AAQ Applied Science Unit 2 Chemistry
Personal Learning Checklist

A1: Atomic and Electronic Structure

Objective	Confidence (R/A/G)		
	1	2	3
A1.1 Features of the periodic table and their relationship with atomic structure			
• use of the concepts (symbols, atomic number, mass number) to determine numbers of subatomic particles (protons, neutrons and electrons) in atoms, isotopes and ions			
• use of relative atomic mass to determine relative abundance of isotopes (and use of relative abundance of isotopes to determine relative atomic mass)			
• use of relative atomic mass to determine relative formula masses			
• use of the concepts (group, period, blocks) to determine the number and arrangement of electrons in atoms and ions			
A1.2 Electronic structure			
• energy levels (shells), subshells and electronic orbitals			
• rules to determine the electronic structure of atoms			
• represent electronic configuration for atoms and ions of elements with atomic numbers 1-36 in terms of: a) s, p and d notation b) electron-in-boxes diagrams.			
A1.3 Ionisation energy			
• definition and equations for first and successive ionisation energies			
• evidence from successive ionisation energies for the electronic structure of an atom			
• factors affecting ionisation energy trends down a group and across a period a) nuclear charge b) number of shells c) shielding d) subshells			

B1: Bonding and Structure

Objective Students will need to be able to describe and represent different types of bonding and structure listed in B1.1, B1.2 and B1.3 as dot-and-cross diagrams and/or lattice arrangements for atoms, ions and molecules.	Confidence (R/A/G)		
	1	2	3
B1.1 Metallic bonding and giant metallic structures			
• be able to describe and represent the structure of metallic substances as positive metal cations with a sea of delocalised electrons			
• be able to describe and represent the bonding in metallic structures as strong electrostatic attractions between positive metal cations with negative electrons			
B1.4 be able to explain how the structure and bonding links to the properties of. a) electrical conductivity b) high melting and boiling points			
B1.2 Ionic bonding and giant ionic structures			
• be able to describe and represent the structure of ionic substances as a giant ionic lattice with positive and negative ions			
• be able to describe and represent the bonding in ionic structures as strong electrostatic attractions between positive metal cations with negative ions			
B1.4 be able to explain how the structure and bonding links to the properties of. a) electrical conductivity in different states b) high melting and boiling points			
B1.3 Covalent bonding and molecules			
• electrostatic attraction between two nuclei and the shared pair of electrons between them			
• single, double, triple and dative covalent (coordinate) bonds			
• sigma and pi molecular orbitals			
• relationship between bond lengths and bond strength			
• simple molecular structures and giant covalent structures			
B1.4 be able to explain how the structure and bonding links to the properties of. a) electrical conductivity b) high melting and boiling points in giant covalent structures c) low melting and boiling points in simple covalent structures			
B1.5 Molecular shape – the use of electron pair repulsion theory to determine shapes of molecules (up to 6 electron pairs around the central atom): • linear • non-linear • trigonal planar • pyramidal • tetrahedral • trigonal bipyramidal **a)** octahedral and their associated bond angles			
B1.6 Electronegativity and polarity			
• definition of electronegativity, trends across a period and down a group			

• use of electronegativity to determine bond polarity			
• use of electronegativity and molecular shape to identify molecules as polar or non-polar			
B1.7 Intermolecular forces: • London dispersion forces/temporary dipole – induced dipole forces • permanent dipole – permanent dipole forces • Hydrogen bonding (and effects on physical properties)			
B1.8 Effect of hydrogen bonding on the properties of water (melting and boiling point, densities of ice and liquid water, surface tension of water)			

C1: Periodicity

Objective Students will need to be able to use the principles covered in section A (atomic and electronic structure) and section B (structure and bonding) to describe and explain the properties and reactions covered in this section.	Confidence (R/A/G)		
	1	2	3
C1.1 Changes in physical properties for the elements across Period 3 (Na to Ar): • atomic radius and ionic radius (positively and negatively charged ions) • melting point • electrical conductivity			
C1.2 Oxidation number concept, oxidation and reduction			
• determination of the oxidation number of an element in compounds and ions using the oxidation number concept			
• application of the oxidation number concept to determine the formula of common oxides, hydroxides/acids and chlorides of Period 3 elements			
• oxidation and reduction in terms of loss and gain of electrons			
• construct half equations and redox equations			
C1.3 Trends and observations for the reactions of the Period 3 elements with;			
• oxygen (formation of the products Na_2O, MgO, Al_2O_3, P_4O_{10} and SO_2 only)			
• water (formation of the products NaOH, $Mg(OH)_2$ and $Al(OH)_3$ only)			
• chlorine (formation of the products NaCl, $MgCl_2$, Al_2Cl_6, $SiCl_4$, and PCl_5 only)			
C1.4 Differences in physical properties (melting point and electrical conductivity only) for the Period 3 oxides and chlorides listed in C1.3			
C1.5 Acid-base behaviour of Period 3 oxides and hydroxides listed in C1.3.1, and of the compounds SiO2, H3PO4, H2SO4, HCl, HClO and HClO4			
C1.6 The action of water with Period 3 chlorides listed in C1.3.3 and the pH of the solutions produced			
C1.7 Write balanced equations for reactions in C1.3, C1.5 and C1.6			
C1.8 Predict the physical and chemical properties of elements in other periods based upon knowledge of the Period 3 elements			
C1.9 Uses of Period 3 elements and compounds, based upon their physical and chemical properties			

D1: Physical Chemistry

Objective	Confidence (R/A/G)		
	1	2	3
D1.1 Concept of the mole and use in calculations involving: • mass and molar mass (relative atomic mass or relative formula mass) • empirical formula and stochiometric ratios in equations • gas volume and molar volume ($24dm^3$ at room temperature and pressure) • percentage yield, actual yield and theoretical yield			
D1.2 Chemical kinetics			
• factors affecting rate of reaction to include concentration, pressure, temperature, surface area and catalysis			
• collision theory and activation energy			
• interpretation of concentration vs time graphs			
• Maxwell-Boltzmann distribution curves – effect of changes in concentration, temperature and catalysis			
• determination of rate equations, to include finding orders of reaction and the value of a rate constant (and its units), when given appropriate data			
D1.3 Chemical energetics			
• enthalpy change – definition, endothermic and exothermic processes			
• energy level diagrams and reaction profile diagrams			
• standard enthalpy changes –standard conditions and definitions of standard enthalpy change of formation, of combustion and of reaction			
• Hess's Law and energy cycles			
• calculations involving energy cycles and standard enthalpy changes			
D1.4 Chemical equilibrium			
• dynamic equilibrium – definition and characteristics			
• Le Chatelier's principle and predicting the effect on equilibrium of changes in concentration, pressure and temperature, and the presence of a catalyst			
• Le Chatelier's principle and predicting the effect on equilibrium of changes in concentration, pressure and temperature, and the presence of a catalyst			
• calculations involving equilibrium constants and concentrations or partial pressures			
• interpretation of yield vs pressure or temperature graphs			
D1.5 Application of chemical kinetics, energetics and equilibrium to the chemical industry			
D1.6 Application of green chemistry in the chemical industry • atom economy and uses of waste products			

• renewable and recycled resources • energy efficiency and catalysis • hazards of reactants and products • recycling of unused reactants • end-of-life for products (recycling and degradation).			

E1: Organic Chemistry

Objective	Confidence (R/A/G)		
	1	2	3
E1.1 Knowledge and understanding of key terms used in organic chemistry: • saturated hydrocarbon and unsaturated hydrocarbon • straight-chain, branched chain and cyclic organic compounds • homologous series and functional group • general formulae for alkanes, alkenes, halogenoalkanes and alcohols			
E1.2 Structure representations of organic compounds, using;			
• addition reactions of alkenes with H_2, halogens, hydrogen halides and steam			
• substitution reactions of alkanes with halogens using UV radiation			
• substitution reactions of halogenolkanes with aqueous sodium hydroxide			
• substitution reactions of alcohols with PCl_5 and with HBr			
• elimination reactions of halogenoalkanes using ethanolic sodium hydroxide			
• oxidation of primary alcohols to carboxylic acids using acidified $K_2Cr_2O_7$			
• condensation reactions of alcohols with carboxylic acids to form esters			
E1.8 Reactions of commercial importance			
• combustion (complete and incomplete) of hydrocarbons and alcohols			
• cracking of large chain alkanes (into smaller alkanes and alkenes)			
• addition polymerisation			
• condensation polymerisation (dicarboxylic acids with diols or diamines)			
E1.9 Benefits and problems arising from combustion, halogenoalkanes (CFCs), polymers (plastics) and alcohol (ethanol)			
E1.10 Solutions to environmental problems caused by organic compounds and their usage in E1.8 and E1.9.			