OCR (B) Chemistry A-level

Storyline 3: Elements from the Sea

Definitions and Concepts

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

Elements from the Sea

Formulae, Equations and Amount of Substance

Amount of substance: The quantity of a chemical species, measured in moles. Used as a way of counting atoms. The amount of substance can be calculated using:

Number of moles = Mass ÷ Mr

Number of moles = (Pressure x Volume) ÷ (Gas constant, R x Temperature)

Number of moles = Concentration x Volume

Atom economy: Measure of the proportion of reacting atoms that become part of the desired product in the balanced chemical equation.

Atom Economy = (Molar mass of desired product / Total molar mass of all products) x 100%

Redox

Anode: Positive electrode where oxidation takes place.

Cathode: Negative electrode where reduction takes place.

Electrode: A conductor through which electricity enters or leaves a substance or region.

Electrolysis: A technique used to assist a non-spontaneous reaction to completion using electricity. Used to separate elements from their ores.

Half equation: A full redox equation can be split into two half-equations, one involving oxidation and the other involving reduction. This is useful for balancing complex redox reactions, such as:

$$MnO_4^- + C_2O_4^{2-} + H^+ \rightarrow Mn^{2+} + CO_2 + H_2O$$

Can be split into:

$$\text{Reduction: } 2\,MnO_4^- + 16\,H^+ + 10\,e^- \rightarrow 2\,Mn^{2+} + 8\,H_2O$$

$$\text{Oxidation: } 5\,C_2O_4^{2-} \rightarrow 10\,CO_2 + 10\,e^-$$

And combined to give the balanced redox equation:

$$2\,MnO_4^- + 5\,C_2O_4^{2-} + 16\,H^+ \rightarrow 2\,Mn^{2+} + 5\,CO_2 + 8\,H_2O$$

Halogen: An element from Group 17 of the periodic table, eg, chlorine, bromine, iodine.

Nomenclature: The naming of a molecule/compound in chemistry.

Oxidation: Process involving the loss of electrons. Results in an increase in oxidation number.

Oxidation state: The charge of an ion or a theoretical charge of an atom in a covalently bonded compound assuming the bond becomes ionic.

Oxidising agent: Electron acceptors. A species which brings about oxidation by gaining electrons. The oxidising agent is itself reduced.

Redox reaction: A reaction in which both reduction and oxidation are occurring simultaneously.

Reducing agent: Electron donors. A species which brings about reduction by losing electrons. The reducing agent is itself oxidised.

Reduction: Process involving the gain of electrons. Results in a decrease in oxidation number.

p-block element: Elements in Groups 3-8/0 of the periodic table. p-block non-metals generally undergo reduction reactions.

s-block element: Elements in Groups 1 and 2 of the periodic table. s-block elements generally undergo oxidation reactions.

Inorganic Chemistry and the Periodic Table

Solubility in water: The degree to which a substance can dissolve in water at a certain temperature.

Thermal stability: How easy/much energy does it take for a molecule to break down using heat.

Volatility: How easily a substance evaporates in standard conditions.

Water treatment: The addition of chlorine to water to kill bacteria. The risks associated with the use of chlorine to treat water are the hazards of toxic chlorine gas and the possible risks from the formation of chlorinated hydrocarbons.

Equilibria

Closed system: A system where there is only heat exchange occurring between the system and its surroundings. No matter can enter or exit the system.

Dynamic equilibrium: Reached when the rate of the forward reaction of a reversible reaction equals the rate of the backward reaction. The concentrations of the reactants and products remain constant.

Effect of changing concentration on equilibrium: If the concentration of a reactant increases, more products will be formed to re-establish the equilibrium.

Effect of changing pressure on equilibrium: If the pressure is increased, the position of equilibrium shifts towards the side with the fewest number of molecules. If the pressure is decreased, the position of equilibrium shifts towards the side with the greatest number of molecules.

Effect of changing temperature on equilibrium: If the temperature of a system in equilibrium is increased, there will be an increase in the relative amount of products for an endothermic reaction and a decrease for an exothermic reaction.

Equilibrium constant (K_c): A value that expresses the relationship between the concentration of products and reactants present at equilibrium in a reversible reaction.

Heterogeneous system: A system where not all the chemicals are in the same phase.

Homogeneous system: A system where all the chemicals are in the same phase.

Le Chatelier's principle: If a reaction at equilibrium is subjected to a change in concentration, temperature or pressure, the position of equilibrium will move to counteract the change.

Reversible reaction: Reactions in which the products from the reaction can react together to form the original reactants. The direction of reversible reactions can be changed by changing the conditions.