The worksheets are available in the tutorials and form an integral part of the learning outcomes and experience for this unit.

Model 1: The origin of osmotic pressure

1. See below

2. (i) Increase.  (ii) Stay the same.  (iii) Decrease.

3. The cells in the blood will swell and possibly burst. This can be fatal.

4. (a) This reduces the total solute concentration in the cell and hence reduces the driving force for water to diffuse in.

   (b) This increases the total solute concentration in the cell causing water to flow in as well. The blood cells become spherical or elliptical rather than disc-shaped. (The change in shape and hence suarface area of the cell reduces the ability to take up oxygen and can reduce stamina and anaemia.

Model 2: Osmotic pressure

1. (i) 0.35 M  (ii) 0.15 M  (iii) 0.50 M

2. 1.00 M = 1.00 mol L$^{-1}$

3. \[ \pi = (1.0 \text{ mol L}^{-3}) \times (8.314 \text{ J K}^{-1} \text{ mol}^{-1}) \times (298 \text{ K}) = 2.5 \times 10^3 \text{ kPa} = 24 \text{ atm. Pretty big!} \]

4. Entropy drives the process: water moves to equalise the concentrations. The entropy of dilute solutions increases with the number of particles present but does not depend on their identity.

5. (i) (b) Stay the same size.

   Remember that only the number of particles not their size is important. The fact that sucrose molecules are larger than glucose molecules is irrelevant.

   (ii) (a) Swell.

   Water will flow from the medium into the compartment, to reduce the sucrose concentration in the compartment and simultaneously increase its concentration in the medium, until the concentrations are equal.

   (The osmotic pressure is larger in the compartment than in the medium as it has the higher sucrose concentration.)

   (iii) (b) Stay the same size.
The concentration of particles is about the same on both sides as NaCl dissociates into 2 ions (Na\(^+\)(aq) + Cl\(^-\)(aq)) whilst sucrose is present as individual molecules and does dissociate.

(iv) (c) Shrink.

Each MgCl\(_2\) dissociates into 3 particles so the concentration in the medium is \(\approx 0.15\) M. Water will flow from the compartment into the medium to increase the concentration in the compartment and simultaneously decrease the concentration in the medium, until the two concentrations are equal.

### Model 3: pH

<table>
<thead>
<tr>
<th>pH</th>
<th>0.50</th>
<th>1.50</th>
<th>2.50</th>
<th>3.50</th>
<th>4.50</th>
<th>5.50</th>
<th>5.75</th>
</tr>
</thead>
<tbody>
<tr>
<td>(<a href="aq">H_3O^+</a>]</td>
<td>(3.2 \times 10^{-1})</td>
<td>(3.2 \times 10^{-2})</td>
<td>(3.2 \times 10^{-3})</td>
<td>(3.2 \times 10^{-4})</td>
<td>(3.2 \times 10^{-5})</td>
<td>(3.2 \times 10^{-6})</td>
<td>(1.8 \times 10^{-6})</td>
</tr>
</tbody>
</table>

2. The part of the pH value after the decimal point affects the coefficient (i.e. the numerical value). The part of the pH value before the decimal point affects the exponent (i.e. the position of the decimal point).

### Model 4: Strong and Weak Acids

1. The major species present are \(H_3O^+(aq)\), Cl\(^-\)(aq) and \(H_2O(l)\). There is essentially no “HCl(aq)”.

2. The major species present are \(CH_3COOH(aq)\) and \(H_2O(l)\). The percentage ionization is very small and there is very little \(H_3O^+(aq)\), \(CH_3COO^-(aq)\).

3. \(CH_3COO^-(aq)\) is the dominant species only at high pH.

4. The major species present are \(CH_3NH_2(aq)\) and \(H_2O(l)\).

5. \(CH_3NH_3^+(aq)\) is the dominant species only at low pH.

6. (a) Aspirin is absorbed in the stomach. In the intestine, it is deprotonated.

(b) Amphetamine is absorbed in the intestine. In the stomach, it is protonated.