Oxford Cambridge and RSA

A Level Biology A

H420/02 Biological Diversity

Question Set 14

1 Water moves by osmosis in living organisms.

(i) Define osmosis. **[2]**

The process by which water moves across partially permeable membranes down a water potential gradient.

(ii) Plants rely on osmosis for support. **[3]**

1 (b) Explain the importance of osmosis in plant support.

water moves into cells increasing hydrostatic pressure on cell wall for turgidity and allow stomata to open or maintain its shape.

The apparatus shown in Fig. 16 can be used to demonstrate osmosis.

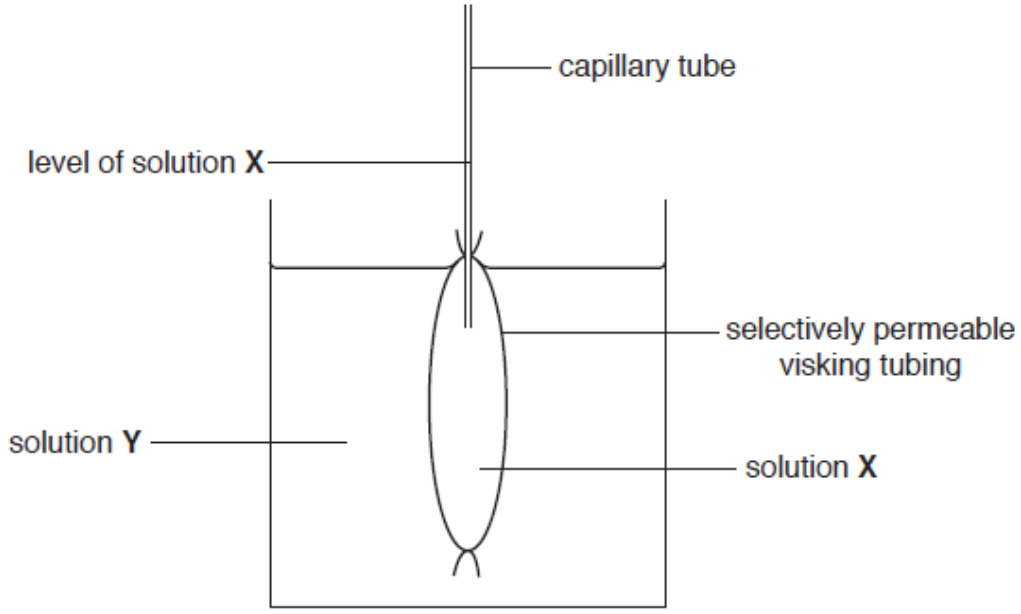

Fig. 16

When the capillary tube with visking tubing bag was placed in solution **Y**, the level of solution **X** inside the capillary tube rose from 10.5 mm to 26.5 mm.

(i) The ruler used to measure the distance along the capillary tube was accurate to thenearest 0.5 mm.

Calculate the percentage uncertainty of the measurement.

uncertainty = 6.25 % $\frac{0.5 + 0.5}{16} \times 100$

$= 6.25\ \%$ **[2]**

(ii) What conclusions can be drawn about the composition of solutions **X** and **Y**? **[2]**

Solution Y is hypotonic (more dilute) than Solution X. Thus water moves in to the visking tube by osmosis where solution X is hypertonic until equilibrium is met. The solute cannot pass through the visking tube so only water can travel by osmosis.

(c) A group of students used the following method to investigate osmosis in plant cells.

Cut pieces of plant material of equal surface area ensuring no skin is present.

- Rinse to remove cell debris.
- Gently pat the plant pieces dry with a paper towel.
- Weigh each piece and record mass.
- Put the plant piece in a 200 cm^3 beaker.
- Cover plant piece with 50 cm^3 of sucrose solution.
- Use sucrose solutions of 0, 0.1, 0.3, 0.5, 0.7 mol dm^{-3}.
- Leave for 24 h.
- Remove the piece of plant material.
- Dry carefully using a paper towel.
- Weigh the plant piece and record the mass.
- Calculate the percentage change in mass for each piece.
- Repeat twice for each sucrose concentration.

The students investigated material from three different plants: carrot, courgette and potato. Their results are shown in Table 16.

Plant	Sucrose concentration / mol dm^{-3}	Percentage change in mass			
		Replicate 1	Replicate 2	Replicate 3	Mean
Carrot	0	+ 6.0	+ 5.8	+ 5.8	+ 5.87
	0.1	+ 4.2	+ 4.1	+ 4.3	+ 4.20
	0.3	+1.5	+1.5	+1.3	+ 1.43
	0.5	– 2.4	– 2.3	– 2.1	– 2.27
	0.7	– 6.3	– 6.1	– 6.3	– 6.23
Courgette	0	+ 7.9	+ 7.8	+ 7.6	+ 7.77
	0.1	+ 5.5	+ 5.5	+ 5.5	+ 5.50
	0.3	+ 1.9	+ 1.8	+ 2.0	+ 1.90
	0.5	– 1.2	– 1.4	– 1.1	– 1.23
	0.7	– 4.3	– 4.4	– 4.1	– 4.27
Potato	0	+ 5.7	+ 5.8	+ 5.7	+ 5.77
	0.1	+ 3.1	+ 2.9	+ 3.0	+ 3.00
	0.3	– 0.3	– 0.4	– 0.6	– 0.43
	0.5	– 2.4	– 2.2	– 2.5	– 2.37
	0.7	– 6.1	– 5.9	– 5.1	– 5.70

Table 16

(i) Explain why it was necessary to calculate **percentage** change in mass.

Because there is some variation in mass at the start, it's more reliable to get percentage change in mass for fair comparisons. **[2]**

(ii) The students identified replicate 3 of the potato in 0.7 mol dm^{-3} sucrose as anomalous.

Suggest a practical error by the students that might have caused this result to beanomalous and explain the likely effect of this error. **[2]**

Not all water was removed when potato was being dried. Excess solution remained on the potato's outer surface which caused it to be heavier than others.

(iii) Use Table 16 to identify which plant cells contained the highest concentration of sucrose.

Justify your conclusion.

[3]

Courgette, Because it has the highest mass gain at $0 mol dm^{-3}$ and at the highest concentration of sucrose solution, it had the least mass loss.

(d) Water has many properties that are essential for living organisms.

Explain how properties relating to the **density** of water contribute to the survival of organisms.

[3]

Water density decreases under 4°C as water expands. This allows frozen lakes to have ice layer on its surface and liquid water underneath for marine life to survive. The freezing point of water decreases if it has substances dissolved in it. Thus it prevents the water in the cells from freezing in temperatures less than 0°C.

Total Marks for Question Set 14: 16