AS Chemistry Module 2 - Specifications

Part 1 Energetics

Enthalpy change ΔH

You should:

- know that reactions can be endothermic or exothermic.
- understand that enthalpy change (ΔH) is the heat energy change measured under conditions of constant pressure.
- know that standard enthalpy changes refer to standard conditions, i.e. 100 kPa and a stated temperature (e.g. ΔH_{298}).
- be able to recall the definition of standard enthalpy changes of combustion $\Delta H_c^{\ominus}$ and formation $\Delta H_f^{\ominus}$

Calorimetry

You should be able to calculate the enthalpy change from the heat change in a reaction using the equation $q = mc\Delta T$, where m is mass, c is specific heat capacity, ΔT is change in temperature

Hess's Law

You should know Hess's Law and be able to use it to perform simple calculations.

Bond enthalpies

You should be able to:

- work out mean bond enthalpies from given data.
- use mean bond enthalpies to calculate a value of ΔH for simple reactions.

Part 2 Kinetics

Collision theory

You should understand that reactions can only occur when collisions take place between particles which have sufficient energy.

Maxwell–Boltzmann distribution

You should have a qualitative understanding of the Maxwell–Boltzmann distribution of molecular energies in gases, and you should be able to draw and interpret distribution curves for different temperatures.

Factors affecting rate of reaction

You should understand the qualitative effect of changes in concentration (pressure for gases) or surface area on the rate of reaction.

You should understand the qualitative effect of temperature changes on the rate of reaction, including:

- being able to define the term **activation energy** and understanding its significance
- understanding that most collisions do not lead to reaction
- understanding how small temperature increases can lead to a large increase in rate.

You should know the meaning of the term **catalyst**, and understand that catalysts work by providing an alternative reaction route of lower activation energy.

Part 3 Equilibria

The dynamic nature of equilibria

You should know that many chemical reactions are reversible, e.g. $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
You should understand that for a reaction in equilibrium, although the concentrations of reactants and products remain constant, both the forward and the reverse reactions are still going on.

Qualitative effects of changes of pressure, temperature and concentration on a system at equilibrium

You should be able to use Le Chatelier's principle to predict the effects on the position of equilibrium in homogeneous reactions of changes in:

- temperature
- pressure
- concentration

You should know that a catalyst does not affect the position of equilibrium.

Importance of equilibria in industrial processes

You should be able to be able to apply the ideas above to given chemical processes, i.e.

- you should be able to predict qualitatively the effect of temperature on the position of equilibrium from the sign of ΔH for the forward reaction
- you should understand why a compromise temperature and pressure may be used.

Part 4 Oxidation and reduction

Oxidation and reduction

Remember OIL-RIG, i.e. oxidation is the loss of electrons, reduction is the gain of electrons.

Oxidation states

You should know and be able to apply the rules for assigning oxidation states to work out the oxidation state of an element in a compound from its formula.
You should understand oxidation and reduction reactions of s and p block elements.

Redox equations

You should be able to:

- write half-equations
- identify the oxidation and reduction processes in redox reactions when the reactants and products are given
- be able to combine half-equations to give an overall redox equation

Part 5 Group VII, the Halogens

Trends in physical properties

You should understand the trends in electronegativity and boiling point of the halogens.

Trends in chemical properties

You should understand that the ability of the halogens to oxidise decreases down the group (e.g. the displacement reactions with halide ions in aqueous solution).

Trends in properties of the halides

You should:

- understand the trend in reducing ability of the halide ions
- know the different products formed by reaction of NaX and H_2SO_4
- be able to use silver nitrate solution as a test to distinguish between F^-, Cl^-, Br^- and I^-
- know the trend in solubility of the silver halides in ammonia

Uses of chlorine

You should know:

- the reactions of chlorine with water
- the use of chlorine in water treatment
- the reaction of chlorine with cold, dilute, aqueous NaOH and the uses of the solutions formed
- the equations for these reactions

Part 6 Extraction of Metals

Reduction of metal oxides with carbon

You should:

- understand how Fe is extracted by carbon reduction at high temperature in a continuous process from Fe_2O_3
- know that both C and CO are reductants in this process
- understand the use of limestone in this extraction process and the use of slag in the construction industry
- understand that Fe from the Blast Furnace is purified by the removal of C and P in a basic oxygen converter, and that S is removed by using Mg
- know that pollution problems can arise from the use of carbon as reductant and the use of sulphide ores
- understand the general limitation of carbon reduction because of carbide formation (e.g. Ti or W)

Reduction of metal oxides by electrolysis of melts

You should understand how Al is manufactured from purified bauxite (energy considerations, electrode equations and conditions only).

Reduction of metal halides with metal

You should:

- understand how Ti is extracted from TiO_2 via $TiCl_4$ in a batch process (equations and conditions only: either Na or Mg as a reducing agent)
- understand the cost implications and hence the limited use despite the unique properties and high natural abundance of Ti
- understand that the choice of the reduction method depends upon the cost of the reductant, the energy requirements and the required purity of the metal

Economic factors and recycling

You should understand how and why Fe and Al are recycled, the problems associated with recycling, and the social and economic benefits.