# Introduction to Solubility

- **solutions** are examples of **homogeneous mixtures** because they are <u>uniform throughout</u>
- the two components of the mixture are
  - > **solute** = substance in lesser concentration
  - > **solvent** = substance in greater concentration

dissolved

dissolving

- substances that dissolve in water can be:
  - > **electrolyte** = a substances that dissolves to give an electrically conducting solution containing ions

    ex. $Na_3PO_4(s) \rightarrow 3Na^+(aq) + PO_4^{3-}(aq)$

    $KCl(g) \rightarrow K^+(aq) + Cl^-(aq)$
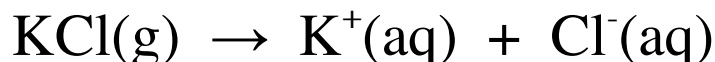
  - > **non-electrolyte** = a substance that dissolves to give a non-conducting solution containing only neutral molecules

    ex. $CH_3OH(g) \rightarrow CH_3OH(aq)$

    $Br_2(l) \rightarrow Br_2(aq)$
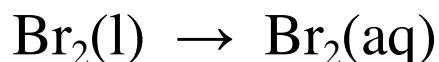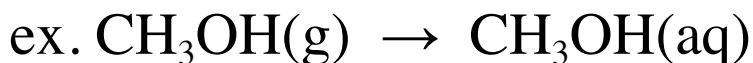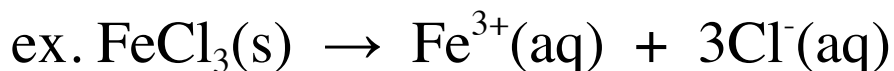
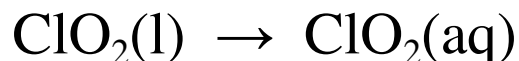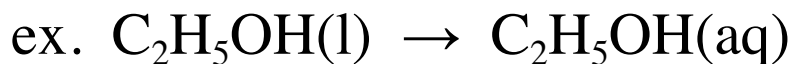> **Molecular solutions** contain only <u>neutral molecules</u> that are <u>non-electrolytes.</u>
>
> **Ionic solutions** contain <u>ions</u> that are <u>electrolytes.</u>

REMEMBER:
- ionic compounds are made up of a metal and a non-metal

$$ex. \ FeCl_3(s) \ \rightarrow \ Fe^{3+}(aq) \ + \ 3Cl^-(aq)$$

$$Na_2SO_4(s) \ \rightarrow \ 2Na^+(aq) \ + \ SO_4^{2-}(aq)$$

- molecular compounds are made up of 2 non-metals

$$ex. \ C_2H_5OH(l) \ \rightarrow \ C_2H_5OH(aq)$$

$$ClO_2(l) \ \rightarrow \ ClO_2(aq)$$

- the **solubility** of a substance is the <u>maximum amount of the substance</u> that can dissolve in a given amount of solvent at a given <u>temperature</u>
  - \> this is a **saturated** solution
  - \> once a solution has been saturated, the addition of more substance will cause the extra to accumulate in undissolved form


SATURATION exists when:
1. some <u>undissolved</u> material is present
2. <u>equilibrium</u> exists between the dissolved ions and the undissolved solid


SOLUBILITY = <u>equilibrium concentration</u> of the substance in a solution at a given temperature or the concentration of a saturated solution

Solubility is often expressed as **MOLAR SOLUBILITY** where the units are mol/L (M).
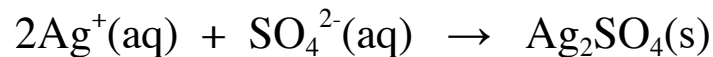
- a solution is shown to be **saturated** by writing an equation showing the substance in **equilibrium** with its aqueous ions

$$Ag_2SO_4(s) \rightleftharpoons 2Ag^+(aq) + SO_4^{2-}(aq)$$
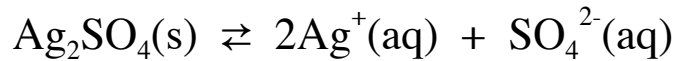
- this equilibrium can be interpreted as:

1. solid Ag_2SO_4 dissociating into ions (dissolving reaction)

$$Ag_2SO_4(s) \rightarrow 2Ag^+(aq) + SO_4^{2-}(aq)$$
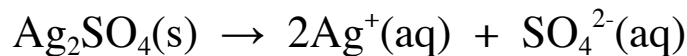
2. Ag^+ and SO_4^{2-} ions come together to form Ag_2SO_4 (crystallization reaction)

$$2Ag^+(aq) + SO_4^{2-}(aq) \rightarrow Ag_2SO_4(s)$$

- initially, there are few ions in solution and the dissolving reaction predominates
- the crystallization reaction speeds up as ion concentration increases
- eventually, the rate of the dissolving reaction equals the rate of the crystallization reaction and equilibrium is reached

dissolving

Dissociation

Rate

Crystallization

Time →