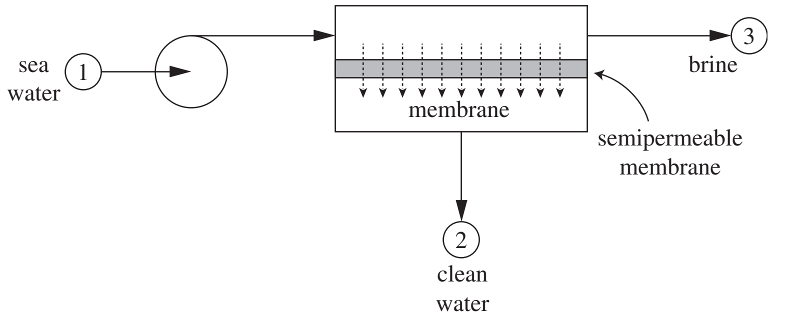

Figure 13-16: Schematic of desalination process by reverse osmosis.

to pass but not any of the ions. The process is shown schematically in Figure 13-16. Effectively, pressure causes water to pass through the membrane, which acts as a filter that keeps out the ions, hence *hyperfiltration*. However, there are important differences between regular filtration and reverse osmosis. In filtration, the applied pressure is needed to overcome the resistance to the flow of the liquid through the filter; even small pressure will produce a trickle of flow. In reverse osmosis, pressure establishes a gradient of chemical potential from the seawater side to the freshwater side that squeezes freshwater out of the water/salt solution. For this process to work, the pressure on the seawater side must be at least equal to the osmotic pressure of the seawater solution. If it is less, freshwater will pass into the seawater by forward osmosis. In desalination, the goal is to produce a stream of pure solvent (water). The same process, however, can be used to concentrate a dilute solution of a solute. An important advantage of reverse osmosis is that it requires no heat (its energy input is entirely in the form of work), which makes it possible to operate at room temperature. For this reason reverse osmosis finds application in the separation of temperature-sensitive products such as proteins.

Example 13.12: Osmotic Pressure

Determine the mol fraction of sugar in water at 25 °C that would produce an osmotic pressure of 10 bar.

Solution The mol fraction of solute that produces osmotic pressure Π is found by solving eq. (13.32) for $x_i = 1 - x_{\text{solv}}$. Taking $\gamma_{\text{solvent}} = 1$ we find

$$x_i = 1 - \exp\left[-\frac{\Pi V_w}{RT}\right].$$

minus sign inside exponential