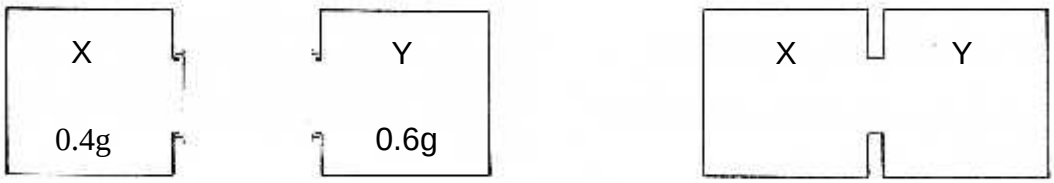
4 How substances get in and out of cells

1 Containers X and Y each hold one litre of air. X also contains 0.4g of a gas and Y contains 0.6 g of the same gas. The two containers are connected together as shown in the diagram.

(a) Which way will the gas diffuse?

(b) After a long period of time, what will be the concentration of the gas (in grams per litre) in each container?



2 The diagram represents (not to scale) molecules of a salt dissolved in the bottom layer of water in a beaker. Make two similar diagrams to show the distribution of salt molecules (a) after a few minutes, (b) after several hours.

3 When a cell is respiring aerobically, which two gases are likely to be diffusing in and out of the cell, and in which direction will they be diffusing?

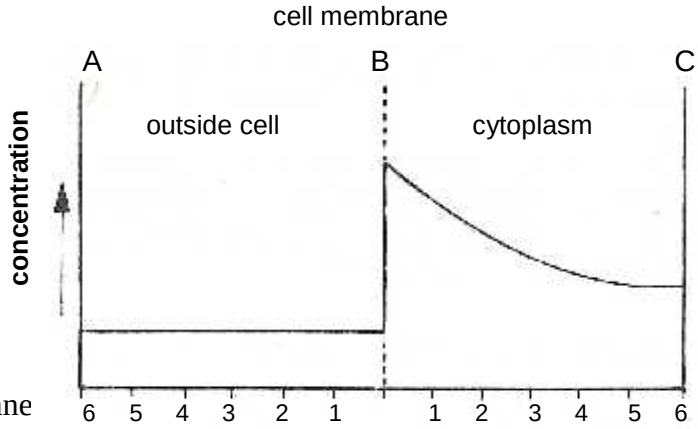
4 The graph shows the concentration of a substance inside and outside a cell.

(a) If the substance is free to move by diffusion, which way will it move

(i) inside the cell

(ii) between the cell and the medium outside the cell?

(b) If, after some hours, the concentration has not changed, what assumption would you make about the movement of the substance across the cell membrane



5 (a) Which one of the following is the best definition of osmosis?

(i) The movement of water from a concentrated solution to a dilute solution across a partially permeable membrane. .

(ii) The movement of a dissolved substance from a concentrated solution to a dilute solution across a partially permeable membrane.

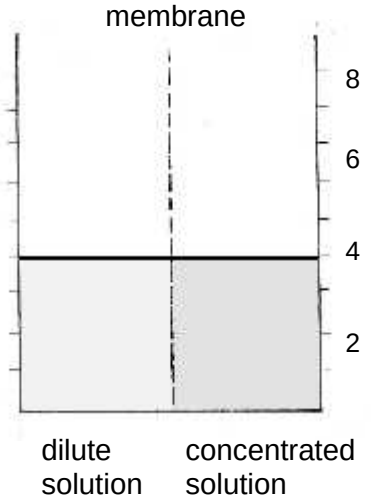
(iii) The movement of water from a dilute solution to a concentrated solution across a partially permeable membrane.

(iv) The uptake of water by a living cell.

(b) Which of the statements is an acceptable description of diffusion?

How substances get in and out of cells (continued)

6 The diagram shows a vessel which contains a concentrated and a dilute solution separated by a partially permeable membrane. Draw a similar diagram to show the liquid levels after an hour or two.



7 Which statement is correct?

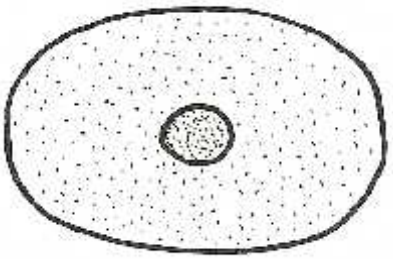
(a) A concentrated solution has a high osmotic potential (water potential).

(b) A concentrated solution has a low osmotic potential (water potential).

8 The drawing shows the outline of a human cell. Copy the drawing and make two further drawings to show how the cell would appear if it were to be immersed for a few minutes in a solution with

(a) a lower osmotic potential (water potential) than its own cytoplasm

(b) a higher osmotic potential (water potential) than its own cytoplasm.



9 Why is it important that a cell membrane does not allow all dissolved substances to diffuse freely through it?

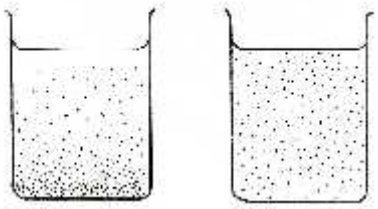
10 The concentration of the tissue fluid, which bathes all cells in the body, is kept more or less constant. Why is this important?

11 When meat is salted, bacteria cannot grow on it. Suggest a reason for this.

4 How substances get in and out of cells - answers

1 (a) The gas will diffuse from Y to X (i.e. from the region of higher concentration to the region of lower concentration).
(b) Eventually, the gas will be evenly distributed between the two containers so each one will contain 0.5g per litre.

2 The salt molecules will move by diffusion till they are evenly distributed.

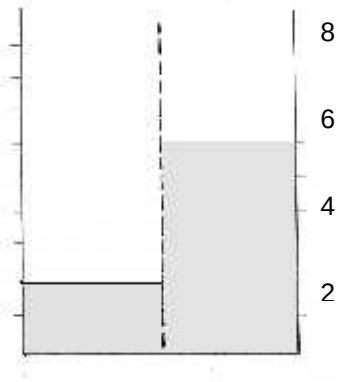

(a) (b)

3 When a cell is respiring aerobically, oxygen will be diffusing into the cell and carbon dioxide will be diffusing out.

4 (a) (i) Inside the cell the substance will diffuse from B to C (i.e. down the concentration gradient).
(ii) If the cell membrane were freely permeable, the substance would diffuse out of the cell, from B to A, because its concentration inside is greater than that outside.
(b) If there is no change in the concentration, you might assume that the substance was not free to diffuse across the cell membrane and was being taken up by active transport and diffusing across the cytoplasm by passive diffusion.

5 (a) The best definition of osmosis is (iii) 'The movement of water from a dilute solution to a concentrated solution across a partially permeable membrane'.
(b) An acceptable description of diffusion (at least in solutions) is (ii) 'The movement of a substance from a concentrated solution to a dilute solution'. (The partially permeable membrane is not essential for diffusion to occur.)

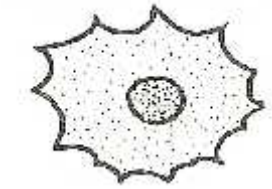
6 There will be a rise in level on the right and a corresponding fall on the left as water passes from the dilute to the concentrated solution by osmosis. (The figures need not be the same as shown here.)



7 (b) A concentrated solution has a low osmotic potential (because it contains effectively fewer free water molecules than a dilute solution).

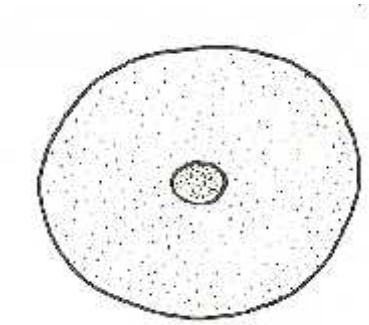
How substances get in and out of cells - answers (continued)

8 (**a**) Lower osmotic potential (water potential)



(cell loses water to more concentrated solution)

(b) Higher osmotic potential (water potential)



(cell gains water from more dilute solution)

9 If the cell membrane were freely permeable, harmful substances could diffuse in and useful substances could diffuse out.

10 If the tissue fluid became more dilute, the cells would absorb water by osmosis and swell up. If the tissue fluid became more concentrated, the cells would lose water by osmosis, shrink and become dehydrated, possibly to a point where metabolism was no longer possible.

11 The salt lowers the meat's osmotic potential so that water is withdrawn, by osmosis, from bacterial cytoplasm and so kills the bacteria.