Name	Date started	Target end date

GCE AS / A LEVEL — BIOLOGY UNIT 1 QUESTION PACK

1071-01 (Legacy BY1) · New spec Unit 1 Topic 5 · AS unit, first sat 2016, 80 marks, 1h 30min paper

REVISE
.wales

BIOLOGY — UNIT 1 · CELL MEMBRANES & TRANSPORT

BY1.3 Cell membranes — fluid mosaic model, diffusion, osmosis, active transport

Singer-Nicolson fluid mosaic model, passive transport (diffusion, facilitated diffusion, osmosis with water potential), and active processes (active transport, endo- and exocytosis).

LEGACY 2008 SPECIFICATION

Estimated time for entire question pack: ~2 h 59 min

Derived from the legacy BY1 paper's pace of ~1.1 min/mark, padded for long-prose answers (112 marks over 12 questions).

*You are advised to **not** attempt to complete all of this in one sitting.*

ABOUT THIS QUESTION PACK

This is a **comprehensive practice question pack**, not a single mock paper. It contains every question from the legacy WJEC BY1 papers (2008 modular spec, 2011-2017) that maps onto new-spec AS Unit 1 Topic 5 (1.3).

Questions are ordered by source paper date.

INSTRUCTIONS

Use black ink or black ball-point pen. Show all working — quality of written communication will affect marks. A calculator is allowed. Diagrams included in answers must be fully annotated.

For Examiner's use only

Q	Source	Max	Mark
1	Jun 11 Q3	11	
2	Jun 14 Q6	9	
3	Jun 15 Q3	9	
4	Jan 12 Q7	13	
5	Jun 17 Q2	9	
6	Jun 14 Q5	6	

Q	Source	Max	Mark
7	Jun 16 Q5	9	
8	Jun 11 Q7	7	
9	Jun 12 Q6	12	
10	Jun 13 Q7	11	
11	Jun 15 Q5	9	
12	Jan 14 Q7	7	
	Total	112	

Cell Membranes & Transport — what the new spec asks

WJEC GCE AS / A Level Biology (from 2015) · Unit 1: Basic Biochemistry & Cell Organisation · Topic 1.3.

Fluid mosaic model

- Phospholipid bilayer — hydrophilic heads outward, hydrophobic tails inward.
- Intrinsic / extrinsic proteins; channel and carrier proteins.
- Cholesterol, glycoproteins, glycolipids stiffen / signal / recognise.
- Width ~7 nm.

Passive transport

- Diffusion: net movement down a concentration gradient until equilibrium.
- Facilitated diffusion: via channel / carrier proteins; for charged or large molecules.
- Osmosis: water moves from high to low water potential through a partially permeable membrane.

Water potential

- $\Psi_{cell} = \Psi_s + \Psi_p$.
- Plant cells: turgid ↔ flaccid ↔ plasmolysed.
- Animal cells: haemolysis vs crenation (no cell wall).

Active processes

- Active transport: against gradient via carrier proteins — requires ATP.
- Endocytosis & exocytosis: bulk transport via vesicles.
- Phagocytosis (solid) vs pinocytosis (fluid).

Cell Membranes & Transport in one page

Quick-reference notes — revisit before each question.

Fluid mosaic

Phospholipid bilayer (heads out, tails in).

Proteins float as mosaic.

Cholesterol stiffens; glycoproteins recognise.

Diffusion

Net movement of particles down a concentration gradient.

Rate ↑ with surface area, conc gradient, temperature; ↓ with thickness.

Fick's law (qualitative).

Facilitated diffusion

For polar / charged / large molecules.

Channel proteins (always open or gated) & carrier proteins (flip).

Passive — no ATP.

Osmosis & water potential

Water from higher Ψ to lower Ψ through partially permeable membrane.

$\Psi_{cell} = \Psi_s + \Psi_p$.

Pure water: Ψ = 0; solutions: Ψ < 0.

Active transport

Against gradient via carrier proteins.

Requires ATP and respiration; stopped by inhibitors.

Examples: Na^+/K^+ pump, mineral uptake by root hairs.

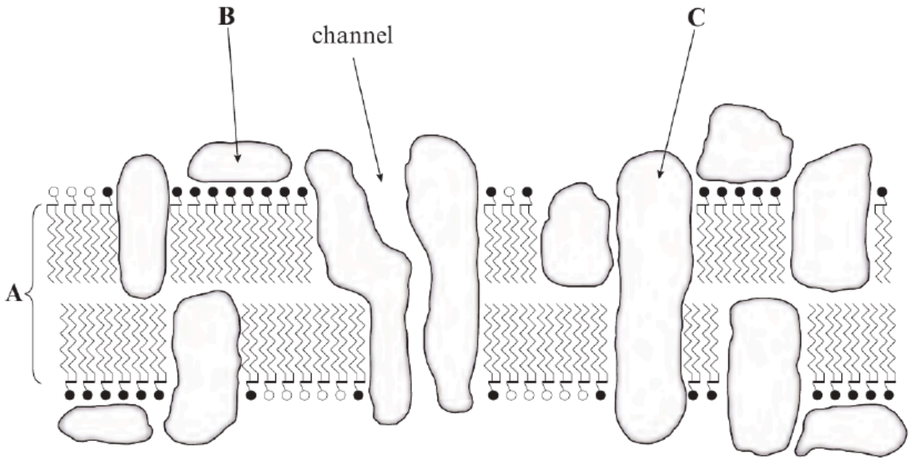
Endo- & exocytosis

Endocytosis: membrane invaginates → vesicle in.

Phagocytosis = solid; pinocytosis = liquid.

Exocytosis: vesicle fuses with membrane → contents out.

3. *(a)* The diagram below is of a model of a section through a cell surface membrane, as proposed by Singer and Nicholson.



(i) State the name given to this model and give reasons why it is so-called. [3]

....

....

....

....

(ii) Name the structures labelled **A**, **B** and **C**. [3]

A ....

B ....

C ....

(iii) Describe the function of the channel shown in the diagram. [1]

....

....

Examiner only

(b) Some molecules are transported across the membrane by active transport. Explain what is meant by the term *active transport*. [2]

....

....

....

(c) Suggest **two** reasons why transport across the membrane is vital to the cell. [2]

....

....

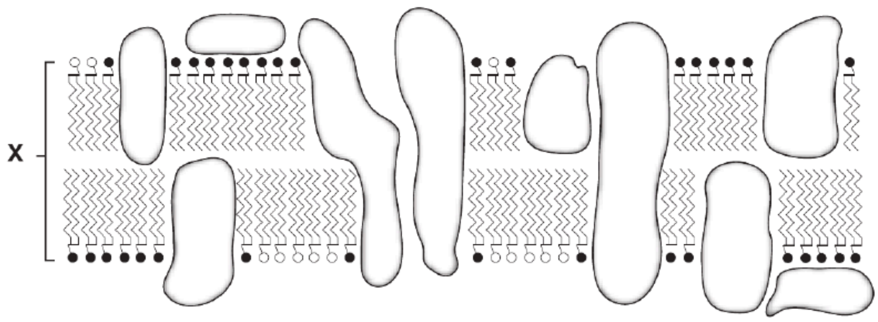
....

(Total 11 Marks)

1071 010005

Examiner only

6. The diagram below shows the fluid mosaic model proposed by Singer and Nicolson in 1972.



(a) The width of the membrane as shown by **X** has been measured using transmission electron microscopes. Membrane width does not vary greatly between different organisms. State a value for this width. [1]

Membrane width = ...

(b) Glucose is water soluble. Vitamin A is lipid soluble. Describe and explain how each molecule crosses the membrane shown above. [4]

Vitamin A

....

....

....

....

....

....

Glucose

....

....

....

....

....

....

Examiner only

(c) Beetroot vacuoles contain a red pigment called *betacyanin*. When beetroot discs are cut with a borer and immersed in a solution of 70% ethanol (an organic solvent) at 15°C, the red pigment begins to leak out of the cells into the ethanol turning it red.

(i) Using your knowledge of the structure of cell membranes, explain why this leakage of pigment occurs. [2]

.....

.....

.....

.....

.....

(ii) When the experiment was repeated at 30°C, the time taken for the ethanol to turn red decreased. Explain why. [2]

.....

.....

.....

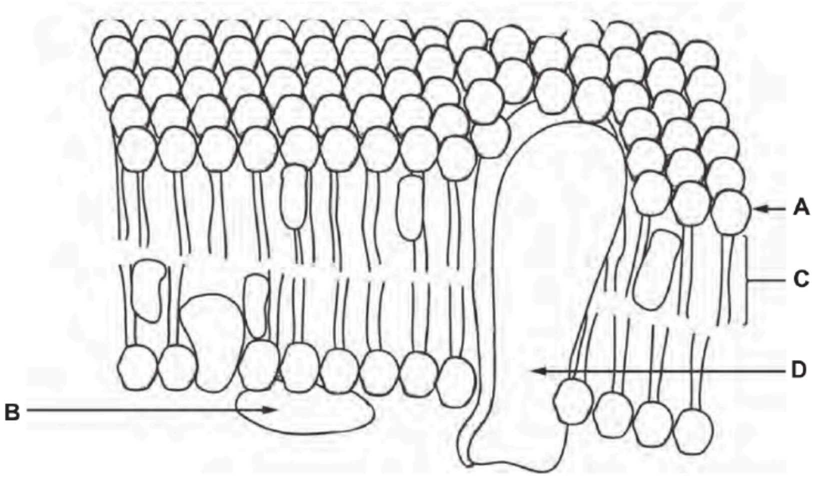
.....

9

BLANK PAGE

PLEASE DO NOT WRITE ON THIS PAGE

3. The diagram below shows part of the plasma membrane from an animal cell.



(a) Complete the table below to identify the structures **A**-**D** shown in the diagram. [4]

Structure	Name
A	
B	
C	
D	

(b) Describe how structure **D** would transport a molecule against a concentration gradient. [2]

....

....

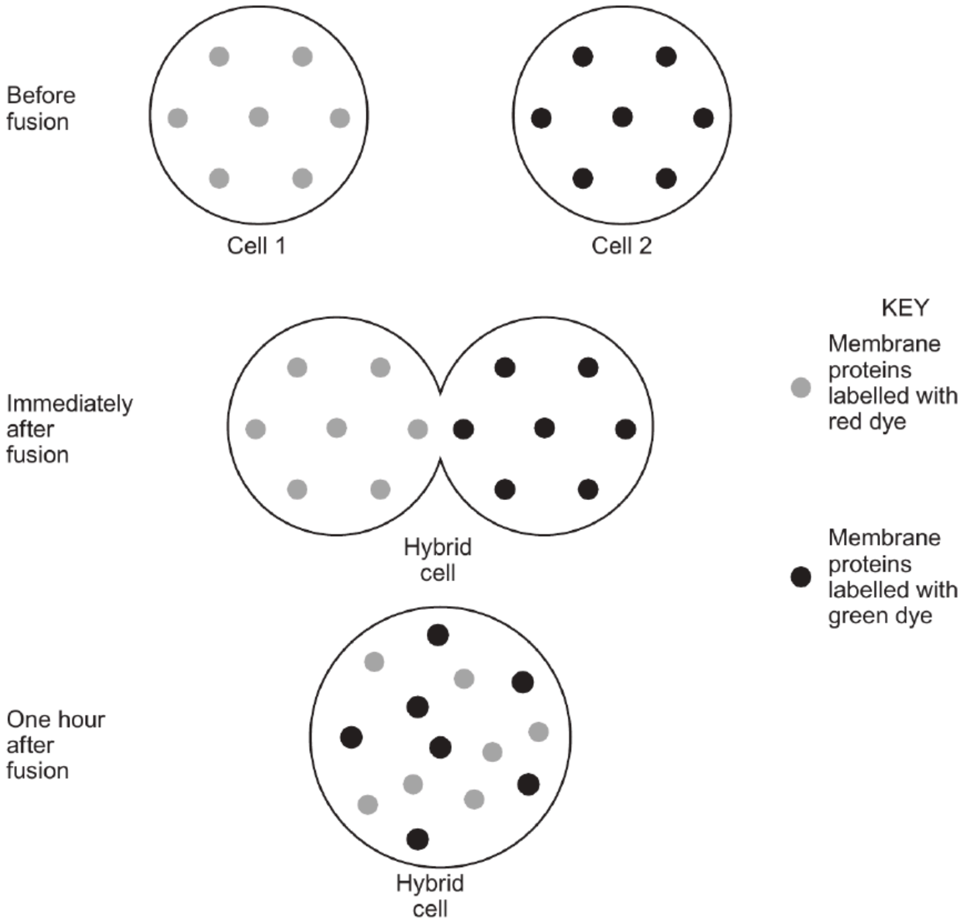
....

....

....

....

(c) In an experiment to determine the structure of the plasma membrane, scientists labelled the membrane proteins from two different cells using coloured dyes. One cell had its membrane proteins labelled with a red dye, whilst a second had its membrane proteins labelled with a green dye. The two cells were then fused to become a hybrid cell. This cell was viewed immediately after fusion and again after one hour. The results are shown below.



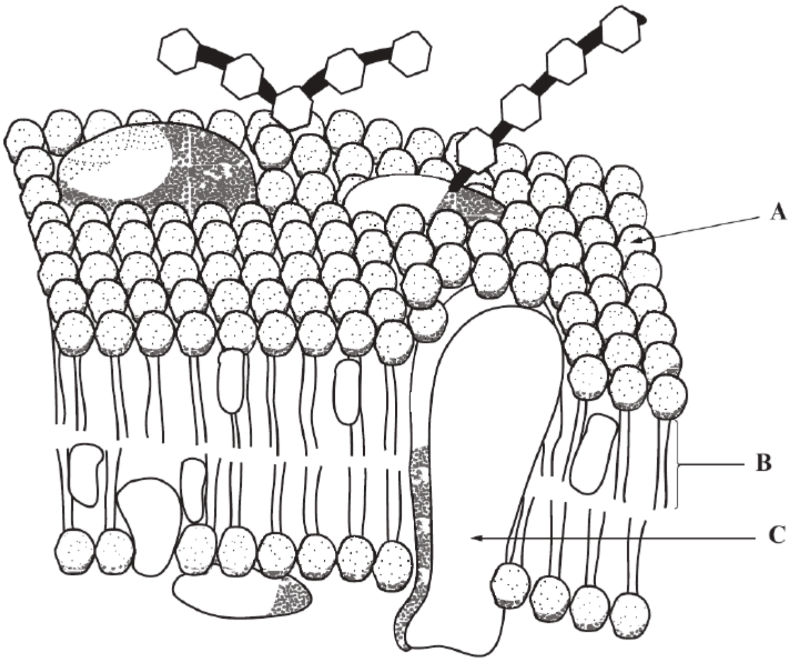
Examiner only

Use your knowledge of the structure and properties of plasma membranes to explain the results seen one hour after fusion. [3]

1071
010009

9

7. The diagram shows the plasma membrane of an animal cell.



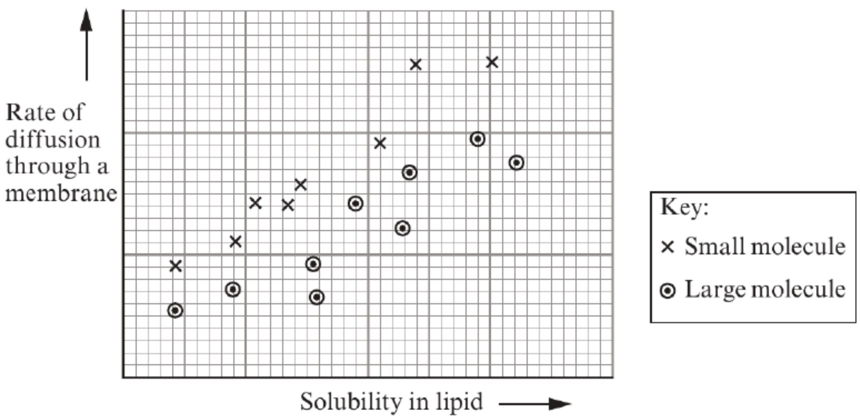
(a) State the names of the structures labelled **A**, **B** and **C**. [3]

A ....

B ....

C ....

(b) The graph shows the effect of molecule size and solubility in lipid on the rate of diffusion of substances through a cell surface membrane.



(i) State with an explanation how the solubility in lipid affects the rate of diffusion through a membrane. [2]

....

....

....

....

(ii) Describe how molecular size affects the rate of diffusion.
Suggest an explanation for your answer. [2]

....

....

....

....

(c) Name **two** factors which affect the rate of facilitated diffusion of a substance through a membrane. [2]

1. ....

2. ....

(d) Vitamins B_1 and K enter cells by crossing the plasma membrane. As vitamin B_1 is water soluble while vitamin K is fat soluble they take different routes across the membrane. Explain how the different routes taken by these vitamins into a cell, is determined by the structure of the plasma membrane. [4]

vitamin B_1 ....

....

....

vitamin K ....

....

....

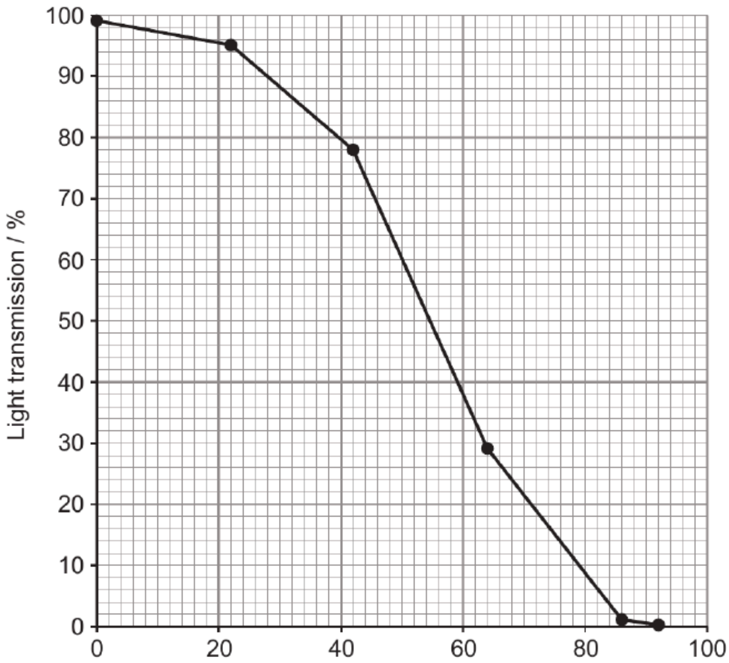
(Total 13 marks)

2. *(a)* Cell surface membranes control the movement of substances into and out of cells. Complete the table showing the features of different modes of transport by using ***yes*** or ***no*** for each feature. [5]

Mode of transport	Requires energy	Uses membrane proteins	Transports individual molecules or ions
Diffusion			
Osmosis			
Facilitated diffusion			
Active transport			
Endocytosis			

Beetroot cells contain a pigment called betalain that gives the tissue its dark purple-red colour. The betalain is contained in the cell vacuole and can escape through the cell surface membrane.

The effect of increasing temperature on the permeability of the cell surface membrane was investigated. A colorimeter was used to measure the transmission of light taken through samples from a range of different temperatures. The lower the percentage transmission, the more red pigment has passed through the cell membrane.



Examiner only

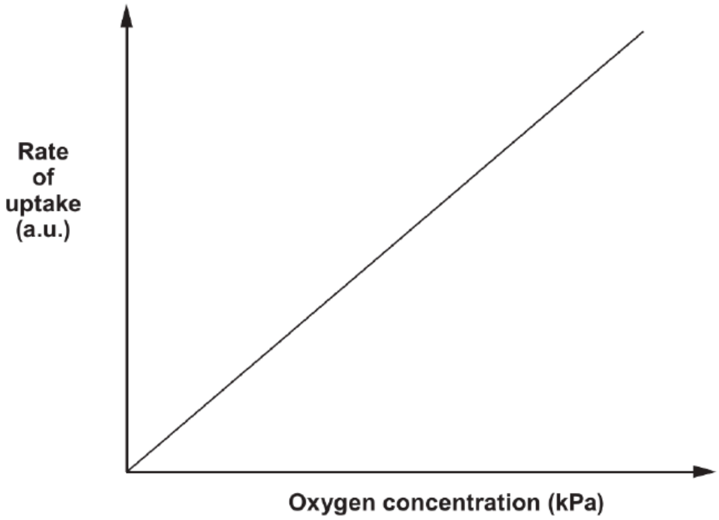
(b) Explain why increasing the temperature would increase the permeability of the cell membrane and result in more betalain being released from the cells. [4]

9

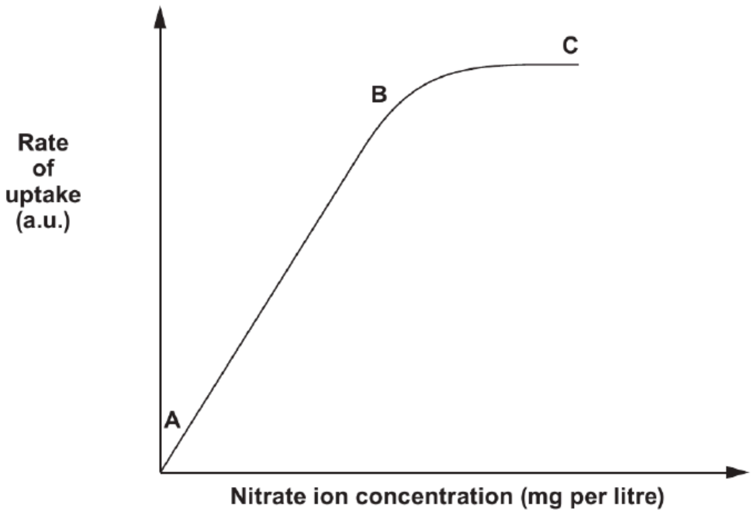
Examiner only

5. The graphs below show the uptake of different molecules into the roots of plants.

I. Oxygen



II. Nitrate ions



Examiner only

(a) Using graph **I**, name the process by which oxygen is absorbed by the roots, giving a reason for your answer. [2]

....

....

....

(b) Explain why the rate of uptake of nitrate ions increases between points **A** and **B** shown on graph **II**. [1]

....

....

....

(c) In the presence of a respiratory inhibitor such as cyanide, the rate of nitrate uptake falls to zero. Name the process by which nitrate ions are taken up. [1]

....

(d) Water enters root hair cells by osmosis. Calculate the solute potential (Ψ_S) of the root hair cell, when there is no net movement of water, the water potential of the soil water is –100 kPa and the pressure potential (Ψ_P) inside the root hair cell is +200 kPa. Use the formula $\Psi = \Psi_S + \Psi_P$.

Show your working and units. [2]

Answer ....

6

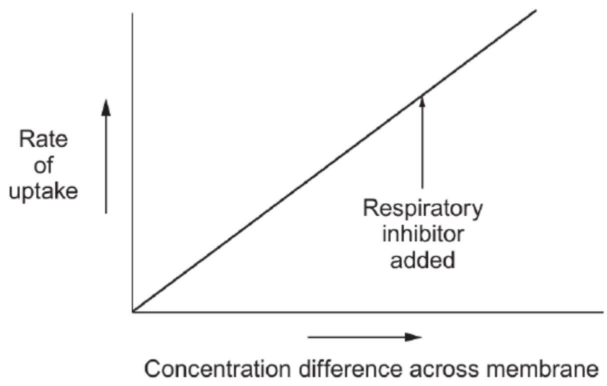
1071
010013

Examiner only

5. The following graphs show the effect of increasing the concentration gradient on the rate of uptake of substances across a cell membrane. The effect of adding a respiratory inhibitor on the rate of uptake is also shown.

For each graph, name the type of uptake involved and give reasons for your choice.

(a)



Type of uptake .... [3]

Reasons for choice

....

....

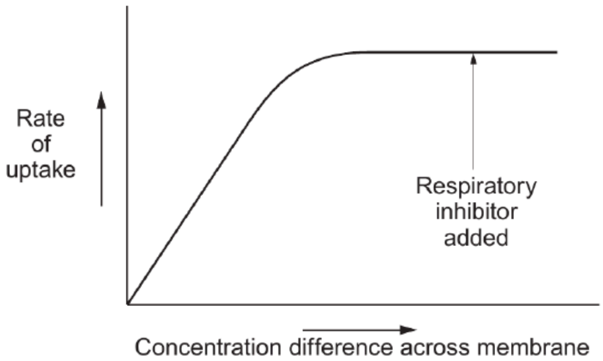
....

....

....

Examiner only

(b)



Type of uptake .... [3]

Reasons for choice

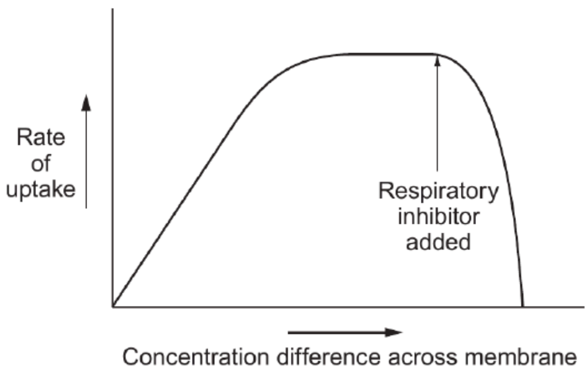
....

....

....

....

(c)



Type of uptake .... [3]

Reasons for choice

....

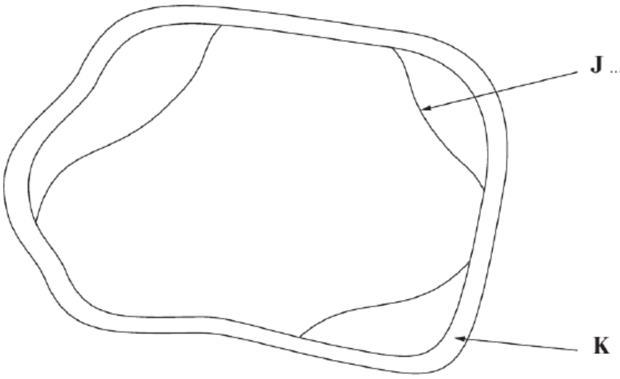
....

....

....

9

7. A student carried out an investigation on the solute potential of a plant tissue. The tissue was placed in a sucrose solution that had a water potential (Ψ) of –600 kPa and was left for one hour. The diagram below shows one cell after that time.
Approximately 50% of the cells showed signs of plasmolysis, the other 50% did not.



(a) Label structure **J** on the diagram. [1]

(b) The student concluded that the solute potential of the cell contents was –600 kPa. Explain why you think the student reached that conclusion. [3]

....

....

....

(c) Explain the role of structure **K** in generating pressure potential in the cell. [3]

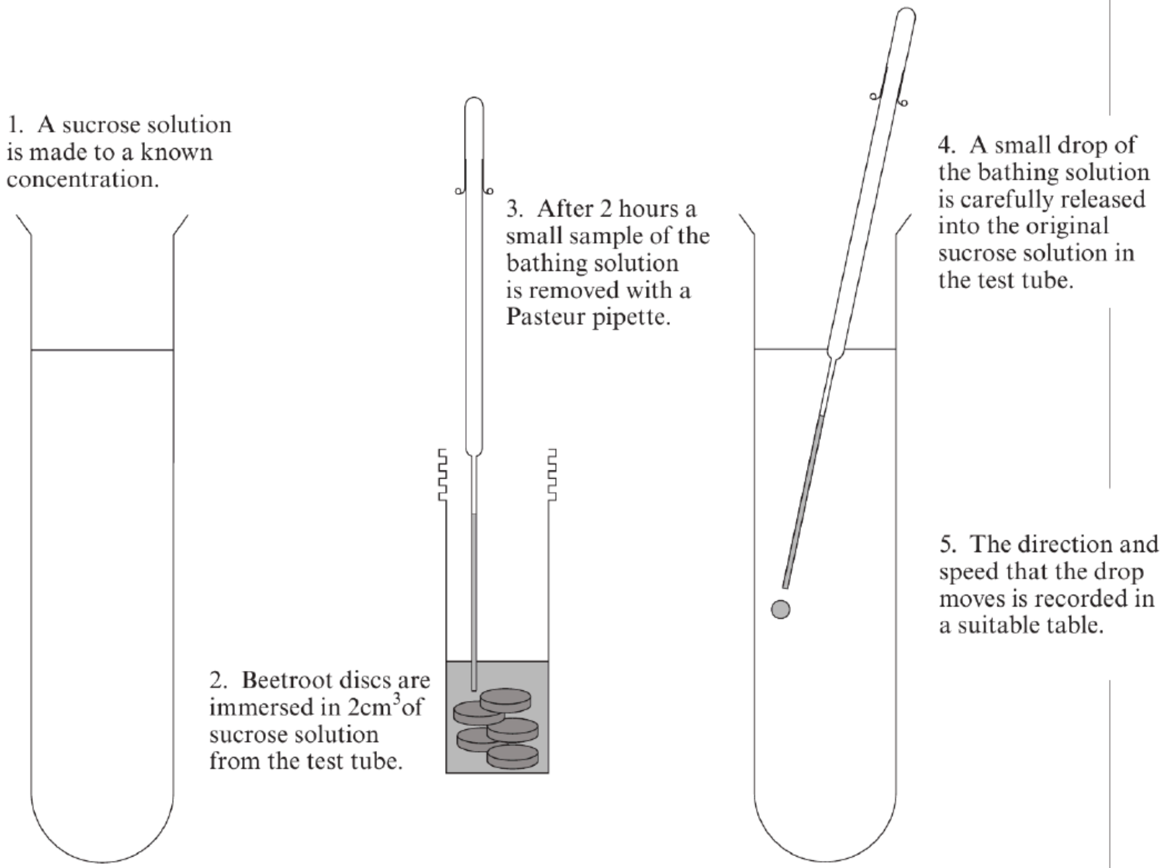
....

....

....

(Total 7 Marks)

6. The diagram below summarises a technique used to measure the water potential of beetroot cells.



(a) The table shows the results of an experiment carried out by some students.

Concentration of sucrose solution (M)	*Direction droplet moved (number of arrows indicates speed of movement)*
0.1	↓↓↓
0.2	↓↓
0.3	↓
0.4	↔
0.5	↑
0.6	↑↑
0.7	↑↑↑

(i) According to these results which concentration of sucrose has the same water potential as the beetroot cells? [1]

....

(ii) Use the table below to find the water potential (Ψ_{cell}) of the beetroot cells.

Concentration of sucrose solution (M)	*Solute potential, Ψ_s (kPa)*
0.1	–269
0.2	–526
0.3	–790
0.4	–1052
0.5	–1322
0.6	–1596
0.7	–1882

water potential (Ψ_{cell}) of the beetroot cells = ... [1]

(b) Explain why the drop of bathing solution rose in the 0.6 M solution. [4]

....

....

....

....

....

....

....

....

(c) The solute potential (Ψ_s) of the contents of the beetroot cells was known to be –1100kPa. Use the equation below to calculate the pressure potential (Ψ_p) of the beetroot cells when they were at equilibrium in the 0.3 M sucrose bathing solution. Show your workings. [2]

$$\Psi_{cell} = \Psi_s + \Psi_p$$

....

....

....

....

(d) (i) In the space below, draw a **labelled** diagram of a single beetroot cell from the 0.7 M sucrose bathing solution, to show how it would have appeared under a light microscope. [3]

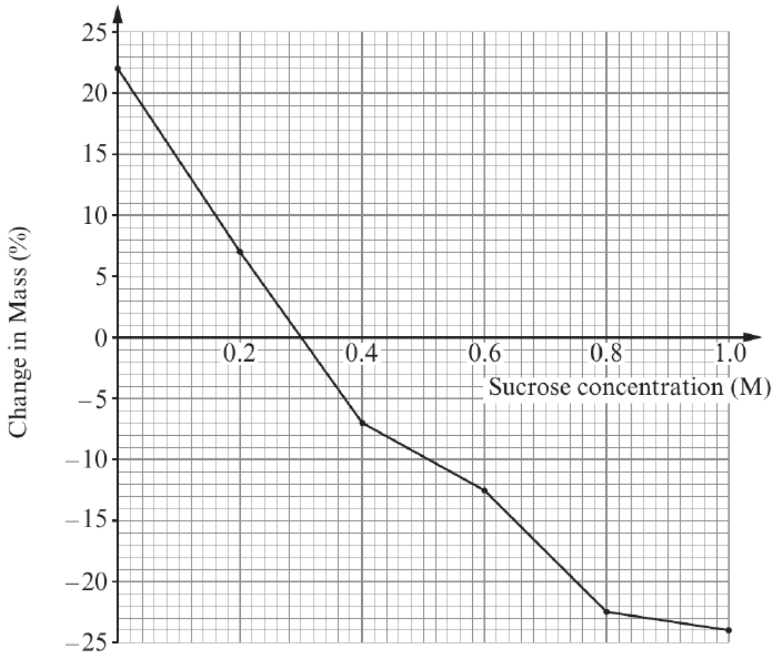
(ii) What term is used to describe cells in this condition? [1]

....

(Total 12 marks)

Examiner only

7. An experiment was carried out to determine the water potential (Ψ_{cell}) of potato. A range of sucrose concentrations were prepared. Potato cylinders were weighed and then one was immersed into each of the solutions. After 2 hours they were blotted dry and reweighed. The percentage change in mass was calculated and the graph below plotted.



(a) (i) Describe the changes in mass in 0.0M (distilled water) **and** 1.0M sucrose solution. [1]

....

....

....

(ii) What term is used to describe the appearance of the cells in 0.0M (distilled water)? [1]

....

(iii) Explain the mass change in the 1.0M sucrose solution in terms of water potential. [3]

....

....

....

....

(iv) What term is given to the solution which causes no change in mass? [1]

....

Table to convert molarity to solute potential (kPa).

Molarity of sucrose solution (M)	*Solute potential kPa*
0.05	–130
0.10	–260
0.15	–410
0.20	–540
0.25	–680
0.30	–860
0.35	–970
0.40	–1120
0.45	–1280
0.50	–1450
0.55	–1620
0.60	–1800

(v) Using the graph opposite and the table above determine the water potential (Ψ_{cell}) of potato tissue and **explain** how you arrived at your answer. [3]

....

....

....

....

(b) Draw a labelled diagram of a cell as it would appear in the 1.0M solution. [2]

(Total 11 marks)

Examiner only

5. *(a)* Define the term *water potential*. [2]

....

....

....

....

....

A student prepared a microscope slide containing a piece of red onion epidermis which had been soaked in a 0.4 M sucrose solution for 30 minutes. The slide was viewed under high-power and the following drawing was made.

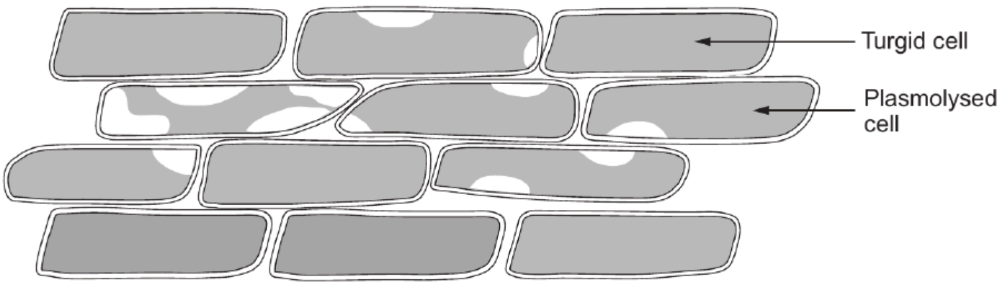


Table to convert molarity to solute potential (kPa).

Molarity of sucrose solution (M)	Solute potential kPa
0.05	–130
0.10	–260
0.15	–410
0.20	–540
0.25	–680
0.30	–860
0.35	–970
0.40	–1120
0.45	–1280
0.50	–1450
0.55	–1620
0.60	–1800

Examiner only

(b) The student concluded that the water potential of the epidermal tissue was –1120 kPa. Using all the information provided, explain why. [4]

....

....

....

....

....

....

....

....

....

....

....

(c) Explain the role of the cell wall in maintaining turgidity. [3]

....

....

....

....

....

....

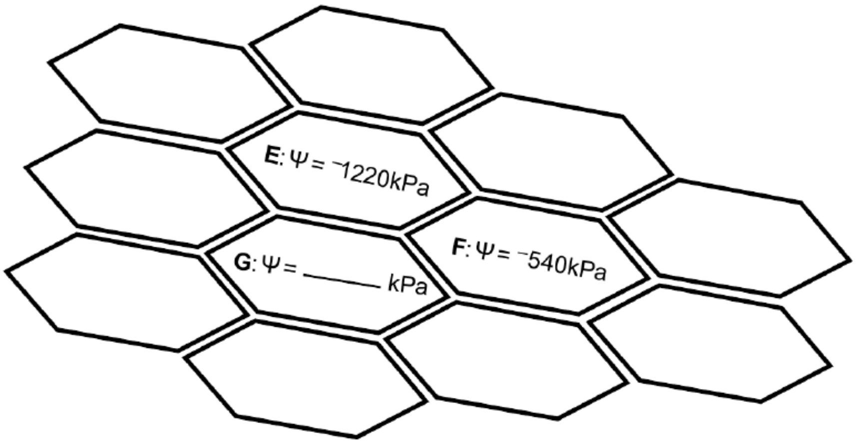
....

....

....

9

7. The diagram below shows cells taken from plant tissue. Cells **E, F,** and **G** are adjacent cells and the water potential of cells **E** and **F** are given.



The water potential of a plant cell can be determined using the following formula:

$$\Psi cell = \Psi s + \Psi p$$

(a) (i) The pressure potential of cell **G** is 900kPa and the solute potential is **−**1600kPa. Calculate the water potential of cell **G** and write your answer in the space on the diagram above. [1]

(ii)

I Draw arrows on the diagram above to show the **net** movement of water molecules between these **three** cells. [1]

II Explain your answer in terms of water potential. [2]

....

....

....

....

....

Examiner only

(b) (i) In an experiment, a student immersed plant tissue in salt solutions of different concentrations. The student then observed the plant tissue under the microscope. In one of the solutions the student concluded that the cells within the tissue were at incipient plasmolysis.
What observation had the student made that allowed her to make this conclusion? [1]

....

....

(ii) The water potential of a cell at incipient plasmolysis was −430kPa.
Using this information state the value of the solute potential of the cell and explain how you arrived at your answer. [2]

....

....

....

7

END OF QUESTION PACK

12 questions · 112 marks · ~2 h 59 min

Source: WJEC BY1 (2008 modular spec, 2011–2017)

Curated for WJEC Biology 2015 spec AS Unit 1 — Topic 5 (1.3)