# CHAPTER 1.
# moles and equations

## Stoichiometry

$2H_2 + O_2 \longrightarrow 2H_2O$

2 mol : 1 mol : 2 mol

$H_2 + O_2 \longrightarrow H_2O$

$20cm^3 : 10cm^3$

ratio of moles 2 : 1

$2H_2 + O_2 \longrightarrow 2H_2O$

At (r.t.p) room temperature and pressure (20°C and 1 atm) one mole of any gas 24 $dm^3$.

## Deducing stoichiometry by titration

1. Calculate the number of moles of each reagent.
2. Deduce the simplest mole ratio of reagents.
3. Write the equation.

**Empirical formula** - simplest whole number ratio, ionic compounds

**Molecular formula** - total number of atoms of each element present in a compound, organic

| Molecular | Empirical |
|---|---|
| $H_2O$ | $H_2O$ |
| $C_4H_{10}$ | $C_2H_5$ |
| $C_6H_{12}$ | $CH_2$ |

**Ar** = $\frac{\text{average mass of one atom of element}}{\text{mass of one atom of carbon-12}} \times 12$

**Avogadro constant** = $6.02 \times 10^{23}$ (atoms / mol)

**number of moles** = $\frac{\text{mass of substance}}{\text{molar mass}}$

**% by mass** = $\frac{\text{atomic mass} \times \text{moles (element)} \times 100}{\text{molar mass of compound}}$

| | |
|---|---|
| ammonium | $NH_4^+$ |
| carbonate | $CO_3^{2-}$ |
| hydrogencarbonate | $HCO_3^-$ |
| hydroxide | $OH^-$ |
| nitrate | $NO_3^-$ |
| phosphate | $PO_4^{3-}$ |
| sulfate | $SO_4^{2-}$ |

**Concentration (mol/$dm^3$)** = $\frac{\text{number of moles of solute}}{\text{volume of solution}}$

(s) solid
(l) liquid
(g) gas
(aq) aqueous

## Titration

(used to determine the amount of substance present in a solution.)

1. Get some acid of known concentration
2. Fill a clean burette with the acid
3. Record the initial burette reading
4. Measure a known volume of the alkali into a titration flask using a graduated (volumetric) pipette.
5. Add an indicator solution to the alkali in the flask.
6. Slowly add the acid from the burette to the flask, swirl until the indicator changes colour
7. Record the final burette reading. Δ reading = titre
8. repeat this process, adding acid drop by drop
9. Repeat again, until two titres no more than 0.10 $cm^3$ apart.
10. Take the average of these two titre values.

| | rough | 1 | 2 | 3 |
|---|---|---|---|---|
| final burette reading/$cm^3$ | 37.60 | 38.65 | 36.40 | 34.75 |
| initial burette reading/$cm^3$ | 2.40 | 4.00 | 1.40 | 0.00 |
| titre/$cm^3$ | 35.20 | 34.65 | 35.00 | 34.75 |