AS Definitions – Paper 2

<u>1.1 Amount of substance:</u>

Relative <u>molecular</u> mass, Mr: Covalent molecules (non metal & non metal):

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

Relative <u>formula</u> mass, Mr: Ionic compounds (metal & non metal):

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

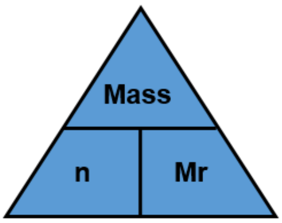
The mole:

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

Nº particles = Moles x N_A

1) Moles and masses

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

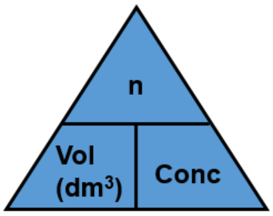


<u>TIP:</u> mass must be in g so make sure you can convert to this. ***k means 1000's of, ie 1000 of grams:*** ***X 1000***   ***/ 1000*** ***1kg → 1000g***   ***1000g → 1kg*** ***X 1 x 10^6***   ***/ 1 x 10^6*** ***1tonne → 1000000g***   ***1000000g → 1tonne***

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

Number of moles = Concentration ($mol\ dm^{-3}$) x Volume (dm^3)

n = C x V (dm^3)



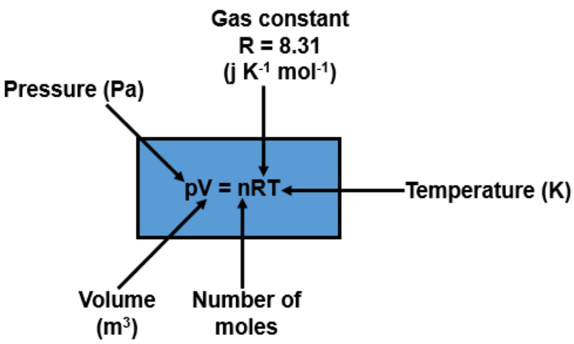
TIP: ***Volume must be in dm^3 so make sure you can convert to this:***

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

X 1000
$1dm^3$ → $1000cm^3$

/ 1000
$1000cm^3$ → $1dm^3$

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
$1m^3$ → $1000dm^3$

x 1000
$1000dm^3$ → $1000000cm^3$

x 1000000
$1m^3$ → $1000000cm^3$

/ 1000
$1000000cm^3$ → $1000dm^3$

/ 1000
$1000dm^3$ → $1m^3$

/ 1000000
$1000000cm^3$ → $1m^3$

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

+273
0^oC → 273K

+273
100^oC → 373K

+273
25^oC → 298K

-273
273K → 0^oC

-273
373K → 100^oC

-273
298K → 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.

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

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.

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

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.

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

Hess's law
The total enthalpy change for a reaction is independent of the route taken.

1.5 Kinetics

Activation energy
The minimum amount of energy that particles require to react when they collide by the breaking of bonds

Rate
The rate of a reaction is the change in concentration of a reactant or product in a given time

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.

3.1 Introduction to organic chemistry

Hydrocarbon:
A compound that contains only hydrogen and carbon

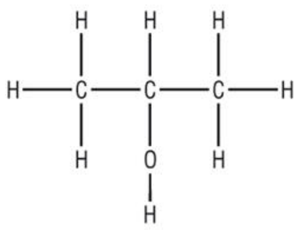
Saturated:
A compound that contains single carbon – carbon bonds only

Unsaturated:
A compound that contains one or more carbon – carbon double bonds

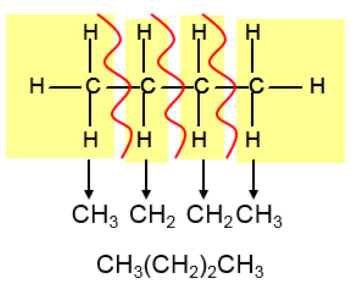
Molecular formula:
The actual number of atoms of each element in a compound

Empirical formula:
Simplest whole number ratio of atoms of each element in a compound

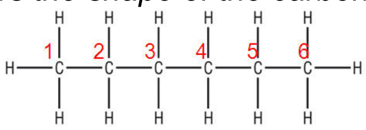
Displayed formula:
Shows all the atoms and bonds in a molecule



Structural formula:
Shows how the atoms in a molecule are arranged



Skeletal formula:
Shows the shape of the carbon skeleton



Displayed formula

Skeletal formula

Homologous series:
Is a family of compounds containing the same functional group and having the same general formula. Each successive member has a different carbon chain length by CH_2

CH_3OH CH_3CH_2OH $CH_3CH_2CH_2OH$ $CH_3CH_2CH_2CH_2OH$

Functional group:
Is an atom or group of atoms which gives an organic compounds its particular chemical properties

Structural Isomer:
Are compounds with the same molecular formula but a different structural formula

Stereo Isomer:
A Molecule with the same structural formula but its atoms are arranged differently in space

Chain Isomerism:
These have the same molecular formula and functional group but a different arrangement of the carbon skeleton

Position Isomerism:
These have the same molecular formula and functional group but the functional group is attached to a different carbon

Functional group Isomerism:
These have the same molecular but the atoms are arranged into a different functional group

Homolytic fission:
The breaking of a covalent bond where free radicals are formed

Heterolytic fission:
The breaking of a covalent bond where ions are formed

Free radical:
These are particles with an unpaired electron, $Cl^{\cdot}$

Electrophile:
These are electron pair acceptors

Nucleophile:
These are electron pair donors

Substitution:
When one atom or group of atoms are swapped with another atom or group of atoms

Elimination
Where a molecule loses atoms or groups of atoms

Hydrolysis
Splitting a molecule apart by using water molecules

3.2 Alkanes

3.3 Halogenoalkanes

3.4 Alkenes

Geometric Isomerism (E/Z isomerism)
These have the same molecular formula but different spatial arrangement due to the restricted rotation around the carbon – carbon double bond

3.5 Alcohols

Carbon neutral
The amount of CO_2 taken in through photosynthesis and fermentation is the same as the amount of CO_2 released from combustion