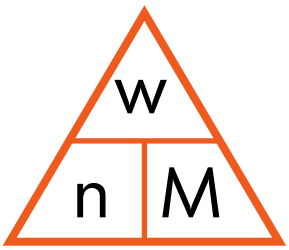
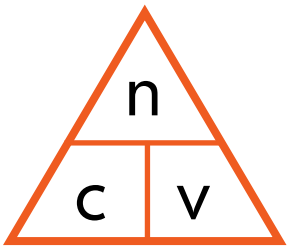
## MOLE CALCULATIONS

**number of moles = mass / molar mass**
(g) (g.mol$^{-1}$)

**number of moles = concentration x volume**
(mol.dm$^{-3}$) (dm$^3$)

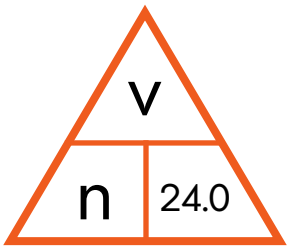



**Avogadro's Constant = 6.02 x $10^{23}$** atoms or molecules = **1 mole**

## MOLAR GAS CONSTANT

**1 mole of ANY gas occupies 24.0 dm$^3$ at room temperature & pressure**




## IDEAL GAS EQUATION

**P** = Pressure (pa) **V** = volume (m$^3$) **n** = no. of moles

**R** = Gas Constant (8.31 J.K$^{-1}$.mol$^{-1}$) **T** = Temperature (K)

$$PV = nRT$$

$$P = \frac{nRT}{V} \qquad V = \frac{nRT}{P} \qquad n = \frac{PV}{RT} \qquad T = \frac{PV}{nR}$$

**For changes in conditions:**

$$\frac{P_1V_1}{T_1} = \frac{P_2V_2}{T_2}$$

## MASS SPECTROSCOPY

$$\text{Relative Atomic Mass (Ar)} = \frac{(\text{mass isotope 1} \times \text{abundance}) + (\text{mass isotope 2} \times \text{abundance}) + \ldots}{\sum \text{abundance}}$$

## OTHER EQUATIONS

$$\%\ \text{by mass} = \frac{\text{mass of element in 1 mole}}{\text{Mr}}$$

$$\text{Empirical formula} = \frac{M1}{Mr1} : \frac{M2}{Mr2} : \frac{M3}{Mr2}$$

Where M1, M2 etc is the mass or % composition of element 1, 2 etc

then divide each by the smallest number to give empirical formula

$$\%\ \text{Atom Economy} = \frac{\text{mass of desired product}}{\text{total mass of all products}} \times 100$$

You can use mass or number of moles here!

$$\%\ \text{Yield} = \frac{\text{actual yield}}{\text{theoretical yield}} \times 100$$

You can replace masses with Mr values here too!

## ENTHALPY

Q = energy transferred (J)
c = specific heat capacity ($J.K^{-1}.mol^{-1}$)
m = mass of **solution** (g)
$\triangle T$ = **change** in temperature ($^{o}C$ **or** K)

$$Q = m.c.\triangle T$$

$$\triangle H = \frac{Q}{n}$$

($J.mol^{-1}$)

Don't forget to add a sign for $\triangle H$!

Divide by 1000 for $kJ.mol^{-1}$

$$\triangle H \text{ reaction} = \sum \text{reactant mean bond enthalpies} - \sum \text{product mean bond enthalpies}$$

($kJ.mol^{-1}$) ($kJ.mol^{-1}$) ($kJ.mol^{-1}$)

## EQUILIBRIA

$$aA + bB \rightleftharpoons cC + dD$$

$$Kc = \frac{[C]^c\ [D]^d}{[A]^a\ [B]^b}$$

Where:
[A] = concentration ($mol.dm^{-3}$)
a = no. of moles from equation

## COMMON IONS

### POSITIVE

GROUP 1 = +

GROUP 2 = 2+

$H^+$

$Ag^+$

$Zn^{2+}$

$Pb^{2+}$

$Al^{3+}$

(Transition metals are variable)

e.g. $Fe^{2+}$, $Fe^{3+}$

### NEGATIVE

GROUP 7 = -

GROUP 6 = 2-

GROUP 5 = 3-

## MOLECULAR IONS

| | | | |
|---|---|---|---|
| $NH_4^+$ ammonium | $OH^-$ hydroxide | $NO_3^-$ nitrate | $CN^-$ cyanide |
| $H_3O^+$ hydronium | $CO_3^{2-}$ carbonate | $SO_4^{2-}$ sulfate | $PO_4^{3-}$ phosphate |

## ACIDS & BASES

### ACIDS

| | |
|---|---|
| HCl | hydrochloric acid |
| $HNO_3$ | nitric acid |
| $H_2SO_4$ | sulphuric acid |
| $H_3PO_4$ | phosphoric acid |
| $CH_3COOH$ | ethanoic acid |

### BASES

| | |
|---|---|
| NaOH | sodium hydroxide |
| KOH | potassium hydroxide |
| $Ca(OH)_2$ | calcium hydroxide |
| CuO | copper (II) oxide |

# COMMON OXIDATION STATES

## POSITIVE

GROUP 1 = +I
GROUP 2 = +II
H = +I
Ag = +I
Zn = +II
Pb = +II or +IV
Al = + III
(Transition metals are variable)
Fe = +II or +III
Cu = +II (sometimes +I)
C = +II or +IV

## NEGATIVE

F = -I
O = -II
Cl = -I
Br = -I
I = -I
N = -III
S = -II
P = -III

Most common oxidation states, but may be positive when covalently bonded to more highly electronegative elements.
i.e. F or O

**GROUP 1** SALTS: ALL SOLUBLE

**NITRATE** SALTS = ALL SOLUBLE

**GROUP 2** SALTS: HYDROXIDES INCREASE IN SOLUBILITY DOWN THE GROUP
SULFATES DECREASE IN SOLUBILITY DOWN THE GROUP
CARBONATES ARE NOT SOLUBLE

**Ag** SALTS: ALL INSOLUBLE EXCEPT $AgNO_3$

**Pb** SALTS ALL INSOLUBLE EXCEPT $Pb(NO_3)_2$

**GROUP 7** SALTS: ALL SOLUBLE EXCEPT AgX and $PbX_2$

**$CO_3$** SALTS: ALL INSOLUBLE EXEPT GROUP 1

# YEAR 1 CHEMISTRY PRACTICALS (EDEXCEL)

| No. | Practical | Detail | Done? |
|---|---|---|---|
| 1 | Moles Determination | Use apparatus to record the volume of a gas | |
| 2 | Prepare a Standard Solution & Titration | Prepare a standard solution from a solid acid and use it to find the concentration of a solution of sodium hydroxide | |
| 3 | Titration | Use titration to find the concentration of a solution of hydrochloric acid | |
| 4 | Rates of Reaction | Investigate the rates of hydrolysis of haloalkanes | |
| 5 | Oxidation of ethanol | Use reflux and distillation techniques to oxidise and alcohol and isolate the product | |
| 6 | Nucleophilic Subsctitution | Chlorination of a 2-methylpropan-2-ol using conc. hydrochloric acid | |
| 7 | Testing for inorganic and organic substances | Use chemical tests to identify:<br>- Group 2, Group 7, $OH^-$, $CO_3^{2-}$ and $SO_4^{2-}$ ions in solution.<br>- A carboxylic acid, an alcohol and an aldehyde. | |
| 8 | Enthalpy Changes | Determine the enthalpy change of a reaction using Hess' law.<br>i.e. Determine the $\triangle H$ experimentally for two reactions and apply to Hess' Law to find another unknown $\triangle H$. | |