2.3 TRANSPORT ACROSS CELL MEMBRANES (2) – MARK SCHEME

Q1.

(a) Accept any three suitable properties e.g.:

- Is a metabolite
- Is a solvent
- Has a (relatively) **high** heat capacity
- Has a (relatively) **large** latent heat of vaporisation / evaporation
- Has cohesion / hydrogen bonds between molecules;

No explanations are needed

However do not accept 'polar' unqualified

3 max

(b) Dilution series;

Accept serial dilution

1

(c) 1. Axes correct way round with linear scales;
2. Axes labelled with mol dm^{-3} and ratio without units;
3. Correct values correctly plotted and suitable curve drawn;

3. Accept point to point or smooth curve but no extrapolation

***NFP** – 3. Graph starts just below 1.4 and finishes just above 0.7 and looks right.*

3

(d) 1. (0.8 mol dm^{-3} sucrose) solution has a more negative / lower water potential than potato (cytoplasm);
OR
potato (cytoplasm) has a less negative / higher water potential than (0.8 mol dm^{-3} sucrose) solution;
2. (therefore) water moves out (of potato) into the (sucrose) solution by osmosis (so cells decrease in mass);

1. Accept sucrose solution is hypertonic / potato cytoplasm is hypotonic

*2. Accept water moves **down** a water potential gradient*

2

[9]

Q2.

(a) Regulator protein.

Accept regulator protein antigen

Reject regulator protein receptor

Ignore regular protein

1

(b) 1. Lipid soluble / hydrophobic
2. Enters through (phospholipid) bilayer

OR

3. (Protein part of) LDL attaches to receptor
4. Goes through carrier / channel protein.

4. Accept by facilitated diffusion or active transport

4. Reject active transport through channel protein

2

(c) Any **two** from:

1. (Monoclonal antibody) has a specific tertiary structure / variable region / is complementary to regulator protein

   Do not award MP1 if reference to active site.

2. Binds to / forms complex with (regulator protein)

   "It" refers to monoclonal antibody in MP1 and MP2

3. (So regulator protein) would not fit / bind to the receptor / is not complementary to receptor

   3. Reject receptor on LDL

2 max

(d) 1. Injection with salt solution

   1. Accept inject placebo in salt solution

2. Otherwise treated the same.

2

[7]

Q3.

(a) 1. Uses energy / ATP;

2. Against concentration gradient / low to high concentration;

3. Does not use channel proteins / <u>only</u> 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]

Q4.

(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^3 (of 1.0 mol dm^{-3} sodium chloride solution) and 16 cm^3 (of distilled water);

Reject: factors and multiples of these figures e.g. 2 cm^3 and 8 cm^3, as final volume should be 20 cm^3

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^{-3})

1

[8]

Q5.

(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]

Q6.

(a) Binary fission;

Reject mitosis

1

(b) 1. Keep lid on Petri dish
OR
Open lid of Petri dish as little as possible.

2. To prevent unwanted bacteria contaminating the dish.
OR
L. monocytogenes may be dangerous / may get out.

OR

3. Wear gloves
OR
Wear mask
OR
Wash hands;

4. To prevent contamination from bacteria on hands / mouth
OR
Prevent spread of bacteria outside the lab;

OR

5. Use sterile pipette
OR
Flame the loop
OR
Flame the neck of the container of the culture;

6. To maintain a pure culture of bacteria

4 max

(c) Cinnamon;

1

(d) 1. Thyme is the most effective / best (at 4 °C);

2. Clove and cinnamon same effectiveness at 4 °C as 35 °C (so suitable);

3. Bay and nutmeg are less effective at 4 °C than 35 °C (so unsuitable).

3

(e) Less kinetic energy
OR
Less movement of oil molecules / of phospholipid molecules

1 max

[10]

Q7.

(a) 1. (If) too much water the concentration of pigment (in solution) will be lower / solution will appear lighter / more light passes through (than expected);
OR
(If) too little water the concentration of pigment (in solution) will be greater / solution will appear darker / less light passes through (than expected);
2. So results (from different temperatures) are comparable;

1. Ignore reference to too much water so red pigment / solution too weak to measure

2

(b) (Take) reading**s** (during the experiment) using a (digital) thermometer / temperature sensor;

1

(c) Point-to-point line drawn between co-ordinates (with a ruler);
OR
Smooth s-shaped line of best fit;

Reject any extrapolations below 20 °C or above 80 °C

Any line should look smooth (not 'sketchy')

1

(d) 1. Damage to (cell surface) membrane;

2. (membrane) proteins denature;

3. Increased fluidity / damage to the phospholipid bilayer;

2 max

[6]

Q8.

(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]

Q9.

(a) Calculations made (from raw data) / raw data would have recorded initial and final masses.

1

(b) Add 4.5 cm^3 of (1.0 mol dm^{-3}) solution to 25.5 cm^3 (distilled) water.
If incorrect, allow 1 mark for solution to water in a proportion of 0.15:0.85

2

(c) 1. Water potential of solution is less than / more negative than that of potato tissue;
Allow Ψ as equivalent to water potential

2. Tissue loses water by osmosis.

2

(d) 1. Plot a graph with concentration on the *x*-axis and percentage change in mass on the *y*-axis;
2. Find concentration where curve crosses the *x*-axis / where percentage change is zero;
3. Use (another) resource to find water potential of sucrose concentration (where curve crosses *x*-axis).

3

[8]

Q10.

(a) (i) 11g sucrose dissolved in water (and made up to) 50 cm^3 / 50g;

1

(ii) make a series of volumes of 22% sucrose solutions;
measure how far each travels up the chromatography paper;

2

(b) (i) both (volume) of nectar and (mass) of sucrose / sugar increased by regular removal;

(proportionately) greater effect on nectar than sucrose;

2

(ii) nectar from flower B has greater concentration of sugar;

(accept references to figures (A has 6.2 – 6.6 µg mm^{-3}, B has 12 – 12.4 µg mm^{-3}))

1

(iii) nectar always available for insects;

1

(c) (adding sucrose solution) decreases nectar secretion / less nectar produced than control;

(allow correct processed figures)

1

adding sucrose solution results in reabsorption of sugar

(gains 2 marks);;

(BUT adding sucrose solution reduces secretion of sugar in nectar / sugar moved out gains 1 mark);

2

(d) via (intrinsic) proteins;

(reject channel proteins)

using ATP / active transport / energy;

2

[12]

Q11.

(a) phospholipids in a double layer / area covered is twice total surface area of red blood cells;
evidence of calculation of number × surface area ($4.74 \times 10^9 \times 99.4\ \mu m^2$) /
calculation of area of 1 cell $\frac{0.92}{4.74 \times 10^{-9}}$;
0.471 $m^2 \approx 0.5 \times 0.92\ m^2$ / 194 µm ≈ 2 × 99.4;

3

(b) EITHER feature + explanation
red blood cells do not contain organelles / nucleus;
so only surface membrane / no internal membranes in macerate;
OR
red blood cells have simple / regular / spherical shape;
so easy to calculate surface area;
OR
any two features, e.g.
simple / regular shape;
all same size;

2

[5]

Q12.

(a) (i) **A** = phospholipid

B = protein;

(both correct)

1

(ii) allows movement of lipid soluble / non-polar molecules / named e.g. water / gases;
prevents movement of water soluble / polar molecules / named e.g. ions / amino acids;
idea of selection / membrane partially / differentially permeable / large molecules do not move through, small molecules do;
(accept semi-permeable)

2 max

(b) (i) diffusion
(reject facilitated)

1

(ii) higher rate of exchange / diffusion;
prevents cooling of the blood / prevents increase in viscosity;

2

(iii) concentration gradient maintained / equilibrium never achieved;
blood always meets fluid with lower concentration of urea;
diffusion / exchange along the whole length of surface;

2 max

(iv) $0.2 \times 60 = 12\ dm^3\ h^{-1}$;
(principle: volume per hour)

$12 \times 5 = 60\ dm^3$;
(correct answer 2 marks)

2

[10]

Q13.

(a) sterilisation of equipment (*once*);
use of pipette / syringe to transfer culture suspension to plate;
use of spreader / shake ;
detail regarding lid, e.g. keeping over plate during transfer / spreading;

3 max

(b) 2.25 = 2 marks
(*general principle* $(1.5^2 \div 1^2)$ *gains 1 mark*)

2

(c) increased temperature increases rate;
increased concentration increases rate;
increased molecule size decreases rate;
(allow increased distance decreases rate)

3 max

[8]

Q14.

(a) (i) potato more negative water potential / hypertonic;
(accept more concentrated)

water enters by osmosis causing cells to extend / become turgid;

2

(ii) little / no water remaining in potato / fully plasmolysed /
all water has moved out;

cell wall prevents further shrinkage / sucrose solution moves in;

or, water potentials are equal / equilibrium / isotonic;
no net movement of water / no further osmosis;

2

(b) (i) faster rate (of decrease) in 0.8 mol dm^{-3};

1

(ii) bigger water potential gradient / greater difference in water potentials (between potato and surrounding solution);

1

(c) (i) water moved into the solution from the potato;
solution diluted / becomes less concentrated;

2

(ii) no net movement of water (in or out);
drops move up / less dense;

or, no net movement of water (in or out);

drop would not move / densities the same;

2

[10]

Q15.

(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]

Q16.

(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]

Q17.

(a) 1. Sodium ions actively transported from ileum cell to blood;

2. Maintains / forms diffusion gradient for sodium to enter cells from gut (and with it, glucose);

3. Glucose enters by facilitated diffusion with sodium ions;

3

(b)

Biochemical test	Liquid from beaker	Liquid inside Visking tubing
Biuret reagent		✔
I_2/KI		✔ or blank
Benedict's	✔	✔

1 mark for each correct row

3

(c) 1. Biuret: protein molecules too large to pass through tubing;
Neutral: enzyme molecules

2. Iodine in potassium iodide solution: starch molecules too large to pass through tubing;
If no tick in 04.2, allow no starch hydrolysed

3. Benedict's: starch hydrolysed to maltose, which is able to pass through tubing.
Reject: glucose

3

[9]

Q18.

(a) 1. Concentration of mineral ion/named mineral ion in soil;
2. Soil pH;
3. Temperature;
4. Light intensity / wavelength / duration;
5. Distance between seeds / plants;
6. Volume of water given;
7. CO_2 concentration;
8. Humidity;

1 and 2. Allow 'growing solution' for 'soil'.

2. pH alone is insufficient.

3. Allow 'colour of light'

Reject 'amount' for mps 1, 4, 6 and 7.

Ignore O_2 concentration

Three correct = 2 marks

Two correct = 1 mark

One or none correct = 0 marks

2 max

(b) 1. 2,4-D causes an increase in release of ions from wild oat cells **and** 2,4-D does not affect / has little effect on the release of ions from wheat cells;

2. (For wheat) Difference is less than LSD / 7 **so** <u>difference</u> is not significant;
OR
(For wild oats) Difference is more than LSD / 10 **so** <u>difference</u> is significant;

3. Loss of ions from cells (likely to) lead to cell / plant death/damage;
OR
Disruption of cell membrane (likely to) lead to cell / plant death / damage;

4. No evidence here about death of plants as a result of this ion loss;

5. No evidence here of other ecological/environmental impact;

1. Accept reference to 'concentration of ions in water' or 'disruption of the cell membranes' in place of 'release of ions'

*1. Accept 'difference in release of ions from wild oats is 25 **and** difference in release of ions from wheat is 1'*

*2. Accept '(For wheat) difference is less than LSD **so** greater than 5% probability that <u>difference</u> is due to chance'*

OR

*'(For oats) difference is more than LSD **so** less than 5% probability that <u>difference</u> is due to chance'*

5. Accept 'development of resistance'

4 max

(c) 1. (Maintain temperature) so that the rate of diffusion (of ions out of cells) remains constant
OR
(Maintain temperature) so no change in fluidity of phospholipids / kinetic energy of phospholipids;
OR
(Maintain temperature) so no change in shape / structure / denaturation of membrane proteins;

2. (Shaking) So all surfaces of the leaf discs are exposed (to water) / so all submerged;
OR
To maintain diffusion / concentration gradient (for ions out of leaf discs);

1. Ignore references to rate of enzyme catalysed reactions

2. Accept 'so that leaf discs do not stick together'

2

[8]

Q19.

(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

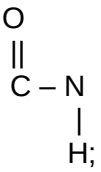
[7]

Q20.

(a) Rate of movement / diffusion proportional to concentration gradient / difference in concentration;
High concentration of potassium ions inside cell compared to outside;
Must mention high concentration. Ignore reference to other factors if reasoning is appropriate.

2

(b) (i)



1

(ii) 10;

1

(c) Action of vanilomycin depends on fluidity of membrane;
Fluidity reduced / not fluid at low temperatures;
Pore formed by gramicidin A remains in place / permanent;

3

(d) Pore between sterol molecules lined with polyene antibiotic;
Hydrophobic region next to sterol;

2

[9]

Q21.

(i) In all cases reject 'energy' unless qualified

A – facilitated diffusion as transport protein needed but ATP not needed;
B – active transport 'energy' unless as (transport protein and) ATP needed; qualified
C – (simple) diffusion as neither ATP nor transport protein needed;
(Ignore all references to concentration gradients)

3

(ii) creates low concentration of amino acids / Na^+ in cell concentration gradient established between lumen and cell (of amino acids or Na^+)

2

[5]

Q22.

(a) (i) 31 / 31.2;

1

(ii) Ratio would be less / smaller;
Cell is thin / has large surface area / (adapted) for diffusion;
Accept converse. Must relate to concept of ratio.

2

(b) (i) 6;

1

(ii) 11;

1

(c) Water potential inside vesicle more negative / lower;
Water moves into vesicle by osmosis / diffusion;

2

(d) Mitochondria supply energy / ATP;
For active transport / absorption against concentration gradient / synthesis / anabolism / exocytosis / pinocytosis;
Do not credit references to making, creating or producing energy.

2

(e) 1 Phospholipids forming bilayer / two layers;
2 Details of arrangement with "heads" on the outside;
3 Two types of protein specified;
e.g. passing right through or confined to one layer /
extrinsic or intrinsic /
channel proteins and carrier proteins /
two functional types
4 Reference to other molecule e.g. cholesterol or glycoprotein;
5 Substances move down concentration gradient / from high to low concentration;
Reject references to across or along a gradient
6 Water / ions through channel proteins / pores;
7 Small / lipid soluble molecules / examples pass between phospholipids / through phospholipid layer;
8 Carrier proteins involved with facilitated diffusion;
Ignore references to active transport.
Credit information in diagrams.

max 6

[15]

Q23.

(i) less / no <u>calbindin</u> protein;
{reject carrier protein)
calcium not transported / moved (across the cytoplasm);
so diffusion gradient reduced at small intestine interface;

2

(ii) **A** is channel / pore protein (for calcium ions);
passage by <u>facilitated</u> diffusion down diffusion / concentration gradient;

2

B is carrier protein(for calcium ions);
passage by active transport against concentration gradient / requires energy / ATP;

2

[6]

Q24.

(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]

Q25.

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

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

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

Only penalise <u>once</u> if active transport is not named
e.g. 'movement against the concentration gradient involves proteins and requires ATP' = 2 marks

5. Active transport / <u>facilitated diffusion</u> involves proteins / carriers;

Accept: facilitated diffusion involves channels
Reject: active transport involves channels

6. Active transport requires energy / ATP;

7. Ref. to Na^+ / 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]

Q26.

(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]

Q27.

(a) (i) Substance that causes an immune response / production of antibodies;

Ignore foreign / non-self

1

(ii) 1. Not lipid soluble;

2. Too large (to diffuse through the membrane);

3. Antigens do not have the complementary shape / cannot bind to receptor / channel / carrier proteins (in membranes of other epithelial cells);

2 max

(b) 1. (Vaccine contains) antigen / attenuated / dead pathogen;

1. Reject if in context of injection of vaccine

2. T-cells activate B-cells;

3. B-cells divide / form clone / undergo mitosis;

4. Plasma cells produce antibodies;

5. Memory cells produced meaning more antibodies / antibodies produced faster in secondary response / on reinfection;

5

[8]

Q28.

(a) 1. Na^+ ions leave epithelial cell and enter blood;

Penalise for Na without ions once.

2. (Transport out is by) active transport / pump / via carrier protein using ATP;

Reject channel protein

3. So, Na^+ conc. in cell is lower than in lumen (of gut);

Maintains diffusion gradient for Na^+ from lumen/into cells;

4. Sodium/Na^+ ions enter by <u>facilitated</u> diffusion;

Accept diffusion/from high to low concentration through a symport/cotransport protein

5. Glucose absorbed with Na^+ ions against their concentration/diffusion gradient / glucose absorbed down an electrochemical gradient;

Accept glucose absorbed with sodium ions by indirect active transport

5

(b) 1. Chloride ions water soluble/charged/polar;

Penalise chloride molecules only once

Ignore ref to size

Accept not lipid soluble

2. Cannot cross (lipid) bilayer (of membrane);
3. Chloride ions transported by facilitated diffusion OR diffusion involving channel/carrier protein;
4. Oxygen not charged/non-polar;

Accept oxygen lipid soluble

5. (Oxygen) soluble in/can diffuse across (lipid) bilayer;

5

[10]

Q29.

(a) Correct answer 23.55 – 24 two marks;
For one mark
5.9
OR
94.2;

2

(b) 1. Method for measuring area;
e.g. draw round (each) leaf on graph paper and count squares;
2. Of both sides of (each) leaf;
3. Divide rate (of water loss / uptake from potometer) by (total) surface area (of leaves);

3

(c) Plant has roots
OR
xylem cells very narrow;

Ignore references to air bubbles / mass flow / photosynthesis

Accept xylem damaged when cut

1

(d) 1. Both small / similar size (so fit channel);
2. Have a similar shape (so bind to / fit channel);

1. Accept same height and width

Ignore refs to polar / non-polar

2. Accept Aquaporin complementary to oxygen(s)

2

(e) 1. Single-stranded RNA (has base sequence) complementary to PIP1 mRNA;
2. Binds to mRNA (of PIP1) / leads to destruction of mRNA;
3. Prevents / reduces translation (of PIP1);
4. Reduces photosynthesis/named process that uses water;

3. Less made is insufficient

3 max

(f) Not all of mRNA bound to single-stranded RNA / there is more mRNA than interfering RNA
OR
Not all mRNA destroyed / disabled;

Accept mutations in transgene,

Accept not all cells with transgenes

1

(g) 1. Loss of PIP reduces water **and** carbon dioxide movement;
2. Differences significant because SDs don't overlap
OR
Need stats test to see whether significant differences (or not);
3. Greater (proportional) effect on carbon dioxide transport;
4. Not all movement through PIP;

1. Accept converse for wild type

2. Reject references to results significant or not significant

2. Accept error bars for SDs

3 max

[15]

Q30.

(a) 1. permeable capillary wall / membrane;
2. single cell thick / thin walls, reduces diffusion distance;
3. flattened (endothelial) cells, reduces diffusion distance;
4. fenestrations, allows large molecules through;
5. small diameter / narrow, gives a large surface area to volume / short diffusion distance;
6. narrow lumen, reduces flow rate giving more time for diffusion;
7. red blood cells in contact with wall / pass singly, gives short diffusion distance / more time for diffusion;

(allow 1 mark for 2 features with no explanation)

4 max

(b) 1. (hydrostatic) pressure of blood high at arterial end;
2. fluid / water / soluble molecules pass out (*reject plasma*);
3. proteins / large molecules remain;
4. this lowers the water potential / water potential becomes more negative;
5. water moves back into venous end of capillary (*reject tissue fluid*) by osmosis / diffusion;
6. lymph system collects any excess tissue fluid which returns to blood / circulatory system / link with vena cava / returns tissue fluid to vein;

6

[10]

QWC 1