

Transport across the membrane

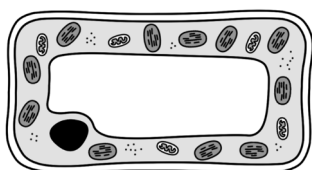
Mark Scheme



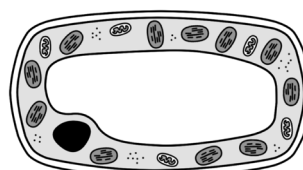
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1. Cell transport is essential for life. Answer each of the following multiple-choice questions relating to cell transport processes.

a) The figure below shows how a plant cell appears under a light microscope at the beginning of a practical and how it appears after it has been placed in a dilute solution of glucose for 10 minutes.



Beginning of the practical



End of the practical

Which of the following statements accurately describes the process?

C – is the only correct answer.	1 mark
	Total: 1 mark

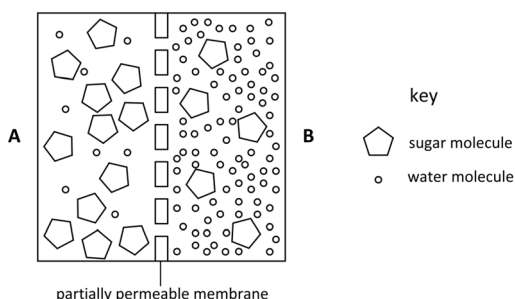
b) Which process in humans does not use energy released from respiration?

A – is the only correct answer.	1 mark
	Total: 1 mark

c) How do carbon dioxide and oxygen move in and out of a mesophyll cell?

B – is the only correct answer.	1 mark
	Total: 1 mark

d) The figure below shows sugar molecules and water on either side of a partially permeable membrane.

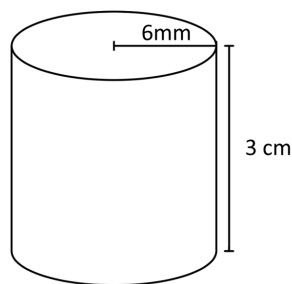


What happens during osmosis? Circle the letter of the correct answer.

D – is the only correct answer.	1 mark
	Total: 1 mark

(Total for Question 1 is 4 marks)

2. A student conducted a practical to investigate the movement of water in potatoes.
The student cut five identical cylinders of potato. The figure below shows one of those cores.



- a) Calculate the volume of this cylinder of potato.
Give your answer to three significant figures.

Volume = $\pi \times r^2 \times h$	Volume = $\pi \times 6^2 \times 30$	Volume = 3392.92 mm ³	3 marks
To 3 significant figures is 3390 mm ³			
			Total: 3 marks

One cylinder was placed in water and each of the other two cylinder were placed in solutions with different concentrations of salt. The cylinders were left for 30 minutes.

- b) State **one** thing the student could do to ensure the measurement of the mass of the cylinder is accurate.

Gently blot the potato cores dry (before measuring mass) or zero the balance (before use).	1 mark
	Total: 1 mark

- c) Calculate the percentage change in mass for the potato core in the concentrated salt solution.
Give your answer to three significant figures.

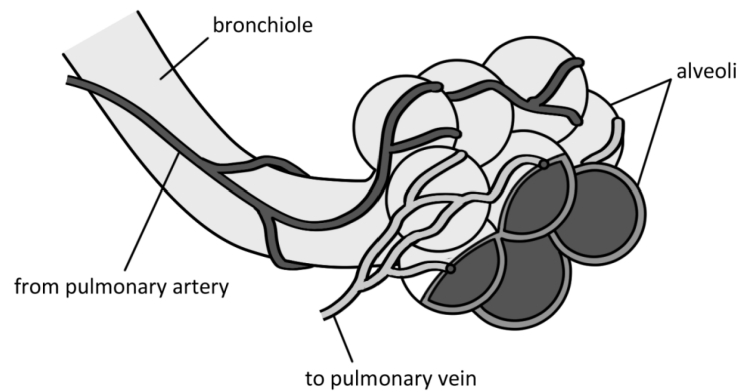
Difference = 1.42 – 1.32	
Difference = 0.10	1 mark
Percentage change = $(0.10 \div 1.42) \times 100$	1 mark
Percentage change = 7.04 to 3 significant figures.	1 mark
	Total: 3 marks

- d) Explain the change in mass for the cylinder core that was in the concentrated salt solution.

An explanation to include the following:	
As the solution was more concentrated than the cell contents.	1 mark
Water moved from the cell to the solution.	1 mark
By osmosis.	1 mark
	Total: 3 marks

(Total for Question 2 is 10 marks)

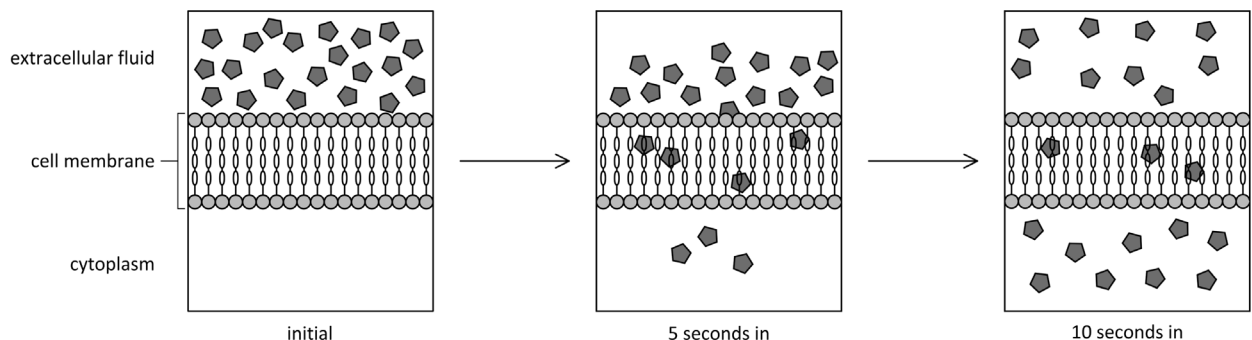
3. The figure below shows some of the alveoli present in a human lung.



a) Explain how alveoli are adapted for gas exchange.

An explanation to include any three of the following:	
Large surface area – a larger surface area through which diffusion can happen increases the diffusion rate	1 mark
Thin walls – diffusion occurs faster when a layer is one cell thick compared to a layer that is three cells thick	1 mark
Capillaries – maintain the concentration gradient for diffusion to occur.	1 mark
Large number – having millions of alveoli increases the surface area for gas exchange.	1 mark
	Total: 3 marks

The figure below shows the movement of molecules across a membrane.



b) Using the figure, describe the molecular movement across the membrane.

A description to include the following:	
Molecules move from a region of high concentration to an area of lower concentration.	1 mark
Through the cell membrane via <u>diffusion</u> .	1 mark
	Total: 2 marks

c) What is active transport?

A description to include the following:	
Active transport is the movement of a substance	1 mark
From an area of low concentration to an area of higher concentration	1 mark
Moving against the concentration gradient.	1 mark
Accept using energy instead of a reference to the concentration gradient.	
	Total: 3 marks

- d) Explain, using Fick's law, the factors that affect the rate of diffusion of molecules into and out of cells.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Provides a basic statement about diffusion. Identifies one factor that affects the rate of diffusion. Limited or no connection to Fick's Law.
Level 2	3 - 4	Provides a reasonable explanation of Fick's Law and identifies some of its components. Describes the effect of at least two components of Fick's Law on the rate of diffusion. Some attempt to relate the concepts to cells.
Level 3	5 - 6	Provides a detailed and coherent explanation of Fick's Law and its components (surface area, concentration gradient, diffusion distance). Accurately links each component of Fick's Law to its effect on the rate of diffusion. Provides relevant examples related to cells.

Indicative content (possible points that could be included, but full marks can be achieved without all of them)	
Statement of Fick's Law: Rate of diffusion is proportional to (surface area $\times$ concentration difference) / diffusion distance OR rate of diffusion $\propto$ (surface area $\times$ concentration gradient) / thickness of membrane. Surface Area: A larger surface area increases the rate of diffusion, as there is more area available for molecules to cross the membrane. For example: microvilli in the small intestine increase the surface area for absorption. Concentration Gradient/Difference: A steeper concentration gradient (larger difference in concentration) increases the rate of diffusion. Diffusion Distance/Membrane Thickness: A shorter diffusion distance (or thinner membrane) increases the rate of diffusion, as molecules have less distance to travel. For example the thin walls of alveoli in the lungs. Explanation of each factor: Clear explanation of <u>why</u> each factor increases or decreases diffusion, with reference to the movement of particles from high to low concentration. Relating to Cells: Mentioning how these factors are important for cells to gain nutrients, remove waste, or exchange gases. For example root hair cells. Mentioning diffusion across a membrane: Mentioning the diffusion is across a cell membrane.	
	Total: 6 marks

(Total for Question 3 is 14 marks)

4. Water can move into and out of plant cells by osmosis.

a) Describe the process of osmosis.

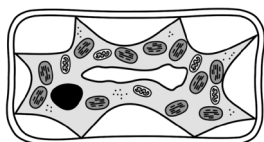
A description to include the following:	
Osmosis is the movement of water	1 mark
From an area of higher water concentration to an area of lower water concentration	1 mark
Moving through a partially permeable membrane.	1 mark
	Total: 3 marks

b) Which diagram shows the changes in appearance of a plant cell when it remains in a concentrated sugar solution for thirty minutes? Circle the letter of the correct answer.

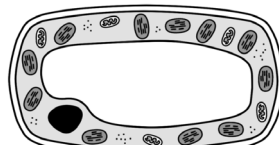
D – is the only correct answer.	1 mark
	Total: 1 mark

The figure below shows plant cells. One cell has too little water in the cell, one cell has the normal amount of water within in and one cell has too much water in the cell.

c) Provide the term used to describe each cell in the figure below.



Plasmolysed



Turgid



Flaccid

1 mark for each correct label as shown above.	
	Total: 3 marks

d) Red blood cells will burst when too much water moves into them.

Explain why plant cells will not burst when water moves into the cells.

An explanation to include the following:	
Cell wall: plant cells have a cell wall made of cellulose this cell wall provides structural support and strength to the cell preventing it from bursting.	1 mark
Contrast with red blood cells: red blood cells don't have a cell wall. When water enters a red blood cell, there is nothing to stop cell membrane expanding. The cell membrane stretches, and eventually, it reaches a point where the cell bursts (lyse).	1 mark
	Total: 2 marks

(Total for Question 4 is 9 marks)

5. Explain how active transport and diffusion provide a plant with named substances it needs for growth.

Marking guidance		
Level	Marks	Descriptor
Level 1	1 - 2	Provides a basic definition of active transport or diffusion. Mentions one substance that plants need. Limited or no connection to plant growth.
Level 2	3 - 4	Provides a reasonable explanation of active transport and diffusion. Mentions specific substances absorbed by each process, although the link may not be consistently accurate. Describes how these processes are important for plant growth.
Level 3	5 - 6	Provides a detailed and coherent explanation of both active transport and diffusion. Accurately links specific substances to the process by which they are absorbed (e.g., nitrates by active transport). Clearly explains why each process is necessary for plant growth and survival.

A description to include the following:	
Definition of diffusion: movement of substances from an area of high concentration to an area of low concentration, down a concentration gradient. Example of Diffusion in Plants: carbon dioxide enters leaves through stomata by diffusion for photosynthesis. Oxygen exits leaves through stomata by diffusion (a waste product of photosynthesis). Water uptake by root hair cells by osmosis is a form of diffusion. Definition of Active Transport: movement of substances from an area of low concentration to an area of high concentration, against a concentration gradient. Requires energy from respiration. Example of Active Transport in Plants: plants take up mineral ions for example, nitrates, phosphates, potassium, from the soil by active transport. These mineral ions are often at a lower concentration in the soil than in the root hair cells. Importance of Mineral Ions (Nitrates): <u>Nitrates are needed for making amino acids</u>, which are used to make proteins for growth and repair. Magnesium ions are needed for chlorophyll production for photosynthesis Importance of Photosynthesis: photosynthesis provides glucose which is the plant's source of energy to grow. Importance of Respiration: active transport needs energy from respiration. Roots and root hair cells: mention of root hair cells increasing the surface area for absorption of mineral ions and water.	
	Total: 6 marks

(Total for Question 5 is 6 marks)

6. The figure below shows a section of a cell membrane of an animal cell.

a) Identify the type of transport shown in the figure above.

Active transport.	1 mark
	Total: 1 mark

b) Describe how this type of transport works and why it requires energy.

A description to include the following:	
A detailed description of active transport: active transport is the movement of a substance	1 mark
from an area of <u>low concentration to an area of higher concentration</u> moving <u>against the concentration gradient</u> .	2 marks
Carrier proteins: are the proteins that move the substances against the concentration gradient and they need the energy from respiration to do this.	1 mark
	Total: 4 marks

c) Give **one** example of where this type of transport occurs in the human body, and explain why it is essential in that location.

Re-absorption of glucose, amino acids and salts by the proximal convoluted tubule of the nephron in the kidney. Essential to prevent the loss of glucose via urine.	2 marks
Sodium/potassium pump in cell membranes (especially nerve cells). Essential to ensure that the nervous system functions	2 marks
	Total: 2 marks

(Total for Question 6 is 7 marks)