Using food and controlling growth – 2021/20 GCSE 21st GCSE Biology B

1. Nov/2021/Paper_J257_04/No.7

Layla is setting up a compost bin, as shown in **Fig. 7.1**.

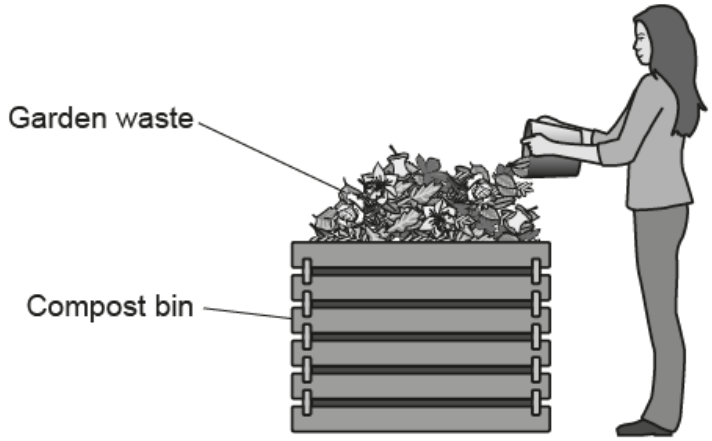


Fig. 7.1

(a) To make good compost, the waste added to the bin should be 50% green (such as grass cuttings) and 50% brown (such as dead leaves).

Today, Layla has added 1.1 kg of grass cuttings and 1.4 kg of dead leaves.

Calculate the percentage of green waste that she added today.

Percentage = ... % **[1]**

(b) Layla adds waste plant material from the garden to the bin, where it will be broken down to make compost.

She is worried that the compost bin might become full of bacteria from the waste.

Explain why the presence of bacteria in the bin will actually be helpful.

.....

.....

.....

..... **[2]**

(c) Compost that is made in the bin can be added to the soil in the garden.

Explain why it is useful to turn garden waste into compost that is added to the soil, rather than throwing the garden waste away.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(d) Layla plans to add a piece of wood to the compost bin.

The length, width and thickness of the wood is shown in **Fig. 7.2**.

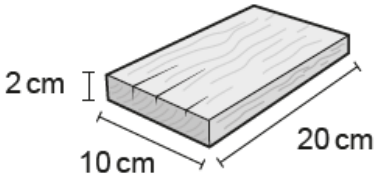


Fig. 7.2

The surface area of the wood is 520 cm^2.

(i) Calculate the surface area to volume ratio of the wood.

Surface area to volume ratio = ... **[3]**

(ii) Explain why the wood will be broken down into compost more quickly if Layla chops it up into small pieces before putting it in the compost bin.

.....

.....

.....

..... **[2]**

(e) Layla did an experiment to investigate how the rate at which garden waste is broken down changes with temperature.

- She weighed out equal masses of garden waste into six beakers.
- Each beaker contained 50% green waste and 50% brown waste, well mixed together.
- Each beaker was kept at a different temperature for 28 days.

The rate at which the waste in each beaker was broken down is shown in the table.

Beaker	Temperature (°C)	Rate at which the waste was broken down (g/day)
1	5	0.6
2	10	0.8
3	15	1.9
4	20	3.0
5	25	3.2
6	30	2.2

The results have been plotted in **Fig. 7.3**.

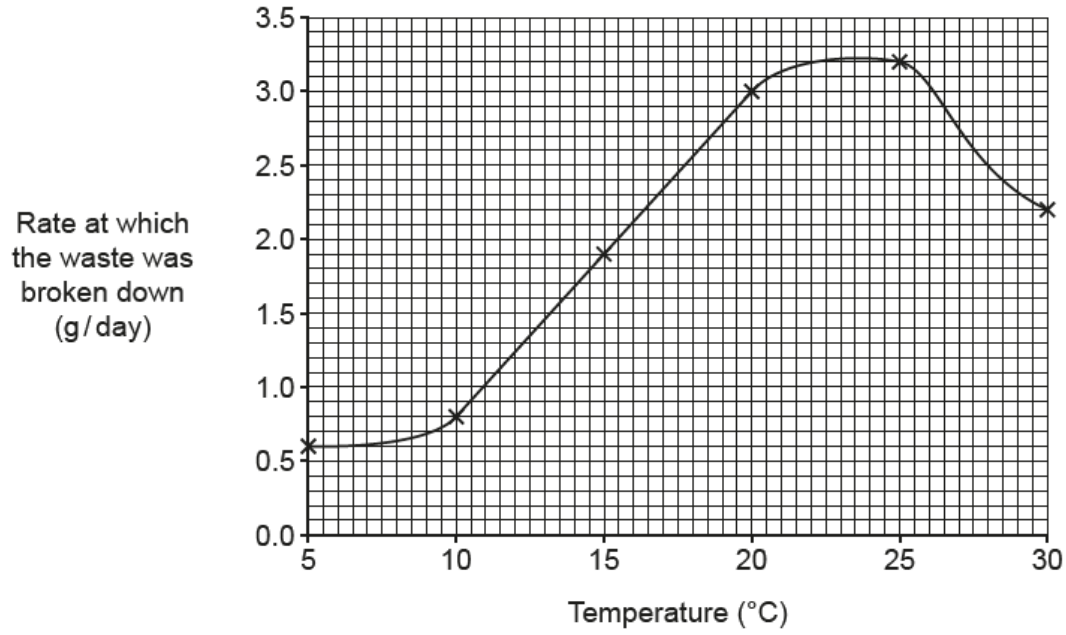


Fig. 7.3

(i) Explain why the rate shown in **Fig. 7.3** was highest at the optimum temperature of approximately 23.5 °C but was lower at temperatures below and above the optimum.

.....

.....

.....

.....

.....

..... **[3]**

(ii) Which part of the line in **Fig. 7.3** could be represented by the relationship y = mx + c?

Tick (✓) **one** box.

The line between 5 °C and 15 °C. ☐

The line between 10 °C and 20 °C. ☐

The line between 15 °C and 25 °C. ☐

The line between 20 °C and 30 °C. ☐

[1]

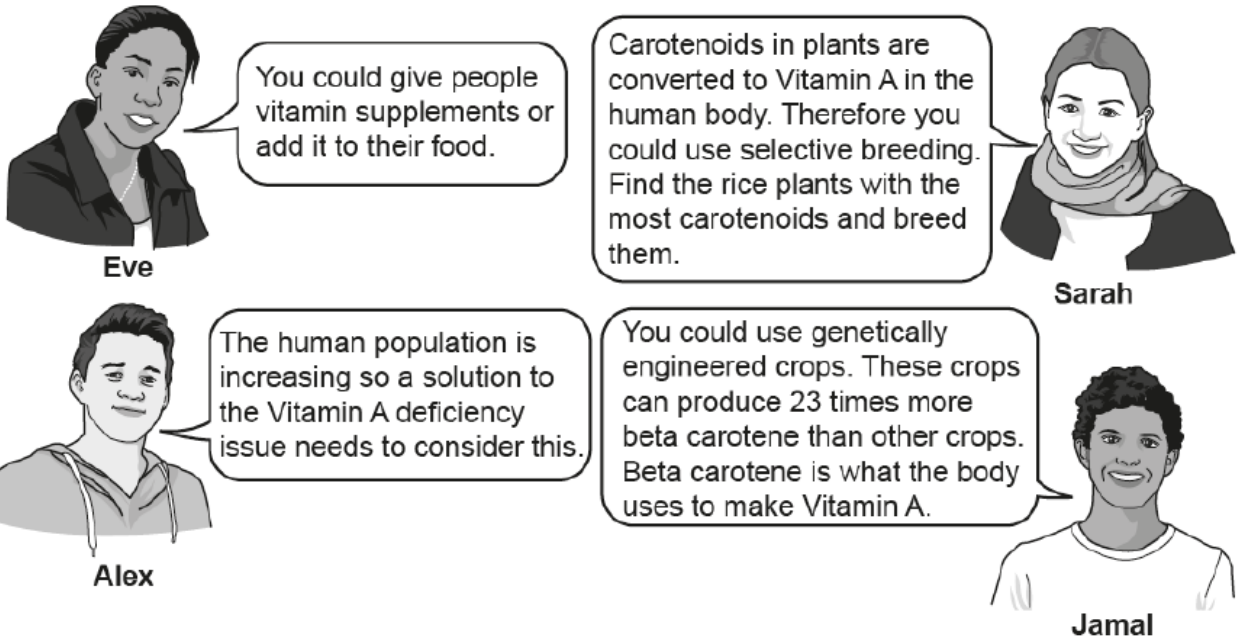
(iii) Calculate the **change** in the rate **per °C** between 10 °C and 20 °C, using **Fig. 7.3**.

Change in rate = ... g/day per °C **[2]**

2. Nov/2020/Paper_J257_03/No.5

In many developing countries people rely on rice and corn for their diet. As both these crops are low in nutrients, Vitamin A deficiency is a concern. Deficiency in Vitamin A can cause blindness.

A group of friends are discussing how Vitamin A deficiency in developing countries could be tackled.



(a) Which method of tackling Vitamin A deficiency in developing countries is the best long-term solution?

Justify your answer.

.....

.....

.....

.....

.....

.....

..... **[3]**

(b) What is meant by 'genetic engineering'?

.....

.....

..... **[2]**

(c) State **one** concern about using genetically engineered crops.

.....

..... **[1]**

3. Nov/2020/Paper_J257_03/No.6

The partially permeable membrane of the cell allows the reactants of respiration to enter the cell and the products to leave.

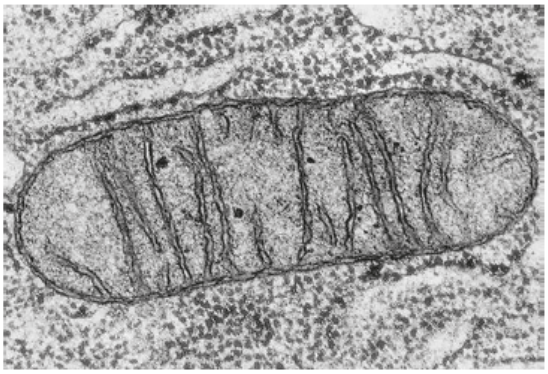
(a) Complete the table to explain how each of these substances is transported into or out of cells.

Tick (✓) **one** box in each row.

Substance	Diffusion	Osmosis	Active transport
Carbon dioxide out of the cell			
Oxygen into the cell			
Water out of the cell			

[3]

(b) This image is of a mitochondrion.



(i) What type of microscope would be used to take this image?

..... **[1]**

(ii) Explain how this type of microscope has increased our understanding of structures such as mitochondria.

.....

.....

.....

..... **[2]**

(iii) Human heart muscle contracts on average 80 times per minute.

Suggest why heart muscle cells contain a large number of mitochondria.

.....

..... **[1]**

(c) A human liver has a mass of approximately 1.3 kg.

Hepatocytes are one type of cell found in the liver. They make up approximately 75% of the liver mass.

It is estimated that 18% of each hepatocyte is mitochondria.

Calculate the mass of the liver that is made of hepatocyte mitochondria.

Mitochondrial mass of liver = ...kg **[2]**

4. Nov/2020/Paper_J257_04/No.1

Beth is investigating the rate of cellular anaerobic respiration in yeast. She tests different sugar solutions to see what effect they have on respiration in the yeast. One of the solutions contains glucose.

(a) Beth starts by measuring out 30 cm^3 of glucose solution using a measuring cylinder.

Fig. 1.1 shows four attempts she made at doing this.

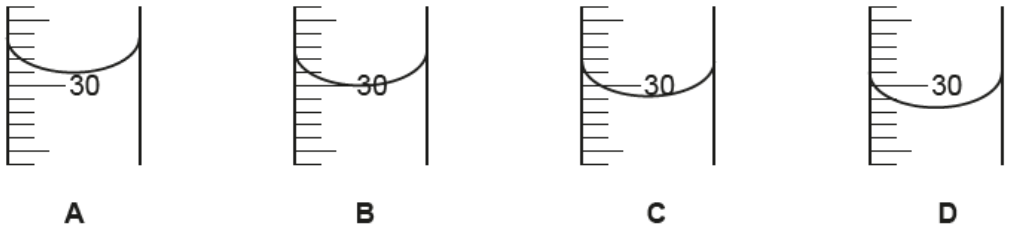


Fig. 1.1

In which attempt, **A**, **B**, **C** or **D**, did Beth have 30 cm^3 of glucose solution?

Attempt ..... **[1]**

(b) Beth sets up her materials and apparatus as shown in **Fig. 1.2**.

Anaerobic cellular respiration takes place in the yeast. This makes a gas.

Beth wants to collect the gas using a **measuring cylinder**.

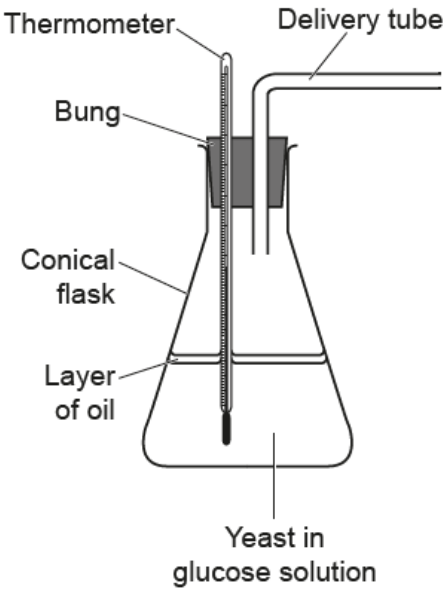


Fig. 1.2

Complete the diagram in **Fig. 1.2** to show how Beth should set up the **measuring cylinder** to collect the gas.

Add labels to your diagram. **[3]**

(c) Beth collects some of the gas made by the anaerobic cellular respiration.
She tests the gas by putting a glowing splint into it.

Table 1.1 describes the results she would see for different gases.

Gas	Result of the test
Air	The splint would continue glowing.
Carbon dioxide	The splint would stop glowing.
Hydrogen	There would be a squeaky pop.
Oxygen	The splint would start burning with a flame.

Table 1.1

What result would you expect to see for the gas Beth has collected?

Explain your answer.

.....

.....

.....

..... **[2]**

(d) Beth noticed that the reading on the thermometer increased during the experiment.

The temperature in the room did **not** increase.

Explain why the glucose solution containing yeast warmed up.

.....

..... **[1]**

Another student, Jamal, is also investigating the rate of anaerobic cellular respiration in yeast.

Jamal sets up his materials and apparatus differently to Beth, as shown in **Fig. 1.3**.

- He places the conical flask in a water bath at room temperature.
- He uses a gas syringe to collect the gas made by anaerobic cellular respiration.

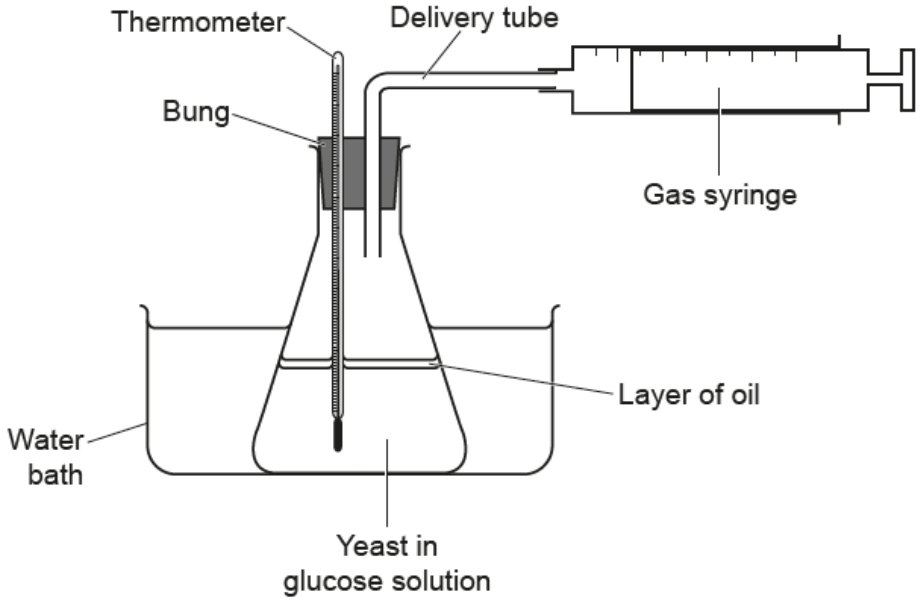


Fig. 1.3

Jamal wants to find out what effect different sugar solutions have on the rate of anaerobic cellular respiration in the yeast.

Jamal collects data from the yeast in the glucose solution and then from the yeast in sucrose solution.

(e) Using the water bath at room temperature will help Jamal to compare his results from the glucose and sucrose more fairly.

Suggest **two** reasons why.

1 .....

.....

2 .....

..... **[2]**

Jamal plots his results on a graph, as shown in **Fig. 1.4**.

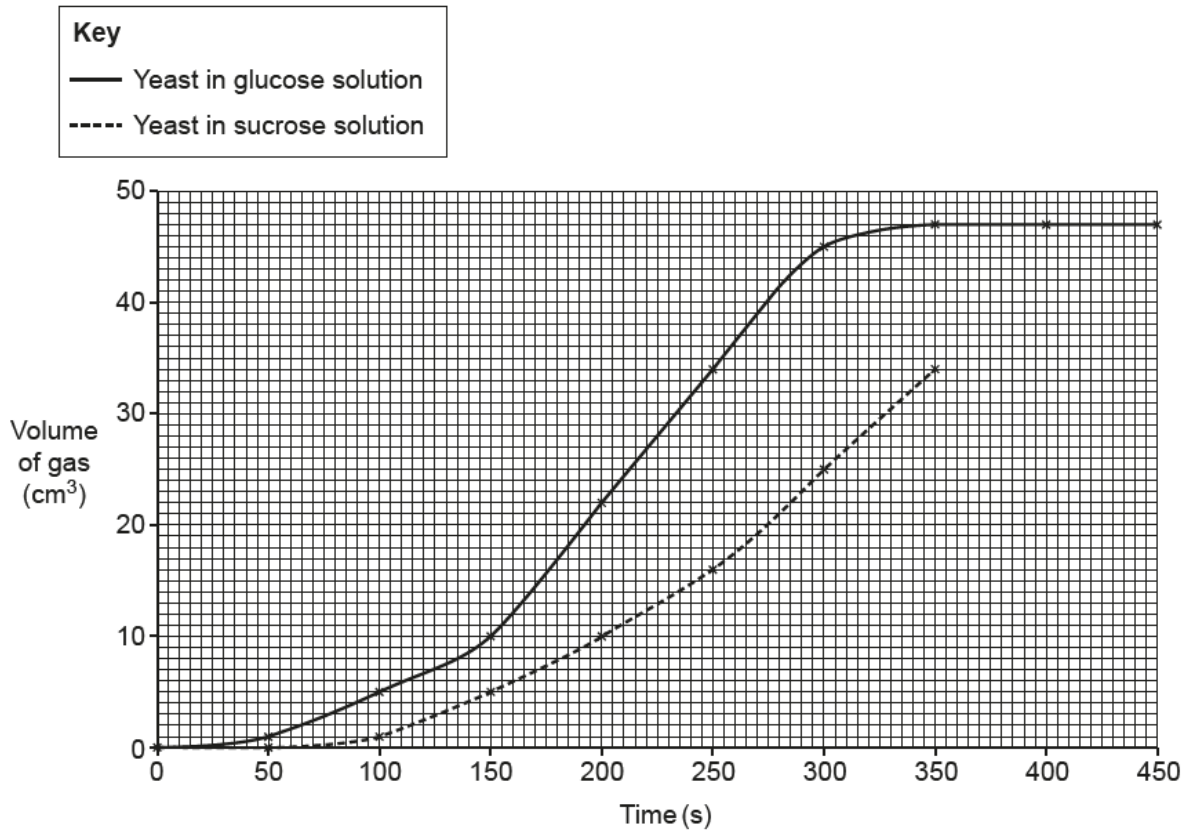


Fig. 1.4

(f) The final measurements for the yeast with the sucrose solution are shown in **Table 1.2**.

Time (s)	Volume of gas (cm^3)
400	42
450	45

Table 1.2

Plot the final measurements on the graph. **[1]**

(g) What volume of gas is collected from the yeast with the sucrose solution after 275 seconds?

Volume = ... cm^3 **[1]**

(h) How long did it take for the yeast to use all of the glucose from the glucose solution?

Explain your answer.

Time ..... s

Explanation .....

.....

..... **[2]**

(i) Calculate the rate of anaerobic respiration in the yeast with glucose solution between 150 seconds and 250 seconds.

Give the **appropriate units** in your answer.

Rate = ... units ..... **[3]**

(j) Jamal concludes that the rate of anaerobic cellular respiration is faster when yeast is in glucose solution.

Describe **two** pieces of evidence from the graph in **Fig. 1.4** that support Jamal's conclusion.

1 .....

.....

2 .....

..... **[2]**

5. Nov/2020/Paper_J257_04/No.4

Mistletoe is a very unusual plant. Instead of growing in the ground, mistletoe grows on another plant such as a tree, as shown in **Fig. 4.1**.

Fig. 4.1

(a) Mistletoe does not have roots in the soil.

Mistletoe takes all the water it needs from a tissue in the tree. This tissue transports water from the tree's roots to the tree's leaves.

(i) What is the name of the tissue in the tree that the mistletoe takes water from?

..... **[1]**

(ii) Explain why water moves through this tissue from the roots to the leaves in a normal tree.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(iii) Suggest one **other** substance that the mistletoe could take from this tissue in the tree.

..... **[1]**

(b) Very little photosynthesis takes place in the mistletoe.

It takes most of the sugar it needs from phloem tissue in the tree. Phloem transports sugars around the tree.

A diagram of the phloem tissue is shown in **Fig. 4.2**.

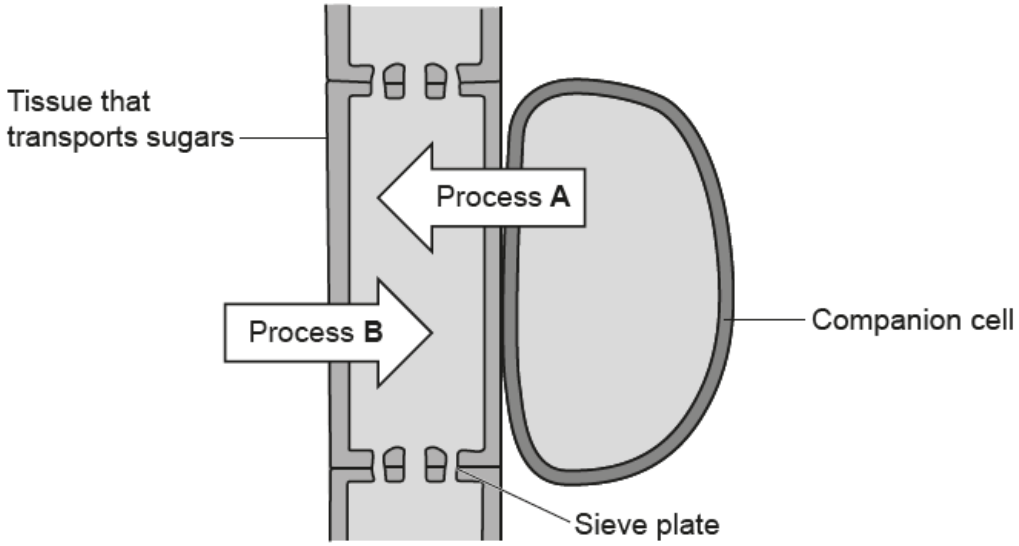


Fig. 4.2

(i) Process **A** and process **B** move substances into the phloem tube.

Describe process **A** and process **B**.

In your answer you should include:
- the names of the processes
- what is moved by each process.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(ii) Explain how sugars are moved along a phloem tube.

.....

.....

.....

.....

.....

..... **[3]**

(iii) The phloem tube is made of living cells, but these cells do not have any mitochondria.

Explain why they depend on the companion cells, which do have mitochondria.

.....

.....

.....

..... **[2]**

(c) Mistletoe can catch diseases from the tree it is growing on.

A scientist thinks some bacteria have spread from a tree to some mistletoe that is growing on it. They collect a sample of the bacteria from the mistletoe.

Fig. 4.3 shows an image of some of the bacteria from the mistletoe.

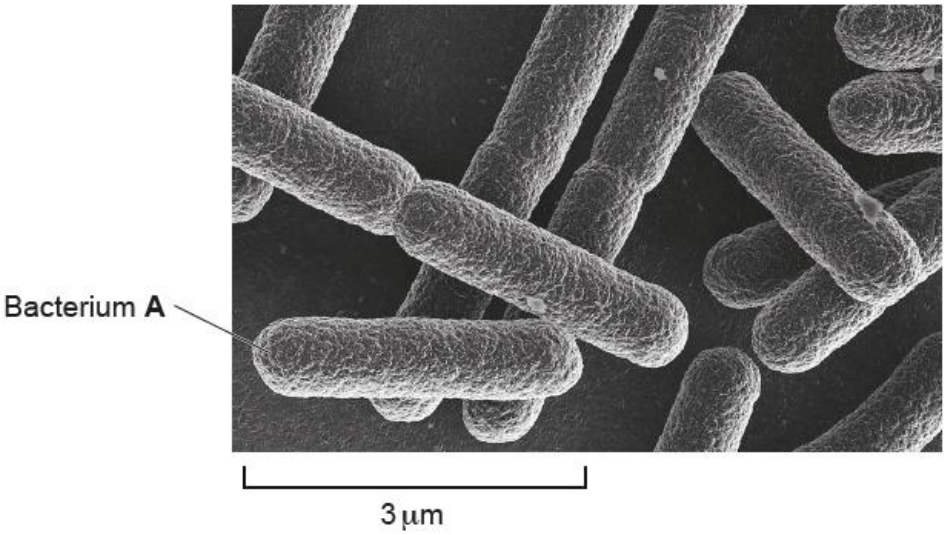


Fig. 4.3

(i) The actual length of bacterium **A** is 3 μm.

In the image in **Fig. 4.3** it appears to be 4.5 cm long.

1 μm = 0.0001 cm

Calculate the magnification of the image.

Use the equation: magnification = measured size ÷ actual size

Magnification = × ..... **[2]**

(ii) Each bacterium from the tree is 3×10^{-4} cm long.

Is it possible that the bacteria from the tree are the same bacteria as bacterium **A** from the mistletoe?

Yes ☐

No ☐

Explain your answer.

.....

.....

.....

..... **[2]**

(d) The scientist has made some monoclonal antibodies that recognise the bacteria from the tree.

(i) Describe how scientists make monoclonal antibodies that recognise the bacteria from the tree.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

(ii) The monoclonal antibodies are designed to recognise the bacteria from the tree.

The scientist wants to test whether they also recognise the bacteria from the mistletoe.

Describe how the scientist could do this in a diagnostic test **and** what the scientist would see if the result was positive.

.....

.....

.....

.....

.....

..... **[3]**

6. Nov/2021/Paper_J257_01/No.6

Multiple sclerosis is a disease which currently does not have a cure.
Scientists have conducted a trial with patients to see if stem cells could help cure this disease.

(a) **(i)** What is a stem cell?

.....

..... **[1]**

(ii) Stem cells can be taken from embryos.

Give **one** reason why people are against the use of these stem cells.

.....

..... **[1]**

(b) Trials using stem cells are not risk free.

Give **one** benefit and **one** risk of taking part in the trial.

Benefit .....

.....

Risk .....

.....

[2]

(c) This research was published in a peer-reviewed journal.

(i) Describe what happens during peer review.

.....

.....

.....

..... **[2]**

(ii) Publishing research in peer-reviewed journals is one way of communicating the scientists' findings.

Identify who else would be interested in finding out about this research, other than scientists.

..... **[1]**

7. Nov/2021/Paper_J257_01/No.9

Catalase is an enzyme. It breaks down hydrogen peroxide into water and oxygen.

The action of this enzyme can be investigated using the equipment shown in **Fig. 9.1**.

The catalase and hydrogen peroxide are placed in the conical flask. The oxygen produced by the reaction is collected in the measuring cylinder.

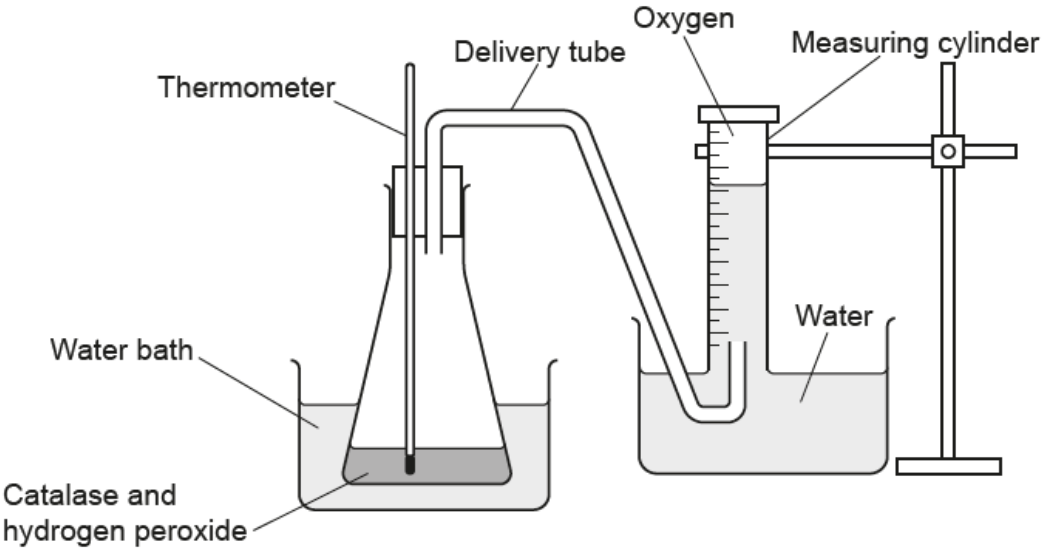


Fig. 9.1

Amir wants to investigate how enzyme concentration affects this reaction.

(a) (i) Amir uses a beaker to measure out the hydrogen peroxide solution.

Suggest **one** piece of equipment that Amir could use instead of a beaker **and** why this would improve his experiment.

Piece of equipment .....

Reason for choice .....

[2]

(ii) Describe how Amir could use the equipment in **Fig. 9.1** to investigate the effect of enzyme concentration on the rate of this reaction.

.....

.....

.....

..... **[2]**

(b) Temperature is one variable that needs to be controlled in this experiment.

State **two** other variables that would need to be controlled.

Variable 1 .....

Variable 2 .....

[2]

(c) **Fig. 9.2** shows the effect of temperature on the rate of reaction for the enzyme catalase.

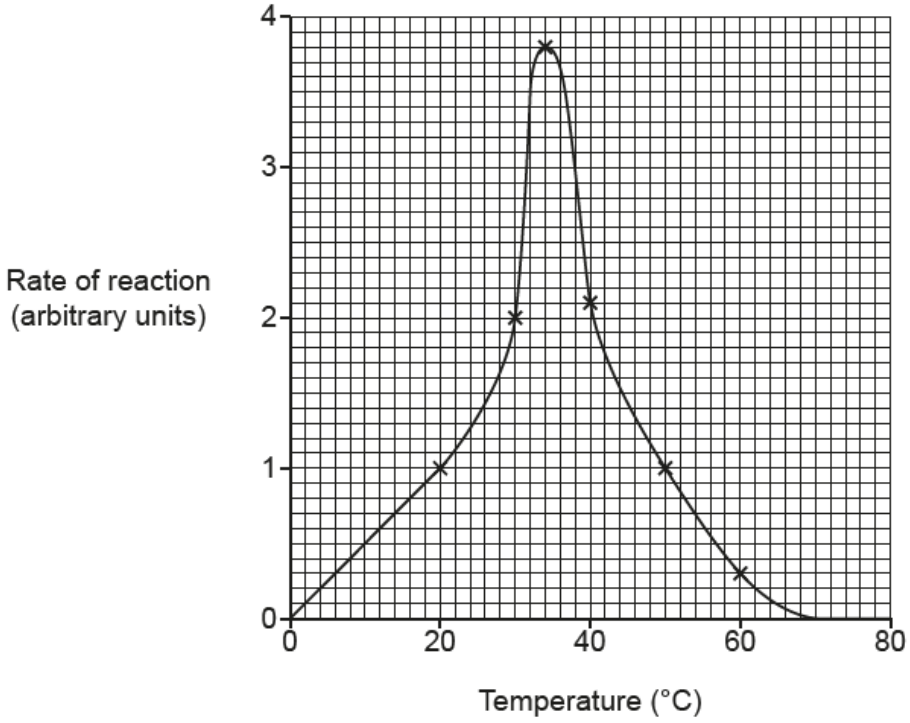


Fig. 9.2

(i) What is the optimum temperature for catalase? ..... °C **[1]**

(ii) How could this investigation be improved to find a more accurate optimum temperature?

.....

..... **[1]**

(d) Enzyme molecules start to become denatured at temperatures above the optimum temperature.

What was the lowest temperature at which all of the catalase molecules became denatured?

Use **Fig. 9.2**.

Tick (✓) **one** box.

0 °C ☐

40 °C ☐

68 °C ☐

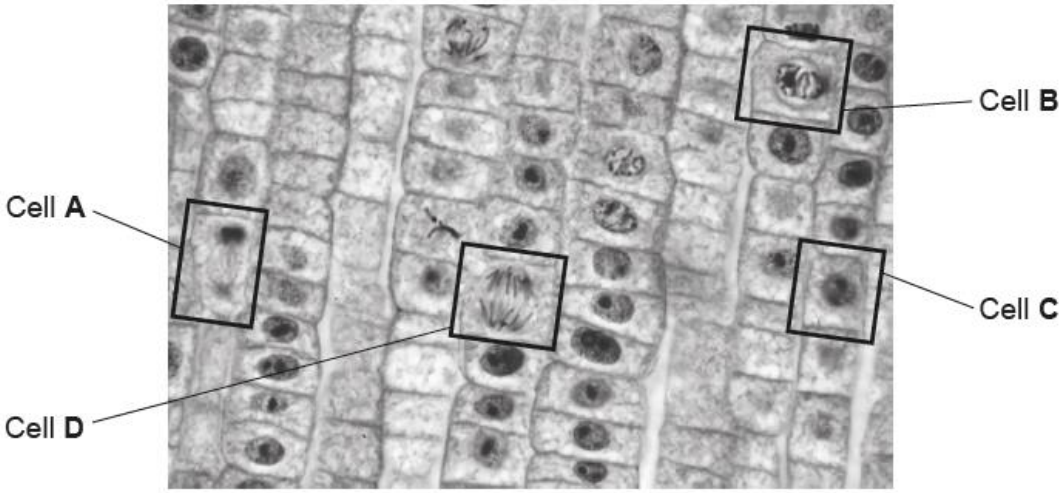
80 °C ☐

[1]

8. Nov/2021/Paper_J257_02/No.5

The photograph shown was taken using a light microscope.

Four cells have been labelled.



(a) Cells **A**, **B**, **C** and **D** illustrate different stages and events during the cell cycle.

Complete the information in the table, using the photograph.

Name of stage of the cell cycle	**Events that take place during the stage**	**Cell that illustrates the event**
.....	Chromosomes are unwound and spread out inside the nucleus so that they can be copied.	C
.....	Chromosomes wind up like springs, and each one has a copy attached to it.	.....
	The nucleus breaks down. The chromosome copies separate and move to opposite ends of the cell.	.....
	Two new nuclei form at opposite ends of the cell. The cell divides in two.	.....

[5]

(b) The photograph shows cells from the tip of a plant's root.

Suggest why cells in the root tip are dividing.

.....

.....

.....

..... **[2]**

9. Nov/2020/Paper_J257_01/No.1

The human body has many specialised cells. Each specialised cell has a certain function.

(a) Draw lines to connect each **specialised cell** with its **function**.

Specialised cell	Function
Red blood cell	Conduction of impulses
Nerve cell	Transport of oxygen
White blood cell	Protection against disease

[2]

(b) When do cells in embryos start to become specialised?

Tick (✓) **one** box.

When the egg is fertilised ☐

Before the eight-cell stage ☐

After the eight-cell stage ☐

[1]

(c) Cells contain many organelles.

Complete the sentences about organelles and their functions.

Use words from the list.

You can use each word once, more than once, or not at all.

chloroplast **mitochondrion** **nucleus** **plasmid**

Aerobic respiration takes place in the ..... .

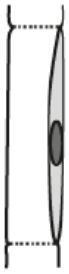
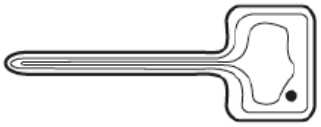
Photosynthesis takes place in the ..... .

[2]

10. Nov/2020/Paper_J257_01/No.9

Sarah is learning about plants.

(a) Draw a line to connect each **diagram** to the **name of the structure** and its **role in the plant**.

Diagram	Name of the structure	Role in the plant
	Xylem	Absorbs water and mineral ions
	Phloem	Transports sugars
	Root hair cell	Transports water and mineral ions

[5]

(b) Sarah's teacher tells her she can observe these structures using a light microscope.

Complete the sentences to describe how to use a light microscope.

Use words from the list.

You can use each word once, more than once, or not at all.

coverslip **eyepiece lens** **focussing knob** **light**

objective lens **stage** **table**

Place the slide with the specimen to be observed on the .....

Select the ..... to be used.

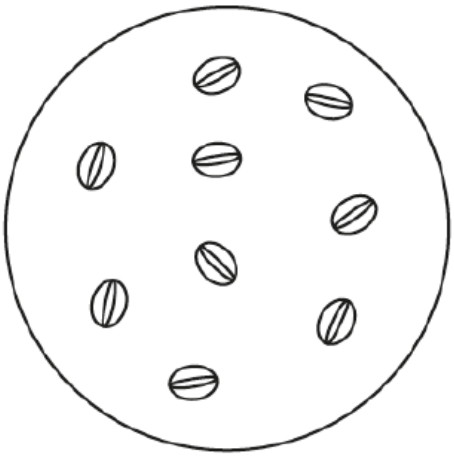
As you look down the microscope column, turn the ..... to bring the specimen into focus.

[3]

(c) Sarah wants to estimate how many stomata there are on the underside of a leaf.

Sarah uses a light microscope to do this.

The diagram shows the field of view from her microscope.



(i) Count how many stomata can be seen in the field of view.

Number of stomata = ... **[1]**

(ii) The area covered by the field of view is approximately 1 mm^2.

The total area of the underside of the leaf is 60 mm^2.

Estimate how many stomata there will be on the underside of this leaf.

Use your answer to part **(c)(i)**.

Estimated number of stomata = ... **[1]**

(iii) Sarah does not think that her sample was representative of the whole leaf.

Suggest how Sarah could improve her method.

.....

..... **[2]**

(iv) If the sample taken was not representative of the leaf, what impact would this have on Sarah's estimate?

.....

..... **[1]**

11. Nov/2020/Paper_J257_02/No.3

Our food and drink choices affect the environment.

Growing and transporting food releases greenhouse gases. These gases cause the Earth to warm up, which can have harmful effects on biodiversity.

The bar chart shows the amount of greenhouse gases released during the production of different foods.

(a) Which type of milk releases the most greenhouse gases per serving, and how much does it release?

Type of milk = ...

Greenhouse gases released per serving = ... kg

[2]

(b) For his breakfast, Alex has sausages, tomatoes and coffee with cow's milk.

The total amount of greenhouse gases released by Alex's breakfast is 3 kg.

The amount of greenhouse gases released by the sausages is 1.8 kg.

What percentage of the total amount of greenhouse gases released by the production of Alex's breakfast is caused by the production of the sausages?

Percentage = ... % **[2]**

(c) The next day Alex decides to have eggs instead of sausages.

(i) Explain why this change will reduce the effect his breakfast has on the environment.

Use evidence from the graph to support your answer.

.....

.....

.....

.....

.....

..... **[3]**

(ii) Scientists have lots of data on the amount of greenhouse gases released by the production of different foods.

Give **two** reasons why it is important that scientists share this data with the public.

1 .....

.....

2 .....

..... **[2]**

(d) Greenhouse gases can cause changes in ecosystems.

Explain why these changes could reduce our supply of food.

.....

.....

.....

.....

.....

.....

.....

..... **[4]**

12. Nov/2020/Paper_J257_03/No.8

Beth is investigating the rate of anaerobic cellular respiration in yeast. She tests different sugar solutions to see what effect they have on the respiration of yeast. One of the solutions contains glucose.

(a) Beth starts by measuring out 30 cm^3 of glucose solution using a measuring cylinder.

Fig. 8.1 shows four attempts she made at doing this.

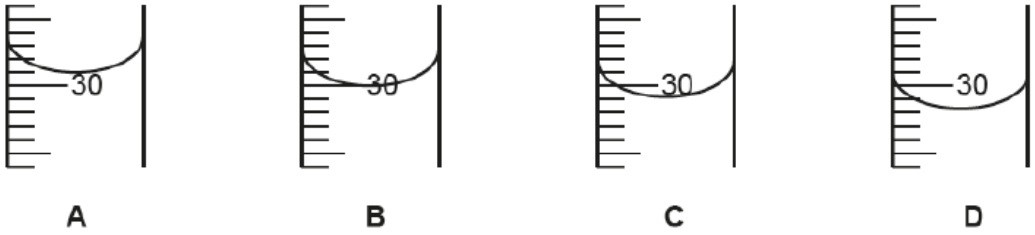


Fig. 8.1

In which attempt, **A**, **B**, **C** or **D**, did Beth have 30 cm^3 of glucose solution?

Attempt ..... **[1]**

(b) Beth sets up her materials and apparatus as shown in **Fig. 8.2**.

Anaerobic cellular respiration takes place in the yeast. This makes a gas.

Beth wants to collect the gas using a **measuring cylinder**.

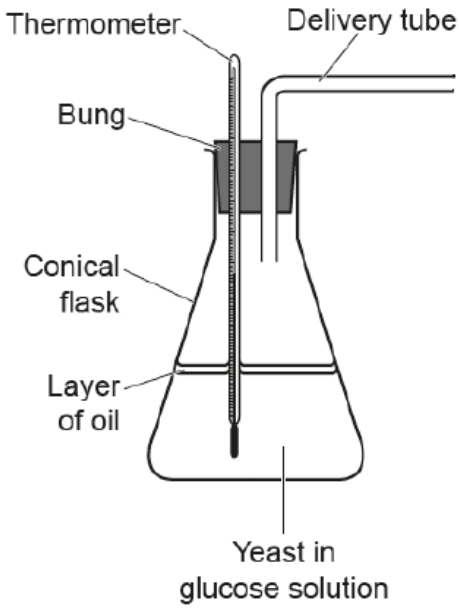


Fig. 8.2

Complete the diagram in **Fig. 8.2** to show how Beth should set up the **measuring cylinder** to collect the gas.

Add labels to your diagram. **[3]**

(c) Beth collects some of the gas made by the anaerobic cellular respiration.
She tests the gas by putting a glowing splint into it.

Table 8.1 describes the results she would see for different gases.

Gas	Result of the test
Air	The splint would continue glowing.
Carbon dioxide	The splint would stop glowing.
Hydrogen	There would be a squeaky pop.
Oxygen	The splint would start burning with a flame.

Table 8.1

What result would you expect to see for the gas Beth has collected?

Explain your answer.

.....

.....

.....

..... **[2]**

(d) Beth noticed that the reading on the thermometer increased during the experiment.

The temperature in the room did **not** increase.

Explain why the glucose solution containing yeast warmed up.

.....

..... **[1]**

Another student, Jamal, is also investigating the rate of anaerobic cellular respiration in yeast.

Jamal sets up his materials and apparatus differently to Beth, as shown in **Fig. 8.3**.

- He places the conical flask in a water bath at room temperature.
- He uses a gas syringe to collect the gas made by anaerobic cellular respiration.

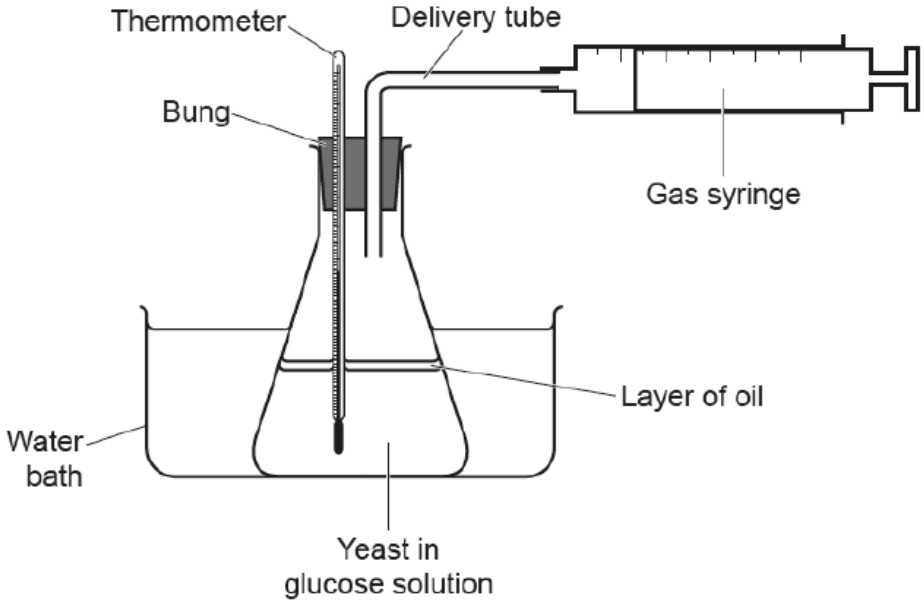


Fig. 8.3

Jamal wants to find out what effect different sugar solutions have on the rate of anaerobic cellular respiration in the yeast.

Jamal collects data from the yeast in the glucose solution and then from the yeast in sucrose solution.

(e) Using the water bath at room temperature will help Jamal to compare his results from the glucose and sucrose solutions more fairly.

Suggest **two** reasons why.

1 .....

.....

2 .....

..... **[2]**

Jamal plots his results on a graph, as shown in **Fig. 8.4**.

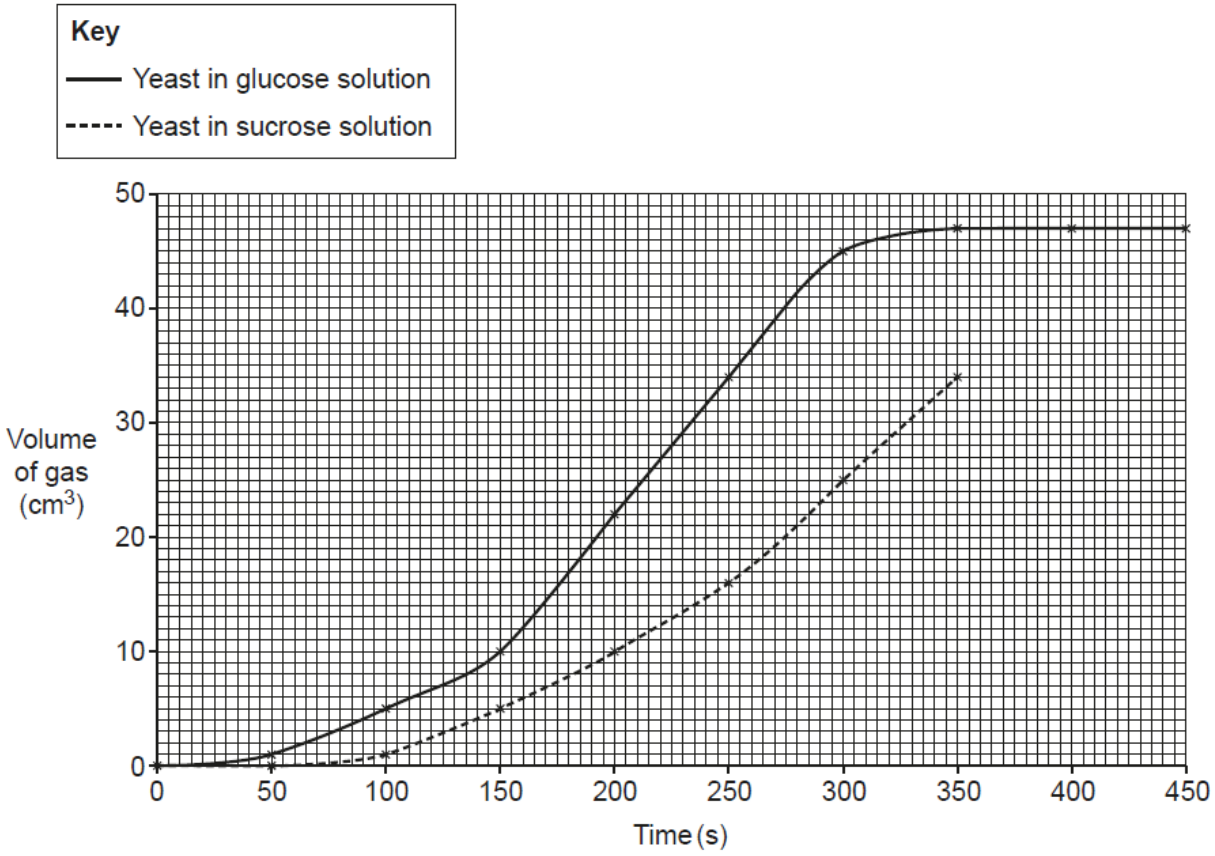


Fig. 8.4

(f) The final measurements for the yeast with the sucrose solution are shown in **Table 8.2**.

Time (s)	Volume of gas (cm^3)
400	42
450	45

Table 8.2

Plot the final measurements on the graph. **[1]**

(g) What volume of gas is collected from the yeast with the sucrose solution after 275 seconds?

Volume = ... cm^3 **[1]**

(h) How long did it take for the yeast to use all of the glucose from the glucose solution?

Explain your answer.

Time ..... s

Explanation .....

.....

..... **[2]**

(i) Calculate the rate of anaerobic respiration in the yeast with glucose solution between 150 seconds and 250 seconds.

Give the **appropriate units** in your answer.

Rate = ... units ..... **[3]**

(j) Jamal concludes that the rate of anaerobic cellular respiration is faster when yeast is in glucose solution.

Describe **two** pieces of evidence from the graph in **Fig. 8.4** that support Jamal's conclusion.

1 .....

.....

2 .....

..... **[2]**