Republic of Uganda

Ministry of Education and Sports

Chemistry Teaching Syllabus

UGA NDA CERTIFICA TE OF EDUCA TION

Senior 1 - 4

National Curriculum Development Centre

P.O. Box 7002 Kampala
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2008

CHEMISTRY TEACHING SYLLABUS

UGANDA CERTIFICATE OF EDUCATION

Senior 1 - 4

National Curriculum Development Centre – Uganda

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The various writing activities benefited greatly from our partners in education who provided the professional information and advise that was put together to come up with content and information for the teacher in the school.

They include Secondary schools, Universities, National Teacher Colleges, Uganda National Examinations Board (UNEB), Directorate of Education Standards (DES), Technical and Business institutions, Private Organisation, Religious Organisation and Ministry of Education and Sports officials.

Last but not least we would like to acknowledge all those behind the scenes who formed part of the team that worked hard to finalise the work on the various syllabi.

Connie Kateeba

DIRECTOR,

National Curriculum Development Centre

FOREWORD

The quality of the human resource depends largely on the emphasis the education sector puts on the nature of courses covered at any particular level. The educational experiences one goes through have a lot of bearing on the knowledge and skills acquired, at titudes developed and consequently what one is able to do in achieving good quality and successful life.

The effort that has been put into having the teaching syllabuses for O-Level subjects in place will go a long way in achieving the government aims and objectives of education for all. This will result into producing a literate population which is a step in enhancing development of a nation.

For the past twenty years there was no syllabus review in most of the subjects taught at O-Level. This coupled with lack of teaching syllabuses caused a fall in education standards in most of the schools. In order to rectify this situation, the Ministry of Education and Sports through National Curriculum Development Centre (NCDC), undertook an important exercise of developing the required teaching syllabuses in subjects handled at that level, with the aim of promoting uniform standards in all schools, in terms of scope and depth of the content taught in the various subjects. This therefore fulfils one of the objectives of the NRM government of br inging about fundamental change.

The teachers qualified to teach this level form part of the delivery mechanism and should therefore endeavour to stick to what has been identified and outlined in the syllabuses, in an effort to cover the entire syllabuses in the allocated time. They are a lso encouraged to make the teaching and learning process interesting, exploratory and more especially learner centred.

I appeal to all stakeholders to join hands and make the implementation of this educational process a success.

Hon. Geraldine Namirembe Bitamazire
Minister of Education and Sports
Government of the Republic of Uganda

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INTRODUCTION

Chemistry is embedded /rooted in science taught at primary level, but introduced to learners for the first time as a subject at the secondary level. The knowledge of Chemistry is necessary in the understanding of the composition, properties and behavior changes of matter that form the environment.

This syllabus presents Chemistry as a practical subject where scientific concepts, principles and skills are developed through experimental investigation. The learning of scientific knowledge by discovery method is encouraged.

The syllabus is designed to meet the needs of those carrying on further studies in chemistry at Advanced level and those that leave school after senior four for the word of work. Although a good deal of the content will be familiar to teachers, the treatment must be based on practical situations whenever possible. A large proportion of the examination questions will demand knowledge and understanding of pra ctical situations. Candidates will be at considerable disadvantage if the teacher has not adopted an approach based on practical work.

The course is divided into two (2) parts. The first part, elementary chemistry, can be viewed as a complete two-year introductory course chemistry.

It should form the basis for UCE chemistry. The second part for year 3 and 4, constitutes a deeper, more theoretical treatment of the topics introduced in elementary chemistry.

The syllabus emphasis the use of international units for physical and applied chemistry (IUPAC)[1] system of namenclature, correct use of chemical terminologies and equations.

[1]International Union of Pure and Applied Chemistry (IUPAC)

Two areas of subject matter are worth noting.

- Applied Chemistry (Topic).
  The aim is to give a clear understanding of the applications of Chemistry in society with particular emphasis on aspects relevant to East Africa. The section should be based on student practical work whenever possible and reference has been made to some suitable experimental work. The application if chemical principles and the use of particular compounds can be integrated naturally into other sections of the course. As an aid to integration the syllabus has been cross-referenced.

- Organic Chemistry.

Emphasis is placed upon simple organic molecules as the basic units of macro molecules and the importance of carbon compounds in the natural and technological environment.

PURPOSE OF THE TEACHING SYLLABUS

The concept of modernization dictates that the teaching of chemistry in this era of globalization should be practical oriented. The world today relies on chemistry as one of the key components in every aspect of life. The chemistry teaching syllabus therefore enhance outputs with adequate science knowledge that will be able to live productively, earn an income, be competitive at both national and international scale and contribute to sustainable economic development at whatever level. The chemical knowledge, concepts and skills acquire will enhance improvement in the quality of life of the people.

BROAD AIMS OF EDUCATION

1. Government further appreciates the Commission's correct assessment of the above national goals established for the society and the citizens of the country, and endorses the following related broad aims of education to be achieved through implementation of the new national policy on education

   (i) To promote understanding and appreciation of the value of national unity, patriotism and cultural heritage, with due consideration of internal relations and beneficial inter-dependence;

   (ii) To inculcate moral, ethical and spiritual values in the individual and to develop self-discipline, integrity, tolerance and human fellowship;

   (iii)To inculcate a sense of service, duty and leadership for participation in civic, social and national affairs through group activities in educational institutions and the community;

   (iv) To promote scientific, technical and cultural knowledge, skills and attitudes needed to promote development;

   (v) To eradicate illiteracy and to equip the individual with basic skills and knowledge to exploit the environment for self-development as well as national development, for better health, nutrition and family life, and the capability for continued learning; and

   (vi) To contribute to the building of an integrated, self-sustaining and independent national economy.

2. Government further agrees that in all future programmes of designing curricula, the following are some of the important concerns which need to be reflected in the educational objectives and in curricula at various levels:

   (i) Scientific and technological orientation of education at all levels;

   (ii) Development of the ability to use data and information for decision-making;

   (iii)Development awareness and concern for protection of the environment.

AIMS AND OBJECTIVES OF SECONDARY EDUCATION

The aims and objectives secondary education are:

(i) Instilling and promoting national unity and an understanding of social and civic responsibilities; strong love and care for others and respect for public property, as well as an appreciation of international relations and beneficial international co-operation.
(ii) Promoting an appreciation and understanding of the cultural heritage of Uganda including its languages;
(iii) Imparting and promoting a sense of self-discipline, ethical and spiritual values and collective personal responsibility and initiative;
(iv) Enabling individuals to acquire and develop knowledge and an understanding of emerging needs of society and the economy;
(v) Providing up-to-date and comprehensive knowledge in theoretical and practical aspects of innovative production, modern management methods in the field of commerce and industry their application in the content of socio-economic development of Uganda;
(vi) Enabling individual to develop basic scientific. Technological, technical, agriculture and commercial skills required for self-employment;
(vii) Enabling individuals to develop persona skills of problem-solving, information gathering and interpretation, independent reading and writing, self-improvement through learning and develop of social, physical and leadership skills such as are obtained through games, sports, societies and clubs.
(viii) Laying the foundation for further education;
(ix) Enabling the individual to apply acquired skills in solving problems of the community and to develop in him a strong sense of constructive and beneficial belonging to that community;

(x) Instilling positive attitudes towards productive work and strong respect for the dignity of labour and those who engage in productive labour activities.

AIMS OF TEACHING THE SUBJECT

- To help students to appreciate the importance and the application of Chemistry in everyday life.
- To assist a student to learn how to think critically in any given learning situation.
- To guide a student to discover knowledge, from known to unknown, using a practical approach.
- To relate and be able to apply the discovered knowledge in everyday life.

SCOPE AND DEPTH AND TIME ALLOCATION

Senior One (90 periods).

Topics

Term I

1. Introduction to Chemistry.	-	10 periods
2. Heating apparatus used in chemistry.	-	10 periods
3. Matter.	-	10 periods

Term II

4. Atoms, elements, molecules, compounds and mixtures	-	9 periods
5. Mixtures.	-	18 periods
6. Air.	-	3 periods

Term III

7. Oxygen.	-	8 periods
8. Rusting of iron.	-	9 periods
9. Combustion of element in oxygen.	-	12 periods

Senior Two (90 periods)

Term 1

10. Reaction of metals with oxygen – a reactivity series for metals.	-	6 periods
11. Water.	-	6 periods
12. Hydrogen.	-	6 periods
13. Atomic structure.	-	9 periods
14. Periodic table.	-	3 periods

Term II

15. Ions and ionic compounds.	-	6 periods
16. Chemical families: Patterns and properties.	-	9 periods
17. Bonding.	-	6 periods
18. Chemical equations.	-	9 periods

Term III

19. Acids, bases and indicators.	-	15 periods
20. Salts (Ionic compounds).	-	9 periods
21. The effect of electricity on substance.	-	6 periods

Senior Three

Term I

22. Atomic and molecular structure chemical bonding	-	09 periods
23. Carbon chemistry	-	09 periods

24. Organic chemistry	-	12 periods

Term II

25. Acidity and alkalinity	-	03 periods
26. The mole concept, formulae and chemical equation	-	27 periods

Term III

27. Ionic chemistry and qualitative analysis	-	10 periods
28. Energy changes in chemical processes	-	10 periods
29. Electro-chemistry	-	10 periods

Senior Four

Term I

30. Reversible reactions and reaction rates	-	15 periods
31. Nitrogen and its compounds	-	15 periods

Term II

32. Sulphur and its compounds	-	15 periods
33. Chlorine and its compounds	-	15 periods

Term III

34. Applied chemistry	-	12 periods

Instructional Time

There are 3 periods of 40 minutes per week

HOW TO USE THE O-LEVEL TEACHING CHEMISTRY SYLLABUS

The O-level chemistry teaching syllabus is meant to help the teacher cover the appropriate depth and scope at each level of the study.

The Teacher is expected to:-

i) Make a scheme of work based on the teaching syllabus

ii) Draw lesson plans with detailed activities, methodology and assessment methods as highlighten in the teaching syllabus

iii) Ensure that assess learners basing on General and specific objectives outlined in the teaching syllabus

iv) Link instructional objectives to aim of education, aims of secondary education Uganda and overall aims of teaching-learning of O-level chemistry in Uganda

v) Follow the sequence of curriculum topics as they are laid down in the teaching syllab us (Note those topics have been arranged in a logical order.)

MODE OF ASSESSMENT (Summative assessment)

Examination format

There will be **three** papers.

Paper 1 (1 1/2 hours)

This will consist of 50 compulsory objective type questions covering the whole syllabus. (50 Marks)

Paper 2 (2 hours)

This will consist of **two** sections, A and B. Section A will consist of ten compulsory structured questions requiring short answers. Section B will consist of **four** structured and semi-structured essay questions. Candidates will be required to answer **two**. In both sections questions will be set on any part of the syllabus.

Paper 3 (2 hours)

This will be a practical test designed to test the abilities specified above. Questions may be set on any section of the syllabus. (30 Marks)

Detailed Syllabus

A feature of the syllabus is that the specific objective of each section are indicated. These statements are designed to: (i) indicate the depth of treatment to be given by the teacher and (ii) indicate the level of understanding to be attained by the pupils.

Since some topics may be treated in an elementary manner early in the course and then in more depth later, teachers must read the topic objectives carefully to ascertain the treatment. For example, terms such as recall, 'state', 'name', demand low-level abilities, while 'explain', 'predict', 'demonstrate', 'analyze', etc demand higher level abilities.

MODE OF ASSESSMENT (SUGGESTED CONTINUOUS ASSESSMENT METHODS)

1. Oral questions
2. Observation of individuals/group activities
3. Short answer questions
4. Practical test assignment
5. Written assignment
6. Project work
7. Field trips
8. Science Fair

SECTION II

SENIOR ONE TERM: I

TOPIC 1: **INTRODUCTION TO CHEMISTRY** **DURATION:** 10 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the importance of Chemistry and use the laboratory safely and effectively.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define chemistry. • Outline the importance of learning Chemistry. • State the rules and regulations of using a Chemistry laboratory. • Name the apparatus used in the laboratory. • Draw the apparatus. • Identify the different apparatus used in the laboratory. • Select appropriate apparatus for particular activities. • Use the apparatus properly.	• Definition of Chemistry • Importance of learning Chemistry. • Laboratory rules and regulations. • Common apparatus used in the Chemistry laboratory.	• Discuss the possible definitions of chemistry • Brainstorm on the importance of learning chemistry • Discuss the laboratory rules and regulations • Demonstrate common laboratory apparatus • Conduct a guided discovery discussion on the uses of common apparatus in the laboratory.

TOPIC 2: **HEATING APPARATUS USED IN CHEMISTR Y LABORATORY** **DURATION:** 10 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to name and use various heating apparatus in the Chemistry laboratory.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Name different heating apparatus. • Draw the heating apparatus used in Chemistry laboratory. • Light the heating apparatus. • Differentiate between the types of flames.	• Different types of heating apparatus e.g. Bunsen burner, stove etc. • Lighting the heating apparatus • Types of flames • Different uses of flames.	• Conduct a guided discussion on the different types of heating apparatus • Demonstrate and experiment on how to light the different heating apparatus. • Conduct experiment to identify and differentiate between the different types of flames. • Conduct a guided discussion on the uses of the different flames.

TOPIC 3: **MATTER** **DURATION:** 10 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to identify the different states of matter and their characteristics.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define matter. • Name the different states of matter. • Identify the different states of matter. • State the difference between physical and chemical changes. • Explain the causes for the changes of state. • Explain the differences between the different states of matter.	• Definition of matter. • States of matter (liquid, solid, gases). • Kinetic theory of matter. - Movement of particles and forces of attractions. - Volume and shape • Definition of physical and chemical changes • Effect of heat on some substances, candle wax, magnesium, sulphur, iodine, platinum wire, hydrated copper (II) sulphate. • Changes of states - Freezing, condensation, melting, evaporation, sublimation - Experiment to study the effect of heat during changes of states. Particular emphasis on naphthalene.	• Conduct a guided discussion on the definition of matter. • Carry out experiments to show the different states of matter. • Conduct a guided discussion on the kinetic theory of matter • Carryout experiments to show physical and chemical changes. • Carryout a project to study the effect of heat on some substances. • Brainstorm on the processes that occur when the state of matter changes.

TERM: II

TOPIC4: **ATOMS, ELEMENTS, MOLECULES, COMPOUNDS AND MIXTURES** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to differentiate between atoms and molecules, compounds and mixtures.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Write a concise definition of atom, element, molecule, compound and mixture. • Differentiate between atom and molecule, compound and mixture. • Name and write chemical symbols of common elements.	• Definition of atom, element, molecule, compound and mixture. • Examples of elements, molecules, compounds and mixtures. • Symbols of common elements (e.g. hydrogen, sodium, oxygen etc). • Difference/similarities between: - Atom and molecule. - Compound and mixture	• Conduct a guided discussion on t he definition of atom, elements, molecule and compound. • Brainstorm on examples of elements, molecules, compounds and mixtures. • Conduct a guided discussion on symbols of common elements. • Conduct a guided discussion on differences. Similarities between atoms and molecules • Carryout experiments to show the differences/similarities between compounds and mixtures.

TOPIC 5: **MIXTURES** **DURATION:** 18 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to list the different types of mixtures and separate them

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • List the different types of mixtures. • Identify the different types of mixtures. • States the methods for separating mixtures. • Separate mixtures using appropriate methods. • Carryout simple experiments to obtain pure substances from mixtures. • State the criteria for identifying a pure substance. • Relate the methods of separation of mixtures stated with those used at home/ real life.	• Types of mixtures - Homogeneous and heterogeneous • Methods of separation of mixtures i.e. - Filtration. - Distillation. - Evaporation. - Magnetism. - Sublimation. - Decanting - Chromatography. - Crystallization. - Solvent extraction. - Separating funnel. • Simple criteria of purity - Melting point - Boiling point	• Brainstorm and conduct a guided discovery discussion on the different types of mixtures. • Carry out experiments, in groups to separate mixtures. • Carryout experiments demonstrate the criteria of purity

TOPIC 6: **AIR** **DURATION:** 3 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to state the different components of air.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define air. • State the components of air and their percentage composition. • Explain how air can be separated into its components.	• Definition of air, • Components of air • Air as a mixture. • Experiment to find out the approximate volumetric ratio of nitrogen/oxygen in air. (Using Copper, Bell jar experiment, burning a candle). • Fractional distillation of air	• Conduct a guided discovery discussion on the definition of air, components of air and air as a mixture. • Carryout an experiment to demonstrate the approximate volumetric ratio of nitrogen to oxygen in air. • Conduct group work presentation on fractional distillation of air.

TERM III

TOPIC 7: **OXYGEN** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to prepare oxygen in the laboratory, state its properties and uses.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Draw and label the experimental set-up of the apparatus for preparing oxygen. • Prepare oxygen in the laboratory. • State the chemical and physical properties of oxygen. • Test for oxygen • Describe the procedure for industrial preparation of oxygen. • State the uses of oxygen	• Laboratory preparation of oxygen. • Physical and chemical properties of oxygen • Test for oxygen • Industrial preparation of oxygen. • Uses of oxygen.	• Carryout an experiment to demonstrate the laboratory preparation of oxygen. • Carry out experiments to discover the physical and chemical properties of oxygen. • Conduct a field trip to a plant that produces oxygen or assign the learners project work of describing the industrial preparation of oxygen. • Brainstorm on the uses of oxygen.

TOPIC 8: **RUSTING OF IRON** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to prevent rusting of iron.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define rusting. • Define rust • State the conditions necessary for rusting. • Carryout experiments to investigate the conditions for rusting and state the composition of rust. • Outline methods of preventing rusting.	• Definition of rusting. • Definition of rust • Conditions necessary for rusting. • Experiment to investigate whether air or water is necessary for rusting to occur. • Experiment to investigate whether rust is hydrated. • Methods of preventing rusting.	• Brainstorm on the definition of rust. • Carryout project work to investigate conditions necessary for rusting. • Carryout an experiment to investigate whether rust is hydrated. • Have a guided discussion on methods of preventing rusting.

TOPIC 9: **COMBUSTION OF ELEMENTS IN OXYGEN** **DURATION:** 12 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to classify the products of burning elements in oxygen as either acidic or basic

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define an oxide. • State the different types of oxides. • Give examples of each type of oxide. • Describe what is observed when C, Cu, P, Na and Mg burn in air • Classify the products of burning elements in oxygen as either acidic or basic.	• Definition of an oxide. • Different types of oxides. • Examples of each type of oxide. • Burning C, Cu, P, S, Mg, Na in air • Classification of products of burning element in oxygen (i.e. acidic and basic oxide).	• Brainstorm on the definition of an oxide. • Conduct a guided discussion on the different types of oxides. • Carryout experiments to classify the different oxides formed.

SENIOR TWO TERM I

TOPIC 10: **REACTIONS OF METALS WITH OXYGEN- REACTIVITY SERIES FOR METALS**

DURATION: 6 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to arrange metals in order of their reactivity with oxygen and apply the principles to different situations.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define the term affinity. • Describe the reaction between a given metal and metal oxide. • Explain the reaction between a given metal and metal oxide. • State the order of elements in the reactivity series.	• Definition of affinity for oxygen. • Displacement reactions. • Competition reactions of the metals for oxygen • Experiments to demonstrate the reactions of metals with metal oxides e.g. CO_2/Mg, PbO/Mg • The reactivity series (K, Na, Ca, Mg, Al, C, Zn)	• Conduct a guided discussion on the definition of affinity for oxygen. • Carryout experiments to demonstrate displacement reactions between metals and different metal oxides. • Brainstorm on the deductions made on the above experiments. • Assign the learners project work of designing their reactivity series based on the experiments carried out. • Have a guided discussion on the recognized reactivity series.

TOPIC 11: **WATER** **DURATION** : 6 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to state the properties of water.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • State the composition of water. • Test for the products of burning organic matter. • Explain the experiment showing that water contains hydrogen. • State the products of reaction of water and steam with different metals. • List the reactivity series obtained from metal/water reaction.	• Composition of water. • The water cycle. • Burning of organic matter (energy source). • Water as an oxide of hydrogen.(Burning hydrogen and a candle in air) • Reactions of metals with water/steam.(Na, Ca, Mg with water and Mg, Zn, Fe with steam)	• Brain storm on the composition of water. • Have a guided discussion on the water cycle. • Carryout an experiment to demonstrate that water is one of the products formed when organic fuels are burnt. • Carryout an experiment to show water is an oxide of hydrogen. • Carryout experiment to show the reaction between t he given metal and water/steam. • Assign the learners project work in groups to design a reactivity series based on the experiments conducted above. • Have a guided discussion on the reactivity series.

TOPIC 12: **HYDROGEN** **DURATION:** 6 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to prepare hydrogen in the laboratory and state its physical and chemical properties.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Prepare and test for hydrogen in the laboratory. • State the physical and chemical properties of hydrogen. • Outline the uses of hydrogen. • Explain oxidation as gain of oxygen and reduction as loss of oxygen with reference to metal oxide-hydrogen reactions.	• Laboratory preparation of hydrogen. • Test for hydrogen • Reactions of hydrogen gas. • Uses of hydrogen gas: - - manufacture of margarine - weather balloons. - manufacture of ammonia. • Oxidation and reduction in terms of gaining oxygen and losing hydrogen.(use copper (II) oxide, hydrogen reduction)	• Demonstrate the laboratory preparation of hydrogen. • Carryout experiments to determine the physical and chemical properties of hydrogen. • Assign the learners project work on the uses of hydrogen. • Have a guided discussion on oxidation and reduction (limit these discussion to transfer of oxygen or hydrogen)

TOPIC 13: **ATOMIC STRUCTURES** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to describe the structure of an atom and write the electronic configuration of the first twenty elements in the Periodic Table.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define an atom. • Name the particles of the atom. • Draw the simple atomic structure. • State the charges on each of the particles of the atom. • Define atomic number, relative atomic mass and isotope. • Write electronic configuration of various elements (1st 20 elements in the Periodic Table).	• Definition of atom • Particles of an atom • Draw the structure of an atom. • Definition of atomic number and mass number. • Definition of isotopes, relative atomic mass, and examples and their significance. • Electronic configuration of the 1st 20 elements in periodic table. • Positive and negative charges (should be introduced through simple electrostatics, experiments with charges, rods and spheres.)	• Conduct a guided discussion on definition of an atom and the particles that make up an atom. • Assign learners group work to design model of atoms of different elements using readily available materials. • Conduct a guided discussion on definition of isotope and relative atomic mass. • Conduct a guided discussion on how to write electronic configuration of an element. • Assign the learners project work on writing electronic configuration of the first 20 element. • Carry out simple electrostatic experiments to demonstrate the effect of positive and negative charges.

TOPIC 14: **THE PERIODIC TABLE** **DURATION:** 3 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to locate the position of the different elements in the Periodic Table using electronic configuration.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define the Periodic Table. • Describe the history of the periodic time. • Arrange the first 20 elements in the Periodic Table. • Identify metals, non-metals and noble gases in relation to outermost electrons. • Describe the Period and group.	• Definition of the Periodic Table and its history. • Groups in the Periodic Table (i.e. I, II, VII, O) and periods. • Arrangement of the 1st 20 elements in the Periodic Table.	• Conduct a guided discussion on the periodic table and its history. • Discuss the electronic configurations of the first 20 elements in the periodic table in relation to their periods and groups. • Assign project work of designing a period table showing the first 20 elements.

TERM II

TOPIC 15: **IONS AND IONIC COMPOUNDS** **DURATION:** 6 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to predict the type of ion formed from the electronic arrangement of the element.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define an ion. • Describe an octet and duplet. • Outline common ions. • Determine valencies of different elements. • Write simple chemical formulae. • Define multivalency. • Define a radical. • Identify elements that are multivalent. • Describe how simple ionic compounds are formed (e.g. sodium chloride).	• Definition of an ion. • The characteristics feature of the outermost energy level (i.e. octet and duplet). • Formation of ions and determination of valencies. • The reaction between sodium and chlorine. • The reaction between magnesium and oxygen. • Common ions (e.g. Li^{+}, Na^{+}, $Mg^{2+,}$ $Ca^{2+,}$ $Al^{3+,}$ etc. F^{-}, Cl^{-}, NO_3^{-}, CO_3^{2-}, etc. • Formulae of ionic compounds.	• Conduct a guided discussion on the definition of an ion. • Brain storm on the characteristic features of the outermost energy level. • Conduct a guided discussion o formation of ions and determination of valencies. • Assign group work in which the learners are to write out formulae of various ionic compounds.

TOPIC 16: **CHEMICAL FAMILIES: PATTERNS IN PROPERTIES** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to explain the reactions of the chemical families in terms of their electronic arrangement.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • State the specified reactions of the alkali, alkaline-earth metals and halogens. • Describe the difference in reactivity within these chemical families • State the properties of noble gas family and its un-reactivity. • Predict the reactions and reactivity of elements within each family on qualitative basis.	• Reaction of alkali metals (Li, Na, K) with air, water and chlorine. • Reaction of alkaline- earth metals (Ca, Mg,) with air, water, chlorine and dilute acids. • Reaction of halogens (Cl_2, Br_2, I_2) with sodium, water (bleaching action), zinc powder, sodium hydroxide solution. • Noble gases. - recognize their low reactivity based on their electronic configuration • ***Note: Word equation should be used though formulae of simple compounds and elements may be given.***	• Conduct experiments to demonstrate the reaction of alkali metals with air, water and chlorine. • Conduct experiments to demonstrate the reaction of alkaline-earth metals with air, chlorine and dilute acids. • Conduct experiments to demonstrate the reaction of halogens with sodium, water, zinc powder and sodium hydroxide. • Conduct a guided discussion on the observations of all of the above experiments. • Discuss the properties of Noble gases.

TOPIC 17: **BONDING** **DURATION:** 6 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to differentiate between electrovalent, covalent, dative and metallic bonding

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define bonding. • Describe the formation of: - electrovalent bond. - covalent bond. - metallic bond • Identify different elements which form the above bonds.	• Definition of bonding. • Description of electrovalent, covalent, dative and metallic bonding. • Differences between electrovalent, covalent, metallic and dative bonding.	• Conduct a guided discussion on the definition of bonding. • Assign the learners group work to design models to represent each type of bonding using readily available materials. • Brain storm on the differences between electrovalent, covalent, dative and metallic bonding.

TOPIC 18: **CHEMICAL EQUATIONS** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to write balanced equations.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define word equation. • Write word equations. • Define formulae equation. • Write formulae equations. • Balance formulae equations.	• Definition of word equation and formulae equation. • Word equations. • Formulae (chemical) equations. • Balancing formulae (chemical equation.	• Brain storm on the definition of word equation and formulae equation. • Conduct a guided discussion on how to derive a formulae equation form a work equation. • Conduct a guided discussion on how to balance chemical equations. • Assign the learners group work on balancing chemical equations.

TERM: III

TOPIC 19: **ACIDS, BASES AND INDICATORS** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to differentiate between acids and bases by use of indicators, and outline the application of acid-base neutralization reactions.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
learners should be able to: • Define an acid, base and indicator. • Prepare and use plant extracts as acid – base indicators. • Use universal indicator to determine the ph of solution. • State characteristics of acids and bases. • Give examples of acids and bases. • Outline some applications of acid – base neutralization.	• Definition of acid, base and indicator. • Indicators - preparing and using indicators. (flower, extracts as simple indicators.) - universal indicator (ph scale.) • Acidic, neutral and basic/alkaline solution. • Strength of acids and bases. • Simple properties of mineral acids. test solutions: nh_4cl, $(nh_4)_2 so_4$, nh_3, naoh, h_2so_4, etc.) • Neutralization reactions of acids and bases. • application of acid – base neutralization reactions	• Conduct a guided discussion on the definition of acid base and indicator • Conduct experiments to prepare indicator from plan extracts such as flower extract and the tea leaves. • Conduct experiments using universal indicator to classify substances as strong or weak acids or bases. • Brainstorm on application of acid-base neutralization reactions.

TOPIC 20: **SALTS (IONIC COMPOUNDS)** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to prepare simple salts in the laboratory using the appropriate method.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define salt. • Identify soluble and insoluble salts. • Select an appropriate method for preparation of a particular salt. • Explain the terms solution, saturated solution, crystallization, neutralization and precipitation. • Describe and explain from experimental observations, the action of heat on various salts.	• Definition of salt. • Normal salts and acid salts. • Soluble and insoluble salts. • Solution. • Crystals. • Crystallization by evaporation. • Preparation of soluble salts. • Preparation of insoluble salts-double decomposition. • Preparation of salts by direct synthesis. • Hydrated salts. • The effect of heat on salts.	• Conduct a guided discussion on the definition of a salt and the different types of salts. • Conduct experiments to prepare various types of salts. • Assign learners project work of growing a crystal (This can be done as group work) • Conduct experiments to observe the effect of heat on various salts. • Brain storm on the deductions made in the experiments on action of head on salts.

TOPIC 21: **THE EFFECT OF ELECTRICITY ON SUBSTANCES** **DURATION:** 6 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to recognize that electrolysis is a means of obtaining elements from chemical compounds.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define conductor/non-conductor and electrolyte/ non-electrolyte. • State the relationship between electrolytes, non-electrolytes and the particles they contain (ions, molecules). • Name the products of electrolysis of simple binary electrolytes. • Explain that, electrolysis is a means of obtaining elements from chemical compounds.	• Definition of conductor, non-conductor, electrolyte and non – electrolyte. • Definition of cathode and anode. • Which substances conduct • Tests for conduction by solids (metals, non-metals, plastic, wood). • Solution: sugar, urea, sodium chloride and copper (II) chloride, dilute mineral acids and molten substances. • Electrolysis of ionic compounds ($CuCl_2$, HCl, $PbBr_2$.)	• Conduct a guided discussion on the definition of conductor, non-conductor, electrolyte and non-electrolyte. • Discuss the definition of cathode and anode. • Conduct experiments to determine which substances are conductors or non –conductors. • Conduct experiments to demonstrate electrolysis of ionic compounds.

SENIOR THREE TERM I

TOPIC 22: **ATOMIC AND MOLECULAR STRUCTURE: CHEMICAL BONDING** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to describe and explain the changes in bond type across the third period of Periodic Table.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Describe the role of the outermost electrons in chemical bonding. • Explain qualitatively the formation of the covalent and ionic bonds. • Illustrate, using diagrams, the covalent and ionic bonds in simple compounds. • Differentiate between bond types on the basis of chemical and physical properties of substances. • Explain the changes in bond type across the third period of the periodic table. • Describe the changes in bond type across the third period of the periodic table. • Describe the trends in the physical and chemical properties of the elements of the third period of the periodic table.	• Definition of chemical bond. • The role of outer most electrons in chemical bonding. • Qualitative treatment of the energetic of chemical bonding. Consider the molecules in terms of a position of balance between p-p, e-e repulsion and p-e attraction (ionic bond as an extreme example). • Significance of the noble gas configuration, covalent bond as electrons sharing, ionic bond as electron – transfer. Consideration of C-C and C=C. • Influence of bond type on physical and chemical properties (melting point, solubility and electrical conductivity.	• Discuss the definition of chemical bonding and the role of valency electrons in chemical bonding. • Assign learners group work of using models to illustrate different types of bonding. • Conduct a guided discussion on the influence of bond type on chemical and physical properties of substances. • Discuss the trends in the physical and chemical properties of elements in the third period of the periodic table. **Note:** Use models to illustrate different types of bonding.
	• Molecular, giant atomic and giant ionic structures (iodine, carbon {diamond} and sodium chloride respectively. • Metallic bond related to electrical conductivity only.	• Conduct guided discussion on the trends in the physical and chemical properties of group I and VII elements in the periodic table.

	• Periodicity of bond type elements Na, Mg, Al, Si, S, Cl, Ar: their electronic structures, their ions (valence), mode of combination in oxide and chloride, inertness of noble gases, chemical and physical properties of metal and non-metals (across a period). • Elements: fluorine, chlorine, bromine and iodine (down the group). Electronic configuration, graduation in size of atom and ion, reaction. • Elements, Li, Na, K (as above including ease of oxidation, reaction with water, chlorine).	Note: Use models to illustrate different types of bonding.

TOPIC 23: **CARBON CHEMISTRY** **DURATION:** 9 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the importance of carbon compounds in natural environment and industry

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Explain the physical properties of the carbon allotropes in terms of their bonding and how these properties are related to the uses of the allotropes. • Describe the preparation and properties of carbon dioxide. • Describe the chemical reactions of carbonates and hydrogen carbonates. • Explain the importance of carbon compounds in the natural environment and in industry. • Explain the physical and chemical properties of carbon monoxide. • Explain the use of carbon dioxide in fire extinguishers. • Extinguish fire break outs in environments.	• Definition of allotropy and allotropes. • Forms of carbon. - Diamond, graphite and charcoal: structure, physical properties and uses (relate uses to structure and physical properties). • Chemical properties of carbon. - Consider combustion, reaction with acids and reducing action. • Preparation and properties of carbon dioxide. (Relate methods of collection to the properties of the gas). • Reaction of CO_2 with water, lime water and alkalis. • Uses of CO_2 e.g. - Soft drinks manufacture - Refrigeration - Baking - Fire extinguishers • Principles and methods of extinguishing fire of different types (practical)	• Conduct a guided discovery discussion on the definition of allotropy and allotropes. • Brain storm on the different forms of carbon. • Discuss the physical properties of each of the different form of carbon. • Conduct experiments to demonstrate the chemical properties of carbon. • Brain storm on the uses of each form of carbon. • Conduct an experiment to show how carbon-dioxide is prepared in the laboratory. • Conduct experiments to demonstrate the chemical properties of carbon-dioxide. • Brain storm on the uses of carbondioxide.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
	• Carbon monoxide - Combustion, reducing action poisonous fumes (car exhausts, coke fire). Laboratory preparation **NOT** required. Reducing action illustrated with copper (II) oxide and blast furnace (see extraction of iron) ***(Note: only theoretical treatment required because it is poisonous).*** • Carbonate and hydrogen carbonates - Action of heat and dilute acids on some carbonates and hydrogen carbonate. - Production of soda ash (Lake Magadi, Soda Company and Solvay process (Applied chemistry). ***Note: Use simple schematic diagram to illustrate solvay process.*** • Importance of carbon and its oxide - Carbon cycle. - Equilibrium of the atmosphere via the oxygen and carbon dioxide cycles. - The effect of carbon dioxide and carbon monoxide on the environment.	• Conduct experiments to demonstrate the principles and methods of extinguishing fire of different types. • Discuss the properties and uses of carbon monoxide. • Conduct experiments to demonstrate the physical and chemical properties of metal carbonates and hydrogen carbonates. • Assign the learners project work of making presentation on the solvay process. • Discuss the carbon cycle and its impact on the environment.

TOPIC 24: **ORGANIC CHEMISTRY** **DURATION:** 12 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to identify various organic compounds and their uses.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define organic chemistry. • Define a hydrocarbon. • Name and draw the structure of the first four alkanes. • Name the sources of alkanes • Name and give the uses of the five fractions of crude oil. • Explain the physical and chemical properties of the homologous series of alkanes, alkenes, and alcohols. • Describe the methods of preparing alkenes and alcohols. • State the different types of plastics and their properties • State the uses of alkanes, alkenes, and alcohols. • List some natural and synthetic fibres and state their uses. • State the advantages and disadvantages of synthetic materials compared to those of natural origin in terms of both structure and properties. • Derive the structure of a polymer from a monomer (polyethene).	• Definition of organic chemistry and hydrocarbon. • Alkanes (methane to butane). - Formulae only. • Sources - Natural gas. - Fractional distillation of crude oil (five fractions and their uses) • Combustion – internal combustion engine as a major source of atmospheric pollution (refer to unburnt C, CO, CO_2, Pb compounds, unburnt hydrocarbons). • Alkenes (ethene only) - Ethene: Formulae - Preparation of ethene by dehydration of ethanol. - Combustion - Reaction with bromine - Polymerisation • Cracking - Thermal and catalytic (of Perspex) • Plastics (Thermoplastics and thermosetting plastics) e.g. rubber, Perspex) • Advantages and disadvantages of plastics.	• Conduct a guided discussion on the definition of organic chemistry and hydro carbon. • Discuss the nomenclature and structures of alkanes with the aide of models. • Discuss the natural sources of alkanes • Discuss the chemistry behind the internal combustion engine emphasis should be placed on the pollution effects of the by-products of this combustion. • Carryout an experiment to prepare ethane. • Carryout experiments to demonstrate the physical and chemical properties of ethane. • Conduct a guided discussion on natural and synthetic fibres. • Brain storm on the uses of natural and synthetic fibres.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
	• Natural polymers (cellulose e.g. cotton, wood, paper). • Natural protein fibres, wool, silk, natural dyes and colouring of fibres. • Natural rubber and its vulcanization • Advantages and disadvantages of man made polymers over those of natural origin • Alcohols (Ethanol only) - Preparation by fermentation (of starch and sugar). - Properties – physical, combustion and dehydration only. - Uses • Fats and oils (local sources) - conversion into soap - Soap Laboratory preparation	• Assign the learners group work on discovering the advantages and disadvantages of natural polymers over synthetic polymers. • Carryout an experiment to prepare ethanol from sugar. • Assign learners project work of preparing ethanol from starch using local materials. • Carry out experiments to demonstrate the properties of ethanol. • Brain storm experiments to extract fats and oils from local sources. • Carry out an experiment to prepare soap.
• Define soap • Give the difference between soap and soapless detergent • Recall the methods of preparation of soap (saponification) • List the advantages and disadvantages of soap over soapless detergents.	- How soap works • Soapless detergents - Definition - Laboratory preparation - Advantages and disadvantages of soap and soapless detergents (Teacher demonstration of laboratory preparation of detergents from caster oil and concentrated H_2SO_4) (Applied Chemistry) ***Note: a detailed study of the organic chemistry of alkanes, alkenes, and alcohol etc is not required.***	• Discuss the cleansing action of soap. • Discuss the definition of soapless detergent. • Carry out an experiment to demonstrate the preparation of a soapless detergent. • Brain storm on the advantages and disadvantages of soap and soapless detergents.

SENIOR THREE TERM II

TOPIC 25: **ACIDITY AND ALKALINITY** **DURATION:** 3 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to write ionic and formulae equations for specified acid–base reactions.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define acids as proton donors and bases as proton acceptors. • Recognize the difference between weak and strong acids and bases. • Explain the role of solvent in the acidity of hydrogen chloride. • Write ionic and formula equations for specified acids-base reactions.	• Definition of acids as proton donors and bases as proton acceptors Weak and strong acids. • Definition of strong/weak acids and bases. • Determination of the strength of acids /bases by use of:- - pH - electrical conductivity - rate of reaction with marble chips and magnesium with acids. (Use hydrochloric acid/ethanoic acid and sodium hydroxide/aqueous ammonia as illustration). ***Note: Other examples are tartaric and citric acids instead of HCl.*** • Role of the solvent - Hydrogen chloride or tartaric acid in methyl benzene compare with aqueous solutions. React with dry litmus, magnesium, marble chips. - Reaction of dry and aqueous ammonia. Importance of $H^{+}_{(aq)}$ and $OH^{-}_{(aq)}$. • Use of ionic equations to illustrate the above • Amphoteric oxides (Al_2O_3, PbO, ZnO): react with acid and alkali (no equation for reaction with alkali).	• Discuss the definition of acids and bases. • Brain storm on the definition of strong/weak acids and bases. • Carry out experiments to demonstrate the strength of an acid or base. • Carry out experiments to demonstrate the role of a solvent in influencing the properties of acid anhydrides and dry ammonia. • Carryout experiments to demonstrate the properties of amphoteric oxides.

TOPIC 26: **THE MOLE CONCEPT: FORMULAE AND CHEMICAL EQUATION** **DURATION:** **27** Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to apply the relationship between the mole and RMM to solve related problem.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • State some experimental evidence for the existence of atoms, molecules, ions and electrons. • Use the kinetic theory to explain the nature of solids, liquids and gases. • Define the mole, molar solution and molar gas volume. • Use the mole, molar solution and molar gas volume in defining chemical formulae and equation from both experimental results and given data. • Represent a chemical reaction by either a full formula or ionic equation.	• Evidence for particles i.e. diffusion, Brownian motion. • Evidence for the existence of electrons (i.e. plastic comb). - Cars and electric shock, lightning. • Evidence for existence of ions. • The gas laws (Boyle's law, Charles's law general gas law). • The mole as a basic unit. • Determination of formulae; ionic compounds, empirical and molecular formulae. - Quantitative determination of magnesium oxide (Mg/air) and copper (II) oxide (reduction of copper (II) oxide with butane should be carried out.) • Molar gas volume (22.4 dm^3 at S.T.P), atomicity of gases, mass volume relationship for gases. • Molar solutions.	• Conduct experiments to demonstrate the existence of atoms molecules, ions and electrons. • Discuss the definition of mole, molar solution and molar gas volume. • Demonstrate to the learners how mole, molar solution and molar gas volume can be manipulated to solve any given problem related to the mole concept.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
	• Stoichiometry of chemical reactions, quantitative work must be emphasized. Reactions to be considered. - $Ba^{2+}_{(aq)} + CO_3^{2-} \longrightarrow BaCO_3\ (s)$ - $Pb^{2+}_{(aq)} + 2I^-_{(aq)} \longrightarrow Pb\ I_{2(s)}$ - $Cu^{2+}{}_{(aq)} + Fe_{(S)} \longrightarrow Fe^{2+}_{(aq)} + Cu(s)$ • CO_2 evolution from Na_2CO_3 & HCl. • Titration of NaOH with HCl and H_2SO_4 recommended. (***Note: Reactions in this section show quantitatively that mass is conserved.*** **$Ba^{2+}_{(aq)} + CO_3^{2-}{}_{(aq)} \longrightarrow BaCO_3(s)$.)**	• Carry out titration experiments to determine concentration of a given solution.

TERM III

TOPIC 27: **IONIC CHEMISTRY AND QUALITATIVE ANALYSIS** **DURATION:** 10 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to identify ions from a series of specific reactions and differentiate between ions using a series of ionic reactions.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define an ion (cation and anion). • Recognize the precipitates and complex ions produced by specified cation – anion reaction. • Differentiate between ions using a series of ionic reactions. • Define redox • Explain redox reaction in term of electron transfer. • Compare the oxidizing and reducing power of ions from displacement and reactions. • Recognize the role of water in the products of electrolysis.	• Definition of an ion. • Precipitation reactions involving the following ions Mg^{2+}(aq), Ca^{2+}(aq), Fe^{3+} (aq), Zn^{2+} (aq), Cu^{2+} (aq), Fe^{2+} (aq), Al^{3+} (aq) with Cl^-(aq), OH^- (aq), CO_3^{2-}(aq). • Complex ions; limited to dissolving of specific metal hydroxides in excess ammonia solution or sodium hydroxide formula of the following are required $Cu(NH_3)_4^{2+}$, $Pb(OH)_4^{2-}$, $Al(OH)_4^-$ ***Note: No instruction on equations is required.*** • Redox reactions: - Definition (note changes in the charge of the ion) - Electron transfer Useful illustrations, Fe^{2+}(aq), Fe^{3+}(aq) with H_2O_2/H^+ (aq) • Displacement reactions as redox reactions (Balancing simple redox reactions) • Reducing power: reaction of metal/cation. • Oxidizing power of halogens: Cl_2, Br_2, I_2 only • The role of water in electrolysis products Preferential discharge of hydrogen and oxygen where appropriate from the following solutions: sodium chloride, dilute sulphuric acid (acidified water), magnesium sulphate.	• Discuss the definition of an ion. • Carry out experiments to demonstrate precipitation reactions of the mentioned substances. • Carry out experiments to demonstrate the formation of the specified complex ions and discuss the observations • Conduct a guided discussion on Redox reactions. • Conduct experiments to demonstrate displacement reactions. • Conduct a guided discussion on reducing power, oxidizing power and the role of water in electrolysis.

TOPIC 28: **ENERGY CHANGES IN CHEMICAL PROCESSES** **DURATION:** 10 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to state the types of energy and explain the heat changes in a reaction.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Learners should be able to: • Define energy. • Define exothermic and endothermic reactions using the enthalpy notation (ΔH) qualitatively. • Explain that energy changes in chemical reactions are due to bond formation and bond breaking. • Define and explain various types of heat or enthalpy changes. • Carry out experiments to determine enthalpy changes for some reactions.	• Definition of energy. • Energy changes during physical changes. Molar heat of vaporization and boiling point (latent heats) as evidence for interparticles forces. • Enthalpy notation (ΔH) for exothermic and endothermic reactions. • Enthalpy of chemical reactions Students should carryout simple quantitative work e.g. enthalpy of combustion (methanol, ethanol), enthalpy of displacement (Cu^{2+} (aq) + Fe (s)), enthalpy of solution (NaOH and conc H_2SO_4). ***(See the combustion of fuel and the internal combustion engine).*** • Combustion of hydrocarbon fuel (practical work, charcoal, methylated spirit, butane and ethane) Heat energy values of charcoal, fuel, oil, methylated spirit and natural gas.	• Brain storm on the definition of energy. • Conduct experiments to demonstrate energy changes that occur during physical changes. • Conduct a guided discussion on enthalpy notation for exothermic and endothermic reactions. • Conduct experiments to demonstrate the various enthalpies of various chemical reactions. • Demonstrate to the learners how a given enthalpy can be determined theoretically.

SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
• Use data provided or obtained experimentally to calculate or graphically determine enthalpy changes. • Explain the construction of Zn – Cu cell. • State and explain the advantages and disadvantages of different fuels	• Electro chemical cells (Conversion of chemical energy to electrical energy) Qualitatively look at the electrochemical series that students can use copper reference, sodium chloride electrolyte and metal strip electrodes. Zn – Cu Cell: teacher demonstration and measurement of potential difference. The potential E is **NOT** required. • Simple treatment of solar energy as energy from atoms. • Fuels ***(Applied Chemistry)*** - Choosing fuel. - Pollution effects of fuels.	• Conduct experiments to demonstrate how to set up and use electro chemical cells. • Conduct a guided discussion on the electro chemical series and how it can be used to predict the reactions t hat will occur in a given electro chemical cell. • Assign the learners project work on the chemistry behind solar energy • Brain storm on the criteria used to select an appropriate fuel. • Assign learners group work on the pollution effects of fuels.

TOPIC 29: **ELECTROCHEMISTRY** **DURATION:** 10 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the application of electrolysis in daily life.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Electrochemical cells (5 periods)	Learners should be able to: • Explain an electrochemical cell in terms of electron transfer processes. • Explain the construction and working of a zinc- copper cell. • Describe simple primary cells • Explain what happens when charging and discharging the battery	• Definition of electro- chemical cell. - Qualitative treatment of the electron flow in Zn (s)/Zn^{2+} (aq)/Cu^{2+} (aq)/Cu (s) • Primary – cell: (Zinc – copper cell). Daniel cell - Daniel cell in comparison to secondary cells- rechargeable cells e.g. lead - acid accumulators used in cars - Charging the battery - Discharging the battery	• Brain storm on the definition of electro-chemical cell. • Conduct experiments to demonstrate electron flow using the primary cell. • Conduct a guided discussion on comparison between the Daniel cell and secondary cells.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Electrolysis and its uses (5 periods)	Learners should be able to: • Define electrolysis. • Explain the migration of ions during electrolysis. • Explain the factors that affect the preferential discharge of ions at an electrode. • Explain electrolysis of given compounds in aqueous and molten form and give their products. • State the applications of electrolysis.	• Definition of electrolysis. • Migration of ions to the cathode and anode • Electrolysis of molten compounds e.g. lead(II) bromide. • Preferential discharge of ions. • Electrolysis of aqueous solutions. - dilute sulphuric acid (acidified water) - Sodium chloride - Copper (II) sulphate • Application of electrolysis. - Electrolysis of sodium chloride solution in industry - The castner-kellner cell. - Manufacture of sodium hydroxide and chlorine. - Copper refining - Electroplating	• Conduct a guided discussion on the definition of electrolysis. • Discussion the migration of ions to the cathodes and anode • Conduct experiments to demonstrate electrolysis of the specified molten compounds and aqueous solutions • Conduct guided discussion on the application of electrolysis.

SENIOR FOUR TERM I

TOPIC 30: **REACTION RATES AND REVERSIBLE REACTIONS** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to explain the effects of different factors on reaction rates.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
	Learners should be able to: • Define rate of reaction. • Describe some methods used to measure the rates of reactions. • Explain the effect of different factors on reaction rates. • Illustrate reaction rates graphically and explain the representation qualitatively using experimental data. • Recall simple reversible reactions. • Recognize the reversible sign and explain how reversible reactions reach a state of "balance".	• Definition of reaction rates. • Reaction rate. The effect of: concentration, pressure, temperature, surface area, light and catalysts on rate of reaction. Only qualitative, descriptive, graphical representation required, quantitative data given to illustrate a qualitative effect. - Marble chips/dilute acids. - Decomposition of H_2O_2. - Manganese (IV) oxide to catalyze H_2O_2 decomposition. - Plantinised asbestos to catalyze SO_2/O_2combination. ***Note: Candidates will be expected to appreciate the applications of reaction rate to laboratory and industrial processes.***	• Discuss the definition of rate of reaction. • Conduct experiments to demonstrate how different variables influence the rte of a given reaction. • Discuss the observation of the above reaction with the aide of graphical representation.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
		• Reversible reactions Elementary treatment incorporating the idea that two - way reactions can reach a state of "balance", equilibrium is avoided. Examples: acids - alkalis plus indicator, chromate/dichromate, acid, hydrated and anhydrous copper (II) sulphate. ***Note: The effect of changing concentration, pressure, temperature on position of equilibrium NOT required. The use in industrial processes should be regarded as optimum only (some section in applied chemistry can be used as illustration i.e. Haber process, manufacture of nitric acid, contact process).***	• Conduct a guided discussion on reversible reactions. • Brain storm on the use of reversible reactions in industrial processes.

TOPIC 31: **NITROGEN AND ITS COMPOUNDS** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the importance of co mpounds of nitrogen in natural and industrial environment.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Nitrogen (4 periods)	Learners should be able to: • Explain how nitrogen is prepared in the laboratory. • Outline the properties of nitrogen. • Explain the unreactive nature of nitrogen in comparison with oxygen. • Explain how nitrogen is isolated from air. • State the uses of nitrogen	• Laboratory preparation of nitrogen. • Properties and tests of nitrogen. • Reactions of nitrogen and oxygen with Na, Ca, P,S (Compare reactivity of nitrogen and oxygen) • Industrial preparation of nitrogen • Uses of nitrogen	• Conduct an experiment to prepare nitrogen in the laboratory. • Carry out experiments to demonstrate the properties of nitrogen. • Assign learner group work on making presentations on the industrial preparation of nitrogen. • Brain storm on the uses of nitrogen.

TOPIC 31: **NITROGEN AND ITS COMPOUNDS** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the importance of compounds of nitrogen in natural and industrial environment.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Ammonia (4 periods)	Learners should be able to: • Explain how ammonia is prepared in the laboratory. • Explain the differences in chemical reactions of ammonia gas and ammonia in aqueous solution. • Explain how ammonia is manufactured. • List the uses of ammonia	• Ammonia . - The laboratory preparation of ammonia. - Properties and tests of ammonia. - Solubility in water • Reactions of ammonia gas - With air / oxygen (catalysed and uncatalysed), with copper (II) oxide, chlorine. • Reactions of aqueous ammonia. - Reaction of ammonia solution with dilute acids and metal ions. • The industrial manufacture of ammonia – the Haber process. • Uses of ammonia - Making fertilizers – fertilizers as artificial replacements e.g. NO_2, PO_4^{3-}, SO_4^{2-} - Industrial production of nitric acid.	• Conduct an experiment to prepare ammonia. • Carry out experiments to demonstrate the properties of ammonia • Assign the learners group work on making presentations on the haber process. • Brain storm on the uses of ammonia

Nitric acid (3 periods)	Learners should be able to: • Explain the preparation and manufacture of nitric acid • Explain the reactions of dilute and concentrated nitric acid • Outline the uses of nitric acid	• Laboratory preparation of nitric acid • Reactions of nitric acid - Dilute: reactions with metals, carbonates, hydroxides, oxides - Concentrated: oxidising action, Iron (II) solution, Sulphur, Copper metal. - Acidic nature of nitrogen (iv) oxide Industrial manufacture of nitric acid and it's uses.	• Conduct on experiment to prepare nitric acid • Carry out experiments to demonstrate the properties of nitric acid. • Assign group work of making presentations on the industrial production of nitric acid. • Brain storm of uses nitric acid.

TOPIC 31: **NITROGEN AND ITS COMPOUNDS** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the importance of compounds of nitrogen in natural and industrial environment.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Nitrates (2 periods)	Learners should be able to: • Name the products when different metal nitrates are heated. • State the method of preparation of nitrates. • Test for nitrates in the laboratory.	• Effect of heat on nitrates. - Action of heat on nitrates of Na, K , Cu, Pb, Ag.. • Test for nitrates - Brown ring test for nitrates.(Teacher demonstration only)	• Carry out experiments to demonstrate the effect of heat on nitrates. • Carry out an experiment to test for nitrates.
Nitrogen compounds in the natural and industrial environment (2 periods)	Learners should be able to: • Explain the importance of compounds of nitrogen in the natural and industrial environments.	• The nitrogen cycle. - Converting nitrogen in the air to nitrates in the soil. - Returning nitrogen to the soil from plants and animals. - Returning nitrogen from the soil to the air. • Elements necessary for plant growth - N, P, K, Ca, Mg, S	• Conduct a guided discussion on the nitrogen cycle.

TERM: II

TOPIC 32: **SULPHUR AND ITS COMPOUNDS** **DURATION:** 15 Periods

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GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the uses of sulphur and it's compounds.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Sulphur (6 periods)	Learners should be able to: • Explain the extraction of sulphur from its ore. • State the properties of sulphur. • State the allotropes of sulphur. • Describe how monoclinic and rhombic sulphur are prepared in the laboratory. • Outline how sulphur reacts with oxygen, carbon, conc. nitric and conc. Sulphuric acid.	• Extraction of sulphur (the frasch process). • The allotropes of sulphur. - Rhombic - Monoclinic • Laboratory preparations of monoclinic sulphur and Rhombic sulphur. • Chemical reaction of sulphur. - Reaction with non-metals: carbon, - oxygen. - Reactions with concentrated acids: Conc. Nitric acid, Conc. Sulphuric acid. • Uses of sulphur	• Discuss the extraction of sulphur • Conduct a guided discussion on the allotropes of sulphur. • Carry out experiments to prepare monoclinic and rhombic sulphur. • Carry out experiments to demonstrate the properties of sulphur. • Brain storm on the uses of sulphur.

TOPIC 32: **SULPHUR AND ITS COMPOUNDS** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the uses of sulphur and it's compounds.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Sulphur dioxide (3 Periods)	Learners should be able to: • Explain the preparation of sulphur dioxide. • State the properties of sulphur dioxide. • Outline the uses of sulphur dioxide. • Explain the pollution effects of sulphur dioxide on the environment.	• Laboratory preparation of sulphur dioxide (sulphite + acid). Relate method of collection to properties of the gas. • Properties of sulphurdioxide - Acid character. - Bleaching action - Test with potassium dichromate (VI). Note: *reducing action not required*. - Combination with oxygen (laboratory demonstration; Pt. catalyst.) • Uses of sulphur dioxide. • Sulphur dioxide as a pollutant from the combustion of coal and heating oils.	• Carry out an experiment to prepare sulphurdioxide. • Carry out experiments to demonstrate the properties of sulphurdioxides. • Brain storm on the uses of sulphur dioxide. • Conduct a discussion on sulphurdioxide a pollutant from combustion of fuels.

TOPIC 32: **SULPHUR AND ITS COMPOUNDS** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the uses of sulphur and its compounds.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Sulphuric acid (3 periods)	Learners should be able to: • Describe the manufacture of sulphuric acid. • State the uses of sulphuric acid. • Explain the differences in chemical action between dilute and concentrated sulphuric acid. • Test for sulphates in the laboratory.	• The industrial manufacture of sulphuric acid – the Contact process. • Uses of sulphuric acid. • Reactions of dilute sulphuric acid with metals, carbonates and bases. • Reactions of concentrated sulphuric acid: dilution with water, copper (II) sulphate crystals, ethanol, sucrose. • Test for sulphates in solution with barium nitrate or barium chloride solution.	• Assign learner group work on the contact process. • Brain storm of uses of sulphuric acid. • Conduct experiments to demonstrate the properties of dilute and concentrated sulphuric acid.
Hydrogen sulphide (3 periods)	Learners should be able to: • Name the reagents used in the preparation of hydrogen sulphide gas in the laboratory. • Identify the gas from it's smell. • Explain the pollution effects of hydrogen sulphide on the environment	• Preparation of hydrogen sulphide gas in the laboratory.(only test tube preparation) • Properties of hydrogen sulphide gas (e.g. "bad eggs" smell). • Pollution effects of hydrogen sulphide on the environment.	• Conduct an experiment to prepare small amounts of hydrogen sulphide • Carry out experiments to demonstrate the properties of hydrogen sulphide. • Conduct a guided discussion on the effects of hydrogen sulphide on the environment.

TOPIC 33: **CHLORINE AND ITS COMPOUND** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to explain the chemistry of chlorine and its compounds.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Chlorine (6 periods)	Learners should be able to: • Describe and explain the laboratory preparation and manufacture of chlorine. • Outline the properties of chlorine. • Outline the uses of chlorine.	• Preparation of chlorine: Conc. HCl + Potassium mangnate (VII). • Electrolysis of chloride solutions. • Properties of chlorine gas. - Reaction of chlorine with metals (Mg, Fe, Na, Zn). - Reaction of chlorine with non metal (P, S). - Reaction of chlorine with: Water and dilute alkali. Bromides and iodides Bleaching action of chlorine - Reaction with hydrocarbons (turpentine) • Uses of chlorine	• Carry out an experiment to prepare chlorine. • Discuss the industrial manufacture of chlorine. • Carry out experiments to demonstrate the properties of chlorine. • Brain storm on t he uses of Chlorine.

TOPIC 33: **CHLORINE AND ITS COMPOUND** **DURATION:** 15 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to explain the chemistry of chlorine and its compounds.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Hydrogen chloride (9 periods)	Learners should be able to: • Explain the preparation of hydrogen chloride in the laboratory. • Explain how the composition of hydrogen chloride can be deduced from a series of chemical reactions. • Explain the properties of hydrogen chloride. • Explain the effect of a solvent on the properties of hydrogen chloride • State the uses of hydrogen chloride. • Test for chloride ions in the laboratory • State the uses of hydrochloric acid	• Preparation of hydrogen chloride in laboratory.(Common salt + conc.H_2SO_4) • Deduction of composition of hydrogen chloride using potassium manganate (VII) and iron metal, direct H_2 and Cl_2 combination • Properties of hydrogen chloride. • Reaction of hydrogen chloride with ammonia gas. • Behaviour of hydrogen chloride in water and methylbenzene. • Test for chloride ions. - Dry solid (action of Conc H_2SO_4) - Using barium nitrate and lead (II) nitrate. - Using silver (I) nitrate solution. - Uses of hydrochloric acid	• Conduct an experiment to prepare hydrogen chloride. • Carry out experiments to deduct the composition of hydrogen chloride. • Carry out experiments to demonstrate the properties of hydrogen chloride. • Carry out experiments to test for the presence of chloride ions. • Brain storm on the uses of hydrochloric acid.

TERM: III

TOPIC 34: **APPLIED CHEMISTRY** **DURATION:** 12 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the importance and application of Chemistry in every day life.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Water resource pollution (7 periods)	Learners should be able to: • State industrial and domestic uses of water. • State the causes of water pollution. • Define hard and soft water • Outline the methods of removing water hardness • Describe water treatment process. • Describe the methods of sewage treatment • Outline the products of sewage treatment.	• Industrial and domestic uses of water. • Causes of water pollution - Pollution from fertilizers, insecticides and others. - Agricultural wastes. (only the pollution aspects) - Oil pollution of the sea and lakes; the dispersal of oil slicks. • Hard and soft water - Definition - Causes of hard water - Removal of hardness (temporary and permanent hardness, include ion exchange method). • Water treatment: filtration, fluoridation and desalination. • Sewage: methods of sewage treatment; production of biogas(methane) and fertilizers.	• Discussion domestic and industrial uses of water. • Assign the learners group work on causes of water pollution. • Discuss the definitions of hard and soft water. • Discuss the causes of hard water and how to remove hardness in water. • Conduct a field trip to a water treatment plant. • Conduct a field trip to a sewage treatment plant.

TOPIC 34: **APPLIED CHEMISTRY** **DURATION:** 12 Periods

GENERAL OBJECTIVE: By the end of this topic the learner should be able to appreciate the importance and application of chemistry in every day life.

SUB-TOPIC	SPECIFIC OBJECTIVE	CONTENT	TEACHING AND LEARNING STRATEGIES
Mineral resources and industrial processes	Learners should be able to: • Outline the application of electrolysis in sodium extraction • Describe how iron is extracted by reduction. • Outline how copper is refined by electrolysis. • Define an alloy. • State some common alloys and give their composition. • Describe how sugar is manufactured in an industry.	The following processes should be used to illustrate: - - The chemical principles already covered in the course. - The influence of the fol owing factors (particular reference to East Africa) availability of raw materials, choice of site, social and economic factors, health and pollution problems, supply and demands. • Extraction of metals - Sodium Occurrence, extraction (downs cel). Uses of Sodium - Iron Occurrence, extraction, uses of iron (manufacture of steel). - Copper refining and uses of copper. - Al oys of metals Examples of al oys, brass, solder, duralumin, bronze and steel their composition. • Large scale extraction of sugar from sugar cane : *Note: Use of very simple flow – charts of the processes should be encourages*. Some of the processes are covered in the previous topics from Senior one to Senior four.	• Discuss the extraction sodium – Highlight the application of electrolysis in the process. • Discuss the extraction of iron. Highlight the application of reduction in the processes. • Discuss copper refining. Highlight the application of electrolysis. • Discuss t he definition of alloy and the compositions of the alloys that have been specified. • Discuss how sugar is manufactured or conduct a field trip to a sugar manufacturing plant.

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APPENDICE

The Periodic Table of the Elements

Group I	Group II											Group III	Group IV	Group V	Group VI	Group VII	Group 0
																	4.0 He helium 2
6.9 Li lithium 3	9.0 Be beryllium 4											10.8 B boron 5	12.0 C carbon 6	14.0 N nitrogen 7	16.0 O oxygen 8	19.0 F fluorine 9	20.2 Ne neon 10
23.0 Na sodium 11	24.3 Mg magnesium 12											27.0 Al aluminium 13	28.1 Si silicon 14	31.0 P phosphorus 15	32.1 S sulphur 16	35.5 Cl chlorine 17	39.9 Ar argon 18
39.1 K potassium 19	40.1 Ca calcium 20	45.0 Sc scandium 21	47.9 Ti titanium 22	50.9 V vanadium 23	52.0 Cr chromium 24	54.9 Mn manganese 25	55.8 Fe iron 26	58.9 Co cobalt 27	58.7 Ni nickel 28	63.5 Cu copper 29	65.4 Zn zinc 30	69.7 Ga gallium 31	72.6 Ge germanium 32	74.9 As arsenic 33	79.0 Se selenium 34	79.9 Br bromine 35	83.8 Kr krypton 36
85.5 Rb rubidium 37	87.6 Sr strontium 38	88.9 Y yttrium 39	91.2 Zr zirconium 40	92.9 Nb niobium 41	95.9 Mo molybdenum 42	– Tc technetium 43	101 Ru ruthenium 44	103 Rh rhodium 45	106 Pd palladium 46	108 Ag silver 47	112 Cd cadmium 48	115 In indium 49	119 Sn tin 50	122 Sb antimony 51	128 Te tellurium 52	127 I iodine 53	131 Xe xenon 54
133 Cs caesium 55	137 Ba barium 56	139 La lanthanum 57 *	178 Hf hafnium 72	181 Ta tantalum 73	184 W tungsten 74	186 Re rhenium 75	190 Os osmium 76	192 Ir iridium 77	195 Pt platinum 78	197 Au gold 79	201 Hg mercury 80	204 Tl thallium 81	207 Pb lead 82	209 Bi bismuth 83	– Po polonium 84	– At astatine 85	– Rn radon 86
– Fr francium 87	– Ra radium 88	– Ac actinium 89 **	– Rf rutherfordium 104	– Db dubnium 105	– Sg seaborgium 106	– Bh bohrium 107	– Hs hassium 108	– Mt meitnerium 109	– Unn ununnilium 110	– Uuu unununium 111	– Uub ununbium 112		– Uuq ununquadium 114		– Uuh ununhexium 116		– Uuo ununoctium 118

Key

relative atomic mass
atomic symbol
name
atomic number

lanthanides *	140 Ce cerium 58	141 Pr praseodymium 59	144 Nd neodymium 60	– Pm promethium 61	150 Sm samarium 62	152 Eu europium 63	157 Gd gadolinium 64	159 Tb terbium 65	163 Dy dysprosium 66	165 Ho holmium 67	167 Er erbium 68	169 Tm thulium 69	173 Yb ytterbium 70	175 Lu lutetium 71
actinides **	– Th thorium 90	– Pa protactinium 91	– U uranium 92	– Np neptunium 93	– Pu plutonium 94	– Am americium 95	– Cm curium 96	– Bk berkelium 97	– Cf californium 98	– Es einsteinium 99	– Fm fermium 100	– Md mendelevium 101	– No nobelium 102	– Lw lawrencium 103

CHEMICALS

1. cetone (Propanone) (‘O’ level)
2. lbumen egg powder/crystals (‘O’ level)
3. scorbic acid (Tablets/powder) (‘O’ level)
4. luminum (Foil and Powder) (‘O’ level)
5. Aluminum salts (nitrate, sulphate and chloride) (‘O’ level)
6. luminum potassium sulphate (‘O’ level)
7. mmonia solution (‘O’ level)
8. mmonium salts (chloride, sulphate and carbonate) (‘O’ level)
9. mmonium iron (II) sulphate (‘O’ level)
10. mmonium iron (III) sulphates (‘O’ level)
11. Ammonium hydrogen carbonate (‘O’ level)
12. mmonium thiocynate (‘O’ level)
13. Barium salts (chloride, nitrate and carbonate) (‘O’ level)
14. Benedict’s solution (‘O’ level)
15. Bicarbonate indicator (‘O’ level)
16. Bromine (‘O’ level)
17. Calcium metal (‘O’ level)
18. Calcium carbonate powder and marble chips (‘O’ level)
19. Calcium salts (nitrate, chloride and sulphates) (‘O’ level)

20. Calcium oxide (‘O’ level)
21. Calcium hydroxide (‘O’ level)
22. Calcium hypochlorite (‘O’ level)
23. Carbon rods (graphite) (‘O’ level)
24. Carbon powder (‘O’ level)
25. Carbon tetra chloride (Tetra chloromethane) (‘O’ level)
26. Cobalt (II) chloride (crystals and paper) (‘O’ level)
27. Copper (Foil powder and turning) (‘O’ level)
28. Copper (II) sulphates (anhydrous and hydrated) (‘O’ level)
29. Copper (II) salts (chloride, nitrate and carbonate) (‘O’ level)
30. Copper (II) oxide (’O’ level)
31. D-Comphor (‘O’ level)
32. 2, 6 Dichlorophenol – indophenol (DCP1P) (‘O’ level)
33. Diethyl ether (Ethoxyethane) (‘O’ level)
34. Ethanol (‘O’ level)
35. Enzymes (diastase, lipase, trypsin, zymase, urease, sucrase and amylase) (‘O’ level)
36. Glass wool (‘O’ level)
37. Hydrochloric acid (concentrated (‘O’ level)
38. Hydrogen peroxide (20 vol and 100 vol) (‘O’ level)
39. Iron (nails and filings) (‘O’ level)
40. Iron (II) salts (chloride, sulphate and carbonate) (‘O’ level)
41. Iron (II) chloride (anhydrous and hydrated) (‘O’ level)

42. Iodine solution and resublimed (‘O’ level)
43. Litmus indicator paper – red (‘O’ level)
44. Litmus indicator paper – blue(‘O’ level)
45. Litmus (solution and solid) (‘O’ level)
46. Litmus indicator – Neural (‘O’ level)
47. Lead metal (foil and shots) (‘O’ level)
48. Lead (II) salts (Nitrate, chloride, sulphates and carbonate) (‘O’ level)
49. Lead (II) oxide (‘O’ level)
50. Lead (IV) oxide (‘O’ level)
51. Lead (II) (IV) oxide (red lead oxide) (‘O’ level)
52. Magnesium oxide (‘O’ level)
53. Manganese (IV) oxide (‘O’ level)
54. Methanol (‘O’ level)
55. Methylated spirit (‘O’ level)
56. Methyl orange indicator (‘O’ level)
57. Millons’ reagent (‘O’ level)
58. Naphthalene (‘O’ level)
59. Nitric acid (concentrated) (‘O’ level)
60. Paraffin wax (‘O’ level)
61. Paraffin oil (‘O’ level)
62. Phenolphthalein indicator solid (‘O’ level)
63. Phosphorus red sticks (‘O’ level)

64. Platinum wire (‘O’ level)
65. Potassium metal (‘O’ level)
66. Potassium salts (chloride, sulphates, nitrate and carbonate) (‘O’ level)
67. Potassium chlorate (‘O’ level)
68. Potassium ferricyanide (‘O’ level)
69. Potassium ferrous cyanide (‘O’ level)
70. Potassium hydroxide (‘O’ level)
71. Potassium iodide (‘O’ level)
72. Potassium manganate (VII) (permanganate) (‘O’ level)
73. Pyrogallol (‘O’ level)
74. Sand acid washed (‘O’ level)
75. silica gel (for chromatography) (‘O’ level)
76. Silver nitrate (‘O’ level)
77. Sodium metal (‘O’ level)
78. Sodium salts (chloride, nitrate and sulphates) (‘O’ level)
79. Sodium carbonate (anhydrous and hydrated) (‘O’ level)
80. Sodium hydrogen carbonate (sodium bicarbonate) (‘O’ level)
81. Sodium hydrogen sulphates (‘O’ level)
82. Sodium citrate (‘O’ level)
83. Sodium hydroxide pellets (‘O’ level)
84. Sodium peroxide (‘O’ level)
85. Sodium nitrite (‘O’ level)

86. Starch (soluble (‘O’ level)
87. Sulphur (powder and rolls) (‘O’ level)
88. Sulphuric acid (concentrated) (‘O’ level)
89. Sudan (III) (‘O’ level)
90. Sugars (sucrose, lactose, maltose, fructose and glucose) (‘O’ level)
91. Universal indicator (solution and pH chart 1.0-14.0) (‘O’ level)
92. Vanadium pentoxide (‘O’ level)
93. Zinc (granulated and powder) (‘O’ level)
94. Zinc chloride (anhydrous) (‘O’ level)
95. Zinc salts (nitrate, sulphates and carbonate) (‘O’ level)
96. Zinc oxide (‘O’ level)

APPARATUS

1. Burettes (50 ml)
2. Stop clocks
3. Weighing balances
4. Pipettes (10ml, 20 ml, and 25ml)
5. Filter funnels
6. Filter papers
7. Retort stands and clamps
8. Conical flasks
9. Glass Beakers (50ml, 100ml, 150ml, 250ml, and 600ml)
10. Plastic beakers (250 ml)
11. Test tubes and test tube racks
12. Heating apparatus (Bunsen burner, Kerosene stove or gas stove)
13. Crucibles and lids
14. Boiling tubes
15. Corks (Assorted sizes)
16. Gas delivery tubes (Assorted sizes)
17. Thermometer (-10-110°C)
18. Volumetric flasks (250ml) (‘ ’ level)
19. Spatulas
20. Glass rods
21. Measuring cylinders (5ml, 10ml, 25ml, 50ml, 100ml, and 250ml)
22. Test tube holders
23. Weighing bottles
24. Evaporating basins
25. Mortars and pestles

26. Tripod stands
27. Round bottom flasks (250ml and 500ml)
28. Volumetric flasks (500ml, 1000ml, and 2000ml) for teacher' use
29. Glass beakers 1000 ml (for teachers' use)
30. Measuring cylinders 1000ml (for teachers' use)
31. Droppers
32. Separating funnels
33. Watch glasses
34. Wire guaze and pipe clay triangles
35. Asbestos mats
36. Reagent bottle
37. Dissecting kits
38. Microscopes
39. Microscope slides and cover slips
40. Hand lenses
41. Visking tubing
42. Rubber bungs
43. Specimen bottle
44. Petri dishes