AS and A LEVEL

Content guide

H033/H433

CHEMISTRY B (SALTERS)

Specification content additional to the GCE AS and A Level common subject criteria

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OCR
Oxford Cambridge and RSA

SPECIFICATION CONTENT ADDITIONAL TO THE GCE AS AND A LEVEL COMMON SUBJECT CRITERIA FOR CHEMISTRY

The OCR AS and A Level GCE qualifications in chemistry follow the subject level conditions and requirements for the subject as set by the regulator, Ofqual. These requirements include the core content and skills that must be included in the specification. According to the requirements, this core content must comprise approximately 60% of the overall specification, for both AS and A Level. This 60% of specification content is therefore common to all awarding organisations.

This document sets out the content within the OCR AS and A Level Chemistry B (Salters) specifications that is **additional** to the core content.

AS AND A LEVEL CONTENT

ELEMENTS OF LIFE

EL(g) how knowledge of the structure of the atom developed in terms of a succession of gradually more sophisticated models; interpretation of these and other examples of such developing models

EL(h) fusion reactions: lighter nuclei join to give heavier nuclei (under conditions of high temperature and pressure); this is how certain elements are formed

EL(o) the relationship between the position of an element in the s- or p-block of the periodic table and the charge on its ion;

the names and formulae of NO_3^-, SO_4^{2-}, CO_3^{2-}, OH^-, NH_4^+, HCO_3^-, Cu^{2+}, Zn^{2+}, Pb^{2+}, Fe^{2+}, Fe^{3+}; formulae and names for compounds formed between these ions and other given anions and cations

EL(r) charge density of an ion and its relation to the thermal stability of the Group 2 carbonates

EL(s) the solubility of compounds formed between the following cations and anions: Li^+, Na^+, K^+, Ca^{2+}, Ba^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Ag^+, Pb^{2+}, Zn^{2+}, Al^{3+}, NH_4^+, CO_3^{2-}, SO_4^{2-}, Cl^-, Br^-, I^-, OH^-, NO_3^-;

colours of any precipitates formed;

use of these ions as tests e.g. Ba^{2+} as a test for SO_4^{2-};

a sequence of tests leading to the identification of a salt containing the ions above

EL(t) the terms: *acid, base, alkali, neutralisation*;

techniques and procedures for making soluble salts by reacting acids and bases and insoluble salts by precipitation reactions

EL(v) the electromagnetic spectrum in order of increasing frequency and energy and decreasing wavelength: infrared, visible, ultraviolet

EL(w) transitions between electronic energy levels in atoms:

(i) the occurrence of absorption and emission atomic spectra in terms of transition of electrons between electronic energy levels

(ii) the features of these spectra, similarities and differences

(iii) the relationship between the energy emitted or absorbed and the frequency of the line produced in the spectra, $\Delta E = h\nu$

(iv) the relationship between frequency, wavelength and the speed of electromagnetic radiation, $c = \nu\lambda$

(v) flame colours of Li^+, Na^+, K^+, Ca^{2+}, Ba^{2+}, Cu^{2+}

DEVELOPING FUELS

DF(b) the bonding in organic compounds in terms of σ- and π-bonds

DF(f) techniques and procedures for measuring the energy transferred when reactions occur in solution (or solids reacting with solutions) or when flammable liquids burn; the calculation of enthalpy changes from experimental results

DF(i) a simple model to explain the function of a heterogeneous catalyst

DF(k) the origin of atmospheric pollutants from a variety of sources: particulates, unburnt hydrocarbons, CO, CO_2, NO_x, SO_x;

the environmental implications and methods of reducing these pollutants

DF(l) the terms *aliphatic, aromatic, arene, saturated, unsaturated, functional group* and *homologous series*

DF(r) structural formulae (full, shortened and skeletal)

DF(u) the benefits and risks associated with using fossil fuels and alternative fuels (biofuels and hydrogen)

making decisions about ensuring a sustainable energy supply

ELEMENTS FROM THE SEA

ES(b) the explanation (given the necessary information) of the chemical processes occurring during the extraction of the halogens from minerals in the sea

ES(c) techniques and procedures in the electrolysis of aqueous solutions; half-equations for the processes occurring at electrodes in electrolysis of molten salts and aqueous solutions:

(i) formation of oxygen or a halogen or metal ions at the anode

(ii) formation of hydrogen or a metal at the cathode

ES(g) use of systematic nomenclature to name and interpret the names of inorganic compounds

THE OZONE STORY

OZ(e) the term *activation enthalpy*;

enthalpy profiles

OZ(h) the term *homogeneous catalysis* and the formation of intermediates

OZ(i) calculations, from given data, of values for composition by volume of a component in a gas mixture measured in percentage concentration and in parts per million (ppm)

OZ(o) homolytic and heterolytic bond fission

OZ(p) the formation, nature and reactivity of radicals and:

(i) explanation of the mechanism of a radical chain reaction involving initiation, propagation and termination

(ii) the radical mechanism for the reaction of alkanes with halogens

(iii) use of 'half curly arrows' in radical mechanisms

OZ(q) the chemical basis of the depletion of ozone in the stratosphere due to haloalkanes;

the ease of photodissociation of the haloalkanes (fluoroalkanes to iodoalkanes) in terms of bond enthalpy

OZ(r) the formation and destruction of ozone in the stratosphere and troposphere; the effects of ozone in the atmosphere, including:

(i) ozone's action as a sunscreen in the stratosphere by absorbing high-energy UV (and the effects of such UV, including on human skin)

(ii) the polluting effects of ozone in the troposphere, causing problems including photochemical smog

OZ(s) the principal radiations of the Earth and the Sun in terms of the following regions of the electromagnetic spectrum: infrared, visible, ultraviolet

OZ(t) the effect of UV and visible radiation promoting electrons to higher energy levels, sometimes causing bond breaking

OZ(u) calculation of values for frequency, wavelength and energy of electromagnetic radiation from given data

WHAT'S IN A MEDICINE

WM(b) primary, secondary and tertiary alcohols in terms of the differences in structures

WM(f) techniques and procedures for preparing and purifying a liquid organic product including the use of a separating funnel and of Quickfit or reduced scale apparatus for distillation and heating under reflux

A LEVEL ONLY CONTENT

THE CHEMICAL INDUSTRY

CI(d) the Arrhenius equation and the determination of E_a and A for a reaction, given data on the rate constants at different temperatures

CI(i) the chemical reactions occurring during industrial processes

CI(j) the following aspects of nitrogen chemistry:

(i) bonding in nitrogen gas, ammonia and the ammonium ion

(ii) the appearance and names of the oxides of nitrogen, N_2O, NO, NO_2

(iii) interconversion of the nitrate(**V**) ion, nitrate(**III**) ion, ammonium ion, oxides of nitrogen

(iv) tests for nitrate(**V**) and ammonium ions

POLYMERS AND LIFE

PL(b) the primary, secondary and tertiary structure of proteins;

the role of intermolecular bonds in determining the secondary and tertiary structures, and hence the properties of proteins

PL(c) DNA and RNA as condensation polymers formed from nucleotides, which are monomers having three components (phosphate, sugar and base):

(i) the phosphate units join by condensation with deoxyribose or ribose to form the phosphate–sugar backbone in DNA and RNA

(ii) the four bases present in DNA and RNA join by condensation with the deoxyribose in the phosphate–sugar backbone

(iii) two strands of DNA form a double-helix structure through base pairing

PL(d) the significance of hydrogen bonding in the pairing of bases in DNA and relation to the replication of genetic information; how DNA encodes for RNA which codes for an amino acid sequence in a protein

PL(e) molecular recognition (the structure and action of a given pharmacologically active material) in terms of:

(i) the pharmacophore and groups that modify it

(ii) its interaction with receptor sites

(iii) the ways that species interact in three dimensions (size, shape, bond formation, orientation)

PL(f) the shape of the rate versus substrate concentration curve for an enzyme-catalysed reaction; techniques and procedures for experiments involving enzymes

PL(g) the characteristics of enzyme catalysis, including: specificity, temperature sensitivity, pH sensitivity, competitive inhibition;

explanation of these characteristics of enzyme catalysis in terms of a three-dimensional active site (part of the tertiary structure)

PL(h) the acidic nature of carboxylic acids, and their reaction with metals, alkalis and carbonates

PL(i) the acid–base properties of amino acids and their existence as zwitterions

PL(p) the relationship between the structural formula of a condensation polymer and the structural formulae of its monomer(s) and *vice versa*

PL(r) the further interpretation and prediction of mass spectra:

(i) use of the high-resolution value of the M^+ peak to work out a molecular formula

(ii) the mass differences between peaks indicating the loss of groups of atoms

THE OCEANS

O(a) the factors determining the relative solubility of a solute in aqueous and non-aqueous solvents

O(b) the terms *hydrated ions, enthalpy change of solution* ($\Delta_{sol}H$), *lattice enthalpy* ($\Delta_{LE}H$) and *enthalpy change of hydration of ions* ($\Delta_{hyd}H$), and:

(i) the solution of an ionic solid in terms of enthalpy cycles and enthalpy level diagrams involving these terms

(ii) use of these enthalpy cycles to perform calculations

(iii) techniques and procedures for measuring the energy transferred in experiments involving enthalpy changes in solution

O(c) the dependence of the lattice enthalpy of an ionic compound and the enthalpy change of hydration of ions on the charge density of the ions

O(d) qualitative entropy changes (of the system); entropy as a measure of the number of ways that molecules and their associated energy quanta can be arranged

O(e) qualitative predictions of the $\Delta_{sys}S$ for a reaction in terms of:

(i) the differences in magnitude of the entropy of a solid, a liquid and a gas

(ii) the difference in number of particles of gaseous reactants and products

O(g) calculation of $\Delta_{sys}S$ for a reaction given the entropies of reactants and products

O(h) the term *solubility product* for ionic compounds; solubility product calculations; techniques and procedures for determining solubility products

O(i) the Brønsted–Lowry theory of acids and bases:

(i) acids as proton donors and bases as proton acceptors

(ii) the identification of the proton donor and proton acceptor in an acid–base reaction

(iii) the terms *conjugate acid* and *conjugate base*

O(l) the term *pH*, and pH calculations involving:

(i) strong acids

(ii) strong bases, using K_w

(iii) weak acids (including calculating any of the terms pH, K_a and concentration from any two others, being aware of the approximations made)

DEVELOPING METALS

DM(b) the term *coordination number*, the shapes and bond angles of complexes with coordination numbers 4 (square planar and tetrahedral) and 6 (octahedral)

DM(d) simple electrochemical cells:

(i) involving metal ion/metal half-cells

(ii) involving half-cells based on different oxidation states of the same element in aqueous solution with a platinum or other inert electrode, acidified if necessary

(iii) techniques and procedures to set up and use electrochemical cells

DM(e) the action of an electrochemical cell in terms of half-equations and external electron flow and the ion flow in the salt bridge

DM(g) transition metals as d-block elements forming one or more stable ions which have incompletely filled d-orbitals;

the common oxidation states of iron (+2 and +3) and copper (+1 and +2) and the colours of their aqueous ions, if any

DM(k) the colour changes in, and ionic equations for, the reactions of: $Fe^{2+}(aq)$, $Fe^{3+}(aq)$ and $Cu^{2+}(aq)$ ions with sodium hydroxide solution and ammonia solution

COLOUR BY DESIGN

CD(a) how some dyes attach themselves to fibres in terms of intermolecular bonds, ionic bonds and covalent bonding

CD(b) the structure of a dye molecule in terms of the chromophore and:

(i) functional groups that modify the chromophore

(ii) functional groups that affect the solubility of the dye

(iii) functional groups that allow the dye to bond to fibres

CD(h) the formation of diazonium compounds and the coupling reactions that these undergo to form azo dyes

CD(j) use of organic reactions and reaction conditions mentioned here and elsewhere in the specification to suggest and explain synthetic routes for preparing organic compounds

CD(m) the origins of colour (and UV absorption) in organic molecules

CHEMICAL LITERACY

CL(a) extract and manipulate data

CL(b) interpret and use information

CL(c) show comprehension by written communication with regard to logical presentation and the correct use of appropriate technical terms.


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