**Movement Into and Out of Cells (4.2): Cambridge (CIE) A Level Biology 9700 Exam Questions by Topic**

22 questions · 51 marks · about 61 minutes. Answer in the spaces, then check the mark schemes at the end.

**Question 1 · Paper 2 · February/March 2022 (22) · Q1(a) · 4 marks**

**1 (a)** Table 1.1 shows three of the processes by which substances in solution can move across cell membranes. It also lists five statements that may apply to each of these three processes.

Complete Table 1.1 to show which of the statements apply to each of the three processes shown.

Use a tick (✓) to show that the statement applies or a cross (✗) to show that the statement does not apply.

Each box must contain a tick or a cross.

The first row has been completed for you.

**Table 1.1**

| statement | process | | |
|---|---|---|---|
| | active transport | facilitated diffusion | simple diffusion |
| movement of oxygen into a red blood cell | ✗ | ✗ | ✓ |
| occurs in both animal and plant cells | | | |
| uses carrier proteins | | | |
| movement of non-polar molecules between the fatty acid tails of the phospholipid molecules | | | |
| movement of ions down a concentration gradient | | | |

[4]

**Question 2 · Paper 2 · February/March 2024 (22) · Q1(b)(i) · 1 mark**

**(b) (i)** Explain why sodium ions **cannot** cross phospholipid bilayers by simple diffusion.

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**Question 3 · Paper 2 · February/March 2024 (22) · Q1(b)(ii) · 3 marks**

**(ii)** Ions and some molecules move across cell surface membranes by facilitated diffusion and active transport.

Compare facilitated diffusion and active transport by stating **one** way in which they are similar and **two** ways in which facilitated diffusion is different from active transport.

similarity .....

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difference 1 .....

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difference 2 .....

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[3]


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**Question 4 · Paper 2 · February/March 2025 (22) · Q1(d) · 3 marks**

**(d)** Mineral ions are taken up by root hair cells.

Table 1.1 shows the concentrations of sodium ions ($Na^+$) and potassium ions ($K^+$) inside the root hair cells of a plant root and in the soil solution surrounding the root.

**Table 1.1**

| concentration of $Na^+$ / g $dm^{-3}$ | | concentration of $K^+$ / g $dm^{-3}$ | |
|---|---|---|---|
| **root hair cell** | **soil solution** | **root hair cell** | **soil solution** |
| 0.35 | 3.34 | 5.46 | 0.16 |

With reference to Table 1.1:

- suggest the mechanisms involved in the transport of $Na^+$ and $K^+$ from the soil solution into the root hair cells
- state the reasons for your suggestions.

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**Question 5 · information from earlier in the question**

**6** The transport of water from the soil solution to the xylem of roots occurs by the apoplast and symplast pathways. Mineral ions can be transported dissolved in water.


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**(b)** Researchers investigated the mechanism of transport used for the uptake of potassium ions ($K^+$) into root epidermal cells at different concentrations of $K^+$ in the soil solution.

Complete Table 6.1 to provide information about the two different transport mechanisms that were identified by the researchers.

**Table 6.1**

| net movement of $K^+$ | membrane protein needed (yes or no) | ATP used (yes or no) | name of transport mechanism |
|---|---|---|---|
| against the concentration gradient | | | |
| down the concentration gradient | | | |

[3]


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**(c)** One role of an intestinal epithelial cell is the absorption of glucose from the gut lumen into the circulatory system. This involves different membrane transport proteins.

The events occurring in an intestinal epithelial cell during the absorption of glucose are summarised in Fig. 1.2.

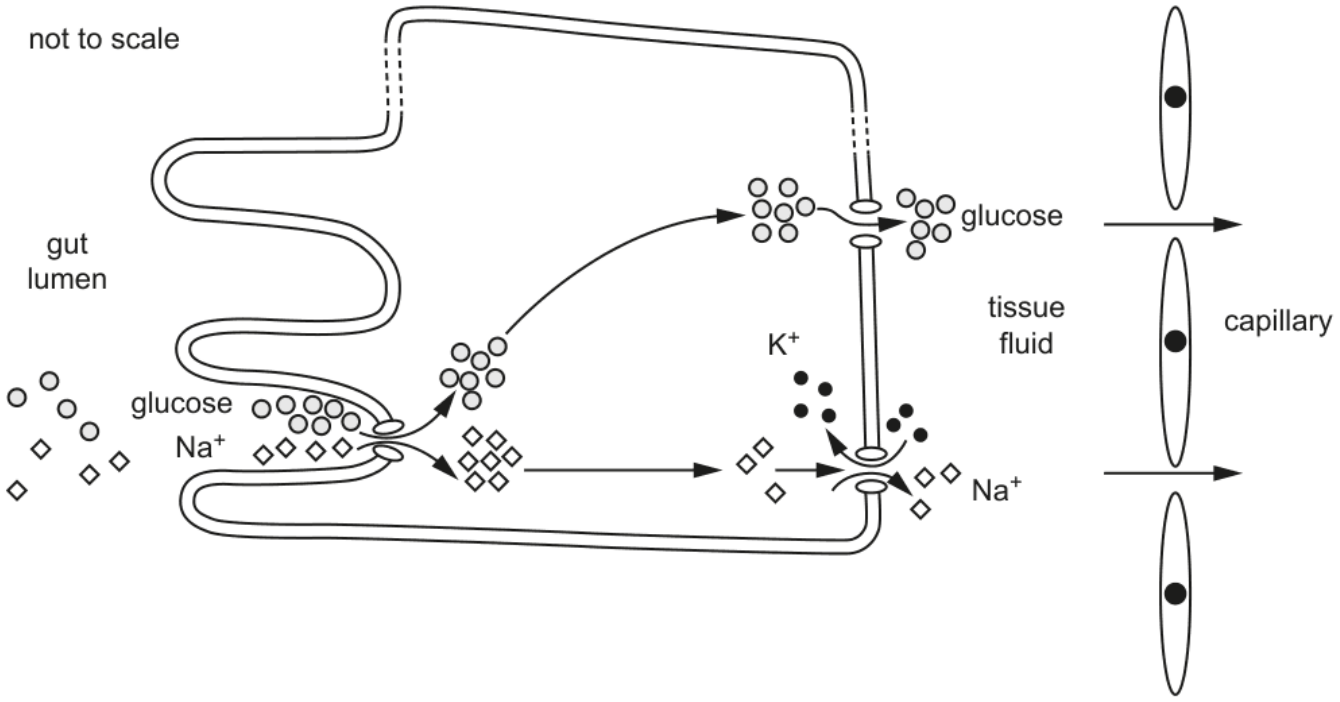



**Fig. 1.2**

- Sodium ions ($Na^+$) are removed from the cell by active transport through a transport protein known as a sodium-potassium ($Na^+/K^+$) pump.
- This decreases the concentration of $Na^+$ in the cell compared to the gut lumen.
- Glucose molecules are cotransported with $Na^+$ into the cell from the gut lumen.
- Glucose molecules are transported out of the cell into the tissue fluid down a concentration gradient.

**(i)** Active transport involves water-soluble substances, such as $Na^+$ and $K^+$, and the use of ATP to provide the energy needed for their transport through carrier proteins.

Outline **other** features of active transport.

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**Question 7 · Paper 2 · May/June 2022 (22) · Q1(c)(ii) · 2 marks**

**(ii)** Glucose molecules enter the cell through a membrane protein.

Suggest why glucose molecules need to be cotransported with $Na^+$ when it enters the cell through the membrane protein.

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**Question 8 · information from earlier in the question**

**4** In the mesophyll tissue of leaves, products of photosynthesis can be used to synthesise organic compounds, such as the polysaccharide cellulose and some amino acids.

A source of nitrogen for amino acid synthesis can be provided by nitrate ions that have been taken up in the roots and transported to the leaves.


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**(e)** The nitrate uptake of excised maize roots was investigated under different conditions.

Table 4.1 shows details and results for a control experiment and four modified experiments, **1**, **2**, **3** and **4**. The same concentration of nitrate solution was used throughout for all the experiments. All the results were taken after a set time period.

**Table 4.1**

| experiment | temperature / °C | aeration | additional substances present in nitrate solution | nitrate uptake / μmol $g^{-1}$ (fresh mass) |
|---|---|---|---|---|
| **1** | 30 | no | nitrogen gas bubbled through instead of oxygen | 0.4 |
| **2** | 3 | yes | none | 0.6 |
| **3** | 30 | yes | protein synthesis inhibitor | 1.4 |
| **4** | 30 | yes | antibacterial compound | 10.0 |
| control | 30 | yes | none | 10.9 |

The results for experiments **1**, **2**, **3** and **4** in Table 4.1 can be compared to the results for the control experiment.

Discuss how comparing each of the results with the control provides information about:

- how nitrate ions are taken up by the root cells
- the factors affecting the uptake of nitrate ions.

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**Question 9 · information from earlier in the question**

**4** The alveoli of the lungs are the main gas exchange surface in humans.

**Question 9 · Paper 2 · October/November 2023 (22) · Q4(c) · 3 marks**

**(c)** Some cells in the alveolar wall are specialised to secrete surfactant to prevent collapse of the alveoli at the end of exhalation. In these cells, surfactant is stored in membrane-bound organelles known as lamellar bodies. Surfactant is a mixture of lipids, mainly phospholipids, and some proteins.

A protein known as ATP-binding cassette transporter A3 (ABCA3) is needed to move surfactant phospholipids into lamellar bodies from the surrounding cytosol (fluid part of cytoplasm).

Suggest **and** explain the features of protein ABCA3 that make it suited to its function.

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**6** **(a)** Fig. 6.1 is a diagram of part of a mitochondrion.

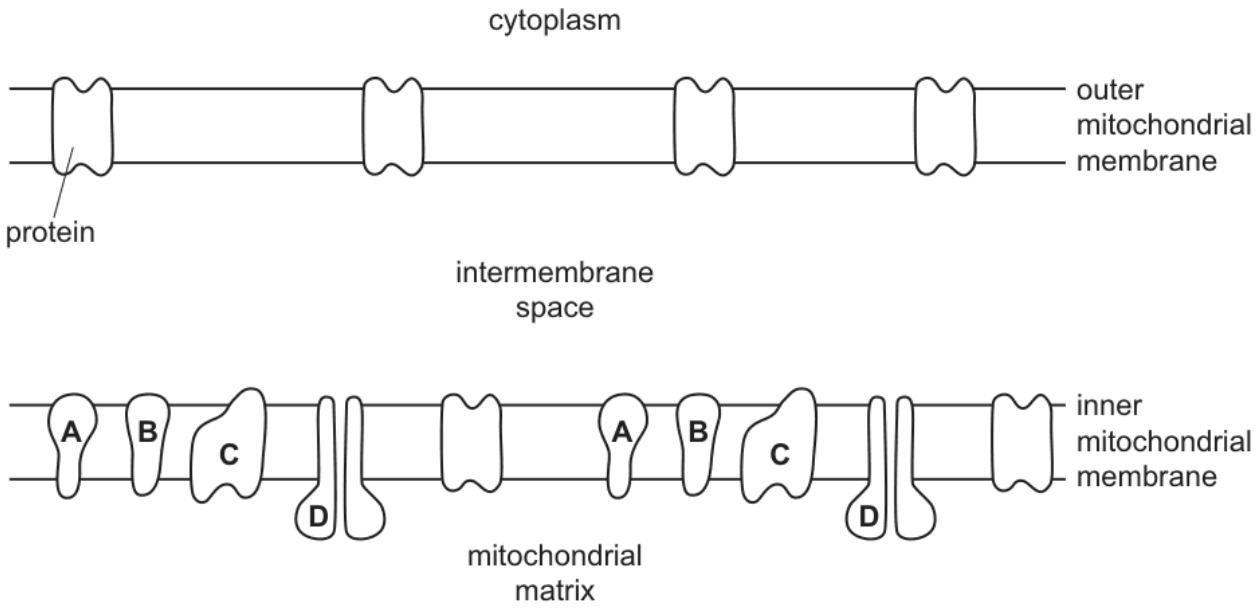



**Fig. 6.1**

On Fig. 6.1, use arrows to show the route taken by oxygen from the cytoplasm into the mitochondrial matrix. [1]


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**Question 11 · information from earlier in the question**

**(b)** In further experiments it was found that, in an intact mitochondrion:

- there is a membrane potential across the inner mitochondrial membrane, with the matrix having a negative charge
- the transport of ATP, ADP and inorganic phosphate ($P_i$) is driven by the membrane potential across the inner membrane.

Fig. 3.1 shows the location of some inner membrane carrier proteins.

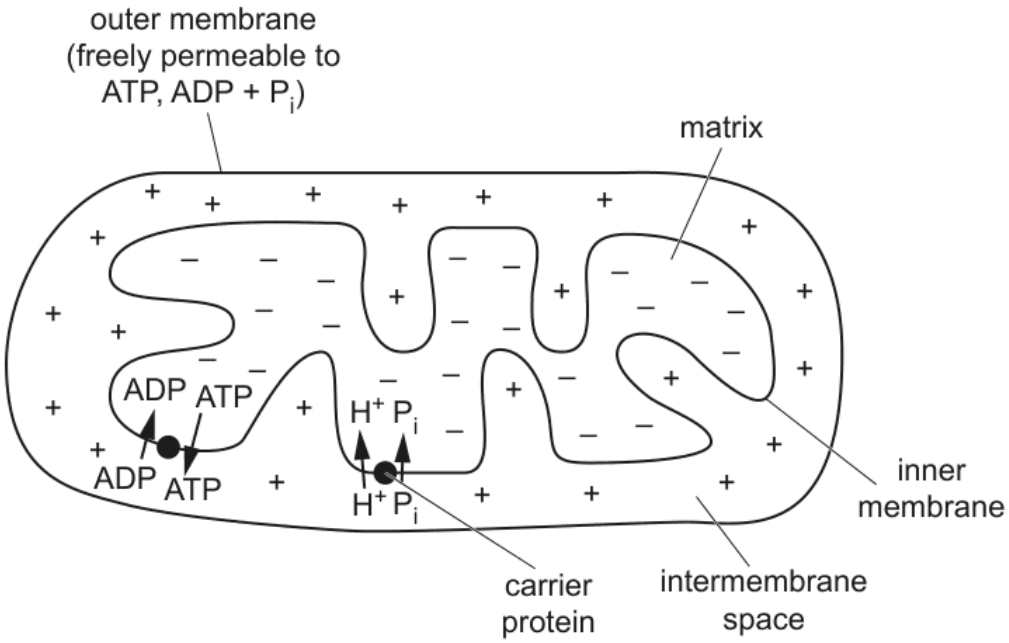



**Fig. 3.1**

**Question 11 · Paper 4 (A level) · October/November 2022 (41) · Q3(b)(ii) · 2 marks**

**(ii)** Suggest **and** explain how $P_i$ is transported across the inner membrane of the mitochondrion into the matrix.

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**Question 12 · information from earlier in the question**

**(b)** Goblet cells in the human gas exchange system produce proteins called mucins.


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**Question 12 · Paper 2 · February/March 2023 (22) · Q2(b)(ii) · 3 marks**

**(ii)** Mucin strands are transported out of the goblet cells and then absorb water to form mucus.

Suggest **and** explain how mucin strands are transported out of the goblet cells.

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**2** Phloem sap containing sucrose is transported in phloem sieve tubes from the source to the sink.

**(a)** A student carried out an experiment using Visking tubing to investigate osmosis. The student prepared a sucrose solution to represent phloem sap at the source. This was put into Visking tubing that was tied at one end, so that the tubing was approximately 75% full.

The rest of the procedure is summarised in Fig. 2.1. The tubing was removed after 20 minutes, dried and re-weighed.

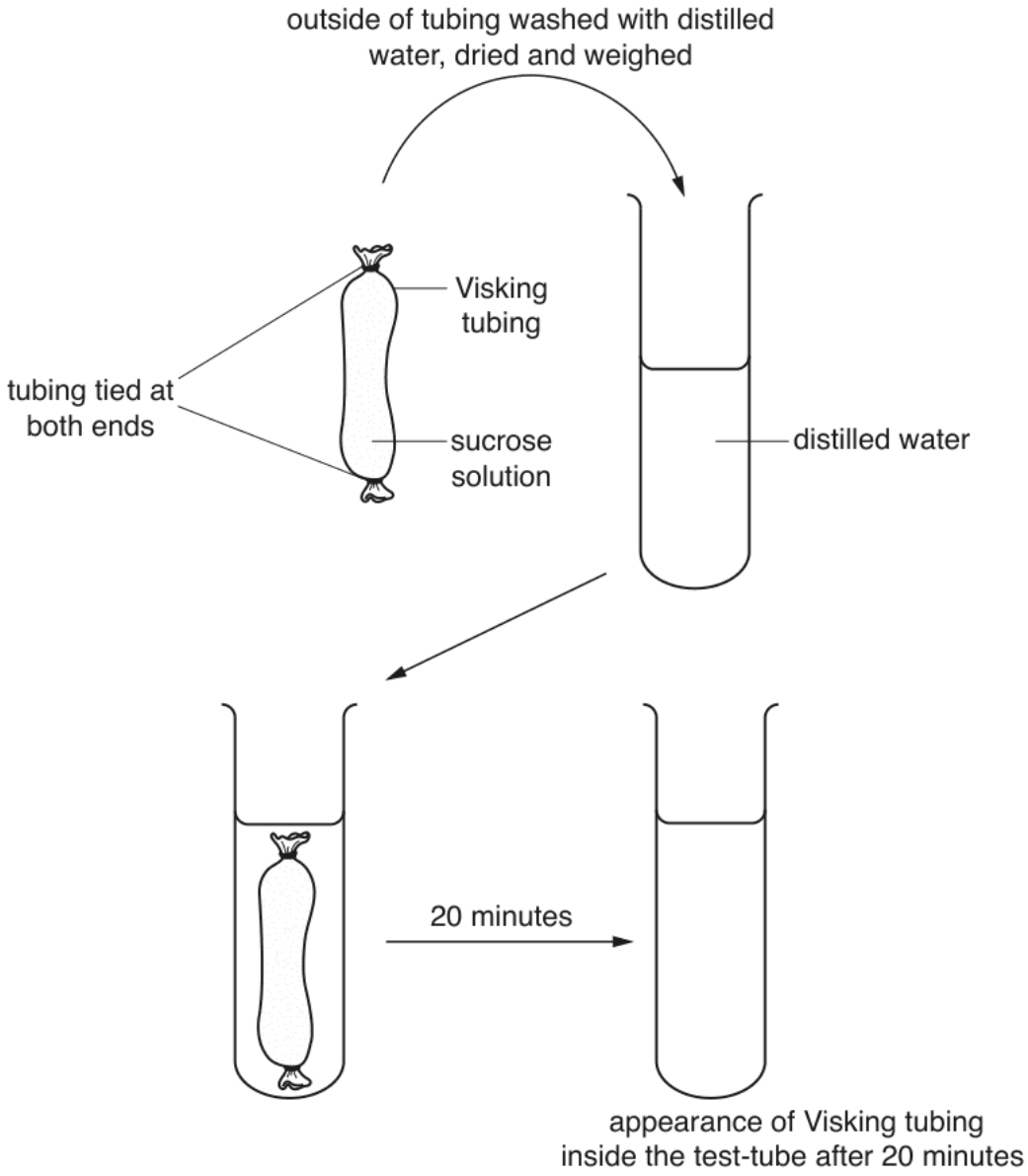



**Fig. 2.1**

**(i)** Complete Fig. 2.1 to show the appearance of the Visking tubing inside the test-tube after 20 minutes. [1]


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**Question 14 · Paper 2 · May/June 2021 (22) · Q4(b) · 2 marks**

**(b)** A student investigated the effect of SA:V on diffusion.

Agar was prepared with Universal Indicator solution and sodium hydroxide solution. The agar was coloured blue.

Three cubes, **A**, **B**, and **C**, were cut from a solid block of blue agar. Each cube was a different size.

Universal Indicator solution changes to a red colour in the presence of acid.

The student prepared Table 4.1 to show the sizes and SA:V of each cube.

**Table 4.1**

| cube | length of each side / cm | total surface area / $cm^2$ | volume / ..... | SA:V |
|---|---|---|---|---|
| **A** | 1 | 6 | 1 | 6:1 |
| **B** | 2 | 24 | 8 | 3:1 |
| **C** | 3 | | | 2:1 |

Complete Table 4.1 by:

- writing the correct units for volume
- calculating the total surface area, and volume, of cube **C**.

[2]

**Question 15 · Paper 2 · May/June 2021 (22) · Q4(c) · 1 mark**

**(c)** Cubes **A**, **B** and **C** were placed in a small beaker. At time 0 seconds, dilute hydrochloric acid was added to the beaker to cover the cubes.

The student timed how long it took for each cube to change colour completely.

Complete Fig. 4.1 to show the results that were obtained.

shortest time to change colour completely → longest time to change colour completely

cube ..... → cube ..... → cube .....

[1]


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**6** **(a)** A student investigated the effect of changing the surface area to volume ratio on diffusion.

- Two different-sized blocks of agar, **X** and **Y**, were made.
- The agar contained Universal Indicator solution.
- Universal Indicator solution changes colour when acid is added.
- The blocks were placed in dilute hydrochloric acid at the same temperature.
- The student timed how long it took for each block to change colour completely.

Blocks **X** and **Y** are shown in Fig. 6.1. All dimensions are in cm.

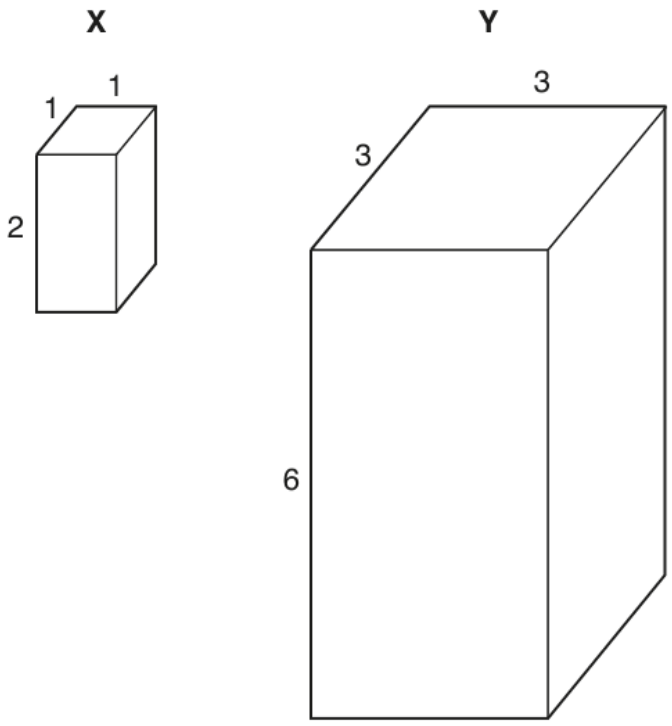



**Fig. 6.1**

**(i)** The surface area to volume ratio of block **X** is 5:1.

Calculate the surface area to volume ratio of block **Y**.

Show your working.


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**Question 17 · Paper 2 · February/March 2017 (22) · Q6(a)(ii) · 2 marks**

**(ii)** The student observed that block **X** changed colour completely in a much shorter time than block **Y**.

Explain why.

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**Question 18 · Paper 2 · February/March 2017 (22) · Q6(a)(iii) · 2 marks**

**(iii)** Suggest how the results of this investigation help to explain why plants need a transport system.

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**Question 19 · Paper 2 · February/March 2025 (22) · Q1(e) · 2 marks**

**(e)** The region between the outer layer of a root and the endodermis is known as the cortex. Table 1.2 shows the water potential of two adjacent cells, **A** and **B**, in the cortex of a root.

**Table 1.2**

| water potential / kPa | |
|---|---|
| **cortex cell A** | **cortex cell B** |
| –120 | –350 |

With reference to Table 1.2, explain the direction of water movement between cell **A** and cell **B**.

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**Question 20 · information from earlier in the question**

**(d)** The polysaccharides and amino acids present in the mucilage are a source of nutrients for soil microorganisms that live in the area surrounding the root. Some of these microorganisms can break down soil compounds to release mineral ions.

**Question 20 · Paper 2 · May/June 2023 (22) · Q2(d)(iii) · 3 marks**

**(iii)** Mineral ions are usually present in the soil in very low concentrations. The action of mucilage enzymes and soil microorganisms can help to increase the presence of mineral ions.

Root hair cells are specialised for the uptake of these mineral ions **and** for the absorption of water from the soil.

Suggest **and** explain how the presence of mineral ions in the root hair cell can **increase** the absorption of water by the root hair cells.

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**Question 21 · Paper 2 · February/March 2020 (22) · Q6(a) · 2 marks**

**6** Fig. 6.1 is a transmission electron micrograph of a plant parenchyma cell.

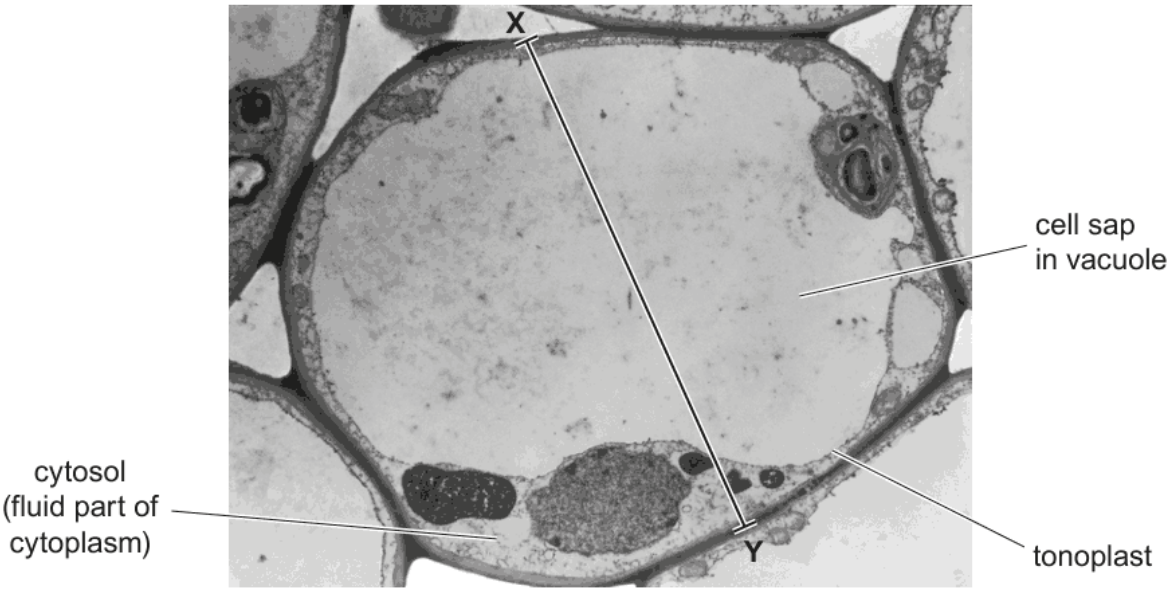



**Fig. 6.1**

**(a)** The external environment of the parenchyma cell has a higher water potential than the internal environment of the cell.

One function of parenchyma cells is to provide support to the plant.

With reference to Fig. 6.1, suggest how parenchyma cells provide support to the plant.

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**Question 22 · information from earlier in the question**

**2** Some tissues of the gas exchange system include cells that are able to produce and secrete mucins. Mucins are stored in vesicles in these cells, ready for secretion. Once outside the cell, mucins adsorb water to form mucus.


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**Question 22 · Paper 2 · May/June 2019 (22) · Q2(d) · 3 marks**

**(d)** Chloride ions move out of the mucin-producing cells at the same time as mucin is secreted.

Suggest **and** explain how the exit of chloride ions helps the formation of mucus from mucin.

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# Mark schemes

**Question 1 · Paper 2 · February/March 2022 (22) · Q1(a) · 4 marks**

1(a) 1 mark for each correct row ; ; ; ; **4**

| statement | process | | |
|---|---|---|---|
| | active transport | facilitated diffusion | simple diffusion |
| movement of oxygen into a red blood cell | ✗ | ✗ | ✓ |
| occurs in both animal and plant cells | ✓ | ✓ | ✓ |
| uses carrier proteins | ✓ | ✓ | ✗ |
| movement of non-polar molecules between the fatty acid tails of the phospholipid molecules | ✗ | ✗ | ✓ |
| movement of ions down a concentration gradient | ✗ | ✓ | ✗ |

**Question 2 · Paper 2 · February/March 2024 (22) · Q1(b)(i) · 1 mark**

1(b)(i) *sodium ions are*
(positively charged), so repelled / AW, by the, hydrophobic tails / non-polar core / non-polar tails / AW ; **1**

**Question 3 · Paper 2 · February/March 2024 (22) · Q1(b)(ii) · 3 marks**

1(b)(ii) *similarity:* **3**
*any **one** from*
1 both occur through / involve, a, membrane / transport, protein **; A** carrier protein *if context is correct*
2 *(both can be)* specific to the, molecule / ion *(passing through)* **; A** correct ref. to binding site(s) on protein
3 (*both involve)* conformational change of (carrier) protein) **; R** if incorrect context of channel protein
AVP **;** e.g. can transport substances, into and out of cell / in both directions *;*
*differences:*

| *facilitated diffusion* | *active transport* |
|---|---|
| substances transported down the concentration gradient | substances transported against a concentration gradient |
| passive **A** does not require, ATP / (metabolic) energy | requires, ATP / (metabolic) energy |
| involves channel and carrier proteins | does not involve channel proteins / only involves carrier proteins |

*If not given as a similarity allow as differences*
*idea that active transport always involves conformational change (facilitated diffusion only carrier protein)*
*idea that active transport always involves specific binding site(s) (facilitated diffusion only with carrier proteins)*

**Question 4 · Paper 2 · February/March 2025 (22) · Q1(d) · 3 marks**

1(d) *max **two** if answer only refers to either $Na^+$ or $K^+$ ions* **3**
*any **three** from:*
1 facilitated diffusion because, higher concentration $Na^+$ in soil solution / lower concentration $Na^+$ in root hair cells **;**
2 active, transport / uptake, because, higher concentration $K^+$ in root hair cells / lower concentration $K^+$ in soil solution **;**
3 ions / AW, cannot, diffuse / pass through the, cell (surface) membrane / phospholipid bilayer **;**
4 (so) facilitated diffusion uses, channel / carrier proteins
**or**
active transport uses carrier proteins **;**


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**Question 5 · Paper 2 · October/November 2024 (22) · Q6(b) · 3 marks**

6(b) **3**

| net movement of $K^+$ | membrane protein needed (yes or no) | ATP used (yes or no) | name of transport mechanism |
|---|---|---|---|
| against the concentration gradient | yes | yes | active, transport / uptake |
| down the concentration gradient | yes | no | facilitated diffusion |

*one mark each correct column* **;;;**

*if no marks gained, allow one mark for a correct row*

**Question 6 · Paper 2 · May/June 2022 (22) · Q1(c)(i) · 2 marks**

1(c)(i) **2**

*any **two** from:*
(movement of substances) against concentration gradient / from low(er) to high(er) concentration ;
(protein has) binding site(s) ;
specific ; **A** description e.g. shape complementary to shape of substance
*can be in context of protein or binding site*
*ref. to* (binding causes protein), conformational change / change of shape ;

**Question 7 · Paper 2 · May/June 2022 (22) · Q1(c)(ii) · 2 marks**

1(c)(ii) **2**

*any **two** from:*
**1** glucose is moving against a (concentration) gradient ; AW e.g. low to high

**2** movement powered by inward movement of $Na^+$ ; AW
**3** $Na^+$ movement (into cell from gut lumen) down an electrochemical gradient **or** down a ($Na^+$), concentration / diffusion, gradient
**or** by facilitated diffusion ;
**A** diffusion if response includes *ref. to* the cotransport protein / cotranporter
4 AVP ;
e.g. *idea that*, cotransport needed so that <u>all</u> glucose will be removed from gut lumen ora
facilitated diffusion of glucose will only be to equilibrium / AW
cotransporter has (specific) binding site for glucose
**I** cotransporter has a complementary shape
*idea that* there is no specific active uptake protein for glucose


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4(e) *any **four** from:* **4**

**1** (experiments suggest mainly) active transport / active uptake **;**
**A** uptake, is an active process / needs energy / needs ATP
*if mp8 given, allow 'active transport and facilitated diffusion'*

**2** comparison of experiments with control, any one **;**

| expt | discussion point |
|---|---|
| 1 | oxygen required for (complete) uptake **A** aeration required<br>**or**<br>almost no /AW, uptake, with no oxygen / in anaerobic conditions |
| 2 | almost no / AW, uptake, in, low temperature / at 3°C<br>**or**<br>uptake, higher / AW, at 30°C / in control |
| 3 | proteins / enzymes, are, required for / involved in, uptake<br>**or**<br>(much) lower / AW, uptake when, proteins not synthesised / protein synthesis inhibitor present |
| 4 | slightly lower / very similar, uptake / AW, without any bacteria<br>**or**<br>slightly higher / very similar, uptake / AW, with bacteria (control) |

**3** one comparative result / manipulated data, with units, to support mp2 **;**

4(e)

| experiment | experiment v control | or | lower by | |
|---|---|---|---|---|
| 1 | 0.4 v 10.9 μmol $g^{-1}$ | | 10.5 μmol $g^{-1}$ | *only needs to state control value once somewhere in response* |
| 2 | 0.6 v 10.9 μmol $g^{-1}$ | | 10.3 μmol $g^{-1}$ | |
| 3 | 1.4 v 10.9 μmol $g^{-1}$ | | 9.5 μmol $g^{-1}$ | |
| 4 | 10.0 v 10.9 μmol $g^{-1}$ | | 0.9 μmol $g^{-1}$ | |

*discussion points*

**4** aerobic respiration needs oxygen **;**

**5** lower temperature means lower activity of enzymes involved in respiration **;**

**6** *ref. to* ATP (for active transport) **;**
e.g. (aerobic) respiration produces ATP
less respiration means less ATP produced
no ATP for, conformational change / AW (of carrier protein)

**7** some (facilitated) diffusion because some uptake without oxygen **;**

**8** protein synthesis needed for transport proteins **;**
**A** membrane / transport / carrier / channel, proteins not being synthesised
**A** no protein synthesis so less ATP synthase

**9** effect of lower temperature on transport **; ora** for control
e.g. reduces rate of (facilitated) diffusion
affects, ATPase / carrier protein, for active transport
transport proteins less efficient at low temperature

**10** bacteria will have, little / no, effect on uptake
**or**


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**Question 9 · Paper 2 · October/November 2023 (22) · Q4(c) · 3 marks**

| | | |
|---|---|---|
| 4(c) | *if stated as facilitated diffusion allow max 1 for mp1 or mp2 or mp5*<br>*any **three** from:*<br>1 membrane / carrier / transport, protein (move phospholipids across into lamellar body) ;<br>**R** channel protein / cotransporter (protein)<br>2 has binding site(s) (specific for surfactant phospholipids) ;<br>**R** ATP binding site for phospholipids / binds ATP<br>**R** has receptors to bind to phospholipids<br>3 ATP, used / hydrolysed / needed, for active transport / to provide energy (for transport) ;<br>**A** ATP binding site for active transport<br>**A** *ref. to* ATPase and, active transport / for energy release<br>**I** has / presence of, ATP energy<br>4 (surfactant) phospholipids move, against a concentration gradient / from a low(er) to a high(er) concentration ;<br>5 able to carry out conformational change / AW ; | **3** |

**Question 10 · Paper 4 (A level) · May/June 2024 (42) · Q6(a) · 1 mark**

| | | |
|---|---|---|
| 6(a) | an arrow through phospholipid layer in outer membrane and an arrow through phospholipid layer in inner membrane ;<br>**R** arrows through proteins or **A**, **B**, **C** or **D** | **1** |

**Question 11 · Paper 4 (A level) · October/November 2022 (41) · Q3(b)(ii) · 2 marks**

| | | |
|---|---|---|
| 3(b)(ii) | *any **two** from:*<br>1 ($P_i$) by facilitated diffusion **or** through a protein, channel / carrier ;<br>2 $P_i$ and $H^+$ move together ;<br>3 (as) $H^+$ ions diffuse (through ATP synth(et)ase / to matrix) ; | **2** |

**Question 12 · Paper 2 · February/March 2023 (22) · Q2(b)(ii) · 3 marks**

| | | |
|---|---|---|
| 2(b)(ii) | exocytosis ;<br>*plus any **two** from:*<br>**either:**<br>(idea of) vesicles will be large enough to contain many mucins / ref. to bulk transport ;<br>vesicles forming from Golgi, body / apparatus ;<br>vesicles moved by microtubules / cytoskeleton (to cell surface membrane) ;<br>vesicles fuse with cell surface membrane ;<br>active process / requires ATP ;<br>AVP ; e.g. mucins are, polar / hydrophilic, so cannot cross, phospholipid bilayer / hydrophobic core of membrane<br>**or:**<br>mucin molecules are hydrophilic ;<br>can exit via protein channels ;<br>by facilitated diffusion ; | **3** |

**Question 13 · Paper 2 · October/November 2016 (22) · Q2(a)(i) · 1 mark**

**2 (a) (i)** tubing drawn more swollen ; [1]


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**Question 14 · Paper 2 · May/June 2021 (22) · Q4(b) · 2 marks**

| | | |
|---|---|---|
| 4(b) | *correct units for volume* $cm^3$ ;<br>*SA <u>and</u> volume calculation* (SA) = 54 (V) = 27 ; | **2** |

**Question 15 · Paper 2 · May/June 2021 (22) · Q4(c) · 1 mark**

| | | |
|---|---|---|
| 4(c) | **A** → **B** → **C** ; **A** 6:1 → 3:1 → 2:1 **A** 1 → 2→ 3 | **1** |

**Question 16 · Paper 2 · February/March 2017 (22) · Q6(a)(i) · 2 marks**

| | | |
|---|---|---|
| 6(a)(i) | surface area : volume = 1.67 : 1 ; ; **A** 1.7 : 1, 5 : 3<br>*if incorrect, **allow** one mark for working*<br>surface area = 90 $mm^2$ <u>and</u> volume = 54 $mm^3$<br>*calculations:*<br>surface area: $6 \times 3 \times 4$ (sides) = 72 $mm^2$; $3 \times 3 \times 2$ (sides) = 18 $mm^2$<br>volume: $6 \times 3 \times 3$<br>ratio: 90 : 54 | **2** |

**Question 17 · Paper 2 · February/March 2017 (22) · Q6(a)(ii) · 2 marks**

| | | |
|---|---|---|
| 6(a)(ii) | (block **X**) has higher, surface area to volume ratio / SA:V ;<br>OR<br>(block **X**) has more surface area proportionately per unit volume / AW ;<br>reference to shorter distance for diffusion to centre ; | **2** |

**Question 18 · Paper 2 · February/March 2017 (22) · Q6(a)(iii) · 2 marks**

| | | |
|---|---|---|
| 6(a)(iii) | *two from:*<br>1 diffusion (rate) too slow ; **A** idea of cannot rely on diffusion<br>2 reference to distances too far to reach all, cells / tissues ;<br>3 time taken is too long / AW ; | **2** |

**Question 19 · Paper 2 · February/March 2025 (22) · Q1(e) · 2 marks**

| | | |
|---|---|---|
| 1(e) | (movement of water) from cell **A** to cell **B** by osmosis ;<br>from higher water potential to lower water potential / from less negative $\psi$ to more negative $\psi$ / down the water potential gradient ; | **2** |


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**Question 20 · Paper 2 · May/June 2023 (22) · Q2(d)(iii) · 3 marks**

| | | |
|---|---|---|
| 2(d)(iii) | *any **three** from:*<br><br>**I** *ref. to* concentration of water / solute concentration<br>**A** ψ for water potential<br><br>mineral ions / nutrients, are solutes / dissolve in water ;<br><br>(solutes) decrease / lower, water potential, within cell / in cytosol / in cytoplasm ;<br>**A** water potential becomes, more negative / low<br><br>increases / steep(er) / presence of / AW, water potential gradient ;<br>**A** the difference in ψ between soil solution and cell increases<br>**A** water moves from high to low water potential<br><br>water follows osmotically / water enters by osmosis ;<br>*in context of, presence / uptake, of mineral ions* | **3** |

**Question 21 · Paper 2 · February/March 2020 (22) · Q6(a) · 2 marks**

| | | |
|---|---|---|
| 6(a) | *any **two** from:*<br>1 water moves into, cell / vacuole, by osmosis / down water potential gradient ;<br>2 (large) vacuole full of, water / sap ;<br>3 turgid / vacuole exerts outward pressure ;<br>4 hydrostatic (support) ; | **2** |

**Question 22 · Paper 2 · May/June 2019 (22) · Q2(d) · 3 marks**

| | | |
|---|---|---|
| 2(d) | *accept symbol Ψ for water potential*<br>*three from:*<br>**1** chloride presence outside cell causes water potential (outside cells) to, decrease / become more negative / become lower<br>**or**<br>chloride leaving cell causes water potential (in cell) to increase / AW ;<br>**2** water potential gradient, created / present (between inside and outside of cell) ;<br>**3** water leaves cell by osmosis (to be taken up by mucin to form mucus) ;<br>**4** from higher to lower water potential / AW ; **R** if term gradient included | **3** |


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