OCR (B) Chemistry A-level

Storyline 4: The Ozone Story

Definitions and Concepts

Definitions and Concepts for OCR (B) Chemistry A-level

The Ozone Story

Bonding and Structure

Dipole: A partial charge on an atom which is caused by the differing electronegativities of atoms in a covalent bond.

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

Hydrogen bonding: An interaction between a hydrogen atom and an electronegative atom, commonly nitrogen, fluorine or oxygen. The slightly positive hydrogen is attracted to the lone pair on the electronegative atom. Hydrogen bonds are stronger than van der Waals and dipole-dipole forces but weaker than ionic and covalent bonds.

Intermolecular forces: Forces which act between molecules. These include permanent dipole-dipole forces, induced dipole-dipole forces and hydrogen bonding.

Polar bond: A covalent bond that has a permanent dipole due to the different electronegativities of the atoms that make up the bond.

Van der Waals: Also known as induced dipole–dipole, dispersion, and London forces, van der Waals forces exist between all molecules. They arise due to fluctuations of electron density within a molecule. These fluctuations may temporarily result in an uneven electron distribution, producing an instantaneous dipole. This dipole can induce a dipole in another molecule, and so on.

Kinetics

Activation enthalpy: The minimum enthalpy required for a reaction to occur between two colliding particles.

Amines: Compounds that contain the NR_3 functional group (where R could be hydrogen atoms or alkyl chains). Amines can act as bases and nucleophiles.

Catalyst: A substance that increases the rate of a reaction without being chemically changed or used up. They work by providing an alternative reaction pathway with a lower activation energy.

Collision theory: The theory that particles must collide with sufficient energy and in the correct orientation to react.

Effect of concentration on reaction rate: As the concentration of reactants increases, the reacting particles get closer together meaning they will collide more often. As a result, there will be a higher rate of successful collisions and a faster rate of reaction.

Effect of pressure on reaction rate: As the pressure of gaseous reactants increases, the reacting particles get closer together meaning they will collide more often. As a result, there will be a higher rate of successful collisions and a faster rate of reaction.

Effect of temperature on reaction rate: Increasing the temperature means the particles will have more kinetic energy and so will move faster. If the molecules are moving faster they will collide more often and, since they have more kinetic energy, a larger proportion of the particles will have energy equal to or greater than the activation energy. For both of these reasons the rate of reaction increases.

Enthalpy profile: A diagram showing the energy change of a reaction as it moves from reactants to products.

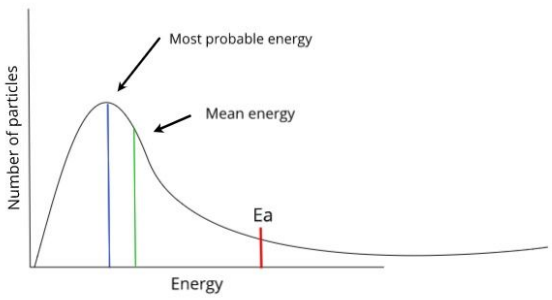
Functional group: An atom/group of atoms responsible for the characteristic reactions of a compound.

Halogenoalkanes: An organic compound containing a halogen atom (F/Cl/Br/I) bound to an alkyl chain. Haloalkanes can be formed from alcohols via a substitution reaction with halide ions in the presence of acid.

Homogeneous catalyst: A catalyst which is in the same state as the reactants in the system.

Homologous series: A series of organic compounds containing the same functional group with successive members differing by $-CH_2$.

Maxwell-Boltzmann distribution: Shows the distribution of the molecular energies in a gas at a constant temperature. The area under the curve indicates the total number of particles present.



Nomenclature: The naming system for compounds.

Rate of reaction: The measure of the amount of product formed or reactant used over time. The units of rate of reaction may be given as g/s, cm^3/s or mol/s.

Organic Reactions

Boiling point: The temperature at which a compound moves from a liquid state to a gaseous state.

Bond enthalpy: The energy required to break one mole of gaseous bonds. Actual bond enthalpies may differ from the average as the average bond enthalpy considers the bond across a range of molecules.

Curly arrow: Shows the movement of a pair of electrons. Curly arrows must start from a bond, a lone pair of electrons or a negative charge.

Free radical substitution: A photochemical reaction between halogens and alkanes to form halogenoalkanes. The reaction requires UV light and involves three stages: initiation, propagation and termination. Initiation creates a radical species. Propagation involves a series of chain reactions where free radicals bond to molecules to form new free radicals. Termination involves the reaction of free radicals with other free radicals to form new molecules.

Free radical: A species with an unpaired electron. These are represented in mechanisms by a single dot.

Heterolytic fission: When a covalent bond breaks and one bonding atom receives both electrons from the bonded pair.

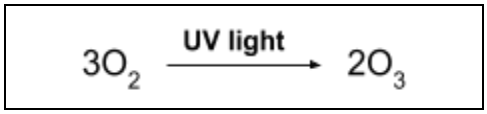
Homolytic fission: When a covalent bond breaks and each bonding atom receives one electron from the bonding pair, forming 2 radicals.

Initiation: The first step in a radical substitution mechanism, involving the formation of the radicals.

Nucleophile: An atom or molecule that donates an electron pair to form a covalent bond. Attracted to electron-deficient areas.

Nucleophilic substitution: The reaction of an electron pair donor (the nucleophile) with an electron pair acceptor (the electrophile). Involves one species being replaced with another species.

Ozone: Chemical formed naturally in the upper atmosphere. It is beneficial because it absorbs ultraviolet radiation and this prevents harmful radiation reaching the earth. Ozone is formed by the following reaction:



Ozone depletion: Chlorine atoms catalyse the decomposition of ozone and contribute to the destruction of the ozone layer.

Partial charges: The slight charge on an atom due to the bonded atoms having different electronegativities.

Photodissociation: The process where a molecule is broken down using photons.

Propagation: The intermediate steps in a radical substitution mechanism where a radical reacts with another species.

S_N2: A nucleophilic substitution reaction where the mechanism route used has two compounds in the rate-determining step.

Substitution: A reaction where one atom/group of atoms is substituted for another atom/group of atoms.

Termination: The final steps in a radical substitution mechanism in which 2 radicals react together to form a species that only contains paired electrons.

Sustainability

Ozone as sunscreen: Ozone blocks out the sun's UV rays so acts as a natural sunscreen.

Pollution effect on ozone: Man-made pollutants thin the ozone layer, meaning it doesn't absorb as much UV radiation in those areas.

Energy and Matter

Electromagnetic spectrum: A range of frequencies of electromagnetic radiation and the respective wavelengths.

Electron promotion: When an electron absorbs a photon and moves from a low energy orbital to a vacant higher energy orbital.

Infrared: An area of the electromagnetic spectrum that has wavelengths between 780 nm and 1 mm.

Ultra-violet (UV): An area of the electromagnetic spectrum that has wavelengths between 10 nm and 400 nm.

Visible light: An area of the electromagnetic spectrum that has wavelengths between 380 and 700 nm.