INTRODUCTION TO CHEMISTRY

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What is chemistry?

Chemistry is a branch of science which deals with composition, decomposition and properties of matter.

Or

It is a branch of science which deals with composition, properties and changes of matter.

Note: In chemistry we study how different substances combine with other substances to form new substances.

-People who study chemistry are called chemists

- Material objects made by application of chemistry,are fertilizers,perticedes,detergents etc

What is the importance of chemistry ?

Chemistry is important for our lives and development due to;

1. It helps in manufacturing of medicine to cure sick people.
2. It helps in manufacturing of cooking oil and sugar in the food industry.
3. It helps in manufacturing of detergents like Omo, Foma etc for cleaning purposes.
4. It helps in manufacturing of fertilizers for agriculture activity.
5. It helps in manufacturing of chemical substances which kill weeds and pests.
6. It helps in manufacturing of fuel i.e. petrol diesel etc.
7. It helps in manufacturing of shoes and clothes.
8. We study chemistry in order to start career. For example To be doctors, pharmacists , physicists etc.
9. We study chemistry in order to answer question about natural things i.e .why does iron rust?

REVIEW EXERCISE

1. Define the following ,

   (i) Chemistry

   (ii) Laboratory

2. People who study chemistry are known as .....

3. Mention different material / objects made by application of chemistry.
(i).....

(ii).....

(iii).....

(iv).....

(v).....

4. Mention the importance of chemistry in your daily life.
(i).....

(ii).....

(iii).....

(iv).....

(v).....

LABORATORY TECHNIQUE AND SAFETY

LABORATORY TECHNIQUE AND SAFETY

What is a laboratory?

This is a special building where scientific experiments are being conducted.

What is a chemistry laboratory?

This is a special building where chemistry experiments are being conducted.

A chemistry laboratory is supplied with gas, electricity and water.

NB: Working in a laboratory is fun because a lot of interesting experiments are done but it can be a very dangerous place for you and others if safety regulations are not followed.

LABORATORY RULES

These are the rules that help to avoid accidents that may occur in the chemistry laboratory.

They are as follows:

1. Ask for permission to your teacher or laboratory assistance before you enter in the laboratory.
2. Do not run or play in the laboratory.
3. Do not eat, drink, taste or smoke in the laboratory.
4. Obey orders immediately from your teacher or laboratory assistance as to avoid accidents.
5. Do not conduct any experiments unless your teacher or laboratory assistance tells you to do so.
6. Do not switch on/off the gas and water taps till you are instructed to do so.
7. Report accidents immediately to the laboratory teacher responsible or laboratory assistance.
8. Wash apparatus before and after using them.
9. Wash your hands after conducting any experiments.
10. Observe the safety labels on the containers of the chemical and take necessary precautions.

SAFETY MEASURE FOR A CHEMISTRY LABORATORY

I/ All chemicals should be well- labelled to prevent a students

II/ Laboratory should contain first aid kit which will be used when people get accidents

III/ Chemical that easily react with each other should never be stored together

Iv/ There should be fume chamber in the laboratory to minimize unexpected gas leaks or emissions.

V/ All students must wear safety glasses (goggle) at all times.

VI/ Shoes (no sandals) must be worn at all time ,Bare feet or open shoes are not permitted in the laboratory.

VII/ All students must wear lab coat at all time .

VIII/ All students should know the location of the extinguishers and fire blankets.

IX/ All students should know the emergency evacuation route.

FIRST AID

Introduction

We must take precautions to avoid accidents in the laboratory. When an accident occurs it must be attended properly first.

What is first aid?

It is an immediate help/treatment given to a victim who has got an accident or injury before taking him/her to the hospital.

1; What are the common accidents in the lab?

- Possible causes of accident in chemistry laboratory are;

- Burns from open fires or boiling chemicals.
- Cuts on hands or fingers.
- Swallowing chemicals **For example**; when sucking alkali in the titration process.
- Having corrosive chemicals on the hands.

2; What is the importance of first aid?

1. It saves the life of a victim.
2. It reduces pain.
3. It brings hope and encouragement to the victim.
4. It prevents further bleeding.
5. It helps in quick recovery of the victim's wound.

FIRST AID KIT

This is a small box consisting of different instruments and chemicals needed for first aid.

It has a sign of a red cross. It is placed in a safe and accessible place.

INSTRUMENTS AND CHEMICALS FOUND IN THE FIRST AID KIT

Instruments/ chemicals	Uses
Pair of scissors	For holding gauze
Role of plaster	For covering wounds
Assorted bandage	For cleaning/covering wounds
Cotton wool	Used for treatment on wounds and cut
Razor blade	For cutting bandage, plaster
Gauze	For covering wounds

Safety pins	For pinning bandages
Adhesive plaster	For attaching the bandage to the skin
Forceps	For holding things such as gauze
Jar of petroleum jelly	To apply on burns
Iodine tincture	To clean fresh wounds
Gentian violet	To apply on minor wounds
Soap	To wash hands and wounds
Anti biotic solution	For cleaning wounds
Methylated spirit	For cleaning wounds
Pain killers	Reducing pain
Water	For washing the wound

BASIC CHEMISTRY LABORATORY

Laboratory is a special building where scientific experiments are conducted.

In order to do experiments we need;

1. Apparatus
2. Chemicals

1. APPARATUS

These are instruments used to carry out scientific experiments in the laboratory.

CLASSIFICATION OF APPARATUS

We can group or classify apparatus into two groups;

a. Material made (what are they made of)
b. Uses (what are they used for)

a. MATERIAL MADE

1. **Apparatus made of glass**

   Large numbers of chemical apparatus are made of glass.

Why?
It's because of easy observation for chemical reaction. Example**:** test tubes, beakers, flasks.

2. **Apparatus made of iron.**

   Example**:**Tongs, Bunsen burner, tripod stand

3. **Apparatus made of wood**

   Example: test tube racks, test tube holders
4. **Apparatus made by clay**

   Example: Tiles, evaporating dish, motor and pestle

5. **Apparatus made of plastic**

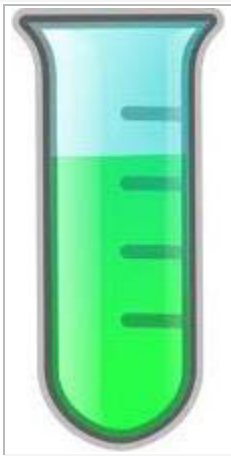
   Example beaker washing bottle, funnels, Tiles, evaporating dish motor and pestle and tiles.

CHEMISTRY LABORATORY APPARATUS ACCORDING TO THEIR USES

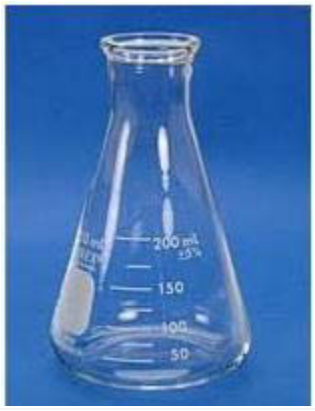
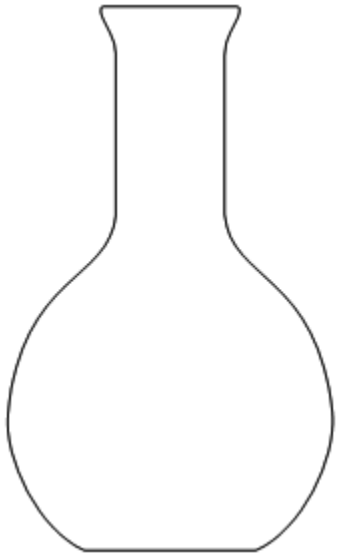
1. Apparatus used for holding liquid i.e. beakers ,test tubes ,flat bottomed flasks and conical flasks.
2. Used for measuring liquid i.e. measuring cylinders ,burette ,beakers and pipette.
3. Used for measuring solids i.e. spring balance, pan balance, beam balance, chemistry balance.
4. Used for heating i. e. crucibles, evaporating dishes, test tubes.
5. Used for holding and supporting i.e. test tube racks ,tongs ,tripod stand and clamp.
6. Used for boiling i.e. cork borers.
7. Used for transferring liquid i.e. dropper funnels.
8. Used for transferring solids i.e. spatulas.

CHEMICAL APPARATUS AND THEIR USES

Apparatus	Uses
Test tube	For heating For watching or observation of reactions For holding liquids

	
Beaker 	For holding liquids For heating For observations
Filter funnel 	For transferring liquids
Thistle funnel	Used for transferring liquids

	
Dropping funnels 	Used for transferring liquids
Separating funnels 	Used for separating immiscible liquid example kerosene and water
Round bottomed flask	Used for mixing reagents in preparation experiment

	
Conical flask 	Used for mixing reagents during experiments
Flat bottomed flask 	Used for heating reagent during experiment
Distilling flask	Used in distillation process

	
Measuring cylinder 	Used for measuring volumes of liquids
Dropper 	Used for transferring solution from a container
Watch glass	Used for holding a solid sample

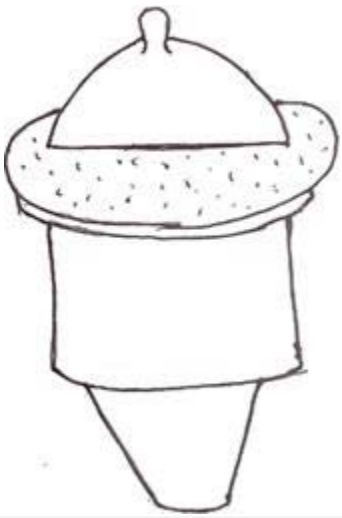
	
Pipette 	Used for delivering or measuring fixed volumes of liquids.
Burette 	To provide control of the volumes of liquid during experiments and also to measure an accurate volume.
Volumetric flask/Graduated	For measuring accurate volumes of liquids -For preparing solution of accurate concentration e.g. titration

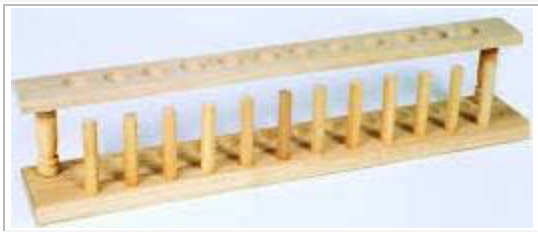
	
Spatula 	Handling chemicals and transferring them to the container.
Tripod stand 	For supporting containers during heating
Wire gauze	Prevent flame from direct heating Support apparatus on tripod stand

	
Motor and pestle 	For grinding solid chemicals to powder
Trough 	For holding water and below the shelf during preparation of gases
Test tube brush 	For cleaning of test tubes
Tongs	For holding hot objects when heating.

	
Delivery tube	For preparation of gases
Retort stand 	For supporting other pieces of apparatus
Condenser	For cooling water vapor to form water during distillation

	
Gas jar 	For collecting gases
Bunsen burner 	Source of heat Production of flames for heating.
U –tube 	For drying gases.
Clamp	For supporting the apparatus

	
Beehive shelf. 	For preparation of gas
Dissector 	To protect chemicals which are hygroscopic or which react with water from humidity
Test tube rack stand	To hold/support test tubes containing chemicals

	
Test tube holder 	To hold/support test tube containing chemicals

WARNING SIGNS

Warning signs are labels on chemical containers that help you to know what you can do or what you cannot do with different chemicals.

Warning signs help you to avoid dangerous accidents in the chemistry laboratory.

Examples of warning signs:

- Harmful or irritant
- Flammable
- Corrosive
- Toxic
- Explosive
- Oxidizing agent

HARMFUL

A harmful chemical are dangerous to your health thus it can make you sick, if it is not used properly.

TOXIC

A toxic chemical can cause death immediately or after a few days when they enter your body. Therefore, do not allow such chemicals to enter your body parts. **E.g.** The eyes, skin, mouth, or ears.

FLAMMABLE

A flammable chemical or substance can catch fire easily. They should never be brought on an open flame. **Examples** ethanol, petrol,methylated spirit.

NB: Put all burners off before working with flammable chemicals.

OXIDANT(OXIDIZING AGENT)

This is a chemical substance which supports burning substance thus materials will burn faster.

Examples: Potassium permanganate ($KMnO_4$).

EXPLOSIVE

This is a forceful rapid reaction which involves throwing particles at high speed. It's very dangerous to keep explosives in a glass container.

Why?

Because if an explosion occurs, glass will fly around the place and cause injuries to people, so handle with care all chemicals containing explosive signs.

CORROSIVE

A corrosive chemical is a substance that can burn your skin. It causes blindness if it gets into your eyes. Pour a lot of water on the affected part so as to reduce concentration of the chemical or substance.

Examples of corrosive chemicals are;

- Concentrated acid
- Sulphuric acid
- Hydrochloric acid
- Nitric acid
- Concentrated alkali
- Sodium hydroxide
- Potassium hydroxide.

REVIEW QUESTIONS

1. (I) Define the word laboratory .

(II) Mention at least ten chemistry laboratory rules .

2. Mention and explain the safety measures needed to avoid accidents in chemistry laboratory.

3. (i) Identify possible causes of accidents in a chemistry laboratory

(ii) Mention all the items found in a first Aid kit.

4.Give the names of three apparatus used in a chemistry laboratory in each of the following below;

a/ (i)Apparatus for holding thing_____,_____,_____.

(ii)Apparatus for taking measurements_____,_____,_____.

(iii)Apparatus for heating purpose _____,_____,_____.

(iv)Apparatus for doing chemical reactions _____,_____,_____.

b/Give the user of each chemistry apparatus you have mentioned apparatus.

5. (a) Define the word warning signs

(b) Draw and label the basic chemical warning signs.

HEAT SOURCES AND FLAMES

HEAT SOURCES AND FLAMES

Introduction

A large number of chemical reactions use heat as one of a factor of altering the rate of reactions. Heat increases the rate or the speed of a chemical reaction.

What is heat?

This is a form of energy.

NB: Energy is the ability of doing work.

What are the sources of heat in the laboratory?

The following are the sources of heat in the laboratory:

1. Bunsen burner
2. Spirit burner
3. Gas stove
4. Electric heater
5. Kerosene stove
6. Charcoal burner

What are the burners?

These are the sources of heat in the laboratory. All burners use fuel or electricity.

Heat may be from natural fuel such as charcoal, coal, gas, spirit (ethanol) or electricity.When fuels burn they produce **heat** and **light**.

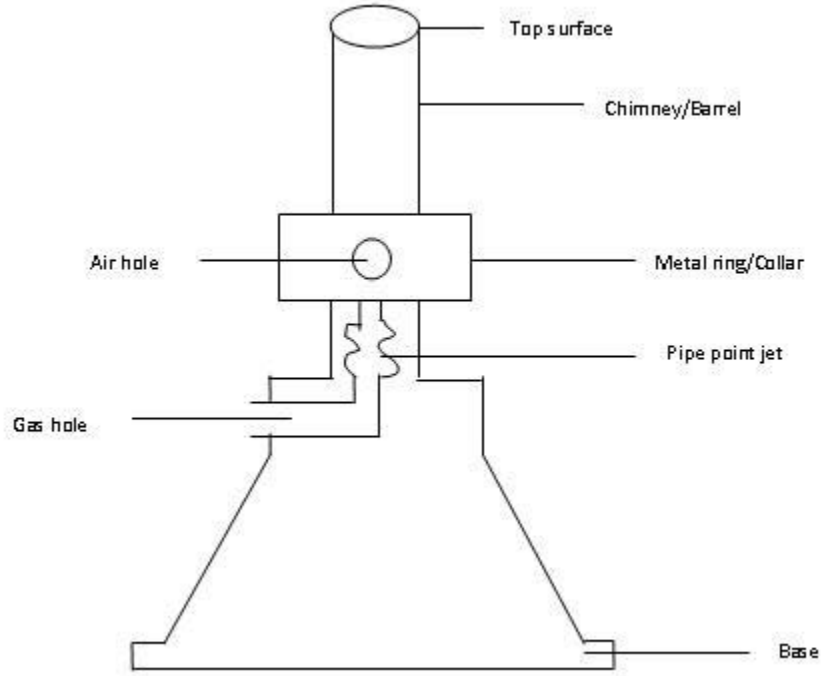
What are the common burners used in our laboratory?

1. Bunsen burner
2. Spirit burner
3. Gas stove

THE BUNSEN BURNER

Most experiments carried out in chemistry require some heating. It is therefore very important to have good heating tools. The common heating apparatus used in laboratory is a Bunsen burner. It is originated by the name of the owner Robert Bunsen 1885.

DIAGRAM OF A BUNSEN BURNER



PARTS OF THE BUNSEN BURNER

There are six main parts of the Bunsen burner and those are:

1. Base
2. Gas hole
3. Pipe point jet
4. Air holes
5. Collar/ metalring
6. Chimney (barrel)

Base-

Supports the burner .It makes the burner stable due to its heavy weight when placed on bench.

Gas hole/gas on-let tube,

lets the gas on from the gas supply.

Pipe point jet/jet

Directs the gas to the barrel / chimney.

Collar

Regulates the amount of air entering the burner . It has air holes that can be turned open or closed depending on the kind of a flame and hence amount of heat required.

Air holes

These are holes on the collar which allows air to enter the burner.

Chimney

is a part of the burner where air from outside and gas from gas supply mix up and burn.

HOW TO LIGHT A BUNSEN BURNER

1. Connect the Bunsen burner by a rubber tube to the gas supply.

2.Close the air holes.

3.Turn the gas tap on to let in sufficient gas.

4.Quickly bring a flame at the top of the barrel.

5.Turn the collar to adjust the air holes until you get a type of a flame you want.

6.Adjust the gas tap until the gas supply enough to produce a non luminous flame.

NOTE; To put off the flame of the burner after you finish heating a substance turn the gas tap off in order to cut off the gas supply to the burner.

THE FLAME

What is a flame?

This is a burning gas that gives out **heat** and **light**. The flame is formed when fuel burns to give out heat and light.

There are the two types of Bunsen burner flames:

1. Luminous flame
2. Non-luminous flame

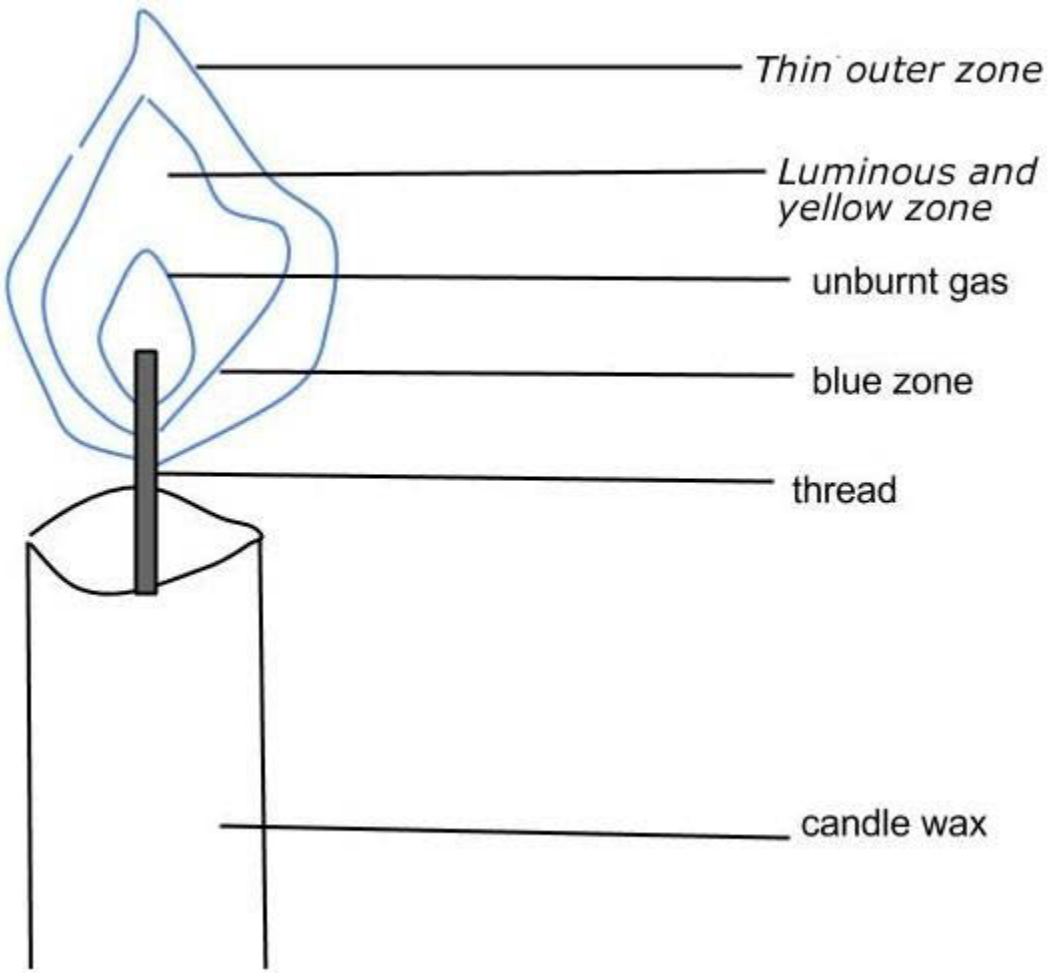
1. THE LUMINOUS FLAME

Is a flame which gives out bright-yellow light. It is formed when the **air holes are closed**.

Characteristics of a luminous flame

- It is bright-yellow in colour
- It burns quietly.
- It has four zones.
- It is smoky and it forms soot on the apparatus or equipment
- It is unstable in other words its shape changes.
- It is hot.

The structure of a luminous flame



Uses

Luminous flame is used for **lighting purposes,** but can not be used for reading because it is **unstable.**

NB: luminous light is due to the presence of the glowing soot particles in the flame.

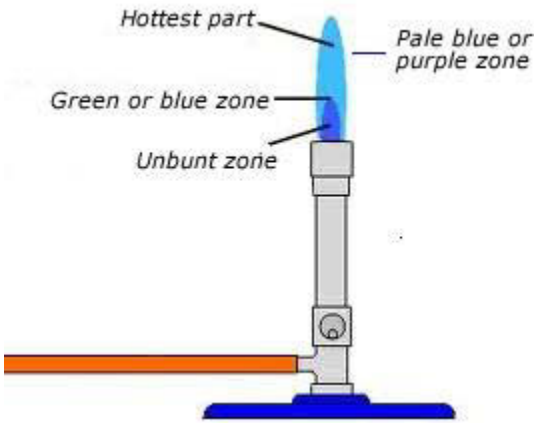
2. NON LUMINOUS FLAME

It is a flame which does not give much light. It is formed when **air holes are opened**.

Characteristics of non luminous flame

- It is blue in colour.
- It is noisy.
- It has three zones.
- It does not form soot.
- It is steady.
- It is very hot.

Structure of a non luminous flame



USES OF NON-LUMINOUS FLAME

1. Used for heating purpose in laboratory.

2. Used in welding.

3. Used at home for cooking.

4. Used in the flame test.

•Non-luminous flame is used for **heating** in a chemistry laboratory and **welding** purposes because it is **very hot** and **does not give out soot**.

Other examples of luminous flames are:

1. Coal gas flame

2. Kerosene lamp flame
3. Fire wood flame
4. Candle flame

Other examples of non luminous flame are:

1. Kerosene store flame
2. Gas cooker flame
3. Oxy-acetylene flame
4. Bunsen burner

STRIKING BACK (BURNING BACK)

When a Bunsen burner is burning to form a non luminous flame and a gas tap is turned off slowly. The supply of the gas is reducing in the gas air mixture. The mixture contains very little gas and much air such as mixture burns rapidly forming an **explosion**. In this case the flame will be accompanied by a **pop sound**. This is called **burning back**, at this time the rate of burning the gas is greater than the rate at which the gas rises up the chimney.

DIFFERENCE BETWEEN A LUMINOUS FLAME AND A NON LUMINOUS FLAME

NON-LUMINOUS FLAME	LUMINOUS FLAME
Farmed when air holes are open	Farmed when air holes are closed
Comprises of three zones	Comprises of four zones
Very noisy	Silent or clam
Forms no smoke or soot on apparatus	Forms a lot of smoke or soot on apparatus
Blue and almost invisible	Bright yellow and clearly visible
Very hot flame	Not hot flame
Not bright	Very bright
Triangular flame	Wave like flame

USES OF DIFFERENT TYPES OF FLAMES

* For heating purpose ,most heating in the laboratory done using an Bunsen burner .

*Is used in the flame test of certain chemical substance .

*It is suitable for welding purposes.

* Suitable for cooking.

REVIEW QUESTIONS

1. a/ Define the following terms;

(i)Heat

(ii)Flame

b/ Explain how Bunsen burner work ?

2. a/ Mention the types of flame.

(i).....

(ii).....

b/ Give the proposes of each types of a flame above.

c/ Give the difference between the types of flame above.

3. Mention the uses of different types of flame.

4. Draw and label ;

(i) A Bunsen burner

(ii) A non luminous

(iii) A luminous

SCIENTIFIC PROCEDURE

Chemistry is other science subject involves systematic ways of discovery, knowledge and solving problems. Discovering knowledge and solving problems involves very careful investigation.

IMPORTANCE OF SCIENTIFIC PROCEDURE

> Is the guide to the mental activities and systems needed for solving the competitiveness problems.

> To minimize the influence of bias or prejudice in the experiment.

> It provides standardized approach to conduct experiment and on doing so improves their

result.

> It is an evidence based method for acquiring knowledge.

> It trains the brain to logically examine and process all the information it receivers.

These careful investigations involve facts and verifying them. Systematic investigation applied in chemistry includes the following steps: -

(i) Identify a problem

(ii) Hypothesis formulation

(iii) Experimentation

(iv) Observation

(v) Interpretation of data

(vi) Conclusion

(i) *Identify a problem*

This is the first step where a problem is recognized in a day life. One often comes across a question which requires explanation, such question is a problem needed to be answered by a chemist.

(ii) Hypothesis formulation

A hypothesis is a testable, assertion, statement or preposition about the relationship(s) between two or more phenomena. Hypothesis is an answer to the course of the problem that may be true or false. It is an intelligent guess to be possible answer to a problem. Sometime hypothesis can be started as an imagination that may lead either to confirmed truth or to biases about what is observed.

Hypothesis comes directly from the objectives. Hypothesis formulation is done after collecting all the available information and predicting an explanation of the phenomena. Any formulated hypothesis is never accepted unless it is proved through an experiment whether it is true or false.

(iii) Experimentation

An experiment is a practical activity which makes chemistry more realistic and interesting. It makes abstract concepts to be more understandable. Experiments are done to test hypothesizes where they are true or false.

After the experiment one may decide to present the data in an essay form, graphs, histograms, table or pie charts.

(iv) Observation

To see what is happening during the experiment and write or record the results.this may be done by using sense organ of eyes, nose, tongue, ears and skin. Recording all events that you consider relevant/important.

(v) Data interpretation

Data are the actual measurements that we make. Data is the plural form of datum. The data gathered are put into categories of particular trends in order to simplify their interpretation. The data analysis helps in drawing conclusion. A person analyzing the data should be capable of reading, interpreting and explaining any trends which it shows.

(vi) Conclusion

A hypothesis will be accepted /rejected on the results obtained from the experiment. When the results of the experiment come as it was predicted, then the hypothesis will be accepted as being correct. If the experimental results do not come out as expected the hypothesis will be rejected.

APPLICATION OF THE SCIENTIFIC PROCEDURE

The following are the common areas where the scientific procedures can be applied;

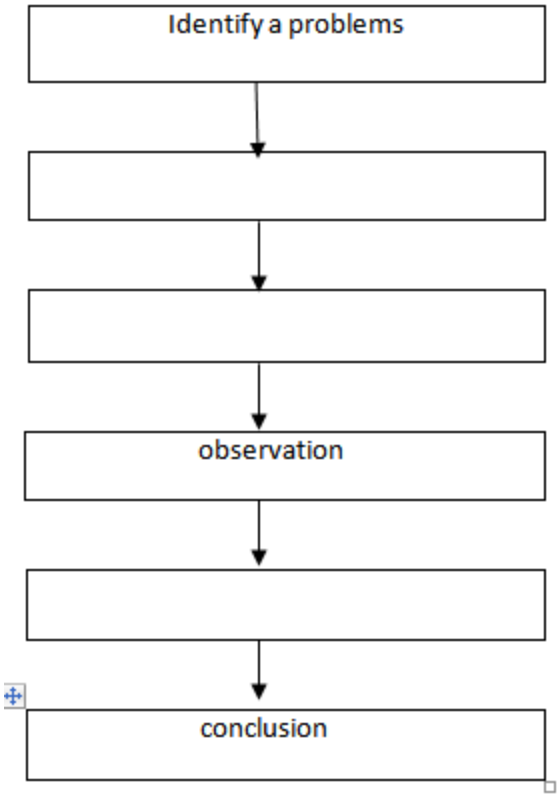
1. **When carrying out experiment**.

2. **In project work**; is a series of activities that allow the student to study, do research and act by themselves using their abilities , interests, personal experience and aptitudes.

3**. In field study**; is a collection of data that occurs outside of an experiment or laboratory setting.

REVIEW QUESTIONS

1. Define the following terms
   - (i) scientific procedure
   - (ii) hypothesis
   - (iii)experiment
   - (iv) conclusion
   - (v) observation
2. Fill in the boxes the missing step in the scientific procedure flow chart



3. (a) Give the importance of scientific procedures.

   (b) What are the application of scientific procedures.

MATTER

CONCEPT OF MATTER

MATTER

Is anything that occupies space and has weight. Including all common materials around animals.

States of matter

1. **Solid-** For example: stones, pen, paper, nails, door, etc.
2. **Liquid-** For example: water, juice, alcohol, tea etc.
3. **Gas-** For example: oxygen, (O_2), nitrogen (N_2) etc.

The kinetic nature of matter to explain the existence of matter in the three states solid ,liquid and gas.

Kinetic nature of matter

IN SOLID

Particles are packed tightly together so they are unable to move about very much.Particles of a solid have low kinetic energy .The electrons of each atom are in motion , so the atoms have a small vibration , but they are fixed in position

- Solid have a definite shape .They do not conform to the shape of the container. Also they have definite volume.

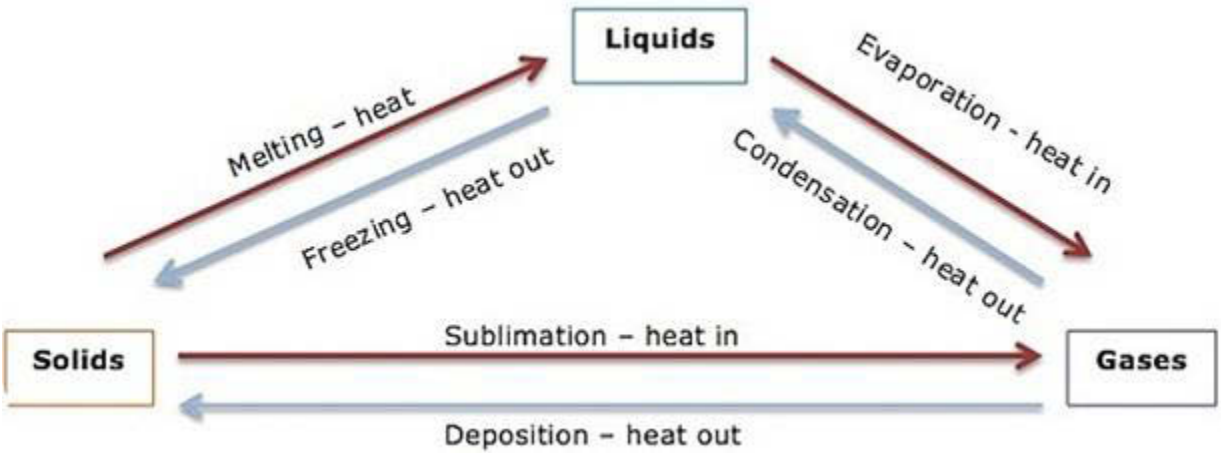
IN LIQUID

The particles of substance have more kinetic energy than those in a solid .The liquid particles are not held in a regular arrangement, but are still very close to each other. So liquids have a definite volume -liquid like solid ,can not be compressed .Particles of liquid have just enough room to flow around each other . So liquids have an indefinite shape.

IN GASES

Gas particles have a great deal of space between them and have high kinetic energy .If unconfined, the particles of a gas will spread out indefinitely.If confined, the gas will expand to fill its container.

Relationship between the states of matter



1. Melting - Is a process of changing solid state to liquid state.

2. Freezing - Is the process of changing liquid state to solid state.

3. Evaporation - Is a process of changing liquid to gas.

4. Condensation- Is the changing of gas to liquid.

5. Sublimation - Is a process of changing solid to gas.

6. Deposition - Is the changing of gases to solid without passing liquid.

IMPORTANCE OF THE RELATIONSHIP BETWEEN THE STATES OF MATTER
(importance of changing one state of matter to another)

A simple example of matter .If you have a block of ice, you have solid water .Add heat (a form of energy) and the ice melts into liquid water that you could drink (it has reached its melting point) continue to apply heat, and the water will evaporate and turn to steam which is water in a gaseous state (it has reached boiling point). This works backward too, gas can cool down by losing energy and condense back into liquid water and cool down farther into a solid. This process is called sublimation where a solid can turn straight into a gas when heat is applied

1. Formation of rainfall i.e. condensation.
2. To help us make business.
3. To help us in the separation of mixtures, eg. separating sugar and H_2O
4. Production of salt.

PHYSICAL AND CHEMICAL CHANGE

•Physical change

This is a type of change whereby no new substances are formed.

Examples of physical changes include the following:

1. Burning of water to form vapor
2. Melting of solid to liquid example ice to water
3. Magnetization of iron
4. Grinding of chalk
5. Breaking of glass into smaller pieces
6. Condensation of steam into water
7. Dissolving salt into water
8. Dissolving sugar in water

Properties of physical change

1. Do not produce new kind of matter
2. It is generally reversible

3. No change in mass
4. No heat is applied

•Chemical change

This is a type of change whereby new substances are formed.

Examples are:

1. Burning of paper
2. Decaying of teeth
3. Souring of milk
4. Rusting of iron
5. Decaying of food

Properties of chemical change

1. New kind of matter is formed
2. The change is irreversible
3. There is change in mass
4. It involves heat change

ELEMENTS AND SYMBOLS

Element

Is a pure substance that cannot be split into a simpler form by a simple chemical process. There are many chemical elements and they are classified into groups;

1. Metals
2. Non metals

1.Metals

These are elements which form positive ions by losing one or more electrons

Properties of metals

1. They are good conductors of heat and electricity.
2. They have high melting and boiling points
3. They are strong and tough
4. They are bright and shiny
5. They have high density
6. They have molecules
7. They make noise when you bang them.

Examples of metals are:

1. Silver
2. Potassium
3. Sodium
4. Magnesium
5. Aluminum
6. Lithium
7. Silicon
8. Iron

2.Non metals

These are elements which form negative ions by electron gain.

Examples of non metals are:

1. Chlorine
2. Fluorine
3. Bromine
4. Iodine
5. Oxygen
6. Sulphur
7. Phosphorus

Properties of non metals

1. They are bad conductors of heat and electricity
2. They have low melting and boiling points
3. They have low density
4. They are not malleable
5. They are not bright
6. They are not strong and tough
7. They are not shiny

Differences between metals and non metals

METALS	NON METALS
They are good conductors of heat and electricity	They are bad conductors of heat and electricity
They have high melting and boiling points	They have low melting and boiling points
They are strong and tough	They are not strong and tough
They are bright	They are not bright
Have high density	They have low density

They are malleable	They are not malleable
Sonority	They do not have sonority

Chemical symbol

This is one or two letters which represents a specific atoms of an element.
OR.

This is the capital letter of the elements name

Name and symbols to chemical elements

Assign name and symbols to chemical elements .

(i) An element may be represented that is derived from the first letter of English name

Examples.

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

(ii) Names of different elements may have the same first letter for example calcium and copper. It thus necessary to differentiate the element .In this case another letter usually the second from the name is used with the first one .The first letter will be capital while the second will be a small letter (not capital)

Examples.

NAME	SYMBOL
Calcium	Ca
Chlorine	Cl
Cobalt	Co
Magnesium	Mg
Manganese	Mn
Aluminum	Al

Argon Ar

(iii) In some cases ,the symbols are derived from Latin names instead of the common English names.

Examples.

NAME	LATIN
Sodium	Nautrium
Potassium	Kalium
Copper	Cuprum
Iron	Ferrum
Mercury	Hydrargyrum
Silver	Argentum
Gold	Ausum
Tin	Stannum
Lead	Plumbum

Element	Symbols	Elements	symbols
Sodium	Na	oxygen	O
potassium	K	chlorine	Cl
magnesium	Mg	Fluorine	F
copper	Cu	Neon	Ne
lithium	Li	Argon	Ar
silicon	Si	Helium	He
Iron	Fe	Nitrogen	N
Gold	Au	Barium	Ba
sulphur	S	Barron	Br
Aluminum	Al	phosphorous	P
Silver	Ag	Lead	Pb
Zinc	Zn	Carbon	C

COMPOUND AND MIXTURES

COMPOUND

Is a pure substance that is made up of two or more elements in a chemical combination.

Examples of compounds are:

- Water(H_2O)
- Salt (NaCl)
- Sodium carbonate (Na_2CO_3)

Properties of compounds

- They cannot be separated by physical means.
- The properties of compounds are different from the ones of an element.
- Heat is usually given out or absorbed with a compound.

Mixture

Is anything that is made up of two or more substance in a physical combination.

Example of a mixture

i. Oil and water
ii. Blood
iii. Air
iv. Urine
v. Ink

Types of mixtures

1. **Homogeneous mixture-** is a mixture which has uniform composition, appearance and properties.

   example: Common salt dissolve in a glass of water.

2. **Heterogeneous mixture-** is a mixture which has non-uniform compositions, appearance and properties.

   example: A mixture of ice and water.

Difference between mixtures and compounds

Mixture	compounds
Components may be seen separately	Components cannot be seen separately
The components can be separated by physical means	The components can be separated by chemical means
The elements are mixed in any proportions	The element proportion is fixed

No chemical change takes place when it is formed	Chemical change takes place in the substance formed.
The properties are those of the individual elements	The properties are different from those of individuals.

SOLUTIONS, SUSPENSIONS AND EMULSIONS

Solution - Is a homogenous mixture of two or more substances in which one of the substance is a solvent and the other are solutes.

Solvent - Is a substance that dissolves the solute. **E.g.** water

Solute - Is the component in a solution that is dissolved in a solution. **E.g.** salt

Types of solutions

An unsaturated solution - Is one that can still dissolve more solute of a given temperature.

A saturated solution - Is the one that cannot dissolve more solute at a given temperature.

A super saturated solution - Is the one that holds more solute than it can dissolve at a given temperature.

Significance of saturation

1. It is applied in the separation of mixtures in the laboratory
2. Extraction of some mineral such as common salt

SEPARATION OF MIXTURES

•Many mixtures contain useful substances combined or mixed with unwanted materials.

•In order to obtain these useful substances chemists have to separate them from the impurities.

•They have developed many different methods of separating the mixtures.

•The separation depends on what properties of the substance contain.

The following are the methods of separating a mixture;

- Decantation
- Evaporation
- Distillation (simple distillation and fraction distillation)

- Sublimation
- Filtration

- Chromatography
- Layer separation
- Solvent extraction.

1.Decantation

Is the process of separating a heterogeneous mixture of a liquid and a solid

Or

•This is the process of separating solids by pouring out the liquid and only remaining with the solid at the bottom of the container.

•The water in the oceans, lakes and rivers and heterogeneous mixtures that contain sand and insoluble matter that later settles at the bottom when water settles. The process of the components of some of the mixture settling at the bottom is called **sedimentation**.

•It is the first step in decantation. When muddy water is left to stand for sometime the mad settles at the bottom of the container and clear water comes on top. Also **decantation** is usually used in the blood tests which require the part of blood to be separated from solid components.

2.Evaporation

Is the process of separating a solute from a liquid.

•The **solvent** is then converted from liquid to gas through heating the solute that remains as a **residue.** When a solution of a common salt in water is heated until it evaporates, while solid crystals of the salt are obtained.

3.Distillation

Is the process of separating a mixture by heating a liquid to a very high temperature until it vaporizes in other words turns into a gas.

This gas is then cooled until it turns back into liquid. The cooled vapor is called **distillate.**

There are two types of distillation.

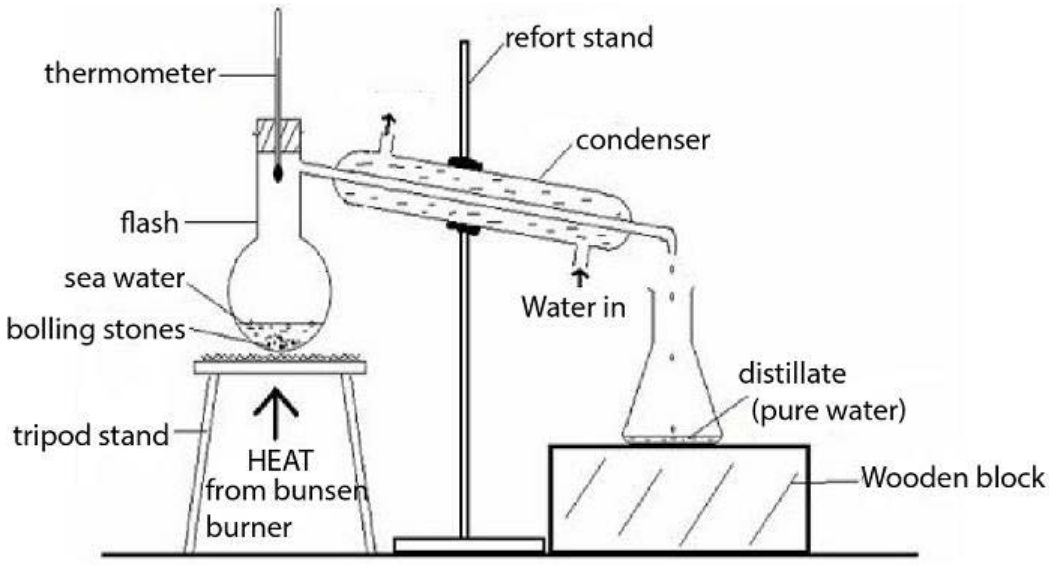
(a) Simple distillation

(b) Fractional distillation

(a)Simple distillation

This is used to separate liquids containing dissolved substances

An example is distilling water from muddy water.



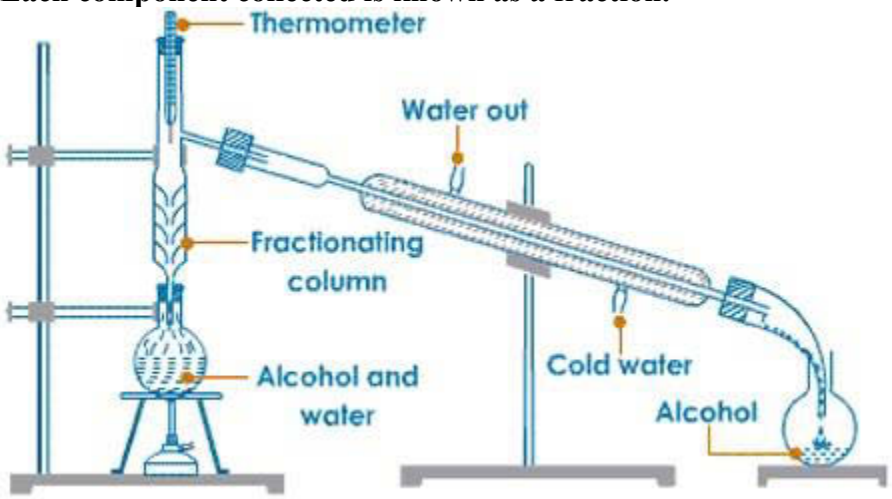
- The condenser helps to cool the steam by means of the water that flows in and out of the condenser. The distillate is pure water and therefore is colorless.

-In a situation where there is no condenser, the distillate is collected in a test tube that is deepen in a beaker containing very cold water or ice.

(b)Fractional distillation

This is the method of separating a mixture of two or more liquid that forms a heterogeneous solution by means of a fractionating column. The liquids are said to be miscible. A good example is ethanol and water, since the two liquids have different boiling points but very close boiling points whereas the solution can be separated by careful heating. The liquid with a lower boiling point is the 1st one to be collected as a distillate.

Each component collected is known as a fraction.

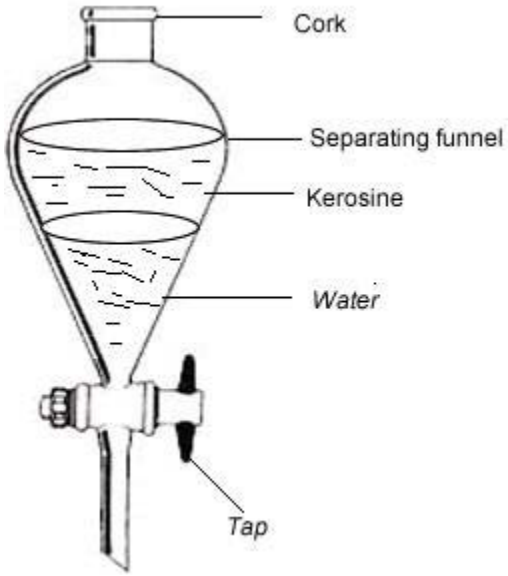


-When a mixture of ethanol and water is heated the ethanol distills first at a temperature of about **78.4%**, this is its boiling point. The boiling point of pure water is **100^0c**.

- The fractionating column separates the two liquids. The one with a lower boiling point ethanol moves to the upper of the column and distills over. Water which has a higher boiling point will tend to stay at the bottom of the column until the ethanol distills over.

4.Layer separation

This is the method used for separating immiscible liquids using a separating funnel. Immiscible are those that do not mix at all but form distinct layers when put together. The most dense remains



-Poured into the separating funnel they both move to the top of the funnel whereas water is drained out first. Materials used for this method are such as separating funnel, kerosene, water, cooking oil, beaker.

5.Sublimation

This is a process whereby solid changes directly to gas usually on heating.

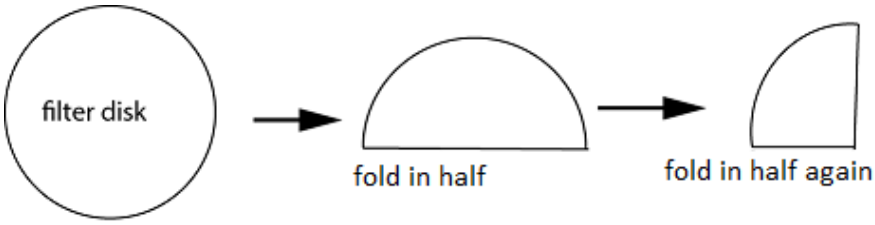
-The solid that is formed after the vapor cools is called a **sublimate**. The process can be used to separate mixtures where one of the substances sublimes. Iodine and ammonium chloride are among the few compounds that will be changed directly from solid to gas when heated.

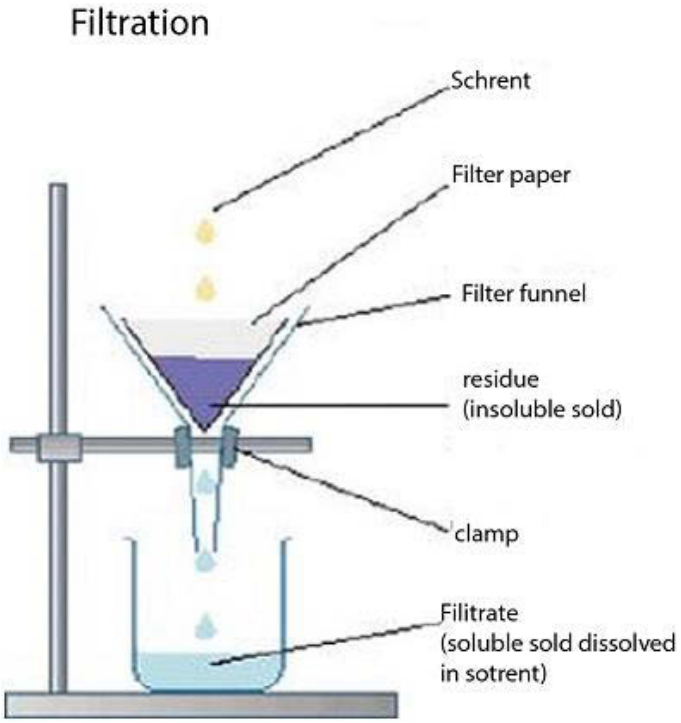
-The reverse process of vapor changing to solid on cooling is called **decomposition**. Materials used are iodine, ammonium chloride, common salt etc. Other apparatus are Bunsen burner, wire gauze, beaker. When a mixture of iodine and solid is heated the iodine sublimes and then condenses at the bottom of the flask, the sand remains in the beaker.

6.Filtration

This is the method used to separate a heterogeneous mixture of a solid and a liquid.

-Some chemical reaction produce insoluble solid and the mixture can be separated by this method. The solid is separated from the mixture using a filter such as a paper, the solid obtained is the residue and the liquid is the filtrate. Materials and apparatus used are muddy water, filter funnel, conical flask, retort stand and clamp.





7.**Chromatography**

This is the process of separating mixtures using a moving soft material that absorbs solvent

- Chromatography is used to separate a mixture of substances into their components so that they can be analyzed and studied. The moving solvent is called mobile phase many may be a liquid or gas. The material that absorb solvent is called **stationary phase**

8.Solvent extraction

This is the process of extracting essential from plant materials especially seeds using liquid that dissolves the oil. The oil is distilled and the solvent is left to evaporate, the process is referred to as liquid extract. For example seeds which are **used to extract oils**.

Exercise.

1.Define the following methods of separating mixtures

i. **Sublimation** - is the process whereby a solid changes state directly to gas usually on heating.

ii. **Decantation** - is the process of separating a heterogeneous mixture of a liquid and a solid.

iii. **Filtration** - is the method used to separate a heterogeneous mixture of a solid and a liquid.

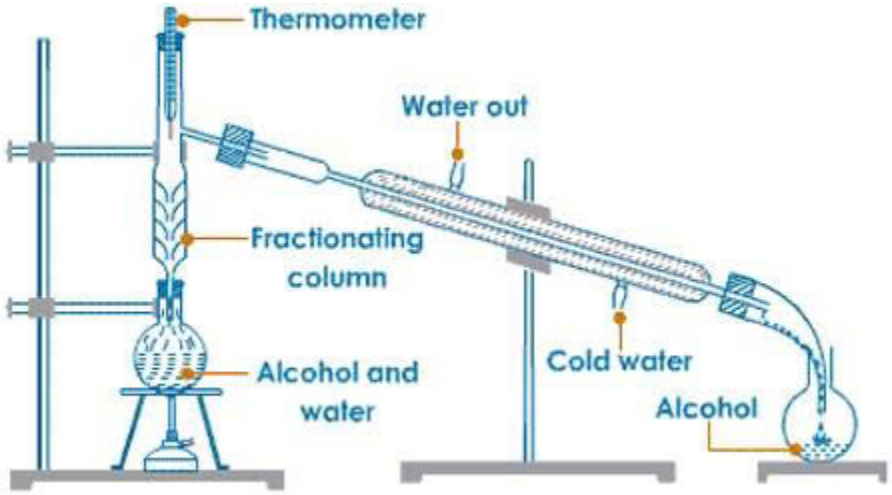
iv. **Distillation** - refers to the process of separating liquids to a very high temperature until it vaporizes burns into gas.

v. **Layer separation** - is the method used for separating immiscible liquids using a separating funnel.

3. List two significances of separating mixtures

i. Used and applied in softening hard water
ii. Applied in obtaining cooking oil from plants and animal

4. Draw and label the diagram of fractional distillation



REVIEW QUESTION

1. (a) Explain the meaning of matter.

   (b) Describe each of the three state of matter.

   (c) Explain importance of changing one state of matter to another.

2. Define a/ (i) chemical change.

(ii) physical change.

b/Give the characteristics of each of the above.

c/ Give the differences between physical change and chemical change.

3.Define a/ (i) Metal.

(ii) Non metals.

b/ Different between metal and non metal.

4. Define the following a/ (i) compound

(ii) mixture

b/ Give the differences between compound and mixtures.

5. Define the following

a/ (i) solutions.

(ii)suspensions.

(iii) emulsion.

b/ mention three classes of mixture.

6. Define the following

(i) Sublimation .

(ii) Decantation.

(iii) Filtration.

(iv) Distillation.

(v) Layer separation.

AIR COMBUSTION, RUSTING AND FIRE FIGHTING

AIR

This is a homogeneous colorless mixture of different gases in the atmosphere.

Composition of gases in air

The gases include: oxygen, nitrogen, carbon dioxide, and noble gas. Air contains water vapor and dust particles. However, they are not usually considered part of air.

The table below shows the percentage composition of gases.

Gas	% composition
Nitrogen	78%
Oxygen	21%
Noble gases	0.94%
Carbon dioxide	0.03%
Water vapor	0-4%

NB: The percentage composition of water vapor is generally caused by;

- Weather
- Geographical location

Test for gases in air.

-It is possible to test for the presence of some of the gases that are found in air.

Carbon dioxide test

-**Lime water** on the watch glass turns **milky** after a few days when left exposed. The conversion of the lime water from colourless to milky color indicates that there is **carbondioxide** present in the air.

Oxygen test

- It **relights a glowing splint** i.e when oxygen is collected in a gas jar and a piece of wood that has been lighted with fire is also placed within the jar, its going to be relighted because oxygen supports burning. Or **copper** turns to **black** on heating because it reacts with oxygen.

Water

-White **anhydrous copper (ii) sulphate** on watch glass turns **blue** when left exposed.This is due the presence of **water** in air.

Combustion

-This is a chemical reaction that involves the burning of a substance in the presence of oxygen then produces energy and light.

Combustible

-Is a material that catch fire and burn easily, combustion takes place in the open place such as fire or in a closed system such as a car engine.

Application of combustion in real life

Areas where combustion is applied;

Area	Application
Industries	• In engines • In large boats • Incinerators for burning waste
Domestic	• Cooking • Heating • Burning
Laboratory	• Sterilization during experiment.

FIRE FIGHTING

Fire - is the process in which ignited material combine with oxygen to give light, heat and a flame.

Fire fighting - is the extinguishing of harmful fire.

Classification of fire

Fire can be classified according to the types of materials burning hence each type of fire will need appropriate fighting technique and equipment.

The table below shows classification of fires and the appropriate extinguishers

CLASS	BURNING MATERIAL	APPRORIATE FIRE EXTI
A	Solid materials. E.g: Paper, wood and clothing.	- Use water. - Portable extinguisher excep dioxide extinguisher.
B	Flammable liquid. E.g: kerosene, petrol, alcohol etc.	- Blanket. - Sand. - Dry powder extinguisher. - Foam extinguisher. - Carbon dioxide extinguisher
C	Flammable gases. E.g: Butane and propane.	- Dry powder extinguisher. - Carbon dioxide extinguishe
D	Flammable metal. E.g: Magnesium, sodium and lithium.	- Dry powder extinguisher. - Foam extinguisher.
E	Electrical equipment. E.g: Wires, circuit etc.	- Switch off the main power. - Dry powder extinguisher. - Carbon dioxide extinguisher.
F	Cooking appliances.	- Wet chemical extinguisher.

Components needed to start fire

For a fire to burn the following components are required in suitable proportions;

1. Source of ignition heat
2. Air (oxygen)
3. Fuel

-The above three components are called **fire triangles.** If any of them is missing no fire will continue burning.

NB: during the fire fighting at least one component is eliminated to cut off the fire especially air.

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FIRE EXTINGUISHERS;

Is an active fire protection device used to extinguisher control small fire often in emergency situation.

> Portable fire extinguisher is an extinguisher that can be easily moved from one place to another.

TYPES OF FIRE EXTINGUISHERS

There are four common types of portable fire extinguishers namely:

1. **Dry powder extinguishers;**

   Contain fire sodium bicarbonate powder pressurized by nitrogen.Extinguish the fire by separating the fuel from the oxygen element or by removing the heat element of the fire triangle.

2. **Foam extinguishers;**

   Contains proteins and fluoroproteins.extinguisher fire by taking a way the heat element of the fire triangle .From agents also separate the oxygen element from the other element.

3. **Water extinguisher**;

   Contain ordinary tap water pressurized air, extinguish fire by taking away the heat element of the fire triangle.

4. **Carbon dioxide extinguisher;**

   Contain CO_2, a non flammable gas, and are highly pressurized air. Extinguish fire by taking a way the oxygen element of the fire triangle and also be removing the heat with very cold discharge.

Using fire extinguishes

The fire extinguishers should be used based on the following; "PASS"

1. **PULL -** The safety pin from the handle. The pin is located at the top of the fire extinguisher. Once removed, it releases the locking mechanism, allowing you to discharge the extinguisher.
2. **AIM** - The extinguisher nozzle at the base of the fire. As explained this removes the sources or fuel of the fire. Keep yourself low.
3. **SQUEEZE** - The handle slowly to discharge the agent. Letting go of the handle will stop the discharge, so keep it held down.
4. **SWEEP** - Sweep side to side over the fire until expended. The sweeping motion helps to extinguish the fire. Stand few meters back from the fire.

RUSTING

Rust: is the reddish brown oxide of iron formed by the action of moisture and oxygen on the mental surface. It consists mainly of hydrated iron (III) oxide ($Fe_2O_3.H_2O$) and iron (III) hydroxide ($Fe(OH)_3$)

RUSTING: Is the process in which iron turns into iron oxide

Rusting process ; steps are the follows

(i) $Fe \rightarrow Fe^{2+} + 2e^-$

(ii) $2e^- + \frac{1}{2}O_2 + H_2O \rightarrow 2OH$

>The hydroxide ion react with iron (Fe^{2+})and more dissolved oxygen to from iron (iii) oxide usually in hydrated form .

(III) $Fe_2^{+} + 2OH^- \rightarrow Fe(OH)_2$

$2Fe(OH)_2 + 1/2O_2 + XH2O\ Fe_2O_3.XH_2O + 2H_2O$

This is a chemical process that occurs in iron or steel forming a red brown coating on the metal.

Conditions for rusting

There are three conditions necessary for rusting and these are;

1. Iron steel
2. Water moisture
3. Air oxygen

Methods of preventing rusting

•**Painting**-Is the coating of items with a special pigment point that are made of iron and usually painted to make the last long.

•**Oiling**-Is the coating of iron with oil .Some machine parts cannot be protected with painting so they use oil.

•**Tin plating-** Is the coating of iron with tin. Tin cans are actually of steel, but inside of them can be coated with a thin layer of tin to make them suitable for carrying foods.

•**Galvanization-** Is the coating of iron or steel with zinc.

•**Use of silica gel-** This is a substance in the form of grate to absorb moisture in a small bag of silica gel is put inside carrying the instrument so as to absorb at moisture that may be there.

•**Use of plastics** - Parts of some machines or instruments are coated with plastic to ensure that they do not rust.

REVIEW QUESTION

1. Define the following

a/ (i) Rusting
(ii) Rust
(iii) Air
(iv) Combustion
(v) Fire
(vi) Fire fighting

b/ Mention the components of air and their percentage

2.(a) Mention classes of fire ,their burning materials and appropriate fire extinguisher.

(b) What are the components needed to start fire .

(c) What are the conditions necessary for ion to rust.

3.(a) Classify the types of extinguisher according to the chemical they contain.

(b) Explain with equation how rusting occur .

(c) Mention the methods of preventing rusting.