

Curriculum Outline for Secondary 4 IP Chemistry 2019

Term/Week	Topic	Essential Ideas	Worksheet/ Activity / Practical	Curriculum Standards
<p align="center">TERM 1 Weeks 1-3</p>	<p>The Nature of Matter: Periodic Trends</p>	<ol style="list-style-type: none"> 1. The arrangement of the elements in the Periodic Table are in order of increasing proton (atomic) number. 2. The arrangement of elements in the Periodic Table helps to predict their electron configuration. 3. The Periodic Table allows the relationship between group number and ionic charge of an element to be deduced. It also explains similarities between the elements in the same group in terms of their electronic structure. 4. The Periodic Table explains the change from metallic to non-metallic character from left to right across a period and describes the relationship between group number, number of valence electrons and metallic/non- metallic character. 5. Elements show trends in their physical and chemical properties across periods and down groups. 6. Group properties: <ol style="list-style-type: none"> a) Group I elements e.g. lithium, sodium and potassium (the alkali metals): is a collection of relatively soft, low density metals showing a trend in melting point and in their reactions with water. b) Group VII elements e.g. chlorine, bromine and iodine (the halogens) : is a collection of diatomic non- metals showing a trend in colour, state and their displacement reactions with solutions of other halide ions. c) Group 0 elements e.g. helium, neon and argon: is a collection of monatomic elements that are chemically unreactive. d) Transition elements are metals having high melting points, high density, variable oxidation states and forming 	<p>Worksheet 9: Periodic Table</p> <p>Activity 9: Group work to discuss periodic trends</p> <p>https://www.webelements.com/</p> <p>https://ed.ted.com/periodic-videos</p> <p>Teacher Demonstration : Reaction of potassium with water</p> <p>Practical :Displacement reactions of Halogens</p>	<p>CU1,CU2</p> <p>CS1,CS2, RS2,RS3</p> <p>ES1,ES2</p>

Term/Week	Topic	Essential Ideas	Worksheet/ Activity / Practical	Curriculum Standards
		coloured compounds. These elements and/or their compounds are often able to act as catalysts.		
Weeks 4-7	The Nature of Matter: Metals- Properties and Reactivity Series	<ol style="list-style-type: none"> 1. Metals are generally elements that exist as solids having high melting and boiling points, malleable, good conductors of heat and electricity. 2. Alloys consist of a mixture of a metal with another element, e.g. brass; stainless steel. Alloys have different physical properties compared to pure metals due to their constituent elements. 3. Metals are ranked in the reactivity series in order of their reactions, if any, with water, steam and dilute hydrochloric acid; reduction of their oxides by carbon and/or by hydrogen as well as the thermal stability of their carbonates. 4. The metal reactivity series is related to the tendency of a metal to form its positive ion when reacting with aqueous ions or oxides of the other metals. 	<p>Worksheet 10: Metals</p> <p>Activity 10: Group work to investigate properties of metals</p> <p>Practical: Investigating reactivity of metals with acids (using Temp probe)</p> <p>Practical : Metal flame tests</p> <p>Coursework 1: Metal extraction from their ores. (Video making)</p>	<p>CU1,CU2</p> <p>CS1,CS2, RS2,RS3</p> <p>ES1,ES2</p> <p>ES1,ES2</p> <p>CS1,CS2, RS1, RS2,RS3</p>
Weeks 8-10	Transforming Matter: Redox Reactions	<ol style="list-style-type: none"> 1. In a redox reaction, both oxidation and reduction occur at the same time. 2. Oxidation and reduction can be considered in terms of oxygen/hydrogen gain/loss, electron gain/loss or changes in oxidation state. 3. In a redox equation, the substance that is oxidized is the reducing agent while the substance that is reduced is the oxidizing agent. 	<p>Worksheet 11: Redox reactions</p> <p>Activity 11: Group work on Redox reactions</p> <p>Practical: Redox experiments</p> <p>Coursework 2 : mini IA</p>	<p>CU1,CU2</p> <p>CS1,CS2, RS2,RS3</p> <p>ES1,ES2</p> <p>CS1,CS2, RS1, RS2,RS3</p>

Term/Week	Topic	Essential Ideas	Worksheet/ Activity / Practical	Curriculum Standards
Term 2 Weeks 1-6	Transforming Matter: Electrolysis	<ol style="list-style-type: none"> Electrolysis as the conduction of electricity by an ionic compound (an electrolyte), when molten or dissolved in water, leading to the decomposition of the electrolyte. Electrolytic cells convert electrical energy to chemical energy. In an electrolytic cell, oxidation occurs at the anode (positive electrode) and reduction occurs at the cathode (negative electrode). When aqueous solutions are electrolyzed, water can be oxidized to oxygen at the anode and reduced to hydrogen at the cathode. The type of product obtained from electrolysis is based on selective discharge of ions e.g. <ol style="list-style-type: none"> cations: linked to the reactivity series anions: halides, hydroxides and sulfates (is essentially the same as electrolysis of water) concentration effects (In all cases above, inert electrodes are used.) Application of electrolysis include metal purification and electroplating of metals. Simple /Voltaic(Galvanic) cells generate electrical energy from chemical reactions. In a simple/voltaic cell, oxidation occurs at the anode (negative electrode) and reduction occurs at the cathode (positive electrode). The production of electrical energy in simple cells is linked to the reactivity series of the two electrodes in the electrolyte, resulting in the movement of electrons from the anode to the cathode via the external circuit. The further apart the 2 electrodes are in the reactivity series, the greater the voltage generated in a simple cell. 	<p>Worksheet 12: Electrolysis</p> <p>Activity 12 : Group work on Electrolytic cells</p> <p>http://en.wikipedia.org/wiki/electrolysis</p> <p>http://hyperphysics.phy-astr.gsu.edu/hbase/thermo/electrol.html</p> <p>http://www.aplustopper.com/oxidation-reduction-chemical-cells/</p> <p>https://www.youtube.com/watch?v=C26pH8kC_Wk</p> <p>Hydrogen Fuel Cell: https://www.youtube.com/watch?v=5_IDGna9MBM</p> <p>Mini project: Design a simple cell that can generate the maximum voltage reading.</p> <p>Practical : Electrolysis in electrolytic cells.</p> <p>Practical : Electrolysis in simple cells.</p> <p>Practical : Electroplating objects.</p>	<p>CU1, CU2</p> <p>CS1, CS2, RS2, RS3</p> <p>CS1, CS2, RS1, RS2, RS3</p> <p>ES1, ES2</p> <p>ES1, ES2</p> <p>ES1, ES2</p>

Term/Week	Topic	Essential Ideas	Worksheet/ Activity / Practical	Curriculum Standards
Weeks 7-8	Transforming Matter: Speed of Reaction	<ol style="list-style-type: none"> 1. Molecules react as a result of collision of sufficient energy and proper orientation. 2. The rate of reaction is expressed as the change in concentration of a particular reactant/product per unit time. 3. Concentration changes in a reaction can be followed indirectly by monitoring changes in mass, volume and colour in experiments. 4. The rate of reaction is not constant during a reaction, but is greatest at the start and decreases as the reaction proceeds. 5. Activation energy is the minimum energy that particles must have before they are able to react. 6. Factors such as concentration, pressure, particle size and temperature will affect the speeds of reactions due to collisions between reacting particles. 7. A catalyst also increases the speed of reactions by providing alternative pathways of lower activation energy, but itself does not undergo any chemical change. 	<p>Worksheet 13 :Speed of reaction</p> <p>Practical: To investigate the effect of the concentration of sodium thiosulfate on the rate of reaction.</p>	<p>CU1,CU2</p> <p>ES1,ES2</p>
Weeks 9-10	Transforming Matter: Energy From Chemicals	<ol style="list-style-type: none"> 1. Enthalpy (H) is a measure of the amount of heat energy contained in a substance. It is stored in the chemical bonds and intermolecular forces as potential energy. 2. When substances react, the difference in enthalpy between the reactants and products result in a heat/enthalpy change (ΔH) which can be observed and calculated from their effect on the temperature of their surroundings. 3. In chemical transformations, energy can neither be created nor destroyed. 4. Energy is absorbed when bonds are broken (endothermic process and ΔH is positive) 5. Energy is released when bonds are formed (exothermic process and ΔH is 	<p>Worksheet 14: Energy from Chemicals</p> <p>Practical: Experiment on enthalpy change</p>	<p>CU1,CU2</p> <p>ES1,ES2</p>

Term/Week	Topic	Essential Ideas	Worksheet/ Activity / Practical	Curriculum Standards
		<p>negative)</p> <p>6. Energy changes can be represented by energy profile diagrams, including reaction enthalpy changes and activation energies</p>		
Term 3 Weeks 1-2	Transforming Matter: Organic Chemistry- Fuels and Crude Oil	<ol style="list-style-type: none"> 1. A fuel is a substance that can release energy by changing its chemical or nuclear structure. 2. Natural gas (mainly methane) and petroleum (crude oil) are two common fossil fuels that provide energy. 3. Petroleum as a mixture of hydrocarbons and its separation into useful fractions is by fractional distillation. The following are some examples of these uses: <ol style="list-style-type: none"> (i) petrol (gasoline) as a fuel in cars (ii) naphtha as feedstock for the chemical industry (iii) paraffin (kerosene) as a fuel for heating and cooking and for aircraft engines (iv) diesel as a fuel for diesel engines (v) lubricating oils as lubricants and as a sources of polishes and waxes (vi) bitumen for making road surfaces 4. Due to the growing demand for the use of petroleum as an energy source and as a chemical feedstock, there is an urgent need to conserve this non-renewable resource and to find alternative sources of energy. 	<p>Worksheet 15.1: Fuels and Crude Oil</p> <p>Activity : Classifying substances as organic and inorganic.</p>	<p>CU1,CU2</p> <p>CS1,CS2, RS2,RS3</p>
Week 3	Transforming Matter: Organic Chemistry- Alkanes	<ol style="list-style-type: none"> 1. A homologous series as a group of compounds with a general formula, similar chemical properties and showing a gradation in physical properties as a result of increase in the size and mass of the molecules, e.g. melting and boiling points; viscosity; flammability 2. Alkanes belong to a homologous series of saturated hydrocarbons with the general 	<p>Worksheet 15.2: Alkanes</p> <p>Activity : Use model kits to build alkanes / alkenes and discuss isomerism.</p>	<p>CU1,CU2</p> <p>CS1,CS2, RS2,RS3</p>

Term/Week	Topic	Essential Ideas	Worksheet/ Activity / Practical	Curriculum Standards
		<p>formula C_nH_{2n+2}</p> <ol style="list-style-type: none"> Alkanes are saturated compounds containing single bonds only Alkanes have low reactivity and undergo substitution reactions e.g. by chlorine. Alkanes can exist as isomers which are compounds having the same molecular formula but different arrangements of the atoms. 		
Week 4	Transforming Matter: Organic Chemistry- Alkenes	<ol style="list-style-type: none"> Alkenes belong to a homologous series of unsaturated hydrocarbons with the general formula C_nH_{2n} Alkenes can be manufactured by cracking of hydrocarbons. Alkenes are more reactive than alkanes and can undergo addition reactions with bromine, steam and hydrogen. Bromine water can be used to distinguish between alkenes and alkanes. During addition reactions, double bonds in alkenes are broken and they can be joined together to produce long chains known as addition polymers. 	<p>Worksheet 15.3: Alkenes</p> <p>Practical: To differentiate between saturated and unsaturated hydrocarbons.</p>	<p>CU1,CU2</p> <p>ES1,ES2</p>
Week 5	Transforming Matter: Organic Chemistry- Alcohols	<ol style="list-style-type: none"> Alcohols belong to a homologous series containing the -OH group. Alcohols undergo oxidation reactions (using acidified potassium manganate(VII) as oxidizing agent) to form carboxylic acids. Ethanol, a typical alcohol, is formed by the catalysed addition of steam to ethene and by fermentation of glucose. Some common uses of ethanol are as a solvent; as a fuel; as a constituent of alcoholic beverages. 	<p>Worksheet 15.4: Alcohols and Carboxylic acids</p> <p>Practical: To investigate alcohol properties</p>	<p>CU1,CU2</p> <p>ES1,ES2</p>
Week 6	Transforming Matter: Organic Chemistry- Carboxylic acids	<ol style="list-style-type: none"> Carboxylic acids belong to a homologous series containing the $-CO_2H$ group. Carboxylic acids are weak acids that react with carbonates, bases and some metals. 	<p>Practical : Create own fragrances – esterification reactions.</p>	<p>ES1,ES2</p>

Term/Week	Topic	Essential Ideas	Worksheet/ Activity / Practical	Curriculum Standards
		<ol style="list-style-type: none"> Ethanoic acid, a typical carboxylic acid, is formed by the oxidation of ethanol in atmospheric oxygen or acidified potassium manganate(VII). Carboxylic acids undergo condensation reaction with alcohols, in the presence of a catalyst (concentrated sulfuric acid) to form esters. Esters are sweet-smelling liquids widely used in perfumes, artificial food flavourings and solvents for paints. 	<p>Practical : Identification of functional groups</p> <p>Activity: Concept map on inter-conversions of different homologous series and their reactions.</p> <p>Mini Project: Create 3D model Organic tree that connects the different homologous series.</p> <p>Coursework 3: Signum Fidei Project</p>	<p>ES1,ES2</p> <p>CU1,CU2</p> <p>CS1,CS2, RS2,RS3</p> <p>CS1,CS2, RS2,RS3</p>
Weeks 7-8	Transforming Matter: Organic Chemistry- Macromolecules	<ol style="list-style-type: none"> Macromolecules are large molecules built up from small units called monomers. Different macromolecules have different units and /or different linkages. Poly(ethene) or plastic, is a typical addition polymer (macromolecule) formed by addition polymerisation of ethene as the monomer. It is commonly used as plastic bags and clingfilm. An addition polymer is formed when the double bonds of many monomer molecules open up to form a long continuous chain. Nylon, a polyamide, and Terylene, a polyester, are condensation polymers. These man-made fibres are commonly used in clothing, curtain materials, fishing line, parachutes and sleeping bags. A condensation polymer is formed when monomers, with two functional groups, undergo a condensation reaction. Proper disposal of non-biodegradable plastic is important in order to reduce environmental pollution. 	<p>Worksheet 15.5: Macromolecules</p> <p>Activity: Discuss issues related to plastic use and recycling codes of plastic.</p> <p>Activity: Crossword puzzle on organic chemistry.</p> <p>http://www.pcs.com.sg (Website of Petrochemical Corporation of S'pore)</p> <p>Group discussion :Toxicity and Human Health Impacts of Plastics</p>	<p>CU1,CU2</p> <p>CS1,CS2, RS2,RS3</p> <p>CU1,CU2</p> <p>CS1,CS2, RS2,RS3</p>

Term/Week	Topic	Essential Ideas	Worksheet/ Activity / Practical	Curriculum Standards
Weeks 9-10		Topical Revision for End of Year Exam (Sec. 3 and Sec. 4 topics)	Revision Worksheets Past year practice papers	
Term 4 Weeks 1-2		Final Revision for End of Year Exam	Past year practice papers	