

2.3 TRANSPORT ACROSS CELL MEMBRANES 3 – MARK SCHEME

Q1.

- (a) 0.22; 1
- (b) 1. Uptake in flask **G** much greater than in flask **F**;
2. Showing use of ATP in flask **G**;
3. Sodium ion concentration in flask **G** falls to zero;
4. Showing uptake against a concentration gradient. 4
- (c) 1. (Uptake of sodium ions occurring by) facilitated diffusion;
2. Equilibrium reached / sodium ion concentrations in solution and in cells the same. 2

[7]

Q2.

- (a) 1. Between 0 and 0.1 calcium (ions) cannot enter by facilitated diffusion
OR
No diffusion gradient for entry into the cell.
2. Between 0.1 and 0.3 calcium (ions) enter by facilitated diffusion;
3. As calcium (ions) enter without oxygen
OR
Oxygen is not required for facilitated diffusion;
4. Between 0 and 0.1 calcium (ions) enter by active transport;
5. Movement is against the concentration gradient;
6. As calcium (ions) only enter in presence of oxygen / oxygen is required for active transport.
- Accept 'they' refers to calcium ions*

5 max

- (b) (She could have used) boiled (and cooled) water
OR
Layer of oil in top of solution;

1

[6]

Q3.

- (a) 2 marks for correct answer 0.2
Accept concentration ÷ 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⁺ pump / description of active transport
Ignore consequences of less Na⁺ in cell

3

[7]

Q4.

- (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

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

- (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]

Q5.

- (a) 1. Facilitated diffusion involves channel or carrier proteins whereas active transport only involves carrier proteins;
2. Facilitated diffusion does not use ATP / is passive whereas active transport uses ATP;
3. Facilitated diffusion takes place down a concentration gradient whereas active transport can occur against a concentration gradient.

Since 'contrast', both sides of the differences needed

3

- (b) 3.3:1.

Correct answer = 2 marks

If incorrect, allow 1 mark for 470–360 / 60 for rate in second hour

2

- (c) 1. Group **A** – initial uptake slower because by diffusion (only);
2. Group **A** – levels off because same concentrations inside cells and outside cells / reached equilibrium;
3. Group **B** – uptake faster because by diffusion plus active transport;
4. Group **B** fails to level off because uptake against gradient / no equilibrium to be reached;
5. Group **B** – rate slows because few / fewer chloride ions in external solution / respiratory substrate used up.

4 max

[9]

Q6.

- (a) 1. Co-transport;
2. Uses (hydrolysis of) ATP;
3. Sodium ion and proton bind to the protein;
4. Protein changes shape (to move sodium ion and / or proton across the membrane);

3. *Accept 'Na⁺ and H⁺ bind to protein' but do not allow incorrect chemical symbols*

3 max

- (b) 1. Tenapanor / (Group)B / drug causes a significant increase;
OR
There is a significant difference with Tenapanor / drug / between **A** and **B**;
2. There is a less than 0.05 probability that the difference is due to chance;
3. (More salt in gut) reduces water potential in gut (contents);
4. (so) less water absorbed out of gut (contents) by osmosis
OR
Less water absorbed into cells by osmosis
OR
Water moves into the gut (contents) by osmosis.
OR
(so) water moves out of cells by osmosis.

1. and 2. *Reject references to 'results' being significant / due to chance once only.*

2. *Do not credit suggestion that probability is 0.05% or 5.*

2. *Accept 'There is a greater than 0.95 / 95% probability that any difference between observed and expected is not due to chance'*

4

- (c) 1. (Higher salt) results in lower water potential of tissue fluid;
 2. (So) less water returns to capillary by osmosis (at venule end);
OR
 3. (Higher salt) results in higher blood pressure / volume;
 4. (So) more fluid pushed / forced out (at arteriole end) of capillary;
For 'salt' accept 'sodium ions'.
Do not allow mix and match of points from different alternative pairs
 3. *Accept higher hydrostatic pressure.*

2

[9]

Q7.

- (a) 1. To allow comparison;
 2. Because different number of cells in samples / different times for incubation / numbers become easier to manipulate;
- (b) 203.7(%);;
Allow 1 mark for 21.8 / 10.7
Allow 1 mark for correct answer (203.74) but not correctly to 1 dp
204 = 1 mark
- (c) (i) 1. (At every concentration) uptake is faster at 37°C / at higher temperature;
 2. Due to faster respiration / ATP production;
- (ii) 1. Uptake at 37°C only small increase / levelling off / almost constant as carrier proteins full;
Accept 'no (significant) change'
Ignore use of numbers
 2. Concentration of imatinib is not the limiting factor;

2

2

2

2

[8]

Q8.

- (a) 1. Water potential becomes lower / becomes more negative (as sugar enters phloem);
 2. Water enters phloem by osmosis;
 3. Increased volume (of water) causes increased pressure.
- (b) 1. Rate of photosynthesis related to rate of sucrose production;
 2. Rate of translocation higher when sucrose concentration is higher.
- (c) 1. Rate of translocation does not fall to zero / translocation still occurs after 120 minutes;
 2. But sucrose no longer able to enter cytoplasm of phloem cells.

3

2

2

Q9.

- (a) 1. (Because) same water potential (as valve);
2. (So) prevents loss or gain of water by osmosis / down water potential gradient;
Loss or gain and method of loss or gain must both be in the answer
3. (So) cells / tissues in the valves aren't damaged; 2 max
- (b) 1. Kills / stops growth of bacteria that could cause infection / disease (in patient);
2. Kills / stops growth of bacteria that could damage the valve;
'Kill / stop growth of bacteria' is insufficient without further explanation. 1 max
- (c) (After surgery) valve closes fully / correctly / works so preventing blood flowing back into the heart;

OR

(After surgery) valve closes fully / correctly / works so preventing blood flowing out of the artery;
Do not credit the converse here

1

- (d) 1. (For maximum) mean decreases, to within the normal range;
2. (For minimum) mean increases to within normal range;
3. No overlap in the (means \pm) standard deviation for minimum pressure so there is a real difference;
Ignore references to the differences in maximum pressure
Accept idea of significant difference for 'real difference'
4. Includes wide range of ages of patients; 3 max
- (e) 1. Standard deviation shows that some of the patients will be outside normal pressure range (after surgery);
Accept this as a general statement or in relation to maximum or minimum pressures
2. Small group;
3. Short follow up times;
4. No comparison with other treatments; 2 max
- (f) Don't know the range; 1

Q10.

1. (Drink) contains carbohydrates / sugars **so** High GI / (drink) contains carbohydrates / sugars **so** raises blood glucose concentration quickly;

Each alternative requires both aspects for credit

The second alternative requires a reference to speed eg 'quickly' or 'immediately'

2. Contains salt so glucose more rapidly absorbed;
3. Increases glucose to muscles for respiration;
4. More / faster respiration so more / faster energy release;

Reject reference to energy production

Accept more ATP produced

[3]

Q11.

- (a) Answer of 9.09 / 9.1;; = 2 marks

Calculation of the difference in mean time (2) divided by original time (22); = 1 mark

Ignore number of decimal places as long as they are correct

2

- (b) (Yes)

Can mix and match yes or no approach, all 5 responses are available

(No)

1. Faster running time after sports drink;
'Faster running time in group Q' is insufficient but accept 'faster running time in group Q in Race 2'
2. Mean times given **so** there will be variation in the group;
3. No standard deviations to know the spread of the data (about the mean) / whether they overlap;
Accept 'no stats analysis'
4. Improvement in running time only small in both groups / both groups improved in Race 2;
5. Did not drink the same volumes;

3 max

- (c) 1. Age;

2. Gender / sex;

3. Ethnicity;

4. Food / fluid intake before the race;

Any fluid / food is included here eg coffee, alcohol

5. Amount of sleep / rest / exercise before the race;
6. Reference to one named health factor eg diabetic or non-diabetic, smoker or non-smoker;
Reference to medication is included here

3 max

- (d)
1. Sodium ions and glucose absorbed by co-transport;
Only penalise omission of 'ions' once in marking points 1, 3, 4 and 5
 2. (Co-transport) via carrier / channel protein;
Accept via symport
Only reward reference to carrier / channel proteins in the context of co-transport
 3. Sodium ions removed (from epithelial cell) by active transport into blood;
 4. Maintains low concentration of sodium ions (in epithelial cell) / maintains sodium ion concentration gradient (between small intestine and epithelial cell);
Principle: marking points 3, 5, and 6 require consideration of 'what moves', 'where it moves to' and 'how it moves' to achieve credit
 5. Sodium ions enter epithelial cells by facilitated diffusion taking glucose with them (from small intestine);
Reference to diffuse / diffusion for movement is required.
Accept facilitated diffusion
 6. Glucose moved by facilitated diffusion into blood (from epithelial cells);

4 max

[12]

Q12.

- (a) Variable that is changed;
Reject 'the variable that changes'.
- (b)
1. Idea of a confounding variable;
 2. (So) genetically similar;
2. Do not accept 'genetically identical / same DNA'.
 3. (So) have similar salt tolerance / response to salt water / response to watering treatment;
 4. (So) have similar yield / mass of seeds;
Do not accept 'amount / number of seeds' or 'growth rate'.
- (c) Mitosis;
Ignore cell division
- (d) 1. Irrigation with sea water / **C** / **D** increased yield compared with no

1

2 max

1

irrigation / **A**;

For 'yield' accept 'mass of seed' throughout.

2. Yield was lower when irrigated with sea water / **C** / **D** compared with fresh water / **B**;

Only penalise once for use of 'amount / number of seeds'.

3. Yield was lower when watered with sea water throughout growth and seed formation / **C** than when watered with sea water just at seed formation / **D**;

Accept use of figures from table.

'It' refers to watering with seawater / mixture.

2 max

- (e) 1. Irrigation with sea water / **C** / **D** increases concentration of salt in soil;
Ignore reference to standard deviation / quality of the data.

2. Lower water potential in the soil linked to reduced uptake of water;

3. Salt concentration in the soil might / might not increase in the future;
Mark point 3 includes the principle for mark point 1 so mp3 gains 2 marks (for mp1 and mp3)

4. Might decrease plant growth / yield in the future;

5. Less food / fewer seeds for future planting;

Mp 3 and 4. Allow 'further' for the idea of 'in the future'.

3 max

[9]

Q13.

FOR

1. (If the husband smokes) there's a greater risk of dying from lung cancer / emphysema / cervical cancer;
2. The more the husband smokes, the greater the risk of dying from lung cancer / emphysema;
3. Suitable use of figures from the table to illustrate answer;

AGAINST

4. Little difference in risk of dying of stomach / heart disease;
5. Other factor (than husband smoking) / named factor might cause death;
6. Only one sample / further studies needed;

4 max

[4]

Q14.

- (a)
1. Trachea and bronchi and bronchioles;
 2. Down pressure gradient;
 3. Down diffusion gradient;
 4. Across alveolar epithelium.

Capillary wall neutral

5. Across capillary endothelium / epithelium.

4 max

(b) (About) 80.0%.

1

- (c) 1. (Group **B** because) breathe out as quickly as healthy / have similar FEV to group **A**;
2. So bronchioles not affected;
3. FVC reduced / total volume breathed out reduced.

Allow this marking point for group C

3

[8]

Q15.

- (a) 1. (Curve for) dog falls rapidly at the start but (curve for) sheep falls slowly at first;

*Do **not** allow curve for dog falls more steeply (since from 0.5% NaCl fall in sheep is just as steep as fall in dog)*

2. Sheep doesn't fall rapidly until 0.5 (but dog falls rapidly from 0);

3. (Trend shows that) for any concentration of sodium chloride haemolysis is lower in the dog;

The idea of a trend is required. Statement of individual values alone is insufficient, eg 'at 0.2, 34% in dog and 98% in sheep' is insufficient

Accept dog reaches 0 at lower concentration of sodium chloride than for sheep / dog reaches 0 at 0.38% compared to 0.84 % in sheep;

2 max

(b) 74 to 76;

Accept a value within this range

1

- (c) 1. (Red) colour is due to haemoglobin;

Note: a correct response to marking point 2 also scores marking point 1

2. The more haemoglobin released the more red the solution;

Need idea of haemoglobin release before giving credit

2

- (d) 1. (Use of 0.9%) will not cause haemolysis in any (of the mammals);

Full credit requires statement of marking point 1 and any approach from marking point 2

2. (So) will not kill any of the animals;

or

Only need to use / store / buy one concentration of sodium chloride solution / cheaper to have one concentration of sodium chloride solution / can buy in bulk;

or

Anyone can give it / no need to find out what concentration any animal requires;

Different approaches available for this marking point

2 max

[7]

Q16.

- (a) 1. (No grease)
means stomata are open
OR
allows normal CO₂ uptake;
Allow 'gas exchange' for CO₂ uptake.
'As a control' is insufficient on its own.
2. (Grease on lower surface)
seals stomata
OR
stops CO₂ uptake through stomata
OR
to find CO₂ uptake through stomata
OR
shows CO₂ uptake through cuticle / upper surface;
3. (Grease on both surfaces) shows sealing is effective
OR
stops all CO₂ uptake.

3

- (b) (i) 1. (Mean rate of) carbon dioxide uptake was constant *and* fell after the light turned off;
Ignore absence of arbitrary units in both marking points.
Both ideas needed for mark.
Accept 'stayed at 4.5' as equivalent to 'was constant'.
2. Uptake fell from 4.5 to 0 / uptake started to fall at 60 minutes and reached lowest at 80 minutes / uptake fell over period of 20 minutes;
One correct use of figures required.
Accept fell to nothing / no uptake for 0.
- (ii) 1. (Because) water is lost through stomata;
2. (Closure) prevents / reduces water loss;
3. Maintain water content of cells.
This marking point rewards an understanding of reducing water loss e.g. reduce wilting, maintain turgor, and is not related to photosynthesis.

2

2 max

- (c) (i) (Carbon dioxide uptake) through the upper surface of the leaf / through cuticle.

1

- (ii) 1. No use of carbon dioxide in photosynthesis (in the dark);
 2. No diffusion gradient (maintained) for carbon dioxide into leaf / there is now a diffusion gradient for carbon dioxide out of leaf (due to respiration).

2

[10]

Q17.

- (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.
- (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"
- (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

2

2

2

[8]

Q18.

- (a) 1. Dissolve in alcohol, then add water;
 2. White emulsion shows presence of lipid.
- (b) Glycerol.
- (c) Ester.
- (d) **Y** (no mark)
 Contains double bond between (adjacent) carbon atoms in hydrocarbon chain.
- (e) 1. Divide mass of each lipid by total mass of all lipids (in that type of cell);
 2. Multiply answer by 100.
- (f) Red blood cells free in blood / not supported by other cells so cholesterol helps to maintain shape;
Allow converse for cell from ileum – cell supported by others in endothelium so cholesterol has less effect on maintaining

2

1

1

1

2

shape.

1

- (g) 1. Cell unable to change shape;
2. (Because) cell has a cell wall;
3. (Wall is) rigid / made of peptidoglycan / murein.

2 max

[10]

Q19.

- (a) contain nitrogen-fixing bacteria in roots / nodules (so don't need fertiliser);
nitrogen containing compounds added to the soil
when plant dies / after harvest of crop;

2

- (b) low(er) / more negative water potential in soil (than in the plant);
prevents roots from taking up water (from the soil) / plants still lose water
by transpiration; plants lose water to soil by osmosis;

2

Q20.

- 1.M** Membrane function as selectively permeable barrier
1.T Transport mechanisms across membranes
1.CT Absorption and co-transport of sodium ions and glucose
2.P Photosynthesis, chloroplast, thylakoids
2.R Respiration, mitochondrion and cristae.
2.Ps Protein secretion, RER, SER and Golgi
3.A Surface receptors / antigen and immune response
3.CD Cell division
3.B Vertical and horizontal transmission – membranes and bacteria
3.Pc Pacinian corpuscle
4.Tr Tropisms – movement of IAA
4.N Nerve impulses / action potentials
4.S Synaptic transmission
4.Mc Muscle contraction, calcium ion movement / storage
4.H Hormones - eg Blood glucose regulation – insulin and glucagon
4.O Osmosis, including water movement in plants

Examiners are free to select other letters if they wish

The emphasis in answers should be on the involvement of membranes in processes, not just the processes themselves

Breadth, one mark for use of an example from each of the following approaches:

1. *Membranes – basic functions*
2. *Organelle membranes*
3. *Cell surface membranes*
4. *Processes – eg protein secretion, synaptic transmission, cell division*

[25]

