

Learn these by heart before the exam.

Atoms and the mole

Atomic structure: protons (+1) and neutrons in the nucleus, electrons (−1) in shells; proton number defines the element

Isotopes: atoms of the same element with the same protons but different neutrons; relative atomic mass = average allowing for abundance

$$\text{moles} = \frac{\text{mass}}{M_r}$$

$$\text{concentration} = \frac{\text{moles}}{\text{volume (dm}^3\text{)}}$$

Electron shells fill 2, 8, 8; group number = outer electrons, period number = number of shells.

Bonding and the Periodic Table

Ionic bonding: a metal gives electrons to a non-metal; oppositely charged ions form a giant lattice – high melting point, conducts when molten or dissolved

Covalent bonding: non-metal atoms share pairs of electrons; usually small molecules with low melting points that do not conduct

Metallic bonding: a lattice of positive ions in a sea of delocalised electrons – conducts and is malleable

Group I (alkali metals): reactivity increases down the group. Group VII (halogens): reactivity decreases down the group.

Group 0 (noble gases) are unreactive – full outer shells. Transition metals: coloured compounds, act as catalysts.

Reactions and energetics

Oxidation and reduction: OIL RIG – Oxidation Is Loss of electrons, Reduction Is Gain; oxidation is also gain of oxygen

Exothermic vs endothermic: exothermic releases heat (temperature rises); endothermic takes in heat (temperature falls)

Rate of reaction: faster with higher concentration, higher temperature, larger surface area, and a catalyst – more frequent successful collisions

Catalyst: speeds up a reaction and is unchanged at the end; lowers the activation energy

Reversible reaction at equilibrium ($\rightleftharpoons$): raising temperature favours the endothermic direction; raising pressure favours the side with fewer gas molecules.

Acids, bases and salts

Acids: $\text{pH} < 7$, turn litmus red. Alkalis: $\text{pH} > 7$, turn litmus blue. Neutral: $\text{pH} = 7$.

$\text{acid} + \text{base} \rightarrow \text{salt} + \text{water}$

Acid + metal $\rightarrow$ salt + hydrogen; acid + carbonate $\rightarrow$ salt + water + carbon dioxide.

Electrolysis: an electric current splits a molten or dissolved ionic compound; positive ions (cations) go to the cathode, negative to the anode

Tests: hydrogen pops with a lit splint; oxygen relights a glowing splint; CO_2 turns limewater milky.

Organic and analysis

Homologous series: a family with the same general formula and functional group (alkanes, alkenes, alcohols, acids)

Alkanes $\text{C}_n\text{H}_{2n+2}$ (saturated, single bonds); alkenes C_nH_{2n} (unsaturated, $\text{C}=\text{C}$ double bond).

Test for an alkene: it decolourises orange bromine water; alkanes do not.

Complete combustion $\rightarrow \text{CO}_2 + \text{water}$; incomplete combustion $\rightarrow$ toxic carbon monoxide + soot.

Flame tests: lithium red, sodium yellow, potassium lilac, copper blue-green.