AQA GCSE Biology | 8461

SPECIFICATION POINT 4.1.3.1

Diffusion

Past-paper questions

Tier	**Higher**
Question groups	**16**
Available paper years	**2008–2025**

Using this booklet

1. Answer the questions in order and show your working.
2. Original question numbers and marks are retained.
3. Print at actual size (100%) for measuring questions.
4. Use the companion answer booklet to check your work.

Name: _____ **Date:** _____

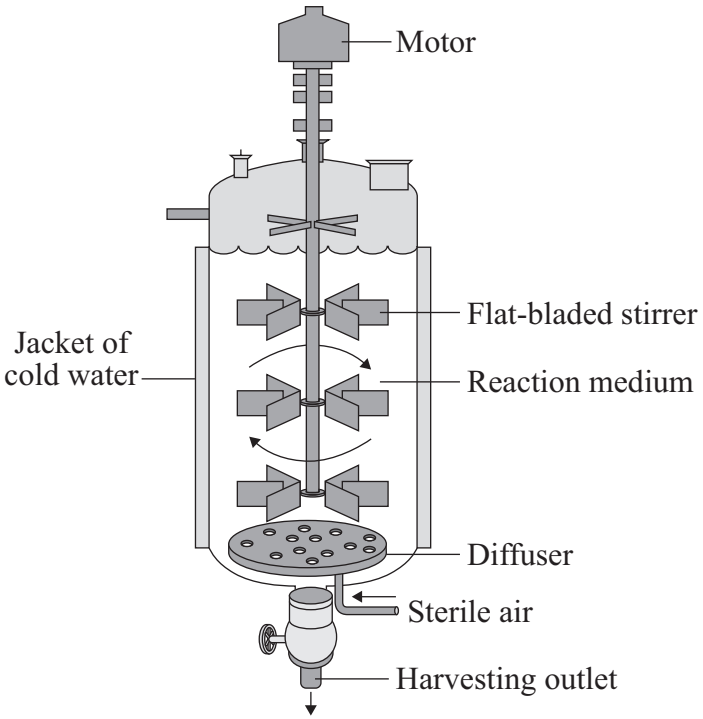
Whole questions are retained for context, so some parts assess other specification points. Current and legacy sources are labelled. Continue on extra paper if needed.

4.1.3.1 Diffusion

Question 01

January 2008 | BLY3H | Original Q7 | Legacy

7 The diagram shows a fermenter. This fermenter was used to grow the fungus *Cephalosporium* which makes the antibiotic Cephalosporin C. The reaction medium contains a mixture of the sugars glucose and sucrose and a variety of mineral ions.



(a) (i) The stirrer continuously mixes the contents of the fermenter. Why is this important?

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(1 mark)

(ii) Explain why the fermenter is surrounded by a jacket of cold water.

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(2 marks)

Question 7 continues on the next page

4.1.3.1 Diffusion

Question 01 · continued

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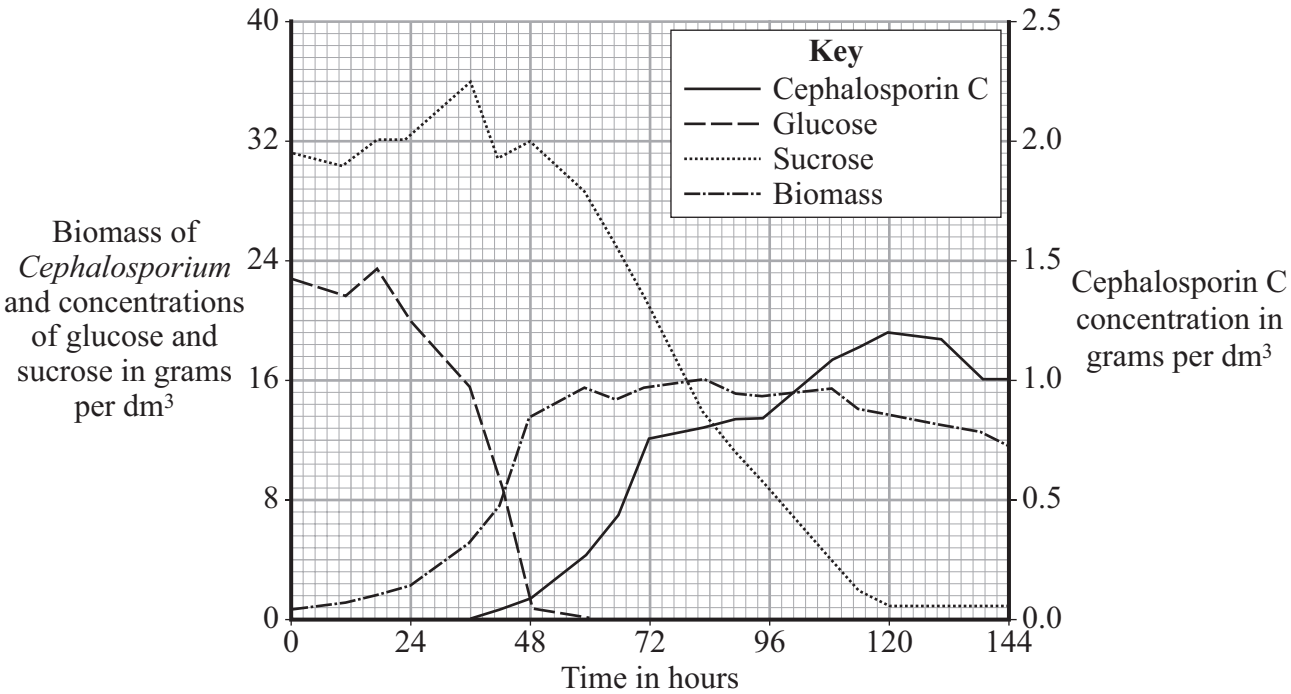
(b) The graph shows changes in the concentrations of glucose, sucrose, Cephalosporin C and the biomass of *Cephalosporium* measured in the fermenter over 6 days.



(i) During which 6-hour time period is the antibiotic being produced at its maximum rate?

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(1 mark)

(ii) What evidence is there that *Cephalosporium* is able to use glucose more easily than sucrose?

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(1 mark)

4.1.3.1 Diffusion

Question 01 · continued

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(iii) Describe and explain the relationship between glucose concentration, the biomass of *Cephalosporium* and the concentration of Cephalosporin C.

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(4 marks)

9

4.1.3.1 Diffusion

Question 02

June 2008 | BLY3H | Original Q5 | Legacy

5 The table shows the concentrations of some substances in one person's blood plasma, kidney filtrate and urine.

Substance	Concentration in grams per dm^3		
	Plasma	**Filtrate**	**Urine**
Water	900.0	900.0	950.0
Protein	78.0	0.0	0.0
Glucose	0.8	0.8	0.0
Amino acids	0.4	0.4	0.0
Urea	0.3	0.3	20.0
Sodium ions	2.8	2.8	3.5

5 (a) (i) Protein is **not** present in the filtrate.

Explain why.

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(1 mark)

5 (a) (ii) Glucose is filtered out of the blood by the kidney and is then completely reabsorbed back into the blood.

What is the evidence for this in the table?

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(2 marks)

4.1.3.1 Diffusion

Question 02 · continued

for mark

5 (a) (iii) Glucose is reabsorbed into the blood by active transport.

Give **two** ways in which active transport differs from diffusion.

1 .....

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2 .....

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(2 marks)

5 (b) The concentration of urea is much higher in the urine than in the filtrate.

Explain what causes this.

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(1 mark)

6

4.1.3.1 Diffusion

Question 03

January 2009 | BLY3H | Original Q5 | Legacy

5 Some scientists investigated the rates of absorption of different sugars by the small intestine.

In one experiment they used a piece of normal intestine.
In a second experiment they used a piece of intestine poisoned by cyanide. Cyanide is poisonous because it prevents respiration.

The results are shown in the table.

	Relative rates of absorption	
Sugar	**Normal intestine**	**Intestine poisoned by cyanide**
Glucose	1.00	0.33
Galactose	1.10	0.53
Xylose	0.30	0.31
Arabinose	0.29	0.29

5 (a) (i) Name **two** sugars from the table which can be absorbed by active transport.

1 .....

2 .....

(1 mark)

5 (a) (ii) Use evidence from the table to explain why you chose these sugars.

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(3 marks)

4.1.3.1 Diffusion

Question 03 · continued

for mark

5 (b) All of the sugars named in the table can be absorbed by diffusion.

Explain how information from the table provides evidence for this.

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(2 marks)

6

Turn over for the next question

4.1.3.1 Diffusion

Question 04

June 2009 | BLY3H | Original Q5 | Legacy

5 (a) The concentration of sulfate ions was measured in the roots of barley plants and in the water in the surrounding soil.

The table shows the results.

	Concentration of sulfate ions in mmol per dm^3
Roots of barley plants	1.4
Soil	0.15

Is it possible for the barley roots to take up sulfate ions from the soil by diffusion?

Draw a ring around your answer. **Yes / No**

Explain your answer.

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(2 marks)

5 (b) Some scientists investigated the amounts of sulfate ions taken up by barley roots in the presence of oxygen and when no oxygen was present.

The graph on the opposite page shows the results.

5 (b) (i) The graph shows that the rate of sulfate ion uptake between 100 and 200 minutes, **without** oxygen, was 0.4 arbitrary units per minute.

The rate of sulfate ion uptake between 100 and 200 minutes, **with** oxygen, was greater.

How much greater was it? Show clearly how you work out your answer.

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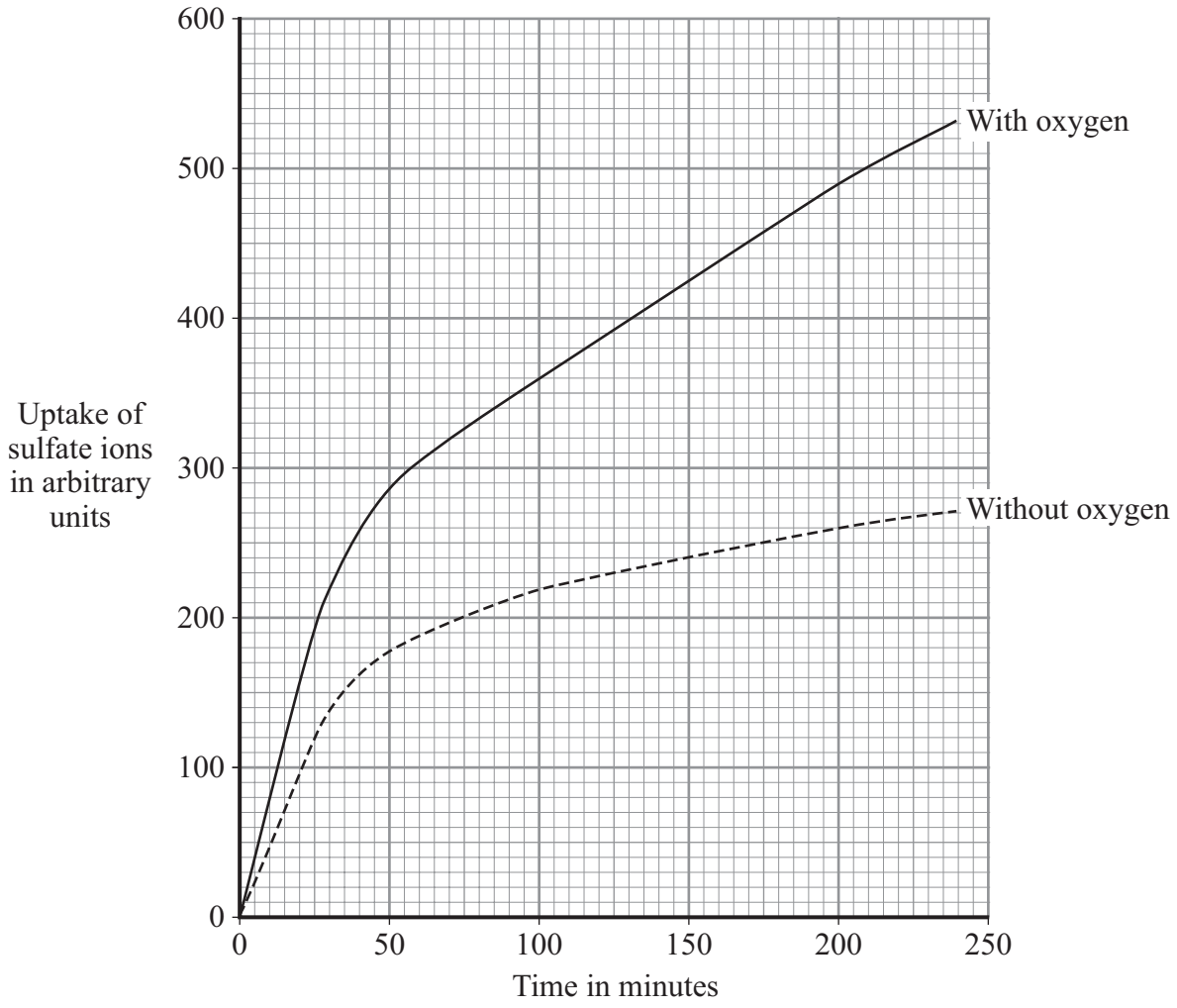
Answer ..... arbitrary units

(2 marks)

4.1.3.1 Diffusion

Question 04 · continued

for mark



5 (b) (ii) The barley roots were able to take up more sulfate ions with oxygen than without oxygen.

Explain how.

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(3 marks)

(Extra space) .....

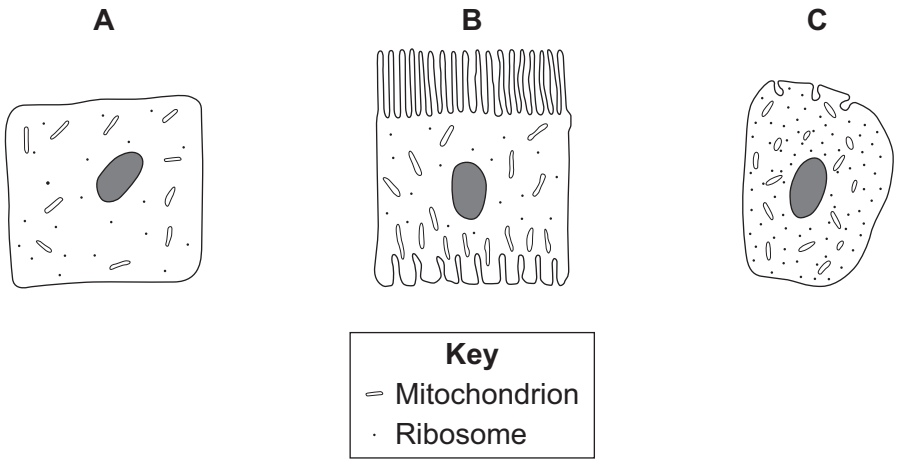
7

4.1.3.1 Diffusion

Question 05

June 2010 | BLY2H | Original Q4 | Legacy

4 Diagrams **A**, **B** and **C** show cells from different parts of the human body, all drawn to the same scale.



4 (a) Which cell, **A**, **B** or **C**, appears to have adaptations to increase diffusion into or out of the cell? ☐

Give **one** reason for your choice.

.....

.....

(1 mark)

4 (b) (i) Cell **C** is found in the pancreas.

Name **one** useful substance produced by the pancreas.

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(1 mark)

4 (b) (ii) Use information from the diagram to explain how cell **C** is adapted for producing this substance.

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(2 marks)

4

4.1.3.1 Diffusion

Question 06

June 2010 | BLY3H | Original Q6 | Legacy

6 Diffusion and active transport take place in healthy kidneys.

6 (a) Explain what is meant by:

6 (a) (i) diffusion.....

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(2 marks)

6 (a) (ii) active transport .....

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(2 marks)

6 (b) Describe, as fully as you can, how urine is produced by the kidneys.

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(5 marks)

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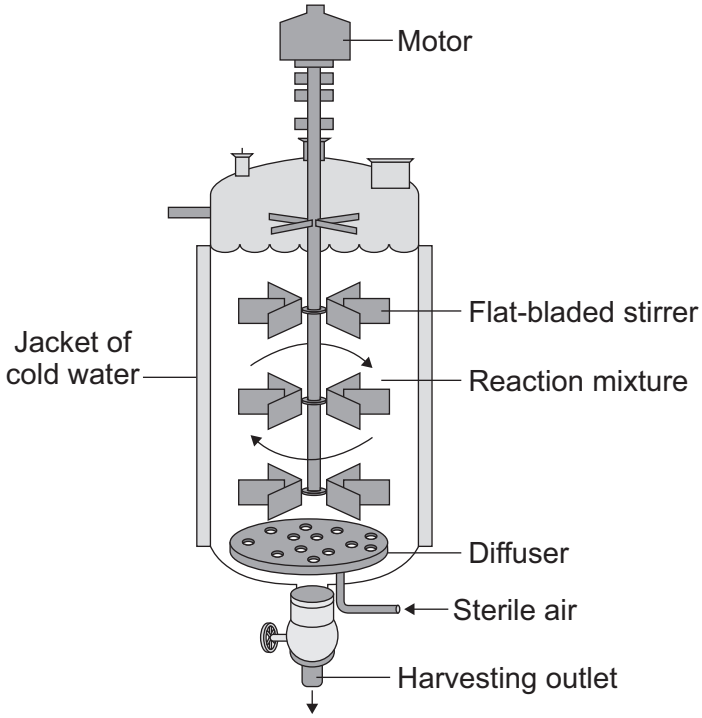
4.1.3.1 Diffusion

Question 07

January 2011 | BLY3H | Original Q6 | Legacy

6 The diagram shows a fermenter.
This fermenter can be used to grow a fungus which makes a protease enzyme.



6 (a) Explain, in detail, why the fermenter needs to be surrounded by a jacket of cold water.

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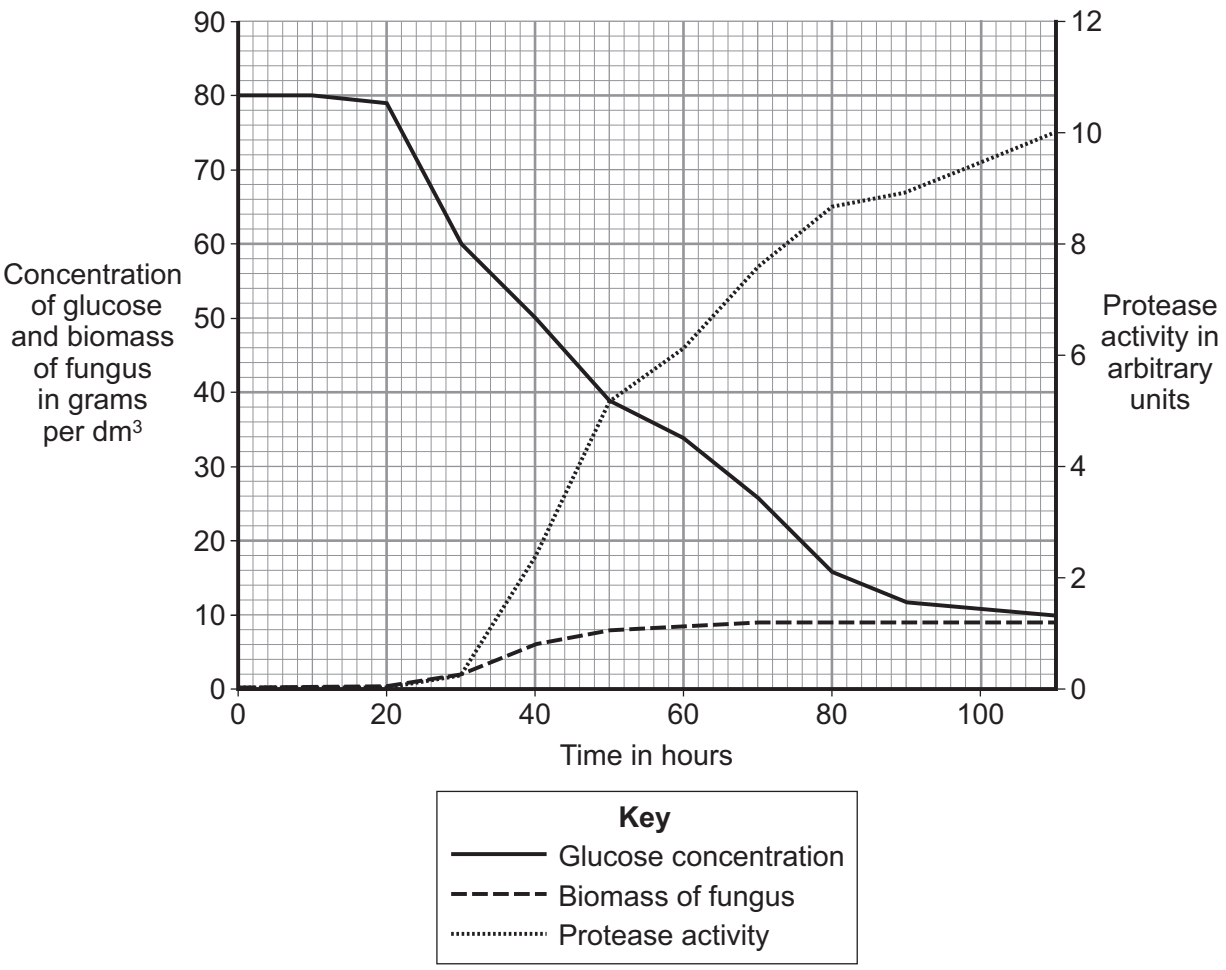
(3 marks)

Question 6 continues on the next page

4.1.3.1 Diffusion

Question 07 · continued

6 (b) Scientists investigated the effect of glucose concentration on the growth of the fungus and on the production of the protease enzyme.
The graph shows the results when the glucose concentration in the fermenter at the start was 80 grams per dm^3.



There was no measurable amount of protease activity in the reaction mixture until after 20 hours.

Suggest an explanation for this.

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4.1.3.1 Diffusion

Question 07 · continued

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(4 marks)

6 (c) The scientists repeated the investigation using 40 grams of glucose per dm^3 and using 60 grams of glucose per dm^3.

The table shows all of their results.

Concentration of glucose in grams per dm^3	Yield of fungus biomass in grams per gram of glucose consumed	Protease activity in arbitrary units per gram of glucose consumed	Protease activity in arbitrary units per gram of fungus biomass produced
40	0.09	0.83	8.93
60	0.11	0.22	1.92
80	0.13	0.14	1.11

The scientists plan to set up the fermenter for commercial production of the protease enzyme.

Which concentration of glucose should they use in the fermenter?

..... grams per dm^3

Explain, in detail, why you chose this concentration.

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(2 marks)

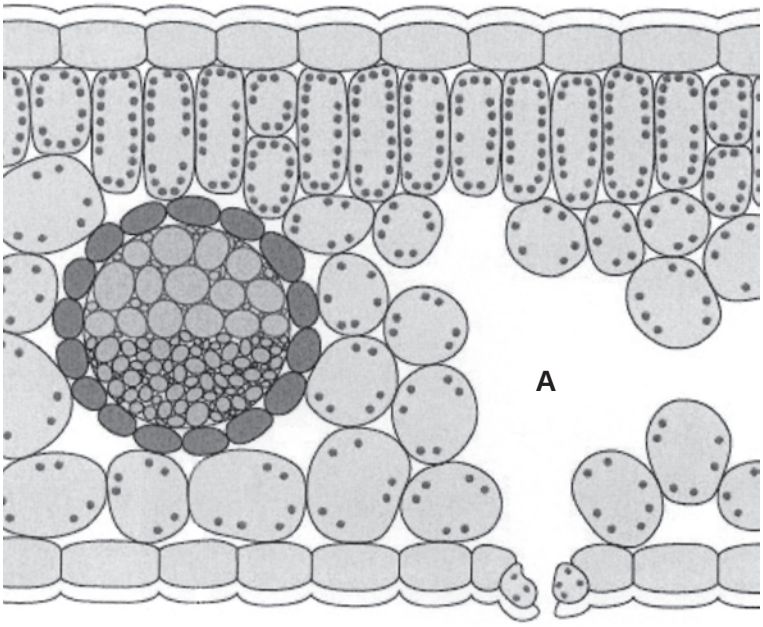
9

4.1.3.1 Diffusion

Question 08

June 2013 | BL2HP | Original Q1 | Legacy

1 The diagram shows a section through a plant leaf.



1 (a) Use words from the box to name **two** tissues in the leaf that transport substances around the plant.

epidermis	**mesophyll**	**phloem**	**xylem**

..... and .....

(1 mark)

1 (b) Gases *diffuse* between the leaf and the surrounding air.

1 (b) (i) What is *diffusion*?

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.....

(2 marks)

1 (b) (ii) Name **one** gas that will diffuse from point **A** to point **B** on the diagram on a sunny day.

.....

(1 mark)

4

4.1.3.1 Diffusion

Question 09

June 2014 | BL2HP | Original Q2 | Legacy

2 **In this question you will be assessed on using good English, organising information clearly and using specialist terms where appropriate.**

Diffusion is an important process in animals and plants.

The movement of many substances into and out of cells occurs by diffusion.

Describe why diffusion is important to animals and plants.

In your answer you should refer to:

- animals
- plants
- examples of the diffusion of named substances.

[6 marks]

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Extra space .....

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6

4.1.3.1 Diffusion

Question 10

June 2017 | BL2HP | Original Q1 | Legacy

1 There are many different types of cell in the human body.

1 (a) (i) Describe where epithelial cells are found in the human body.

[1 mark]

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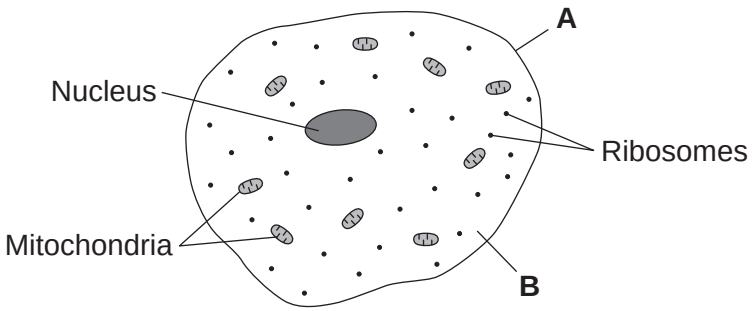
_____

1 (a) (ii) **Figure 1** shows an epithelial cell.

Figure 1



Name part **A** and part **B**.

[2 marks]

A _____

B _____

1 (b) What is the function of ribosomes?

[1 mark]

Tick (✓) **one** box.

Aerobic respiration ☐

Digestion ☐

Photosynthesis ☐

Protein synthesis ☐

4.1.3.1 Diffusion

Question 10 · continued

1 (c) Carbon dioxide moves out of an epithelial cell by diffusion.

[2 marks]

What is diffusion?

_____

_____

_____

_____

6

Turn over for the next question

4.1.3.1 Diffusion

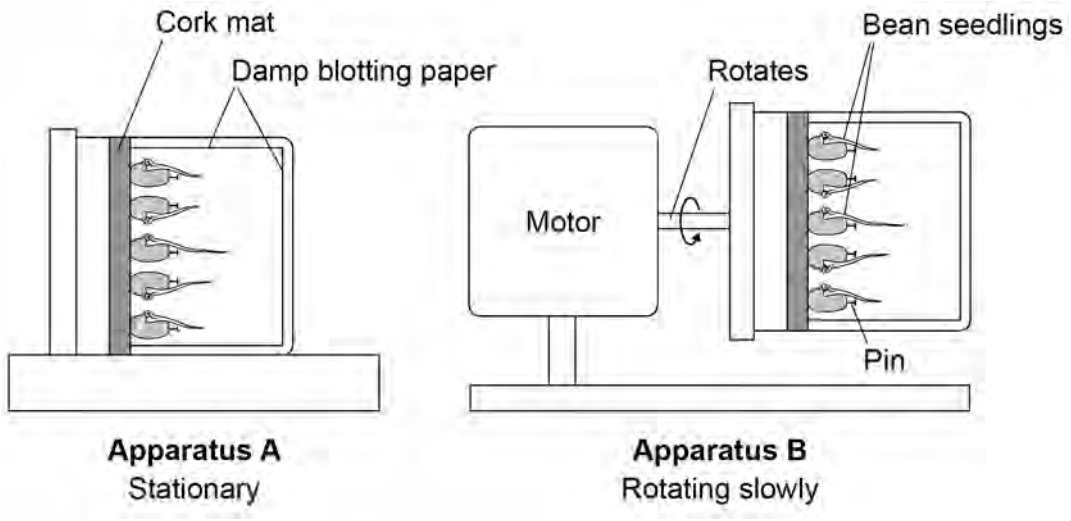
Question 11

June 2018 | 8461/2H | Original Q6

0 6 Some students investigated geotropism in the roots of bean seedlings.

Figure 6 shows the apparatus used.

Figure 6



This is the method used.

1. Measure the length of the root of each of 10 bean seedlings.
2. Pin 5 seedlings to the cork mat in apparatus **A**.
3. Pin 5 seedlings to the cork mat in apparatus **B**.
4. Leave **A** and **B** in a dark cupboard for 2 days.
5. After the 2 days:
   - make a drawing to show the appearance of each seedling
   - measure the length of the root of each seedling.

0 6 . 1 Why did the students surround the seedlings with damp blotting paper?

[1 mark]

Tick **one** box.

- To prevent light affecting the direction of root growth ☐
- To prevent photosynthesis taking place in the roots ☐
- To prevent the growth of mould on the roots ☐
- To prevent water affecting the direction of root growth ☐

4.1.3.1 Diffusion

Question 11 · continued

Apparatus **B** is a control.

Apparatus **B** rotates slowly.

0 6 . 2 How does apparatus **B** act as a control?

[1 mark]

Table 4 shows the students' results.

Table 4

	Apparatus A					Apparatus B				
Seedling number	**1**	**2**	**3**	**4**	**5**	**1**	**2**	**3**	**4**	**5**
Length at start in mm	35	41	32	33	39	30	33	29	28	31
Length after 2 days in mm	49	57	43	45	54	45	45	44	29	44
Length change in mm	14	16	11	12	15	15	12	15	1	13
Mean length change in mm	14					11				

0 6 . 3 One student stated:

'The mean length change for the seedlings in apparatus **B** is **not** valid.'

Suggest the reason for the student's statement.

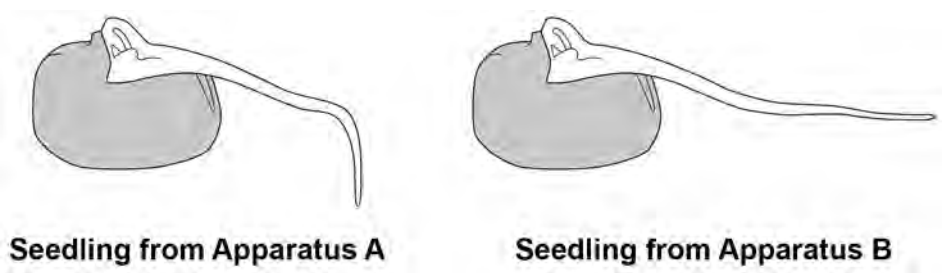
[1 mark]

0 6 . 4 Suggest **one** improvement the students could make to obtain a more valid mean length change for the seedlings in apparatus **B**.

[1 mark]

0 6 . 5 **Figure 7** shows the students' drawings of two seedlings at the end of the 2 days.

Figure 7



A plant hormone is made in the root tip.

The hormone diffuses from the tip into the tissues of the root.

Explain how the hormone causes the appearance of the seedlings in **Figure 7** to be different.

You should refer to **both** seedlings in your answer.

[3 marks]

4.1.3.1 Diffusion

Question 11 · continued

0 6 . 6 In horticulture plant hormones are used for controlling plant growth.

Draw **one** line from each plant hormone to the correct use of that hormone.

[3 marks]

Plant hormone	Use of hormone
	To reduce the time taken for tomatoes to ripen
Auxin	To slow down the growth of plant stems
Ethene	To promote seed germination
Gibberellin	To stimulate root growth in plant cuttings

10

4.1.3.1 Diffusion

Question 12

June 2019 | 8461/1H | Original Q6

0 6 People with diabetes have difficulty controlling their blood glucose concentration.

0 6 . 1 Which part of the blood transports glucose?

[1 mark]

Tick (✓) **one** box.

- Lymphocytes ☐
- Plasma ☐
- Platelets ☐
- Red blood cells ☐

Glucose is often found in the urine of people with diabetes.

0 6 . 2 Name a chemical used to test for glucose.

[1 mark]

_____

0 6 . 3 Describe a test that could be used to show that a person's urine contains glucose.

[2 marks]

Test _____

_____

Positive result _____

_____

4.1.3.1 Diffusion

Question 12 · continued

0 6 . 4 The body cells of a person with untreated diabetes lose more water than the body cells of a person who does **not** have diabetes.

Explain how diabetes can cause the body cells to lose more water.

[3 marks]

0 6 . 5 Glucose is absorbed into the blood in the small intestine by both diffusion and active transport.

Describe how the small intestine is adapted for efficient absorption.

[5 marks]

12

4.1.3.1 Diffusion

Question 13

November 2020 | 8461/1H | Original Q2

0 2 Diffusion is an important process in animals and plants.

0 2 . 1 What is meant by the term diffusion?

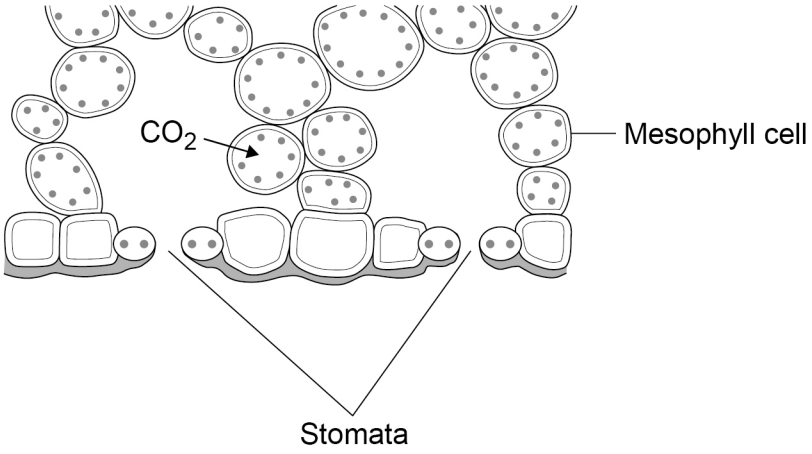
[2 marks]

4.1.3.1 Diffusion

Question 13 · continued

0 2 . 2 **Figure 2** shows part of a leaf.

Figure 2



Molecules of carbon dioxide diffuse from the air into the mesophyll cells.

Which **two** changes will increase the rate at which carbon dioxide diffuses into the mesophyll cells?

[2 marks]

Tick (✓) **two** boxes.

- Decreased number of chloroplasts in the cells ☐
- Decreased surface area of cells in contact with the air ☐
- Increased carbon dioxide concentration in the air ☐
- Increased number of stomata that are open ☐
- Increased oxygen concentration in the air ☐

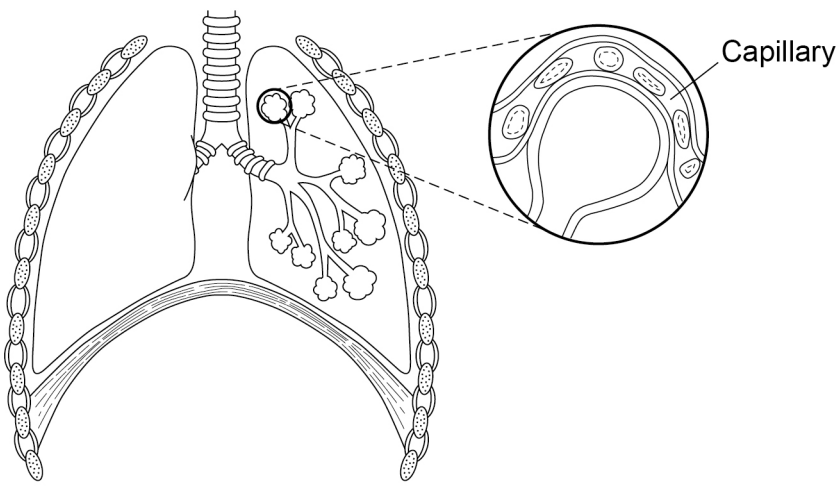
4.1.3.1 Diffusion

Question 13 · continued

0 2 . 3 Diffusion also happens in the human lungs.

Figure 3 shows the human breathing system.

Figure 3



Explain how the human lungs are adapted for efficient exchange of gases by diffusion.

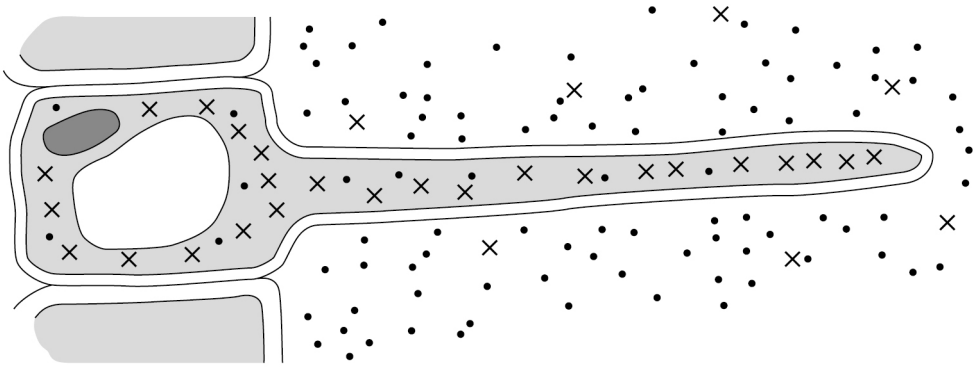
[6 marks]

4.1.3.1 Diffusion

Question 13 · continued

Figure 4 shows a root hair cell.

Figure 4



Key

Water molecules

Nitrate ions

0 2 . 4 Name the process by which water molecules enter the root hair cell.

[1 mark]

_____

0 2 . 5 Nitrate ions need a different method of transport into the root hair cell.

Explain how the nitrate ions in **Figure 4** are transported into the root hair cell.

Use information from **Figure 4** in your answer.

[3 marks]

Name of process _____

Explanation _____

_____

_____

_____

_____

14

4.1.3.1 Diffusion

Question 14

June 2022 | 8461/1H | Original Q6

0 6 **Table 6** shows information about five different organisms.

Table 6

Organism	Surface area in m^2	Volume in m^3	Surface area to volume ratio
A	6.04×10^{-8}	1.65×10^{-12}	36606:1
B	3.21×10^{-3}	1.25×10^{-6}	2568:1
C	9.96×10^{-3}	1.35×10^{-4}	**X**:1
D	4.61×10^{-1}	1.57×10^{-2}	29:1
E	1.99×10^{1}	6.12×10^{0}	3:1

0 6 . 1 Calculate value **X** in **Table 6**.

Give your answer to the nearest whole number.

[3 marks]

X (nearest whole number) = _____

0 6 . 2 What is the relationship between the size of an organism and its surface area to volume ratio?

Use **Table 6**.

[1 mark]

4.1.3.1 Diffusion

Question 14 · continued

0 6 . 3 Organism **B** exchanges gases with the environment directly through its skin.

Organism **D** exchanges gases with the environment using its respiratory system.

Explain why organism **D** requires a respiratory system, but organism **B** does **not** require a respiratory system.

[2 marks]

Question 6 continues on the next page

4.1.3.1 Diffusion

Question 14 · continued

Table 6 is repeated below.

Table 6

Organism	Surface area in m^2	Volume in m^3	Surface area to volume ratio
A	6.04×10^{-8}	1.65×10^{-12}	36606:1
B	3.21×10^{-3}	1.25×10^{-6}	2568:1
C	9.96×10^{-3}	1.35×10^{-4}	**X**:1
D	4.61×10^{-1}	1.57×10^{-2}	29:1
E	1.99×10^{1}	6.12×10^{0}	3:1

Table 7 shows information about organism **D** and organism **E**.

Table 7

Organism	Metabolic rate in arbitrary units
D	890
E	75

4.1.3.1 Diffusion

Question 14 · continued

0 6 . 4 Organisms **D** and **E** both keep a constant body temperature (warm-blooded).

Explain why the metabolic rate of organism **D** is greater than the metabolic rate of organism **E**.

Use information from **Table 6** and **Table 7**.

[4 marks]

Question 6 continues on the next page

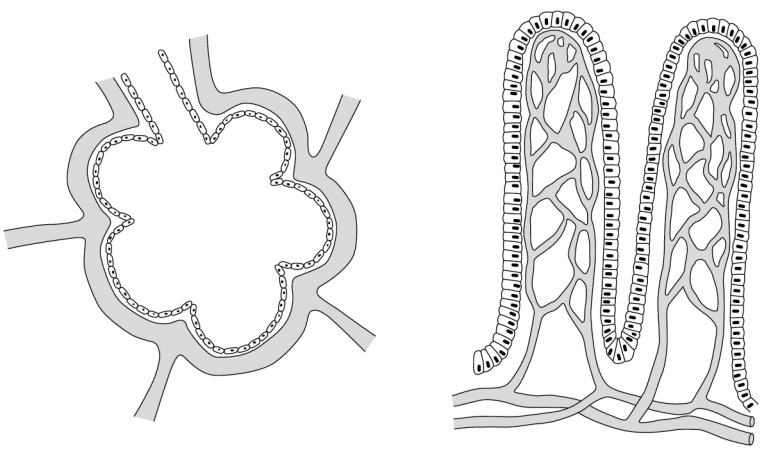
4.1.3.1 Diffusion

Question 14 · continued

0 6 . 5 Organism **D** and organism **E** both have alveoli in the lungs and villi in the small intestine.

Figure 8 shows some alveoli and some villi.

Figure 8



Alveoli **Villi**

Describe how the alveoli and the villi are adapted to increase absorption.

[4 marks]

14

4.1.3.1 Diffusion

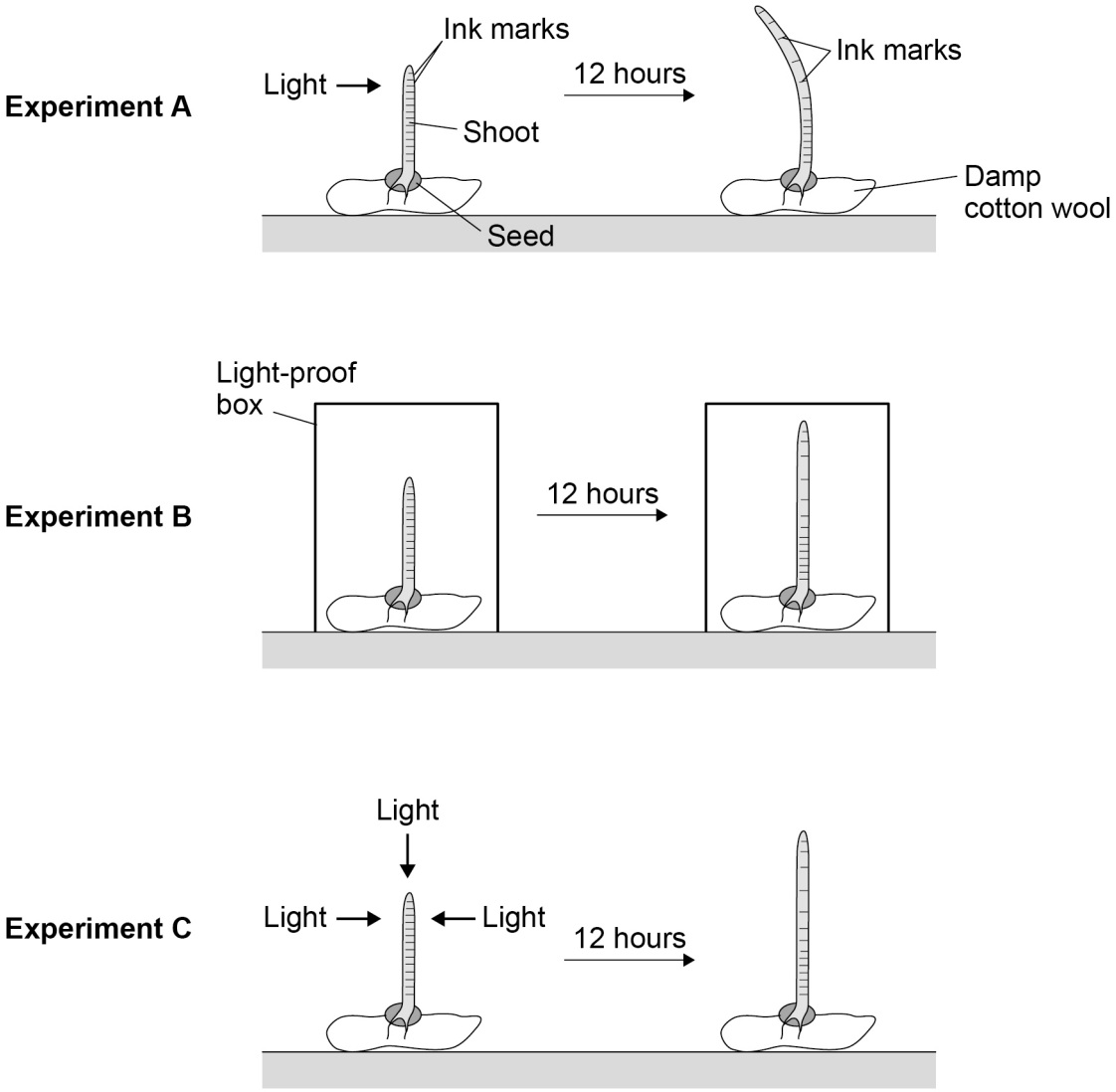
Question 15

June 2022 | 8461/2H | Original Q9

0 9 Students investigated the response of plant shoots to one-sided light.

Figure 13 shows how the students set up three experiments.

Figure 13



4.1.3.1 Diffusion

Question 15 · continued

0 9 . 1 Suggest **two** control variables the students should have used in their investigation.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 2 Describe how experiment **B** and experiment **C** acted as controls for the investigation.

[2 marks]

Experiment **B** _____

_____

Experiment **C** _____

_____

0 9 . 3 Give **two** conclusions that the students could make from the **ink marks** on the shoot in experiment **A**.

[2 marks]

1 _____

_____

2 _____

_____

0 9 . 4 Name the type of response shown by the seedling in experiment **A**.

[1 mark]

_____

Question 9 continues on the next page

4.1.3.1 Diffusion

Question 15 · continued

Auxin is a plant hormone. Auxin is made in the shoot tip.

Scientists investigated the role of auxin in the response of shoot tips to light.

This is the method used.

1. Grow four seedlings in the dark for a few days.

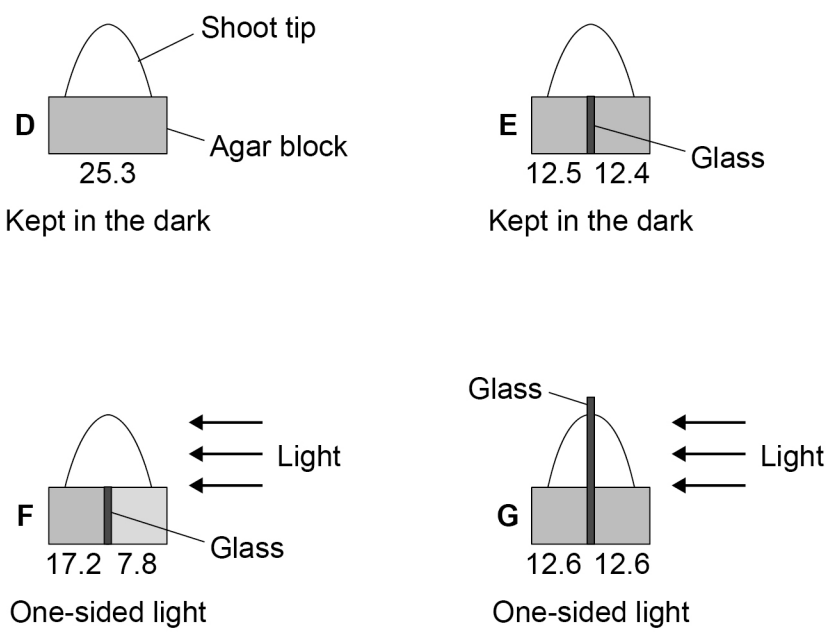
2. Cut the tip off the shoot of each seedling.

3. Place each shoot tip on a small block of agar jelly.

4. Place the shoot tips and agar in different conditions as shown in **Figure 14**.

5. After 24 hours, measure the mass of auxin in the agar blocks.

Figure 14



The numbers under each block show the mass of auxin that diffused into the blocks from the shoot tips.

The mass of auxin is given in arbitrary units.

4.1.3.1 Diffusion

Question 15 · continued

0 9 . 5 A scientist made a hypothesis:

'Light causes auxin to move from the side of the shoot nearest to the light to the side furthest from the light.'

Describe the evidence from **Figure 14** which supports the hypothesis.

[3 marks]

0 9 . 6 Another scientist made a different hypothesis:

'Light causes the breakdown of auxin.'

Give the evidence from **Figure 14** that shows that auxin is **not** broken down by light.

[1 mark]

11

4.1.3.1 Diffusion

Question 16

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0 6 Diffusion is important for gas exchange.

0 6 . 1 Define the term ‘diffusion’.

[1 mark]

Question 6 continues on the next page

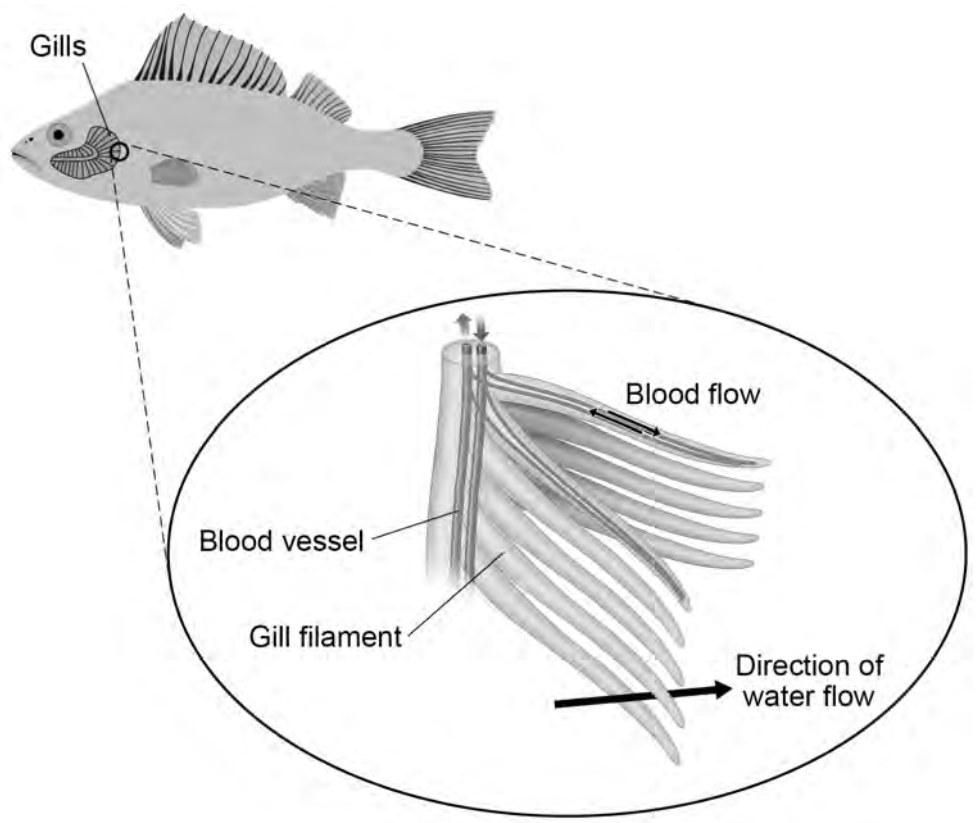
Question 16 · continued

0 6 . 2 Fish exchange gases through gills.

Oxygen from the water enters the blood of a fish through the gills.

Figure 8 shows part of a gill.

Figure 8



Explain how gills are adapted to maximise the exchange of oxygen between the water and the blood.

[4 marks]

4.1.3.1 Diffusion

Question 16 · continued

0 6 . 3 Some fish rest on the sea floor.

Explain why the metabolic rate of a fish is higher when swimming compared with when resting.

[4 marks]

9