ZIMBABWE

MINISTRY OF PRIMARY AND SECONDARY EDUCATION

O-LEVEL CHEMISTRY SYLLABUS

FORMS 3 - 4

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1.0 PREAMBLE

1.1 Introduction

The forms 3 - 4 Chemistry syllabus document is designed to put greater emphasis on the heritage based technological concepts acquired through a hands-on learner centred approach. The syllabus is hinged on the rich cultural heritage of our community and focuses to stimulate interest, imagination and critical thinking. Traditional scientific knowledge and modern innovations are used to connect scientific concepts to everyday lives and global challenges through hands on activities. By integrating chemistry syllabus with cultural relevant, learners are empowered to investigate, innovate, solve problems and become informed, responsible citizens who appreciate our heritage and promote sustainable development. The learners will be assessed through a continuous assessment system in the form of project-based assessments, hands on experiences and demonstrations.

1.2 Rationale

The Heritage-Based Chemistry syllabus provides an integration of traditional knowledge and contemporary technologies learners will develop essential critical thinking, problem solving and

collaborations skills through hands on enquiry-based learning to apply scientific principles to real world challenges and impact the society positively. The syllabus fosters responsible stewardship of natural resources and cultural heritage.

1.3 Summary of Content

The Chemistry syllabus emphasizes integrating heritage-based knowledge into secondary education and supports diversity. The syllabus covers various topics aimed at fostering a deep connection with cultural roots while promoting scientific curiosity and technological skills. Continuous assessment is based on school projects to evaluate the understanding of both the scientific and cultural aspects of the learning area. Forms 3 - 4 Chemistry syllabus will cover theory and practical activities in the following areas, Physical chemistry, Inorganic chemistry, Organic chemistry and Environmental chemistry.

1.4 Assumptions

The Heritage-Based Chemistry syllabus for Zimbabwe has taken deliberate consideration of several assumptions critical for socio-economic transformation. The assumptions are based on the context of Zimbabwe's heritage, educational system, societal needs and aspirations. It therefore becomes critical to consider that learners:

- are exposed to scientific experiences
- live in diverse social contexts
- use technological devices
- are conscious of their environment
- are aware of their obligation towards health and well-being

The general assumption is that a Heritage-Based Chemistry syllabus can effectively integrate science and technology education, fostering a deeper understanding of scientific concepts, technological innovations and their relationship with Zimbabwe's heritage.

1.5 Cross- Cutting Themes

This phase will develop an appreciation of:

- Environmental management
- Enterprise Education
- Gender equality
- Child rights and responsibilities
- Climate change

- Health and wellbeing
- Disaster risk management
- ICT

2.0 PRESENTATION OF THE SYLLABUS

The Ordinary Level Chemistry syllabus is a single document covering Forms 3 - 4. It contains the Preamble, Aims, Syllabus Objectives, Syllabus Topics, Methodology and Time Allocation, Scope and Sequence, Competency Matrix and Assessment. The Scope and Sequence chart shows the progression of topics from Forms 3 - 4, while the syllabus matrix gives details of the content to be covered.

3.0 AIMS

The aims are to:

3.1 create opportunities for learners to acquire research, experimental and practical skills and attitudes in Chemistry

3.2 enable learners to acquire basic principles of Chemistry for application in life and as a basis for further studies in Chemistry and related discipline

3.3 inculcate in learners the desire to apply Chemistry for the benefit of society as guided by the principles of Unhu/Ubuntu and recognising the detrimental effects of misapplication of Chemistry

3.4 inculcate in learners the appreciation of the usefulness of ICT in the study and application of Chemistry

3.5 develop, in learners the appreciation of the use of Chemistry in value creation, addition and beneficiation in mining and other industries.

3.6 inculcate in learners the regard for safety and protection of the environment in the study of Chemistry.

3.7 introduce learners to the principles of science and technology, through a heritage-based approach.

3.8 incorporate indigenous knowledge, cultural practices, historical perspectives and national endowments into science and technology education.

3.9 foster an understanding of the learning area matter and promoting cultural appreciation in its diverse nature.

4.0 OBJECTIVES OF THE SYLLABUS

Learners should be able to:

4.1 demonstrate knowledge of facts, laws, definitions and concepts in Chemistry

4.2 follow instructions in practical work in order to manipulate record observations and analyse data to confirm or establish relationships

4.3 apply safety measures in all practical work

4.4 demonstrate knowledge about physical phenomena, facts, laws, definitions and concepts of Chemistry
4.5 design a practical solution through a Chemistry project to solve a real-life problem.
4.6 use ICT to simulate Chemistry phenomena, present and analyse data
4.7 apply safety measures in all practical work
4.8 explore the connections among heritage, science and technology
4.9 explain and apply procedures in Chemistry to protect the environment
4.10 use ICT to simulate Chemistry phenomena
4.11 present, analyse and interpret data to establish relationships

5.0 METHODOLOGY AND TIME ALLOCATION

5.1 METHODOLOGY

It is envisaged that teaching and learning programmes based on this Heritage based Chemistry syllabus could feature a wide variety of learning experiences designed to promote acquisition of scientific expertise and understanding, and to develop values and attitudes relevant to science and life. Teachers are encouraged to use a combination of appropriate strategies to effectively and equitably engage and challenge their learners through:

- Planned experiments
- Problem based learning
- Individual and group work
- Educational tours
- Project based learning
- Design based learning
- Learning by discovery
- E-learning such as simulation
- Collaboration with museums and heritage sites.

N.B. Ortho-didactic principles, such as visual tactile, simulation and self-activity, will be applied when need arises to cater for diverse needs of learners.

Safety precautions must always be observed.

5.2 TIME ALLOCATION

A minimum of **8** periods of 40 minutes each in a week should be allocated as double periods for adequate coverage of the syllabus

6.0 SUBJECT TOPICS

- Physical Chemistry:
- Inorganic Chemistry:
- Organic Chemistry:
- Environmental Chemistry

7.0 SCOPE AND SEQUENCE

TOPIC	FORM 3	FORM 4
PHYSICAL CHEMISTRY:		
Laboratory techniques	• Measuring Instruments • Separation techniques - Filtration, - Distillation - Crystallisation	• Volumetric Analysis • Separation Techniques - Fractional distillation - Chromatography • Qualitative analysis
Matter	• Matter	• Heating and cooling curves
Atoms, Elements and Compounds	• Atomic structure • Elements • Compounds • Metallic Bonding	
The Mole concept	• Mole Concept	• Percentage Composition • Molar gas volume
Stoichiometry	• Chemical equations	• Percentage yield and purity
Acids, Bases and Salts	• Properties of Acids and Bases • Preparation of salts	
Electrochemistry	• Redox reactions • Cells and batteries • Electrolysis of water	• Redox equations • Electrolytic purification of copper
Chemical energetics	• Endothermic and Exothermic reactions • Energy profile diagrams	• Enthalpy changes - Neutralisation - Combustion - Solution
Equilibrium	• Reversible reactions • Dynamic equilibrium • Haber process • Contact process	• Production of fertilisers

	• Ostwald process	
Reaction kinetics	• Rates of reactions • Factors affecting rate of reactions	• Industrial applications
INORGANIC CHEMISTRY		
Periodic table	• Periodic trends • Group trends	• Transition elements - Properties and uses
Metals and Non - Metals	• Properties of metals and non-metals • Reactivity series	• Composition of mineral ores • Extraction of metals
Non metals	• Lime in agriculture and construction	• Processing of diamond and coal • Liquefaction and distillation of air
ORGANIC CHEMISTRY:		
Fuels	• Types of fuels • Production of fuels	• Fuel efficiency
Classification and nomenclature of organic Compounds	• Homologous series - Hydro carbons - Alcohols - Carboxylic acids	• Isomerism
Hydrocarbons		• Alkanes and Alkenes
Alcohols		• Fermentation • Properties of ethanol
Carboxylic Acids		• Carboxylic acids
Polymers		• Synthetic polymers • Natural Polymers
ENVIRONMENTAL CHEMISTRY		

Waste management	• Classification of waste • Effects of waste on the environment	• Waste disposal methods
Pollution		• Sources of pollutants
Water purification	• Composition of water from different sources	• Water purification
Herbs		• Herbs

8.0 COMPETENCY MATRIX

FORM 3

8.1 LABORATORY TECHNIQUES

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Measuring Instruments	• Identify suitable apparatus used in measurement of - Time - Temperature - mass - volume - distance • use measuring apparatus correctly .	• Apparatus for measuring: - Thermometer - balance, - Burettes, - pipettes, - measuring cylinders - gas syringes - stop watch • Measurement of - Time - Temperature - mass - volume	•Naming apparatus used in measurement of time, temperature, mass, volume, distance • Taking measurements of temperature, mass, volume, distance, time	• Stop watches • thermometer • Balance • burettes • Pipettes • syringes • measuring cylinders
Separation techniques	• identify different methods of separating mixtures • Suggest suitable separation techniques,	- Methods of separation such as: Filtration, Simple distillation and Crystallization and evaporation	• Discussing on methods of separating mixtures • Experimenting on separating mixtures	• Filter papers • Cheese cloth • Funnels • Sand filters • Distillation apparatus

	given the nature of the mixture.		• Making sand filters	• Evaporating dishes • Beakers • Sodium chloride • Burner

8.2 MATTER

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Matter	• State the three states of matter • Explain the states of matter using the kinetic theory. • Explain the changes between the states of matter in terms of energy and arrangement of particles • Describe and explain diffusion	• States of matter • Kinetic theory • Change of states of matter • Diffusion of matter	• Discussing states of matter • experimenting on the changes of state of matter • Drawing and describing arrangement of particles in solids, liquids and gases • Demonstrating diffusion using perfume, ammonia and Hydrochloric acid, potassium permanganate	• Ice • Candle wax • Iodine • Heating source • Gas jars • Potassium permangana te

			• **NB: use of Bromine is not recommended since it is poisonous**	

8.3 ATOMS, ELEMENTS AND COMPOUNDS

TOPIC	**OBJECTIVES** **Learners should be able to:**	**CONTENT** (knowledge, skills, values, and attitudes)	**SUGGESTED NOTES AND ACTIVITIES**	**SUGGESTED RESOURCES**
Atomic Structure	• Describe the sub- atomic particles of an atom	• Atomic Structure - Protons - Electrons - Neutrons	• Drawing diagrams to illustrate structure of atoms	• Atomic models
Elements	• Represent elements using chemical symbols • Use and interpret nuclide notation • deduce the electronic configuration of an element from given data • Explain the concept of an isotope	• Elements • Atomic Number • Mass Number • Nuclide notation • Electronic configuration of the first 20 elements • Isotopes	• representing elements using chemical symbols and nuclide notation • calculating number of protons, electrons and neutrons from mass numbers and atomic numbers • drawing electronic structures of elements using dots and crosses	• periodic tables • models of elements • text books • ICT tools • Moulding clay/ plasticine

Compounds	• describe the formation of an ionic bonds between a metal and a non-metal • describe the formation of a covalent bond • deduce chemical formula of a compound from dots and cross diagram • Differentiate ionic from covalent compounds.	• Valence Theory • Ionic bonding • covalent bond • Properties of ionic and covalent compounds	• Drawing dot and cross diagrams to show ionic and covalent bonding in the following: NaC*l*, MgO, Al_2O_3, H_2; Cl_2; O_2; HC*l*; N_2;H_2O; CH_4, CO_2, NH_3, • Constructing models to represent compounds • Experimenting on: - melting points - boiling points - electrical conductivity - solubility	• Text books • Molecular models • Science kits • Sodium chloride • Candle wax • Burner • Circuit boards • Water
Metallic bonding	• describe metallic bonding as a lattice of positive ions in a 'sea of electrons' • relate the physical properties of metals to metallic bonding	• metallic bonding • ***refer to Properties of Metals***	• discussing metallic bonding • simulating • drawing metallic bond model	• ICT tools • textbooks

8.4 THE MOLE CONCEPT

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES

Mole Concept	• describe the mole concept	• Mole • Relative atomic mass • Relative molecular mass • Concentration of solutions • molar mass	• Calculating: - moles from mass - mass from moles - relative molecular masses - concentrations	• periodic table • Balance • Science kit

8.5 STOICHIOMETRY

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED NOTES AND ACTIVITIES	SUGGESTED RESOURCES
Chemical Equations	• Write balanced chemical equations • Calculate quantities of products given the quantities of reactants and vice versa • Determine limiting reactant from given data	• Balancing chemical equations • Masses and volumes of reactants and products • Limiting reagents	• Writing balanced chemical equations • Experimenting with neutralisation, precipitation and decomposition reactions • Calculating quantities from given data	• Science kits • Text book • Acids • Bases

8.6 ACIDS, BASES AND SALTS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES

Properties of Acids and Bases	• Identify properties of acids and bases • classify oxides as acidic, basic or amphoteric	• Acids, bases, pH scale, acid-base indicators • Calcium oxide, sodium oxide, aluminium oxide, sulphur trioxide, carbon dioxide, nitrogen dioxide,	• Experimenting to identify acidic and basic substances • Describing properties of acids and bases	• Science kit • ICT tools • acid-base indicators • vinegar • lemons • toothpaste • ash • household detergents
Preparation of salts	• describe the methods of preparing salts	• methods of preparing salts - neutralisation - displacement - precipitation	• preparing salts by reacting acids with alkalis, carbonates, metals, metal oxides • preparing salts by precipitation and displacement reactions	• Science kits • ICT tools • textbooks

8.7 ELECTROCHEMISTRY

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Redox reactions	• Define oxidation and reduction in terms of	• Redox reactions	• Discussing redox reactions	• Test tubes • Droppers

	electron transfer and changes in oxidation number • Identify oxidising and reducing agents		• Observing redox reactions • Describing redox reactions	• Potassium permanganate • Potassium dichromate • Hydrogen peroxide • Ethanol • Iron (II) sulphate • Potassium iodide • Sulphuric acid
Cells and batteries	• identify the composition of a simple cell • Describe the electrode reactions in a simple cell • Describe the composition and maintenance of a lead acid batteries	• Cells • Batteries - Electrolyte - Electrodes	• Describing the composition of a simple cell • Constructing of Zinc/Copper cell • Examining a car battery	• Ammeter/ voltmeter • Zinc rod • Carbon rod • Copper rod • Lemon / dilute acid • Torch bulb • Car battery
Electrolysis of water	• Describe the electrolysis of acidified water • Identify the products of electrolysis of water and their uses	• Electrolysis of acidified water • Uses of hydrogen and oxygen • Formula for water	• Constructing electrolytic cell • Discussing electrode reactions • Testing for hydrogen and oxygen gases • Calculating ratio of volumes	• Power supply (DC) • Test tubes • Beaker • Graphite electrodes • Wooden splints

	• Deduce the formula of water from the ratio of volumes of products			

8.8 CHEMICAL ENERGETICS

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Endothermic and Exothermic reactions	• describe endothermic and exothermic reactions in terms of bond forming and bond breaking • differentiate between endothermic and exothermic reactions	• Endothermic and exothermic reactions	• Burning of fuels e.g. ethanol, sugar, saw dust, mealie-meal • dissolving washing powders in water • Reacting acids and bases • Dissolving ammonium nitrate/fertiliser, sodium hydroxide, potassium iodide, copper (II) sulphate plus zinc powder in water **N.B. sodium hydroxide is corrosive**	• Washing powder • Sodium hydroxide • Ammonium nitrate • Potassium iodide • Plastic beakers/cups • Copper (II) sulphate plus Zinc powder • Thermometers • Spatula • Ethanol • Sugar • Saw dust • Mealie-meal
Energy profile diagrams	• draw energy profile diagrams to represent endothermic and exothermic reactions • interpret energy profile diagrams	• Energy profile diagrams	• Drawing energy profile diagrams • Analysing energy profile diagrams	• Images of energy profile diagrams

8.9 EQUILIBRIUM

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Reversible reactions	• explain the term reversible reaction • use the reversible sign in equations (⇌) • analyse reversible reactions • predict the effect of change of conditions of a reversible reactions at equilibrium	• Reversible reactions	• Dipping litmus in acid and in base • Experimenting on the chromate/ dichromate conversion using dilute acids and bases	• Burner • Copper (II) sulphate • Litmus paper • Chromate
Dynamic equilibrium	• explain the term dynamic equilibrium	• dynamic equilibrium	• Experimenting on the sublimation of iodine in a sealed tube	• Iodine • Sealed tube • Water bath
Haber process	• describe the production of raw materials for the Haber process (nitrogen and hydrogen) • explain the conditions for the Haber process • state the uses of ammonia • observe safety during site visits • describe environmental impacts of ammonia production	• Haber process (refer to electrolysis of water and liquefaction and fractional distillation of air) • Uses of ammonia • Safety • Impacts of ammonia production on the environment	• Discussing the production of ammonia • Visiting sites e.g. Sable Chemicals • Making models of the plant • Discussing the uses of ammonia • Discussing possible hazards of ammonia production • Discussing environmental impacts of ammonia production	• Flow charts • Models • Protective clothing • Chart with danger warning signs • Ammonium nitrate fertiliser • Household detergents

Contact process	• identify sources of raw materials for the contact process • explain the conditions for the contact process • describe the contact process • state the uses of sulphuric acid • describe environmental impacts of sulphuric acid production	• Sources of raw materials (refer to production of copper, iron and coal) • Contact process • Uses of sulphuric acid • Impacts of sulphuric acid production on the environment	• Discussing the production of sulphuric acid • Visiting sites e.g Zimphos • Making models of the plant • Discussing the uses of sulphuric acid • Discussing possible hazards of sulphuric acid production • Discussing environmental impacts of sulphuric acid production	• Flow charts • Models • Protective clothing • Chart with danger warning signs • Ammonium sulphate fertiliser • Household detergents
Ostwald process	• identify sources of raw materials for the Ostwald process • explain the conditions for the Ostwald process • describe the Ostwald process • state the uses of nitric acid • describe environmental impacts of nitric acid production	• Sources of raw materials (refer to Haber process) • Ostwald process • Uses of nitric acid • Impacts of nitric acid production on the environment	• Discussing the production of nitric acid • Visiting sites e.g Sable Chemicals • Making models of the plant • Discussing the uses of nitric acid • Discussing possible hazards of nitric acid production • Discussing environmental impacts of nitric acid production	• Flow charts • Models • Protective clothing • Charts with danger warning signs • Ammonium nitrate fertiliser • Pictures of explosives • Resource person

8.10 REACTION KINETICS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Rates of reactions	• describe methods of measuring reaction rates • deduce from graphs the rates of reactions • calculate reaction rates from given information	• Rates of reactions such as changes in volume, mass, colour with time	• Measuring rates of reactions e.g. using magnesium and hydrochloric acid, sodium thiosulphate and hydrochloric acid/ sulphuric acid	• Balance • Stop watch • Beaker • Conical flask • Magnesium • Hydrochloric acid • Gas syringe • Sodium thiosulphate • Sulphuric acid
Factors affecting rate of reactions	• describe factors affecting rates of reaction	• Factors affecting rates of reactions - Temperature - Concentration - Surface area - Catalysts - Pressure - Stirring	• Experimenting on factors affecting rates of reaction	• Sodium thiosulphate • Hydrogen peroxide • Potassium iodide • Hydrochloric acid • Manganese dioxide/ potato/ liver

INORGANIC CHEMISTRY

8.11 PERIODIC TABLE

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Periodic trends	• describe the changes from metallic to non-metallic character across a period • explain the relationship between number of electron shells and the period	• Periodic trends (refer to electronic configuration)	• Analysing the periodic table • Making a model of the periodic table	• Periodic tables
Group trends	• describe the relationship between group number and number of valence electrons • describe the reactions of magnesium, calcium and barium with oxygen and water • describe the trend in the physical properties of group (VII) elements	• Group trends (refer to electronic configuration) • Reactivity of group (II) elements • Trends in physical properties of group (VII) elements - Colour - Physical state - Volatility	• Analysing the periodic table • Experimenting on reaction of calcium and magnesium ribbon with cold water • Simulating the reactions of group (II) elements • Simulating the reactions of group (II) elements **NB: Experiments involving pure fluorine and bromine should be avoided for safety reasons**	• Periodic tables • Magnesium ribbon • Calcium granules • Test tubes • Spatula • ICT tools • Text books

8.12 METALS AND NON- METALS

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Properties of metals and non-metals	• Compare the physical properties of metals and non-metals • Explain the differences in the physical properties of metals and non-metals	• Physical properties - Malleability - Ductility - Conductivity (thermal and electrical) - Melting and boiling points - Density - Lustre	• Collecting and classifying materials as metals or non-metals • Comparing the physical properties of metals and non-metals	• Samples of metals and non-metals
Reactivity series	• demonstrate practically the reactivity of metals • arrange elements in order of reactivity • use the reactivity series to explain electroplating, electrolytic cells and metal extraction	• Reactivity series • Displacement reactions (refer to electrochemistry and metal extraction)	• Listing of elements in order of reactivity • Experimenting on reactions of metals with water and dilute acids • Reacting zinc and copper (II) sulphate solution • Comparing the voltages of different combinations of elements in a simple cell **NB: potassium, sodium and calcium should be used in very small quantities and never to be used with acids.**	• Dilute acids • Distilled water • Splinters • Copper • Calcium • Iron • Magnesium • Potassium • Silver • Sodium • Zinc • Copper (II) sulphate • Test tubes • Voltmeter • Connecting wires

8.13 NON-METALS

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Lime in agriculture and construction	• describe the production of calcium oxide (lime) from calcium carbonate (limestone) • explain the use of calcium oxide in agriculture and construction	• Lime in Agriculture and construction	• Demonstrating Lime as a base • Reacting lime with dilute acids	• Calcium oxide • Dilute acids • Calcium carbonate

ORGANIC CHEMISTRY

8.14 FUELS

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Types of fuels	• classify fuels according to their physical states	• Classification of fuels - Solid fuel - Liquid fuels - Gaseous fuels	• Discussing the Classification of fuels	• Wood • Charcoal • Ethanol • Diesel • Petrol • Biogas • Coal • Coke • Biodiesel

Production of fuels	• Describe the process of fermentation • Outline the fractional distillation of crude oil • Describe the process of destructive distillation of coal and wood • Describe the production of biodiesel from Jatropha oil	• Fermentation • Fractional distillation of petroleum • Destructive distillation of coal and wood • Biodiesel production	• Experimenting on production of fuels by: - fermentation of carbohydrates - destructive distillation of coal/ wood • Visiting sites e.g. Green Fuels, Mutoko Jatropha plant	• Glucose • Yeast • Burners • Distillation apparatus • Models of biogas Digester • Science kit

8.15 CLASSIFICATION AND NOMENCLATURE OF ORGANIC COMPOUNDS

TOPIC	**OBJECTIVES** **Learners should be able to:**	**CONTENT** (knowledge, skills, values, and attitudes)	**SUGGESTED ACTIVITIES AND NOTES**	**SUGGESTED RESOURCES**
Homologous series	• Define the term homologous series • Classify organic compounds as hydrocarbons, alcohols and carboxylic acids up to six carbon atoms	• Homologous series - Hydrocarbons - Alcohols - Carboxylic acid	• Making molecular models up to six carbon atoms • Drawing structures of organic molecules up to six carbon atoms • Simulations of organic molecules	• Plasticine • Molecular model kits • Models of organic molecules

ENVIRONMENTAL CHEMISTRY

8.16 WASTE MANAGEMENT

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Classification of waste	• Classify waste into solids, liquids and gases • Identify biodegradable and non-biodegradable waste • Identify the different sources of waste • Suggest ways of controlling waste • Describe methods of identifying wastes from industries	• Classification of waste • Household and industrial waste such as: - Food left overs - Waste gases - gold processing - oils from soap making - tyre industries - dust from cement industry • Methods of controlling wastes	• Collecting and classifying waste material • Discussing sources of waste material • Visiting sites • Burning of papers and an explanation on observable changes •	• Refuse from shops and residential areas • Industrial wastes • Environmental policies and Acts • Pictures and films • Resource person
Effect of waste on the environment	• describe the effects of waste on the environment	• Eutrophication • Acid rain • Global warming • Health effects • Ozone layer depletion	• Visiting sites • Researching and discussing the effects • Case studies	• Magazine articles • Resource persons • ICT tools • Text books

8.17 WATER PURIFICATION

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Composition of water from different sources	• describe the composition of water from different sources • distinguish between hard and soft water • describe the effects of hard water	• Composition of water from different sources such as dam, borehole, river and rain • hard and soft water • effects of hard water on: boilers, electric jug, geysers, water pipes, solubility of soap	• Colleting water samples from different sources and analysing the following: colour, smell and pH • testing for hardness of water using foam, boiling water and analysing the residue • desalting using an acid /vinegar, lemon juice	• Water samples • pH meter • burners • matches • science kit • acid • heating elements • soap

FORM 4

COMPETENCY MATRIX

8.1.1 LABORATORY TECHNIQUES

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURSES
Volumetric Analysis	• carry out a titration •	• Volumetric Analysis •	• Assembling titration apparatus • Carrying out experiments on acid – base titrations	• Science kit •
Separation techniques	• describe the principles of fractional and steam distillation • describe the concept of paper chromatography	• Separation Techniques -Fractional distillation - Steam distillation • Chromatography • R_f values	• Separating ethanol from water • Carrying out steam distillation to produce perfumes and flavours • separating ink/chlorophyll pigments by paper chromatography • Calculating R_f values	• Fractional distillation apparatus • Filter paper • ethanol

Qualitative analysis	• carry out tests to identify ions • describe tests to identify gases	• Qualitative Analysis (Al^{3+}, NH_4^+, Mg^{2+}, Pb^{2+}, Cu^{2+}, Fe^{2+}, Fe^{3+}, Cr^{3+}, Zn^{2+}, Cl^-, I^-, NO_3^-, SO_4^{2-}, CO_3^{2-} • Tests for gases such as: ammonia; carbon dioxide; chlorine; hydrogen; oxygen and sulphur dioxide	• Carrying out experiments to identify cations and anions (refer to qualitative analysis table) • Testing for: - oxygen - Hydrogen - Carbon dioxide - Ammonia - Sulphur dioxide	• Sodium hydroxide • Ammonia solution • Silver nitrate • Nitric acid • Barium chloride • Aluminium powder • Delivery tube • Oranges, lemon, herbs, flowers • Limewater/bicarbonate indicator • Litmus paper • splints

7.1.2 MATTER

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURSES
Heating and cooling curves	• interpret heating and cooling curves • describe the effects of impurities on boiling and melting point	• Heating and cooling curves • Melting and boiling points • Effects of impurities on melting and boiling points	• Experimenting on heating and cooling of ice, stearic acid, wax and naphthalene. • Drawing heating and cooling curves • Interpreting heating and cooling curves	• Science kit • Heating source • Thermometers • Boiling tubes • Salt • ice, • stearic acid, • wax • naphthalene.

7.1.3 THE MOLE CONCEPT

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURSES
Percentage composition	• calculate percentage compositions of elements in compounds and ores	• Percentage composition (hematite, copper pyrite, fertilizers, bauxite, platinum group of metals (PGMs) • empirical and molecular formula	• Calculating percentage compositions of given elements in given compounds and ores. • Calculating Empirical formula and molecular formula.	• Balances • Text books • Science kit • Ore samples • Resource people
Molar gas volume	• explain the concept of molar gas volume • use the molar gas volume concept in calculations.	• Molar gas volume	• collecting and measuring gases produced from chemical reactions • Calculating volumes of gases N.B **Use 24dm^3/mole as molar gas volume at rtp**	• Science kit

7.1.4 STOICHIOMETRY

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURSES
Percentage yield and purity	• Calculate percentage purity and yield • Explain the difference between actual and theoretical yield.	• Percentage yield - actual yield, theoretical yield • Percentage purity	• Experimenting on determining percentage yield and purity - Thermal decomposition of calcium wood carbonate - destructive distillation of, coal, sawdust • Calculating percentage yields and purity	• Science kit • Calcium carbonate • Periodic table • Balance • wood • Coal • sawdust

7.1.6 ELECTROCHEMISTRY

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Redox equations	• Construct balanced redox equations	• redox equations e.g displacement reactions	• Deducing electrode reactions • Balancing redox equations Visiting sites e.g Sable Chemicals, , Chloride batteries	• ICT tools
Electrolytic purification of copper	• Describe the electrolytic cell on production of copper	• Electrolytic purification of copper	• Assembling the electrolytic cell • Analysing electroplating	• Beakers • Cell/ batteries • Connecting wires

		• uses of copper and by-products of the electrolytic process	• Discussing the uses of copper and by-products • Visiting sites e.g Empress mine,	• Copper electrode • Graphite electrodes • Copper (II) sulphate • Resource persons • ICT tools

7.1.7 CHEMIICAL ENERGETICS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Enthalpy changes	• describe the concept of enthalpy change • determine experimentally enthalpy change • calculate enthalpy changes using the relationship, q = mc ΔT	• Enthalpy changes - combustion - neutralisation - solution	• Carrying out experiments to determine enthalpy changes of combustion, neutralisation and solution • Calculating enthalpy changes	• Thermometers • Ethanol • burner • Stirrer • Styrofoam/ plastic cups • Sodium hydroxide • Hydrochloric acid • Ammonium nitrate • potassium iodide

7.1.8 EQUILIBRIUM

TOPIC	OBJECTIVES	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES

	Learners should be able to:			
Production of fertilisers	• Describe the manufacture of ammonium nitrate and ammonium sulphate fertilisers	• Production of fertilisers - ammonium nitrate - ammonium sulphate	• experimenting on production of fertilisers by neutralising ammonia with nitric acid/ sulphuric acid followed by crystalisation • visiting sites e.g Sable chemicals, ZimPhos	• science kit • resource persons • text book • titration apparatus • ammonia • nitric acid • sulphuric acid

7.1.9 REACTION KINETICS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Industrial applications	• Link reaction conditions to production costs for the Haber, and contact process • Analyse the cost of production in relation to the cost of product • Justify the conditions for Haber and contact processes	• Industrial Applications • Effects of conditions on yields and costs • Alternative sources of raw materials	• Analysing reaction conditions against productivity • Visiting sites • Analysing graphs showing relationships between conditions and yield	• Resource person • ICT tools • Graphs

INORGANIC CHEMISTRY

7.1.10 PERIODIC TABLE

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Transition elements	• Describe the properties of transition elements • explain the industrial and biological significance of transition elements	• Transition elements (copper, iron, manganese, cobalt, chromium, nickel, vanadium) • Physical properties • Industrial and biological significance of transition elements (catalysis, haemoglobin and alloys)	• Discussing properties of transition elements • Experimenting to investigate the colours and catalytic properties of transition elements iron II, iron (III), Cu^{2+}, MnO_4^-, Cr^{3+},$Cr_2O_7^{2}$, CrO_4^{2-} • visiting site	• Periodic table • Salts • metals • Science kit • Resource person • iron II, iron (III), Cu^{2+},MnO_4^-,Cr^{3+},$Cr_2O_7^{2}$, CrO_4^{2-}

7.1.11 METALS AND NON - METALS

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES

Composition of Mineral ores	• Describe the composition of mineral ores	• Composition of mineral ores of - Iron - Copper - Platinum - Lithium - Nickel - Gold	• visiting sites e.g Zimbabwe School of Mines, Bikita minerals, Platinum mines, Arcturus mine • analysing composition of samples of mineral ores	• Sample of mineral ores • ICT tools • Resource person
Extraction of metals	• Describe the methods of processing minerals • Explain the uses of metals and alloys in respect to their properties	• Methods of processing minerals - Blast furnace - Purification of copper, nickel, platinum, gold • Value addition and beneficiation • Uses of metals and alloys	• Discussing the methods of extracting minerals • discussing importance of value addition and beneficiation on mineral resources • visiting sites e.g Zimbabwe School of Mines, Bikita minerals, Platinum mines, Arcturus mine • discussing the formation of alloys of copper, iron, aluminium • discussing uses of metals and alloys	• Sample of mineral ores • ICT tools • Resource person

7.1.12 NON METALS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES

Processing of diamond and coal	• Describe the processing of diamond and coal	• Processing of diamond and coal • Destructive distillation of coal • Coal gasification • Value addition and beneficiation	• discussing importance of value addition and beneficiation on mineral resources • Visiting sites - Hwange - Zimchem	• ICT tools • Coal • Resource person
Liquefaction and fractional distillation of air	• Describe the liquefaction and fractional distillation of air • Identify the uses of Oxygen, Nitrogen, Carbon dioxide and noble gases	• Composition of air • liquefaction and fractional distillation of air • uses of Oxygen, Nitrogen, Carbon dioxide and noble gases	• discussing the composition, liquefaction and fractional distillation of air • visiting sites e.g Sable chemicals, BOC gases • simulating using ICT tools •	• Flow charts • ICT tools • Resource person

ORGANIC CHEMISTRY

7.1.13 FUELS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Fuel efficiency	• Determine, experimentally, the heating values of fuels • Explain why some fuels are more efficient than others	• Types of fuels • Fuel efficiency	• Experimenting with fuels to determine their heating values • Discussing the reasons why the fuels have different efficiency	• Fuels • Thermometer • Beaker • Burners • Science kit

7.1.14 CLASSIFICATION AND NOMENCLATURE OF ORGANIC COMPOUNDS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Isomerism	• describe the term isomerism • identify structural isomers of alkanes • draw the structures of the isomers	• structures of isomers of alkanes up to 6 carbon atoms	• discussing on isomerism • making models of isomers of alkanes • simulating isomerism	• models • ICT tools • Text books

7.1.15 HYDROCARBONS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES

Alkanes and Alkenes	• Describe the manufacture of alkanes and alkenes • Distinguish between alkanes and alkenes • Describe the chemical properties of alkanes as exemplified by methane • Describe the chemical properties of alkenes as exemplified by ethene	• Cracking of long chain alkanes • Combustion of alkanes and alkenes • Reaction with chlorine in the presence of UV light and in darkness • Reaction with bromine water • Reaction of ethene with steam and hydrogen	• Making models of alkenes and alkanes • Drawing structures of alkanes and alkenes • Experimenting with cooking oil to demonstrate cracking • Burning hydrocarbons • Discussing the manufacture of margarine	• Hydrocarbon • Burner • Sand • Cooking oil • Bromine water • Boiling tube • Delivery tubes

7.1.16 ALCOHOLS

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Fermentation	• Describe the conditions necessary for the fermentation process • Describe the industrial production of ethanol by fermentation	• Conditions for fermentation • Fermentation - ethanol - mahewu - Indigenous beer brewing	• Discussing conditions necessary for fermentation • investigating the conditions necessary for fermentation • visiting sites e.g breweries, ethanol production plants	• Glucose • Yeast • Sugarcane • Malt, hops, maize, barley, rapoko, sorghum
properties of ethanol	• Describe the properties of ethanol • describe the uses and social effects of ethanol	• Solubility • Boiling point • Combustion • Oxidation to carboxylic acids • Dehydration of ethanol to ethene • Uses of ethanol - Solvents - Fuels (blend petrol) - Perfumes - Alcoholic beverages • Social effects	• Burning of ethanol • Testing for ethanol using potassium dichromate • Dehydrating ethanol using concentrated sulphuric acid • Discussing the uses and social effects of using ethanol	• ethanol • $K_2Cr_2O_7$ • concentrated sulphuric acid • burner • science kit

7.1.17 CARBOXYLIC ACIDS

TOPIC	OBJECTIVES Learners should be able to:	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Carboxylic acids	• describe the formation of ethanoic acid • describe the chemical properties of carboxylic acids • describe the uses of ethanoic acids • describe the process of saponification	• Oxidation of ethanol (refer to alcohols) • Properties of carboxylic acids - Esterification - Reaction with carbonates • Uses of ethanoic acids - Manufacture of perfumes - Food preservation - Flavouring • Soap manufacturing • Structure of soap molecule • Glycerine/glycerol	• Experimenting on chemical properties of ethanoic acid • Discussing the uses of ethanoic acids • Making soap in the laboratory	• Science kit • Ethanoic acid • Ethanol • Sulphuric acid • Sodium carbonate • Perfume samples • Vinegar • Animal fat • Sodium chloride • Sodium hydroxide

7.1.18 POLYMERS

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Synthetic polymers	• Describe the formation of polythene • Draw structures to represent synthetic polymers • Deduce the structure of the monomer from a given polymer and vice-versa • Describe the uses of synthetic polymers	• Addition polymerisation • Structures of: - Polythene - Nylon - Terylene • Uses of synthetic polymers **N.B:** Use block diagrams to represent condensation polymers	• Discussing polymerisation • Identifying and naming linkages in synthetic polymers • Drawing structures to represent monomers and polymers • Discussing on the uses of synthetic polymers • Visiting sites - Saltrama plastics - Treger plastics	• Models and images to represent structures of monomers • ICT tools • Samples of different polymers • Resource persons
Natural Polymers	• Name the type of linkages in each of the polymers • Draw structures to represent natural polymers • Deduce structure of the monomer from a given polymer and vice-versa • Describe the hydrolysis of natural polymers	• Natural polymers - Starch - Proteins • Hydrolysis of natural polymers	• Discussing structures of natural polymers • Drawing structures of natural polymers • Discussing hydrolysis of natural polymers • Experimenting on acid hydrolysis of natural polymers	• Starch • Mineral acid • Albumen • Science kit

ENVIRONMENTAL CHEMISTRY

7.1.19 WASTE MANAGEMENT

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Waste disposal methods	• Identify the waste disposal methods • Describe the advantages and disadvantages of each of the methods of waste disposal • Explain the concepts of re-using and recycling of waste	• Waste disposal methods: incineration, landfills, activated sludge • re-using and recycling of wastes	• Visiting sites e.g bio-digesters, incinerators, landfills • Describing each of the methods of waste disposal	• Incinerators • Landfills • Sewage treatment plants • Composts • Bio-digesters • Resource person

7.1.20 POLLUTION

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Sources of pollutants	• List the sources of pollutants • Explain the effects of pollution • describe methods of controlling pollution	• Sources of pollutants - Industrial waste - Exhaust fumes - Domestic waste • Effects of pollutants - Acid rain - Eutrophication - Global warming - Health hazards - Ozone layer depletion • Methods of controlling pollution - Catalytic convertors - Scrubbers - shakers	• Discussing sources of pollution • Discussing effects of pollution • Visiting sites • Discussing methods of controlling pollution	• ICT tools • Text books • Resource person • Catalytic convertor

7.1.21 WATER PURIFICATION

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Water purification	• Describe the process of large scale water purification • Explain the role of aluminium sulphate and chlorine in the treatment of water	• Water purification - Filtration - Flocculation - Sedimentation - Chlorination • role of aluminium sulphate and chlorine • challenges associated with water purification	• Experimenting on sedimentation and filtration • Visiting sites e.g - Water works • Discussing the roles of aluminium sulphate and chlorine	• Resource person • Models of Sand filters • Water guard • Aluminium sulphate • Chloride tablets • Chlorate (V)

7.1.22 HERBS

TOPIC	OBJECTIVES **Learners should be able to:**	CONTENT (knowledge, skills, values, and attitudes)	SUGGESTED ACTIVITIES AND NOTES	SUGGESTED RESOURCES
Herbs	• describe the uses of herbs • Describe advantages and disadvantages of using herbs	• Uses of herbs - Health and agriculture • Advantages and disadvantages of herbs	• Listing of herbs found in the local environment • Visiting herbal gardens • discussing on the advantages and disadvantages of using herbs	• herbs • Resource person

9.0 ASSESSMENT

The Lower Secondary Chemistry syllabus learning area for Forms 3 – 4 shall be assessed through School Based Continuous Assessment (SBCA) and Summative Assessment (SA). These assessments shall be guided by the principles of inclusivity, practicability, authenticity, transparency, flexibility, validity and reliability. The principles are crucial for creating a supportive and effective learning environment that fosters growth and development in learners at secondary school level. Arrangements, accommodations and modifications shall be visible to enable candidates with special needs to access assessments.

This section covers the assessment objectives, the assessment model, the scheme of assessment, and the specification grid.

9.1 Assessment Objectives

Learners will be assessed on their ability to:

9.1.1 Show knowledge and understanding.
9.1.2 Handle information and solve problems.
9.1.3 Display experimental skills and investigations.

9.2 Assessment Model

Assessment of learners at Lower Secondary school level for Chemistry Syllabus shall be both Continuous and Summative as illustrated in Figure 1. School Based Continuous Assessment shall include recorded activities from the School Based Projects. The mark shall be included on the learner's end of term and year report. Summative assessment at school level shall include terminal examinations which are at the end of the term and year.

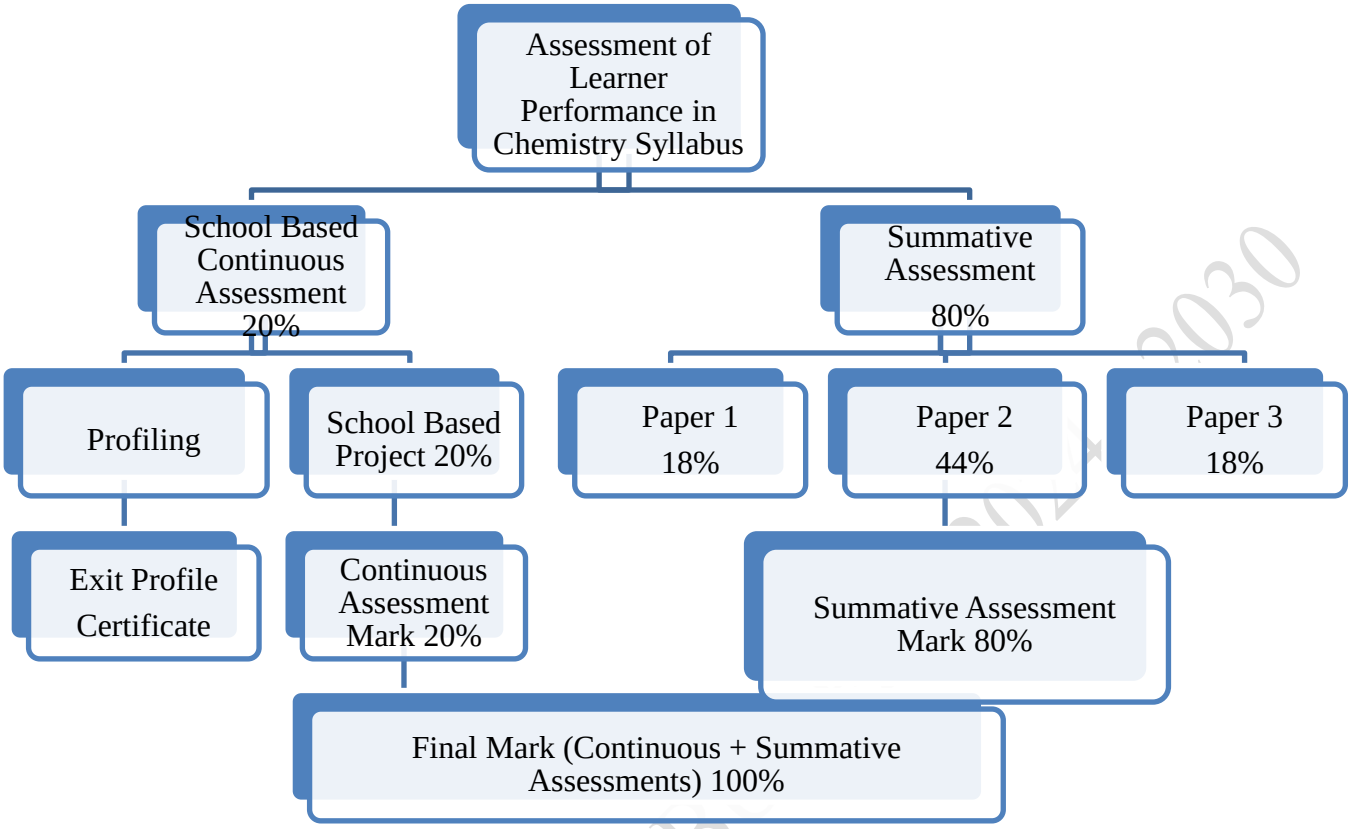

Fig. 1 Assessment Model

In addition, learners shall be profiled and learner profile records established. Learner profile certificates shall be issued for checkpoints assessment in schools as per the dictates of the Teacher's Guide to Learning and Assessment. The aspects to be profiled shall include learner's prior knowledge, values and skills, and subsequently the new competences acquired at any given point.

9.3 Scheme of Assessment

The Assessment Model shows that learners shall be assessed using both School Based Continuous Assessment and Summative Assessment for both School and ZIMSEC assessments.

The table shows the Scheme of Assessment where 20% is allocated to School Based Continuous Assessment and 80% to School or ZIMSEC Summative Assessment.

FORM OF ASSESSMENT	WEIGHTING
School Based Continuous Assessment	**20%**
Summative Assessment	**80%**
Total	**100%**

9.3.1 Description of School Based Continuous Assessment

Learners shall do one school-based project per Form which contributes to 20% of the end of year final mark. The end of year summative assessment shall then contribute 80%. However, for ZIMSEC public examinations, two (2) school-based projects shall be considered as School Based Continuous Assessment at Form 4. The two School Based Projects shall include those done during Form 3. and Form 4 sessions. Each will contribute 10%.

9.3.1.1: School – Based Project Continuous Assessment Scheme

The Table given below shows the Learning and Assessment Scheme for the School Based Project.

Project Execution Stages	Project Stage Description	Timelines	Marks
1	Problem Identification	January	5
2	Investigation of related ideas to the problem/innovation	February	10
3	Generation of possible solutions	March	10
4	Selecting the most suitable solution	April-May	5
5	Refinement of selected solution	June	5
6	Presentation of the final solution	July	10
7	Evaluation of the solution and Recommendations	August-September	5
	TOTAL		**50**

9.3.2 Description of the ZIMSEC Summative Assessment

ZIMSEC Summative Assessment shall be a public examination at Form 4. The examination shall consist of three papers of different weighting.

Paper	Paper type	Marks	Duration	Weighting
1	Multiple choice	40	1hr	20%
2	Theory	100	2hrs	40%
3	Practical test	40	1hr 30 mins	20%
TOTAL				**80%**

Paper 1: Multiple choice
Duration: 1 hour
The paper consists of 40 compulsory multiple-choice items of the direct choice type. Each question shall have 4 response items.

Paper 2: Theory
Duration: 2 hours.
The paper has 2 sections
Section A will carry 40 marks and will consists of five compulsory structured questions of variable mark valve.
Section B carries 60 marks and will consist of 4 structured questions. Each question will carry 20 marks. Candidates will be required to answer any 3 questions.

Paper 3: Practical Test
Duration: 2hours
This paper will consist of 2 compulsory questions each carrying 20 marks.

9.4 Specification Grid

SKILL	Paper 1	Paper 2	Paper 3	Paper 4
KNOWLEDGE AND UNDERSTANDING	15%	15%		15%
ANALYSIS, SYNTHESIS AND EVALUATION	45%	45%		45%
APPLICATION AND PROBLEM SOLVING	40%	40%		40%
PRACTICAL			100%	
TOTAL	**100%**	**100%**	**100%**	**100%**