## Syllabus 9701 Chemistry A2

**Recommended Prior Knowledge**

Students should have completed an IGCSE chemistry course or its equivalent. Some of these A2 units (or sub-units) can be taught at the same time, or immediately following, the AS unit covering a related area of the syllabus. Alternatively, some centres will prefer to teach all of the AS units in year 1 and leave the se A2 units to year 2. At the start of each of the following units the specific prior knowledge required for its study is described. Those students not following an A level mathematics course may need some extra help with the concepts of logarithms and indices.

**GENERAL RESOURCES**

**(a) General Internet Sites.** These are as described in the AS Scheme of Work overview.

**(b) Resources for Experiments and Practical Work**

- The practical skills support booklet "Teaching A2 Practical Skills" published by CIE is available from the Teachers Support website. References in the Scheme of Work are given the abbreviation **P(A2)**.

**(c) Resources for the Applications of Chemistry Section (Unit 11)**

- The CIE-published "A Level Science Applications Support Booklet: **Chemistry**" is available from the Teachers Support website.

**(d) General textbooks for reference.** These are as described in the AS Scheme of Work overview.

## The A2 Scheme of Work

### UNITS

The A2 part of the course splits naturally into 13 self-contained sub-units, of which four are Physical Chemistry, two are Inorganic Chemistry, four are Organic Chemistry and three are concerned with the Applications of Chemistry. For convenience these are grouped in pairs or threes to create the following 6 units (namely, units 6-11: units 1-5 comprise the AS course), but their individual integrity has been kept so that teachers can feel free to teach them in any order (within the provisos mentioned below). Although the overall proportion of marks allocated to Physical, Inorganic and Organic Chemistry in the theory papers is 3:2:3, it is recommended that proportionately more teaching time is allocated to the Physical Chemistry units. At the A2 level Physical Chemistry involves much quantitative work, which will need practice and familiarisation on the part of the student. Experience has also shown that the teaching of the Applications Section must not be rushed. Unit 11 will also prove useful as a vehicle for the revision of some of the ideas contained within the previous units.
Syllabus references in *italics* refer to sections of which the A2 learning outcomes form only a part (the rest being AS learning outcomes).

| unit and title | sub unit | sub-unit title | outline of sub-unit | syllabus references |
|---|---|---|---|---|
| **6** Physical Chemistry I | 6A | Ionic Compounds | Lattice energies; the Born-Haber cycle; trends in the thermal decomposition of Group II nitrates and carbonates, and in the solubilities of their sulfates. | *5b*, 5d, *5e*, 9.2g, 9.2h |
| | 6B | Electrochemistry | Redox in terms of electron transfer; industrial electrolyses; standard electrode potentials; the use of $E^{\ominus}$ values; fuel cells; calculations involving the Faraday. | 6c – 6m, *9.3e, 9.4c,* 9.5h. |
| **7** Physical Chemistry II | 7A | Equilibria | Ionic equilibria involving acids and alkalis; the use of pH, $K_a$, $pK_a$, $K_w$; the calculation of $[H^+]$ and pH values for solutions of acids, bases and buffers; the solubility product, $K_{sp}$. | 7j -7r |
| | 7B | Reaction Kinetics | Rate equations of the form rate = $k[A]^m[B]^n$; deducing the order of a reaction by the initial rates method; the use of concentration-time graphs; the relationship between a reaction mechanism and the observed kinetics; the half-life of a first-order reaction and its use; experimental techniques for studying rates; homogeneous and heterogeneous catalysis. | *8a,* 8g, 8h, 8i, 8j, 8k |
| **8** Inorganic Chemistry | 8A | Group IV | Physical properties of the elements; physical and chemical properties of the tetrachlorides and the oxides; relative stabilities of higher and lower oxidation states. | 9.3a - 9.3f |
| | 8B | Transition Elements | Electronic configurations and physical properties of the transition elements; variable oxidation states; redox systems involving $Fe^{3+}/Fe^{2+}$, $MnO_4^-/Mn^{2+}$ and $Cr_2O_7^{2-}/Cr^{3+}$;ligands and ligand exchange involving $Cu^{2+}$ and haemoglobin ; the use of $E^{\ominus}$ values to predict likelihood of reactions. | 9.5a - 9.5m |
| **9** Organic Chemistry I | 9A | Arenes and Phenol | Structure and bonding in aromatic compounds; delocalisation; substitution reactions of benzene and methylbenzene with $Cl_2$ and $Br_2$; nitration of arenes; oxidation of side chains; the position of substitution in substituted benzenes; side chain versus nuclear substitution; reactions of, and acidity of, phenol. | *3e, 10.1a, 10.1c, 10.1d,* 10.2j - 10.2m, *10.3c,* 10.4d, 10.4e |

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|---|---|---|---|---|
| | 9B | Carboxylic Acid Derivatives | The tri-iodomethane reaction; the acidities of chlorinated ethanoic acids; the formation and reactions of acyl chlorides and phenyl esters; the relative ease of hydrolysis of alkyl, acyl and aryl chlorides. | *10.1a,* 10.4c, 10.5e, *10.6b*, 10.6c - 10.6f, *10.6g*, 10.6i |
| **10** Organic Chemistry II | 10A | Nitrogen Compounds | The formation of ethylamine and phenylamine; the basicities of amines; the reactions of phenylamine; diazotisation and coupling to form dyes; the formation and hydrolysis of amides, aminoacids and proteins. | 10.7a -10.7l |
| | 10B | Polymers | Condensation polymerisation; polyesters, polyamides and proteins as examples; the structural and formulaic relationship between a polymer and its monomer(s). | 10.8c, 10.8g |
| **11** Applications of Chemistry | 11A | Chemistry of Life | Structure of proteins. Enzyme catalysis. Structure and function of DNA, Mutations. Genetic basis of some diseases. ATP. Interaction of some metals with biomolecules. | 11.1(a) - 11.1(n) |
| | 11B | Analytical Chemistry | Electrophoresis. DNA fingerprinting. NMR spectroscopy. Use of NMR and X-ray crystallography in structure determination. Partition coefficient. Chromatography. Mass spectrometry. | 11.2(a) - 11.2((i) |
| | 11C | Design and Materials | Drug design. Polymers. Nanotechnology. Environmental chemistry and resource management. | 11.3(a) – 11.3(g) |

**TEACHING ORDER**

All the Physical chemistry needed for the Organic units is contained within the AS course. Sub-units 10A and 10B should follow 9B, however. Both the Inorganic chemistry sub-units 8A and 8B make a little use of $E^{\ominus}$ values, so should follow sub-unit 6B. Sub-unit 11A needs to follow 10A and 10B, and it might help if sub-unit 11B also followed 10A. With these provisos the 13 sub-units can be taught in any order, and taught sequentially or concurrently, depending on the resources available and the wishes of the teachers involved.

As mentioned in the AS outline page, the order of units can also be varied to allow for a mix of practical and theoretical topics.