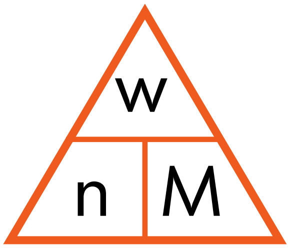
Tailored Tutors

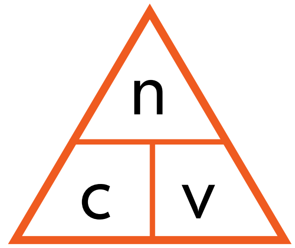
# YEAR 1 CHEMISTRY EQUATIONS (AQA)

## MOLE CALCULATIONS

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

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

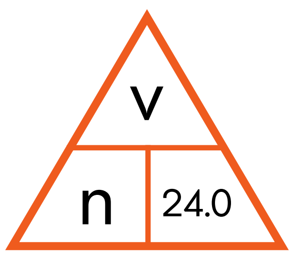



**Avogadro's Constant = $6.02 \times 10^{23}$** atoms or molecules = **1 mole**

## 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 (8.314 $J.K^{-1}.mol^{-1}$) **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:**

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

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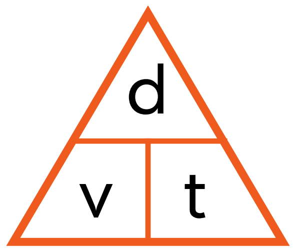
## MASS SPECTROSCOPY

K.E. = Kinetic Energy (J) m = mass of ONE ion (Kg) v = velocity ($m.s^{-1}$)

$$K.E. = \frac{1}{2} m.v^2 \qquad v = \sqrt{\frac{2K.E.}{m}} \qquad m = \frac{\sqrt{2K.E.}}{v}$$

d = distance **or** length of flight tube (m) t = time (s) v = velocity ($m.s^{-1}$)




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

## OTHER EQUATIONS

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

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

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) m = mass of **solution** (g)

c = specific heat capacity ($J.K^{-1}.mol^{-1}$) $\triangle T$ = **change** in temperature ($^{o}C$ **or** K)

$$\mathbf{Q = m.c.\triangle T}$$

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

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

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

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

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

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

## 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

$H_3O^+$
hydronium

$OH^-$
hydroxide

$NO_3^-$
nitrate

$CN^-$
cyanide

$CO_3^{2-}$
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

| No. | Practical | Detail | Done? |
|---|---|---|---|
| 1a | Make a standard solution | Prepare a 250cm$^3$ sample of a solution (e.g. NaOH) to a known concentration using the standard method. | |
| 1b | Perform a simple acid-base titration | Titrate an acid of known concentration against an alkali. Deduce the concentration of the alkali using a the mean titre. e.g. HCl + NaOH | |
| 2a | Measure the enthalpy change of combustion of a fuel ($\Delta$Hc) | Use a calorimeter to experimentally determine the energy released by a fuel and the $\Delta$H for the reaction. | |
| 2b | Measure the enthalpy change of neutralisation ($\Delta$Hn) | Use a calorimeter to experimentally determine the energy released by a neutralisation reaction and the $\Delta$H for the reaction. | |
| 3 | Measure temperature affects the rate of a reaction | Use the initial rate method to determine the effect of increasing temperature ion the rate of a reaction. e.g. HCl + Sodium Thiosufate | |
| 4 | Testing for ions in solution | Use chemical tests to identify Group 2, Group 7, $OH^-$, $CO_3^{2-}$ and $SO_4^{2-}$ ions in solution | |
| 5 | Distillation of an organic product | Produce a liquid organic compound and use distillation to separate and purify. e.g. Aldehyde or Ester | |
| 6 | Testing for organic functional groups | Use chemical tests to identify a carboxylic acid, an alcohol and an aldehyde. | |