

# Transport across cell membranes 2

Level: CIE AS 9700

Subject: Biology

Exam Board: Suitable for all boards

Topic: Transport across cell membranes 2

Type: Mark Scheme

To be used by all students preparing for CIE AS Biology 9700 foundation or higher tier but also suitable for students of other boards.

## Mark schemes

- 1**
- (a) Does not have the resolution / cannot distinguish between points this close together;  
As light has longer wavelength;  
*The key ideas in marking this part of the question are resolution and wavelength.* 2
- (b) Lipid soluble / small / non-polar / not charged; 1
- (c) (i) Concentration of sodium ions (outside cell);  
As concentration / independent variable increases so does  
the rate of diffusion; 2
- (ii) Sodium ions are passing through the channels / pores at their maximum rate;  
Rate is limited by the number of sodium channels / another limiting factor; 2
- [7]**
- 2**
- (a) 1. Cell wall not formed / production inhibited;  
*1. Q Accept: weakened cell wall, but do not accept 'cell wall is broken down'*
2. Lower water potential in bacterium;  
*2. Accept: converse*  
*2. Must be clear that the lower water potential is in the bacterium*
3. Water enters and causes lysis / expansion / pressure; 2 max
- (b) Human cells lack enzyme (**B**) / have a different enzyme / produce different fatty acids  
/ use different substrates;  
*Neutral: 'human cells do not have cell walls' as out of context* 1
- (c) 1. Change in base sequence (of DNA / gene) leading to change in amino acid  
sequence / primary structure (of enzyme);  
*1. Accept: different amino acids coded for*  
*1. Reject: different amino acids produced*
2. Change in hydrogen / ionic / disulphide bonds leading to change in the tertiary  
structure / active site (of enzyme);  
*2. Neutral: alters 3D structure / 3D shape*
3. Substrate not complementary / cannot bind (to enzyme / active site) / no  
enzyme-substrate complexes form; 3
- [6]**



3

- (a) 1. Flatten / moves down;  
*1. Ignore: additional information about rib movements*
2. (Diaphragm muscle) contracts; 2
- (b) 1. Diaphragm contracts / moves down / flattens;  
*Ignore refs to rib movement*
2. Increases volume (of thorax) and decrease in pressure;  
*2. Accept pressure lower than atmospheric pressure*
3. Air moves from high to lower pressure / down pressure gradient;  
*3. Reject: by diffusion* 3
- (c) 1. Diffusion;  
*Accept down diffusion gradient*
2. Across (alveoli) epithelium / (capillary) endothelium;  
*2. Accept: capillary epithelium / squamous cell* 2 max

[7]

4

- (a) 2 marks for correct answer 0.2  
*Accept concentration  $\div$  time*
- 1 mark for 6 / 30; 2
- (b) 1. (Uptake) decreases / slower, then no further uptake / uptake stops;
2. (Decreases) to 20 - 22 / no uptake after 20 / 22 minutes;  
*Accept: (only) 1.6 (arbitrary units) absorbed / (only) drops to 8.4*  
*Is for correct use of data from graph* 2
- (c) 1. Stops / reduces / inhibits respiration;  
*Accept: inhibits respiratory enzymes*
2. No / less energy released / ATP produced;  
*Ignore: less energy produced / made*
3. (ATP / energy needed) for active transport;  
*Accept ref to Na<sup>+</sup> pump / description of active transport*  
*Ignore consequences of less Na<sup>+</sup> in cell* 3

[7]



5

- (a) 1. Add Benedict's;  
*Hydrolyse with acid negates mp1*
2. Heat;  
*Accept warm, but not an unqualified reference to water bath*
3. Red / orange / yellow / green (shows reducing sugar present);  
*Accept brown*

3

- (b) (i) 1. Starch hydrolysed / broken down / glucose / maltose produced;  
*Neutral: Sugar produced*
2. Lower water potential;
3. Water enters by osmosis;

3

- (ii) Only 2 pHs studied / more pHs need to be tested;  
*Accept: different amylase may have a different optimum pH*

1

[7]

6

- (a) Hydrolysis (reaction);  
*Accept phonetic spelling*

1

- (b) 1. Too big / wrong shape;  
*Wrong charge - neutral*  
*Accept insoluble*
2. To fit / bind / pass through (membrane / into cell / through carrier / channel protein);
3. Carrier / channel protein;  
*Accept carrier / channel protein not present*

3



(c) Foreign / (act as) antigen / non-self;  
*Reject foreign cells* 1

(d) 1. Dose to be given;  
*Accept: interaction with other drugs*

2. No (serious) side effects;

3. How effective;

4. Cost of drug; 2 max

[7]

**7** (a) (i) 1. Increases (surface) area / inside surface exposed / more cells exposed / shorter distance for water to move;

2. Producing water loss;  
*Accept better answers, such as diffusion or osmosis relating to water loss.* 2

(ii) 1. Sucrose solution / water / liquid (on the slices) would add to the mass / weight of the slices;

2. Would vary;  
*Ignore references to reliability* 2

(b) This is initial mass / the time is too short for water to have left / the time is too short for osmosis / have not been treated; 1

(c) 1. Percentage loss in mass increases with time;

2. Texture decreases then levels out;  
*Only credit answers that refer to decreasing and levelling out.*

3. (Texture levels out) after first 2 hours; 3



- (d) 1. Plot graph of percentage loss in mass against time;  
2. Draw curve (of best fit);  
*Although curve is the technical term accept references to line etc*  
3. Extrapolate / record when no further change in mass / record when curve flattens out;

3

[11]

- 8** (a) (i) Diffusion;  
*Ignore references to structures, membrane components etc*  
*Allow simple diffusion*  
*Reject facilitated diffusion*
- (ii) 1. (Thin / flat body) so short distance for diffusion / short diffusion pathway;  
*Ignore references to membrane, wall, body surface*  
2. (Thin / flat body so) large surface area to volume ratio;  
*'It' refers to flatworm's body*

1

2

- (b) (i) A group of tissues;  
*Ignore references to function Group = more than one*

1

- (ii) 1. (Carbon dioxide enters) via stomata;  
*Reject stroma*  
2. (Stomata opened by) guard cells;  
3. Diffuses through air spaces;  
*Allow concentration gradient. Reject along gradient unless direction made clear*  
4. Down diffusion gradient;

3 max

[7]

- 9** (a) (i) 1. Allows results to be compared;  
2. Because initial masses may have been different;
- (ii) 1. Quantitative measure (of cooking);  
2. Ensures all cooked to same extent as not all turkey pieces same shape / thickness;  
*2 Emphasis here must be on being cooked to the same extent. Do not accept reference to all being cooked.*

2

2



- (iii) 1. (Yes) Loss of water results in loss in mass;  
2. (No) Loss of other substances / other substances being burnt;  
*No marks should be given for "Yes" or "No"*

2

- (b) 1. Water potential in brine lower than in cells / meat;  
*Accept water potential more negative or converse answers*  
2. Water would move out of the meat / water does not move out of the meat;

2

[8]

10

- (a) (i) 1. Water potential same (inside and outside) / no water potential gradient;  
*Accept symbol  $\Psi$  or abbreviation WP as alternatives to water potential.*  
2. Water does not enter / leave spores;  
3. By osmosis / prevents osmotic damage;  
*Answer must refer to osmosis.*

2 max

- (ii) Prevents growth (before ready) / stops growth of (other) microorganisms / slows enzyme action / prevents enzymes being denatured;

1

- (b) 1. Nitrogen / N / sulfur / S;  
2. Catalase is a protein / catalase is made up of amino acids / enzymes are proteins / enzymes are made up of amino acids;  
*Specific reference needed to proteins or amino acids.*

2

- (c) 1. Prevents contamination by (other) microorganisms;  
*Accept alternatives such as microbes, bacteria, other fungi.*  
2. Which also produce the enzyme / catalase / which would produce substances that affect catalase;

2

- (d) (i) 90 hours;  
*Hours must be specified in answer to (c)*

1

- (ii) 70 – 80 (hours);  
*Allow with no reference to units.  
Incorrect units negates answer.*

1



- (e)
1. Extra steps (with intracellular enzymes);
  2. Cells have to be broken open;
  3. Cell walls / bits of cells have to be removed / separated from enzyme;
  4. Needs to be separated from all the other enzymes in the cell;

2 max

[11]

- 11**
1. Vaccines contain antigens / dead / weakened pathogens / antigens dead / weakened pathogens are injected;

*Ignore references to T or B cells.*

2. Memory cells made;
3. On second exposure memory cells produce antibodies / become active / recognise pathogens;

*3. Idea of memory cells responding.*

4. Rapidly produce antibodies / produces more antibodies;

*4. Production of antibodies must be qualified for mark. Underlined ideas essential.*

5. Antibodies destroy pathogens;

*5. Accept bacteria / viruses etc but not disease*

[5]

- 12**
- (a) Nitrification;

*Accept nitrifying.*

*Do not accept nitrogen fixing.*

1

- (b) 1. Uptake (by roots) involves active transport;

*Reject all references to bacteria*

2. Requires ATP / aerobic respiration;

2

- (c) (i) 1. Not enough time / fast flow washes bacteria away;

*“Not enough time for bacteria to convert all the ammonia to nitrate”  
gains 2 marks*

2. (Not all / less) ammonia converted to nitrate / less nitrification;

2





- (ii) 1. Algal bloom / increase in algae blocks light / plants / algae die;  
2. Decomposers / saprobionts / bacteria break down dead plant materials;  
3. Bacteria / decomposers / saprobionts use up oxygen in respiration / increase BOD causing fish to die;  
3. *Accept alternatives such as microbes / saprophytes.*

3

[8]

13

- (a) 1. Uses energy / ATP;  
2. Against concentration gradient / low to high concentration;  
3. Does not use channel proteins / only uses carrier proteins;  
*Assume "it" refers to active transport.*  
1. *Facilitated diffusion is passive - neutral*  
2. *Along / across concentration gradient - neutral*  
*Accept up / down concentration gradient*  
*Accept AT does not need concentration gradient.*

2 max

- (b) (i) To see the effect of the drug / effect not due to anything else in the tablet;  
*Neutral "to compare results"*

1

- (ii) Placebo / dummy drug / tablet without drug;

(Otherwise) treated the same;

*No drug - neutral*

*Accept: Example e.g. tablet given at same time*

2

- (c) Decrease for 3 hours;

*Accept decreases from 1 - 4 hours*

1

[6]

14

- (a) (i) Hydrolysis;  
*Accept phonetic spelling.*  
*Ignore reaction.*

1

- (ii) (Alpha) glucose;

*Accept  $\alpha$  glucose.*

*Reject  $\beta$  glucose / beta glucose*

1



(b) (i) Add Benedict's (reagent) and heat / warm;

Red / orange / yellow / green (colour);

*Reject Add HCl*

*Accept brown, reject other colours*

2

(ii) 2 products / 2 sugars produced;

*Look for idea of **two***

*Accept named monosaccharides produced.*

*"More" insufficient for mark*

*Neutral if incorrect products named*

*Neutral "lactose is a polysaccharide"*

*Neutral "lactose is not a reducing sugar"*

*Neutral: Reference to surface area.*

1

(c) 1. Galactose is a similar shape / structure to lactose / both complementary;

*Q Reject: Same shape / structure*

2. (Inhibitor / Galactose) fits into / enters / binds with active site (of enzyme);

*Accept blocks active site*

3. Prevents / less substrate fitting into / binding with (active site) / fewer or no E-S complexes;

*Look for principles:*

*1. Shape*

*2. Binding to active site*

*3. Consequence*

2 max

[7]

15

(a) Cell wall;

Starch (store);

Chloroplast;

*Accept: phonetic spelling*

2 max

(b) Insoluble;

Reduces / 'stops' water entry / osmosis / does not affect water potential / is osmotically inactive;

*Accept: description for first point e.g. 'does not dissolve'.*

2



(c) Light sensitive eyespot / eyespot detects light;

Flagellum enables movement towards light;

Chloroplast / chlorophyll absorbs light / for photosynthesis;

*Do not penalise references to 'many chloroplasts'.*

3

[7]

16

(a) Water will affect the mass / only want to measure water taken up or lost;

Amount of water on cylinders varies / ensures same amount of water on outside;

*Neutral: removes water*

*Accept: '(sodium chloride) solution' for water*

*Do not accept 'sodium chloride'*

*Neutral: refs. to fair testing*

2

(b) 4 cm<sup>3</sup> (of 1.0 mol dm<sup>-3</sup> sodium chloride solution) and 16 cm<sup>3</sup> (of distilled water);

*Reject: factors and multiples of these figures e.g. 2 cm<sup>3</sup> and 8 cm<sup>3</sup>, as final volume should be 20 cm<sup>3</sup>*

1

(c) Allows comparison / shows proportional change;

Idea that cylinders have different starting masses / weights;

*Reject: if comparison is in context of the start and final mass of the same cylinder*

*Neutral: different masses*

*Neutral: different starting sizes*

2

(d) (Allows) anomalies to be identified / ignored / effect of anomalies to be reduced / effect of variation in data to be minimised;

Makes the average / mean / line of best fit more reliable / allows concordant results;

*Accept: 'outliers' instead of anomalies*

**Q** *Reject: abnormalities*

*Reject: idea of not recording anomalies / preventing anomalies from occurring*

*Accept: 'cancels out anomalies' as bottom line response*

**Q** *Reject: makes the average / mean more accurate*

*Neutral: makes the average / mean more valid*

*Neutral: makes 'it' / results / conclusion more reliable*

2

(e) 0.35 (mol dm<sup>-3</sup>)

1

[8]



17 (a) 1. (Simple / facilitated) diffusion from high to low concentration / down concentration gradient;

*Q Do not allow across / along / with concentration gradient*

2. Small / non-polar / lipid-soluble molecules pass via phospholipids / bilayer;

*Reject: named molecule passing through membrane by an incorrect route*

*Accept: diagrams if annotated*

**OR**

Large / polar / water-soluble molecules go through proteins;

3. Water moves by osmosis / from high water potential to low water potential / from less to more negative water potential;

4. Active transport is movement from low to high concentration / against concentration gradient;

*Only penalise once if active transport is not named*

*e.g. 'movement against the concentration gradient involves proteins and requires ATP' = 2 marks*

5. Active transport / facilitated diffusion involves proteins / carriers;

*Accept: facilitated diffusion involves channels*

*Reject: active transport involves channels*

6. Active transport requires energy / ATP;

7. Ref. to Na<sup>+</sup> / glucose co-transport;

*Credit ref. to endo / exocytosis as an alternative*

5 max

(b) 1. Many alveoli / alveoli walls folded provide a large surface area;

*Neutral: alveoli provide a large surface area*

2. Many capillaries provide a large surface area;

3. (So) fast diffusion;

*Neutral: greater / better diffusion*

*Neutral: fast gas exchange*

*Allow 'fast diffusion' only once*

4. Alveoli or capillary walls / epithelium / lining are thin / short distance between alveoli and blood;

*Reject: thin membranes / cell walls*

*Accept: one cell thick for 'thin'*



5. Flattened / squamous epithelium;  
*Accept: endothelial*
6. (So) short diffusion distance / pathway;
7. (So) fast diffusion;
8. Ventilation / circulation;  
*Accept: descriptions for ventilation / circulation*
9. Maintains a diffusion / concentration gradient;
10. (So) fast diffusion;  
*Do not double penalise if description lacks detail  
e.g. thin membranes so a short diffusion distance = 1 mark*

5 max

[10]

18

- (a) (i) (Lactose +) Water; → (Glucose +) Galactose;  
*Accept: H<sub>2</sub>O for water*

2

- (ii) Hydrolysis;  
*Accept: if phonetically correct*

1

- (b) (i) (Add Biuret reagent to both solutions) – no mark;  
*Neutral: positive / negative result*

Lactase / enzyme will give purple / lilac / mauve;  
*Neutral: incorrect reference to the method*

**OR**

Lactose / reducing sugar will not give purple / lilac / mauve / will remain blue;

1

- (ii) Lactase / enzyme is a protein;  
*Accept: lactase / enzyme contains peptide bonds*

1

[5]

19

Affects germination of Y more than (germination of) X;

After four days:

No effect on (germination of) X up to 15 (mmol dm<sup>-3</sup>) and then constant decrease /  
(causes) sharp decrease in (germination of) Y up to 15 (mmol dm<sup>-3</sup>) and then more gradual decrease;



After eight days:

Decrease in (germination of) X up to 45 (mmol dm<sup>-3</sup>) and then no further decrease / sharp decrease in (germination of) Y up to 15 (mmol dm<sup>-3</sup>) and then more gradual decrease;

[3]

20

(a) (i) 1.08;

*Must be to 3 significant figures, as in the table*

1

(ii) Allows comparison / shows proportional change;

*Neutral: sizes / amounts*

Idea that discs had different starting masses / weights;

*Neutral: different masses*

2

(iii) (Allows)

*Accept: outliers instead of anomalies*

Anomalies to be identified / effect of anomalies to be reduced / effect of variation in data to be minimised;

*Reject: idea of not recording anomalies / preventing anomalies from occurring*

A mean to be calculated;

*Neutral: average*

2

(b) (i) Plot (sodium chloride) concentration against ratio / draw line of best fit;

*Reject: if wrong axes or type of graph*

Find (sodium chloride concentration from the graph) where the ratio is 1 / there is no change in mass;

2

(ii) Line / curve of best fit is more reliable / precise;

*Neutral: graph*

Intercept / point where line crosses axis is more reliable / precise;

*Reject: references to 'more accurate'*

**OR**

Can plot SD values / error bars;

(To show) variability about the mean / how spread out the results are;

2

[9]



- 21** (a) (Blood) plasma; 1
- (b) More / larger proteins / less urea / carbon dioxide / more glucose / amino acids / fatty acids / oxygen / high(hydrostatic) pressure;  
*Q Reference to blood cells / water potential = neutral*  
*Q No Protein should not be credited* 1
- (c) (i) Contracts;  
*Q Do not accept pumping of heart / heart beating* 1
- (ii) Loss of fluid / volume;  
Friction / resistance (of capillary wall);  
*Q Reference to a narrow lumen is not sufficient to gain a mark unless friction or resistance is mentioned.* 1 max
- (d) Water potential (in capillary) not as low / is higher / less negative / water potential gradient is reduced;  
More tissue fluid formed (at arteriole end);  
Less / no water absorbed (into blood capillary) by osmosis; (into blood capillary);  
*Q The last two marking points must be in context of movement into the blood capillary* 3

[7]

- 22** (a) No effect on dry mass / small increase in dry mass;  
Decrease in fresh mass;  
*Ignore reference to figures.* 2
- (b) Water potential inside tomato plant becomes higher / less negative;  
Water drawn out of tomato plants / more difficult for tomato plants to take up water;  
By osmosis;  
Most of the fresh mass is (mass of) water; 3 max

[5]



- 23** (a) Lengthways / down the root;  
Through one tissue only / through same part / same proportion of tissues; 2
- (b) To prevent the water from evaporating / prevent evaporation;  
Changing the concentrations / water potential (of solution); 2
- (c) (i) Plot data on a graph;  
Find (sucrose concentration) from the graph where the ratio is 1; 2
- (ii) No, because the results are given as a ratio / as a proportion of initial length; 1
- 24** (a) (i) Many people do not go to the doctor; 1
- (ii) 36000;  
*No marks awarded for working here as calculation is very straightforward* 1
- (b) Same sugars / antigens on bacteria / nerve cells;  
*Do not accept references to same shape as equivalent to complementary.*  
Bind with antibody / form antigen-antibody complex;  
*Reject react*  
Have complementary shape / fit binding site;  
*Reject active site* 3
- (c) Diaphragm will not move down / flatten / contract;  
*Ignore references to breathing out*  
Thoracic cavity / lung volume not increased so cannot breathe in; 2
- 25** (a) (i) no cell wall / only has (plasma) membrane; 1
- (ii) has capsule / slime layer; 1
- (b) correct approach which makes use of scalebar; *ignore reference to units.* 1

[7]

[7]





- (c) cellulose / starch / amylose / amylopectin; 1
- (d) (i) water potential lower / more negative in cell;  
(water enters by) osmosis; 2
- (ii) plant cell wall made of a different substance / cellulose / penicillin  
does not affect cellulose; 1
- [7]

26

- (a) Measure diameter of field with ruler; And proportion taken up by the cell; or Measure length with (eyepiece) graticule / eyepiece scale;  
Calibrated against stage micrometer / something of known length;  
*Reject divide apparent length by magnification* 2
- (b) Membrane / cytoplasm shrinks / pulls away from cell wall / cell plasmolysed / goes flaccid;  
Water moves down water potential gradient / to lower / more negative water potential; By osmosis; 3
- (c) (i) Reaches equilibrium / no further / maximum change in length;  
*Reject osmosis takes time* 1
- (ii) Line / curve of best fit; Extrapolate (and read off) / find where it crosses x-axis; 2
- (iii) Greater decrease / length smaller; More water removed;  
Greater difference in water potential / cell with higher / less negative water potential;  
Starch is insoluble / has no effect on osmosis
- max 2
- [10]

27

- (a) partially / selectively permeable *accept semi-permeable*  
allows water to pass through but not potassium nitrate / solute; 1
- (b) potassium nitrate (solution);  
cell wall permeable; 2
- (c) water potential more negative / lower in cell E; water removed;  
greater solute / sap concentration (in cell); 3
- [6]



28

- (a) Several / more than one polypeptide chain in molecule;  
*Evidence must only relate to 4<sup>o</sup> structure* 1
- (b) Chemical bonds formed between sulphur-containing groups /  
R-groups / form stronger disulphide bonds;  
Bind chain(s) to each other; 2
- (c) Different number / sequences of amino acids;  
Bonds in different places which gives different shape; 2
- (d) Outer layer of skin cells are dead / do not respire  
Do not contain mitochondria / do not produce ATP / release energy;  
Cells do not have required proteins / carriers; 3
- (e) Advantages:
- 1 Small objects can be seen;
  - 2 TEM has high resolution as wavelength of electrons shorter;  
*Accept better*
- Limitations:
- 3 Cannot look at living cells as cells must be in a vacuum;
  - 4 must cut section / thin specimen;
  - 5 Preparation may create artefact
  - 6 Does not produce colour image;

6

[14]

29

- (a) greater rate of oxygen consumption / leads to greater rate of respiration and greater rate of uptake;  
*(allow this mark even if spread through account but cause and effect must be within the correct context)*

oxygen required for respiration;  
respiration produces ATP / releases energy;  
*(ignore ref to producing or making energy)*  
potassium ions taken up by active transport / against concentration gradient;

4



- (b) (i) 0.25 (mol dm<sup>-3</sup>); 1
- (ii) 1 mark Incorrect answer but derived from ratio of 1.2 and initial length of 90 mm  
2 marks Correct answer of 108 mm; 2
- (iii) water potential inside potato higher / less negative than in solution;  
water moves out by osmosis; 2
- 30** (a) antibiotic has diffused / spread / moved into agar;  
killed / inhibited bacteria; 2
- (b) largest clear area / inhibition zone / killed the most bacteria; 1
- (c) disrupts cell wall / prevents cell wall synthesis;  
stops DNA replication; 2
- [9]
- [5]



31

- (a) (i) Made of (different) tissues / more than one tissue; 1
- (ii) 1. (Muscle) contracts;  
*Assume that 'they' or 'it' = muscle*
2. (Arteriole) narrows / constricts / reduces size of lumen / vessel / vasoconstriction;  
*Ignore: references to pressure*  
**Q** *Correct context for muscle contracts, vessel constricts* 2
- (b) (i) Short diffusion distance / pathway;  
*Accept: thin diffusion pathway* 1
- (ii) (More) time for exchange / diffusion (of substances);  
*Accept: example of more time for specific substance to be exchanged* 1
- (c) 1. Water potential (in capillary) not as low / is higher / less negative / water potential gradient is reduced;  
*Accept: 'blood or plasma' instead of 'capillary'*
2. Less / no water removed (into capillary);  
*Accept converse: water remains in the tissue*
3. By osmosis (into capillary);  
**Q** *Marking points 2. and 3. must be in the context of movement into the capillary*  
*Neutral: reference to more tissue fluid being formed as in the question stem*  
*Neutral: reference to lymphatic drainage* 3

[8]