Structure 1 Models of Particulate Matter	**1.1 – Particulate Nature of Matter**	Solvation, Filtration, Re-crystallisation, Evaporation, Distillation & Paper Chromatography	Homogenous & Heterogenous Mixture	Melting, Freezing, Vaporisation, Condensation, Sublimation and Deposition	Kelvin (K) scale of temperature
	1.2 – The nuclear atom	Nuclear Symbol	Isotopes, % Abundance of isotopes	**Interpret Mass Spectra of Isotopes (AHL)**	-
	1.3 – Electronic Configurations	Emission Spectrum & Energy Levels	Continuous & Line Spectrum	Shells, Sub-shells, Orbitals (s, p, d, f) notation. Aufbau, Hund's Rule, Pauli exclusion principle & orbital box diagrams.	**Trends & Discontinuities in first IE across period & down the group. (AHL)** **Calculate the value of first IE from wavelength or frequency of convergence limit. (AHL)**
	1.4 – Mole concept	Mol, Relative atomic mass, Relative formula mass, Molar Mass	Empirical Formula Based on Mass and Combustion.	Concentrations Molar volume	-
	1.5 – Ideal Gases	Assumptions & limitations in ideal gas model.	Ideal Gas Equations	Ideal Gas Graphs	-

Structure 2 Models of bonding and structure	**2.1 – Ionic Model**	Formation of Ions – Predict from electronic configuration	Deduce formula of ionic compounds including polyatomic ions	Physical properties of ionic compounds: Volatility, electrical conductivity and solubility	Lattice Enthalpy and factors affecting it.
	2.2 – Covalent Model	Lewis structures, Dative bond & VSEPR	Bond Polarity & Molecular Polarity	Intermolecular Forces: LDF, Dipole-induced, Dipole-dipole & Hydrogen bonding.	Giant covalent compounds Physical properties of covalent compounds: Volatility, electrical conductivity and solubility
	2.2 – Covalent Model (continued)	Chromatography (Rf calculations)	**Transition Metal Complexes (AHL)**	**Resonance & Benzene (AHL)** **Expanded Octet (AHL)** **Formal Charges (AHL)**	**Sigma, Pi-bonds (AHL)** **Hybridisation (AHL)**
	2.3 – Metallic Model	Physical properties of metals: Thermal & electrical conductivity and Malleability	Trends in melting points in s & p block metals.	**Explain high melting point and conductivity of transition metals (AHL)**	-
	2.4 – Models to Materials	Triangular Bonding Diagram	Properties of alloys	Properties of Polymers, Addition Polymerisation & Condensation Polymerisation	

Color code:
Standard Level
Higher level (AHL)

Structure 3 Classification of Matter	**3.1 – Periodic Table**	Identify metals, metalloids & non-metals	Deduce electronic configurations for elements up to Z=36	Explain the periodicity of atomic radius, ionic radius, ionisation energy, electron affinity, electronegativity and period 3 oxides.	Describe and explain the reactions of group 1 metals with water and if group 17 elements with halides ions.
	3.1 – Periodic Table (continued)	Deduce the oxidation states of an atom in an ion or a compound.	**Explain how these discontinuities provide evidence for the existence of energy sublevels (AHL)**	**Transition metals – variable oxidation state (AHL)** **Transition metals – High MP & Magnetic Properties (AHL)** **Transition metals – Coloured Complexes (AHL)**	
	3.2 Functional Groups in Organic Chemistry	Molecular, Skeletal & Structural Formula. Homologous series & properties Name of Functional Groups IUPAC rules for naming organic compounds			Structural Isomers : Chain/Branch, Positional & Functional Group.
	3.2 Functional Groups in Organic Chemistry (continued)	**Stereoisomers (AHL)** -Optical Isomers -Geometric	**Mass Spectrometry of Organic Compounds (AHL)**	**Infrared Spectrometry of Organic Compounds (AHL)**	**Proton Nuclear Magnetic Resonance (NMR) of Organic Compounds (AHL)**

<table>
<tr><td rowspan="4"><u>Reactivity 1</u>
What drives chemical reactions ?</td><td>1.1 – Measuring Enthalpy Changes</td><td colspan="2">Exothermic & Endothermic Reactions :
Energy Level, Energy profile diagrams & stability of products, intermediates, transition states and reactants</td><td colspan="2">Calorimetric Calculations :
$q = mc \Delta T$
$\Delta H = \pm q / n$</td></tr>
<tr><td>1.2 – Energy Cycles in reactions</td><td>Calculating enthalpy change from average bond enthalpy data</td><td>Hess’s Law (multi-step reactions only)</td><td>Hess’s Law using Enthalpy changes of Combustion & Formation (AHL)</td><td>Born-Haber cycle: Atomisation, I.E, E.A, L.E & Formation of ionic compounds (AHL)</td></tr>
<tr><td>1.3 – Energy from Fuels</td><td>Complete & Incomplete combustion equations</td><td><u>Fossil Fuels :</u>
Coal
Crude Oil
Natural Gas</td><td><u>Bio – Fuels:</u>
Renewable & Non-renewable energy.
Advantages & Disadvantages</td><td><u>Fuel Cell:</u>
Hydrogen & methanol fuel cells.</td></tr>
<tr><td>1.4 – Entropy & Spontaneity (AHL)</td><td>Entropy ($S^{\ominus}$) & Δ Entropy ($\Delta S^{\ominus}$) (AHL)</td><td colspan="3"><u>Gibbs Free Energy (AHL)</u>
1) $\Delta G^{\ominus} = \Delta H^{\ominus} - T \Delta S^{\ominus}$
2) Calculate T when reaction becomes spontaneous
<u>Gibbs Free Energy at equilibrium (AHL)</u>
1) $\Delta G = \Delta G^{\ominus} + RT \ln Q$
2) $\Delta G^{\ominus} = - RT \ln Kc$</td></tr>
</table>

<table>
<tr><td rowspan="4"><u>Reactivity 2</u>
How much, How fast and how far?</td><td>2.1 – How much?</td><td colspan="4">Percentage Yield, Limiting Agents & Atom Economy</td></tr>
<tr><td>2.2 – How fast?</td><td>Energy Profile Diagrams

Calculate rate of reactions.

Factors affecting rate of reactions</td><td><u>Maxwell-Boltzmann distribution curves</u> for catalyst and temperature</td><td>Rate equations, order of reactions and calculations using experimental data. (AHL)

<u>Multi-step mechanisms</u>
Distinguish between transition state & intermediates. (AHL)

Rate determining step & Molecularity (AHL)</td><td>Rate constant (k) (AHL)

Arrhenius equation to calculate Ea (AHL)

Arrhenius factor A (AHL)</td></tr>
<tr><td>2.3 – How far?</td><td>Physical Equilibria
<u>Chemical Equilibria</u>
Homogenous
Heterogenous</td><td><u>Equilibrium constant</u>
Kc > 1, Kc >> 1
K=1
Kc < 1, Kc << 1</td><td colspan="2"><u>Le-Chatelier's Principle</u>
Temperature, Pressure & Concentration effects.
Concentration – time graph illustrating LCP</td></tr>
<tr><td>2.3 – How far? (continued)</td><td>Reaction Quotient (Q) calculations (AHL)</td><td colspan="2">Initial, Change & Equilibrium calculations for homogenous equilibrium.</td><td><u>Gibbs Free Energy at equilibrium (AHL)</u>
1) $\Delta G = \Delta G^{\ominus} + RT \ln Q$
2) $\Delta G^{\ominus} = - RT \ln K$</td></tr>
</table>

Reactivity 3 What are the mechanisms of a chemical change?	**3.1 – Proton Transfer**	Brønsted-lowry theory pH Scale Strong acid vs weak acid	Ionic product constant (Kw) of water. pH curves Shapes and equivalence point	**pOH scale, pH + pOH =14 (AHL)** **Ka, Kb, pKa & pKb** **Ka x Kb = Kw (AHL)**	**pH of salts (salt hydrolysis) (AHL)** **pH curves (all forms)** **Acid bases indicators (AHL)**	**Buffer solutions (AHL)** How it works? How to prepare?
	3.2 – Electron Transfer	Redox half equations Ease of oxidation of metals and halogens	Voltaic Cells & Secondary Cells Electrolytic cells (Molten)	Oxidation of Organic compounds Reduction of Organic compounds	**Standard Hydrogen Electrode (AHL)** **$\Delta G^{\ominus} = - nF E^{\ominus}_{cell}$ (AHL)**	
	3.2 – Electron Transfer (continued)	**Electrolysis in concentrated and aqueous electrolyte (AHL)**		**Electroplating & Purification (AHL)**		
	3.3 – Electron-sharing **3.4 – Electron-pair sharing**	Free Radical Substitution Homolytic & Heterolytic fission		Nucleophile & Electrophile Nucleophilic substitution (Equations only)	Addition reactions of alkenes (Equations only)	
	3.4 Electron-pair sharing (AHL)	**Lewis Acid-Base Theory (AHL)** Transition metal ion and ligands	**S_N1, S_N2 mechanisms** Leaving Groups	**Electrophilic addition mechanisms & Markovnikov rule:** Unsymmetrical alkenes	**Electrophilic substitution** Nitration of benzenes Halogenation of benzenes	