**Q1.**

The diagram shows the structure of the cell-surface membrane of a cell.



(a)     Name **A** and **B.**

**A** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**B** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**(2)**

(b)     (i)      **C** is a protein with a carbohydrate attached to it. This carbohydrate is formed by joining monosaccharides together. Name the type of reaction that joins monosaccharides together.

Name the type of reaction that joins monosaccharides together.

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**(1)**

(ii)     Some cells lining the bronchi of the lungs secrete large amounts of mucus. Mucus contains protein.

Name **one** organelle that you would expect to find in large numbers in a mucus-secreting cell and describe its role in the production of mucus.

Organelle\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Description of role \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

**(Total 5 marks)**

**Q2.**

(a)  Describe how an ATP molecule is formed from its component molecules.

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**(4)**

A scientist investigated the effect of cyanide on the rate of amino acid uptake in two types of *Escherichia coli*, **G** and **H**.

•   **G** cells produce enzymes involved in ATP production **only** on their cell-surface membrane.

•   **H** cells produce enzymes involved in ATP production on their cell-surface membrane **and** in their cytoplasm.

The graph below shows her results.



(b)  Use the graph above to calculate the percentage decrease in the rate of amino acid absorption by **H** cells in 30 mmol dm–3 cyanide solution.

Answer \_\_\_\_\_\_\_\_\_\_ %

**(1)**

(c)  Using the graph above and the information provided, what can you conclude about amino acid uptake by **G** cells and by **H** cells?

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**(3)**

**(Total 8 marks)**

**Q3.**

A student investigated the effect of ethanol, hydrochloric acid and temperature on the loss of red pigment from beetroot cells.

During the procedure, the student:

•        added 10 cm3 water into one test tube

•        added 10 cm3 ethanol into a second test tube

•        added 10 cm3 hydrochloric acid into a third test tube

•        put the three tubes into a 25 °C water bath

•        cut four cylinders of tissue from a beetroot

•        put a cylinder into each tube and fitted bungs

•        added 10 cm3 water into a fourth test tube and put this tube into a 70 °C water bath

•        placed the fourth cylinder into this tube and fitted a bung

•        later removed the cylinders from the tubes

•        estimated the intensity of red pigment in each solution by eyesight.

(a)     Give **one** way in which the student could ensure the first three beetroot cylinders were kept at 25 °C throughout her experiment.

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**(1)**

(b)     Give **two** variables that the student did **not** control in her procedure.

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2 \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(c)     The student used a measuring cylinder to obtain 10 cm3 of each solution.

**Figure 1** shows some of the scale graduations on the side of this measuring cylinder.

**Figure 1**

****

What is the uncertainty of taking a reading of 10 cm3 with this measuring cylinder?

Suggest how you could reduce the uncertainty calculated.

Uncertainty ± \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ cm3

Reducing uncertainty \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

A different student used the same procedure and she controlled **all** variables appropriately. Her results are shown in **Figure 2**.

**Figure 2**

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(d)     Using **Figure 2**, what can you conclude about the damage caused to beetroot cells by water, ethanol, hydrochloric acid and different temperatures?

Provide explanations for your conclusions.

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**(4)**

**(Total 9 marks)**

**Q4.**

(a)     Give **two** similarities in the movement of substances by diffusion and by osmosis.

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**(2)**

A scientist measured the rate of uptake of a monoglyceride and a monosaccharide by epithelial cells of the small intestine of mice. A monoglyceride is a molecule of glycerol with one fatty acid attached. She did this for different concentrations of monoglyceride and monosaccharide.

Her results are shown in the graph.



(b)     Use your knowledge of transport across membranes to explain the shape of the curve in the graph for uptake of monosaccharides between concentrations:

**A** and **B** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**C** and **D** \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(3)**

(c)     The graph is evidence for monoglycerides being lipid-soluble molecules.

Suggest how.

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**(2)**

**(Total 7 marks)**

**Q5.**

2,4-D is a selective herbicide that kills some species of plants but not others. 2,4-D disrupts cell-surface membranes but the extent of disruption differs in different species.

Scientists investigated the effect of 2,4-D on wheat plants (a crop) and on wild oat plants (a weed).

They grew plants of both species in glasshouses. They put plants of each species into one of two groups, **W** and **H**, which were treated as follows:

•   Group **W** – leaves sprayed with water

•   Group **H** – leaves sprayed with a solution of 2,4-D.

After spraying, they cut 40 discs from the leaves of plants in each group and placed them in flasks containing 10 cm3 de-ionised water. After 5 minutes, they calculated the disruption to cell-surface membranes by measuring the concentration of ions released into the water from the leaf discs.

Their results are shown in the table below.

The lowest significant difference (LSD), is the smallest difference between two means that would be significant at P≤0.05

|  |  |  |
| --- | --- | --- |
| **Group** | **Treatment** | **Mean concentration of ions in water / arbitrary units** |
| **Wheat** | **Wild oats** |
| **W** | Water | 26 | 45 |
| **H** | 2,4-D | 27 | 70 |
| Lowest significant difference (LSD) |   | 7 | 10 |

(a)     Give **three** environmental variables that should be controlled when growing the plants before treatment with the different sprays.

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**(2)**

(b)     Evaluate the use of 2,4-D as a herbicide on a wheat crop that contains wild oats as a weed. Use all the information provided.

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**(4)**

(c)     The scientists incubated the flasks containing the leaf discs at 26 °C and gently shook the flasks.

Suggest **one** reason why the scientists ensured the temperature remained constant and **one** reason why the leaf discs were shaken.

Temperature \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

**(Total 8 marks)**

**Q6.**

A scientist investigated the uptake of sodium ions by animal tissue.
To do this, he:

•        used two flasks, **F** and **G**

•        put equal masses of animal tissue into each flask

•        added equal volumes of a solution containing sodium ions to each flask

•        added to flask **F** a solution of a substance that prevents the formation of ATP by cells

•        measured the concentration of sodium ions **remaining** in the solution in each flask.

The graph below shows his results.

 
                        Time / minutes

(a)     Calculate the rate of uptake of sodium ions by the tissue in flask **G** during the first 20 minutes of this investigation.

Answer = \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ arbitrary units per minute

**(1)**

(b)     The scientist concluded that the cells in flask **G** took up sodium ions by active transport. Explain how the information given supports this conclusion.

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**(4)**

(c)     The curve for flask **F** levelled off after 20 minutes. Explain why.

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**(2)**

**(Total 7 marks)**

**Q7.**

A group of students carried out an investigation to find the water potential of potato tissue.

The students were each given a potato and 50 cm3 of a 1.0 mol dm−3 solution of sucrose.

•        They used the 1.0 mol dm−3 solution of sucrose to make a series of different concentrations.

•        They cut and weighed discs of potato tissue and left them in the sucrose solutions for a set time.

•        They then removed the discs of potato tissue and reweighed them.

The table below shows how one student presented his processed results.

|  |  |
| --- | --- |
| **Concentration of sucrose solution / mol dm−3** | **Percentage change in mass of potato tissue** |
| 0.15 | +4.7 |
| 0.20 | +4.1 |
| 0.25 | +3.0 |
| 0.30 | +1.9 |
| 0.35 | −0.9 |
| 0.40 | −3.8 |

(a)     Explain why the data in the table above are described as **processed** results.

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**(1)**

(b)     Describe how you would use a 1.0 mol dm−3 solution of sucrose to produce 30 cm3 of a 0.15 mol dm−3 solution of sucrose.

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**(2)**

(c)     Explain the change in mass of potato tissue in the 0.40 mol dm−3 solution of sucrose.

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**(2)**

(d)     Describe how you would use the student’s results in the table above to find the water potential of the potato tissue.

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**(3)**

**(Total 8 marks)**

**Q8.**

Water and inorganic ions have important biological functions within cells.

(a)     Give **two** properties of water that are important in the cytoplasm of cells.

For each property of water, explain its importance in the cytoplasm.

Property 1\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Biological importance within cells\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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Property 2\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Biological importance within cells\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(4)**

(b)     Other than sodium, name **one** inorganic ion and give **one** example of its biological importance in a cell.

Name of inorganic ion\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

Biological importance\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

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**(2)**

(c)     Compare and contrast the processes by which water and inorganic ions enter cells.

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**(3)**

**(Total 9 marks)**

**Q9.**

(a)     Glucose is absorbed from the lumen of the small intestine into epithelial cells.

Explain how the transport of sodium ions is involved in the absorption of glucose by epithelial cells.

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**(5)**

(b)     Oxygen and chloride ions can diffuse across cell-surface membranes. The diffusion of chloride ions involves a membrane protein. The diffusion of oxygen does not involve a membrane protein.

Explain why the diffusion of chloride ions involves a membrane protein and the diffusion of oxygen does not.

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**(5)**

**(Total 10 marks)**

**Q10.**

A scientist placed plant cells in solutions containing different concentrations of calcium ions. She measured the rate of uptake of calcium ions by plant cells.

The graph below shows her results.



(a)     What can you conclude from the graph about the processes involved in the uptake of calcium ions by these plant cells?

Use evidence from the graph to support your answer.

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**(5)**

(b)     Suggest **one** way in which the scientist could have ensured the solutions she used for curve **X** contained **no** oxygen.

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**(1)**

**(Total 6 marks)**

Mark schemes

**Q1.**

(a)     1.       **A**: phospholipid (layer);

*1. Reject hydrophobic / hydrophilic phospholipid*

2.      **B**: pore / channel / pump / carrier / transmembrane / intrinsic / transport protein;

*2. Ignore unqualified reference to protein*

**2**

(b)     (i)      Condensation (reaction);

**1**

(ii)     Organelle named; Function in protein production / secretion;

*Function must be for organelle named*

*Incorrect organelle = 0*

eg

1.      Golgi (apparatus);

*1. Accept smooth endoplasmic reticulum*

2.      Package / process proteins;

***OR***

3.      Rough endoplasmic reticulum / ribosomes;

*3. Accept alternative correct functions of rough endoplasmic reticulum. ER / RER is insufficient*

*3. Accept folding polypeptide / protein*

4.      Make polypeptide / protein / forming peptide bonds;

***OR***

5.      Mitochondria;

6.      Release of energy / make ATP;

*6. Reject produce / make energy*

*6. Accept produce energy in the form of ATP*

***OR***

7.      Vesicles;

8.      Secretion / transport of protein;

**2**

**[5]**

**Q2.**

(a)     1. and 2. Accept for 2 marks correct names of three components adenine, ribose/pentose, three phosphates;;

*Accept for 1 mark, correct name of two components*

*Accept for 1 mark, ADP* ***and*** *phosphate/Pi*

*Ignore adenosine*

*Accept suitably labelled diagram*

3. Condensation (reaction);

*Ignore phosphodiester*

4. ATP synthase;

*Reject ATPase*

**4**

(b)     Correct answer for 1 mark = 57/57.1;

**1**

(c)     1.      (Amino acid uptake by) active transport;

*Accept for ‘transport’, process*

2.      Cyanide reduces/stops amino acid uptake;

3.      ATP production stops on membranes

**OR**

Enzymes not working on membranes;

4.      ATP production continues in cytoplasm

**OR**

Enzymes active in cytoplasm;

**3 max**

**[8]**

**Q3.**

(a)     Measure temperature (in tube) at intervals **and** use appropriate corrective measure (if temperature has fluctuated);

*Accept use thermometer/probe/ equivalent device for measure temperature*

**1**

(b)     1.      Length **and** diameter

**OR**

Surface area

**OR**

Volume

**OR**

Mass/weight (of cylinders);

*Ignore shape/size*

2.      Time in solution;

*Ignore ‘time’ if unqualified*

**2**

(c)     1.      1;

2.      Use instrument with closer/finer/smaller intervals/graduations/scale;

*Accept correct numerical figure, eg <2 (cm3)*

*Ignore ‘higher resolution’*

**2**

(d)     1.      Water/25oC caused no damage/no pigment release (in E);

*Accept no colour/intensity change for ‘pigment’*

*Accept ‘high temperature’ for 70°C*

*Accept description of 'pigment release' for 'damage'*

2.      (Damage to) cell(-surface) membrane;

*Accept description of membrane, eg phospholipid bilayer/bilayer*

3.      Ethanol/acid caused some/similar/identical damage

**OR**

70oC caused most damage;

*Accept description of ‘pigment release’ for ‘damage’*

4.      (By) ethanol dissolving phospholipid bilayer

**OR**

(By acid) altering membrane protein;

*Accept carrier OR channel OR intrinsic OR extrinsic protein for membrane protein*

5.      (By) 70oC denaturing/altering membrane protein

**OR**

(By) 70oC increasing fluidity/permeability of membrane;

*Accept carrier OR channel OR intrinsic OR extrinsic protein for membrane protein*

*Ignore reference to enzymes unless qualified as membrane bound*

**4 max**

**[9]**

**Q4.**

(a)     1.      (Movement) down a gradient / from high concentration to low concentration;

*Ignore along / across gradient*

*Reject movement from gradient to gradient*

2.      Passive / not active processes;

**OR**

Do not use energy **from** respiration / **from** ATP / **from** metabolism;

**OR**

Use energy **from** the solution;

*Reject do not use energy unqualified*

**2**

(b)     1.      Movement through carrier proteins;

**OR**

Facilitated diffusion;

**Between A and B**

*Accept MP1 in either section*

*Ignore co-transport / active transport*

*Accept channel proteins*

2.      Rate of uptake proportional to (external) concentration;

**Between C and D**

*Accept description of proportional*

3.      All channel / carrier proteins in use / saturated / limiting;

*Accept used up*

*Accept transport proteins*

**3**

(c)     1.      Rate of uptake is proportional / does not level off (so diffusion occurring);

*Accept as one increases the other increases*

2.      (Lipid-soluble molecules) diffuse through / are soluble in phospholipid (bilayer);

**2**

**[7]**

**Q5.**

(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.      CO2 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 O2 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** difference is not significant;

**OR**

(For wild oats) Difference is more than LSD / 10 **so** difference 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 difference is due to chance’*

***OR***

*‘(For oats) difference is more than LSD* ***so*** *less than 5% probability that difference 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]**

**Q6.**

(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]**

**Q7.**

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

**1**

(b)     Add 4.5 cm3 of (1.0 mol dm–3) solution to 25.5 cm3 (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]**

**Q8.**

(a)     1.      Polar molecule;

2.      Acts as a (universal) solvent;

**OR**

3.      (Universal) solvent;

4.      (Metabolic) reactions occur faster in solution;

**OR**

5.      Reactive;

6.      Takes place in hydrolysis / condensation / named reaction;

*Polar molecule so acts as (universal) solvent so (metabolic reactions are faster = 3 marks*

**4**

(b)     Name of ion;

Correct function within cell;

*Ions other than sodium in specification are H+, Fe2+ and PO43– but accept any correct ion (other than sodium) plus relevant function = 2.*

*Allow ion to be named in words but not as element, e.g, iron ion but not iron.*

**2**

(c)     1.      Comparison: both move down concentration gradient;

2.      Comparison: both move through (protein) channels in membrane;

*Accept aquaporins (for water) and ion channels*

3.      Contrast: ions can move against a concentration gradient by active transport

**3**

**[9]**

**Q9.**

(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 facilitated 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]**

**Q10.**

(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]**

Examiner reports

**Q1.**

(a)     The majority of students gained both of the marks on this question, although some failed to score because they made unqualified references to protein or lipid. Although some students had learnt the term ‘integral protein’, few qualified this to show they recognised this integral protein spanned the membrane. A few answers referred to guard cells, microvilli and mitochondria, suggesting that the students had not understood the difference between the molecular structure of a membrane and the gross structure of cells or organelles.

(b)     (i)       Most students knew this term although some were clearly guessing between condensation and hydrolysis, having written both down and then crossed out one or other of the terms.

(ii)     The great majority of students gave mark points 3 and 4, with a few failing to score because they used abbreviations such as ER or RER. These abbreviations were not accepted, since students were asked to name the organelle. The full name endoplasmic reticulum is given in the specification, with no abbreviation offered as an alternative. Where Golgi was given as the organelle, the associated function was not often correctly linked to protein formation. For mark point 6 (release of energy / make ATP), references to producing or making energy were not given credit. Incorrect references to cilia, microvilli, stomach acids and lysosomes suggested that some students did not understand what was meant by the term organelle.

**Q3.**

(a)     Most answers successfully suggested it was a method to measure and monitor the temperature of the solutions over time. However, almost all then assumed that the temperature of the waterbath would not change during the investigation and made no mention of a suitable corrective measure.

(b)     This question discriminated well because it gave credit to those who described an aspect of cylinder size, such as measuring the surface area, mass or volume. Descriptions in which the dependent variable or the independent variable was given as a control variable was a common misconception.

(c)     Approximately 20% of answers identified the correct uncertainty (±1), with many giving a figure of 2 (a correct scale reading, but the value was not halved) or 0.5 (an incorrect scale reading which was halved). Many students suggested using a valid type of graduated scale to reduce the uncertainty of measurement, although suggestions referring to increased resolution or better reading of the meniscus gained no mark.

(d)     This question produced answers covering the full range of marks with a mean of 2 marks. Many students successfully described the different levels of pigment release from the shading given in the figure. Those who focussed on the damage caused to cell-surface membranes achieved more marks, but many referred to cell walls rather than cell-surface membranes or made vague references to ‘the damage caused to cells’ in general.

**Q4.**

Most answers to (a) achieved one mark for describing the movement of substances down a gradient. Some went further to identify the concentration gradient in diffusion and the water potential gradient in osmosis. No marks were awarded when movement was described inaccurately as being along or across a gradient, or from one gradient to another gradient. A commonly held misconception about passive processes was found in a large number of answers which described these processes as ‘requiring no energy’.

Many students answered question (b) well by applying an understanding of facilitated diffusion to explain the shape of the curve and 9.3% of them achieved all three marks. Often these explanations demonstrated logical progression of thought, by describing a trend in the data and explaining how the action of carrier proteins accounted for it. The principles of diffusion were well understood. The most common errors were to suggest that the loss of a concentration gradient accounted for levelling off in the curve or to write about no uptake between C and D: they suggested these students had not taken sufficient notice of the y-axis label. The description of a correlation, to achieve the second marking point, was often little more than a ramble of tortuously unclear comparisons. A significant minority referred incorrectly to enzyme active sites in the context of carrier proteins.

In question (c), on the whole, students demonstrated good ability to apply their understanding of facilitated diffusion and membrane structure to the graph and scored marks. Their ability to describe the relationship shown by the monoglyceride curve, however, was weaker. Many described the change in rate as ‘constant’, when what they really meant was ‘constant increase’, or they did not include both variables in the description of the relationship. Some stated incorrectly that concentration had no effect on the rate of uptake. Most students understood that the graph indicated the absence of active transport and carrier proteins. Students often went on to discuss the phospholipid bilayer, but occasionally failed to mention diffusion or the solubility of monoglycerides in the bilayer.

**Q5.**

This question was based on required practical activity 4 – an investigation into the effect of a named variable on the permeability of cell-surface membranes. The practical skills assessed here are found in section 8.3 of the specification.

(a)     Some good understanding was demonstrated here, but students often failed to gain credit due to poor use of language. “Amount” and “level” are not accepted units; pH and light must be qualified, e.g. ‘soil pH’ and ‘light intensity’, and ‘nutrients’ is not an acceptable alternative to mineral ion concentration at this level.

(b)     A very small number of students achieved 4 marks here. The most commonly awarded mark was for identifying that 2,4-D increased the release of ions from wild oats but had very little effect on wheat (mark point 1). There was quite a lot to read and understand in the stem of the question, and some students did not appreciate that disruption of the cell-surface membranes was linked to loss of ions, and so damage to the plant itself. Some students confused these ions from leaves with ions in the soil and consequently suggested greater ion concentration in the water would allow more ion uptake, to be used for growth. The lowest significant difference (LSD) was a novel context, and many students did not read / understand the explanation, and assumed the LSD was a form of standard deviation.

(c)     Unfortunately, many students did not fully link the context of this question to the practical they had carried out, and so were not confident in their suggestions here. Many mistakenly thought that the 2,4-D was in the water at this point. Those who did appreciate that the temperature must remain constant, to avoid further changes in membrane permeability (rather than enzyme activity), were often too vague in their responses to gain credit. Better students often appreciated that temperature would affect the rate of diffusion of ions out of the leaf discs. Why the leaf discs were shaken was generally better answered, although those who showed some idea of maintaining the diffusion gradient for ions often gave vague, imprecise answers that could not be given credit.

**Q9.**

(a)     This question required recall of the mechanism for co-transport of glucose and sodium ions but only 2% were able to give the full story correctly. Many stated correctly that sodium ions were actively transported out of the epithelial cell but they often stated that the ions went into the lumen rather than into the blood. It was apparent that some students did not understand the term lumen, confusing lumen with epithelial cell, which made most of their answer incorrect. Many had both sodium ions and glucose entering the cell by facilitated diffusion with only the most able students stating that glucose enters against its concentration gradient. Weaker answers included references to transport of chloride ions or to the effect of the ions on water potential. Many students went to describe the movement of glucose from the epithelial cell into the blood which was not required. This is an exam technique issue, to understand what is asked, rather than churning out everything that has been learnt, and thus wasting lots of exam time for no gain in marks.

(b)     This question discriminated well and some excellent answers were seen, with 10% gaining all 5 marks. Many students were aware of the properties of chloride ions and oxygen and how these affected their ability to cross the phospholipid bilayer, although many just wrote about the relative size of chloride ions and oxygen molecules, often incorrectly. Students often failed to access the mark points as they were imprecise in their use of terminology. Chloride ions were referred to as chloride molecules and chloride ions or oxygen were said to be soluble, without stating in what they were soluble. Weaker responses tended to concentrate on whether the ion or molecule was needed by the cell and many wrote about osmosis and water potential.