6.0.0 STRUCTURE OF THE ATOM AND THE PERIODIC TABLE (24 Lessons)

6.1.0 Specific Objectives

By the end of this topic, the learner should be able to:

a) name and write the chemical symbols of the first twenty elements of the periodic table
b) describe the structure of the atom and write the electron arrangement of the first twenty elements of the periodic table
c) explain the electron arrangement of the atom in terms of energy levels
d) define atomic number, mass number, isotopes and relative atomic mass
e) calculate the relative atomic masses from isotopic composition
f) explain the position of an element in the periodic table in terms of the electron arrangement
g) define valency and oxidation number of an element
h) predict the type of ion formed from a given electron arrangement of an atom
i) predict the valencies and oxidation numbers from position of elements in the periodic table
j) derive the formulae of some simple compounds from valencies of elements and radicals
k) write simple balanced chemical equations.

6.2.1 Content

6.2.1 The Structure of the Atom

- Names and symbols of the first twenty elements of the periodic table.
- Simple structure of the atom; protons, electrons and neutrons; electron energy levels in atoms.

6.2.2 Atomic characteristics

- Definitions of atomic number, mass number, isotopes and relative atomic mass (reference C-12); examples of isotopes
- Calculations of relative atomic mass from relative abundance of isotopes of an element

6.2.3 The periodic table

- Build up of the periodic table for the first twenty elements on the basis of energy levels
  - rows (periods)
  - columns (groups)

6.2.4 Ion formation

- Formation of simple ions (cations and anions): qualitative treatment of the ionisation energy and electron affinity.
- Writing of the electron arrangement of ions formed from atoms; lithium, sodium, fluorine, chlorine, aluminium, magnesium and Sulphur; definition of valency and oxidation numbers.
- Derive valency and oxidation number of an element from atoms; its position in the periodic table
- Names and formulae of common radicals
- Use of valencies in determining the chemical

formulae of some common compounds
- Writing simple balanced chemical equations

6.3.0 Project
- Atomic model construction

Note: The use of chemical equations with state symbols should be emphasised henceforth

7.0.0 CHEMICAL FAMILIES; PATTERNS IN PROPERTIES (28 Lessons)

7.1.0 Specific Objectives

By the end of this topic, the learner should be able to:

a) identify alkali metals, alkaline-earth metals, halogens and noble gases in the periodic table and write their electron arrangement
b) state and explain trends in physical properties of alkali metals, alkaline-earth metals, halogens and noble gases
c) state and explain the trends in reactivity of the alkali metals, alkaline-earth metals and halogens
d) explain the similarities in formulae of compounds formed by alkali metals, alkaline-earth metals and halogens
e) state the uses of alkali metals, alkaline-earth metals, halogens and noble gases
f) explain the unreactive nature of the noble gases in terms of their electron arrangement
g) identify the elements in a given period and write their electron arrangement
h) state and explain the trends in physical properties of elements in a period
i) state and explain the trends in chemical behaviour of elements in a given period.

7.2.0 Content

7.2.1 **Alkali metals (Group 1);** (lithium, sodium, and potassium).
- Electron arrangement, gradation in size of the atom, ion and trends in ionisation energy.
- Physical properties; appearance, melting point, boiling point, thermal and electrical conductivity
- Reaction with air, water and chlorine.
- Similarity of ions and formulae of hydroxides, oxides and chlorides of alkali metals
- Uses of alkali metals (sodium only).

7.2.2 **Alkaline - earth metals (Group 2)** (Beryllium, magnesium, and calcium)
- Electron arrangement, gradation in size of atom, ion and trends of ionisation energy
- Physical properties; appearance, melting point, boiling point, thermal and electrical conductivity
- Reaction with air, water, chlorine and dilute acids.

(Caution: Reaction between calcium and acid is violent. Use very dilute acid)

- Similarity of ions and formulae of oxides, hydroxides and chlorides
- Importance of alkaline-earth metals

7.2.3 **Halogens (Group 7);**
(Fluorine, chlorine, bromine and iodine);

- Electron configuration of fluorine and chlorine, gradation in size of atoms and ions
- Physical properties (appearance, melting point, boiling point, thermal and electrical conductivity)
- Reaction with metals, sodium, zinc, iron and water
- Similarity of ions and formulae of compounds
- Importance of fluorine, chlorine, bromine and iodine

7.2.4 **Noble gases (group 8);**
(Helium, neon, argon)

- Electron arrangement and gradation in size of atoms
- Electron arrangement - the basis of low reactivity of helium, neon and argon
- Importance of noble gases

7.2.5 Properties and trends across a period

- Period three elements (sodium, magnesium, aluminium, silicon, phosphorus, sulphur, chlorine and argon)
- Electron arrangement of the elements
- Physical properties of period three elements (atomic size, ionisation energy, melting point, boiling point, thermal and electrical conductivity)
- Reaction of period three elements with oxygen, water and dilute acids

(**Caution**: Reaction of sodium with acids is explosive. Give theoretical treatment only)

7.3.0 Project

- Construction of models of the Periodic table

8.0.0 STRUCTURE AND BONDING (20 Lessons)

8.1.0 Specific Objectives
By the end of this topic, the learner should be able to:

a) describe the role of the outer electrons in determining chemical bonding
b) explain qualitatively the formation of covalent and ionic bonds
c) illustrate the covalent and ionic bonds using diagrams
d) explain the unique nature of the metallic bonding
e) state the effect of intermolecular forces of attraction on physical properties of substances
f) distinguish between bond types on the basis of physical properties of substances
g) compare and explain the changes in bond type across a period
h) select appropriate materials for use based on bond type.

8.2.0 Content

8.2.1 The role of outer electrons in chemical bonding

- significance of the outer electrons in chemical bonding.
- the noble gas electron arrangement
- electron transfer and ionic bonding
- electron sharing and covalent bonding
- use dot (.) and cross (x) diagrams to illustrate bonding, electrostatic forces of attraction in the following: molecular (iodine), giant

covalent (diamond, graphite and silicon (IV) oxide), giant ionic (sodium chloride) and giant metallic (copper)
- other types of bonds: coordinate, hydrogen bond, Van der waals forces of attraction (simple explanation only)
- the influence of hydrogen bonds and Van der waals forces on physical properties (melting point, boiling point, solubility, electrical and thermal conductivity)

8.2.2 Types of bonds across a period (period 3)
- Changes in types of chemical bonds in oxides and chlorides of sodium, magnesium, aluminium, silicon, phosphorous, Sulphur and chlorine.

Note: Use of models to illustrate bonding should be encouraged.

8.2.3 Applications
Selection of materials for various uses; e.g. diamond, graphite and aluminium

8.2.6 Project
Investigation of materials in terms of their structure and bonding.

9.0.0 SALTS (20 Lessons)

9.1.0 Specific Objectives
By the end of this topic, the learner should be able to:
a) select and use appropriate methods of preparing particular salts
b) explain the terms saturated solution, crystallisation, neutralisation and precipitation
c) write ionic equations for the preparation of salts
d) state types of salts
e) identify soluble and insoluble salts
f) describe and explain from experimental observations the action of heat on various salts
g) state uses of some salts.

9.2.0 Content

9.2.1 Methods of preparing salts
- preparation of soluble salts by reaction of acids with; metals, metal hydroxides, metal oxides, metal carbonates and metal hydrogen carbonates
- preparation of insoluble salts by precipitation (ionic equations required)
- direct combination reaction (e.g. sodium with chlorine, iron with sulphur)
- Types of salts; normal, acid and double salts.

9.2.2 Solubility of salts
- Solubility of sulphates, chlorides, nitrates and carbonates in water
- Relationship between method of preparation and solubility

Note: The solubility of hydroxides and oxides should be considered along with others

9.2.3 Action of heat on salts
- Effects of heat on the following salts; carbonates, nitrates, sulphates and hydrated salts (include ammonium salts)
- Applications
  - use of lime to change soil pH
  - use of salts as anti - acids
  - use of salts as inorganic fertilizers

9.2.4 Project
Analysing anti-acid drugs.

10.0.0 EFFECT OF AN ELECTRIC CURRENT ON SUBSTANCES (16 Lessons)

10.1.0 Specific objectives
By the end of this topic, the learner should be able to:

a) define the terms conductor and non-conductor; electrolyte and non - electrolyte
b) classify solutions and molten substances as electrolytes and non-electrolytes
c) distinguish between electrolytes and non-electrolytes in terms of the particles they contain
d) explain the process of electrolysis and define the terms anode and cathode
e) state the products of electrolysis of a binary electrolyte
f) state some applications of electrolysis.

10.2.0 Content

10.2.1 Conduction of electricity

- Conductors and non-conductors
- Test for conduction of electricity by;
  - Solids, metals and non metals; (wood, aluminium foil, sodium chloride, sugar and lead(II) bromide)
  - aqueous solutions of: sugar, urea, copper(II) chloride, sodium chloride and mineral acids.
  - melts: Sulphur, lead(II) bromide or lead(II) iodide and sugar
- Electrolytes and non-electrolytes
- Ions as the particles in electrolyte solutions and melts
- Molecules as the particles in non-electrolyte solutions and melts

10.2.2 Electrolysis

- Passage of a direct electric current through an electrolyte (electrolysis of molten lead(II) bromide or lead(II) iodide)
- Anode and cathode
- Applications of electrolysis
  - electroplating
  - production and purification of metals

Note: details of the processes not required at this level

11.0.0 CARBON AND SOME OF ITS COMPOUNDS (20 Lessons)

11.1.0 Specific Objectives
By the end of this topic, the learner should be able to:

a) define allotropy and allotropes
b) explain the physical properties of the carbon allotropes in terms of bonding and how the properties are related to the uses of the allotropes
c) describe some chemical properties of carbon
d) describe laboratory preparation and properties of carbon (IV) Oxide (Carbon dioxide)
e) state and explain the physical and chemical properties of carbon(IV) Oxide (Carbon dioxide)
f) describe laboratory preparation and some properties of Carbon (II) Oxide (Carbon monoxide)
g) describe the chemical reactions of carbonates and hydrogen carbonates

h) describe the manufacture of sodium carbonate
i) explain the advantages and disadvantages of Carbon(IV) oxide and carbon(II) oxide gases in the atmosphere
j) explain the importance of carbon compounds in the natural environment and industry.

11.2.0 Content

11.2.1 Forms of carbon

- Diamond, graphite and charcoal: structure, physical properties and uses (relate uses to structure and physical properties)

11.2.2 Chemical properties of carbon

- Consider combustion, reaction with acids and reducing action

11.2.3 Preparation and properties of Carbon (IV) oxide (carbon dioxide)

(Relate methods of collection to the properties of the gas)

- Reactions of the gas with water, calcium hydroxide and alkalis.
- Uses of carbon(IV) oxide (carbon dioxide)

11.2.4 Preparation and properties of carbon(II) oxide (carbon monoxide)

- Preparation of carbon(II) oxide (carbon monoxide). Physical properties
- Chemical properties; combustion, reducing action, poisonous nature such as car exhausts fumes and charcoal fire

Note: only theoretical treatment required because of its poisonous nature

11.2.5 Carbonates and hydrogen carbonates

- Action of heat and dilute acids on some carbonates and hydrogen carbonates
- Production and manufacture of sodium carbonate (Magadi Soda Company and solvay process)

Note: Use simple schematic diagrams to illustrate solvay process.

11.2.6 Importance of carbon and its oxides

- Carbon cycle
- Soft drinks manufacture
- Fire extinguishers
- The effects of Carbon(IV) oxide (carbon dioxide) and carbon(II) oxide (carbon monoxide) on the environment

11.3.0 Projects

- construction and use of simple fire extinguishers
- construction of carbon cycle chart.