AS Definitions – Paper 1

1.1 Atomic structure:

Isotope:
An atom of the same element that has the same number of protons and electrons but a different number of neutrons.

RAM, Relative Atomic Mass:
The weighted mean mass of an atom compared with 1/12th of the mass of carbon -12

Relative isotopic mass:
The mass of an isotope compared with 1/12th of the mass of carbon -12

1st ionisation energy of an element:
The energy required to remove 1 mole of electrons from 1 mole of gaseous atoms to form 1 mole of gaseous 1+ ions

1.2 Amount of substance:

Relative molecular mass, Mr: Covalent molecules (non metal & non metal):

The weighted mean mass of a molecule compared with 1/12th of the mass of carbon -12

Relative formula mass, Mr: Ionic compounds (metal & non metal):

The weighted mean mass of a formula unit compared with 1/12th of the mass of carbon -12

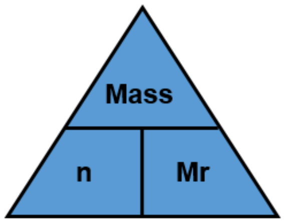
The mole:

Avogadro's constant, N_A: *6.02×10^{23}*

Nº particles = Moles x N_A

1) Moles and masses

Number of moles = $\frac{\text{Mass of substance}}{\text{Mr}}$	**$n = \frac{m}{Mr}$**



TIP: ***mass must be in g so make sure you can convert to this.***
k means 1000's of, ie 1000 of grams:

X 1000 — ***1kg → 1000g***

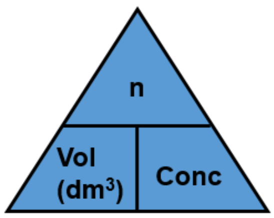
/ 1000 — ***1000g → 1kg***

$X\ 1 \times 10^6$ — ***1tonne → 1000000g***

$/\ 1 \times 10^6$ — ***1000000g → 1tonne***

2) Moles and Solutions, (aq) – mol dm^{-3}

Number of moles = Concentration (mol dm^{-3}) x Volume (dm^3)	**$n = C \times V (dm^3)$**



TIP: ***Volume must be in dm^3 so make sure you can convert to this:***

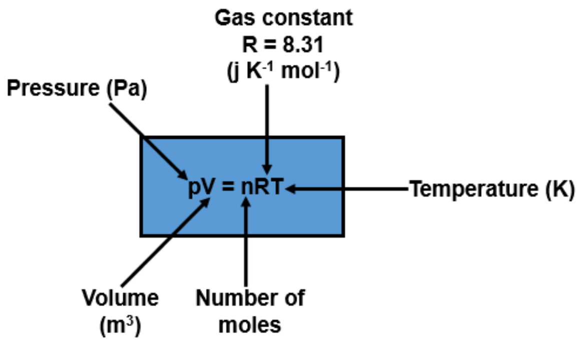
$1dm^3 = 1000cm^3 = 1litre$

X 1000 — ***$1dm^3 \rightarrow 1000cm^3$***

/ 1000 — ***$1000cm^3 \rightarrow 1dm^3$***

3) Moles and gases, (g) – M^3

The Ideal gas equation



2 assumptions:

- The volume of the molecules is negligible
- The molecules have no intermolecular forces of attraction

TIP: ***Volume must be in m^3 so make sure you can convert to this:***

$$1000000cm^3 = 1000dm^3 = 1m^3$$

x 1000	x 1000	x 1000000
$1m^3 \rightarrow 1000dm^3$	$1000dm^3 \rightarrow 1000000cm^3$	$1m^3 \rightarrow 1000000cm^3$
/ 1000	/ 1000	/ 1000000
$1000000cm^3 \rightarrow 1000dm^3$	$1000dm^3 \rightarrow 1m^3$	$1000000cm^3 \rightarrow 1m^3$

TIP: ***Temperature must be in kelvin, K so make sure you can convert to this:***

+273	+273	+273
$0^oC \rightarrow 273K$	$100^oC \rightarrow 373K$	$25^oC \rightarrow 298K$
-273	-273	-273
$273K \rightarrow 0^oC$	$373K \rightarrow 100^oC$	$298K \rightarrow 25^oC$

Empirical formula:
The simplest whole number ratio of atoms of elements in a molecule

Molecular formula:
The actual number ratio of atoms of elements in a molecule

Percentage yield:
Is a measure of how wasteful a chemical process is

$$\% \text{ Yield} = \frac{\text{Actual Yield}}{\text{Theoretical Yield}} \times 100$$

Atom economy:
Is a measure of how wasteful a reaction is

$$\text{Atom economy} = \frac{\text{Mr of the desired product}}{\text{Sum of Mr's of all products}} \times 100$$

1.3 Bonding

Metallic bonding – Giant structure
Strong electrostatic attraction between the positive metal ions and the negative delocalised electrons.

Ionic Bonding – Giant structure
Strong electrostatic forces of attraction occur between oppositely charged ions

Covalent Bond
Shared pair of electrons

Multiple covalent Bond
Multiple shared pairs of electrons

Dative covalent Bond
Shared pair of electrons where one atom provides both electrons in the pair

Electronegativity
The ability of an atom to attract the bonding pair of electrons in a covalent bond.

Polar bond
Two elements of different electronegativity

Polar molecule
A molecule that is not symmetrical with a polar bond

1.4 Energetics

Enthalpy change
Is the change in heat energy at constant pressure

Exothermic reaction
When heat energy is transferred from the system to the surroundings, negative values

Endothermic reaction
When heat energy is transferred from the surroundings to the system, positive values

Activation energy
Is the minimum energy required to start a reaction by the breaking of bonds

Bond Enthalpy
Is the energy required to break one mole of a given covalent bond in the molecule in the gaseous state

Mean bond Enthalpy
Is the average value for the bond enthalpy over the range of compounds it is found in

Standard enthalpy change of formation, $\Delta_f H^\theta$

The enthalpy change that occurs when 1 mole of a compound is formed from its constituent elements in their standard states under standard conditions.

$$H_{2(g)} + \tfrac{1}{2}O_{2(g)} \rightarrow H_2O_{(l)}$$

Standard enthalpy of combustion – $\Delta_c H^\theta$

The enthalpy change that occurs when 1 mole of a compound reacts completely with oxygen under standard conditions where all reactants and products are in their standard states.

$$CH_{4(g)} + 2O_{2(g)} \rightarrow CO_{2(g)} + 2H_2O_{(l)}$$

Standard enthalpy change of reaction, $\Delta_r H^\theta$

The enthalpy change when a reaction occurs in the molar quantities shown in the equation under standard conditions where all reactants and products are in their standard states.

$$Fe_2O_{3(s)} + 2Al_{(s)} \rightarrow 2Fe_{(s)} + Al_2O_{3(s)}$$

Hess's law

The total enthalpy change for a reaction is independent of the route taken.

1.6 Equilibria

Le Chatelier's Principle

When a reaction at equilibrium is subject to a change in concentration, pressure or temperature, the position of the equilibrium will move to counteract the change.

1.7 REDOX

Oxidation

Loss of electrons

Reduction

Gain of electrons

Oxidation – oxidation states

Increase in oxidation state

Reduction – oxidation states

Decrease in oxidation state (Reduction in oxidation state)

Reducing agents

Are themselves oxidised
Therefore is loss of electrons

Oxidising agents

Are themselves reduced
Therefore is gain of electrons

2.1 Periodicity

Periodicity
The repeating trends in physical and chemical properties of elements as you go across the Periodic Table

2.2 Group 2 – The alkaline earth metals

2.3 Group 7 – The halogens

Disproportionation:
Is a REDOX reaction where the same element has been both Oxidised and Reduced