Concentrations of ions in solution

- When an ionic compound is in solution, it dissociates into its ions.

- In many industries it is important to know the concentration of the individual **ions**, not the **compound**

- To do this we use the dissocaition/ionization equations

$1\ NaI_{(s)} \rightarrow 1\ Na^+_{(aq)} + 1\ I^-_{(aq)}$

10 mol → 10 mol + 10 mol

- Ion concentration is always equal to a whole number multiple of the compound concentration.

$1\ CaCl_{2(s)} \rightarrow 1\ Ca^{2+}_{(aq)} + 2\ Cl^-_{(aq)}$

1 mol → 1 mol + 2 mol

- 1 mole of $CaCl_{2(s)}$ will produce 1 mole of $Ca^{2+}_{(aq)}$ and 2 moles of $Cl^-_{(aq)}$. Because the volume doesn't change we can use that ratio to determine the concentration of the ions

Example:

$1\ CaCl_{2(s)} \rightarrow 1\ Ca^{2+}_{(aq)} + 2\ Cl^-_{(aq)}$

2.50mol/L → $[Ca^{2+}_{(aq)}] = \frac{1}{1} \times 2.50\ mol/L = 2.50\ mol/L$ + $[Cl^-_{(aq)}] = \frac{2}{1} \times 2.50 = 5.00\ mol/L$

Practice Sheet 5

1. Find the amount concentration of each ion in the following solutions:

(a) 0.41 mol/L $Na_2S(aq)$

$1\,Na_2S_{(s)} \rightarrow 2\,Na^+_{(aq)} + 1\,S^{2-}_{(aq)}$

$[Na_2S] = 0.41\,mol/L \quad [Na^+] = 0.82\,mol/L \quad [S^{2-}] = 0.41\,mol/L$

(a) 1.2 mol/L $Sr(NO_3)_2(aq)$

$Sr(NO_3)_{2(aq)} \rightarrow 1\,Sr^{2+}_{(aq)} + 2\,NO_3^-{}_{(aq)}$

$[Sr(NO_3)_2] = 1.2\,mol/L \quad [Sr^{2+}] = 1.2\,mol/L \quad [NO_3^-] = 2.4\,mol/L$

(b) 0.13 mol/L $(NH_4)_3PO_4(aq)$

$(NH_4)_3PO_{4(aq)} \rightarrow 3NH_4^+{}_{(aq)} + PO_4^{3-}{}_{(aq)}$

$[(NH_4)_3PO_4] = 0.13\,mol/L \quad [NH_4^+] = 0.39\,mol/L \quad [PO_4^{3-}] = 0.13\,mol/L$

2. A 250 mL solution is prepared by dissolving 2.01 g of iron(III) chloride in water. What is the amount concentration of each ion in the solution?

$FeCl_{3(s)} \rightarrow Fe^{3+}_{(aq)} + 3Cl^-_{(aq)}$

$m = 2.01\,g$

$M = 162.20\,g/mol$

$n = 0.0123\ldots\,mol$

$V = 0.250\,L$

$c = 0.0495\,mol/L$

$[Fe^{3+}] = 0.0496\,mol/L \quad [Cl^-] = 0.149\,mol/L$

3. In order to prepare for a chemical analysis, a lab technician requires 500 mL of each of the following solutions. Calculate the mass of solid required for each solution:

(a) $[Cl^-(aq)] = 0.400\,mol/L$ from $CaCl_{2(s)}$

$m = ?$

$c = \frac{n}{V}$

$n = cV$

$CaCl_{2(s)} \rightarrow Ca^{2+}_{(aq)} + 2Cl^-_{(aq)}$

$[Cl^-] = 0.400\,mol/L$ $\xrightarrow{\times \frac{1}{2}}$ $c = [CaCl_2] = 0.200\,mol/L$

$V = 500\,mL = 0.500\,L$

$n = cV \quad n = 0.100\,mol$

$M = 110.98\,g/mol$

$m = nM = 11.1\,g$

(b) $[CO_3^{2-}(aq)] = 0.35\,mol/L$ from $Na_2CO_{3(s)}$

$1\,Na_2CO_{3(s)} \rightarrow 2\,Na^+_{(aq)} + 1\,CO_3^{2-}{}_{(aq)}$

$[Na_2CO_3] = 0.35\,mol/L \quad [CO_3^{2-}] = 0.35\,mol/L$

$V = 0.500\,L$

$n = cV = 0.175\,mol$

$M = 105.99\,g/mol$

$m = nM = 18.548\ldots\,g = 19\,g$