OCR (B) Chemistry A-level

Storyline 8: Oceans

Definitions and Concepts

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

Oceans

Energetics

Aqueous solution: The solution formed when a species is dissolved in water.

Born-Haber cycle: Calculates the lattice enthalpy by applying Hess's law and comparing the standard enthalpy change of formation of the ionic compound to values such as ionisation energy and electron affinity.

Charge density: The ratio of the charge of an ion compared to its volume, for example, a 3+ ion will have a higher charge density than a 1+ ion of similar size.

Energy profile: A graph used to show the relative energy levels of reaction species (including reactants and products) as a reaction proceeds. Also shows the activation energy of a reaction.

Enthalpy (H): A value that represents the heat content of a system.

Enthalpy change (ΔH): The change in the heat content of a system during a reaction. This can be determined from experimental results using $q = mc\Delta T$ (where q is the heat change of the surroundings, m is the mass of the surroundings, c is the specific heat capacity and ΔT is the change in temperature).

Enthalpy of hydration: The enthalpy change when one mole of a gaseous ion is completely dissolved in water under standard conditions.

E.g. $Na^+ (g) \rightarrow Na^+ (aq)$

Enthalpy of lattice dissociation: The enthalpy change when one mole of a solid ionic compound is converted into its gaseous ions.

Enthalpy of lattice formation: The enthalpy change when one mole of a solid ionic compound is formed from its gaseous ions.

Enthalpy of solution: The enthalpy change when one mole of ionic solid completely dissolves in water under standard conditions to form an infinitely dilute solution.

E.g. $KCl(s) \rightarrow K^+ (aq) + Cl^- (aq)$

Entropy: A measure of the disorder of a system. The units of entropy are $JK^{-1}mol^{-1}$. On a molecular level, gases are more disordered than liquids, which are more disordered than solids. A reaction that produces a greater number of molecules than the number of reactants molecules will have a positive entropy change, as there will exist more random arrangements of these molecules, i.e. the system will become more disordered.

Entropy change: This can be calculated by finding the difference between the standard entropies of the products and the reactants:

$$\Delta S_{total} = \Sigma \Delta S_{products} - \Sigma \Delta S_{reactants}$$

If the entropy change for a reaction is positive, the products are more disordered than the reactants. If the entropy change for a reaction is negative, the products are less disordered than the reactants.

Feasible reaction: For a reaction to be feasible at a given temperature it must occur spontaneously. This means no extra energy is required for the reaction to occur.

Hydrated ions: Ions that have dissolved in water to form a solution and are therefore surrounded by water molecules. These water molecules are often organised into a shell around the ion.

Nonaqueous solution: A solution in which the solvent is any liquid except for water.

Solubility: The ability of a given substance to dissolve in a solvent.

Solubility product (K_{sp}): The product of dissolved ion concentrations raised to the power of their stoichiometric coefficients. A high value for K_{sp} indicates a high solubility.

Standard conditions: Solutions of 1.0 mol dm^{-3} concentration, a temperature of 298K and 100 kPa pressure.

Standard state: The physical state (solid, liquid, gas, aqueous) of a substance under standard conditions.

Equilibria (Acid-Base)

Acidic buffer: A buffer containing a weak acid and its conjugate base, e.g. a solution of acetic acid and sodium acetate.

Basic buffer: A buffer containing a weak base and its conjugate acid, e.g. a solution of ammonia and ammonium chloride.

Brønsted-Lowry acid: Proton donors. They release hydrogen ions when mixed with water. The hydrogen ions react with water molecules to form hydronium ions:

$$HA + H_2O \rightleftharpoons H_3O^+ + A^-$$

Brønsted-Lowry base: Proton acceptors. In solution, they bond to hydrogen ions from water molecules to release OH^- ions.

For a base B: $B + H_2O \rightleftharpoons BH^+ + OH^-$

Buffer: A solution that resists changes in pH when small volumes of acid or base are added.

Conjugate acid-base pair: A pair of compounds that transform into each other by the transfer of a proton. Conjugate acid-base pairs are important in the formation of buffers to control pH.

Diprotic acid: An acid that can release two H^+ ions upon dissociation, e.g. H_2SO_4.

K_a: Acid dissociation constant, a quantitative measure of the strength of an acid in solution. The larger the K_a value the stronger the acid, since it means the acid is largely dissociated into its ions.

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

K_w: Ionic product of water. At 298K, Kw = 1.0×10^{-14} $mol^2\,dm^{-6}$.

$$Kw = [H^+][OH^-]$$

Monoprotic acid: An acid that can release only one H^+ upon dissociation, e.g. HCl.

Neutralisation: A reaction between an acid and a base to form water and a salt. The ionic equation for neutralisation is:

$$H^+_{(aq)} + OH^-_{(aq)} \rightarrow H_2O_{(l)}$$

pH: A value expressing the acidity or alkalinity of a solution. A value of 0-6 indicates an acidic solution, 7 indicates a neutral solution, and 8-14 implies an alkaline solution.

$$pH = -\log[H^+] \qquad [H^+] = 10^{-pH}$$

Strong acid: An acid that dissociates almost completely in water. This means nearly all the H^+ ions will be released. E.g. HCl.

Strong base: A base which ionises almost completely in water. E.g. NaOH.

Weak acid: Acids that only dissociate very slightly in water so that only a small number of H^+ ions are released. E.g. Ethanoic acid.

Weak base: A base that only slightly ionises in water. E.g. NH_3.

Energy and Matter

Greenhouse effect: The warming of the globe due to the trapping of heat in the Earth's atmosphere, due to an increase in greenhouse gasses being released.

Greenhouse gases: Cause the greenhouse effect. Examples include: carbon dioxide, water vapour and nitrous oxide.

Troposphere: The lowest part of the atmosphere, closest to the earth.