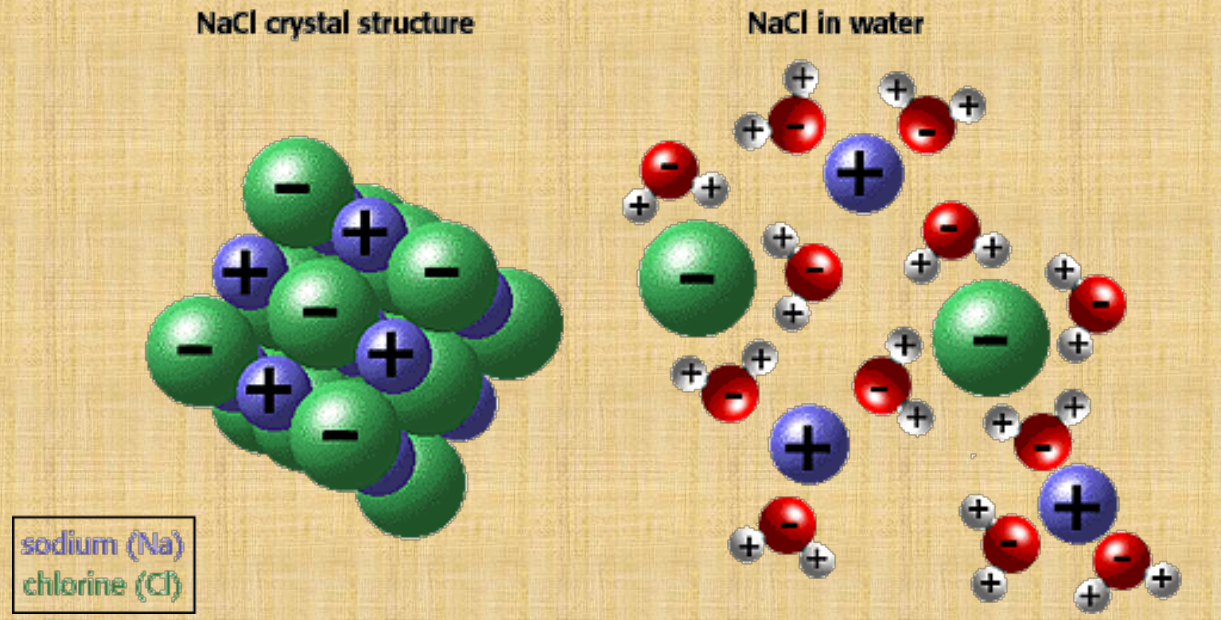
Key Concepts essential for A Level Chemistry

Part 4 – Ionic Equations

- When you dissolve ionic compounds, the ions separate to produce a solution containing positive and negative ions.

- A few covalent substances also form ions when they dissolve in water e.g hydrogen chloride and sulphuric acid.



Look at the formula: Na_2SO_4 is made up from 2 Na^+ ions and 1 SO_4^{2-} ion.

Solubility Rules (you do not need to memorise these)

1. All salts of ammonium (NH_4^+) and Group 1 are always soluble.
2. Chlorates (ClO_3^-), nitrates (NO_3^-), and ethanoates (CH_3COO^-) are soluble
3. All halides are soluble except silver, mercury and lead.
4. Sulphates (SO_4^{2-}) are soluble except $CaSO_4$, $SrSO_4$, $BaSO_4$, $HgSO_4$, $PbSO_4$, and Ag_2SO_4 which are insoluble.
5. Phosphates (PO_4^{3-}), carbonates (CO_3^{2-}), metallic oxides and metallic hydroxides are insoluble except NH_4^+, Group 1 and $Mg(OH)_2$.
6. All sulphides (S^{2-}) are insoluble except NH_4^+, Groups 1 and 2.

Ionic equations only include the ions which take part in the reaction.

Example 1

$$FeSO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Fe(OH)_{2(s)} + Na_2SO_{4(aq)}$$

$$Fe^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} + 2Na^{+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow Fe(OH)_2(s) + 2Na^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$$

$$Fe^{2+}_{(aq)} + SO_4^{2-}{}_{(aq)} + 2Na^{+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow Fe(OH)_2(s) + 2Na^{+}_{(aq)} + SO_4^{2-}{}_{(aq)}$$

$$Fe^{2+}_{(aq)} + 2OH^{-}_{(aq)} \rightarrow Fe(OH)_2(s)$$

Example 2

$$K_2CO_{3(aq)} + 2HCl_{(aq)} \rightarrow 2KCl_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

$$2K^+_{(aq)} + CO_3^{2-}{}_{(aq)} + 2H^+_{(aq)} + 2Cl^-_{(aq)} \rightarrow 2K^+_{(aq)} + 2Cl^-_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

$$2K^+_{(aq)} + CO_3^{2-}{}_{(aq)} + 2H^+_{(aq)} + 2Cl^-_{(aq)} \rightarrow 2K^+_{(aq)} + 2Cl^-_{(aq)} + CO_{2(g)} + H_2O_{(l)}$$

$$CO_3^{2-}{}_{(aq)} + 2H^+_{(aq)} \rightarrow CO_{2(g)} + H_2O_{(l)}$$

Example 3

$$NH_4Cl_{(aq)} + NaOH_{(aq)} \rightarrow NaCl_{(aq)} + NH_{3(g)} + H_2O_{(l)}$$

$$NH_4^+{}_{(aq)} + Cl^-{}_{(aq)} + Na^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow Na^+{}_{(aq)} + Cl^-{}_{(aq)} + NH_{3(g)} + H_2O_{(l)}$$

$$NH_4^+{}_{(aq)} + Cl^-{}_{(aq)} + Na^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow Na^+{}_{(aq)} + Cl^-{}_{(aq)} + NH_{3(g)} + H_2O_{(l)}$$

$$NH_4^+{}_{(aq)} + OH^-{}_{(aq)} \rightarrow NH_{3(g)} + H_2O_{(l)}$$