Law Ting Pong Secondary School
S.4 Chemistry
Course Outline (2020-2021)

General Description

Chemistry deals with the composition, structures and properties of matter, the interactions between different types of matter, and the relationship between matter and energy. Through the learning of Chemistry, it is possible to acquire relevant conceptual and procedural knowledge. A study of Chemistry also helps to develop understanding and appreciation of developments in engineering, medicine and other related scientific and technological fields. Furthermore, learning about the contributions, issues and problems related to innovations in Chemistry will help students develop an understanding of the relationship between science, technology, society and the environment.

Learning Objectives

By the end of S.4, students will be able to

- Develop interest and maintain a sense of wonder and curiosity about Chemistry
- Construct and apply knowledge of Chemistry, and appreciate the relationship between Chemistry and other disciplines
- Appreciate the understand the evolutionary nature of Science
- Develop skills for making scientific inquiries
- Develop the ability to think scientifically, critically and creativity, and solve problems individually and collaboratively in Chemistry-related contexts
- Discuss Science-related issues using the language of Chemistry
- Make informed decision and judgements on Chemistry-related issues
- Develop open-mindedness, objectivity and pro-activeness
- Show appropriate awareness of working safely
- Understand and evaluate the social, ethical, economic, environmental and technological implications of Chemistry, and develop an attitude of responsible citizenship

Topics and Teaching Schedule

Date	Week	Module	Learning Targets	Assessments
Sept 2020	1-2	**Introduction to Chemistry lessons:** - learn about the DSE curriculum - learn about the assessment criteria - learn about continuous assessment - understand the assessment and homework policies - understand the safety measures in doing practical	**Students should be able to** ● use symbols to represent elements ● classify elements as metals or non-metals on the basis of their properties ● describe the structure of an atom in terms of protons, neutrons and electrons ● perform calculations related to isotopic masses and relative atomic masses ● understand and deduce the electronic	**Formative Practices:** - Chapter exercises - Searching for and presenting information on elements and the development of the Periodic Table

		- understand the rules and regulations in the laboratory - Atomic structure - Periodic table	arrangements of atoms ● represent the electronic arrangements of atoms using electron diagrams ● relate the stability of noble gases to the octet rule ● understand that elements in the Periodic Table are arranged in order of ascending atomic number ● appreciate the Periodic Table as a systematic way to arrange elements ● define the group number and period number of an element in the Periodic Table	
Sept 2020	3-5	**Topic II – Microscopic World I (Book 1B)** **Topics and sub-topics** - metallic bonding - structures and properties of metals - ionic bonding (transfer of electrons in the formation of ionic bond/ cations and anions/ electron diagrams of simple ionic compounds/ ionic structure as illustrated by NaCl) - covalent bonding (sharing of electrons in the formation of covalent bond/ single, double and triple bonds/ electron diagrams of simple covalent compounds/ formula masses and relative molecular masses) - structure and properties of giant ionic substances, simple molecular substances, giant covalent substances	**Students should be able to** ● describe the simple model of metallic bond ● describe the general properties of metals and relate the properties to their giant metallic structures ● describe, using electron diagrams, the formation of ions and ionic bonds ● name some common cations and anions according to the chemical formulae of ions ● name ionic compounds based on the component ions ● describe the formation of a covalent bond ● describe, using electron diagrams, the formation of single, double and triple bonds ● write the names and formulae of covalent compounds based on their component atoms ● describe giant ionic structures of substances such as sodium chloride and caesium chloride	**Formative Practices:** - Chapter exercises -Drawing electron diagrams to represent atoms, ions and molecules -Building models of diamond, graphite and covalent compounds -Experiment: Investigating the migration of ions of aqueous solutions, e.g. copper(II) dichromate and potassium permanganate, towards oppositely charged electrodes.

		- comparison of structures and properties of important types of substances	● state and explain the properties of ionic compounds in terms of their structures and bonding ● describe simple molecular structures of substances such as carbon dioxide and iodine ● state and explain the properties of simple molecular substances in terms of their structures and bonding ● compare the structures and properties of substances with giant ionic, giant covalent, simple molecular and giant metallic structures	
Oct 2020	6-9	**Topic III – Metals (Book 1C)** **Topics and sub-topics** - occurrence and extraction of metals - reactivity of metals (with oxygen, water and dilute acids/ metal reactivity series/ displacement reactions / relation between extraction method and position in the metal reactivity series) - corrosion of metals and their protection factors that influence the rusting of iron - anodisation of aluminium -reacting masses	**Students should be able to** ● state the sources of metals and their occurrence in nature ● understand that the extraction of metals involves reduction of their ores ● describe and explain the major methods of extraction of metals from their ores ● relate the ease of obtaining metals from their ores to the reactivity of the metals ● describe and compare the reactions of some common metals with oxygen/air, water and dilute acids ● describe the essential conditions for the rusting of iron ● describe and explain factors that influence the speed of rusting of iron ● describe and explain the methods of rusting prevention ● perform calculations related to moles, Avogadro's constant and molar masses	**Formative Practices:** - Chapter exercises -Searching for and presenting information about the occurrence of metals and their uses in daily life -Experiment: To investigate reactions of metals with oxygen/air, water and dilute acids -Experiment: To investigate the displacement reactions of metals with aqueous metal ions - Test on Book 1C and 1B (UT1)

			● calculate the percentage by mass of an element in a compound using appropriate information ● determine empirical formulae and molecular formulae from compositions by mass and molar masses	
Nov – Dec 2020	10, 12-16	**Topic IV – Acids and Bases (Book 2A)- Part 1** **Topics and sub-topics** - common acids and alkalis in daily life - acidic properties and hydrogen ions (H^+ (aq)), and alkaline properties and hydroxide ions (OH^- (aq)) - Indicator and pH - strength of acids and alkalis - salts and neutralization (preparation of soluble and insoluble salts/ application of neutralization) - concentration of solutions	**Students should be able to** ● describe the characteristics of acids and their typical reactions ● write chemical and ionic equations for the reactions of acids ● relate acidic properties to the presence of hydrogen ions ● state the basicity of different acids such as HCl, H_2SO_4, CH_3COOH ● define bases and alkalis in terms of their reactions with acids ● describe the characteristics of alkalis and their typical reactions ● write chemical and ionic equations for the reactions of alkalis ● relate alkaline properties to the presence of hydroxide ions (OH^-(aq)) ● state the colours produced by litmus, methyl orange and phenolphthalein in acidic solutions and alkaline solutions ● describe how to test for acidity and alkalinity using suitable indicators ● relate the pH scale to the acidity or alkalinity of substances	**Formative Practices:** - Chapter exercises -Experiment: Investigating the actions of dilute acids on metals, carbonates, hydrogencarbonates, metal oxides and metal hydroxides -Experiment: Investigating the action of dilute alkalis on aqueous metal ions to form metal hydroxide precipitates -Experiment: To investigate the corrosive nature of concentrated acids/alkalis
Jan	19-20	**Topic IV – Acids and Bases (Book 2A)- Part 2** **Topics and sub-topics**	**Students should be able to** ● perform volumetric analysis (preparation of standard solutions, acid-alkali titrations)	**Formative Practices:** - Chapter exercises -Experiment: Preparing a standard solution for volumetric analysis

		- volumetric analysis (preparation of standard solutions, acid-alkali titrations)	● perform calculations related to the concentration of $H^+(aq)$ and the pH value of a strong acid solution ● suggest and demonstrate appropriate ways to determine pH values of substances	-Experiment: Performing acid-alkali titrations using suitable indicators - Test on Book 2A (UT2)
Jan 2021	21	**Revision for SA**		
Jan-Feb 2021	22-24			**Summative Assessment** (mid-term, 25/1-10/2)
Feb – Mar 2021	26-28	**Topic VI – Microscopic World II (Book 2C)** **Topics and sub-topics** - polarity of bond and molecules	**Students should be able to** ● define the electronegativity of an atom ● describe the general trends in the electronegativities of the main group elements down a group and across a period in the Periodic Table ● explain the polar nature of molecules and the non-polar nature of molecules with reference to electronegativity, polarity of bonds and molecular shape	**Formative Practices:** - Chapter exercises -Searching for and presenting information on the important role of hydrogen bonding in macromolecules such as DNA and proteins -Investigating the shapes of some selected molecules with the aid of computer simulations
		- intermolecular forces (van der Waals' forces/ hydrogen bonding)	● explain the existence of van der Waals' forces in non-polar and polar covalent substances ● state the factors affecting the strength of van der Waals' forces between molecules	-Experiment: Investigating the effect of a non-uniform electrostatic field on a jet of polar and non-polar liquid -Experiment: Determining the strength of the hydrogen bonding formed between ethanol molecules
		-structures and properties of molecular crystals	● describe the structures of ice ● state and explain the properties of ice in terms of their its structures and bonding	
		-simple molecular substances with non-octet structures	● recognise the existence of covalent molecules with non-octet structures ● draw the electron diagrams of some non-octet molecules such as BF_3, PCl_5 and SF_6	- Test on Book 2C (UT3)

		- shapes of simple molecules	● predict and draw three-dimensional diagrams to represent shapes of molecules with central atoms obeying octet rule ● predict and draw three-dimensional diagrams to represent shapes of molecules with central atoms not obeying octet rule and with no lone pair of electrons	
Apr 2021	32-35	**Topic VII – Redox Reactions, Chemical Cells and Electrolysis (Book 2B)-part 1** **Topics and sub-topics** - chemical cells in daily life (primary and secondary cells) - reactions in simple chemical cells - redox reactions (oxidation and reduction/ oxidation number/ common oxidizing agents/ common reducing agents)	**Students should be able to** ● describe the characteristics of primary and secondary cells ● describe and demonstrate how to build simple chemical cells using metal electrodes and electrolytes ● explain the functions of a salt bridge/porous device ● describe and demonstrate how to build simple chemical cells using metal-metal ion half cells and salt bridges/porous devices ● identify redox reactions, oxidising agents and reducing agents ● assign oxidation numbers to the atoms of elements and compounds ● construct a general trend of the reducing power of metals and the oxidising power of metal ions ● describe the chemical changes of some common oxidising agents and reducing agents	**Formative Practices:** - Chapter exercises -Experiment: Making simple chemical cells and measuring their voltages -Experiment: To investigate redox reactions with common oxidising and reducing agents -Experiment: Investigating redox reactions of nitric acid of different concentrations and conc. sulphuric acid with metals - Test on Book 2B (UT4)

May 2021	36-39	**Topic VII – Redox Reactions, Chemical Cells and Electrolysis (Book 2B)-part 2** **Topics and sub-topics** - redox reactions in chemical cells - electrolysis	**Students should be able to** ● predict the chemical changes at each half cell of the chemical cells with inert electrodes ● write a half equation for reaction occurring at each half cell and the overall ionic equation for reaction in the chemical cells with inert electrodes ● understand the principles of hydrogen-oxygen fuel cell ● predict products at each electrode of an electrolytic cell with reference to the factors affecting the preferential discharge of ions ● describe the anodic and cathodic reactions, overall reaction and observable changes of the electrolyte in electrolytic cells ● understand the principles of electroplating	**Formative Practices:** - Chapter exercises -Experiment: To investigate factors affecting preferential discharge of ions during electrolysis -Experiment: Designing and performing electroplating experiments -Discussing the pros and cons of using hydrogen-oxygen fuel cells in vehicles
Jun 2021	40-41	**Revision for Final Examination**		**Practical Assessment:** -Titration
Jun 2021	41-43			**Final examination**

Course Materials and Requirements

- Book 1B to 2C

Continuous Assessment (60%)

- Tests
- Assignments
- Practical Assessment

Summative Assessment (40%)

- In Jan (Mid-term Examination)
- In June (Final Examination)

Grade Boundaries

Grade	Mark Range
5*	≥ 85
5	75-84
4	65-74
3	55-64
2	40-54
1	≤ 39

Law Ting Pong Secondary School
S.5 Chemistry
Course Outline (2020-2021)

General Description

Chemistry deals with the composition, structures and properties of matter, the interactions between different types of matter, and the relationship between matter and energy. Through the learning of Chemistry, it is possible to acquire relevant conceptual and procedural knowledge. A study of Chemistry also helps to develop understanding and appreciation of developments in engineering, medicine and other related scientific and technological fields. Furthermore, learning about the contributions, issues and problems related to innovations in Chemistry will help students develop an understanding of the relationship between science, technology, society and the environment.

Learning Objectives

By the end of S.5, students will be able to

- Develop interest and maintain a sense of wonder and curiosity about Chemistry
- Construct and apply knowledge of Chemistry, and appreciate the relationship between Chemistry and other disciplines
- Appreciate the understand the evolutionary nature of Science
- Develop skills for making scientific inquiries
- Develop the ability to think scientifically, critically and creativity, and solve problems individually and collaboratively in Chemistry-related contexts
- Discuss Science-related issues using the language of Chemistry
- Make informed decision and judgements on Chemistry-related issues
- Develop open-mindedness, objectivity and pro-activeness
- Show appropriate awareness of working safely
- Understand and evaluate the social, ethical, economic, environmental and technological implications of Chemistry, and develop an attitude of responsible citizenship

Topics and Teaching Schedule

Date	Week	Module	Learning Targets	Assessments
Sept 2020	1-5	**Topic V – Fossil Fuels and Carbon Compounds (Book 3A)** **Topics and sub-topics** a. Hydrocarbons from fossil fuels	**Students should be able to** • describe the origin of fossil fuels • relate the gradation in properties (e.g. colour, viscosity, volatility and burning characteristics) with the number of carbon atoms in the molecules of the various fractions	**Formative Practices:** - Chapter exercises -Experiment: Acid-alkali titrations using suitable indicators -Experiment: preparing a standard solution for volumetric analysis

		b. Homologous series, structural formulae and naming of carbon compounds c. Alkanes and alkenes d. Addition polymers	• explain the meaning of a homologous series • understand that members of a homologous series show a gradation in physical properties and similarity in chemical properties • describe the reactions of alkenes with bromine and with potassium permanganate solution • demonstrate how to carry out chemical tests for unsaturated hydrocarbons • recognise that synthetic polymers are built up from small molecules called monomers • recognise that alkenes, unsaturated compounds obtainable from cracking of petroleum fractions, can undergo addition reactions • understand that alkenes and unsaturated compounds can undergo addition polymerisation • describe addition polymerisation using chemical equations • deduce the repeating unit of an addition polymer obtained from a given monomer • deduce the monomer from a given section of a formula of an addition polymer	-Searching for and presenting information about petroleum fractions regarding their major uses and the relation between their uses and properties -Experiment: Cracking of a petroleum fraction and testing the products
Oct 2020	6-9	**Topic VII – Redox Reactions, Chemical Cells and Electrolysis (Book 2B)-Part 1** **Topics and sub-topics** - chemical cells in daily life (primary and secondary cells) - reactions in simple chemical cells	**Students should be able to** • describe the characteristics of common primary and secondary cells • describe and demonstrate how to build simple chemical cells using metal electrodes and electrolytes • explain the functions of a salt bridge/porous device	**Formative Practices:** - Chapter exercises -Experiment: Making simple chemical cells and measuring their voltages -Experiment: To investigate redox reactions with common oxidising and

		- redox reactions (oxidation and reduction/ oxidation number/ common oxidizing agents/ common reducing agents)	• describe and demonstrate how to build simple chemical cells using metal-metal ion half cells and salt bridges/porous devices • identify redox reactions, oxidising agents and reducing agents • assign oxidation numbers to the atoms of elements and compounds • construct a general trend of the reducing power of metals and the oxidising power of metal ions • describe the chemical changes of some common oxidising agents and reducing agents	reducing agents -Experiment: Investigating redox reactions of nitric acid of different concentrations and conc. sulphuric acid with metals **Continuous Assessment:** - Test on Book 3A
Nov 2020	10-13	**Topic VII – Redox Reactions, Chemical Cells and Electrolysis (Book 2B)-part 2** **Topics and sub-topics** - redox reactions in chemical cells - electrolysis	**Students should be able to** • predict the chemical changes at each half cell of the chemical cells with inert electrodes • write a half equation for reaction occurring at each half cell and the overall ionic equation for reaction in the chemical cells with inert electrodes • understand the principles of hydrogen-oxygen fuel cell • predict products at each electrode of an electrolytic cell with reference to the factors affecting the preferential discharge of ions • describe the anodic and cathodic reactions, overall reaction and observable changes of the electrolyte in electrolytic cells • understand the principles of electroplating	**Formative Practices:** - Chapter exercises -Experiment: To investigate factors affecting preferential discharge of ions during electrolysis -Experiment: Designing and performing electroplating experiments -Discussing the pros and cons of using hydrogen-oxygen fuel cells in vehicles **Continuous Assessment:** - Test on Book 2B

Dec 2020 -Jan 2021	15-16 19-21	**Topic XI – Chemistry of Carbon Compounds (Book 3B)- part 1** **Topics and sub-topics** a. Introduction to selected homologous series - homologous series - structural formulae and systematic naming b. Isomerism - structural isomerism - cis-trans isomerism as exemplified by acyclic carbon compounds containing one C=C bond - enantiomerism as exemplified by compounds containing one chiral carbon	**Students should be able to** • give systematic names, general formulae, condensed formulae and structural formulae for: alkanes, alkenes, haloalkanes, alcohols, aldehydes and ketones, carboxylic acids, esters, unsubstituted amides and primary amines • draw the structures of the compounds based on their systematic names • understand the effects of functional groups and the length of carbon chains on physical properties of carbon compounds • identify common trivial names of some carbon compounds (e.g. formaldehyde, chloroform, acetone, isopropyl alcohol, acetic acid) • understand that isomerism occurs when two or more compounds have the same molecular formula but different structures • recognise and predict the existence of structural isomerism which includes isomers containing the same functional group and isomers containing different functional groups • recognise the existence of cis-trans isomerism in acyclic carbon compounds resulting from restricted rotation about a C=C bond • show an understanding of structural and cis-trans isomerism by predicting	**Formative Practices:** - Chapter exercises -Building molecular models of compounds with different functional groups -Searching for common trivial names of common carbon compounds -Building molecular models of but-2-ene, butan-2-ol and 2-hydroxypropanoic acid **Continuous Assessment:** - Test on Book 3B

			structures of the isomers of some given carbon compounds • recognise the existence of enantiomerism in compounds with only one chiral carbon	
Jan-Feb 2021	22-24			**Summative Assessment** (mid-term, 25/1-10/2)
Feb - Mar 2021	26-27	**Topic XI – Chemistry of Carbon Compounds (Book 3B)- part 2** **Topics and sub-topics** b. Typical reactions of various functional groups d. Inter-conversions of carbon compounds - inter-conversions between the functional groups - laboratory preparations of simple carbon compounds e. Important organic substances	**Students should be able to** • describe the typical reactions of various functional groups, in terms of reagents, reaction conditions and observations, and write the relevant chemical equations • predict and name the products of the typical reactions of various functional groups • suggest routes to convert one functional group into another by using the typical reactions of various functional groups • describe how to carry out laboratory preparations and purification of simple carbon compounds such as ethanoic acid and ester • calculate the percentage yield of a product obtained from a reaction • identify the functional groups of the acetylsalicylic acid molecule • describe the structures of soaps and soapless detergents • relate the cleansing action of soaps and soapless detergents to their structures	**Formative Practices:** - Chapter exercises -Experiment: Preparing esters from different alkanoic acids and alcohols using microscale apparatus -Experiment: Performing an experiment to prepare nylon -Experiment: Preparing soap from a fat or an oil, and testing its properties -Experiment: To study the reduction of vanillin to vanillyl alcohol using sodium borohydride as reducing agent -Searching for and presenting information on environmental issues related to the use of detergents

			• describe the structures and properties of nylon and polyesters	
Mar 2021	28-29	**Topic VIII – Chemical Reactions and Energy (Book 3C)** **Topics and sub-topics** a. Energy changes in chemical reactions - conversion of energy - endothermic and exothermic reactions and their relationship to the breaking and forming of bonds b. Standard enthalpy changes of reactions c. Hess's law - use of Hess's law to determine enthalpy changes which cannot be easily determined by experiment directly - calculations involving enthalpy changes of reactions	**Students should be able to** • explain energy changes in chemical reactions in terms of the concept of conservation of energy • explain diagrammatically the nature of exothermic and endothermic reactions in terms of enthalpy change • explain the nature of exothermic and endothermic reactions in terms of the breaking and forming of chemical bonds • explain and use the terms: enthalpy change of reaction and standard conditions • calculate enthalpy changes from experimental results • apply Hess's law to construct simple enthalpy change cycles • perform calculations involving such cycles and relevant energy terms, with particular reference to determining enthalpy change that cannot be found directly by experiment	**Formative Practices:** - Chapter exercises -Experiment: Determination of standard enthalpy change of acid-base neutralisation -Experiment: Determination of standard enthalpy change of combustion of alcohols -Experiment: To determine the enthalpy change of formation of metal oxides or metal carbonates **Continuous Assessment:** - Test on Book 3B and 3C
Apr 2021	32-35	**Topic IX – Rate of Reaction (Book 4A)** **Topics and sub-topics** a. Rate of chemical reaction - methods of following the progress of a chemical reaction - instantaneous and average rate	**Students should be able to** • select and justify the following techniques to follow the progress of a reaction • interpret a graph showing the progress of a reaction	**Formative Practices:** - Chapter exercises -Experiment: Using appropriate methods, skills and techniques, such as the micro-scale chemistry technique and data-loggers, to study

			• determine instantaneous and average rate from a suitable graph	the progress of a reaction
		b. Factors affecting rate of reaction - concentration - temperature - surface area - catalyst	• design and perform experiments to study the factors affecting rate of reaction • explain qualitatively the effect of changes in concentration, surface area and temperature on the rate of reaction	-Experiment: Investigating the effect of changes in concentration of reactant, temperature, surface area, or the use of catalyst on reaction rate -Experiment: To determine the molar volume of a gas
		c. Molar volume of gases at room temperature and pressure (r.t.p.) - calculations involving molar volume of gases	• deduce the molar volume of gases at r.t.p. as 24 dm3 using a given data set • perform stoichiometric calculations involving molar volume of gases at r.t.p.	
May 2021	36-37	**Topic X – Chemical Equilibrium (Book 4B)** **Topics and sub-topics** a. Dynamic equilibrium - characteristics of dynamic equilibrium	**Students should be able to** • describe reversible and irreversible reactions by using suitable examples • describe characteristics of a system existing in dynamic equilibrium	**Formative Practices:** - Chapter exercises - Searching for information on issues related to chemical equilibrium
		b. Equilibrium constant - equilibrium constant expressed in terms of concentrations (K_c)	• express the mathematical relationship between concentrations of reactants and products at equilibrium and Kc • perform calculations involving Kc	- Experiment: Investigating the qualitative effects of pH on chemical equilibrium systems - Experiment: To determine Kc of a chemical equilibrium system
		c. The effect of changes in concentration and temperature on chemical equilibrium - a change in temperature results in possible changes in K_c of the system - changes in concentration result in the adjustment of the system without changing the value of K_c	• predict qualitatively the effect of temperature on the position of equilibrium from the sign of $\triangle$H for the forward reaction • deduce the effect of change in concentration on the position of chemical equilibrium	**Continuous Assessment:** - Test on Book 4A and 4B

May 2021	38-39	**Topic XII – Patterns in the Chemical World (Book 5)** **Topics and sub-topics** a. Periodic variation in physical properties of the elements from Li to Ar - variation in the nature of bonding - variation in melting point and electrical conductivity b. Bonding, stoichiometric composition and acid-base properties of the oxides of elements from Na to Cl c. General properties of transition metals - coloured ions - variable oxidation states - catalytic properties	**Students should be able to** • describe the nature of bonding and structures of elements of Group I through Group 0 of the Periodic Table • describe the periodic variations of melting point and electrical conductivity of the elements • describe the nature of bonding and stoichiometric composition of the oxides of elements from Na to Cl • recognise the variations of acid-base properties of the oxides of elements from Na to Cl • recognise that most aqueous ions of transition metals are coloured • describe the colours of some transition metal ions such as $Fe^{3+}(aq)$, $Cr^{3+}(aq)$, $Cu^{2+}(aq)$ • describe that transition metals and their compounds can be used as catalysts	**Formative Practices:** - Chapter exercises -Searching for information on developments of the Periodic Table -Experiment: Investigating the behavior of oxides of the elements Na to Cl in water and their corresponding acid-base properties
Jun 2021	40-41 41-43	**Revision**		**Summative Assessment:** -Final Exam (10-24/6)

Course Materials

- Books 2B, 3A, 3B, 3C, 4A, 4B & 5

Continuous Assessment (60%)

- Tests
- Assignments
- Practical Assessments (SBA)

Summative Assessment (40%)

- In Jan (Mid-term Examination)
- In June (Final Examination)

Grade Boundaries

Grade	Mark Range
5*	≥ 85
5	75-84
4	65-74
3	55-64
2	40-54
1	≤ 39

Law Ting Pong Secondary School
S.6 Chemistry
Course Outline (2020-2021)

General Description

Chemistry deals with the composition, structures and properties of matter, the interactions between different types of matter, and the relationship between matter and energy. Through the learning of Chemistry, it is possible to acquire relevant conceptual and procedural knowledge. A study of Chemistry also helps to develop understanding and appreciation of developments in engineering, medicine and other related scientific and technological fields. Furthermore, learning about the contributions, issues and problems related to innovations in Chemistry will help students develop an understanding of the relationship between science, technology, society and the environment.

Learning Objectives

By the end of S.6, students will be able to

- Develop interest and maintain a sense of wonder and curiosity about Chemistry
- Construct and apply knowledge of Chemistry, and appreciate the relationship between Chemistry and other disciplines
- Appreciate the understand the evolutionary nature of Science
- Develop skills for making scientific inquiries
- Develop the ability to think scientifically, critically and creativity, and solve problems individually and collaboratively in Chemistry-related contexts
- Discuss Science-related issues using the language of Chemistry
- Make informed decision and judgements on Chemistry-related issues
- Develop open-mindedness, objectivity and pro-activeness
- Show appropriate awareness of working safely
- Understand and evaluate the social, ethical, economic, environmental and technological implications of Chemistry, and develop an attitude of responsible citizenship

Topics and Teaching Schedule

Date	Week	Module	Learning Targets	Assessments
Sept 2020	1-2	**Revision** **Topic XII – Patterns in the Chemical World (Book 5)** **Topics and sub-topics** a. Periodic variation in physical properties of the elements from Li to Ar - variation in the nature of bonding	**Students should be able to** ● describe the nature of bonding and structures of elements of Group I through Group 0 of the Periodic Table	**Formative Practices:** - Chapter exercises

		- variation in melting point and electrical conductivity b. Bonding, stoichiometric composition and acid-base properties of the oxides of elements from Na to Cl c. General properties of transition metals - coloured ions - variable oxidation states - catalytic properties	● describe the periodic variations of melting point and electrical conductivity of the elements ● describe the nature of bonding and stoichiometric composition of the oxides of elements from Na to Cl ● recognise the variations of acid-base properties of the oxides of elements from Na to Cl ● recognise that most aqueous ions of transition metals are coloured ● describe the colours of some transition metal ions such as $Fe^{3+}(aq)$, $Cr^{3+}(aq)$, $Cu^{2+}(aq)$ ● describe that transition metals and their compounds can be used as catalysts	
Sep 2020	3-4	**Revision** **Topic X – Chemical Equilibrium (Book 4B)** **Topics and sub-topics** a. Dynamic equilibrium - characteristics of dynamic equilibrium b. Equilibrium constant - equilibrium constant expressed in terms of concentrations (K_c) c. The effect of changes in concentration and temperature on chemical equilibrium - a change in temperature results in possible changes in K_c of the system - changes in concentration result in the adjustment of the system without changing the value of K_c	**Students should be able to** ● describe reversible and irreversible reactions by using suitable examples ● describe characteristics of a system existing in dynamic equilibrium ● express the mathematical relationship between concentrations of reactants and products at equilibrium and Kc ● perform calculations involving Kc ● predict qualitatively the effect of temperature on the position of equilibrium from the sign of $\triangle H$ for the forward reaction ● deduce the effect of change in concentration on the position of chemical equilibrium	**Formative Practices:** - Chapter exercises - Searching for information on issues related to chemical equilibrium - Experiment: Investigating the qualitative effects of pH on chemical equilibrium systems - Experiment: To determine Kc of a chemical equilibrium system

Oct 2020	5-9	**Topic XIII – Industrial Chemistry (Book 6)** **Topics and sub-topics** a. Importance of industrial processes - development of synthetic products for modern ways of living	**Students should be able to** ● discuss the advantages and disadvantages of using industrial processes such as petrochemistry for manufacturing products from social, economic and environmental perspectives	**Formative Practices:** - Chapter exercise as assignments - searching for information on accidents caused by the failure to control reaction rate. -Experiment: Investigating the effect of changes in concentration of reactant on reaction rate. -Experiment: Investigating the effect of changes in temperature on reaction rate. -Searching for and presenting information about green chemistry -Experiment: Using initial rate method to determine the rate equation of the reaction between sodium thiosulphate and dilute hydrochloric acid. -Experiment: To determine the activation energy of a chemical reaction. **Continuous Assessment:** - Test on Topic XIII – Industrial Chemistry
		b. Rate equation - rate equation determined from experimental results	● understand the interrelationship between reaction rate, rate constant, concentration of reactants and order of reaction ● determine the rate equation of a chemical reaction by method of initial rate	
		c. Activation energy - energy profile - explanation of the effect of temperature change on reaction rate in terms of activation energy	● draw an energy profile of a reaction ● explain the relationship between temperature and reaction rate using Maxwell-Boltzmann distribution curve	
		d. Catalysis and industrial processes - meaning and characteristics of catalyst - relation between activation energy and catalysis	● describe the characteristics of catalysts using suitable examples ● understand that catalysts work by providing an alternative reaction route ● describe the effect of catalyst on reversible reactions	
		e. Industrial processes - conversion of raw materials to consumer products as illustrated by the production of fertilisers - applications of principles of electrochemistry in industry as exemplified by the processes in the chloroalkali industry	● describe feedstock, principles, reaction conditions, procedures and products for processes involved in the production of ammonia ● describe the process of the conversion of ammonia to fertilisers ● explain how industrial processes such as the Haber process often involve a compromise	

		- advancement of industrial processes as exemplified by the conversion of methane to methanol - social, economic and environmental considerations of industrial processes f. Green chemistry - principles of green chemistry - green chemistry practices	between rate, yield and economic considerations ● describe the importance of the chloroalkali industry ● recognise the significance of the conversion of methane to methanol ● discuss social, economic and environmental considerations of industrial processes as illustrated by the Haber process, the chloroalkali industry or the manufacturing of methanol via syngas ● describe the relation between sustainable development and green chemistry ● evaluate industrial processes using principles of green chemistry	
Nov 2020	10-13	**Topic XV – Analytical Chemistry (Book 8)** **Topics and sub-topics** a. Detecting the presence of chemical species - detecting the presence of calcium, copper, potassium and sodium in substances by the flame test - application of appropriate tests for detecting the presence of i. molecules: hydrogen, oxygen, chlorine, carbon dioxide, water, ammonia, sulphur dioxide and hydrogen chloride ii. cations: aluminium, ammonium, calcium, magnesium, copper (II), iron (II), iron (III) and zinc iii. anions: chloride, bromide, iodide, carbonate, hypochlorite and sulphite iv. various functional groups in carbon compounds: C=C, -OH, -CHO, >C=O and –COOH	**Students should be able to** ● gather empirical information using chemical tests ● record observations accurately and systematically ● decide and carry out an appropriate chemical test to detect the presence of a chemical species ● state the reaction conditions and observations of the tests for the presence of carbonyl compounds using 2,4-dinitrophenylhydrazine and Tollens' reagent ● devise a scheme to separate a mixture of known substances	**Formative Practices:** - Chapter exercises - Experiments: To detect the presence of certain chemical species in a sample. -Experiment: Titrimetric analysis of chloride using silver nitrate with chromate indicator (Mohr's method) -Experiment: To determine the concentration of an unknown solution using a colorimeter. **Continuous Assessment:** - Test on Topic XV – Analytical Chemistry

		c. Separation and purification methods - crystallisation - distillation/ fractional distillation - liquid-liquid extraction - paper, column or thin layer chromatography d. Quantitative methods of analysis - volumetric analysis e. Instrumental analytical methods - basic principles and applications of colorimetry - identification of functional groups of carbon compounds using IR spectroscopy - basic principles and applications of mass spectrometry, including simple fragmentation pattern	● describe various separation and purification methods ● examine the purity of a substance by measuring its melting or boiling point ● justify the choice of an appropriate method used for the separation of substances in a mixture ● gather data with appropriate instruments and apparatus in quantitative analysis ● perform calculations on data obtained to draw evidence-based conclusions ● understand the basic principles deployed in the instrumental analytical methods, viz. colorimetry, IR spectroscopy and mass spectrometry ● identify the organic function groups from an IR spectrum and a given correlation table ● identify the following groups from a mass spectrum: R^+, RCO^+ and $C_6H_5CH_2^+$ ● analyse data from primary sources and draw evidence-based conclusions	
Dec 2020	14-16	**Revision** **(Organic Chemistry Books 3A and 3B)**		**Formative Practices:** -Experiment: To detect the presence of functional groups by simple chemical tests. **Continuous Assessment:** -Saturday Practice Examination

Jan 2021	19-21	**Revision (Acids and bases, Redox, Mole calculation Books 1C, 2A and 2B)**		**Formative Practices:** -Experiment: Iodometric titration of ascorbic acid in a sample of vitamin C tablets or fruit juices. **Continuous Assessment:** - Tests
Jan - Feb 2021	22-24	/	/	**Summative Assessment:** -Final Exam (Mock Exam, 25/1 - 10/2)

Course Materials and Requirements

- Books 6 and 8

Continuous Assessment (60%)

- Tests
- Saturday Practice Examination (5/12/2020)
- Assignments

Summative Assessment (40%)

- Final Examination (Mock Examination)

Grade Boundaries

Grade	Mark Range
5*	≥ 85
5	75-84
4	65-74
3	55-64
2	40-54
1	≤ 39