



### Chemistry Syllabus 2009/10

<p><b>1. Atoms, Ions and Molecules</b></p>	<p><b>1.1 Atoms and isotopes</b>  electrons, protons and neutrons  atomic number (proton number) and mass number (nucleon number)  isotopes and relative isotopic mass  the mass spectrometer, determining relative atomic mass from mass spectrum</p> <p><b>1.2 Electronic structure</b>  atomic spectra and ionisation energies  quantum shells and sub-shells,  s, p, d, orbitals; The Aufbau principle,  electronic configuration</p> <p><b>1.3 Structure and bonding in elements</b>  noble gases; simple molecules, giant covalent structures, metallic structures</p> <p><b>1.4 Structure and bonding in covalent compounds</b>  simple covalent molecules  dative covalent bonding  electronegativity and polarisation  shapes of molecules (VSEPR)  structure and bonding in ionic compounds  simple ionic bonding and the ionic model  ionic lattices  polarisation and Fajan's rules  trends in thermal stability and solubility of organic compounds</p> <p><b>1.5 Intermolecular forces</b>  Van der Waal's forces,  dipole-dipole interactions,  hydrogen bonding</p> <p><b>1.6 Formulae and equations</b>  chemical formula, empirical formula,  molecular formula, ionic formula,  chemical equations, ionic equations  half equations</p> <p><b>1.7 Amount of substance and the mole</b>  Relative atomic mass, relative molecular mass,  relative formula mass  the Avogadro constant  concentration of solutions  molar volume of gases</p> <p><b>1.8 Gases</b>  kinetic molecular theory of gases;  the gas laws, the ideal gas equation,  Dalton's law of partial pressures,  real gases</p>
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<p><b>2. Energy Changes</b></p>	<p><b>2.1 Measuring enthalpy changes</b>                      basic principles of calorimetry                      using a simple calorimeter  <b>2.2 <math>\Delta H</math> and Hess's Law</b>                      standard molar enthalpy change                      standard molar enthalpy changes of formation,                      of combustion and of neutralisation;                      First Law of Thermodynamics and Hess's law  <b>2.3 Bond enthalpies</b>                      bond dissociation enthalpies, calculating bond                      energies with Hess's law  <b>2.4 Lattice energies</b>                      Born-Haber cycles, comparing theoretical and                      experimental lattice energy values  <b>2.5 Free energy (<math>\Delta G</math>) and entropy (<math>\Delta S</math>)                      changes</b>                      state functions, entropy and entropy changes,                      Gibbs free energy, spontaneous and feasible                      reactions, second law of thermodynamics</p>
<p><b>3. Rates of Reaction</b></p>	<p><b>3.1 Theories of reaction rate</b>                      collision theory                      transition state theory  <b>3.2 Factors affecting rate of reaction</b>                      concentration, temperature, surface area;                      activation energy, catalysis  <b>3.3 Measuring rate of reaction</b>                      rate of reaction                      first order processes and constant half-life                      initial rate method                      rate equation, rate constant and order of reaction  <b>3.4 Deducing mechanism from rate</b>                      order and molecularity</p>

<p><b>4. Equilibrium</b></p>	<p><b>4.1 Dynamic equilibrium and the equilibrium law</b>  calculations based on <math>K_c</math> and <math>K_p</math>  homogeneous and heterogeneous equilibria</p> <p><b>4.2 Factors affecting equilibrium</b>  Le Chatelier's Principle</p> <p><b>4.3 Acid-base equilibrium</b>  Bronsted-Lowry Theory  strong acids and bases  dissociation of weak acids and bases (<math>K_a</math> and <math>pK_a</math>)  Ionisation of water (<math>K_w</math> and <math>pK_w</math>)  pH scale, acid-base titrations</p> <p><b>4.4 Buffers and indicators</b>  buffering action; acid-base indicators;  mid-point colour and pH range of an indicator;  selecting an indicator</p>
<p><b>5. Redox and Electrochemistry</b></p>	<p><b>5.1 Introduction to Oxidation and Reduction</b>  identifying redox reactions  oxidation numbers  balancing redox reactions  redox titrations and calculations</p> <p><b>5.2 Electrochemical cells and the Electrochemical Series</b>  displacement reactions and the Reactivity Series  electromotive force of electrochemical cells  cell diagrams and conventional representation of cells  standard electrode potentials  standard hydrogen electrode  predicting spontaneous redox reactions</p>

<p><b>6. Organic Chemistry</b></p>	<p><b>6.1 Functional Groups</b>                  Examples of functional groups</p> <p><b>6.2 Reaction Mechanisms</b>                  Addition, elimination and substitution                  Free radicals, nucleophiles and electrophiles</p> <p><b>6.3 Hydrocarbons - Alkanes, Alkenes and Arenes</b>                  Combustion                  Free radical substitution                  Electrophilic addition                  Markownikow's Rule                  Addition polymerisation                  Electrophilic substitution and aromaticity                  Nitration of benzene                  Chlorination of methylbenzene</p> <p><b>6.4 Halogenoalkanes</b>                  Nucleophilic substitution,                  Elimination</p> <p><b>6.5 Alcohols and phenol</b>                  Primary, secondary and tertiary alcohols                  Reactions of alcohols                  Manufacture of alcohols from alkenes                  Differences between phenol and ethanol                  Tests for phenol</p> <p><b>6.6 Aldehydes and ketones</b>                  The Carbonyl Group:                  Tests for the carbonyl group                  Distinguishing between aldehydes and ketones                  Addition reactions                  Addition-elimination reactions</p> <p><b>6.7 Carboxylic acids and derivatives</b>                  Carboxylic acids as weak acids                  Acyl chlorides                  Esters and polyesters                  Amides and polyamides</p> <p><b>6.8 Nitrogen containing compounds</b>                  Primary, secondary and tertiary amines                  Reactions of primary amines                  Diazotisation                  Nitriles                  Amino acids and proteins</p> <p><b>6.9 Organic Instrumental Analysis</b>                  Mass spectrometry                  UV/visible spectroscopy                  Infrared (IR) spectroscopy                  NMR spectroscopy</p>
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<b>7. Inorganic Chemistry</b>	<b>7.1 Patterns and trends in the Periodic Table</b> Groups and Periods <b>7.2 Periodicity in the 3<sup>rd</sup> Period</b> Trends in properties of elements, oxides and chlorides <b>7.3 Transition metals</b> Electronic structure Physical properties Variable oxidation state Complex formation
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