Past-paper walk-through

Movement into and out of cells ▪ 4.2

eXercise

Questions in this set

- 9700/11 N25 Q16 ▪ 1 mark
- 9700/11 N25 Q17 ▪ 1 mark
- 9700/11 N25 Q18 ▪ 1 mark
- 9700/12 N25 Q19 ▪ 1 mark
- 9700/13 N25 Q19 ▪ 1 mark
- 9700/13 N25 Q20 ▪ 1 mark
- 9700/14 N25 Q17 ▪ 1 mark
- 9700/14 N25 Q18 ▪ 1 mark
- 9700/23 N25 Q1 ▪ 7 marks
- 9700/54 N25 Q1 ▪ 13 marks

Reading the mark scheme

- **B1** a mark that stands on its own – the point is either made or not.
- **M1** a *method* mark: the right approach, even if the number is wrong.
- **A1** an *answer* mark, and it usually needs its M mark first.
- **C1** a working mark on the way to the answer.
- // separates answers the examiner accepts equally.
- **ecf** = error carried forward: a later part is marked on your own earlier answer.
- **owtte** = "or words to that effect" – the wording need not match.

Question 16

9700/11 N25 ▪ Q16 ▪ 1 mark

16 A sample of healthy plant cells taken from the same tissue is placed in a beaker containing distilled water.

The cells change in size.

What would explain this change in size?

A Water will leave the cells by active transport.

B Water will enter the cells by osmosis.

C Solutes will enter the cells by active transport.

D Solutes will leave the cells by osmosis.

Solution 16

Answer: **B**

Why

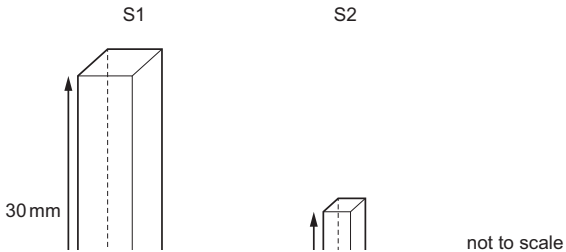
- Distilled water has a higher (less negative) water potential than the cell contents.
- So water moves in, down the water potential gradient, by osmosis.
- Osmosis is passive – no active transport and no movement of solutes is needed.

Question 17

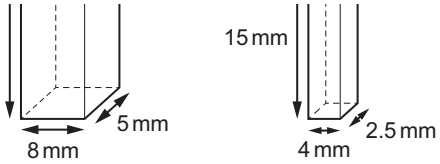
9700/11 N25 ▪ Q17 ▪ 1 mark

17 A student studying surface area to volume ratio and diffusion made a cuboid, S1, using agar stained blue with a pH indicator. The dimensions of S1 are shown in the diagram.

The student made a second agar cuboid, S2. Each dimension of S2, (the length, the width and the height), was half that of S1.



Question 17



The student placed each cuboid in a test-tube and covered it in acid. The time taken for each cuboid to completely change colour was recorded. All variables other than the size of the cuboids were standardised.

Which row shows the surface area to volume ratio of S1 and the time taken for S1 to change colour completely in acid compared to the time taken for S2 to change colour completely?

	surface area to volume ratio of S1	time taken for S1 to change colour completely in acid compared to S2

Question 17

A	0.72 : 1	S1 takes less time than S2
B	0.72 : 1	S1 takes more time than S2
C	1.4 : 1	S1 takes less time than S2
D	1.4 : 1	S1 takes more time than S2

Solution 17

Answer: **B**

Why

- Halving every dimension divides the volume by 8 but the surface area by only 4.
- So the surface area to volume ratio *doubles*.
- A larger ratio means the dye diffuses to the centre faster.

Question 18

9700/11 N25 ▪ Q18 ▪ 1 mark

18 Two test-tubes, labelled X and Y, were set up containing equal volumes of solution X or solution Y respectively.

A large number of type P cells and a large number of type Q cells were added into test-tube X and also into test-tube Y.

After a few minutes, samples of the solutions were taken and the cells were observed with a microscope.

- In solution X, all of cell type P had burst and cell type Q had **not** burst.

Question 18

- In solution Y, **no** cells had burst.

Which row correctly identifies cell type Q and solutions X and Y?

	cell type Q	solution X	solution Y
A	red blood cells	5% NaCl solution	distilled water
B	goblet cells	5% glucose solution	distilled water
C	liver cells	distilled water	5% glucose solution
D	root hair cells	distilled water	5% NaCl solution

Solution 18

Answer: **D**

Why

- Cells shrink in a solution of lower water potential and swell in one of higher water potential.
- Compare each cell type's response in each solution to rank the water potentials.
- Whichever solution changes both cell types the same way is the one furthest from their internal water potential.

Question 19

9700/12 N25 ▪ Q19 ▪ 1 mark

19 In an experiment, four different-sized cubes of colourless agar were placed into a blue dye. The time taken for each cube to turn blue was recorded.

Which row shows the surface area and volume of the cube that took the longest time to turn completely blue?

	surface area / cm^2	volume / cm^3
A	6.0	1
B	9.5	2
C	12.5	3
D	38.0	16

Solution 19

Answer: **D**

Why

- A larger cube has a smaller surface area to volume ratio.
- The dye has further to diffuse and relatively less surface to enter through.
- So the slowest cube is the one with the lowest surface area to volume ratio.

Question 19

9700/13 N25 ▪ Q19 ▪ 1 mark

19 Which statements about the cell surface membrane are correct?

1 Channel proteins allow water soluble ions and molecules across the membrane.

2 Glucose can pass into the cell via carrier proteins.

3 Oxygen passes freely through the membrane as it is soluble in lipids.

4 Some glycoproteins act as antigens.

A 1, 2, 3 and 4

B 1, 3 and 4 only

C 1 and 2 only

D 2, 3 and 4 only

Solution 19

Answer: **A**

Why

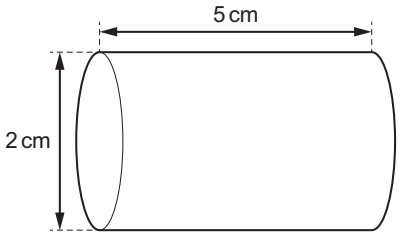
- Channel proteins let water-soluble ions through, and carrier proteins move glucose – 1 and 2 are right.
- Oxygen is non-polar and small, so it passes straight through the phospholipid bilayer – 3 is right.
- Glycoproteins act in recognition and attachment, so that statement holds too.

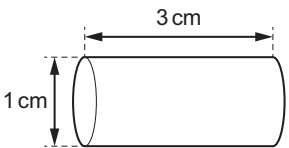
Question 20

9700/13 N25 ▪ Q20 ▪ 1 mark

20 The diagram shows two cylinders of agar.

The agar cylinders are placed into a solution of dye at the same time. The time taken for the dye to diffuse into the centre of each cylinder is recorded.





Question 20

X Y

Which statement explains why the dye reaches the centre of one agar cylinder faster than the other agar cylinder?

A The dye reaches the centre of X in a shorter time than the dye reaches the centre of Y because X has a larger surface area to volume ratio.

B The dye reaches the centre of X in a shorter time than the dye reaches the centre of Y because X has a larger surface area.

C The dye reaches the centre of Y in a shorter time than the dye reaches the centre of X because the dye has a shorter distance to diffuse to the centre.

D The dye reaches the centre of Y in a shorter time than the dye reaches the centre of X because Y has a smaller volume.

Solution 20

Answer: **C**

Why

- Compare the surface area to volume ratio of the two cylinders.
- The dye must diffuse from the outside to the centre, so what matters is the *distance* to the centre.
- The cylinder with the smaller radius has the shorter diffusion path, so its centre colours first.

Question 17

9700/14 N25 ▪ Q17 ▪ 1 mark

17 When red blood cells are put into distilled water they burst (haemolysis).

Which statements explain this haemolysis?

1 The water potential of the surrounding liquid is lower than the water potential of the contents of the red blood cell.

2 The cell surface membranes of red blood cells are **not** supported by cell walls.

3 More water moves into the red blood cells by osmosis than leaves the cells.

4 Water enters the red blood cells by osmosis but does **not** leave the cells.

A 1 and 3 **B** 1 and 4 **C** 2 and 3 **D** 2 and 4

Solution 17

Answer: **C**

Why

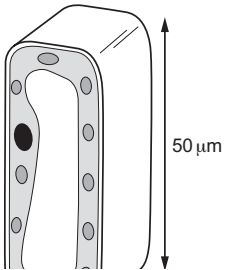
- Distilled water has a *higher* water potential than the cell contents, so statement 1 is the wrong way round.
- Water enters the red blood cell by osmosis and the cell swells.
- A red blood cell has no cell wall to resist the pressure, so it bursts.

Question 18

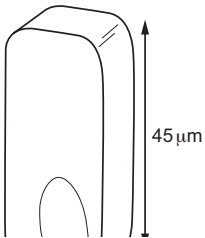
9700/14 N25 ▪ Q18 ▪ 1 mark

18 The diagrams show the shape and size of two types of cell.

palisade mesophyll cell
surface area = 2200 μm^2



columnar epithelial cell
volume = 2250 μm^3



not to scale

Question 18

Which statement about the palisade cell and epithelial cell shown in the diagrams is correct?

A An increase in surface area reduces the distance for gases to reach the centre of the cell.

B The surface area of the palisade mesophyll cell is 500 μm^2 greater than the columnar epithelial cell.

C The surface area to volume ratio is greater in the columnar epithelial cell than the palisade mesophyll cell.

D The volume of the palisade mesophyll cell is 2500 μm^3 greater than that of the columnar epithelial cell.

Solution 18

Answer: **C**

Why

- Work out the missing quantity for each cell from the figures given.
- Then form the surface area to volume ratio for both.
- The cell with the larger ratio exchanges materials more efficiently for its size.

Question 1

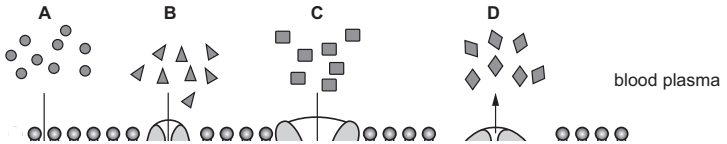
9700/23 N25 ▪ Q1 ▪ 7 marks

1 Many substances can move through cell surface membranes between the cytoplasm of animal cells and the extracellular environment.

(a) A student made a drawing to summarise the movement of substances across the cell surface membranes of mammalian red blood cells.

Fig. 1.1 shows the drawing made by the student:

- Each arrow indicates the movement of a substance through the membrane.
- The number of each of the 4 shapes represents the relative concentrations of each substance in the cytoplasm and in the blood plasma.



Question 1

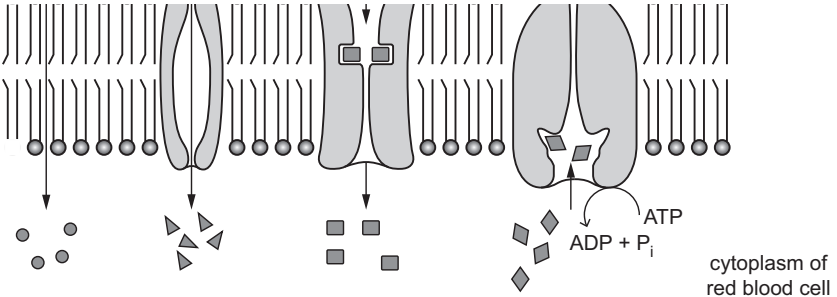


Fig. 1.1

The student carried out research and made a list of some of the substances found in red blood cells as shown in Fig. 1.2.

Question 1

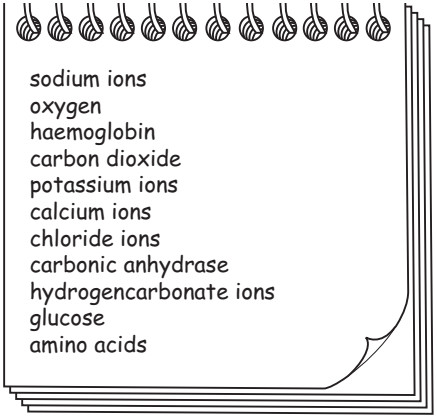


Fig. 1.2

Question 1

Table 1.1 shows information about the 4 types of movement of substances across the cell surface membranes of red blood cells as shown in Fig. 1.1.

Complete Table 1.1 using the information in Fig. 1.1 and Fig. 1.2.

Table 1.1

letter from Fig. 1.1	type of movement	name of part of membrane involved	example of a substance that moves across the membrane (from Fig. 1.2)
A	simple diffusion	phospholipids	
B	facilitated diffusion		calcium ions

Question 1

Question 1

C	facilitated diffusion		
D			

[5]

(b) Some viruses infect plants through the surfaces of damaged leaves. These plant viruses can travel from one leaf cell to another without having to pass through any cell surface membranes.

Explain how some plant viruses can travel from one cell to another without passing through cell surface membranes.

Question 1

[Total: 7]

Solution 1

(a) Mark scheme

- letter A: example of substance = carbon dioxide / oxygen ;
- letter D: type of movement = active transport ;
- letter D: part of membrane involved = carrier / pump, protein and example of a substance = sodium ions ;
- R sodium-potassium pump A potassium ions / chloride / amino acids
- A sodium pump (if sodium is example) A glucose if not given for letter C
- letter C:example of a substance = glucose ;
- A amino acids / chloride (ions) / potassium ions / sodium ions

Solution 1

- part of membrane involved: for B = channel protein and for C = carrier protein ;
- 5

Solution 1

(b) Mark scheme

- any two from
- viruses travel through
- symplast pathway ; I apoplast pathway if described correctly
- R symplast and apoplast pathways if no further detail of apoplast given
- plasmodesmata / cytoplasmic connections between cells ; A strands of cytoplasm
- because viruses are small enough (to pass through plasmodesmata) ;
- AVP ; A any ref. to actual size (width of plasmodesmata ~ 50 nm, width of Tobacco Mosaic Virus 18 nm)

Solution 1

- 2
- 9700/23
- October/November 2025

Question 1

9700/54 N25 ▪ Q1 ▪ 13 marks

1 *Beta vulgaris vulgaris*, as shown in Fig. 1.1, is a food crop with a swollen, edible root known as beetroot.

Question 1

Fig. 1.1

A student determined the concentration of a sucrose solution that has the same water potential as the cells of the beetroot.

The student used distilled water and a stock solution of 2.0 mol dm^{-3} sucrose to prepare a range of sucrose solutions.

Each sucrose solution was prepared using proportional dilution and had a final volume of 30 cm^3.

(a) Complete Table 1.1 to show how the concentrations were made.

Table 1.1

Question 1

final concentration of sucrose solution / mol dm^{-3}	volume of distilled water / cm^3	volume of 2.0 mol dm^{-3} stock sucrose solution / cm^3
2.0	0.0	30.0
.....	.....	.....
.....	.....	.....
.....	.....	.....
.....	.....	.....
0.0	30.0	0.0

[2]

Question 1

(b) Describe a method the student could use to collect the data needed to determine the concentration of a sucrose solution that has the same water potential as the cells of the beetroot.

The student was supplied with the sucrose solutions prepared in **1(a)** and standard laboratory equipment.

Do **not** include details of how the student:

- prepared the sucrose solutions in **1(a)**
- would use the data collected to determine the concentration of a sucrose solution that has the same water potential as the cells of the beetroot.

Your method should be set out in a logical order and be detailed enough to allow another person to follow it.

Question 1

(c) The student calculated the mean percentage change in mass of the beetroot for each concentration of sucrose solution.

(i) The student plotted these calculated values to obtain a line graph.

Complete Fig. 1.2 by:

- labelling the axes
- sketching the line that the student obtained.

Question 1

Question 1

Fig. 1.2

[2]

(ii) Explain how the student used the completed line graph in Fig. 1.2 to estimate the concentration of sucrose solution that has the same water potential as the cells of the beetroot.

Question 1

(iii) The cells of the beetroot contain a red pigment which can leak out into the solution when the tissue is cut. The student noticed that each sucrose solution was coloured red at the end of the investigation.

Suggest **one** improvement the student could make to the method to reduce the amount of red pigment in each sucrose solution.

Question 1

[Total: 13]

Question 1

Question 2 starts on page 6.

Solution 1

(a)

Mark scheme

- any sensible concentrations ;
- corresponding volumes of distilled water and sucrose;
- 2

Solution 1

(b) Mark scheme

- any seven from:
- 1
- same / stated, variety / age / AW, of beetroots ;
- 2
- remove the outer skin (of the beetroot) / AW ;
- 3
- same / stated, dimensions / AW, of (beetroot) block / AW ;
- 4

Solution 1

- ref. to apparatus for obtaining same size of (beetroot) blocks ;
- 5
- for each sucrose concentration, place (beetroot) block in a suitable container and submerge / AW (in sucrose solution);
- 6
- (for each sucrose concentration) measure the initial mass and the final mass ;
- 7
- (measure final mass) after a (suitable) stated time ;
- 8
- method to remove excess liquid from beetroot (before measuring final mass) ;

Solution 1

- 9
- use at least three different (beetroot) blocks and calculate a mean, for each sucrose concentration ;
- 10 safety comment with named hazard and risk and precaution ;
- hazard
- risk
- precaution
- beetroot
- allergy / irritant
- gloves / mask / PPE

Solution 1

- knife / scalpel / cork borer / AW cut
- cut away from the hand / cut onto a, board / tile / AW
- 7

Solution 1

(c)(i) Mark scheme

- 1
- appropriate axis labels and units ;
- 2
- sketch shows decreasing line crossing x-axis ;
- 2
- 9700/54
- October/November 2025

Solution 1

(c)(ii)

Mark scheme

- (identify the) x-axis intercept point
- or
- (identify the point on the x-axis where the mean) percentage change in mass is zero ;
- 1

Solution 1

(c)(iii)

Mark scheme

- rinse (beetroot) blocks (after cutting / before adding to sucrose solution) ;
- 1