HELICATE · AS AND A-LEVEL BIOLOGY · TOPIC BANK

3.2.3 Transport across cell membranes

Mark scheme

Version 1 · 2 October 2026

TOTAL MARKS	QUESTIONS
62	8

How to use this mark scheme

;	Separates marking points. Each semicolon marks the end of one creditable point, and each point is worth one mark.
;;	Two marks for this answer (used for calculations).
/	Alternative words or phrases that are credited for the same point.
OR	An alternative answer for the same mark.
( )	Words in brackets are not needed to gain the mark.
max	More marking points are listed than marks available. Award up to the number of marks shown.
Accept	An alternative answer that gains credit.
Reject	A wrong answer. It does not gain credit and cancels a correct point it contradicts.
Ignore	Neither credited nor penalised. Mark the rest of the answer.
ECF	Error carried forward: credit correct working that uses an earlier wrong answer.
AO	Assessment objective: AO1 knowledge and understanding; AO2 applying knowledge; AO3 analysing, interpreting and evaluating.

Where an answer is correct but not listed, credit it if it is biologically accurate and answers the question at the depth the marks require. Right + wrong = wrong: a contradiction cancels a correct point.

Not affiliated with or endorsed by AQA.

Structure of cell membranes 3.2.3

Question	Marking guidance	Mark	Comments
01.1	Phospholipid molecules can move sideways within their own layer of the bilayer;	**1** (1 × AO1)	

Question	Marking guidance	Mark	Comments
01.2	1. A cell-surface membrane has water on both sides (cytoplasm and tissue fluid), and the hydrophilic (phosphate) heads are attracted to it, so one layer of heads faces each side; 2. (Fatty acid) tails are hydrophobic/repelled by water, so they point inwards/towards each other, away from the water on both sides;	**2** (2 × AO1)	1. Must refer to water (or an aqueous environment) on both sides of the membrane **Accept** polar/charged for hydrophilic and non-polar/uncharged for hydrophobic **Accept** a labelled diagram of a bilayer with water shown on both sides for both marks **Reject** phosphate heads hydrophobic or fatty acid tails hydrophilic (hydrophilic and hydrophobic swapped) **Ignore** descriptions of what the membrane lets through

Question	Marking guidance	Mark	Comments
02.1	1. Cholesterol restricts the movement of phospholipids/fatty acid tails OR makes the bilayer less fluid/more stable; 2. So the more cholesterol, the less dye diffuses/leaks out (through the bilayer) OR fewer/smaller gaps form between phospholipids for dye to pass through;	**2** (1 × AO1) (1 × AO2)	1. **Accept** stabilises the membrane / makes it stiffer/more rigid/holds it together 1. **Ignore** strengthens the membrane 2. Must relate more cholesterol to less leakage of dye **Ignore** references to carrier or channel proteins

Question	Marking guidance	Mark	Comments
02.2	Correct answer in the range 75–81 (%) for 2 marks;; Accept for 1 mark, a difference of 39 (%) OR (50 − 11) ÷ 50 **OR** correct method using the student's own readings from the graph	**2** (2 × AO2)	Plotted values: 50% (0% cholesterol) and 11% (30% cholesterol), giving 78% **Accept** readings of 49–51 and 10–12 **Reject** a percentage increase

Question	Marking guidance	Mark	Comments
02.3	1. (Small, non-polar) molecule is lipid-soluble so can pass through/dissolve in the (hydrophobic) fatty acid tails/core of the bilayer; 2. By simple diffusion, down its concentration gradient, without needing channel/carrier proteins, so cholesterol does not prevent it;	**2** (1 × AO1) (1 × AO2)	1. **Accept** hydrophobic tails do not repel it 1. **Ignore** 'fat soluble' or 'not water soluble' for lipid-soluble 2. **Accept** diffuses from a high to a low concentration 2. **Reject** passes through channel/carrier proteins **Ignore** references to the size of the molecule unless linked to the bilayer

Simple diffusion and facilitated diffusion 3.2.3

Question	Marking guidance	Mark	Comments
03.1	1. A by simple diffusion **and** B by facilitated diffusion; 2. Rate of uptake of A is (directly) proportional to concentration/keeps increasing, so it is not limited by the number of (transport) proteins; 3. Rate of uptake of B levels off (at high concentrations) because all the carrier/channel proteins are in use/saturated;	**3** (2 × AO2) (1 × AO3)	1. Do not award if the processes are reversed, but points 2 and 3 can still be awarded 2. **Accept** rate of A increases linearly as the concentration gradient increases 3. **Accept** carrier/channel proteins are working at their maximum rate 3. **Reject** carriers are used up 3. **Reject** 'transport proteins' unless carrier or channel is named

Question	Marking guidance	Mark	Comments
03.2	The (fatty acid tails in the) centre of the phospholipid bilayer are hydrophobic/non-polar, so polar molecules cannot pass through (the bilayer);	**1** (1 × AO1)	**Accept** B is not lipid-soluble so cannot dissolve in/pass through the bilayer **Reject** answers based only on the size of the molecule **Reject** the fatty acid tails are hydrophilic

Question	Marking guidance	Mark	Comments
03.3	1. No/less ATP is produced (when respiration stops), so no/less energy is released by ATP hydrolysis for active transport; 2. Uptake of B is not affected, so it does not need ATP/energy (from respiration) OR uptake of B is passive;	**2** (2 × AO3)	1. **Reject** ATP/respiration produces/makes energy 2. **Accept** uptake of B is down a concentration gradient, so no ATP is needed

Question	Marking guidance	Mark	Comments
03.4	It involves channel proteins or carrier proteins;	**1** (1 × AO1)	

Osmosis and water potential (Required practical 3) 3.2.3

Question	Marking guidance	Mark	Comments
04.1	Volume of 1.00 mol dm^{-3} sucrose solution / cm^3: 6.0 Volume of distilled water / cm^3: 14.0;	**1** (1 × AO2)	0.30 ÷ 1.00 × 20 = 6.0 cm^3 of sucrose solution, made up to 20 cm^3 with 14.0 cm^3 of water

Question	Marking guidance	Mark	Comments
04.2	Correct answer for 2 marks: −5.3 (%);; Accept for 1 mark, change in mass of −0.13 (g) OR 0.13 ÷ 2.44 (× 100) **OR** 5.3 without a negative sign or statement of decrease **OR** −5.33 (not to one decimal place)	**2** (2 × AO2)	**Accept** 5.3% decrease / loss for 2 marks

Question	Marking guidance	Mark	Comments
04.3	The cylinders had different initial masses, so percentage change allows (valid) comparison between them;	**1** (1 × AO3)	Must refer to different (starting/initial) masses **Ignore** 'fair test' or 'more accurate' unqualified

Question	Marking guidance	Mark	Comments
04.4	1. Axes correct way round (water potential of solution on *x*-axis, percentage change in mass on *y*-axis), labelled with units; 2. Suitable linear scales, including negative values, with plotted points covering at least half of the grid in each direction; 3. All points plotted correctly (± half a small square) **and** joined by a line or curve of best fit OR by straight lines between points;	**3** (3 × AO2)	1. **Accept** kPa and % as units, eg '/ kPa' or '(kPa)' 1. **Accept** axes drawn to show negative values, eg the *x*-axis at 0% change in mass 3. **ECF** for the student's value from 04.2 3. **Reject** a line extended beyond the plotted data points

Question	Marking guidance	Mark	Comments
04.5	Value in the range −690 to −790 (kPa);	**1** (1 × AO2)	Value where percentage change in mass = 0; joining the points at −540 kPa and −820 kPa gives −725 kPa A correct reading of the intercept from the student's own line takes priority over the range above **Reject** a positive value

Question	Marking guidance	Mark	Comments
04.6	1. Solution has a lower/more negative water potential than the (parsnip) cells/tissue; 2. So water moves out of the cells by osmosis (through the partially permeable membrane);	**2** (1 × AO1) (1 × AO2)	1. **Accept** the cells have a higher/less negative water potential than the solution 1. **Accept** Ψ for water potential. Reject 'WP' 1. **Reject** 'water concentration' in place of water potential 2. **Reject** diffusion in place of osmosis 2. **Accept** selectively/semi-permeable 2. Do not award for describing osmosis through a partially permeable membrane without the direction of water movement **Reject** sucrose moves into the cells

Question	Marking guidance	Mark	Comments
04.7	Use more concentrations/smaller intervals between 0.20 and 0.30 mol dm^{-3};	**1** (1 × AO3)	**Accept** any narrower range that includes the point of no change in mass, eg 0.20, 0.22, 0.24 … 0.30 mol dm^{-3} **Ignore** 'use more concentrations' unqualified **Ignore** repeats (these do not change the concentrations used)

Active transport, co-transport and adaptations for rapid transport 3.2.3

Question	Marking guidance	Mark	Comments
05.1	1. Sodium ions are actively transported out of the epithelial cell into the blood (by a carrier protein); 2. Using energy released by the hydrolysis of ATP; 3. This keeps the concentration of sodium ions in the cell lower than in the lumen OR maintains a sodium ion concentration/diffusion gradient; 4. Sodium ions move into the cell from the lumen down their concentration gradient through a co-transporter (protein); 5. Glucose moves in with the sodium ions (through the same protein) against its concentration gradient; 6. Glucose moves out of the cell into the blood by facilitated diffusion (through a carrier protein);	**5 max** (5 × AO1)	**Accept** Na^+ for sodium ions. Reject 'sodium' or 'Na' without reference to ions once, then accept 1. **Accept** pumped out of the cell into the blood using a carrier protein / sodium–potassium pump 1. **Reject** channel proteins in active transport 2. **Reject** ATP produces/makes/creates energy 4. **Accept** symport / co-transport protein 5. **Reject** glucose enters by active transport (alone) unless co-transport is described 6. **Reject** simple diffusion or active transport for the exit of glucose

Question	Marking guidance	Mark	Comments
05.2	1. Glucose allows more sodium ions to be co-transported into the epithelial cells (with glucose) OR both are needed by the co-transporter protein; 2. More solute (sodium ions **and** glucose) is absorbed, so the water potential of the cells/blood becomes lower than with sodium ions alone; 3. So a steeper water potential gradient from the lumen, so more water moves (from the lumen) into the cells/blood by osmosis;	**3** (3 × AO2)	2. Must be comparative: more solute absorbed OR lower water potential than with sodium ions alone 2. **Accept** makes the water potential more negative 2. **Accept** Ψ for water potential. Reject 'WP' 3. Must be comparative (more water / steeper gradient); water moving in by osmosis alone is not enough, as it happens in both cases 3. **Reject** water diffuses in place of osmosis 3. **Reject** the solution/sodium ions move by osmosis **Ignore** references to the solution being absorbed faster without explanation

Question	Marking guidance	Mark	Comments
06.1	1. Facilitated diffusion only moves substances down their concentration gradient, but lactose moves against its concentration gradient; 2. Movement of hydrogen ions into the cell down their concentration gradient (through the same protein) drives/provides the energy for lactose uptake;	**2** (1 × AO1) (1 × AO2)	1. **Accept** lactose moves from a lower to a higher concentration 2. **Accept** the hydrogen ion gradient (maintained by ATP-driven pumping) is used to move lactose 2. Do not award for only restating that the protein moves lactose and hydrogen ions together 2. **Reject** lactose enters by active transport using ATP (directly) **Reject** 'hydrogen' for hydrogen ions/H^+ once

Question	Marking guidance	Mark	Comments
06.2	1. Lower pH means a higher concentration of hydrogen ions outside, so a steeper hydrogen ion concentration gradient into the cell; 2. So more hydrogen ions diffuse into the cell through the (co-transporter) protein; 3. So more lactose is co-transported into the cell (with the hydrogen ions); 4. At pH 7.6 the hydrogen ion concentration is the same inside and outside, so there is no gradient and (almost) no lactose uptake;	**3 max** (2 × AO2) (1 × AO3)	1. **Accept** larger difference in hydrogen ion concentration 1. Must link pH to hydrogen ion concentration or gradient, not just describe the trend 2. **Accept** H^+ move down their concentration gradient into the cell 3. **Reject** lactose moves by facilitated diffusion **Reject** 'hydrogen' for hydrogen ions/H^+ once

Question	Marking guidance	Mark	Comments
06.3	1. Hydrogen ions diffuse into the cell through the bilayer (without passing through the co-transporter protein); 2. Concentration of hydrogen ions in the cytoplasm rises, so the hydrogen ion concentration gradient is lost/reduced; 3. The cell cannot pump hydrogen ions out fast enough to keep the concentration inside low; 4. So fewer hydrogen ions move through the (co-transporter) protein and less lactose is co-transported;	**3 max** (1 × AO2) (2 × AO3)	1. **Accept** H^+ leak into the cell / move in by (simple) diffusion 2. **Accept** the hydrogen ion concentration becomes the same inside and outside 3. **Accept** D may also reduce ATP production, so fewer H^+ are pumped out 4. Must refer to fewer H^+ through the protein or less co-transport **Reject** substance D blocks/denatures the co-transporter protein unless linked to the gradient

Question	Marking guidance	Mark	Comments
06.4	Active transport **and** carrier protein;	**1** (1 × AO1)	Both needed for the mark **Accept** pump / ATPase for carrier protein **Reject** channel protein **Reject** co-transport or facilitated diffusion for the process

Question	Marking guidance	Mark	Comments
07.1	1. More (aerobic) respiration, so more ATP (produced); 2. More active transport of sodium ions out of the cell (into the blood); 3. Maintains a (steeper) sodium ion concentration gradient, so more glucose is co-transported into the cell (with sodium ions);	**3** (1 × AO1) (2 × AO2)	1. **Reject** respiration/mitochondria produce energy 2. **Accept** Na^+ for sodium ions 3. **Accept** more sodium ions diffuse into the cell with glucose (through the co-transporter) **Ignore** more ATP for glucose uptake unqualified

Question	Marking guidance	Mark	Comments
07.2	Correct answer for 2 marks: 2.5;; Accept for 1 mark, 1.5 **and** 0.6 (arbitrary units per μm^2) **OR** 1800 ÷ 48 ÷ (1200 ÷ 80) with no final answer	**2** (2 × AO2)	**Accept** 2.5 : 1

Question	Marking guidance	Mark	Comments
07.3	1. Surface area of P is 15 times that of Q, so it does account for part of the difference (supports the conclusion); 2. Rate per μm^2 is (2.5 times) higher in P, so surface area alone does not explain the difference OR another factor must be involved; 3. P also has more mitochondria, so the effects cannot be separated; 4. Number/density of co-transporter/carrier proteins (per μm^2) not measured OR may differ; 5. Only one cell of each type measured OR no repeats/means;	**2 max** (2 × AO3)	2. **Accept** ECF from the student's answer to 07.2 if greater than 1 4. **Accept** number of microvilli not known for number of proteins only if linked to proteins **Credit** points that support or oppose the conclusion

Required practical 4: permeability of cell-surface membranes 3.2.3

Question	Marking guidance	Mark	Comments
08.1	To remove pigment released from cells damaged/cut when the discs were cut, so the absorbance only shows pigment released during the experiment/because of the ethanol;	**1** (1 × AO3)	**Accept** so pigment from cut cells does not affect the absorbance **Ignore** to clean the discs unqualified

Question	Marking guidance	Mark	Comments
08.2	1. Little change in absorbance between 0% and 20% ethanol, so (most) membranes stay intact/pigment cannot leave the cells; 2. Absorbance increases steeply from 20% to 50%/60% ethanol, so more pigment leaves the cells OR membranes become more permeable; 3. Ethanol dissolves (lipids in) the phospholipid bilayer; 4. Ethanol denatures (membrane) proteins, leaving gaps in the membrane; 5. Absorbance levels off above 50%/60% because (almost) all the pigment has been released OR the membranes are fully permeable;	**4 max** (1 × AO1) (1 × AO2) (2 × AO3)	**Accept** values read from the graph for description 2. and 5. Accept any value from 50% to 60% for where the steep rise ends / levelling off begins 3. **Accept** ethanol is a solvent for lipids/phospholipids 4. **Ignore** enzymes unless described as membrane proteins **Reject** cell wall for cell-surface membrane **Reject** answers in terms of osmosis/water potential

Question	Marking guidance	Mark	Comments
08.3	1. Cut discs/cylinders of beetroot of the same diameter **and** thickness/length (using a cork borer and ruler/scalpel); 2. Rinse the discs (in distilled water) to remove pigment from cut cells and blot dry; 3. Place the same number of discs in the same volume of distilled water (in each tube); 4. Trial a wide range of temperatures first (eg 20–80 °C at 10 °C intervals) in water baths; 5. Then repeat using small intervals (eg 2 °C) around the temperature at which absorbance starts to rise; 6. Let the water reach the temperature before adding the discs OR monitor the temperature with a thermometer and adjust the water bath; 7. Leave for the same time (eg 20 minutes), then remove the discs (and shake/mix the solution); 8. Measure the absorbance of each solution with a colorimeter (zeroed using distilled water and with the same filter each time); 9. Repeat (at least three times) at each temperature and calculate a mean; 10. Plot mean absorbance against temperature and identify the temperature where absorbance starts to rise sharply;	**6 max** (2 × AO1) (4 × AO3)	1. **Ignore** ‘same shape/size’ unqualified 1. **Accept** same mass or same surface area 4. **Accept** a range of at least five temperatures if point 5 is not given 6. Must describe how the temperature is checked or kept constant; reject ‘keep the temperature constant’ unqualified 8. **Accept** compare colour with a set of standards of known pigment concentration **Ignore** ‘fair test’

Copyright © 2026 Helicate. All rights reserved.