Chemistry

Unit One

Moles

- **One mole: 6.02 X 10^{23} (Avogadro's number)**
- **Molar mass:** the mass of one mole of something.

- **Number of particles = Moles X 6.02 X 10^{23}**

- **Mass = Moles X RAM**

  (g) (mol) (g/mol)

- **Moles = Concentration X Volume**

  (mol) (mol/dm^3) (dm^3)

- **Volume of a gas = Moles X 24 dm^3**

  (dm^3) (mol)

Example

Calculating Empirical Formula from Data

- When a hydrocarbon is burnt in excess oxygen, 4.4g of carbon dioxide and 1.8g of water are made. What is the empirical formula?

1. Moles of carbon dioxide: 4.4/44 = 0.1 moles

   Moles of water: 1.8/18 = 0.1 moles
2. 1 mole of carbon dioxide contains 1 mole of carbon atoms so you must have started with 0.1 moles.

   1 mole of water contains two moles of hydrogen atoms (H_20) so you must have started with 0.2 moles (0.1 x 2).
3. C:H = 0.1:0.2
4. 0.1/0.1 = 1

   0.2/0.1 = 2

- **So the empirical formula of the hydrocarbon is CH_2**

Anhydrous and Hydrated Salt

- **Salt:** where a positive metal ion replaces a H+ ion from an acid.
- **Anhydrous:** doesn't contain water.
- **Hydrated:** does contain water.

- All solid salts form a lattice of positive and negative ions.
- In some, water molecules are incorporated in the lattice – this is the water of crystallisation.
- Many hydrated salts lose their water of crystallisation when heated.

- **If you know the mass of the hydrated and anhydrous salt, you can work out the formula:**

1. Mass of water = mass of hydrated salt – mass of anhydrous salt.
2. Find the number of moles of water lost.
3. Find the number of moles of anhydrous salt produced.
4. Work out the molar ratio of anhydrous salt to the moles of water.
5. Divide each by the smallest mole, and round the answer.

- **Water of crystallisation is represented by a dot in the formula.**
- For example: $CuSO_4 \cdot 5H_20$

Redox Reactions

- **Oxidation:** loss of electrons.
- **Reduction:** gain of electrons.
- **Redox reaction:** something loses electrons and something else gains them.

- **Oxidising agent:** accepts electrons and gets reduced.
- **Reducing agent:** donates electrons and gets oxidised.

Group 2 – The Alkaline Earth Metals

- When group 2 elements react, they lose electrons to form positive ions.
- The easier it is to lose electrons, the more reactive the element.
- **Ionisation energy decreases down group – reactivity increases.**

- **Reactions:** (X is a group 2 element):
- $X + 2H_20 \rightarrow Ca(OH)_2 + H_2$
- $2X\ (s) + O_2\ (g) \rightarrow 2XO\ (s)$

- Oxides react readily with water to form metal hydroxides which dissolve to make strongly alkaline solutions (pH 12-13)
- **Exception: magnesium oxide – reacts slowly and hydroxide isn't very soluble.**
- Go down the group – hydroxides are more soluble.

- **Thermal Decomposition:** when a substance decomposes when heated.
- **Reaction:** Group 2 carbonate → metal oxide + carbon dioxide.
- Tendency for group 2 carbonate to decompose is measured in terms of thermal stability – the greater the thermal stability, the less likely it'll undergo thermal decomposition – **increases down the group.**

- Calcium hydroxide is used to neutralise acid soils.
- Magnesium hydroxide is used in some indigestion tablets to neutralise stomach acid.