



REPUBLIC OF LIBERIA

MINISTRY OF EDUCATION



NATIONAL CURRICULUM FOR GRADES 10 TO 12

CHEMISTRY

February 2011

MESSAGE FROM THE MINISTER OF EDUCATION

I wish to extend my thanks and appreciation to ECSEL, UNESCO and all our partners for their immense contribution to this important task of revising and strengthening of the National Curriculum. Special thanks to USAID through LTTP for their funding and technical support in the harmonization or realignment of the curriculum. We extend sincere thanks and appreciation to the Bureau of Curriculum Development and Textbook Research, the National Curriculum Taskforce, and the subject specialists from various institutions for the level of professionalism that went into this exercise.

The revision and strengthening of our National Curriculum comes at a time when our nation is faced with the Herculean task or challenge of education transformation, national reconstruction, recovery and renewal in the aftermath of a devastating civil war. Hence, critical to this national challenge is the rebuilding of the education sector as Liberians can not achieve the desired socio-economic progress in the absence of a strong, vibrant and productive education and training system.

The revised national curriculum has two features which include the regular core subject areas of Mathematics, Science, Language Arts and Social Studies and emphasis is being given to the global challenge of HIV/AIDS, Peace, Citizenship, Human Rights and Environmental education. Secondly, the new curriculum is developed in line with international standards especially those practiced and enshrined in the curriculum of our sisterly Republic of Nigeria and Ghana who are also members of the West African Examinations Council (WAEC) .

We wish to urge all our education partners including students, teachers, principals, proprietors of schools and members of school boards to use this curriculum in our schools to enhance quality and relevant instruction and to enable our students to be adequately prepared to take the West African Senior Secondary Certificate Examinations (WASSCE) come 2013 as envisaged by us in the education sector.

May I conclude by once again saying big thank-you to all those who contributed to make this project a success.

Hon. E. Othello Gongar
MINISTER

INTRODUCTION

This curriculum on Chemistry for Grades 10 to 12 has been designed to build on what students have learnt in their Integrated Science and Mathematics courses, among others, at the Junior School. It aims primarily at stimulating students' interest in the study of Science, particularly Chemistry. Accordingly, therefore, it provides ample scope for practical laboratory work, and for exercises that will help develop in students' critical thinking skills, including those of keen observation, accurate recording of observations, and the proper interpretation of data, among others. While the curriculum will provide a solid foundation for the further study of Chemistry, it will also provide much needed scientific knowledge, skills, and competencies, as well as a positive attitude to Science for those who may not study it beyond Senior High School.

A student-centred approach is emphasized in this curriculum. This is based on the firm belief that learning becomes more permanent, meaningful, and exciting when students themselves take ownership of the learning process. Teachers are, therefore, urged to contrive those classroom strategies that would engage students actively in the teaching/learning process.

AIMS AND OBJECTIVES

Upon the completion of this course of study, students will be able to:

1. Acquire knowledge and understanding of the basic principles of Chemistry, and how to apply these principles to familiar and unfamiliar circumstances.
2. Develop keen interest in Chemistry as a discipline and in Science generally.
3. Acquire essential laboratory skills, as well as the skills of critical thinking, keen observation, data collection, analysis, and interpretation.
4. Develop the scientific attitude of problem solving, and an acute sense of curiosity and creativity.

SEMESTER: ONE

PERIOD: I

GRADE: 10

TOPIC 1 : INTRODUCTION TO CHEMISTRY

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Demonstrate knowledge of the origins and various stages in the development of chemistry.
2. Show appreciation for the scientific method.
3. Define Chemistry and its branches.
4. Demonstrate familiarity with the various systems of units of measurement and solve simple conversion problems.
5. Correctly write the symbols of elements and use symbols to write formulae for compounds.
6. Adopt proper behavior when conducting laboratory experiments, thereby avoiding unnecessary accidents.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Overall appreciation for the scientific method, and the importance of Chemistry in particular. Proper laboratory safety measures.	1. History and development of Chemistry/ Branches of Chemistry 2. Units and measurements 3. Chemical Symbols and Formulae 4. Safety and safety rules	1. Lab session: Know the Apparatus & format of lab report; 2. Assignments/exercises: Trace key developments in modern Chemistry. List and define the branches of Chemistry 3. Lab session: Measurements- Length, area, volume 4. Assignments/exercises: Calculations and conversions of units 5. Lab Session: Measurements- Time, mass, temperature	<u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) <u>B. Secondary Texts</u> <ul style="list-style-type: none">• <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010)• <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <u>C. Other Resources/Supplementary Readings</u> Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) <ul style="list-style-type: none">• Laboratory equipped with at least the apparatus listed on minimum apparatus list.• Poster sheets.	<u>Essential tasks students should be able to do:</u> <ol style="list-style-type: none">1. State the development and stages of development of Chemistry.2. Describe the scientific method, and defend their preference for it.3. Define Chemistry and name its branches.4. Correctly write the symbols of elements and use symbols to write formulae for compounds.5. Demonstrate proper behavior when conducting laboratory experiments

		6. Assignments/exercises: IUPAC nomenclature of some simple compounds 7. Lab Session: Safety & Safety Rules 8. Assignments/exercises: Recognizing/identifying safety & hazard signs	<ul style="list-style-type: none"> • Rulers, tape rules, vernier calipers, micrometer. • Stopwatches, balances, scales, thermometers. • Safety and hazard signs. 	<u>Other essential evaluation tools:</u> Grading of assignments/ lab reports Regular quizzes and tests Grading of assignments/lab reports
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SEMESTER: ONE

PERIOD: I

GRADE: 10

TOPIC 2 : MATTER AND ITS PROPERTIES

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Describe the states of matter.
2. Identify pure and impure substances by making use of their special characteristics.
3. Identify and classify various changes as either physical or chemical.
4. Describe techniques used to purify impure substances and use various techniques to separate mixtures.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/RESOURCES	EVALUATION
Knowledge of states of matter, and acquisition of the techniques to separate mixtures.	1. Properties and Changes of Matter. 2. States of Matter and Changes of State. 3. Purification and separation	1. Assignments/exercises: Identifying physical and chemical properties of matter, as well as physical and chemical changes 2. Assignments/exercises: Identify the specific method used to purify some given	<u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) <u>B. Secondary Texts</u> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) 	<u>Essential tasks students should be able to do:</u> <ol style="list-style-type: none"> 1. Describe the states of matter. 2. Identify pure and impure substances by making use of their special characteristics. 3. Using appropriate examples, identify and classify various changes as either physical or

	techniques.	substances and to separate some given mixtures	<u>C. Other Resources/Supplementary Readings</u> Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • Poster sheets & markers • Poster sheets & markers	chemical. 4. Describe techniques used to purify impure substances and use various techniques to separate mixtures. <u>Other essential evaluation tools.</u> Grading of assignments Regular quizzes and tests
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SEMESTER: ONE

PERIOD: II

GRADE: 10

TOPIC 1 : ATOMIC STRUCTURE

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Name and describe the fundamental particles of an atom using the concepts from Dalton's Atomic Theory, J.J. Thomson's, Rutherford's and other experiments.
2. Position the fundamental particles using Neil Bohr's model.
3. Define atomic number and mass number and their relationship to isotopes.
4. Calculate the relative atomic mass of an element.
5. Distinguish atoms, molecules and ions, as well as elements and compounds
6. Describe the four quantum numbers and use them to describe the sizes (energy levels), shapes, orientations and spin states of orbitals.
7. Describe the position of electrons in terms of energy levels.
8. Make use of Aufbau's, Hund's and Pauli's rules/ principles to describe the arrangement of electrons in the sub-energy (write electronic configurations for atoms levels including orbital and electron dot configuration).

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Knowledge of the major concepts, theories and principles relating to Atomic Structure, and the appropriate application of these principles.	<ol style="list-style-type: none"> 1. Fundamental particles 2. Arrangement of the particles in the atom; 3. Atoms, molecules and ions; 4. Elements and compounds 5. Quantum numbers – shapes and sizes of orbitals; 6. Electronic energy levels 7. Electronic configuration 	<ol style="list-style-type: none"> 1. Lab sessions: Conductivity of metals and nonmetals 2. Assignments/exercises: J. J. Thompson's, Rutherford's and Geiger-Marsden experiments. Dalton's atomic theory. 3. Lab sessions: Flame photometry 4. Assignments/Exercises: preparation of models of atoms using the Bohr atomic model 5. Lab sessions: Sublimation of naphthalene 6. Assignments/exercises: Calculations of relative atomic mass using MS data. 7. Lab sessions: <ol style="list-style-type: none"> a) Separation by filtration b) Separation of a mixture of liquids c) Separation of a mixture of solids 8. Assignments/exercises: Preparation of models of atoms and simple molecules. 9. Assignments/exercises: Preparation of charts /drawings showing shapes of s, p and d 	<p>A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p>B. Secondary Texts</p> <ul style="list-style-type: none"> • Edexcel IGCSE Chemistry (Pearson, 2010) • Edexcel Mastering Chemistry (Pearson, 2010) <p>C. Other Resources/Supplementary Readings Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999)</p> <ul style="list-style-type: none"> • Dry cell batteries, wires coins and other metallic objects, pencil, rubber and other nonmetallic objects • Burners, glass rods, $MgCl_2$, NaCl, KCl, $CuSO_4$ • Burner, naphthalene, camphor balls, watch glasses, evaporating dishes. • Diagram of mass spectrometer • Filter paper, beakers, funnels, magnets, etc. • Poster sheets, markers 	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none"> 1. Name and describe the fundamental particles of an atom. 2. Position the fundamental particles using Neil Bohr's model. 3. Define atomic number and mass number and their relationship to isotopes. 4. Calculate the relative atomic mass of an element. 5. Distinguish atoms, molecules and ions, as well as elements and compounds 6. Describe the four quantum numbers and use them to describe the sizes (energy levels), shapes, orientations and spin states of orbitals. 7. Describe the position of electrons in terms of energy levels. 8. Make use of Aufbau's, Hund's and Pauli's rules/ principles to describe the arrangement of electrons in the sub-energy. <p><u>Other essential evaluation tools.</u></p> <p>Grading of assignments/ lab reports</p>

		orbitals 10. Assignments/exercises: Write energy level electron configurations for the first 20 elements 11. Assignments/exercises: Electronic configuration of first 20 elements and first transition series.		Regular quizzes and tests
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SEMESTER: ONE

PERIOD: III

GRADE: 10

TOPIC 1 : THE PERIODIC TABLE/ PERIODIC CHEMISTRY

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Discuss the history and development of the periodic table and the periodic law.
2. Show that the chemical properties of the elements are a function of their relative positions on the periodic table.
3. Recognize the main blocks and the periods of the periodic table, making use of electronic configurations.
4. Recognize group variations and any anomalies in properties such as physical states.
5. Show the variation of periodic properties for the first 20 elements on the periodic table, and on this basis, describe the progression from metallic to non-metallic character of elements and from ionic to covalent bonding tendency.
6. Describe the first transition series of the periodic table, citing the unique physical and chemical properties of the elements in this series.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
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<p>Demonstrated knowledge of the Periodic Table, and the ability to use electronic configuration.</p>	<ol style="list-style-type: none"> History & Origin / The Periodic Law Structure of the Periodic Table Trends in Periodic Properties Main group elements: electronic configuration, physical properties /chemical reactivities of the elements. Elements of the 1st transition series- physical states, metallic and magnetic properties, variable oxidation states, formation of colored compounds, catalytic abilities, etc. 	<ol style="list-style-type: none"> Lab sessions: Use of pipette and burette. Assignments/exercises: Draw two diagrams of the periodic table to illustrate Mendeleyev's periodic law and the modern periodic law. Lab sessions: Investigating the pattern of arrangement of elements on the periodic table. Assignments/exercises: Draw a Periodic table. Lab sessions: Comparison of the relative reactivity of some elements of main groups I and II, and that of some elements within main group I. Assignments/exercises: Plot a graph of atomic number of the second period elements vs. ionic radius and another graph of atomic number vs. ionic radius of main group I. Then use these graphs to explain the variation of ionic radius along a series and within a group of the periodic table. Assignments/exercises: 	<p>A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p>B. Secondary Texts</p> <ul style="list-style-type: none"> <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p>C. Other Resources/Supplementary Readings Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999)</p> <ul style="list-style-type: none"> Burettes, pipettes, beakers Poster sheets, markers Periodic table, Poster sheets, markers Poster sheets, markers, graph paper Strips of some metals including Na, K, Li, Mg and Ca, Water Poster sheets, markers, 	<p>Essential tasks students should be able to do:</p> <ol style="list-style-type: none"> Discuss the history and development of the periodic table and the periodic law. Show that the chemical properties of the elements are a function of their relative positions on the periodic table. Recognize the main blocks and the periods of the periodic table, making use of electronic configurations. Recognize group variations and any anomalies in properties such as physical states. Show the variation of periodic properties for the first 20 elements on the periodic table, and on this basis, describe the progression from metallic to non-metallic character of elements and from ionic to covalent bonding tendency. Describe the first transition series of the periodic table, citing the unique physical and
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		<p>Make a list of all the main group elements. Then separate the metals, non-metals and metalloids.</p> <p>9. Assignments/exercises: Make a list of all first transition elements and identify those elements which form colored compounds, those which may serve as catalysts and those which have magnetic properties.</p>		<p>chemical properties of the elements in this series.</p> <p><u>Other essential evaluation tools.</u></p> <ul style="list-style-type: none"> • Grading of assignments/ lab reports. • Regular quizzes and tests.
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PERIOD: IV

GRADE: 10

TOPIC 1 : CHEMICAL BONDING

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Identify the different types of chemical bonding.
2. Define / describe ionic bonding and the properties of ionic compounds.
3. Define /describe covalent bonding and the properties of compounds.
4. Explain the factors influencing their formations.
5. Define electronegativity and use the concept to explain bond polarity, using water as an example of a polar molecule.
6. Use various bonding theories to describe the shapes of various covalent molecules.
7. Use schematic diagrams to illustrate the types of bonding and the shape of molecules.
8. Describe metallic bonding and the factors influencing the formation of metallic bond.
9. Distinguish between inter-atomic bonding and intermolecular bonding.
10. Describe hydrogen bonding and appreciate the unusual boiling point of water due to the hydrogen bonding.
11. Explain the coordinate covalent (dative) bond.
12. Compare the various bond types in terms of their structure, properties and basic units.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
A deep understanding of the different types of bonding.	<p>1. Bond Types – Ionic Bonding: Factors influencing formation, properties of ionic compounds</p> <p>2. Covalent Bonding: Factors influencing its formation, properties of covalent/ molecular compounds</p>	<p>1. Assignments/exercises: Draw electron dot & orbital diagrams to illustrate ionic bond formation involving different compounds</p> <p>2. Lab sessions: Physical properties of ionic and covalent solids</p> <p>3. Assignments/exercises: Draw electron dot & orbital diagrams to illustrate ionic bond formation involving different compounds</p>	<p><u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p><u>B. Secondary Texts</u></p> <ul style="list-style-type: none">• <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010)• <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p><u>C. Other Resources/Supplementary Readings</u> Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999)</p>	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none">1. Identify the different types of chemical bonding.2. Define / describe ionic bonding and the properties of ionic compounds.3. Define /describe covalent bonding

	<p>2. Bond Polarity</p> <p>3. Simple molecules and their shapes</p> <p>4. Metallic Bonding: Factors influencing its formation, properties of metals</p> <p>5. Intermolecular bonding –van der Waal's forces and hydrogen bonding</p> <p>6. Coordinate bonding; Comparison of all bond types</p>	<p>4. Lab sessions: Investigating the polarity of some solvents</p> <p>5. Assignments/exercises: Calculating electro-negativity difference/ % ionic character and using the result to predict bond polarity</p> <p>6. Lab sessions: Investigating the effects of heat, electricity & some solvents on covalent compounds</p> <p>7. Assignments/exercises: Draw the shapes of various molecules predicted by the hybridization theory and the VSEPR theory</p> <p>8. Assignments/exercises: List all the characteristics of metals that enable them to form metallic bonds</p> <p>9. Lab sessions: Comparison of the boiling points of two liquids to show how hydrogen bonding affects boiling point</p> <p>10. Assignments/exercises: Deducing the relative boiling points of various substances based on their structures.</p> <p>11. Assignments/exercises: Make a chart to compare ionic covalent and metallic bond in terms of structure, heat and electrical conductivities, boiling & melting points, solubility in water and non-polar solvents and hardness.</p>	<ul style="list-style-type: none"> • Poster sheets, • markers • Sugar, NaCl, NaHCO₃, I₂, water, 2-propanol (isopropyl alcohol). • Polar solvents such as alcohol (ethanol), water; • Non-polar solvents such as diethyl ether; • NaCl, kerosene • Naphthalene, graphite, iodine, camphor balls, Ethanol, Water, Ether, • Ethanol, Diethyl ether, thermometer, simple distillation equipment. 	<p>and the properties of compounds.</p> <p>4. Explain the factors influencing their formations.</p> <p>5. Define electronegativity and use the concept to explain bond polarity, using water as an example of a polar molecule.</p> <p>6. Use various bonding theories to describe the shapes of various covalent molecules.</p> <p>7. Use schematic diagrams to illustrate the types of bonding and the shape of molecules.</p> <p>8. Describe metallic bonding and the factors influencing the formation of metallic bond.</p> <p>9. Distinguish between inter-atomic bonding and intermolecular</p>
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				<p>bonding.</p> <p>10. Describe hydrogen bonding and appreciate the unusual boiling point of water due to the hydrogen bonding.</p> <p>11. Explain the coordinate covalent (dative) bond.</p> <p>12. Compare the various bond types in terms of their structure, properties and basic units.</p> <p><u>Other essential evaluation tools.</u></p> <p>Grading of assignments/ lab reports Regular quizzes and tests</p>
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SEMESTER: TWO**PERIOD: VI****GRADE: 10****TOPIC I : OXIDATION-REDUCTION REACTIONS****SPECIFIC OBJECTIVES:**

Upon completion of this topic, students will be able to:

1. Distinguish between oxidation and reduction, and between oxidizing and reducing agents, giving examples of each.
2. Cite examples of some oxidation processes in everyday life such as rusting, souring of milk.
3. Appreciate the use of painting to prevent oxidation.
4. Assign oxidation numbers to elements in a chemical species.
5. Balance simple redox reactions

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Demonstrate knowledge of oxidation-reduction reaction, and the ability to balance simple redox equation.	1. Differences between oxidation and reduction and between oxidizing and reducing agents. 2. Oxidation numbers. 3. Balancing simple redox equations.	1. Lab sessions: determining the mole ratio, and writing the balanced equation, for the reaction between aqueous CuSO_4 and Zn metal. 2. Assignments/exercises: Identify oxidized and reduced species in a redox reaction without determining oxidation numbers. 3. Lab sessions: Experiment on “Testing for reducing agents and oxidizing agents”. 4. Assignments/exercises: Determine oxidation states for elements in various species. 5. Lab session: Preparation and	A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) B. Secondary Texts <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) C. Other Resources/Supplementary Readings Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) <ul style="list-style-type: none"> • Hydrated CuSO_4 crystals • Zn foil • distilled water • beakers, balances, stirring rods, 	<u>Essential tasks students should be able to do:</u> <ol style="list-style-type: none"> 1. Distinguish between oxidation and reduction, and between oxidizing and reducing agents, giving examples of each. 2. Cite examples of some oxidation processes in everyday life such as rusting, souring of milk. 3. Appreciate the use of painting to prevent oxidation. 4. Assign oxidation numbers to elements in a chemical species. 5. Balance simple redox reactions <u>Other essential evaluation tools.</u> <ul style="list-style-type: none"> • Grading of assignments/ lab

		Properties of Gases: 6. Lighter than air gases – H ₂ , NH ₃ 7. Heavier than air gases – (O ₂ , HCl & SO ₂) 8. Assignments/exercises: Balancing simple redox equations in acidic and basic media	etc. • Br ₂ , H ₂ O ₂ , Conc. HNO ₃ , KmnO ₄ , K ₂ Cr ₂ O ₇ , KI, FeSO ₄ , Cu turnings, FeCl ₃ , KIO ₃ , S, SO ₂ , test tubes • HCl, Zn foil or granules, KClO ₃ MnO ₄ , burner, NaCl, H ₂ SO ₄ , beakers, water bath	reports • Regular quizzes and tests
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SEMESTER: ONE

PERIOD: I

GRADE: 11

TOPIC 1 : KINETIC THEORY

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. State the postulates of the kinetic model of matter and use it to explain the nature of solids, liquids and gases, as well as the changes of state of matter.
2. Correctly state and interpret the gas laws, (Boyle's, Charles', Gay-Lussac's, Dalton's, Avogadro's, Graham's, & Ideal Gas Laws) and solve related problems..
3. Describe the preparation and properties of gases (both lighter and heavier than air gases).
4. Demonstrate the principles of purification and collection of gases.
5. Demonstrate awareness that air is a mixture of gases with variable proportions by volume and humidity.
6. State the physical properties of air and the uses of the component gases.
7. Show that air may be polluted, stating the major air pollutants.
8. Explain that a liquid acts as intermediate state between gases and solids by studying the physical properties of liquids.
9. State the main sources of water and appreciate the importance of safe water in their daily lives and life processes.
10. Identify the main causes of hardness in water (both permanent and temporary) and the methods of softening hard water.
11. Discuss the physical and chemical properties of water and describe these terms: *hygroscopy*, *deliquescence* and *efflorescence* in relation to drying agents.
12. Realize the importance of sanitation and hence, keep their surroundings and materials they use clean.
13. Compare the types, structures and properties of solids.

14. Demonstrate awareness that melting points can serve as indicators of the purity of solids and that the properties and uses of solids are dependent on their structure.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/RESOURCES	EVALUATION
Demonstrate overall knowledge of Kinetic Theory, and the basic laboratory skills in carrying out related experiments.	<ol style="list-style-type: none"> Properties of solutions; Types of solutions (Saturated, Unsaturated and Supersaturated solutions) Dilute and concentrated solutions Solution concentration units (molarity, molality, ppm normality, % w/w, % v/v, ppb) Colligative properties: Vapor pressure, boiling point, freezing point, osmotic pressure Solution Stoichiometry 	<ol style="list-style-type: none"> Lab sessions: Separation of a solution mixture. Assignments/exercises: Identify the solutes and solvents in common/household solution mixtures. Lab sessions: Dilution of concentrated solutions. Assignments/exercises: Simple dilution calculations. Lab sessions: Preparation of standard solutions. Assignments/exercises: Simple calculations involving solution concentration units. Lab sessions: Simple experiment to demonstrate the elevation of boiling point by the addition of a nonelectrolytic solute to a pure solvent. Assignments/exercises: Simple calculations involving boiling point elevation, freezing 	<p>A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p>B. Secondary Texts</p> <ul style="list-style-type: none"> <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p>C. Other Resources/Supplementary Readings</p> <ul style="list-style-type: none"> Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) Simple distillation apparatus, (flasks, stoppers, tubing, boiling chips, condensers, burners, etc.). Stock solutions of Conc. H_2SO_4, Distilled water volumetric flasks, etc. Na_2CO_3, HCl, distilled water, burette, beakers, methyl orange indicator. Distilled water, granulated sugar, thermometer, boiling chips, thermometer, stopper, etc. 	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none"> State the postulates of the kinetic model of matter and use it to explain the nature of solids, liquids and gases, as well as the changes of state of matter. Correctly state and interpret the gas laws, (Boyle's, Charles', Gay-Lussac's, Dalton's, Avogadro's, Graham's, & Ideal Gas Laws) and solve related problems.. Describe the preparation and properties of gases (both lighter and heavier than air gases). Demonstrate the principles of purification and collection of gases. Explain that air is a mixture of gases with variable proportions by volume and humidity. State the physical

		<p>point depression, lowering of vapor pressure and osmotic pressure.</p> <p>7. Assignments/Exercises: Simple calculations on solution stoichiometry.</p>		<p>properties of air and the uses of the component gases.</p> <p>7. Demonstrate that air may be polluted, stating the major air pollutants.</p> <p>8. Explain that a liquid acts as intermediate state between gases and solids by studying the physical properties of liquids.</p> <p>9. State the main sources of water and appreciate the importance of safe water in their daily lives and life processes.</p> <p>10. Identify the main causes of hardness in water (both permanent and temporary) and the methods of softening hard water.</p> <p>11. Discuss the physical and chemical properties of water and describe these terms: <i>hygroscopy</i>, <i>deliquescence</i> and <i>efflorescence</i> in relation to drying agents.</p> <p>12. Explain the Importance of sanitation..</p>
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				<p>13. Compare the types, structures and properties of solids.</p> <p>14. Explain how melting points can serve as indicators of the purity of solids and that the properties and uses of solids are dependent on their structure.</p> <p><u>Other essential evaluation tools.</u></p> <ul style="list-style-type: none"> • Grading of assignments/ lab reports. • Regular quizzes and tests.
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SEMESTER: ONE

PERIOD: II

GRADE: 11

TOPIC I : SOLUTIONS

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Define solution and describe how various types/kinds of solution are prepared.
2. Define stock solution and distinguish between dilute and concentrated solutions.
3. Prepare dilute solutions.
4. Prepare standard molar, molal and normal solutions with the required concentration.
5. Perform calculations involving the various concentration units.
6. State/describe the colligative properties of solutions and solve related mathematical problems.
7. Solve stoichiometric calculations involving solution concentration units.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Demonstrate knowledge of solutions, and competent related laboratory skills.	1. Properties of solutions; Types of solutions (Saturated, Unsaturated and Supersaturated solutions). 2. Dilute and concentrated solutions. 3. Solution concentration units (molarity, molality, ppm normality, % w/w, % v/v, ppb). 4. Colligative properties: Vapor pressure, boiling point, freezing point, osmotic pressure. 5. Solution Stoichiometry.	1. Lab sessions: Separation of a solution mixture. 2. Assignments/exercises: Identify the solutes and solvents in common/household solution mixtures. 3. Lab sessions: Dilution of concentrated solutions. 4. Assignments/exercises: Simple dilution calculations. 5. Lab sessions: Preparation of standard solutions.	A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) B. Secondary Texts <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) C. Other Resources/Supplementary Readings <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • Simple distillation apparatus, (flasks, stoppers, tubing, boiling chips, condensers, burners, etc.). 	<u>Essential tasks students should be able to do:</u> <ol style="list-style-type: none"> 1. Define solution and describe how various types/kinds of solution are prepared. 2. Define stock solution and distinguish between dilute and concentrated solutions. 3. Prepare dilute solutions. 4. Prepare standard molar, molal and normal solutions with the required concentration. 5. Perform calculations involving the various concentration units. 6. Describe the colligative

		<p>6. Assignments/exercises: Simple calculations involving solution concentration units.</p> <p>7. Lab sessions: Simple experiment to demonstrate the elevation of boiling point by the addition of a nonelectrolytic solute to a pure solvent.</p> <p>8. Assignments/exercises: Simple calculations involving boiling point elevation, freezing point depression, lowering of vapor pressure and osmotic pressure.</p> <p>9. Assignments/Exercises: Simple calculations on solution stoichiometry.</p>	<ul style="list-style-type: none"> • Stock solutions of Conc. H_2SO_4, Distilled water volumetric flasks, etc. • Na_2CO_3, HCl, distilled water, burette, beakers, methyl orange indicator. • Distilled water, granulated sugar, thermometer, boiling chips, thermometer, stopper, etc. 	<p>properties of solutions and solve related mathematical problems.</p> <p>7. Solve stoichiometric calculations involving solution concentration units.</p> <p><u>Other essential evaluation tools.</u></p> <ul style="list-style-type: none"> • Grading of assignments/lab reports; regular quizzes and tests.
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SEMESTER: ONE
PERIOD: III

GRADE: 11

TOPIC 1 : ELECTROLYTES - ACID, BASES AND SALTS

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Distinguish between electrolytes and non-electrolytes and demonstrate that acids, bases and salts are electrolytes.
2. Define acids and bases according to the Arrhenius, Bronsted-Lowry and Lewis theories.
3. Explain the physical and chemical properties of acids and bases, including their effects on indicators, metals and carbonate salts.
4. Demonstrate an understanding of amphotericism.
5. Describe the pH scale and use the knowledge about pH scale to measure/determine acidity and alkalinity.
6. Calculate pH and pOH.
7. Perform various acid-base titrations with the use of the appropriate acid-base indicators and the corresponding color changes.
8. Describe the behavior of weak acids and bases in water as example of equilibrium system and solve related problems.
9. Describe the behavior of certain salts towards hydrolysis.
10. Define and describe the properties of a buffer solution.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Enhanced knowledge of electrolytes – acid, bases, and salts; and the ability to perform various acid-based titrations.	1. Definitions of electrolytes. 2. Theories and Properties of acids and bases. 3. pH and pOH calculations. 4. Acid-base titrations. 5. Weak acids and bases (calculations involving K_a , K_b , pK_a and pK_b). 6. Buffer solutions.	1. Lab sessions: Experiment to demonstrate the conductivity of electrolytic solutions. 2. Assignments/exercises: List several acids, bases and salts. Then write chemical equations to show how they behave as electrolytes. 3. Lab sessions: Preparation of an indicator from local plants and its use to test acidity and basicity. 4. Assignments/exercises: Identifying Bronsted-Lowry and Lewis acids and bases in an acid-base reaction.	<u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) <u>B. Secondary Texts</u> <ul style="list-style-type: none">• <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010)• <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <u>C. Other Resources/Supplementary Readings</u> <ul style="list-style-type: none">• Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999)	<u>Essential tasks students should be able to do:</u> <ol style="list-style-type: none">1. Distinguish between electrolytes and non-electrolytes and demonstrate that acids, bases and salts are electrolytes.2. Define acids and bases according to the Arrhenius, Bronsted-Lowry and Lewis theories.3. Explain the physical and chemical properties of acids and bases, including

		<p>5. Lab sessions: Determination of pH using pH meter and the use of the pH paper</p> <p>6. Assignments/exercises: Simple calculations on pH and pOH</p> <p>7. Lab sessions: Acid-base titration using a colored indicator</p> <p>8. Assignments/exercises: Simple calculations involving acid-base titrations.</p> <p>9. Assignments/exercises: Solve simple calculations K_a and K_b.</p> <p>10. Assignments/exercises: List five (5) different buffer solutions and classify them as either weak acid-salt buffer or weak base-salt buffer</p>	<ul style="list-style-type: none"> • NaCl, granulated sugar, distilled water, dry cell or lead storage battery, electric wires, light bulbs sockets. • Purple cabbage or hibiscus flower, isopropyl alcohol (2-propanol), burner, beaker, vinegar, citrus fruits, caustic solution, etc. • pH meter, pH papers, buffer solutions of pH 4, 7 & 10, distilled water acidic and basic solutions, etc. • Phenolphthalein indicator, NaOH, HCl, burette, beakers, flasks, etc. 	<p>their effects on indicators, metals and carbonate salts.</p> <p>4. Explain amphoterism.</p> <p>5. Describe the pH scale and use the knowledge about pH scale to measure/determine acidity and alkalinity.</p> <p>6. Calculate pH and pOH.</p> <p>7. Perform various acid-base titrations with the use of the appropriate acid-base indicators and the corresponding color changes.</p> <p>8. Describe the behavior of weak acids and bases in water as example of equilibrium system and solve related problems.</p> <p>9. Describe the behavior of certain salts towards hydrolysis.</p> <p>10. Define and describe the properties of a buffer solution.</p> <p><u>Other essential evaluation tools.</u></p> <p>Grading of assignments/ lab reports; regular quizzes and tests</p>
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SEMESTER: ONE

PERIOD: III

GRADE: 11

TOPIC 2 : SOLUBILITY

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Define solubility and state the influencing factors;
2. State the solubility rules.
3. Draw and interpret solubility curves.
4. Demonstrate the practical applications of solubility.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
A firm knowledge of solubility, and the ability to demonstrate its practical application.	<ol style="list-style-type: none"> 1. Definitions; Factors affecting solubility 2. Solubility curves (drawing and interpreting these curves 3. Practical applications of solubility 	<ol style="list-style-type: none"> 1. Assignments/exercises: Perform some simple calculations involving Henry's law of solubility. 2. Assignments/exercises: Draw a curve showing the solubilities of various salts – solubilities of the salts to be given by the teacher. 3. Assignments/exercises: write report on solvent extraction 	<p><u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p><u>B. Secondary Texts</u></p> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p><u>C. Other Resources/Supplementary Readings</u></p> <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • Graph paper. 	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none"> 1. Define solubility and state the influencing factors; 2. State the solubility rules. 3. Draw and interpret solubility curves. 4. Demonstrate the practical applications of solubility. 5. <p><u>Other essential evaluation tools.</u></p> <p>Grading of assignments/ lab reports; regular quizzes and tests</p>

SEMESTER: TWO

PERIOD: IV

GRADE: 11

TOPIC 1 : ENERGETICS

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Define and describe energy and energy changes.
2. Explain the use of one form of energy to produce another.
3. Distinguish between *endothermic* and *exothermic* processes, and describe energy changes in both physical and chemical processes.
4. Explain energy level diagrams and their uses.
5. Draw and interpret energy profiles illustrating activation energy and enthalpy change.
6. Discuss heat of formation and heat of combustion, and demonstrate that enthalpy and entropy are driving forces of reactions.
7. Identify common gaseous, liquid and solid substances which act as fuels.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/RESOURCES	EVALUATION
Ability to define and explain major concepts in Energetics; and to draw and interpret related energy level diagrams.	1. Energy changes in physical and chemical processes 2. Enthalpy /Elementary treatment of thermo-chemistry 3. Energy diagrams 4. Description and illustrations of energy changes and effects (Hess's law);	1. Assignments/exercises: Identifying exothermic and endothermic processes 2. Lab session: Determining the heat of solution of: H ₂ SO ₄ , NaOH, CuSO ₄ 3. Assignments/exercises: Simple calculations on heat of reaction 4. Lab session: Effect of temperature on the	<u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) <u>B. Secondary Texts</u> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <u>C. Other Resources/Supplementary Readings</u> <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 	<u>Essential tasks students should be able to do:</u> <ol style="list-style-type: none"> 1. Define and describe <i>energy</i> and <i>energy changes</i>. 2. Explain how one form of energy can be used to produce another. 3. Distinguish between <i>endothermic</i> and <i>exothermic</i> processes, and describe energy changes in both physical and chemical processes. 4. Given energy level diagrams, explain them and describe

	<p>5. Fuels: Gaseous, liquid and solid fuels as sources of energy</p>	<p>solubility of substances</p> <p>5. Assignments/exercises: Plot simple energy vs. time.</p> <p>6. Assignments/exercises: Simple calculations using Hess's law.</p> <p>7. Assignments/exercises: Identify several sources of fuels – solids, liquids and gases</p>	<p>1999)</p> <ul style="list-style-type: none"> Graph paper. NaOH & CuSO₄ crystals Conc. H₂SO₄, Distilled water, volumetric flasks graduated cylinders balance. Thermometer, distilled water, sugar, NaCl. 	<p>their uses.</p> <p>5. Draw and interpret energy profiles illustrating <i>activation energy</i> and <i>enthalpy change</i>.</p> <p>6. Discuss <i>heat of formation</i> and <i>heat of combustion</i>, and demonstrate that <i>enthalpy</i> and <i>entropy</i> are driving forces of reactions.</p> <p>7. Identify common gaseous, liquid and solid substances which act as fuels.</p> <p><u>Other essential evaluation tools.</u></p> <p>Grading of assignments/ lab reports; regular quizzes and tests.</p>
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SEMESTER: TWO

PERIOD: IV

GRADE: 11

TOPIC I : NUCLEAR CHEMISTRY

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Define radioactivity and describe its historical development.
2. Explain how *nuclear reactions* differ from *chemical reactions*.
3. Describe the types and nature of radiations.
4. Explain the role of half-life in the stability of the nucleus.
5. Distinguish between *fusion* and *fission*.
6. Explain the effects and applications of radioactivity.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
A good grasp of the basic concepts of Nuclear Chemistry.	<ol style="list-style-type: none"> Definition and history of radioactivity. Difference between ordinary and nuclear reactions. Types and nature of radiations. Half-life as a measure of the stability of the nucleus. Nuclear reactions – fission and fusion in nuclear reactors. Effects and application of radioactivity. 	<ol style="list-style-type: none"> Assignments/exercises: Research on the key scientists in the development of nuclear chemistry. Lab sessions: Crystallization and Recrystallization of a dissolved solid. Assignments/exercises: Write and balance simple nuclear equations. Assignments/exercises: Identify and name various types of radiation. Assignments/exercises: Simple calculations using half-life. Lab sessions: Solvent extraction. Assignments/exercises: Write <i>fusion</i> and <i>fission</i> reactions; Identify fission and fusion reactions. Assignments/exercises: Explain how radioactivity is applicable in food preservation and pest control. 	<p><u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p><u>B. Secondary Texts</u></p> <ul style="list-style-type: none"> <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p><u>C. Other Resources/Supplementary Readings</u></p> <ul style="list-style-type: none"> Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) KNO₃, distilled water, HNO₃. Acetone, ammonia solution, NH₄Cl, separator funnel. Poster sheets. 	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none"> Define radioactivity and describe its historical development. Explain how <i>nuclear reactions</i> differ from <i>chemical reactions</i>. Describe the types and nature of radiations. Explain the role of half-life in the stability of the nucleus. State the difference between <i>fusion</i> and <i>fission</i>. Explain the effects and applications of radioactivity. <p><u>Other essential evaluation tools.</u></p> <p>Grading of assignments/ lab reports; regular quizzes and tests.</p>

SEMESTER: TWO**PERIOD: V****GRADE: 11****TOPIC I: CHEMICAL EQUILIBRIUM****SPECIFIC OBJECTIVES:**

Upon completion of this topic, students will be able to:

1. Realize that rate is a function of time, and as such, time must be used wisely in performing assigned duties.
2. Explain the principle of reversible reactions and how it relates to equilibrium systems.
3. Provide an explanation to support the notion that all dynamic systems always undergo adjustment to achieve stability.
4. State Le Chatelier's principle and use the concept to predict the effects of external influences on equilibrium systems.
5. Explain the nature of equilibrium constant, write equilibrium constant expressions, and perform simple related calculations.
6. Show the mathematical relationship between K_p & K_c .

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Demonstrate an initial understanding of chemical equilibrium, and its related expressions and calculations.	<ol style="list-style-type: none"> 1. General principles (Reversible reactions and law of mass action). 2. Factors influencing equilibrium (Le Chatelier's principle). 3. The Equilibrium Constant. 4. Relationship between K_p & K_c. 	<ol style="list-style-type: none"> 1. Lab sessions: Determination of rate constant of a reaction. 2. Assignments/exercises: Describe several reversible reactions in nature. 3. Lab sessions: Determination of rate constant of a reaction. 4. Assignments/exercises: Describe several reversible reactions in nature. 5. Assignments/exercises: Solve simple problems on equilibrium 	<p>A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p>B. Secondary Texts</p> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p>C. Other Resources/Supplementary Readings</p> <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) 	<p>Essential tasks students should be able to do:</p> <ol style="list-style-type: none"> 1. Express the function of <i>time</i> on <i>rate</i>. 2. Explain the principle of reversible reactions and how it relates to equilibrium systems. 3. Explain the notion that all dynamic systems always undergo adjustment to achieve stability. 4. State Le Chatelier's principle and use the concept to predict the effects of external influences on equilibrium systems. 5. Explain the nature of equilibrium constant, write equilibrium constant expressions, and perform simple related calculations.

		constant calculations. 6. Lab sessions: Measuring reaction rate . 7. Assignments/exercises: Solve simple problems on equilibrium constant calculations.	<ul style="list-style-type: none"> • Potassium thiocyanate solution,. • test tubes, iron(III) nitrates solution, corks, etc. • Weighing balance, conical flask, cotton wool, marble chips (CaCO₃), stop clock, etc., poster sheets, etc. 	6. Show the mathematical relationship between K _p & K _c . <u>Other essential evaluation tools.</u> Grading of assignments/ lab reports; regular quizzes and tests.
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SEMESTER: TWO

PERIOD: V

GRADE: 11

TOPIC: II CHEMICAL KINETICS

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Define reaction rate and state the factors influencing reaction rate.
2. Discuss/explain the collision and activation energy theories as well as their influencing factors.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/RESOURCES	EVALUATION
Ability to define and explain concepts related to Chemical Kinetics.	1. Rates of reactions. 2. Factors influencing reaction rate (physical state, reactant concentration, temperature, catalysts and medium). 3. Theory of reaction rates	1. Lab sessions: Effect of temperature on reaction rate. 2. Assignments/exercises: Describe the speed of certain natural reactions such as explosions, food decay,	<u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) <u>B. Secondary Texts</u> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> 	<u>Essential tasks students should be able to do:</u> <ol style="list-style-type: none"> 1. Define reaction rate and state the factors influencing reaction rate. 2. Discuss/explain the collision and activation energy theories as well as their influencing factors. <u>Other essential evaluation tools.</u> Grading of assignments/ lab reports;

	(collision theory, activation energy–elementary treatment).	<p>rusting of iron, ripening of fruits etc.</p> <p>3. Lab sessions: Effect of catalyst on reaction rate.</p> <p>4. Assignments/exercises: Explain why paper torn into pieces before being burned.</p> <p>5. Assignments/exercises: Deduce activation energy from energy profile diagrams or draw energy profile diagrams from data.</p>	<p>(Pearson, 2010)</p> <p><u>C. Other Resources/Supplementary Readings</u></p> <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • Thermometer • Beaker, cross, stirring rod, sodium thiosulfate solution, boiling test tube, ice, etc. • KClO_3, MnO_2, Burner, test tubes, crucibles, Beaker with cork, syringe, gas, stop clock, etc. 	regular quizzes and tests.
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SEMESTER: TWO**PERIOD: VI****GRADE: 11****TOPIC I: ELECTROCHEMISTRY****SPECIFIC OBJECTIVES:**

Upon completion of this topic, students will be able to:

1. Demonstrate an awareness of the presence and importance of electrolytes in the body.
2. Distinguish between electrolytes and non-electrolytes.
3. Distinguish between the two types of electrodes in solutions.
4. State the meaning of standard electrode potential and its use.
5. Write cell reactions for the electrolysis of various species.
6. Draw a diagram of an electrochemical cell and label its parts.
7. Determine the EMF of given cells, as well as the meaning of the magnitude and sign of the EMF.
8. Distinguish between primary and secondary cells and state their applications.
9. Explain how intense heat can reduce the potential of a dry cell.
10. State the principles of electrolysis and the factors which influence the discharge of species from electrolytic solutions during electrolysis.
11. Discuss the use of specific electrochemical cells such as dry cell, etc. in the generation of electrical energy from chemical reactions.
12. State Faraday's 1st and 2nd laws of electrolysis and perform simple related calculations.
13. State the uses of electrolysis including its practical applications such as electroplating and smelting.
14. Explain how electroplating materials can prevent rusting and corrosion.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/RESOURCES	EVALUATION
A demonstrable knowledge of the concepts, and principles of Electrochemistry, and its practical application.	<ol style="list-style-type: none"> 1. Review of redox reactions/balancing of redox equations; 2. Electrolytes and non-electrolytes; Electrodes in solution 3. Electrochemical cells – Standard Electrode 	<ol style="list-style-type: none"> 1. Assignments/exercises: Practice problems on balancing redox reactions 2. Assignments/exercises: Practice problems on balancing redox reactions 3. Lab sessions: Construction of an electrochemical cell 	<p>A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p>B. Secondary Texts</p> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) 	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none"> 1. Explain the presence and importance of electrolytes in the body. 2. Distinguish between electrolytes and non-electrolytes. 3. Distinguish between the two types of electrodes in solutions. 4. State the meaning of standard

	<p>Potential;</p> <p>4. Cell Diagrams (emf of cells)</p> <p>5. Application of electro-chemical cells (Primary & secondary cells, Daniel cell, lead battery, dry cell, fuel cells – their use as generators of electrical energy from chemical reactions)</p> <p>6. Principles of electrolysis – comparison of electrolytic cell with electrochemical cell;</p> <p>7. Factors influencing discharge of species from electrolytes,</p> <p>8. Electrolysis of common electrolytic species (molten NaCl & PbBr₂, dil. NaCl solution, conc. NaCl solution, CuSO₄ solution, dil. H₂SO₄ (using Pt or graphite and copper electrodes)</p> <p>9. Faraday's 1st and 2nd laws of electrolysis</p> <p>10. Practical applications of electrolysis –</p>	<p>4. Assignments/exercises: Problem solving using standard electrode potentials</p> <p>5. Assignments/exercises: Drawing diagrams of various electrochemical cells; simple calculations of emf of cells.</p> <p>6. Lab sessions:Electrolysis of water and of dilute NaCl solution</p> <p>7. Assignments/exercises: Identifying the various types of electrochemical cells</p> <p>8. Assignments/exercises: Assignments/exercises: List the factors that influence the discharge of species from electrolytes; Identify the species and to be discharged from certain solutes.</p> <p>9. Assignments/exercises: Sample problems on the writing of cell reactions for the electrolysis of various species, using as a guide, the factors that influence the discharge of species from electrolytes.</p> <p>10. Lab sessions: Electroplating of copper Assignments/exercises: Solve sample problems to illustrate Faraday's laws of electrolysis</p>	<p>C. Other Resources/Supplementary Readings</p> <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • Dry cell batteries, wires, graphite rods, NaCl, distilled water, flasks, beakers, etc. • Beakers, graphite rods, NaCl crystals as salt bridge, etc. • Graphite rods, wires, source of electricity, distilled water, Dilute sodium NaCl solution, dilute sulfuric acid, etc. • Copper rods for electrodes, wires, source of electricity, aqueous copper(II) sulfate • Poster sheets 	<p>electrode potential and its use.</p> <p>5. Write cell reactions for the electrolysis of various species.</p> <p>6. Draw a diagram of an electrochemical cell and label its parts.</p> <p>7. Determine the EMF of given cells, as well as the meaning of the magnitude and sign of the EMF.</p> <p>8. Distinguish between primary and secondary cells and state their applications.</p> <p>9. Explain how intense heat can reduce the potential of a dry cell.</p> <p>10. State the principles of electrolysis and the factors which influence the discharge of species from electrolytic solutions during electrolysis.</p> <p>11. Discuss the use of specific electrochemical cells such as dry cell, etc. in the generation of electrical energy from chemical reactions.</p> <p>12. State Faraday's 1st and 2nd laws of electrolysis and perform simple related calculations.</p> <p>13. State the uses of electrolysis including its practical applications such as electroplating and smelting.</p> <p>14. Explain how electroplating materials can prevent rusting and corrosion.</p> <p><u>Other essential evaluation tools.</u> Grading of assignments/ lab reports;</p>
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	electroplating, smelting, etc.; 11. Corrosion of metals	11. Assignments/exercises: :Describe/explain how and why stainless steel is often used to make cooking and eating utensils. 12. Assignments/exercises: Students collect several materials available in their neighborhoods or communities that have been electroplated; also identify and collect various samples of corroded materials.		regular quizzes and tests.
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SEMESTER: ONE**PERIOD: I****GRADE: 12****TOPIC 1: INTRODUCTION TO ORGANIC CHEMISTRY****SPECIFIC OBJECTIVES:**

Upon completion of this topic, students will be able to:

1. List the general characteristics of organic compounds and appreciate the abundant nature of organic compounds.
2. Classify organic compounds in various ways.
3. Demonstrate practical knowledge about the separation and purification methods for organic compounds.
4. Define and identify functional groups for various organic compounds.
5. Define homologous series and give several examples.
6. Define homologous series and give several examples.
7. List the general properties of hydrocarbons.
8. List the general formulae, sources, nomenclature, properties, uses of aliphatic and aromatic hydrocarbons (alkanes, alkenes, alkynes and benzene).
9. Define isomerism and draw structural or geometric isomers for alkanes and alkenes.
10. Describe the composition, fractional distillation, physical properties and uses of petroleum and petrochemicals.
11. Define octane number and knocking and show how these terms are related to petrol quality.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Demonstrate an initial understanding of the fundamental concepts and principles of Organic Chemistry.	1. General characteristics of organic compounds; Classification of organic compounds (Straight Chain & Branched, Cyclic & Acyclic; Aromatic compounds); Separation & Purification (distillation, crystallization, chromatography, etc.); Functional Groups & Homologous Series,	1. Lab sessions: a) Purification of an organic compound by distillation and determination of its boiling point. b) Recrystallization of an organic solid. 2. Assignments/exercises: a) Answer questions or solve problems on the determination of an organic compound from its structure b) Identifying and	A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) B. Secondary Texts <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) C. Other Resources/Supplementary Readings <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical</i> 	<u>Essential tasks students should be able to do:</u> 1. List the general characteristics of organic compounds and appreciate the abundant nature of organic compounds. 2. Classify organic compounds in various ways. 3. Demonstrate practical knowledge about the separation and

	<p>Isomerism; Chemical properties/reactions.</p> <p>2. Hydrocarbons; Alkanes-general formula, sources, uses, physical properties, nomenclature and chemical properties, Petroleum – composition, fractional distillation, cracking and reforming, petrochemicals, petrol quality (octane number, knocking) Alkenes – Sources, structure, nomenclature, properties (physical and chemical).</p> <p>3. Alkynes – Sources, structure, nomenclature, physical properties, uses and reactions; Benzene – Structure and physical properties, chemical properties/reactions</p>	<p>recognizing the functional groups present</p> <p>c) Drawing of structural isomers</p> <p>3. Lab sessions: a) Paper chromatography b) Functional group tests</p> <p>4. Assignments/exercises Field trip to LPRC to see how the quality of petrol, using the concept of octane rating</p>	<p><i>Chemistry for SSS</i> (Sedco/Pearson, 1999)</p> <ul style="list-style-type: none"> Distillation apparatus, heating units, thermometer, melting point apparatus (capillary tube, rubber band, oil, etc. Organic compounds: Ethanol. Filter paper, scissors, ruler, wooden splint, ball-point pen, large boiling test tube, ethanol, cork, test tube, liquid bromine, carbon tetrachloride, a solution of an alkene, etc. 	<p>purification methods for organic compounds.</p> <ol style="list-style-type: none"> Define and identify functional groups for various organic compounds. Define homologous series and give several examples. Define homologous series and give several examples. List the general properties of hydrocarbons. List the general formulae, sources, nomenclature, properties, uses of aliphatic and aromatic hydrocarbons (alkanes, alkenes, alkynes and benzene). Define isomerism and draw structural or geometric isomers for alkanes and alkenes. Describe the composition, fractional distillation, physical properties and uses of petroleum and petrochemicals. Define octane number and knocking and show how these terms
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				<p>are related to petrol quality.</p> <p><u>Other essential evaluation tools.</u> Grading of assignments/ lab reports; regular quizzes and tests.</p>
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SEMESTER: ONE

PERIOD: II

GRADE: 12

TOPIC I: INTRODUCTION TO ORGANIC CHEMISTRY (cont'd)

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. List the general formulae, sources, general preparations, uses and physical properties of alcohols, aldehydes, ketones, ethers, alkyl halides, carboxylic acids and esters.
2. Name and draw structural formulae of some of these hydrocarbon derivatives.
3. Describe the basic chemical reactions and characterization tests for these hydrocarbon derivatives.
4. Demonstrate practical knowledge about the production of soap.
5. Distinguish between natural and synthetic organic materials.
6. Define polymerization, polymers, polymers, dimers, and monomers, and distinguish between condensation polymers & addition polymers and between thermoplastic & thermosetting polymers with examples.
7. Describe the physical properties, chemical properties and uses of rubber.
8. Classify and draw structures of simple carbohydrates, and state their properties and uses.
9. Identify fats and oils as esters and describe their sources and properties.
10. Describe the structure of amino acids and their use as monomers of proteins.
11. Describe the synthesis and hydrolysis of proteins, as well as their use in living systems.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
An understanding of the fundamental concepts and processes of Organic Chemistry.	<p>1. Hydrocarbon derivatives Sources, classification, nomenclature, physical and chemical properties (including laboratory tests characterization) of: Alkanols (Alcohols); Alkanals (Aldehydes); Alkanones (Ketones); Ethers; Halocarbons (Alkyl Halides); Alkanoic (Carboxylic Acids); and Alkyl Alkanoates (Esters).</p> <p>2. Synthetic and Natural Organic Compounds: Synthetic and natural polymers – definitions of polymerization, polymers, monomers, dimers, addition and condensation polymers, plastics and resins; important properties of polymers (thermoplastic and thermosetting polymers); Rubber. Synthetic Polymers – Classification and preparation based on</p>	<p>1. Lab sessions: Saponification of an ester.</p> <p>2. Assignments/exercises: Practice problems on the classification, nomenclature, physical properties, preparation and reactions of these hydrocarbon derivatives..</p> <p>3. Lab sessions: Composition of aspirin by back titration.</p> <p>4. Assignments/exercises: Practice problems on the writing of polymerization reactions involving some of these polymers.</p> <p>5. Field trip to plastic or rubber processing plant.</p> <p>6. Lab sessions: 1. Coagulation of latex.</p> <p>7. Investigating some properties of starch and proteins.</p> <p>8. Assignments/exercises: Practice</p>	<p>A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p>B. Secondary Texts</p> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p>C. Other Resources/Supplementary Readings</p> <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • Palm oil, NaOH solution, heating unit, etc. • Aspirin tablets, NaOH, phenolphthalein indicator, weighing balance,, heating unit, volumetric flask, beaker, pipette, burette, distilled water, etc. • Latex, ammonia solution, etc. Powdered starch, a piece of white tile, iodine solution, distilled water, beaker, heating unit, sulfuric acid solution, sodium hydroxide solution,, Fehling's or Benedict's solution, 	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none"> 1. List the general formulae, sources, general preparations, uses and physical properties of alcohols, aldehydes, ketones, ethers, alkyl halides, carboxylic acids and esters. 2. Name and draw structural formulae of some of these hydrocarbon derivatives. 3. Describe the basic chemical reactions and characterization tests for these hydrocarbon derivatives. 4. Description of the processes of soap production. 5. Distinguish between natural and synthetic organic materials. 6. Define polymerization, polymers, polymers, dimers, and monomers, and distinguish between condensation polymers & addition polymers and between

	<p>the monomers and co-polymers.</p> <p>3. Introduction to Biochemistry : Amino acids (Difunctional nature). Proteins – synthesis from amino acids, hydrolysis, uses in living systems ; Carbohydrates – classification, formulae, properties (including reactions) and uses; Fats and oils as esters (sources, physical and chemical properties);</p>	<p>problems on the classification, structural drawing and reactions involving these bio-molecules</p>	<p>boiled egg, Millon's reagent, copper(II) sulfate solution</p>	<p>thermoplastic & thermosetting polymers with examples.</p> <ol style="list-style-type: none"> Describe the physical properties, chemical properties and uses of rubber. Classify and draw structures of simple carbohydrates, and state their properties and uses. Identify fats and oils as esters and describe their sources and properties. Describe the structure of amino acids and their use as monomers of proteins. Describe the synthesis and hydrolysis of proteins, as well as their use in living systems. <p><u>Other essential evaluation tools.</u> Grading of assignments/ lab reports; regular quizzes and tests.</p>
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SEMESTER: ONE

PERIOD: III

GRADE: 12

TOPIC I: CHEMISTRY, INDUSTRY AND THE ENVIRONMENT

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Give an acceptable definition of industry and briefly describe the historical development of industry.
2. Give the general characteristics of industries and fully classify the chemical industry.
3. Explain the role of chemistry in chemical industries.
4. Name some chemical industries in Liberia and their corresponding raw materials.
5. Discuss the factors that determine the location of chemical industries and the effect of industries on the community.
6. Distinguish between heavy and fine chemicals.
7. Describe how raw materials are processed and how by-products may be recycled.
8. Discuss the sources, effects and control of pollution in Liberia.
9. Explain the greenhouse effect and depletion of ozone layer, and describe how this relates to the prevailing climatic conditions in Liberia.
10. Distinguish between bio-degradable and non-biodegradable pollutants and suggest methods of handling non-biodegradable pollutants.
11. Describe the processing of some food and alcoholic beverages in Liberia and explain how food testing in Liberia is carried out.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
A deeper awareness of the impact of industries on the environment.	<ol style="list-style-type: none">1. Brief history and definition of industry; characteristics and classification of the chemical industry.2. Chemical industries in Liberia and their corresponding raw materials; Factors that determine sitting of chemical industries.3. Heavy and fine chemicals –	<ol style="list-style-type: none">1. Lab sessions:<ol style="list-style-type: none">a) Protein testb) Assignments/exercisesc) Field Trips to leading chemical industries in Liberia, including Coca-cola, MBI,etc.2. Lab sessions:<ol style="list-style-type: none">a) Fermentation processes3. Assignments/exercises:<ol style="list-style-type: none">a) List several examples of biodegradable and non-biodegradable pollutants in your	<p><u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p><u>B. Secondary Texts</u></p> <ul style="list-style-type: none">• <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010)• <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p><u>C. Other Resources/Supplementary Readings</u></p>	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none">1. Give an acceptable definition of industry and briefly describe the historical development of industry.2. Give the general characteristics of industries and fully classify the chemical industry.3. Explain the role of chemistry in chemical industries.4. Name some chemical industries in Liberia and their corresponding raw materials.

	<p>distinction.</p> <p>4. Effect of industries on the community.</p> <p>5. Air, Water and Soil Pollution – Sources, effects and control.</p> <p>6. Greenhouse effect and depletion of the ozone layer.</p> <p>7. Bio-degradable and non-biodegradable pollutants.</p> <p>8. Biotechnology – Food processing, fermentation (including production of bread, farina and palm wine and other alcoholic beverages, e.g. the local cane juice); food testing (using Ninhydrin, Xanthoproteic, Biuret and Millon's tests for proteins).</p>	<p>environment.</p> <p>b) Write an essay on one of the major environmental challenges facing Liberia.</p> <p>5. Lab sessions b) Production of biogas.</p> <p>6. Assignments/exercises: write balanced chemical equations of the processes involved in alcoholic fermentation.</p> <p>6. Field Trips</p>	<ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • Transportation • Cassava, • distilled water, • beaker, • yeast, • distillation apparatus, • sulfuric acid solution, • potassium dichromate solution, • potassium permanganate solution, • iodine solution, • sodium hydroxide 	<p>5. List and discuss the factors that determine the location of chemical industries and the effect of industries on the community.</p> <p>6. Distinguish between heavy and fine chemicals.</p> <p>7. Describe how raw materials are processed and how by-products may be recycled.</p> <p>8. Discuss the sources, effects and control of pollution in Liberia.</p> <p>9. Explain the greenhouse effect and depletion of ozone layer, and describe how this relates to the prevailing climatic conditions in Liberia.</p> <p>10. Distinguish between bio-degradable and non-biodegradable pollutants and suggest methods of handling non-biodegradable pollutants.</p> <p>11. Describe the processing of some food and alcoholic beverages in Liberia and explain how food testing in Liberia is carried out.</p> <p><u>Other essential evaluation tools.</u> Grading of assignments/ lab reports; regular quizzes and tests.</p>
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SEMESTER: ONE

PERIOD: III

GRADE: 12

TOPIC 2: CHEMISTRY OF SELECTED METALS AND THEIR COMPOUNDS

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Discuss the properties and uses of sodium and its compounds
2. Discuss the properties and uses of calcium and its compounds

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Knowledge of the properties and uses of metals.	<ol style="list-style-type: none"> 1. Properties and uses of sodium and its compounds - (Compounds limited to NaCl, NaOH, Na₂CO₃, NaHCO₃ and Na₂SO₄). 2. Properties and uses of calcium and its compounds - (Compounds limited to CaCO₃, CaO, CaSO₄, CaCl₂, and Ca(OH)₂) 	<ol style="list-style-type: none"> 1. Lab sessions: Qualitative analysis of cations 2. Assignments/exercises: Make a list of common household sodium compounds including their chemical formulae and uses. 3. Assignments/exercises: Make a list of common household calcium compounds including their chemical formulae and uses 	<p><u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p><u>B. Secondary Texts</u></p> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p><u>C. Other Resources/Supplementary Readings</u> Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999)</p> <ul style="list-style-type: none"> • 5% solutions of cations from groups I – III. • Solutions of HCl, H₂S, (NH₄)₂S. • Test tubes & holders, • Test tube racks,. • Centrifuge. 	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none"> 1. Discuss the properties and uses of sodium and its compounds 2. Discuss the properties and uses of calcium and its compounds

			• Distilled water, pH.	
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SEMESTER: TWO**PERIOD: IV****GRADE: 12****TOPIC 1: CHEMISTRY OF SELECTED METALS AND THEIR COMPOUNDS (cont'd)****SPECIFIC OBJECTIVES:**

Upon completion of this topic, students will be able to:

1. Define metallurgy and describe the raw materials, by-products and main products in the metallurgy of Al, Fe, Au and Sn.
2. Discuss the properties and uses of Al, Fe, Au and Sn.
3. Define alloys and describe the composition and uses of common alloys such as brass, bronze, steel, duralumin.
4. Compare the reactivities of iron and aluminum with air, water and acids.
5. Discuss the extraction, purification, properties and uses of copper and its compounds.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Deeper Knowledge of the properties and uses of non-metals.	<p>1. Metallurgy: Extraction of metals (Al and Fe, Au and Sn) – raw materials, processing, main product, by-products, recycling; uses of the metals; Alloys – common alloys of Cu, Al, Pb, and Fe and their uses.</p> <p>2. Reactivities of iron and aluminum with air, water and acids.</p> <p>3. Purification, Chemical properties and uses of copper and its compounds (compounds limited to CuSO₄, CuO and CuCl₂).</p>	<ol style="list-style-type: none"> 1. Lab sessions. 2. Assignments/exercises: Identify several alloys in your surroundings and state their composition. 3. Identify several ores and show their constituent metals. 	<p><u>A. Primary Text</u> Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p><u>B. Secondary Texts</u></p> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p><u>C. Other Resources/Supplementary Readings</u></p> <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • 5% solutions of cations from groups I – III. • Solutions of HCl, H₂S, (NH₄)₂S. • Test tubes & holders, • Test tube racks,. • Centrifuge. 	<p><u>Essential tasks students should be able to do:</u></p> <ol style="list-style-type: none"> 1. Define metallurgy and describe the raw materials, by-products and main products in the metallurgy of Al, Fe, Au and Sn. 2. Discuss the properties and uses of Al, Fe, Au and Sn. 3. Define alloys and describe the composition and uses of common alloys such as brass, bronze, steel, duralumin. 4. Compare the reactivities of iron and aluminum with air, water and acids. 5. Discuss the extraction, purification, properties and uses of copper and its compounds.

			<ul style="list-style-type: none"> • Distilled water, pH. 	
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SEMESTER: TWO

PERIOD: IV

GRADE: 12

TOPIC 1: CHEMISTRY OF SELECTED NON-METALS AND THEIR COMPOUNDS

SPECIFIC OBJECTIVES:

Upon completion of this topic, students will be able to:

1. Define allotrope and list the allotropes of carbon (mainly diamond, graphite, coal and coke).
2. Discuss the sources, preparations, properties and uses of the two main oxides of carbon (CO_2 and CO).
3. Discuss the preparation, properties, and uses of nitrogen and some of its compounds such as NH_3 & HNO_3 .
4. Discuss the reactions of these compounds and their salts.
5. Describe the occurrence, preparation, properties and uses of oxygen.
6. Describe the properties, reactions and uses of acidic, basic and neutral oxides.
7. Describe the allotropic forms of sulfur and their uses.
8. Discuss the sources, preparations, properties and uses of the following compounds of sulfur: SO_2 , SO_3 , H_2SO_3 and H_2SO_4 .
9. List the halogens and describe the laboratory preparation, physical properties, reactions and uses of chlorine or other halogens and some of their compounds.
10. Discuss the properties and uses of the noble gases.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/ RESOURCES	EVALUATION
Knowledge of the properties and uses of non-metals.	<p>1. Carbon and its compounds: Allotropes of carbon (including the properties of diamond & graphite), oxides of carbon (CO and CO₂ their sources, preparations, properties & uses).</p> <p>2. Nitrogen: preparation, properties and uses (both laboratory & industrial preparations from liquefied air); Compounds of nitrogen: Ammonia – industrial preparation and uses; Trioxonitrate (V) (Nitric) acid preparation (including the contact process), reactions & uses; Salts of trioxonitrate (V)/nitrates</p> <p>3. Oxygen: Laboratory & industrial methods of preparation, properties and uses; binary compounds of oxygen including acidic oxides, basic oxides, amphoteric oxides and neutral oxides.</p> <p>4. Sulfur: Allotropes and uses; compounds of sulfur – sulfides, trioxosulfate (IV) acid (sulfurous acid – H₂SO₃) and its salts; tetraoxosulfate (VI) acid/sulfuric acid – H₂SO₄</p>	<p>1. Lab sessions: Qualitative analysis of anions.</p> <p>2. Assignments/exercises: Compare and contrast the properties of carbon dioxide and carbon monoxide.</p> <p>3. Lab session: Brown ring test for nitrogen.</p> <p>4. Assignments/exercises: Write short notes on the Haber process and the Contact process in the productions of ammonia and nitric acid, respectively.</p> <p>5. Lab session: Displacement reactions of halogens.</p> <p>6. Assignments/exercises: Write reactions to describe the acidic, basic and amphoteric oxides.</p> <p>7. Assignments/exercises: Compare the properties of sulfur dioxide and sulfur trioxide, and sulfuric acid and sulfurous acid.</p> <p>8. Assignments/exercises: Make a list of common halogen compounds and describe how each is used.</p> <p>9. Assignments/exercises: Explain why certain noble gases may react under certain conditions.</p>	<p>A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p>B. Secondary Texts</p> <ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <p>C. Other Resources/Supplementary Readings</p> <ul style="list-style-type: none"> • Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) • Solutions of some anions such as MnO₄⁻, CO₃²⁻, Cr₂O₇²⁻, Cl⁻, I⁻, etc., nitric, hydrochloric and acetic acid solutions, ammonia solution, distilled water. • Crystals of FeSO₄, distilled water, NaNO₃, conc. H₂SO₄, test tubes, etc. • NaI, NaBr, NaCl crystals, distilled water, beakers, flasks, etc. • Chart of the Periodic Table, etc. 	<p>Essential tasks students should be able to do:</p> <ol style="list-style-type: none"> 1. Define allotrope and list the allotropes of carbon (mainly diamond, graphite, coal and coke). 2. Discuss the sources, preparations, properties and uses of the two main oxides of carbon (CO₂ and CO). 3. Discuss the preparation, properties, and uses of nitrogen and some of its compounds such as NH₃ & HNO₃. 4. Discuss the reactions of these compounds and their salts. 5. Describe the occurrence, preparation, properties and uses of oxygen. 6. Describe the properties, reactions and uses of acidic, basic and neutral oxides. 7. Describe the allotropic forms of sulfur and their uses. 8. Discuss the sources, preparations, properties and uses of the following compounds of sulfur: SO₂, SO₃, H₂SO₃ and H₂SO₄.

	<p>(industrial preparation, reactions and uses).</p> <p>5. Halogens: Chlorine-Laboratory preparation, properties and reactions, uses of halogen compounds such as silver halide for photography and sodium oxochlorate (I)/sodium hypochlorite, NaOCl as bleaching agent.</p> <p>6. The Noble Gases: Properties and Uses.</p>			<p>9. List the halogens and describe the laboratory preparation, physical properties, reactions and uses of chlorine or other halogens and some of their compounds.</p> <p>10. Discuss the properties and uses of the noble gases.</p>
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SEMESTER: TWO

PERIOD: V

GRADE: 12

TOPIC 1: REVIEW OF SOME FUNDAMENTAL TOPICS PREVIOUSLY TREATED (GRADES 10-12)

SPECIFIC OBJECTIVES:

Upon completion of this revision exercise, students will be able to:

1. Successfully attempt the WASSCE Chemistry examination.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/RESOURCES	EVALUATION
Demonstrated ability to correctly answer questions set in the WASSCE Chemistry examination.	<ol style="list-style-type: none"> 1. Units of Measurement. 2. The History and Importance of Chemistry. 3. Matter and its Properties. 4. The Atomic Structure. 5. The Periodic Table/Chemistry. 6. Chemical Bonding. 7. Chemical Reactions/Equations and 	<ol style="list-style-type: none"> 1. Assignments/exercises: Related to the topics being treated /reviewed. 	<p>A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011)</p> <p>B. Secondary Texts</p> <ul style="list-style-type: none"> • Edexcel IGCSE Chemistry (Pearson, 2010) 	<p>Grading of assignments Regular quizzes and tests</p> <p>MOCK EXAMINATION I</p>

	Stoichiometry. 8. Oxidation-Reduction Reactions. 9. States of Matter. 10. Kinetic Molecular Model. 11. Gases – Gas Laws, Air. 12. Liquids – Water. 13. Solids. 14. Solutions – Solution Concentration Units and Solution Stoichiometry. 15. Acids, Bases and Salts - Acid-Base (Volumetric) Titrations. 16. Solubility of Substances. 17. Energetics . 18. Nuclear Chemistry. 19. Chemical Equilibrium. 20. Reaction Rates. 21. Electrochemistry.		<ul style="list-style-type: none"> <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) C. Other Resources/Supplementary Readings Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) <ul style="list-style-type: none"> Same as before 	
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SEMESTER: TWO

PERIOD: VI

GRADE: 12

TOPIC 1: REVIEW OF SOME FUNDAMENTAL TOPICS PREVIOUSLY TREATED (GRADES 10-12) – Cont’d.

SPECIFIC OBJECTIVES:

Upon completion of this revision exercise, students will be able to:

2. Successfully attempt the WASSCE Chemistry examination.

OUTCOMES	CONTENTS	LABORATORY/ACTIVITIES	MATERIALS/RESOURCES	EVALUATION
Demonstrated ability to correctly answer questions set in the WASSCE Chemistry examination.	1. Introduction to Organic Chemistry: <ol style="list-style-type: none"> General Characteristics of Organic Compounds; Classification of Organic Compounds; 	Assignments/exercises: Related to the topics being treated/reviewed.	A. Primary Text Michael C. Cox & John Sadler, <i>Senior Secondary Guide for Liberia – Chemistry</i> (Star Books/Pearson, 2011) B. Secondary Texts	Grading of assignments Regular quizzes and tests MOCK EXAMINATION II

	c) Homologous Series and Functional Groups; d) Hydrocarbons; e) Hydrocarbon Derivatives; f) Natural and Synthetic Organic Compounds. 2. Chemistry, Industry and the Environment 3. Chemistry of Selected Metals and their Compounds 4. Chemistry of Selected Nonmetals and their Compounds.		<ul style="list-style-type: none"> • <i>Edexcel IGCSE Chemistry</i> (Pearson, 2010) • <i>Edexcel Mastering Chemistry</i> (Pearson, 2010) <u>C. Other Resources/Supplementary Readings</u> Kobina Adu Lartson, <i>Practical Chemistry for SSS</i> (Sedco/Pearson, 1999) <ul style="list-style-type: none"> • Same as before 	
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