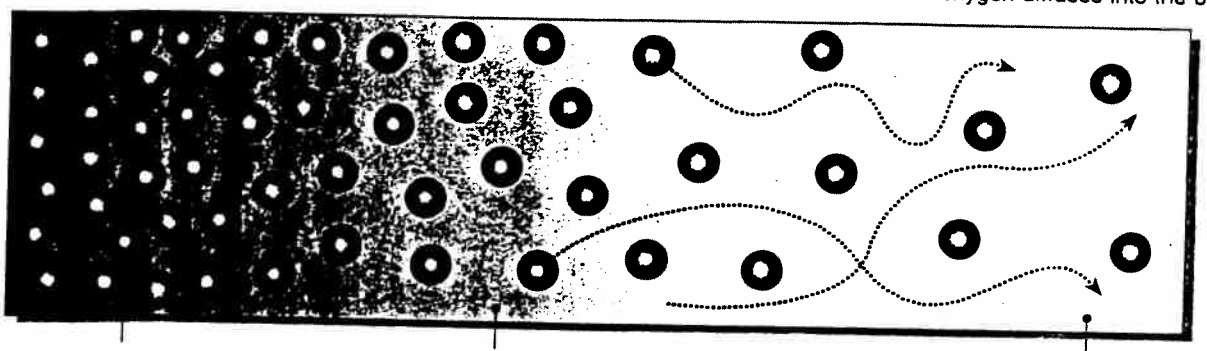
A 2

Diffusion and Osmosis

The molecules that make up substances are constantly moving about in a random way. This random motion causes molecules to disperse from areas of high to low concentration – a process called **diffusion**. The molecules move along a **concentration gradient**. Diffusion and osmosis (diffusion of water molecules across a semi-permeable membrane) are passive processes, and use no energy. They are important in allowing exchanges with the environment and regulation of cell water content.

Diffusion of Molecules Along Concentration Gradients

Diffusion is the movement of particles from regions of high to low concentration. The end result is that the molecules become evenly distributed. Diffusion occurs freely across membranes, as long as the membrane is permeable to that molecule (selectively permeable membranes allow the passage of some molecules but not others). Each type of molecule diffuses **along its own concentration gradient**. Diffusion of molecules in one direction does not hinder the movement of other molecules. Two-way diffusion is common in biological systems e.g. at the lung surface, carbon dioxide diffuses out and oxygen diffuses into the blood.



High Concentration
Particles are closely bunched together

Medium Concentration
Particles are moderately close to each other

Low Concentration
Particles are well spaced apart from each other

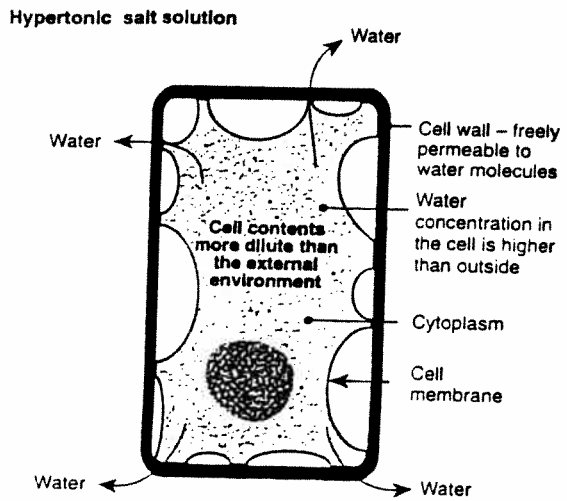
Concentration Gradient

If molecules are free to move, they move from high to low concentration until they are evenly dispersed.

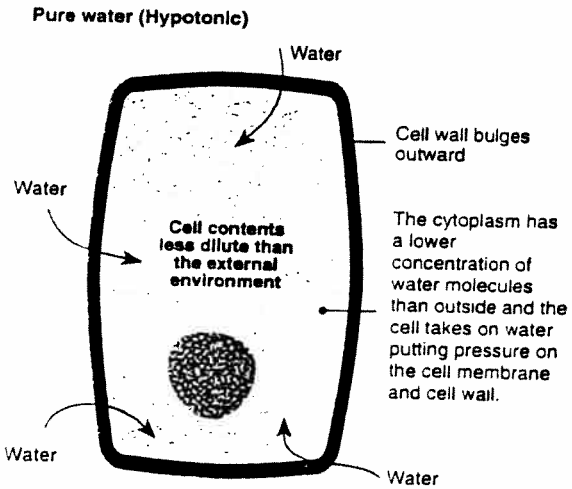
Osmosis and the Concentration of Water in Cells

Osmosis is simply the diffusion of water molecules from high concentration to lower concentration, across a selectively permeable membrane. ***Water always diffuses from regions of higher concentration to lower concentration of water molecules.*** When the external water concentration is the same as that of the cell there is no net movement of water. Two systems (cell and environment) with the same water concentration are termed **isotonic**. The diagram below illustrates two situations: when the external water concentration is higher than the cell (**hypotonic**) and when it is lower than the cell (**hypertonic**).

Plasmolysis in a Plant Cell



Turgor in a Plant Cell



In a **hypertonic** solution, the external water concentration is lower than the water concentration of the cell. Water leaves the cell and, because the cell wall is rigid, the cell membrane shrinks away from the cell wall. This process is termed **plasmolysis** and the cell becomes **flaccid** (turgor pressure =0). Full plasmolysis is irreversible – the cell cannot recover by taking up water.

In a **hypotonic** solution, the external water concentration is higher than the cell cytoplasm. Water enters the cell causing it to swell tight. A wall (turgor) pressure is generated when sufficient water has been taken up to cause the cell contents to press against the cell wall. Turgor pressure rises until it offsets further net influx of water into the cell. The rigid cell wall prevents cell rupture. Cells in this state are said to be **turgid**.

1. Define the term **diffusion**: _____

_____

2. Explain what is meant by a **semi-permeable membrane**: _____

_____

3. Describe how the following factors will affect the rate of diffusion of a substance:

(a) Concentration of molecules: _____

_____

(b) Size of the molecules: _____

_____

(c) Density of the environment the substance is diffusing through (ie. solid/liquid/gas): _____

_____

(d) Temperature: _____

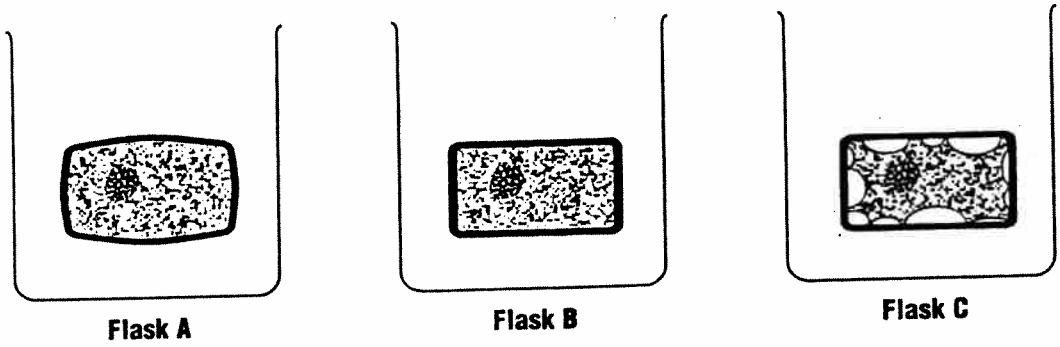
_____

4. Name two biological processes where diffusion plays an important role:

(a) _____

(b) _____

5. In each of the flasks below, a plant cell was placed in a salt solution of different concentration. For each of the flasks (labelled A-C) below, describe the concentration (hypertonic, isotonic, hypotonic) of the salt solution surrounding the cell (given the cell condition shown) and the effect it has had on the cell (normal, plasmolysed or turgid):



Flask A **Flask B** **Flask C**

	Flask A	Flask B	Flask C
Saltiness of the water in the flask:			
Cell condition:			

6. Explain the purpose of the plant cell wall in limiting osmotic flow into the cell: _____

_____

_____

7. (a) Describe what would happen if a red blood cell was placed into pure water (hypotonic environment):

_____

_____

(b) Describe what would happen if a red blood cell was placed into a strong salt solution (hypertonic environment):

_____

_____