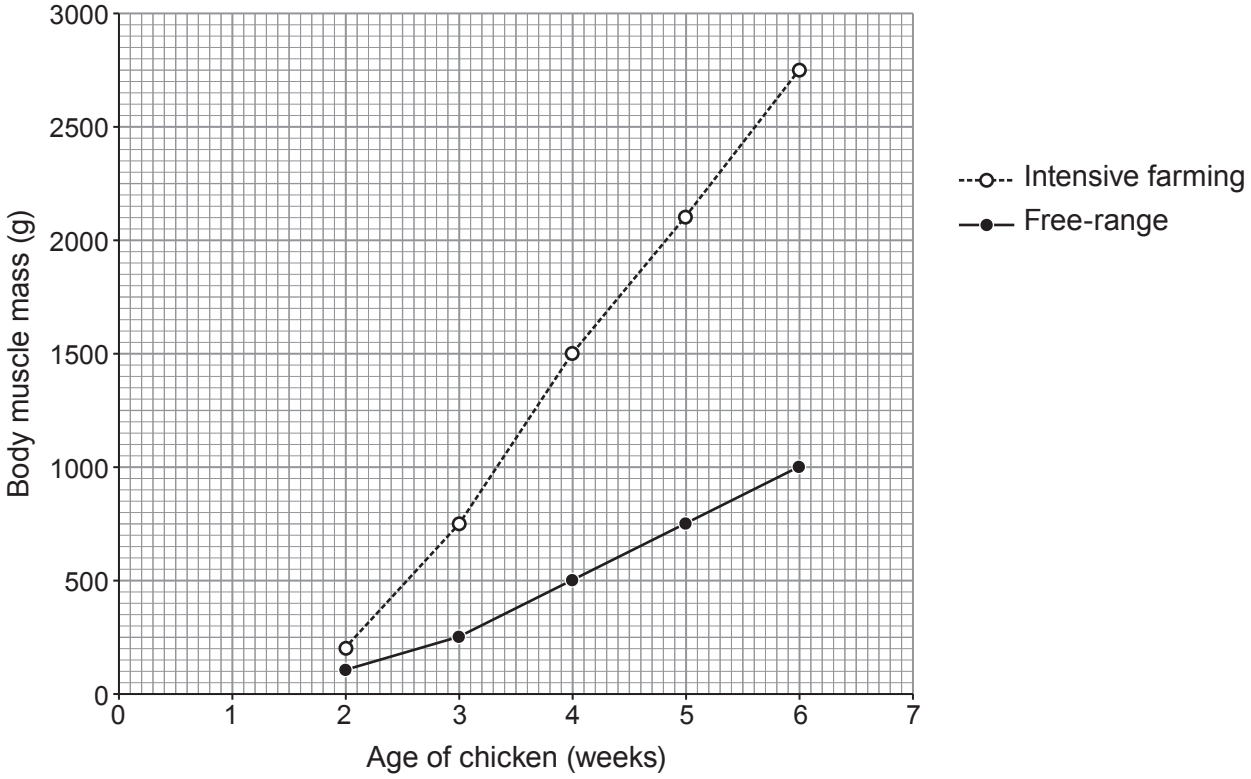

Table 2.3

Organ mass in chickens at six weeks

Organ	Mass (g)	
	Free-range	Intensively farmed
Heart	6.5	4.8
Lungs	4.0	3.5
Liver	20.0	15.0

Table 2.4

Bone quality in chickens at six weeks

	Free-range	Intensively farmed
Bone density (g/cm^3)	1.29	0.79
Presence of broken bones (%)	2.5	37
Length of leg bones (mm)	73	118

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(ii) Use **Graph 2.2** to calculate the difference in the body muscle mass at 5 weeks between intensively farmed chicken and a free–range chicken. [1]

Difference = ... g

(b) (i) Use the information on page 7 to suggest **one** advantage to farmers of farming chickens intensively. [1]

.....

.....

(ii) State **one** feature of intensive farming which is an environmental disadvantage. [1]

.....

(c) Some groups of people have ethical objections to intensive farming because of animal welfare concerns.

Using the information in **Tables 2.3** and **2.4**, state **three** features of intensive farming which support this point of view. [3]

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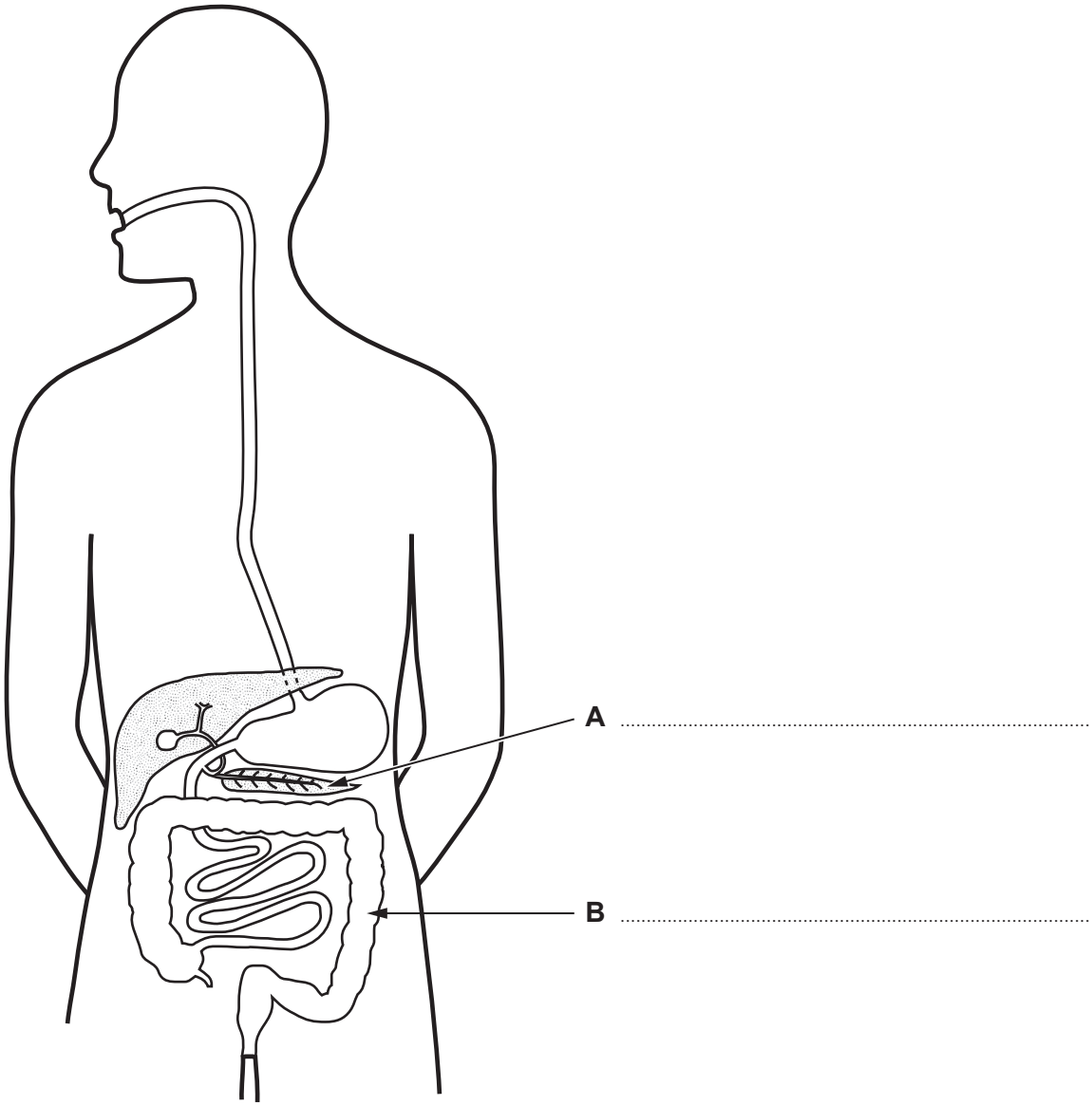
3. **Image 3.1** shows the human digestive system.

Image 3.1



(a) Label parts **A** and **B** on **Image 3.1**. [2]

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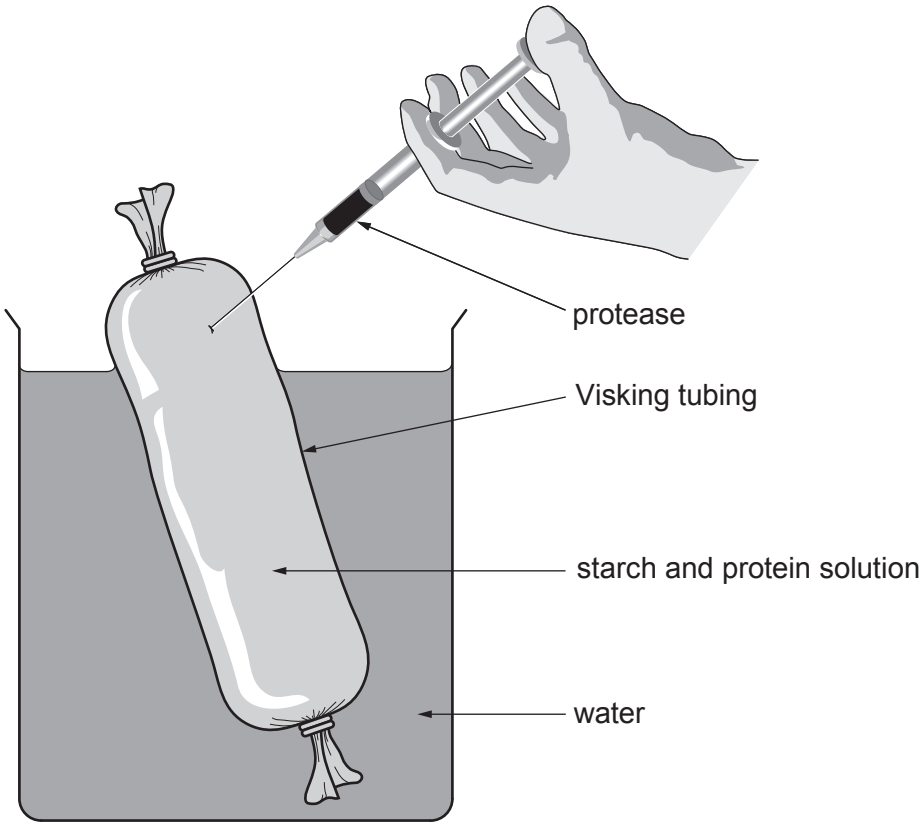
(b) A length of Visking tubing was used to model a part of the digestive system. The Visking tubing was filled with a solution of starch and protein. The apparatus was kept at a temperature of 35 °C. The apparatus is shown in **Image 3.2**.

Image 3.2



A sample of the water surrounding the Visking tubing was tested for protein, starch, amino acids and glucose at the start of the experiment. After 15 minutes, protease was injected into the Visking tubing. After 30 minutes, the water surrounding the Visking tubing was tested again.

(i) Describe how you would use a chemical to test the water for the presence of **glucose**. [2]

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(ii) **Complete Table 3.3** below to show the expected results for this experiment. One column has been done for you.

✓ = present in the water surrounding the Visking tubing
✕ = absent in the water surrounding the Visking tubing [2]

Table 3.3

Time /minutes	Starch	Protein	Amino acids	Glucose
0	✕			
30	✕			

(c) Suggest which part of the digestive system shown in **Image 3.1** is represented by the Visking tubing. Give a reason for your answer. [2]

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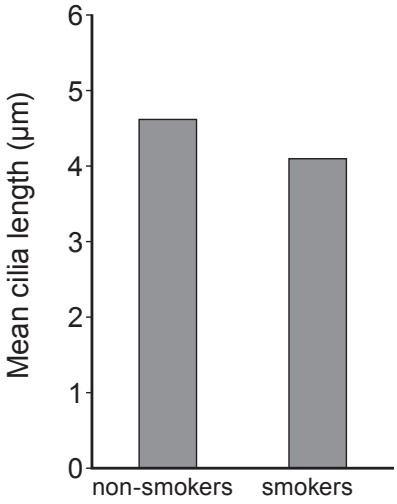
4. A study of cilia length in the cells lining the bronchioles of 15 non-smokers and 15 smokers was carried out. The results are shown in **Graphs 4.1** and **4.2**.

Graph 4.1 mean cilia length in non-smokers and smokers



Graph 4.2 variation in cilia length in non-smokers and smokers

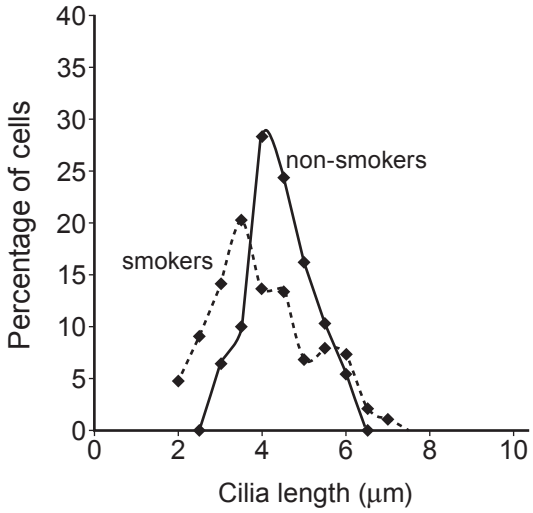
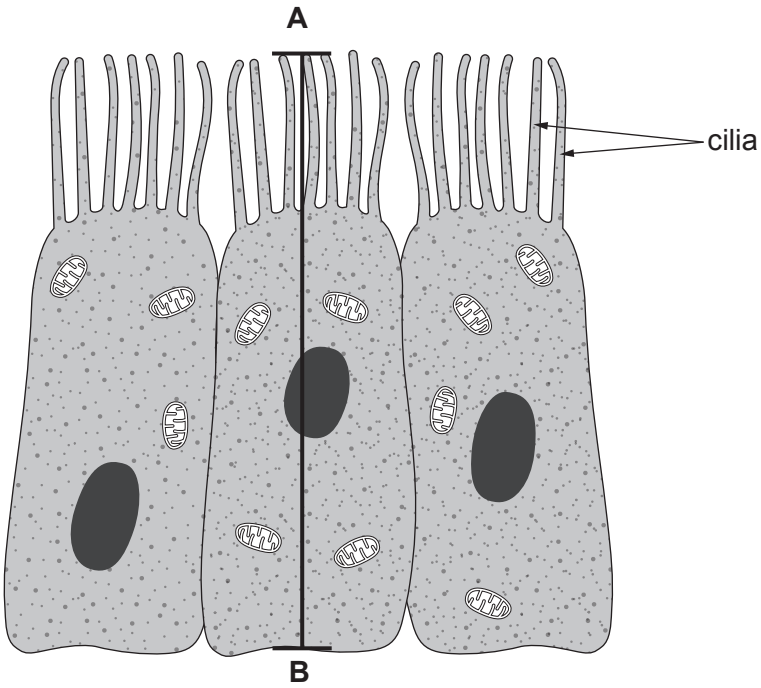


Image 4.3 shows three of the cells that line the bronchiole.

Image 4.3 – Cells lining the bronchioles.



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(a) Describe the function of cilia in the human respiratory system and the effect of smoking on them. [2]

.....

.....

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.....

(b) (i) Measure the length of line **A–B** on **Image 4.3**. [1]

length **A–B** = ... mm

(ii) The actual value of **A–B** in **Image 4.3** is 5μm. Calculate the magnification of the drawing. (1 mm = 1000μm) [2]

magnification = × .....

(c) (i) Using the information from **Graphs 4.1** and **4.2**, state **two** conclusions you can make about the effect of smoking on the length of cilia. [2]

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(ii) Suggest **one** way in which you could improve the confidence in your conclusions. [1]

.....

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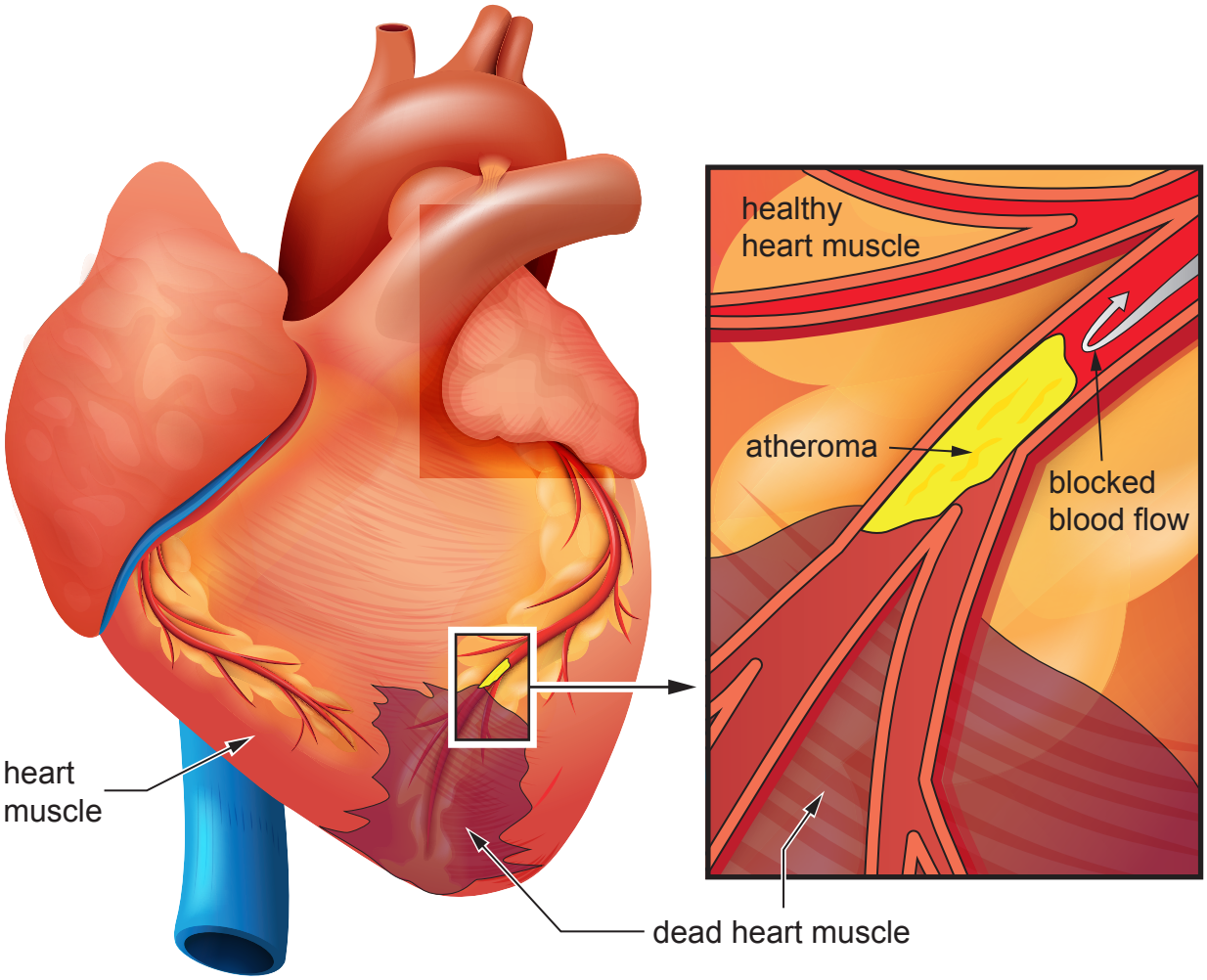
5. According to a report by the British Heart Foundation in 2017, more than 20 million people in the UK were physically inactive. The report warned that inactivity increases the risk of heart disease and costs the NHS around £1.2 billion each year.

A heart attack is a serious medical emergency in which the supply of blood to the heart is suddenly blocked, usually by a blood clot.

Image 5.1 shows the heart following a heart attack and **Image 5.2** shows a section through one of the heart's blood vessels.

Image 5.1 **Image 5.2**



(a) (i) State the name of the blood vessel shown in **Image 5.2**. [1]

.....

(ii) State which part of blood is responsible for clot formation. [1]

.....

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(b) (i) Explain how the atheroma has led to the death of heart muscle cells shown in **Images 5.1** and **5.2**. [3]

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(ii) Apart from lack of exercise, state **two** other factors which are linked to the increased risk of developing an atheroma. [2]

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(iii) State the name of a surgical procedure which can be used to remove blockages in the blood vessels surrounding the heart. [1]

.....

(iv) Suggest **one** way in which the Welsh Government could reduce the number of cases of heart disease each year. [1]

.....

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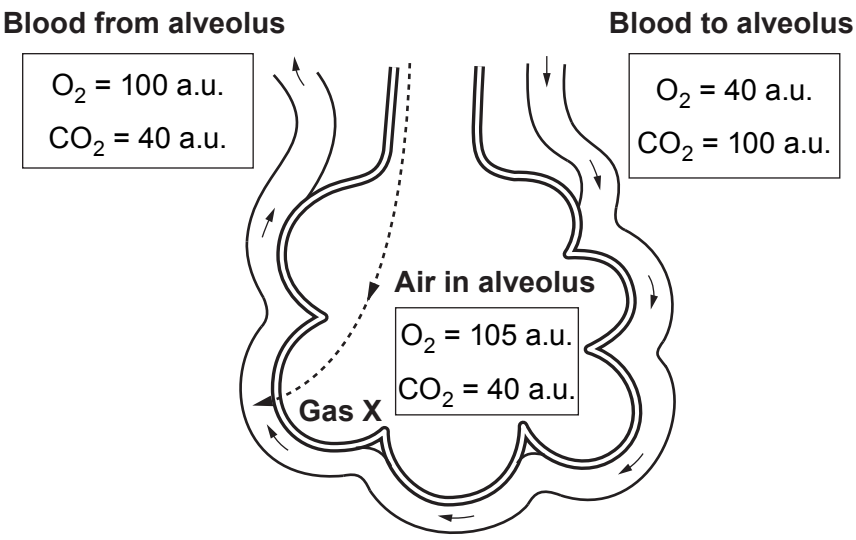
6. **Image 6** shows gas exchange taking place between an alveolus and a blood capillary. The numbers shown represent the concentrations of oxygen (O_2) and carbon dioxide (CO_2) in arbitrary units (a.u.).

Image 6



(a) State **one** way in which the alveolus and capillary are adapted to their function. [2]

Adaptation of alveolus

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Adaptation of capillary

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(b) Using **Image 6**, name gas **X** and use the data to explain how this gas moves from the air in the alveolus into the blood. [3]

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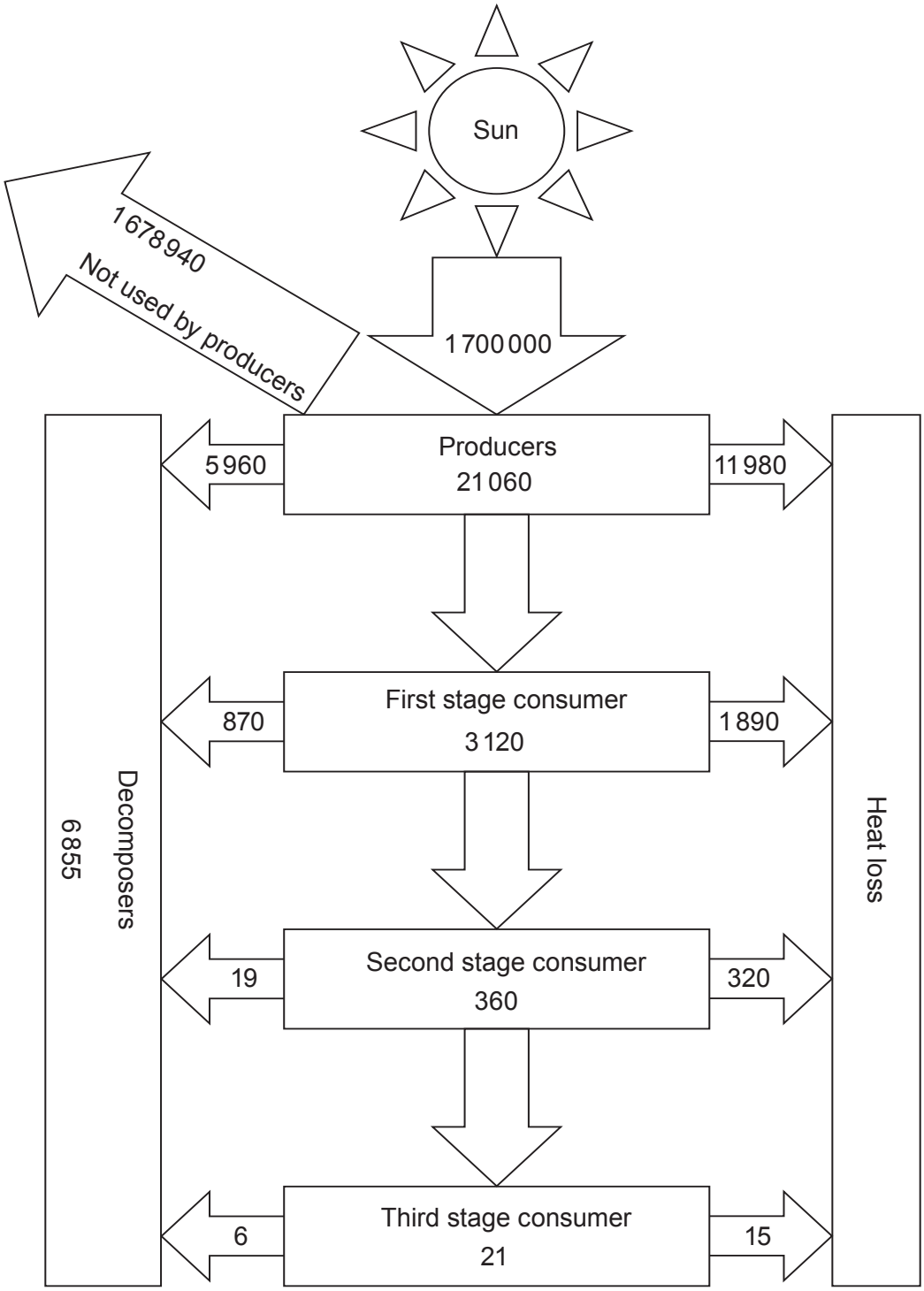
7. **Image 7** shows the total amount of energy entering a grassland habitat in kilojoules per square metre during a year. The transfer of energy in a food chain is shown, as well as the energy that is lost from it as heat.

Image 7



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(a) (i) State the name of the stage in **Image 7** which represents the herbivores. [1]

.....

(ii) State the name of **one** type of decomposer. [1]

.....

(b) (i) Use the data from **Image 7** to calculate the percentage of energy transferred from the first stage consumer to the second stage consumer. **Give your answer to three significant figures.** [2]

Percentage of energy transferred = ...

(ii) Suggest why the food chain shown in **Image 7** would be unable to support a fourth stage consumer. [1]

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(c) In the space below, **use a ruler** to draw a **labelled** pyramid of biomass to represent the food chain shown in **Image 7**. **The pyramid does not need to be to scale.** [1]

(d) State which process is responsible for the heat loss in **Image 7**. [1]

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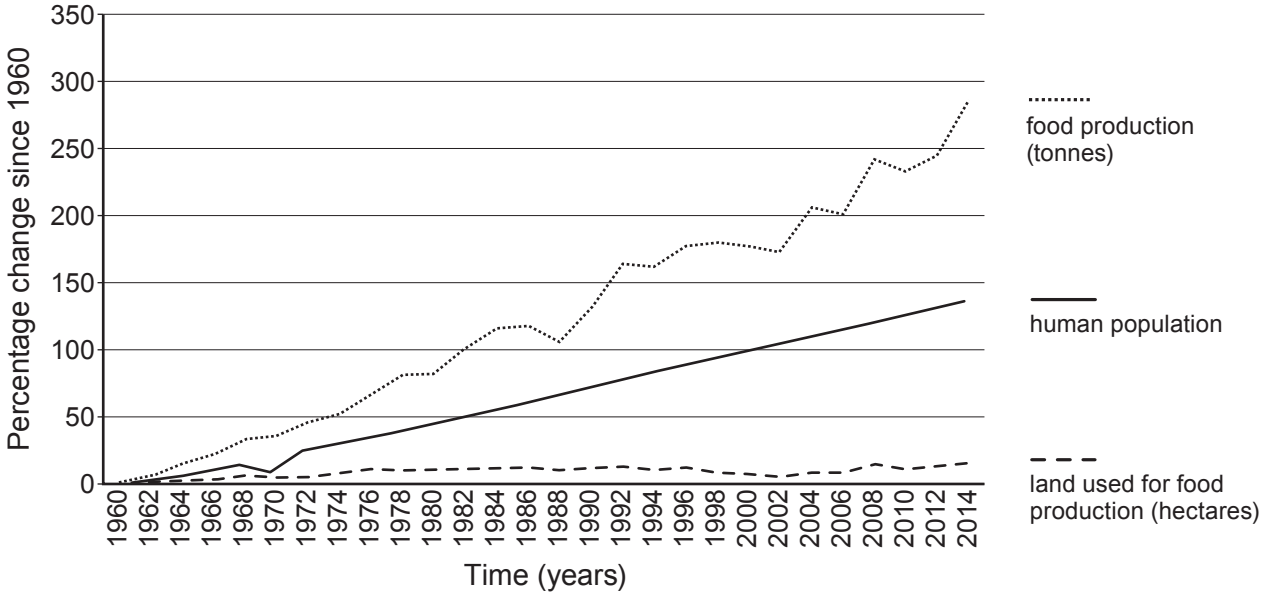
8. **Graph 8** shows the percentage change in global food production, human population and the land used for food production between 1960 and 2014.

Graph 8



(a) Use the information in **Graph 8** to state **one** conclusion about the efficiency of food production. Explain your answer. [2]

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(b) Use your knowledge of the nitrogen cycle to explain how farmers can increase the nitrogen available to their crops and so increase their yield. Diagrams will not gain credit. [6 QER]

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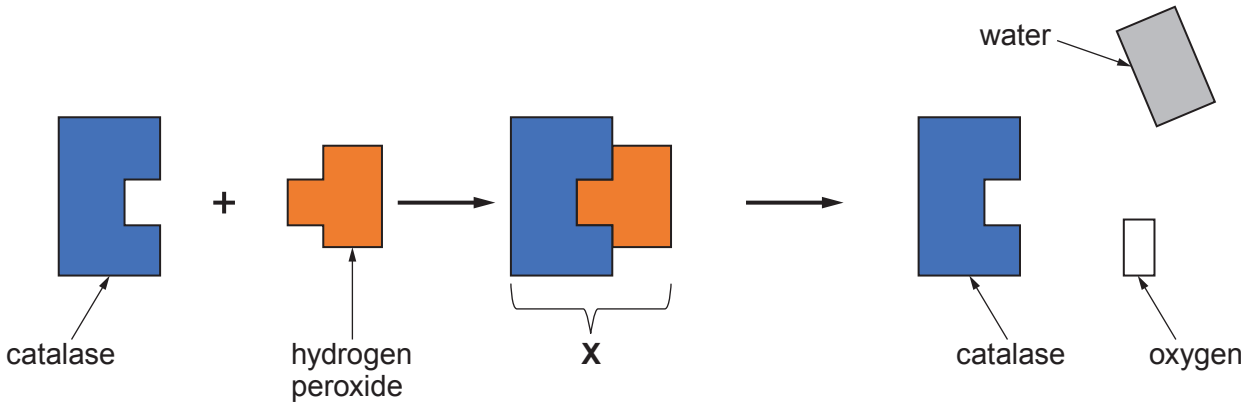
9. Catalase is an enzyme found in most cells. Catalase speeds up the breakdown of hydrogen peroxide to form water and oxygen.
Image 9.1 represents the breakdown of hydrogen peroxide by the action of catalase.

Image 9.1



(a) (i) State the name of the structure labelled **X** in **Image 9.1**. [1]

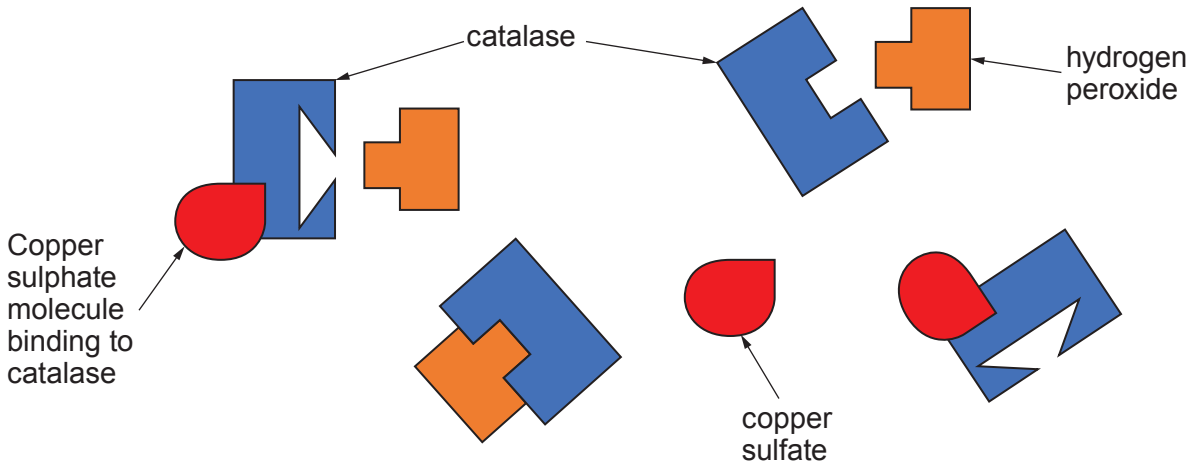
.....

(ii) State the name of the model of enzyme action shown in **Image 9.1**. [1]

.....

(b) **Image 9.2** represents the effect of copper sulfate on catalase. If a copper sulfate molecule binds to catalase it prevents it from working.

Image 9.2



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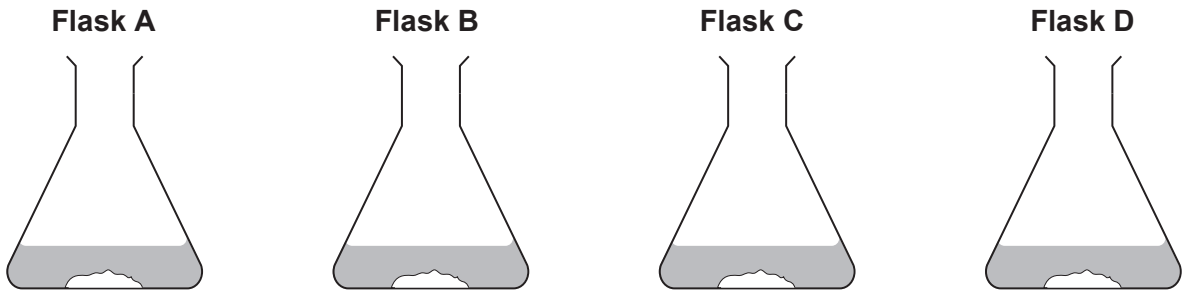
Students investigated the effect of copper sulfate on catalase activity in potatoes.

The students set up the following four flasks. as shown in **Image 9.3**.

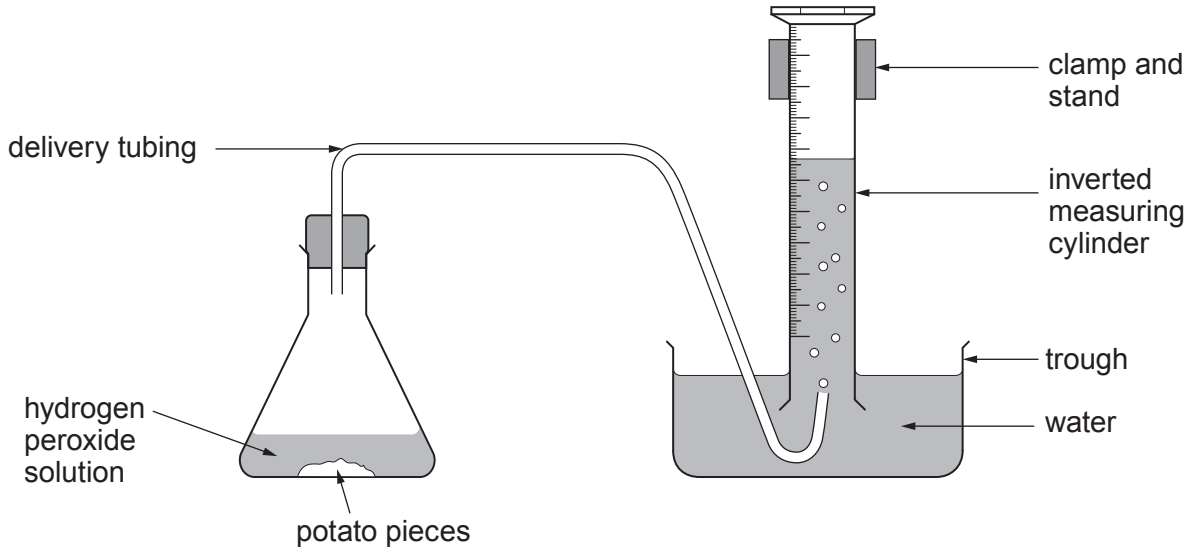
Image 9.3



Flask A	Flask B	Flask C	Flask D
9 cm^3 hydrogen peroxide solution 1 cm^3 water fresh potato pieces	9 cm^3 hydrogen peroxide solution 1 cm^3 water boiled potato pieces	9 cm^3 hydrogen peroxide solution 1 cm^3 copper sulfate solution fresh potato pieces	9 cm^3 hydrogen peroxide solution 1 cm^3 copper sulfate solution boiled potato pieces

The students measured the volume of gas produced from each flask using the apparatus shown in **Image 9.4**.

Image 9.4



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The results of the investigation are shown in **Table 9.5**.

Table 9.5

Time (minutes)	Volume of gas present in the cylinder (cm^3)			
	Flask **A**	Flask **B**	Flask **C**	Flask **D**
0	0	0	0	0
5	12	0	3	0
10	20	0	5	0
15	28	0	7	0
20	34	0	10	0
25	38	0	12	0
30	38	0	14	0

(i) Describe **and** explain the results for flask **A**. [4]

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(ii) The rate of gas production in flask **A** between 10 and 15 minutes is 1.6 cm^3/min. Calculate the rate of gas production between 10 and 15 minutes in flask **C**. [2]

Rate of gas production = ... cm^3/minute

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(iii) Use the information in **Image 9.2** to explain why less gas is produced in flask **C** than in flask **A**. [3]

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(c) (i) State the purpose of flasks **B** and **D** in **Image 9.3**. [1]

.....

.....

(ii) State **two** variables that should have been controlled in this investigation to make it a fair test. [2]

.....

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(iii) Describe how the students could improve the accuracy of their investigation. [1]

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END OF PAPER

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

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