FIRST TERM Chemistry E-LEARNING NOTE

Name_____ Date_____

FIRST TERM E-LEARNING NOTE

SUBJECT: CHEMISTRY **CLASS: SS1**

SCHEME OF WORK

WEEK	TOPIC
1.	INTRODUCTION TO CHEMISTRY
2.	LABORATORY FAMILIARIZATION
3.	NATURE OF MATTER
4.	ELEMENTS & SYMBOLS, VALENCY
5.	COMPOUNDS AND MIXTURES
6.	STANDARD SEPARATION TECHNIQUES FOR MIXTURES
7.	PARTICULATE NATURE OF MATTER
8.	IUPAC NOMENCLATURE OF CHEMICAL COMPOUNDS
9.	ATOMIC NUMBER, MASS NUMBER, ISOTOPES AND CALCULATIONS
10	STRUCTURE OF THE ATOM: ORBITALS AND ELECTRONIC STRUCTURE OF THE ATOM
11	REVISION
12	EXAMINATION

REFERENCE MATERIALS

- New School Chemistry for Senior Secondary School by Osei Yaw A.
- Practical Chemistry for Schools and Colleges by G. O. Ojokuku
- Calculation in Chemistry by E.U. Akusoba and G.O Ewelukwa
- WASSCE Past Questions and Answers on Chemistry
- UTME Past Questions and Answers on Chemistry

WEEK ONE
TOPIC: INTRODUCTION TO CHEMISTRY

CONTENT

- CHEMISTRY AS A SCIENCE SUBJECT
- BRANCHES OF CHEMISTRY
- SOME LABORATORY APPARATUSES AND THEIR USES

CHEMISTRY AS A SCIENCE SUBJECT

Science is an organized body of knowledge gathered through systematic experimentations and philosophical observations. Chemistry can be defined as a branch of science which deals with the study of the nature, structure, composition, properties and uses of all forms of matter and the changes in structure and composition which matter undergoes.

BRANCHES OF CHEMISTRY

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Chemistry is divided into three main branches, namely
Physical chemistry
Organic chemistry
Inorganic chemistry

Physical chemistry deals with the physical aspect of chemistry like quantum theory, heat and electricity.
Organic chemistry deals with the study of carbon and its compounds.
Inorganic chemistry deals with the study of elements, their properties and uses

SCIENTIFIC METHODS OF DISCOVERIES

Scientific method of discovery includes the following steps and stages:

1. Observation
2. Pattern
3. Problem
4. Hypothesis,
5. Experiments
6. Theory
7. Law

Hypothesis refers to a prediction or guesses which explains an observed problem. When the hypothesis has been tested and found to be true within the limits of available evidence, it becomes a theory. A theory which has been extensively tested and proven correct without any exception becomes a scientific law.

EVALUATION

1. Define chemistry
2. State the stages or steps involved in scientific discoveries
3. When does a theory become a scientific law?

APPLICATIONS OF CHEMISTRY

Chemistry is applied in our everyday life as different activities take place in the environment. The effect of chemistry is felt in different aspects of life such as cooking, washing with soaps or detergent, digestion of food, drugs etc. Other applications of chemistry include health care, transportation, food, houses and clothes.

CAREER PROSPECTS IN CHEMISTRY

Chemistry is involved in our everyday lives and there is a vast range of careers open to those who have studied chemistry at any level. Great career opportunities exist both inside and outside the laboratory. You can choose a career from different fields such as:

1. Pharmaceutical/drug development
2. Science education
3. Chemical engineering
4. Mining and Metallurgy
5. Pure and applied chemistry
6. Petroleum and Petrochemical Engineering
7. Quality control
8. Medicine and surgery
9. Chemical analysis/forensic science
10. Environmental Chemistry
11. Science Laboratory Technology
12. Biochemistry etc

EVALUATION

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1. State five applications of chemistry in our daily life.
2. Mention five adverse effects of chemicals and how they can be controlled.

GENERAL EVALUATION

1. Mention ten (10) career opportunities in chemistry.
2. List the branches of chemistry.

READING ASSIGNMENT

- New School Chemistry for SSS by O.Y Ababio. Pg 2 to 7
- Practical Chemistry for School and Collegs by G. O. Ojokuku pg 2-15

WEEKEND ASSIGNMENT

1. The aspect of chemistry that deals with the study of carbon and its compound is called (a) physical chemistry (b) Organic chemistry (c) Inorganic chemistry (d) Analytical chemistry
2. Which of the following is not an adverse effect of chemistry? (a) pollution (b) poisoning (c) emulsion (d) corrosion
3. A stage in scientific method of discoveries is (a) Evaporating (b) Hypothesis (c) Dehydrating (d) dissolving
4. A theory which has been extensively tested and proven correct without any exception becomes (a) scientific law (b) hypothesis (c) experiment (d) pattern
5. Career prospects in chemistry includes all the following **EXCEPT** (a) Biochemistry (b) Quality control (c) Accounting (d) Metallurgy

THEORY

1. State five applications of chemistry in our daily life
2. Mention five laboratory apparatus and their uses

WEEK TWO
TOPIC: LABORATORY FAMILIARIZATION

CONTENT

- DEFINTION OF LABORATORY
- LABORATORY APPARATUS; MEANING, USES AND IDENTIFICATION
- LABORATORY SAFETY RULES

Name_____ Date_____

DEFINITION OF LABORATORY

A laboratory is a room or building equipped for scientific experimentation or research. It is a special facility where experiments are done and typically contains scientific equipment and apparatus.

LABORATORY APPARATUS

Laboratory apparatus refers to the various tools or equipment used by scientists working in the laboratory.

Some common laboratory apparatuses include: test tube, beaker, conical flask, flat bottomed flask, round-bottomed flask, funnel (plastic or glass) thistle funnel, brush, Woulff's bottle tripod stand, retort stand, spatula, Bunsen burner, separating funnel, wire gauze, clamp, beehive shelf, gas jar, desiccated, reflux-condenser, Liebig condenser, pipette, burette, delivery tube, deflagrating spoon, u-tube, thermometer, aspirator bottle, wash bottle, chemical balance, reagent bottle, fume cupboard etc.

SOME LABORATORY APPARATUS AND THEIR USES

1. **EVAPORATING DISH:** It is made of porcelain. It may be round or flat bottomed. It is used in the evaporation of solution to dryness
2. **BEAKER**: It is available in different sizes. It is flat bottom cylindrical, graduated and usually with a lip for easy pouring of solution. It is used to hold solution or measure solution during an experiment.
3. **ASPIRATOR BOTTLE:** It is a Jerry can made of plastic or glass with a screw tap. It is used for storing distilled water during an experiment.
4. **CRUCIBLE:** It is usually made of porcelain with a lid to match. It can withstand high temperature hence, it is used for ignition of substances until they are decomposed.
5. **WOULFF'S BOTTLE**: It is a glass bottle used during the preparation of dry gases to hold liquid or solutions that are employed as drying agents or in absorbing unwanted gases.
6. **CONICAL FLASK:** It is commonly used during titration experiments. It is usually graduated and used to estimate the volume of a solution.
7. **FLAT AND ROUND BOTTOM FLASKS:** They are made of glass and are mainly used for boiling especially during distillation experiments.
8. **STANDARD VOLUMETRIC FLASK:** It has a flat-bottom, pear-shaped and with a narrow neck. It is used in preparing standard solutions to a specific or definite volume.
9. **FUME CUPBOARD:** It is usually a wooden cupboard with its front made of glass which can easily move up and down. It is used to prepare poisonous gases
10. **DISTILLATION FLASK:** It has a flat or round bottom with a slanting long side arm. It is used during distillation.
11. **BELL JAR**: It is made of thick glass, cylindrical, tall and usually with a knob at the top. It is used in combustion experiments.
12. **GAS JAR:** It is made of thick glass, cylindrical, tall and sealed at the bottom. It is used for the collection of gas over water or dry gas
13. **DROPPING BOTTLE OR DROPPING PIPETTE:** It is used in keeping or transferring solutions or reagents that are required in drops during experiments.
14. **SPATULA:** It is made of iron which looks like a spoon. It is used in transferring little quantity of solids into test tubes
15. **BURETTE:** It is used during titration experiments and also in transferring small volume of solution.
16. **RETORT STAND WITH CLAMP**: It is used as support during experiments
17. **DESSICATOR**: It is used in keeping and drying solids in an atmosphere that is dry and free of dust.
18. **MEASURING CYLINDER**: It is used to measure the volume of solutions.
19. **KIPPS APPARATUS**: It is used in the intermittent supply of gases.

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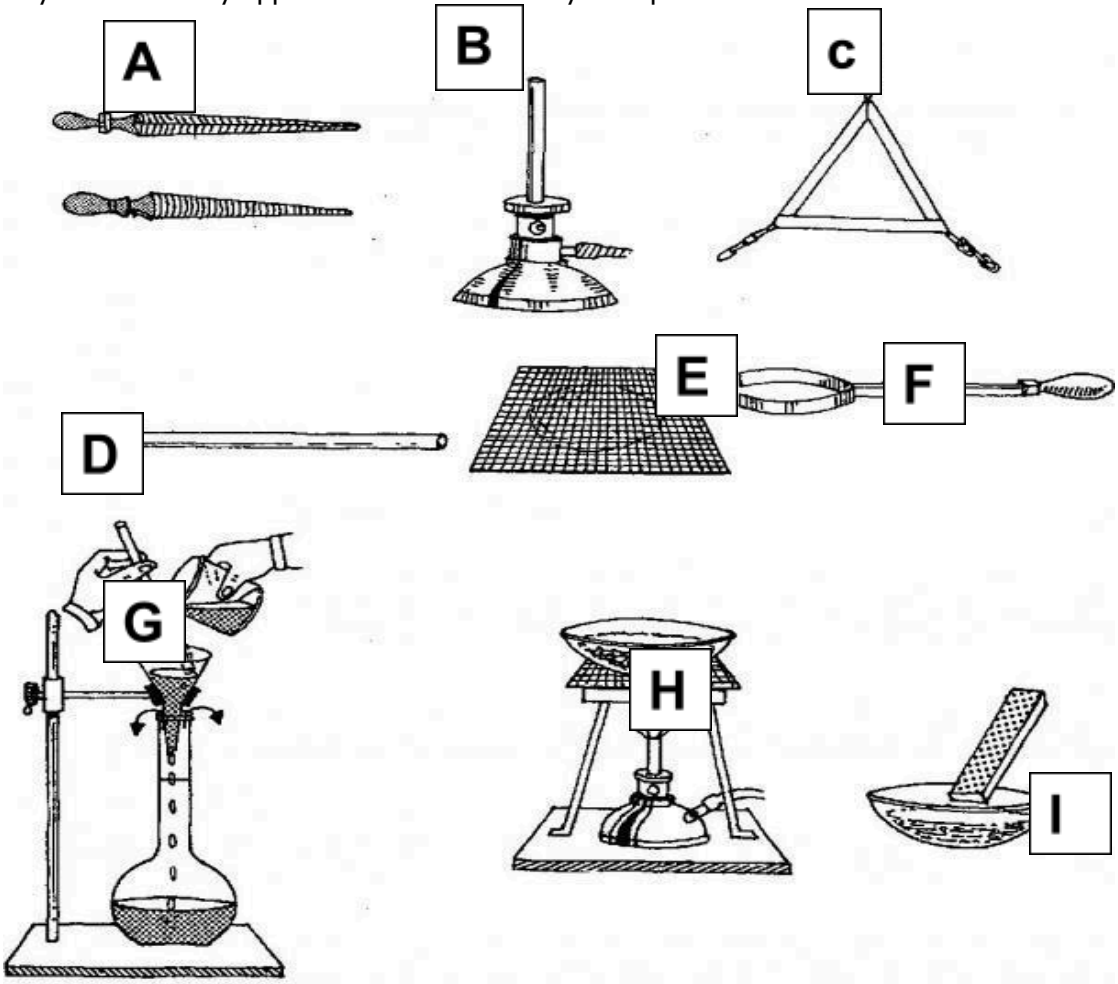
20. **WIRE GUAZE**: It is used as a support for flasks during heating.
21. **FILTER FUNNEL**: It is used in filling the burette or in supporting the filter paper during filtration.
22. **CONDENSER (LIEBIG)**: It is used in cooling or condensing vapour into liquid during distillation or when refluxing.
23. **CENTRIFUGE**: It is used in separating fine solid particles in a liquid.
24. **TEST-TUBE**: It is used in qualitative analyses to hold reactants'
25. **SEPARATING FUNNEL:** It is used in the separation of immiscible liquids.

EVALUATION

1. Mention ten (10) laboratory pieces of apparatus you know and their uses
2. Define (a) Laboratory (b) Laboratory apparatus

IDENTIFICATION OF SOME LABORATORY APPARATUS

Identify the laboratory apparatuses and laboratory set-up labeled A-I below:



LABORATORY SAFETY RULES

1. Dress well for the laboratory: Wear lab coat, safety goggles, footwear and tie long hair back to avoid catching fire
2. Keep pathways clear by placing items such as books and bags on the shelves or under the work table.
3. Do not taste or smell chemicals
4. Unauthorized experiments or procedures must not be attempted
5. Pay close attention to any cautions described in the laboratory exercise
6. Do not leave your assigned laboratory station without the permission of the teacher
7. Do not lean, hang over or sit on the laboratory tables

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8. Fooling around or "horse play" in the laboratory is absolutely forbidden
9. Learn location of the fire extinguisher, eye wash station, first aid kit and safety shower.
10. Reports all accidents, injuries, and breakage of glass or equipment to instructor only.
11. Always follow the instructions given by your teachers
12. No eating or drinking in the laboratory at any time!
13. Leave your work station clean and in good order before leaving the laboratory

GENERAL EVALUATION

1. List ten safety measures in the laboratory
2. State the uses of: (a) Evaporating dish (b) Pipette (c) Retort stand (d) Measuring cylinder (e) Conical flask

READING ASSIGNMENT

- Practical Chemistry for School and Collegs by G. O. Ojokuku pg 2-15

WEEKEND ASSIGNMENT

1. An apparatus in the laboratory in which the preparation of poisonous gases is done is called (a) distillation tank (b) Aspirator bottle (c) fume cupboard (d) bell jar
2. In the laboratory _____ is used for the collection of a gas over water (a) gas jar (b) Woulff's bottle (c) reagent bottle (d)burette
3. Two liquids which are immiscible with each other can be separated using (a) bell jar (b) gas jar (c) wash bottle (d) separating funnel
4. An apparatus used to hold drying agents during the preparation of dry gases is (a) conical flask (b) gas jar (c) Woulff's bottle (d) flat bottom flask
5. Coloured reagent bottles are used to store reagents which are capable of _____ easily by sunlight (a) evaporating (b) decomposing (c) dehydrating (d) dissolving

THEORY

1. a. Define Laboratory
   b. List five safety measures that must be taken when in the laboratory
2. State the use of the following apparatuses
   a. Separating funnel
   b. Condenser

WEEK THREE
TOPIC: NATURE OF MATTER

CONTENT

- NATURE OF MATTER
- COMPARISON BETWEEN SOLID, LIQUID AND GAS
- TYPES OF CHANGE

NATURE OF MATTER

Matter is anything that has weight and occupies space. It exists in three states namely: solid, liquid and gas.

The fundamental difference between the three states of matter depends on the degree of movement of the particles they are made of.

SOLID STATE

The particles of a solid are tightly packed and held together by a strong electrostatic force.

The particles only vibrate to and fro about an equilibrium or a fixed position. They have a definite shape and volume and very difficult to compress.

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LIQUID STATE

The forces of attraction between molecules of liquids are weak compared to that of solids. Hence they have slight movements. This is why liquids can flow. They have definite volume but not definite shape.

GASEOUS STATE

As a result of the distance between the molecules of gases, the cohesive forces between them are very negligible and so they move randomly. Gases have no definite shape and volume. They assume the shape of the containing vessel.

EVALUATION

1. What is matter?
2. List and explain the three states of matter.

COMPARISON BETWEEN SOLID, LIQUID AND GAS

	SOLID	LIQUID	GAS
1.	Fixed mass	Fixed mass	Fixed mass
2.	Very dense	Less dense	Least dense
3.	Definite shape	Shapeless	Shapeless
4.	Definite volume	Definite volume	No volume
5.	Incompressible	Incompressible	Compressible
6.	Particles vibrate and move about a fixed position	Particles vibrate, rotate and move about a restricted space	Particles move about constantly at a fixed speed.

EVALUATION

1. Define matter
2. Compare the three states of matter in terms of (a) density (b) compressibility

TYPES OF CHANGES

Whenever a given substance is heated, its state changes. There are two types of changes: physical and chemical.

PHYSICAL CHANGE:

A physical change is a change which is easily reversible and in which no new substances are formed. Examples are:

1. Dissolution of common salt
2. Changes in states of matter such as melting of solids, freezing of liquids, evaporation of liquids, liquefaction of gases to solids, sublimation of solids.
3. Magnetization and demagnetization of iron nails.
4. Separation of mixture by evaporation, distillation, fractional distillation etc.

EVALUATION

1. What is a physical change?
2. Give two examples of a physical change.

CHEMICAL CHANGE:

A chemical change is a change which is not easily reversible and in which new substances are formed.

Examples of chemical change

1. Rusting of iron/metals.
2. Dissolution of metals and limestone in acids.
3. Fermentation and decay of substances.

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4. Changes in electrochemical cells.
5. The addition of water to quick lime.
6. Burning of materials.

COMPARISON BETWEEN PHYSICAL AND CHEMICAL CHANGES

	Physical Change	Chemical Change
1.	Easy to reverse	Difficult to reverse
2.	No new substances are formed	New substances are always formed
3.	Very little energy changes take place	There are often large heat change.
4.	No change in mass	The new substances formed have different masses but the total mass is unchanged.

GENERAL EVALUATION/REVISION

1. What is a chemical change?
2. Give two examples of a chemical change.
3. State three differences between physical and chemical changes.
4. State the function of the following laboratory apparatuses: a) Fume cupboard b) Burette (c) Bunsen burner

READING ASSIGNMENT

- New School Chemistry for SSS by O.Y. Ababio.Pg 8 -9

WEEKEND ASSIGNMENT

1. Which of the following changes is a chemical change? (a) melting of ice (b) liquefaction of air (c) slaking of lime (d) evaporation of a liquid
2. Which of the following substances will occupy a wider space? (a)carbon (iv) oxide (b) liquid milk (c) pieces of chalk (d) water
3. When a solid changes to gas directly, this process is called (a) freezing (b) sublimation (c) vaporization (d) evaporation
4. Which of the following changes produces a new substance ?(a) reaction of water with sodium chloride (b) addition of acid to base (c) turning of margarine to oil (d) evaporation of water
5. Which one of the following has a fixed shape and volume? (a) a cube of sugar (b) liquid wax (c) smoke (d) kerosene

THEORY

1. Give two differences between physical and chemical changes.
2. Give three processes, which involve a physical change

WEEK FOUR
TOPIC: ELEMENTS, SYMBOLS & VALENCY

CONTENT

- ELEMENTS AND SYMBOLS
- CLASSIFICATION OF ELEMENTS
- VALENCY

ELEMENTS AND SYMBOLS

An element is a substance which cannot be split into simpler units by ordinary chemical process. There are over one hundred known elements.

SYMBOLS OF ELEMENTS

There are three ways in which symbols of elements are derived.

1. From the first letter of the name of the element

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Element	Symbols
Hydrogen	H
Oxygen	O
Iodine	I
Fluorine	F
Nitrogen	N
Sulphur	S
Carbon	C
Phosphorus	P

2. The first letter written in capital letter and one other letter from its name written in small letter.

Element	Symbol
Chlorine	Cl
Bramine	Br
Calcium	Ca
Aluminium	Al
Magnesium	Mg
Berylium	Be
Helium	He
Neon	Ne
Lithium	L

3. The symbols of some elements were derived from their Latin names.

Elements	Latin name	Symbols
Mercury	Hydragyrium	Hg
Sodium	Natrium	Na
Iron	Ferrum	Fe
Copper	Cuprum	Cu
Silver	Argentum	Ag
Tin	Stannum	Sn
Gold	Aurum	Au
Potassium	Kalium	K
Lead	Plumbum	Pb

EVALUATION

1. How many elements are discovered now?
2. Write the symbols for the following elements: silicon, iodine, fluorine, sulphur, silver, Iron, copper, potassium and sodium.

CLASSIFICATION OF ELEMENTS

Elements can be classified into metals and non-metals.
Examples of metals include iron, zinc, tin, aluminium, copper etc.
Examples of non-metals are: Chlorine, oxygen, sulphur, fluorine, hydrogen etc.
Some elements however possess the properties of metals as well as non-metals. They are called metalloids, examples are silicon and germanium.

THE DIFFERENCES BETWEEN METALS AND NON-METALS

	Metal	Non – metals
1.	They are solids (except mercury)	They are solids, liquids and gases
2.	Good conductors of heat and electricity	Poor conductors of heat and electricity (except graphite which conduct electricity)
3.	Malleable	Brittle
4.	Ductile	Not ductile
5.	Shiny	Not shiny

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6. Often very dense (high density) Usually less dense(low density)

EVALUATION

1. What are metalloids?
2. State two differences between metals and non-metals.

VALENCY

Valency is the combining power of an element. It can also be defined as the number of hydrogen atoms that can combine with or replace one atom of that element.
Valency of an element depends on the structure of that element. At times it corresponds to the number of electrons in the outermost shells called valence electrons.
Below are the valencies of some elements:

Element	Symbol	Valency
Aluminium	Al	+3
Argon	Ar	Nil
Calcium	Ca	+2
Chlorine	Cl	-1
Sulphur	S	-2, -4 or -6
Sodium	Na	+1
Magnesium	Mg	+2
Copper	Cu	+1 or +2
Carbon	C	-2 or -4
Barium	Ba	+2
Silver	Ag	+1
Iron	Fe	+2 or +3

Valencies have either positive or negative values showing whether electrons are gained or lost. If an element gains electrons, its value is negative but positive when it loses electrons.
Generally, metals exhibit positive valencies while non – metal tend to have negative valencies. Some element exhibit more than one valency. Valency can also be called oxidation number or state.

RADICALS

A radical is a group of atoms having an electric charge either positive or negative which keeps its identity and react as a single unit. Any small group of atoms carrying a negative charge is called an acid radical. Examples of acid radicals include $S0_4^{2-}$, $C0_3^{2-}$, $N0_3^-$
The valency of a radical corresponds to the charge it carries.

Radical	Formula	Valency
Ammonium	NH_4^+	+1
Hydroxide	$0H^-$	-1
Trioxonitrate(V)	$N0_3^-$	-1
Dioxonitrate(III)	$N0_2^-$	-1
Trioxocarbonate(IV)	$C0_3^{2-}$	-2
Tetraoxosulphate(VI)	$S0_4^{2-}$	-2
Hydrogen trioxocarbonate	$HC0_3^-$	-1

GENERAL EVALUATION/REVISION

1. Define (i) valency (ii) Radical
2. Write the valency of: a) Oxygen (b) Potassium c) Sulphur d) $S0_4^{2-}$ e) NH_4^+

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3. Classify the following into physical or chemical changes: a) Rusting of iron b) Fermentation of palm wine c) Evaporation of a salt solution d) Melting of ice

READING ASSIGNMENT

- New School Chemistry for SSS by O.Y Ababio. Pg 26, 32-33

WEEKEND ASSIGNMENT

1. The combining power of oxygen is (a)+2 (b)-2 (c)-1 (d)+1
2. Which of the following is a metalloid? (a) sulphur (b) iron (c) silicon (d) carbon
3. The symbol Au represents (a) silver (b) lead (c) copper (d) gold
4. Which of the following elements is used as a standard in defining valency? (a) oxygen (b) copper (c) carbon (d) hydrogen
5. Which of the following metals is a liquid at room temperature? (a) iron (b) gold (c) tin (d) mercury

THEORY

1. a. Define an element.
   b. Write the symbols of the following elements
      (i) Manganese (ii) Caesium (iii) Cobalt
2. a. What are metalloids?
   b. Give two differences between metals and non-metal

WEEK FIVE
TOPIC: COMPOUNDS AND MIXTURES

CONTENT

- COMPOUND
- FORMULAE OF COMPOUNDS
- MIXTURES
- DIFFERENCES BETWEEN COMPOUNDS AND MIXTURES

COMPOUND

A Compound is a substance which contains two or more elements chemically combined together. A compound is formed as a result of chemical change.

Examples of compounds are

Compound	Constituent Elements
Water	Hydrogen, oxygen
Sand	silicon, oxygen
Limestone	calcium, carbon, oxygen
Common salt	sodium, chlorine
Ethanol	carbon, hydrogen, oxygen

PROPERTIES OF A COMPOUND

1. It has properties different from those of its component elements.
2. Its formation often requires large amount of heat.
3. It cannot be separated by physical means.
4. The components of a compound have a fixed ratio by mass.
5. Compounds are homogenous.

EVALUATION

1. Define a compound.
2. Give three examples of a compound.

FORMULAE OF COMPOUNDS

When an element exists as a molecule, a number is written as a subscript after the symbol of that element. For example, hydrogen is written as H_2 and oxygen as 0_2.

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A compound contains whole numbers of atoms of the component elements. Its molecular formula is written as follows.

1. The symbols of all the component elements are written close together as a group.
2. The number of atoms of each component element is written as a subscript after the symbol of that element.

Examples

Compound	**Formula**
Hydrochloric acid	HCl
Water	H_20
Ammonia	NH_3
Carbon(IV)oxide	$C0_2$
Lead II chloride	$PbCl_2$
Calcium trioxonitrate(V)	$Ca(NO_3)_2$

WRITING FORMULA FROM VALENCIES

Formulae of compounds can be deduced from the valencies of the component elements or radicals, following the rules below.

i. Write the symbols of the element or radicals in a compound
ii. Write their valencies below the symbols of elements/radicals
iii. Exchange their valencies.
iv. Now write the formula of the compound bringing the symbols of the element or radicals together

Examples

1. Write the formula of sodium tetraoxosulphate(VI)

Rule 1	Na	$S0_4$
Rule 2 & 3	1	2
Rule 4	Na_2S0_4	

2. Write the formula of calcium chloride

Rule 1	Ca	Cl
Rule 2 & 3	2	1
Rule 4	$CaCl_2$	

EVALUATION

1. Write the formulae of; (i) tetraoxosulphate(vi) acid (ii) Magnesium Chloride
2. State three properties of a compound

MIXTURES

A mixture contains two or more constituents which can easily be separated by physical methods. Examples of mixtures with their constituents are outlined below:

Mixture	Constituents
Air	Oxygen, Carbon (iv)oxide, nitrogen, rare gases, dust, moisture
Soil	Sand, clay, humus, water, air, mineral salts
Urine	urea, water, mineral salt
Palm wine	water, sugar, alkanol, mineral salts, vitamins, yeast, protein, fat
Coca-cola	water, sugar, cola, CO_2
Milk	water, sugar, fat, protein, mineral salts, vitamin
Sea water	water, mineral salts, bacteria, remains of organic matter

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Brass copper and zinc

DIFFERENCES BETWEEN MIXTURES AND COMPOUNDS

	Mixture	Compound
1.	It may be homogenous or heterogeneous.	It is always homogenous.
2.	It can be separated into its constituents by physical means	It cannot be separated into its components by physical means.
3.	The constituents can be added in any ratio by mass Hence a mixture cannot be represented by a chemical Formula.	The components are present in a fixed ratio by mass. Hence a compound can always be repre-sented by a chemical formula.
4.	The properties of a mixture are the sum of those of its individual constituents.	The properties of a compound are entirely different from those of its components.

EVALUATION

1. List five (5) compounds and their formulae
2. What is a mixture?
3. State four differences between compound and mixture

READING ASSIGNMENT

- New School Chemistry for SSS by O.Y Ababio. Pg 11, 36 to 37

GENERAL EVALUATION/REVISION

1. State the valency of the following elements and radicals: Na, K, S, O, SO_4^{2-}, NO_3^-, CO_3^{2-}
2. Write the formula of: a) Lead (ii) tetraoxosulphate (vi) b) Hydrochloric acid c) Sodium trioxocarbonate (iv) d) Calcium hydroxide

WEEKEND ASSIGNMENT

1. Which of the following is a mixture? (a) water(b) sugar(c) milk (d) starch
2. Which of the following is a compound? (a) water (b) soil (c) diamond (d) graphite
3. Which of these formulae represents ammonia? (a) NH_3 (b) NH_4^+ (c) NH_2 (d) CH_4
4. The formula for sand is (a) $C0_2$ (b) SO_2 (c) NO_2 (d) SiO_2
5. Compounds are always (a) heterogeneous (b) homogeneous (c) homogeneous or heterogeneous (d) chemogeneous

THEORY

1. a. Define (i) Compound (ii) Mixture
   b. Give two examples each of compound and Mixtures
2. a. State four differences between compound and mixture
   b. What is the formula of
   i) tetraoxosulphate (vi) acid
   ii) Ammonium sulphide
   iii) Sodium tetraoxophosphate

WEEK SIX

TOPIC: STANDARD SEPARATION TECHNIQUES

CONTENT

- STANDARD SEPARATION TECHNIQUES

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STANDARD SEPARATION TECHNIQUES

The importance of separating a mixture into its constituents cannot be over emphasized since most substances are needed in their pure form. There are many standard separation techniques. Some of these separating techniques are filtration, centrifugation and decantation. Others include sieving, magnetic separation and sublimation, evaporation, crystallization, fractional precipitation, distillation, fractional distillation, using separating funnel and chromatography.

FILTRATION

Filtration is a separation technique that involves separating an insoluble solid from liquid using a filter. For example, a mixture of chalk particles in water can be separated using filtration technique. Filtration is used in industries such as water purification plants and breweries.

CENTRIFUGATION

A CENTRIFUGE MACHINE

Centrifugation is a standard separation technique used to separate a mixture of insoluble solid from liquid by using a centrifuge. A centrifuge is a machine which can spin test tubes containing suspensions at high speed. Centrifugation is often used when there is only a small amount of material. In hospitals, blood samples are centrifuged to separate the blood cells from the plasma.

DECANTATION

Decantation is a separation technique used to separate a mixture containing insoluble solid from a liquid. This is done when the mixture is allowed to settle down with the upper clear liquid carefully poured or decanted into a clean container thereby leaving the lower solid in the container originally containing the mixture. This is a quick but inaccurate method of separating the components of a mixture.

EVAPORATION

Evaporation is a separation technique used to recover soluble solute from its solvent. For example salt can be separated from salt solution by evaporation.

A Salt Evaporation Pond

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Salt is produced in the San Francisco area mainly by solar evaporation, where seawater is fed into large ponds that are gradually evaporated by the sun and the wind. After the water is evaporated, the salt is collected.
Evaporation is used in salt –making industries.

CRYSTALLIZATION
Crystallization is used to obtain pure crystals of salts which decompose easily on heating from its solution. The solution is concentrated by heating. It is allowed to cool down and crystals start to form. To induce crystal formation:

(a) add crystals of the salt (seedling)
(b) scratch the inside of the container with a glass rod
Crystallization is used in industries where purity of the product is important, such as in drug industries and sugar industries.

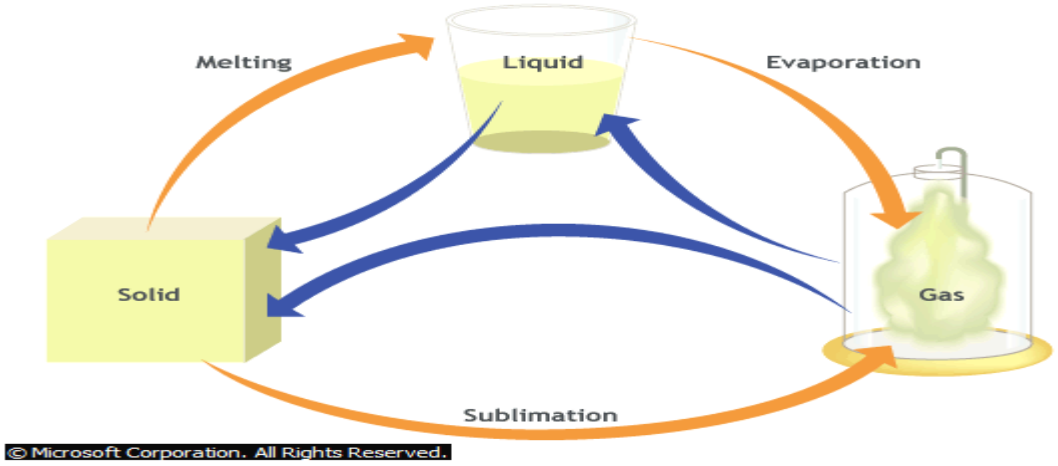
FRACTIONAL CRYSTALLIZATION
It is used to separate two or more solutes (solids) which are present in the same solution. The solutes to be separated must have different solubilities at different temperatures. Starting from a particular temperature, as cooling of the solution of those solutes takes place, the crystals of the relevant solutes appear leaving the other solutes in the solution.

EVALUATION
1. Explain briefly the following methods of separation of mixtures: (a) Filtration (b) Decantation (c) Centrifugation
2. Explain how a pure sample of copper (II) tetraoxosulphate (VI) crystals can be obtained from its solution in the laboratory.
3. How would you separate a mixture of $PbCl_2$ and NaCl

PRECIPITATION
In precipitation, a difference in the solubility of a solid in two different miscible liquids is used. For example, $FeS0_4$ is soluble in water but not on ethanol. If ethanol is added to a solution of $FeS0_4$ in water, the $FeS0_4$ will be precipitated out of the solution and filtered out.

SUBLIMATION
Sublimation is the change of state from solid to gas directly on application of heat. Examples of substances that sublime are iodine and ammonium chloride. Sublimation can be used to separate these substances. The pure crystal recovered is the sublimate.

Name_____ Date_____



DISTILLATION

This is used to recover a solvent from a solution. It involves vapourising a liquid and then condensing the vapour into a liquid called distillate. The solute and other impurities remain in the distillation flask. It is used in gin and water distilleries to manufacture gin and distilled water.

FRACTIONAL DISTILLATION

This is used to separate a mixture of two or more miscible liquids based on their boiling points. When two liquids have boiling points that are very close (less than 100°C the use of simple distillation becomes difficult. A fractionating column is inserted into the distillation flask. It is used to separate crude oil into fractions, separation of liquid air into oxygen and nitrogen, manufacture of spirits and to separate benzene and methyl benzene mixture.

EVALUATION

1. State the major difference between distillation and fractional distillation in terms of (a) Features of the apparatus (b) Mixtures to be separated
2. Explain the following separation techniques

(a) Precipitation
(b) Sublimation

SEPARATING FUNNEL

This is used to separate immiscible liquids. It depends on the densities of the two liquids. The less dense will be on top and the denser below. It is used to separate water and kerosene

SIEVING

Name_____ Date_____

This is used to separate solid particles of different sizes. Particles smaller than the size of the sieve (mesh) pass through leaving behind particles of larger sizes. It is used in gold and diamond mines and in garri industries.

MAGNETIC SEPARATION

This is used to separate magnetic substances from non-magnetic particles. It is used in mining and steel industries. It can be used to remove magnetic impurities from tin ores. It can be used to separate iron filings from sulphur powder.

CHROMATOGRAPHY

This method uses a solvent moving over an adsorbent medium (paper) which is porous to separate mixtures of solutes.

A chemist uses liquid chromatography to analyze a complex mixture of substances. The chromatograph utilizes an adsorptive medium, which when placed in contact with a sample, adsorbs the various constituents of the sample at different rates. In this manner, the components of a mixture are separated. Chromatography has many valuable applications, such as determining the level of pollutants in air, analyzing drugs, and testing blood and urine samples.

Types

1. Paper chromatography
2. Thin layer chromatography
3. Gas chromatography
4. Column chromatography

In paper chromatography, a solution, such as ink, is spotted into the paper near one end. The paper is dipped into an appropriate solvent such as water or ethanol in a closed air-tight jar. The solvent moves up the paper. The paper is removed and dried. The different spots on the paper show the different substances the solution (ink or dye) contains.

It is used in medicine to analyze blood. In industry, it is used to identify petroleum fractions. It is also used in scientific research.

CRITERIA FOR PURITY

1. The melting point and boiling point of a pure substance are fixed but change in the presence of impurities. Impurities lower the melting point of a substance and increase its boiling point
2. A pure substance gives one spot on a paper chromatogram.

GENERAL EVALUATION

1. Explain the following separation techniques. Magnetic separation, paper chromatography and sieving

Name_____ Date_____

2. Describe how you would separate a mixture of NaCl, $PbCl_2$ and NH_4Cl
3. What method can be applied to separate a mixture of iron filings and sulphur
4. Mention two criteria for purity of a substance.

READING ASSIGNMENT

- New School Chemistry for SSS by O.Y Ababio.Pg 16 to 20

WEEKEND ASSIGNMENT

1. A mixture of oil and water can be separated by (a) sublimation (b) evaporation to dryness
   (c) using a separating funnel (d) fractional distillation
2. Fractional distillation is used to separate (a) an insoluble substance from a soluble volatile substance (b) liquids with differing boiling points (c) gas, liquid or solid impurities from a mixture (d) liquid with close boiling points
3. Which of the following separating techniques can be used to separate a mixture of iodine and sodium chloride? (a) distillation (b) evaporation (c) sublimation (d) decantation
4. Which of the following is not a type of chromatography ?(a) thin layer (b) gas (c) paper (d) glass
5. Which of the following is a quick but inaccurate way of separating mixture? (a) decantation (b) evaporation (c) filtration (d) distillation

THEORY

1. Explain briefly the following separation techniques (a) evaporation (b) filtration (c) fractional distillation
2. Mention two criteria for purity of a substance.

WEEK SEVEN
TOPIC: PARTICULATE NATURE OF MATTER

CONTENT

- ATOMS AND MOLECULES
- IONS
- DALTON'S ATOMIC THEORY
- MODIFICATIONS OF DALTONS ATOMIC THEORY

ATOMS AND MOLECULES

Matter is made up of discrete particles. The main ones are atoms, molecules, and ions.
An atom is the smallest part of an element which can take part in a chemical reaction.
A molecule is the smallest particle of a substance that can exist alone and still retains the chemical properties of that substance. Molecules are made up of atoms.
Atomicity of an element is the number of atoms in one molecule of the element.
We have monatomic, diatomic and triatomic for those elements that contain one atom, two atoms and three atoms respectively in their molecules.

Examples:

Element	**Atomicity**
Hydrogen	Diatomic
Oxygen	Diatomic
Nitrogen	Diatomic
Neon	Monoatomic
Helium	Monoatomic
Argon	Monoatomic

EVALUATION

1. Define an atom.
2. Give two examples of diatomic molecules.

Name_____ Date_____

IONS

An ion is an atom or group of atoms which carries an electric charge. Such groups of atoms that carry either a positive or negative charge are called RADICALS.

An acid radical is thus a small group of atoms carrying a negative charge that keeps its identity. Examples include $S0_4^{2-}$, $N0_3^-$ e.t.c.

Generally ions are grouped as cations and anions. Cations are positively charged ions e.g Ca^{2+}, Na^+, NH_4^+ e.t.c.

Anions are negatively charged ions e.g.. $C0_3^{2-}$, $S0_4^{2-}$, Cl^-, OH^-, etc.

EVALUATION

1. What are ions?
2. State the cation and anion present in (I) H_2S0_4 (ii) NaCl (iii) $FeS0_4$

DALTON'S ATOMIC THEORY

John Dalton, British Physicist and Chemist (1808) proposed the atomic theory thus:

1. All elements are made up of small indivisible particles called atoms.
2. Atoms can neither be created nor destroyed in any chemical reaction.
3. Atoms of the same elements are exactly alike in aspect and are different from atoms of all other elements.
4. Atoms of different elements can combine in simple whole number ratios to form compounds.
5. All chemical changes result from the combination or separation of atoms

MODIFICATIONS OF DALTON'S ATOMIC THEORY

Due to new discoveries in the twentieth century, Dalton's atomic theory cannot hold in its entirety. There is need for its modification.

i. The first statement has been proved wrong by Rutherford's discovery of protons, electron and neutrons as constituents of the atom. An atom is not an indivisible solid piece.

ii. The second statement still holds good for ordinary chemical reactions. During nuclear reactions, however, the nucleus can be broken into simpler atoms giving out large amount of heat (nuclear fission). This destroys the atoms involved.

iii. The discovery of isotopes makes the third statement unacceptable. Chlorine for example has two atoms with different nucleus content and hence different relative atomic masses although the same proton numbers.

iv. The fourth statement is true only for inorganic compounds which contain a few atoms per molecule. Carbon forms very large organic molecules such as proteins, starch and fats which
contain thousands of atoms.

GENERAL EVALUATION/REVISION

1. State the modifications of the Dalton's atomic theory.
2. A mixture contains propanone, ethanol and water with boiling point of 56^0C, 78^0C and 100^0C respectively.
   a) What method will be used to separate the liquids
   b) Name the first liquid that will distil over. Explain your answer
   c) Name an industrial process that uses fractional distillation

READING ASSIGNMENT

- New School Chemistry for SSS by O.Y Ababio. Pg 25-26

WEEKEND ASSIGNMENT

1. Which of the following is not a constituent of the atom (a) proton (b) electron (c) neutron
   (d) isotope

Name_____ Date_____

2. Which of the following statement about an atom is not correct? (a) it is indivisible (b) it is destructible in some cases (c) it is the smallest part of a substance that takes part in a reaction (d) it is made up of protons, neutrons and electrons
3. Which of the following is a liquid at room temperature? (a) copper (b) gold (c) mercury (d) silver
4. How can you separate a mixture of iron filings and sulphur powder? (a) distillation (b) chromatography (c) magnetization (d) evaporation
5. What is the atomicity of neon? (a) monoatomic (b) diatomic (c) triatomic (d) polyatomic

THEORY

1. Give any two postulates of the Dalton's atomic theory.
2. (a) Differentiate an atom from a molecule.
   (b) How will an atom become an ion?

WEEK EIGHT
IUPAC NOMENCLATURE OF CHEMICAL COMPOUNDS

CONTENT

Naming of:

- **---- binary compounds**
- **---- radials and compounds having elements with variable oxidation numbers.**
- **---- tertiary and quartenary compounds.**
- **---- compounds with cations replaced with hydrogen.**

NAMING OF BINARY COMPOUNDS

Nomenclature: This is the system of naming chemical compounds. The system is called IUPAC (International union of pure and applied chemistry). The naming is determined by the constituent elements in the compound and the oxidation number if necessary.

In naming binary compounds (compounds with only two elements), electropositive elements (cations) are usually named first while the electronegative elements (anions) come last with a modification of the name end with – ide.

Examples:

Formula	IUPAC name
MgO	Magnesium oxide
H_2S	Hydrogen sulphide
NH_4Cl	Ammonium chloride
NaH	Sodium hydride

But in cases where the two elements involved are non-metals, the above rule is not followed. For example, H_2O (water) NH_3 (ammonia) and PH_3 (phosphine)

EVALUATION

Name the following compounds: (a) NaCl (b) CaO (c) H_2O_2.

Name_____ Date_____

NAMING OF RADICALS AND COMPOUNDS HAVING ELEMENTS WITH VARIABLE OXIDATION NUMERS

Radicals (group of atoms of element carrying electrical charge) are treated as a single element when naming their compounds.

Examples of radicals with their names are as follows:

Radical	IUPAC NAME
$NH4^+$	Ammonium ion
OH	Hydroxyl ion

But in naming acid radicals, the oxidation number of elements is indicated by Roman numbers in bracket.

Example:

Formula	IUPAC
NO_2	Dioxonitratei(iii) ion
NO_3^-	Trioxonitrate(v) ion
CO_3^{2-}	Trioxocarbonate(iv) ion.

Also the compounds having elements with Roman numbers in bracket indicating their oxidation numbers in that compound

Examples

Formula	IUPAC
FeO	Iron (ii) oxide
Cu_2O	Copper (i) oxide
$MgCO_3$	Magnesium trioxocarbonate (iv)

EVALUATION

1. Name the following compounds (a) Fe_2O_3 (b) CuO
2. What are the oxidation numbers of Fe and Cu in (1) above?

NAMING TERTIARY COMPOUNDS AND QUARTENARY COMPOUNDS.

These are compounds containing more than two elements.

Examples are oxo-acids, normal salts, and acid salts.

Acid	IUPAC
HNO_3	Trioxonitrate(v) acid
H_2SO_4	Tetraoxosulphate (vi) acid
H_3PO_4	Tetraoxophospate (v) acid

Examples of Normal Salts.

Normal salts	IUPAC
KNO_3	Potassium trioxonitrate (iv)
$NaSO_4$	Sodiumtetraoxosulphate (vi)
$CuCO_3$	Copper (ii) trioxocarbonate (iv)

EVALUATION

1. Determine the oxidation number of: a) C in H_2CO_3 b) Mn in $KMnO_4$ c) Cu in $CuSO_4$
2. Name the compounds in 1 above

Name_____ Date_____

NAMING OF COMPOUNDS WHOSE CATIONS HAS BEEN PARTIALLY REPLACED WITH HYDROGEN IONS.

In naming compounds whose cations have been partially replaced with hydrogen ion, the cations is named first followed by hydrogen, then the radicals present indicating the roman number standing for the oxidation number of the element that is combined with oxygen to form the radical.

E.g Formula	IUPAC
$NaHSO_4$	Sodium hydrogen tetraoxosulphate (vi)
$KHSO_3$	Potassium hydrogen trioxosulphate (iv)

GENERAL EVALUATION/REVISION:

1. Determine the following oxidation number of a) C in $LiHCO_3$ b) S in $KHSO_4$ and name the compounds
2. Write the chemical formula of the following compounds a) Oxochlorate (I) acid b) Iron (ii) tetraoxosulphate (VI) pentahydrate
3. State the uses of the following laboratory apparatuses a) Condenser b) Kipp's apparatus c)Tripod stand

READING ASSIGNMENT

- Practical Chemistry for Senior Secondary Schools By Godwin O. Ojokuku pg 20-28.

WEEKEND ASSIGNMENT

1. The compound Na_2S is called ____ (a) Sodium (ii) sulphate (b) Sodium sulphur (c) Sodium sulphide (d) Sodium sulphite.
2. The formula of sulphur (iv) oxide is (a) SO_4 (b) SO_2 (c) S_2O_4 (d) S_4O_2
3. Ammonium chloride can be written as (a) NH_4Cl (b) NH_3Cl_2 (c) NH_4HCl (d) NH_4OH
4. The IUPAC name of $NaHSO_4$ is (a) Sodium bicarbonate (b) Sodium tetraoxosulphate (vi) acid (c) Sodium sulphate (c) Sodium hydrogen tetraoxosulphate (vi)
5. Which of the following compounds have cation with variable oxidation state. (a) FeO_3 (b) $ZnCO_3$ (c) CuO (d) KU

THEORY

1. Name the following compounds (a) Fe_2O_3 (b) $KMnO_4$ (c) $KClO_3$
2. Calculate the oxidation number of (a) Sulphur in H_2SO_4 (b) Carbon in $CuCO_3$

WEEK NINE

ATOMIC NUMBER, RELATIVE ATOMIC MASSES, ISOTOPES AND CALCULATIONS

CONTENT

- ATOMIC NUMBER AND MASS NUMBER
- ISOTOPES
- CALCULATIONS OF RELATIVE ATOMIC MASS

Name_____ Date_____

CONSTITUENTS OF AN ATOM

Atoms are made up of sub-particles. Protons, electrons and neutrons. Proton has a positive charge, electron has a negative charge and neutron has no charge.

Atomic number and mass number

The atomic number of an element is the number of protons in the nucleus of its atom.
Mass number or atomic mass of an element is the sum of the number of protons and neutrons in the nucleus of its atom.
Mass Number = Number of proton + Number of neutron
An element X can be represented as

$${}_{Z}X^{A}$$

where A= Atomic mass or mass number
Z= Atomic number

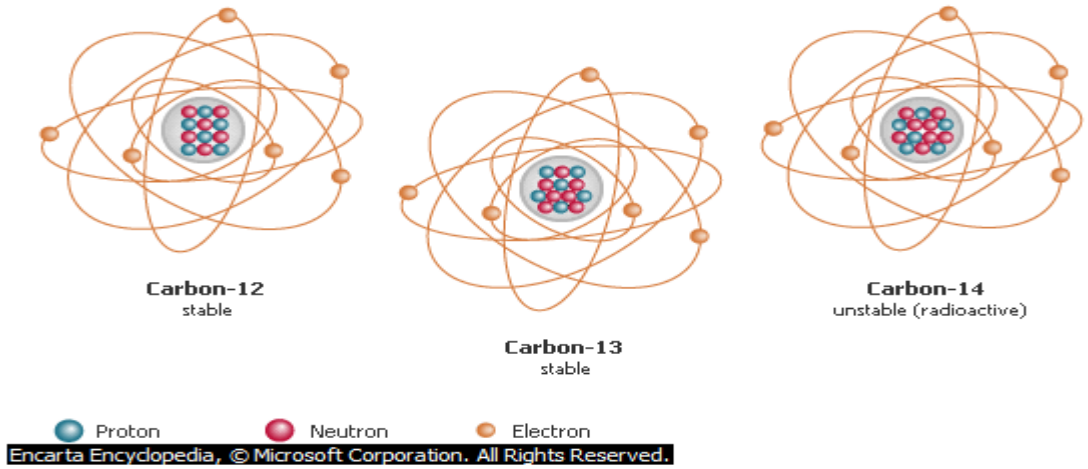
e.g. 40 mass no = 40
Ca
20 atomic no = 20

EVALUATION

1. State the constituents of an atom.
2. What is the number of proton in the following elements?
   (a) 11_B (b) 12_C
   5 6

ISOTOPES

Isotopy is the occurrence of atoms of elements having the same atomic number but different mass numbers. This is due to the difference in the number of neutrons present in the atoms. The atoms that exhibit isotopy are called ISOTOPES.
Examples of atoms that exhibit isotopy are chlorine 35_{Cl} and 37_{Cl}



Carbon- ^{12}C, ^{13}C and ^{14}C
Potassium – $^{39}K_{19}$ and $^{41}K_{19}$
Oxygen- $^{16}O_{16}$ and $^{18}O_{16}$

EVALUATION

1. Define isotopy.
2. Write the isotopes of chlorine.

CALCULATION OF RELATIVE ATOMIC MASS

Name_____ Date_____

The following is an example of calculation of relative atomic mass of an element from percentage abundance of its isotopes.

1. X is an element which exists as an isotopic mixture containing 90% of $^{39}X_{19}$ and 10% of $^{41}X_{19}$

a. How many neutrons are present in the isotope ^{41}X

b. Calculate the mean relative atomic mass of X

Solution

a. Neutrons in $^{41}X_{19}$

= 41-19 = 22

b. R.A.M $= \frac{90}{100} \times 39 + \frac{10}{100} \times 41$

$= \frac{90 \times 39 + 41 \times 10}{100}$

$= \frac{3920}{100} = 39.20$

EVALUATION

1. How many neutrons are present in the isotope $^{37}Cl_{17}$?
2. A given quantity of chlorine contains 75% $^{35}Cl_{17}$, and 25% $^{37}Cl_{17}$, determine the relative atomic mass of chlorine.

CALCULATIONS

1. The following are more examples of calculations of relative atomic masses of elements.
2. An element Y exist in two isotopic forms $^{39}Y_{18}$ and $^{40}Y_{18}$ in the ratio 3:2 respectively. What is the relative atomic mass of the element?

SOLUTION

R.A.M of Y $= \frac{3}{5} \times 39 + \frac{2}{5} \times \frac{40}{1}$

$= 0.6 \times 39 + 0.4 \times 40$

$= 23.4 + 16$

$= 39.4$

3. An element with relative atomic mass 16.2 contains two isotopes 16P8 with relative abundance 90% and mP8 with relative abundance 10%. What is the value of m?

SOLUTION

$16.2 = \frac{90 \times 16 + 10 \times m}{100}$

$16.2 = \frac{9 \times 16}{10} + \frac{m}{10}$

$16.2 = \frac{144}{10} + \frac{m}{10}$

$16.2 = \frac{144 + m}{10}$

$16.2 \times 10 = 144 + m$

$162 = 144 + m$

$162 - 144 = m$

$18 = m$

The value of m is 18

GENERAL EVALUATION/REVISION

1. Consider the atoms represented below:

$^{q}_{p}X$ $^{r}_{p}X$

a. State the relationship between the two atoms.

b. What is the difference between them?

Name_____ Date_____

c. Give two examples of other elements which exhibit the phenomenon illustrated.

2. State the number of electrons, protons and neutrons present in the following atoms/ions
   a) Ca b) S^{2-} c) Al^{3+} d) P

3. If an element R has isotopes 60% $^{12}R_6$ and 40% $^{x}R_6$ and the relative atomic mass of R is 12.4, find x.

READING ASSIGNMENT

- New School Chemistry for SSS by O.Y Ababio. Pg 48-49

WEEKEND ASSIGNMENT

1. The atomic number of an element is precisely
   (a) the number of protons in the atom (b) the number of electrons in the atom (c) the number of neutrons in the atom
2. An atom can be defined more accurately as (a) the smallest indivisible parts of an element that can take part in a chemical reaction (b) the smallest part of an element that can take part in a chemical reaction (c) a combination of protons, neutrons
3. The mass number is (a) proton number + neutron number (b) electron number + proton number (c) neutron number + electron number
4. Calculate the relative atomic mass of an element having two isotopes ^{107} Ag and ^{109}Ag in the ratio 1:1 (a)106 (b)107 (c)108
5. An element X has two isotopes $^{18.8}$X and $^{15.8}$X in the proportion of 1:9 respectively. Find the relative atomic mass of X (a)16.1 (b)13.6 (c)16.8

THEORY

1. (a) Define the term isotopy.
   (b) Determine the number of electrons, protons and neutrons in each of the following: $^{39}K_{19}$, $^{63.5}Cu_{29}$
2. If an element R has isotopes 60% of $^{12}R_6$ and 40% $^{x}R_6$ and the relative atomic mass is 12.4, find x.

WEEK TEN

TOPIC: STRUCTURE OF THE ATOM

CONTENT

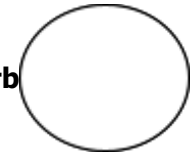
- Orbitals of The Atom
- Electronic Structure Of the Atom
- Filling Of Electrons in to Orbitals
- Quantum Numbers

ORBITALS OF THE ATOM

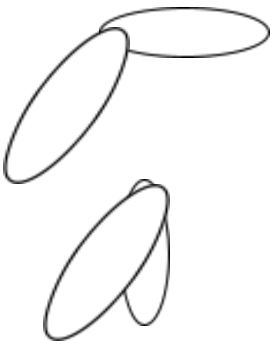
The region in space within which there is maximum possibility of finding an electron in an atom is called an ATOMIC ORBITAL. We have s, p, d, and f orbitals.

Shapes of s and p orbitals are as follows**:**

s-orb

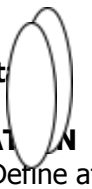


p_x orbital



p_y orbital

p_z orbit



EVALUAT N

1. Define atomic orbital

Name_____ Date_____

2. State the shape of (i) S-orbital (ii) P-orbital.

ELECTRONIC STRUCTURE OF THE ATOM

With the knowledge of atomic orbital the spectra of more complex atoms than hydrogen atom can be explained as follows:

a) that within a given principal quantum number or energy level, there are sub energy levels, i.e. energy levels otherwise called K,L,M,N,O,P AND Q shells have sub-energy levels otherwise called s,p,d and f orbitals

(b) The total number of sub-shells within a shell is given by n^2
while the total maximum number of electrons is given by $2n^2$ where n is the number of enregy level.

Energy Level	Number of orbitals	Maximum No of electrons
n = 1(K- shell)	$1^2 = 1$	$2\times1^{2=2}$
n =2 (L- shell)	$2^2 = 4$	$2\times2^{2=8}$
n = 3 (M- shell)	$3^2 = 9$	$2\times3^2 = 18$
n = 4 (N- shell)	$4^2 = 16$	$2\times 4^2 = 32$
n = 5 (O- shell)	$5^2 = 25$	$2\times 5^2 = 50$
n = 6 (P-shell)	$6^2 = 36$	$2\times6^2 = 72$
n = 7 (Q - shell)	$7^2 = 49$	$2\times7^2 = 98$

(c) In a given orbital there could be a maximum of only two electrons and electron in all orbitals of the same type within a principal quantum number possess equal energies.

(d) The electrons in the different sub- shells or orbitals within a principal quantum number do not all have equal energies.
The gradation of energies of orbitals is as follows:
1s< 2s<2p<3s<3p<3d<4s<4p<4d---

EVALUATION

1. State the first five energy levels.
2. Calculate the total no of electrons when n is equal to (i) 2 (ii) 4.

FILLING OF ELECTRONS IN ORBITALS

In filling electrons into the atoms of elements, considerations are given to the conditions laid down by Aufbau Principle, Pauli exclusion principle and Hund's rule of maximum multiplicity.

AUFBAU PRINCIPLE states that electrons go in to fill orbitals of lower energy first before filling orbitals of higher energy and each orbital may hold up to two electrons.

PAULI EXCLUSION PRINCIPLE states that no two electrons have identical sets of the four quantum numbers {n, l, m and s in an atom}.

HUND'S RULE OF MAXIMUM MULTIPLICITY state that in filling degenerate orbitals with electrons, electrons go in singly first before pairing up occurs.

EVALUATION

State the following principle
{a} Aufbau Principle {b} Hund's rule.

QUANTUM NUMBERS

Studies show that the energy of an electron may be characterized by four quantum numbers. These are

Name_____ Date_____

{1}The principal quantum number represented by n with integral values of 1,2,3,4 e.t.c.

{2}The subsidiary or Azimuthal quantum number represented by l with integral values ranging from O to (n-1).

(3) The magnetic quantum number represented by m with integral values ranging from –l to +l.

4. The spin quantum number represented by s with integral values $-{}^{1}/_{2}$ and $= {}^{1}/_{2}$.

Element	**Atomic Number**	**Electronic configuration.**
H	1	$1S^1$
He	2	$1S^2$
Li	3	$1S^2\ 2S^1$
Be	4	$1S^2\ 2S^2$
B	5	$1S^2\ 2S^2\ 2P^1$
C	6	$1S^2\ 2S^2\ 2P^2$
N	7	$1S^2\ 2S^2\ 2P^3$
O	8	$1S^2\ 2S^2\ 2P^4$
F	9	$1S^2\ 2S^2\ 2P^5$
Ne	10	$1S^2\ 2S^2\ 2P^6$
Na	11	$1S^2\ 2S^2\ 2P^6\ 3S^1$
Mg	12	$1S^2\ 2S^2\ 2P^6\ 3S^2$
Al	13	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^1$
Si	14	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^2$
P	15	$1S^2\ 2S^2\ 2P^6 3S^{23} 3P^3$
S	16	$1S^2\ 2S^2\ 2P^6 3S^2\ 3P^4$
Cl	17	$1S^2\ 2S^2\ 2P^6\ 3S^2\ 3P^5$
Ar	18	$1S^2\ 2S^2\ 2P^6\ 3S^2 3P^6$
K	19	$1S^2\ 2S^2\ 2P^6\ 3S^2 3P^6\ 4S^1$
Ca	20	$1S^2\ 2S^2\ 2P^6\ 3S^2 3P^6\ 4S^2$

GENERAL EVALUATION

1. State the four quantum numbers.
2. Write the electronic configuration of the following a) Mg b) S^{2-} c) Ca^{2+} d) Si

READING ASSIGNMENT

- New School Chemistry By O.Y. Ababio pg 49-54.

WEEKEND ASSIGNMENT

1. Which of the following orbitals is spherical in shape?
   (a) s (b) p (c) d (d) f
2. Which of the following shells have a maximum of eight electrons ?
   (a) k (b) l (c) m (d) n
3. $1s^2\ 2s^2\ 2p^6\ 3p^1$ is the electronic configuration of
   (a) potassium (b) calcium (c) sodium (d) aluminum.
4. "No two electrons have identical sets of four quantum numbers". This statement is
   (a) Aufbau principle (b) Pauli exclusion (c) Hund's rule (d) Rutherford's model.
5. Which of the quantum number is represented by L?
   (a) principal quantum no (b) subsidiary quantum no (c) magnetic quantum
   (d) spin quantum.

THEORY

1. State the following principle (a) Pauli exclusion principle. (b) Aufbau principle.
2. Write the electronic configuration of
   (a) Oxygen
   (b) Calcium (c) Chloride ion (Cl^-) (d) Aluminum ion (Al^{3+})