CHEMISTRY Syllabus

FORM 1

1. INTRODUCTION TO CHEMISTRY

1. Definition of chemistry and its role in society
2. Properties of matter
3. States of matter
4. Mixtures and their separations
5. Conductors and non-conductors of electricity
6. Mention of drugs prescription, dosage and abuse)
7. Chemistry laboratory

1. Heating apparatus Bunsen burner, spirit
lamp, candle, gas or kerosene stove and electric heater)
2. Parts of a Bunsen burner and its flame
3. Measuring apparatus volume, temperature, mass, time)
4. Other apparatus glass ware, spatula, deflagrating
spoon, crucible, wire gauze e.tc)
5. Laboratory safety rules

2. SIMPLE CLASSIFICATION OF SUBSTANCES

1. Separation of mixtures
1. Filtration, evaporation and condensation
2. Distillation simple and fractional),
chromatography, solvent extraction as a method of extracting
oil from nut seeds, crystallization, separation by using
separating funnel, sublimation and decantation
3. Simple criteria for purity; melting point and
boiling point

2**. Effect of heat on substances**
1. States of matter solid, liquid, gases); The kinetic theory
2. Melting and boiling, condensation and evaporation of liquids in terms of kinetic theory
3. Permanent and non-permanent changes illustrate using iodine, wax, copper (II) sulphate crystals,
potassium manganate (VII), Zinc (II) oxide e.t.c)

3. **Constituents of matter**
1. Elements, atoms, molecules and compounds
2. Names and symbols of common elements
3. Simple word equations

4. Applications
1. Fractional distillation of crude oil (e.g changamwe oil refinery) and liquid air, salt extraction e.g. Magadi
soda
Company and Ngomeni; removal of stains from fabrics (dry cleaning); obtaining cream from milk

5. Projects
1. Extraction of natural dyes, medicines and oils from plants
2. Construction and use of a fractionating column

3. ACIDS, BASIS AND INDICATORS

1. Acid/Base indicators
1. Plant-extracts as simple acid-base indicators
2. Common acid-base indicators, universal indicators and pH scale
3. Acidic, neutral and basic/alkaline solutions illustrated by the use of the following examples; water, aqueous solution/suspension; lemon juice, soap, wood ash, baking powder, anti-acid tablets and powders, toothpaste, sour milk, ammonia, ammonium sulphate, sodium chloride, sodium hydroxide, carbon (IV) oxide, sulphur (IV) oxide, sulphur acid, hydrochloric acid, nitric acid, calcium hydroxide and magnesium oxide

2**. Simple properties of acids and bases**

1. Reaction of dilute acids with metals, metal oxides, hydroxides, carbonates and hydrogen carbonates
2. Effects of acids on substances

3. Applications
1. Use of acids and bases

4. Projects
1. Investigate various plant extracts and use them as acid/base indicators

4. AIR AND COMBUSTION

1. **Composition of air**

1.Approximate percentage of nitrogen and oxygen in air by volume mention of carbon dioxide and noble gases as other constituents of air)
2. Quantitative determination of oxygen in air using copper, iron fillings and burning candle
3. Burning of substances in air; carbon, sulphur, phosphorus (CARE), sodium and copper
4. Oxygen as an active part of air mass changes involved)
5. Fractional distillation of liquefied air
6. Rusting: conditions, composition and prevention

2. Oxygen

1. Laboratory preparation of oxygen using 20 volume by volume (v/v) hydrogen peroxide with water(relate methods of collection to the properties of the gas)
2. Properties; physical and chemical
3. Combustion of elements in oxygen (metals and non-metals)
4. Competition for combined oxygen illustrated by the reaction of magnesium with carbon (IV) oxide, lead (II) oxide and copper(II)oxide
5. Mention atmospheric pollution due to burning in oxygen

3. Reactivity series
1. Order of reactivity of elements from reaction with oxygen: potassium, sodium, calcium, magnesium, aluminium, carbon, zinc, iron, lead and copper
2. Uses: oxy-acetylene in welding; life support functions

4. Application
1. Extraction of metals - use the concept of reactivity series only)
5. Projects

1. Determination of oxygen in water from different sources. Investigate industrial processes of large scale oxygen production (e.g the British Oxygen Company (BOC) Kenya Limited)

5. WATER AND HYDROGEN

1. Water

1. Sources of water; Burning of organic matter e.g burning candle in air(test for carbon (IV) oxide and water vapour using calcium hydroxide and cobalt chloride paper or anhydrous copper (II)sulphate respectively)

2. Water as an oxide of hydrogen
3. Reaction of sodium, calcium, magnesium with cold water
and reaction of magnesium, zinc, iron with steam.

4. Hydrogen

1. Laboratory preparation of hydrogen by reacting a metal with dilute acid. Test for hydrogen
2. Properties: physical and chemical
3. Oxidation and reduction (Oxygen gain and removal only)
4. Uses - manufacture of margarine, rocket fuels,
ammonia, hydrochloric acid, Oxy-hydrogen flame for welding and
weather balloons)

5. Project
1. Identification of common pollutants of water from local sources and suggesting their control

* FORM 2

1. STRUCTURE OF THE ATOM AND PERIODIC TABLE

1. The structure of the atom

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

2. Atomic characteristics

1. Definition of atomic number, mass number, isotopes
and relative atomic mass (reference C-12); Examples of isotopes
2. Calculation of relative atomic mass from relative
abundance of isotopes of an element

3. The periodic table

1. Build up of the periodic table for the first twenty elements on the basis of energy levels

4. Ion formation

1. Formation of simple ions (cations and anions):qualitative treatment of the ionisation energy and electron affinity
2. Writing of the electron arrangement of ions formed from atoms; lithium, sodium, fluorine, chlorine, aluminium, magnesium and sulphur; definition of valency and oxidation numbers.
3. Derive latency and oxidation number of an element from atoms; its position in the periodic table
4. Names and formula of common radicals
5. Use of valencies in determining the chemical formula of some common compounds
6. Writing simple balanced chemical equations

5. Project

1. Atomic model construction

2. CHEMICAL FAMILIES; PATTERNS IN PROPERTIES

1. **Alkali metals (Group 1); Lithium, sodium and potassium**

1. Electron arrangement, gradation in size of the atom, ion and trends in ionisation energy
2. Physical properties; appearance, melting point, boiling point, thermal and electrical conductivity
3. Reaction with air, water and chlorine
4. Similarity of ions and formula of hydroxides, oxides and chlorides of alkali metals
5. Uses of alkali metals(sodium only)

2. **Alkaline-earth metals Group 2)(Berylium, magnesium, and calcium**)

1. Electron arrangement, gradation in size of atom, ion and trend of ionisation energy
2. Physical properties; appearance, melting point, boiling point, thermal and electrical conductivity
3. Reaction with air, water, chlorine and dilute acids
4. Similarity of ions and formula of oxides, hydroxides and chlorides
5. Importance of alkaline earth metals

3. **Halogens Fluorine, chlorine, bromine and iodine)**

1. Electron configuration of chlorine and fluorine, gradation in size of atoms and ions
2. Physical properties (Appearance, melting point, boiling point, thermal and electrical conductivity)
3. Reaction with metals, sodium, zinc, iron and water
4. Similarity of ions and formulae of compounds
5. Importance of fluorine, chlorine, bromine and iodine

4. Noble gases (Helium, neon, argon)

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

5. Properties and Trends Across a period

1. Period three elements sodium, magnesium, aluminium, silicon, phosphorus ,sulphur, chlorine and argon)
2. Electron arrangement of the elements
3. Physical properties of period three elements atomic size, ionisation energy, melting point, boiling point, thermal and electrical conductivity)
4. Reaction of period three elements with oxygen, water and dilute acids. (Caution: Reaction of sodium with acids is explosive. Give theoretical treatment only)

6. Project

1. Construction of the models of the periodic table

3. STRUCTURE AND BONDING

1. The role of outer electrons in chemical bonding

1. Significance of outer electrons in chemical bonding
2. The noble gas electron arrangement

3. Electron transfer and ionic bonding
4. Electron sharing and covalent bonding
5. 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)

6. Other types of bonds: coordinate, hydrogen bond,
van der waals forces of attraction(simple explanation only)
7. The influence of hydrogen bonds and Van der waals
forces on physical properties melting point, boiling point,
solubility, electrical and thermal conductivity)

2. **Types of Bonds Across a Period**

1. Changes in types of chemical bonds in oxides and chlorides of sodium, magnesium, aluminium, silicon, phosphorus, Sulphur and chlorine

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

4. Project
1. Investigation of materials in terms of their
structure and bonding

4. SALTS

1. **Methods of preparing salts**

1. Preparation of soluble salts by reaction of acids with; metals, metal hydroxides, metal carbonates and metal hydrogen carbonates
2. Preparation of insoluble salts by precipitation (ionic equations required)
3. Direct combination reaction(e.g. sodium with chlorine, iron with sulphur)
4. Types of salts; normal, acid and double salts

2**. Solubility of salts**

1. Solubility of sulphates, chlorides, nitrates and carbonates in water
2. Relationship between method of preparation and solubility

3. Action of heat on salts
1. Effects of heat on the following salts; carbonates, nitrates, sulphates and hydrated salts (include ammonium salts)
2. Applications

4. Project
1. Analysing anti-acid drugs

5. EFFECT OF AN ELECTRIC CURRENT ON SUBSTANCES

1. Conduction of electricity
1. Conductors and non-conductors
2. Test of conduction of electricity by:

* FORM 3

1. GAS LAWS

1. Boyle's law and Charles' law
1. Boyle's law, Charles law and combined gas laws
2. Explanation of the laws
3. Calculations involving gas laws

2. **Grahams' law of diffusion**

2. THE MOLE: FORMULAE AND CHEMICAL EQUATIONS

1. **The mole as a basic unit**
1. Molar mass
2. Relative atomic mass
3. Conversion of mass in grams to moles and vice versa

2. **Determination of formulae**

Empirical and mass formulae, Molar solutions . Molar gas volume

3. ORGANIC CHEMISTRY 1 (HYDROCARBONS)

1. Alkanes
2. Alkenes
3. Alkynes

4. **Action of heat on nitrates**

4. NITROGEN AND ITS COMPOUNDS

1. Isolation of nitrogen gas from air
2. Laboratory preparation of nitrogen gas
3. Oxides of nitrogen (nitrogen (I) oxide, nitrogen (II) oxide, nitrogen (iv) oxide)

4. **Ammonia**

5. **Nitric acid**

SULPHUR AND ITS COMPOUNDS

1. Occurrence and extraction of sulphur
2. Sulphur (iv) oxide (sulphur dioxide)
3. Manufacture of sulphuric(vi) acid
4. Properties of sulphuric(vi) acid
5. Hydrogen sulphide

6. CHLORINE AND ITS COMPOUNDS

1. Chlorine
2. Hydrogen chloride
3. Effects of solvent on the properties of hydrogen chloride
4. Use of hydrogen chloride gas

* FORM 4

1. ACIDS, BASES AND SALTS

1. Acid and bases
1. Acids as substances which dissociate in water to give hydrogen ions
2. Bases as substances which dissociates in water to give hydroxide ions
3. Weak and strong acids and bases

2. Characteristics of amphoteric oxides and hydroxides
1. Reactions with acids and alkalis

3. **Role of solvent**
1. Characteristics of hydrogen chloride in methyl benzene and aqueous solution
2. Reaction of dry and aqueous ammonia

4**. Salts**
1. Salts as ionic compounds formed when cations combine with anions
2. Precipitation reactions

5. **Complex ions**
6. **Water and hardness**

2. ENERGY CHANGES IN CHEMICAL AND PHYSICAL PROCESSES

1. Endothermic and exothermic reactions
1. Enthalpy notation for exothermic and endothermic reactions

2. **Latent heat**
1. Molar heat of fusion and vaporization as evidence of overcoming forces of attraction between particles

3. **Quantitative determination of enthalpies**
1. Formation of hydrogen chloride gas from hydrogen and chlorine

4. **Simple energy level diagrams**

1. Hess Law
2. Relate heat of solution to hydration and lattice energy Common fuels; Energy contents of:
1. Charcoal, fuel, oil, ethanol (methylated spirit), kerosene and diesel
2. Choice of fuel
3. Precautions necessary when using fuels

6. Pollution by common fuels

3. REACTION RATES AND REVERSIBLE REACTIONS

1. Reaction rates
1. Definition of rate of reaction
2. Collision theory and activation energy (qualitative treatment only)
3. Qualitative treatment of the effects of concentration, pressure, temperature.

2. **Reversible reactions**

1. Equilibrium as the state of balance
2. Le chateliers principle
3. Uses in industrial processes(Haber and contact processes)

4. ELECTROCHEMISTRY

1. Redox reactions
1. Electron transfer(gain and loss of electrons)
2. Determination of oxidation numbers
3. Use an illustration of iron (II)
2. Displacement reactions (as redox reactions)
1. Reducing power
2. Oxidising power of halogens

3. **Electrochemical cells**

1. Qualitative treatment of the electron flow in zinc and copper
2. Standard electrode potentials

4. **Electrolysis**

1. Role of water in electrolysis
2. Preferential discharge in electrolysis
3. Factors affecting preferential discharge

5. Applications
1. Extraction of metals
2. Copper refining, electroplating

METALS

1. Metals, methods of extraction:
1. Chief metal ores of: sodium, aluminium, zinc, iron, copper and lead
2. General methods of extraction (electrolysis and reduction)
3. The electrolytic production of sodium and aluminium
4. Extraction of iron, copper and zinc from their ores.

Properties of metals

1. Physical properties
2. Chemical properties
3. Uses of metals and their alloys
4. Pollution effect of the industrial production of metals on the environment

6. ORGANIC CHEMISTRY II (ALKANOLS AND ALKANOIC ACIDS)

1. Alkanols
1. General formula(ROH)
2. Preparation of alkanols
3. Uses-solvents, fuels and pharmaceuticals

2. Alkanoic acids
1. General formula -RCOOH
2. Nomenclature
3. Preparation by oxidation of primary alkanols
4. Gradual change in physical properties
5. Acid properties

3. **Detergents**
1. Soapy detergents
2. Soapless detergents
3. Polymers
4. Names of some natural polymers and fibres
5. Names of some synthetic fibres and polymers
6. Synthetic rubber
7. Advantages and disadvantages of synthetic polymers and fibres over those of natural origin
8. Uses of polymers and fibres

7. RADIOACTIVITY

1. Stability of isotopes of elements
1. Types of radiation, beta and gamma rays
2. Radioactive decay as measured by half life
3. Nuclear equations: changes in nuclei resulting from radioactive decay by alpha and gamma rays
4. Qualitative treatment of fission and fusion

2. Uses and importance of radioisotopes in chemistry, medicine, carbon dating and agriculture

3. Pollution effects of radioactivity
1. Dangers of radioisotopes
2. Environmental pollution