(vi) Wash with lots of water any skin contact with chemicals immediately. Report immediately to teacher/laboratory technician any irritation, cut, burn, bruise or feelings arising from laboratory work.

(vii) Read and follow safety instruction. All experiments that evolve/produce poisonous gases should be done in the open or in a fume chamber.

(viii)Clean your laboratory work station after use. Wash your hand before leaving the chemistry laboratory.

(ix) In case of fire, remain calm, switch of the source of fuel-gas tap. Leave the laboratory through the emergency door. Use fire extinguishers near the chemistry laboratory to put of medium fires. Leave strong fires wholly to professional fire fighters.

(x) Do not carry unauthorized item from a chemistry laboratory.

An apparator /apparatus are scientific tools/equipment used in performing scientific experiments. The conventional apparator used in performing scientific experiments is called **standard** apparator/apparatus. If the conventional standard apparator/apparatus is not available, an **improvised** apparator/apparatus may be used in performing scientific experiments. An improvised apparator/apparatus is one used in performing a scientific experiment **for** a standard apparator/apparatus. Most standard apparatus in a school chemistry laboratory are made of **glass** because:

(i)Glass is transparent and thus reactions /interactions inside are clearly visible from outside

(ii) Glass is comparatively cheaper which reduces cost of equipping the school chemistry laboratory

(iii) Glass is comparatively easy to clean/wash after use.

(iv) Glass is comparatively unreactive to many chemicals.

Apparatus are designed for the purpose they are intended in a school chemistry laboratory:

(a) APPARATUS FOR MEASURING VOLUME

1. Measuring cylinder

Measuring cylinders are apparatus used to measure volume of liquid/ solutions. They are calibrated/ graduated to measure any volume required to the maximum. Measuring cylinders are named according to the maximum calibrated/graduated volume e.g.

“10ml” measuring cylinder is can hold maximum calibrated/graduated volume of “10mililitres” /“10 cubic centimetres”

“50ml” measuring cylinder is can hold maximum calibrated/graduated volume of “50mililitres” /“50 cubic centimetres”

“250ml” measuring cylinder is can hold maximum calibrated/graduated volume of “250mililitres” /“250 cubic centimetres”

“1000ml” measuring cylinder is can hold maximum calibrated/graduated volume of “1000mililitres” /“1000 cubic centimetres”

2. Burette

Burette is a long and narrow/thin apparatus used to measure small accurate and exact volumes of a liquid solution. It must be clamped first on a stand before being used. It has a tap to run out the required amount out. They are calibrated/ graduated to run out small volume required to the maximum 50ml/50cm3.

The maximum 50ml/50cm3 calibration/ graduation reading is at the **bottom** .This ensure the amount run **out** from a tap **below** can be determined directly from **burette reading** before and after during volumetric analysis.

BURETTES ARE EXPENSIVE AND CARE SHOULD BE TAKEN WHEN USING THEM.

3. (i) Pipette

Pipette is a long and narrow/thin apparatus that widens at the middle used to measure and transfer small very accurate/exact volumes of a liquid solution. It is open on either ends.

The maximum 25ml/25cm3 calibration/ graduation mark is a visible **ring** on one thin end.

To fill a pipette to this mark, the user must suck up a liquid solution upto a level above the mark then adjust to the mark using a finger. This requires practice.

(ii) Pipette filler

Pipette filler is used to suck in a liquid solution into a pipette instead of using the mouth. It has a suck, adjust and eject button for ensuring the exact volume is attained. This requires practice.

4. Volumetric flask

A volumetric flask is thin /narrow but widens at the base/bottom. It is used to measure very accurate/exact volumes of a liquid solution.

The maximum calibration / graduation mark is a visible **ring.**

Volumetric flasks are named according to the maximum calibrated/graduated volume e.g.

“250ml” volumetric flask has a calibrated/graduated mark at exact volume of “250mililitres” /“250centimetres”

“1l” volumetric flask has a calibrated/graduated mark at exact volume of “one litre” /“1000 cubic centimeters”

“2l” volumetric flask has a calibrated/graduated mark at exact volume of “two litres” /“2000 cubic centimeters”

5. Dropper/teat pipette

A dropper/teat pipette is a long thin/narrow glass/rubber apparatus that has a flexible rubber head.

NH_3 **(g)** + (aq) -> NH_3 **(aq)**

3. Copper (II) sulphate (VI) solution is a solution formed after dissolving Copper (II) sulphate (VI) crystals/solid in water. Copper (II) sulphate (VI) exists in aqueous state after dissolving.

Copper (II) sulphate (VI) + Water -> Copper (II) sulphate (VI) solution

$CuSO_4$**(s)** + (aq) -> $CuSO_4$ **(aq)**

4. Potassium manganate(VII) solution is a solution formed after dissolving Potassium manganate(VII) crystals/solid in water.

Potassium manganate(VII)exist in aqueous state after dissolving. Potassium manganate(VII) + Water -> Potassium manganate(VII) solution

$KMnO_4$**(s)** + (aq) -> $KMnO_4$ **(aq)**

(b)Suspension/ precipitates/solid-liquid mixture which do not dissolve

Experiment: To make soil, flour and Lead (II) Iodide suspension/precipitate

Procedure

Put about 100 cm3 of water in three separate beakers. Separately place a half spatula end full of soil, maize and lead (II) Iodide to each beaker. Stir for about two minutes.

Observation

Some soil, maize and lead (II) Iodide float in the water

A brown suspension/precipitate/particles suspended in water containing soil

A white suspension/precipitate/particles suspended in water containing flour

A yellow suspension/precipitate/particles suspended in water containing Lead (II) iodide. Some soil, maize and lead (II) Iodide settle at the bottom after some time.

Explanation

Some solid substances do not dissolve in a liquid. They are said to be **insoluble** in the solvent .When an insoluble solid is put in liquid:

(i) Some particles remain **suspended/floating** in the liquid to form a **suspension /precipitate**.

(ii) Some particles **sink/settle** to the bottom to form **sediments** after being allowed to stand.

An **insoluble** solid acquire the colour of the suspension/precipitate .e.g.

1. A white suspension /precipitate have some fine white particles suspended /floating in the liquid. **Not** "white solution"
2. A blue suspension /precipitate has some fine **blue** particles suspended /floating in the liquid.
3. A green suspension /precipitate has some fine **green** particles suspended /floating in the liquid.
4. A **brown** suspension /precipitate has some fine **brown** particles suspended /floating in the liquid.
4. A yellow suspension /precipitate has some fine yellow particles suspended /floating in the liquid.

	alloy	
Brass	Copper and Zinc	Making screws and bulb caps
Bronze	Copper and Tin	Making clock springs, electrical contacts and copper coins
Soldier	Lead and Tin	Soldering, joining electrical contacts because of its low melting points and high thermal conductivity
Duralumin	Aluminum, Copper and Magnesium	Making aircraft, utensils, and windows frames because of its light weight and corrosion resistant.
Steel	Iron, Carbon ,Manganese and other metals	Railway lines, car bodies girders and utensils.
Nichrome	Nichrome and Chromium	Provide resistance in electric heaters and ovens
German silver	Copper, Zinc and Nickel	Making coins

METHODS OF SEPARATING MIXTURES

Mixtures can be separated from applying the following methods:

(a) Decantation

Sediments can be separated from a liquid by pouring out the liquid. This process is called **decantation.**

Experiment

Put some sand in a beaker. Add about 200cm3 of water. Allow sand to settle. Pour off water carefully into another beaker.

Observation

Sand settles at the bottom as sediments.

Less clean water is poured out.

Explanation

Sand does not dissolve in water. Sand is denser than water and thus settles at the bottom as **sediment**. When poured out, the less dense water flows out.

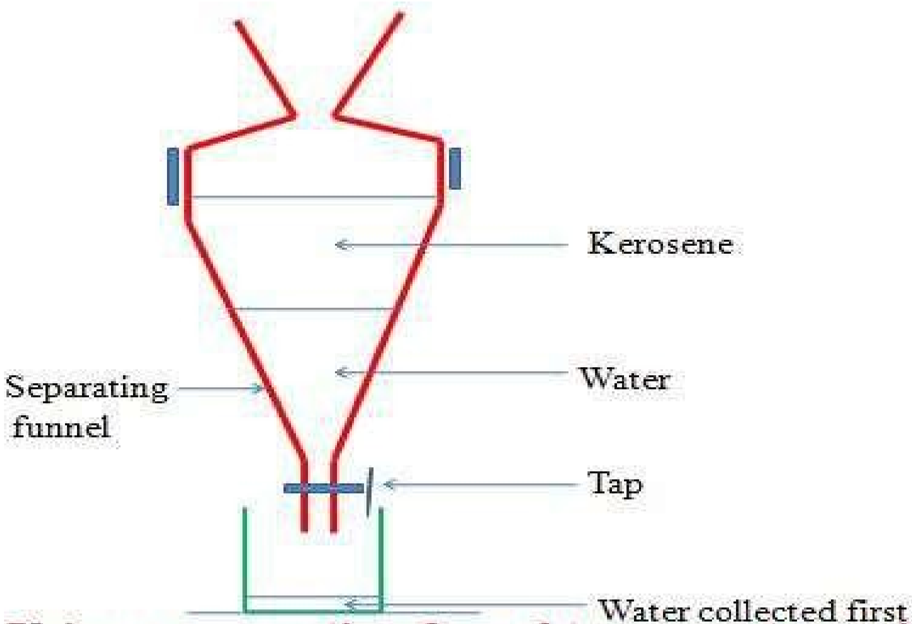
(b)Filtration

Decantation leaves suspended particles in the liquid after separation. Filtration is thus improved decantation.Filtration is the method of separating insoluble mixtures/particles/solids from a liquid.

Experiment: To separate soil and water using filtration

Water and paraffin are immiscible. Water is denser than paraffin. When put in a separating funnel, paraffin float on water. On opening the tap, water runs out. A mixture of water and paraffin at the junction of the two is discarded. It is not pure.

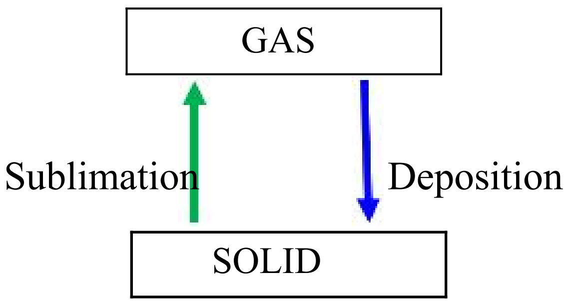
Set up of apparatus



Using a separating funnel to separate a mixture of water/ paraffin

(g)Sublimation/deposition

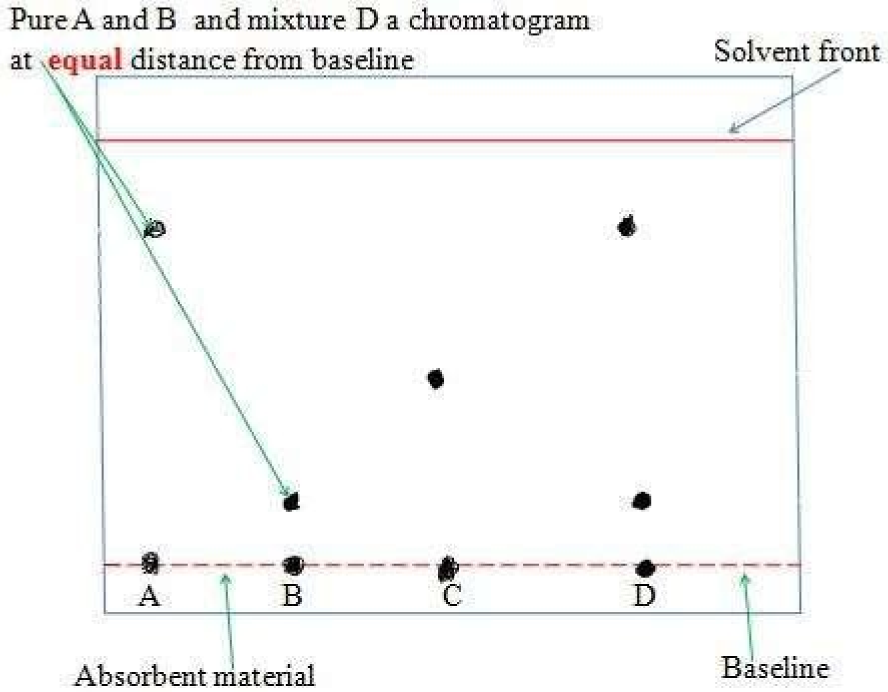
Some solids on heating do not melt to a liquid but change directly to a gas. The process by which a solid changes to a gas is called **sublimation**. The gas cools back and changes directly to a solid. The process by which a gas changes to a solid is called **deposition.** Sublimation and deposition therefore are the same but opposite processes.



Some common substances that undergo sublimation/ deposition include:

(i)Iodine (ii)Carbon(IV)oxide (iii)Camphor (iv) ammonium chloride (v)Iron(III)chloride (vi)Aluminum(III)chloride (vii) benzoic acid

If a mixture has any of the above as a component, then on heating it will change to a gas and be deposited away from the source of heating.



Chromatogram showing pure A,B,C and mixture D

(i) Solvent extraction

Solvent extraction is a method of separating oil from nuts/seeds. Most nuts contain oil. First the nuts are crushed to reduce their size and increase the surface area. A suitable volatile solvent is added. The mixture is filtered. The filtrate solvent is then allowed to crystallize leaving the oil/fat. If a filter paper is rubbed/smeared with the oil/fat, it becomes translucent. This is the test for the presence of oil/fat.

Experiment: To extract oil from Macadamia nut seeds

Procedure

Crush Macadamia nut seeds form the hard outer cover .Place the inner soft seed into a mortar. Crush (add a little sand to assist in crushing).

Add a little propanone and continue crushing. Continue crushing and adding a little propanone until there is more liquid mixture than the solid. Decant/filter. Put the filtrate into an evaporating dish. Vapourize the solvent using solar energy /sunlight. Smear/rub a portion of the residue left after evaporation on a clean dry filter paper.

Observation /Explanation

Propanone dissolve fat/oil in the macadamia nuts. Propanone is more volatile (lower boiling point) than oil/fat. In sunlight/solar energy, propanone evaporate/vaporize leaving oil/fat(has a higher boiling point).Any seed like corn, wheat , rice, soya bean may be used instead of macadamia seed. When oil/fat is rubbed/ smeared on an opaque paper, it becomes translucent.

(j) Crystallization

Crystallization is the process of using solubility of a solute/solid to obtain the solute/solid crystals from a saturated solution by cooling or heating the solution.

A crystal is the smallest regular shaped particle of a solute. Every solute has unique shape of its crystals.

(ii)**Oxy-hydrogen** flame is produced when Hydrogen is burn in pure oxygen. The flame has a temperature of about $2000^{O}C$.It is used also for **welding /cutting metals**.

3. **Oxy-hydrogen** mixture is used as rocket fuel
4. A mixture of charcoal, petrol and liquid Oxygen is an explosive.

(d) Chemical properties of Oxygen /combustion.

Oxygen is a very reactive non metal. Many elements react with oxygen through burning to form a group of compounds called **Oxides**.

Burning/combustion is the reaction of Oxygen with an element/substances.

Reaction in which a substance is added oxygen is called **Oxidation reaction**.

Burning/combustion are an example of an oxidation reaction.

Most **non metals** burn in Oxygen/air to form an Oxide which in solution / dissolved in water is **acidic** in nature. They turn blue litmus red.e.g. Carbon (IV) oxide/CO_2, Nitrogen (IV) oxide/ NO_2, Sulphur (IV) oxide/ SO_2

Some non metals burn in Oxygen/air to form an Oxide which in solution / dissolved in water is **neutral** in nature. They **don't** turn blue or red litmus. E.g. Carbon (II) oxide/CO, Water/ H_2O

All **metals** burns in Oxygen/air to form an Oxide which in solution/dissolved in water is **basic/alkaline** in nature. They turn red litmus blue.e.g.

Magnesium oxide/MgO, Sodium Oxide/ Na_2O, Copper (II) oxide/CuO

Elements/substances burn **faster** in pure Oxygen than in air

Air contains the inactive part of air that **slows** the rate of burning of substances/elements.

(i)Reaction of metals with Oxygen/air

The following experiments show the reaction of metals with Oxygen and air.

I. Burning Magnesium

Procedure

(a)Cut a 2cm length piece of magnesium ribbon. Using a pair of tongs introduce it to a Bunsen flame. Remove it when it catches fire. Observe.

Place the products in a beaker containing about 5cm3 of water. Test the solution/mixture using litmus papers

(b)Cut another 2cm length piece of magnesium ribbon. Using a pair of tongs introduce it to a Bunsen flame. When it catches fire, lower it slowly into a gas jar containing Oxygen.

Place about 5cm3 of water into the gas jar. Test the solution/mixture using litmus papers. Test the solution/mixture using litmus papers

Observations

(a)In air

Magnesium burns with a bright blindening flame in air forming white solid/ash /powder. Effervescence/bubbles/ fizzing Pungent smell of urine. Blue litmus paper remains blue. Red litmus paper turns blue

(b) In pure Oxygen

Magnesium burns **faster** with a very bright blindening flame pure oxygen forming white solid/ash /powder. No effervescence/bubbles/ fizzing. No pungent smell of urine. Blue litmus paper remains blue. Red litmus paper turns blue

Explanation

Magnesium burns in air producing enough heat energy to react with both Oxygen and Nitrogen to form **Magnesium Oxide** and **Magnesium nitride.** Both Magnesium Oxide and Magnesium nitride are white solid/ash /powder.

Chemical equations

Magnesium + Oxygen -> Magnesium Oxide

$2Mg(s) + O_2(g) \rightarrow 2MgO(s)$

Magnesium + Nitrogen -> Magnesium **Nitr**ide

$3Mg(s) + N_2(g) \rightarrow Mg_3N_2\ (s)$

Magnesium Oxide dissolves in water to form a basic/alkaline solution of Magnesium hydroxide

Chemical equations

Magnesium Oxide + Water -> Magnesium hydroxide

$2Mg(s) + O_2\ (l) \rightarrow 2MgO(s)$

Magnesium Nitride dissolves in water to form a basic/alkaline solution of Magnesium hydroxide and producing **Ammonia gas**. Ammonia is also an alkaline/basic gas that has a pungent smell of urine.

Chemical equations

Magnesium Nitride + Water -> Magnesium hydroxide + Ammonia gas

$Mg_3N_2\ (s) + 6H_2O\ (l) \rightarrow 3Mg\ (OH)_2\ (aq) + 2NH_3(g)$

II. Burning Sodium

Procedure

(a)**Carefully** cut a very small piece of sodium. Using a deflagrating spoon introduce it to a Bunsen flame. Remove it when it catches fire. Observe.

Place the products in a beaker containing about 20cm3 of water. Test the solution/mixture using litmus papers

(b) **Carefully** cut another very small piece of sodium. Using a deflagrating spoon introduce it to a Bunsen flame. When it catches fire, lower it slowly into a gas jar containing Oxygen.

Place about 20 cm3 of water into the gas jar. Test the solution/mixture using litmus papers. Test the solution/mixture using litmus papers

Observations

(a)In air

Sodium burns with a **yellow** flame in air forming a **black** solid. Blue litmus paper remains blue. Red litmus paper turns blue

(b) In pure Oxygen

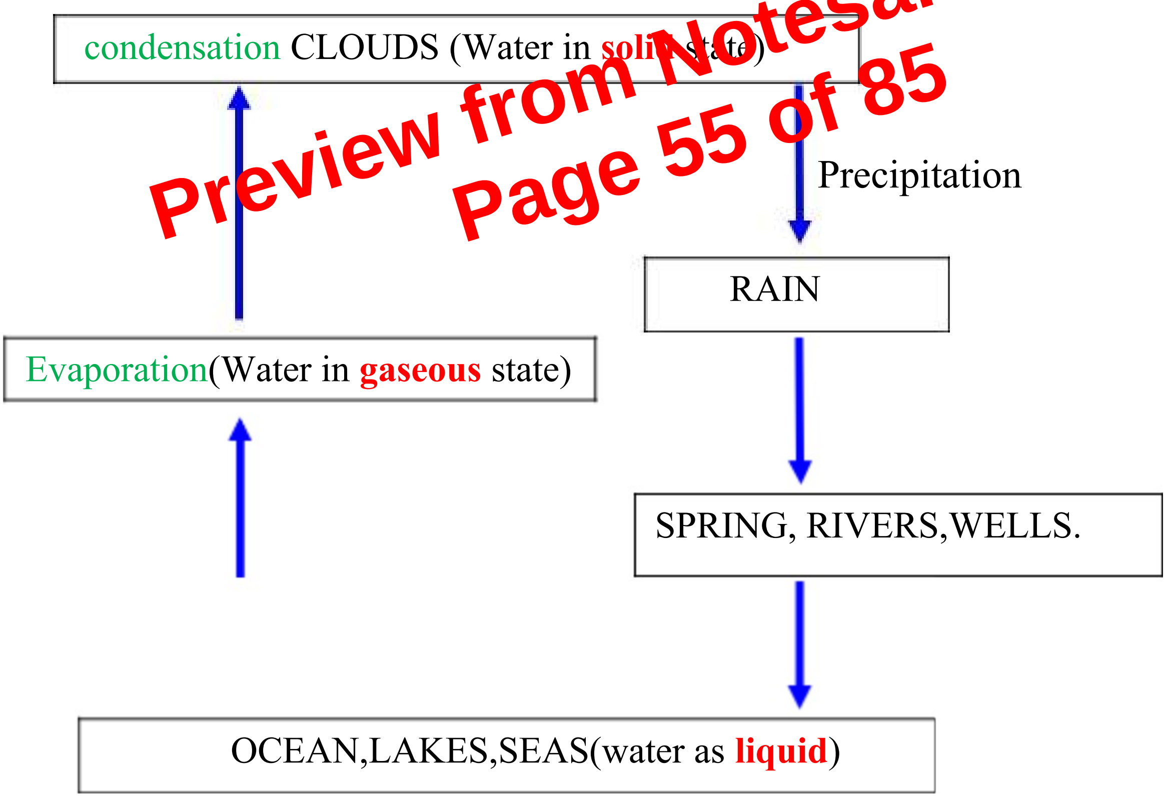
WATER AND HYDROGEN

A.WATER

Pure water is a **colourless**, **odorless**, **tasteless**, neutral liquid. Pure water does not exist in nature but naturally in varying degree of purity. The main sources of water include rain, springs, borehole, lakes, seas and oceans: Water is generally **used** for the following purposes:

(i) Drinking by animals and plants.
(ii) Washing clothes.
(iii) Bleaching and dyeing.
(iv) Generating hydroelectric power.
(v) Cooling industrial processes.

Water dissolves many substances/solutes.
It is therefore called **universal solvent**.
It contains about 35% **dissolved** Oxygen which support aquatic fauna and flora.
Water naturally exists in three phases/states **solid** ice, **liquid** water and **gaseous** water vapour.
The three states of water are naturally **interconvertible**.
The natural interconvertion of the three phases/states of water forms the water cycle.



Liquid water in land, lakes, seas and oceans use the solar/sun **energy** to **evaporate/vapourize** to form water vapour/**gas**. Solar/sun energy is also used during transpiration by plants and respiration by animals.

Lead (II) Oxide + Hydrogen -> Lead + Hydrogen gas
(oxidizing agent) (reducing agent)
(brown when hot/ yellow when cool) (grey)

$PbO (s) + H_2 (g) \rightarrow Pb(s) + H_2O (l)$

(ii) when excess Hydrogen is burning.

Oxygen + Hydrogen -> Water

$O_2 (g) + 2H_2 (g) \rightarrow 2H_2O(l)$

(**c**)Chemical equation

(i) In glass tube

Iron (III) Oxide + Hydrogen -> Iron + Hydrogen gas
(oxidizing agent) (reducing agent)
(Dark grey) (grey)

$Fe_2O_3 (s) + 3H_2 (g) \rightarrow Fe(s) + 3H_2O (l)$

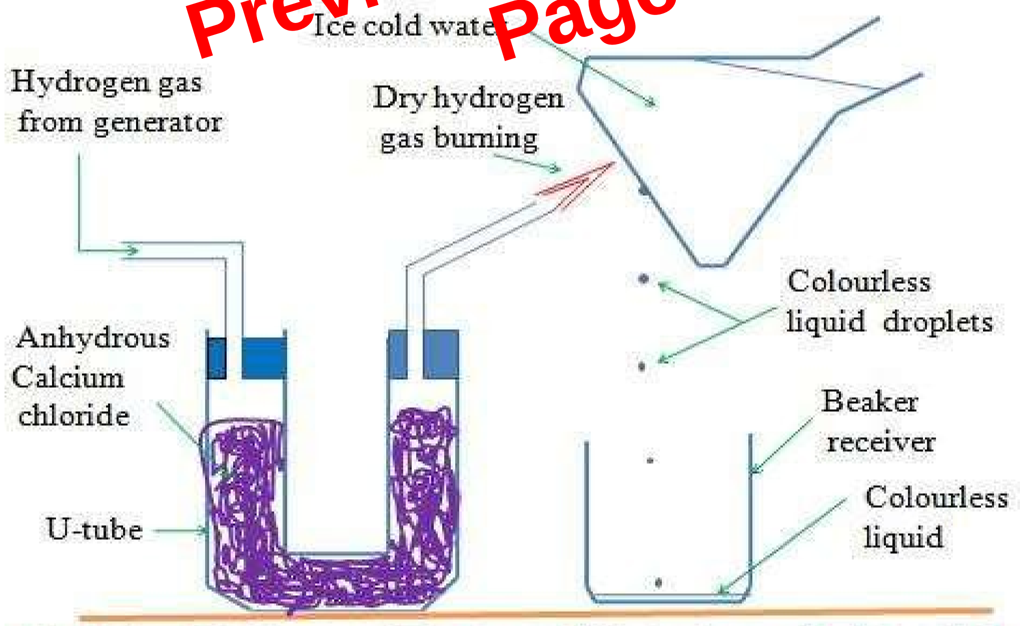
(ii) when excess Hydrogen is burning.

Oxygen + Hydrogen -> Water

$O_2 (g) + 2H_2 (g) \rightarrow 2H_2O (l)$

(iii) Water as an Oxide as Hydrogen

Burning is a reaction of an element with Oxygen. The substance formed when an element burn in air is the oxide of the element. When hydrogen burns, it reacts/ combines with Oxygen to form the **oxide of Hydrogen**. The oxide of Hydrogen is called water. Hydrogen is first dried because a mixture of Hydrogen and air explode. The gas is then ignited .The products condense on a cold surface/flask containing a freezing mixture. A freezing mixture is a mixture of water and ice.



Burning Hydrogen:To show Water is an Oxide of Hydrogen

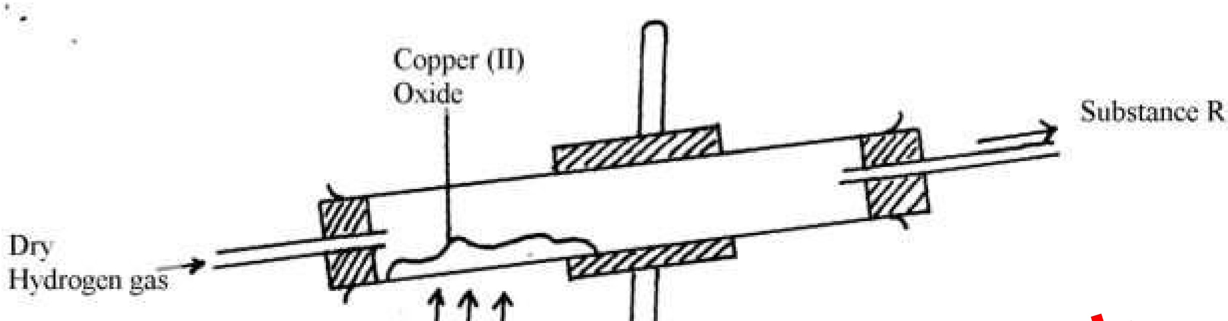
The condensed products are collected in a receiver as a colourless liquid.

(b) When water reacts with potassium metal the hydrogen produced ignites explosively on the surface of water.

(i) What causes this ignition?

(ii) Write an equation to show how this ignition occurs

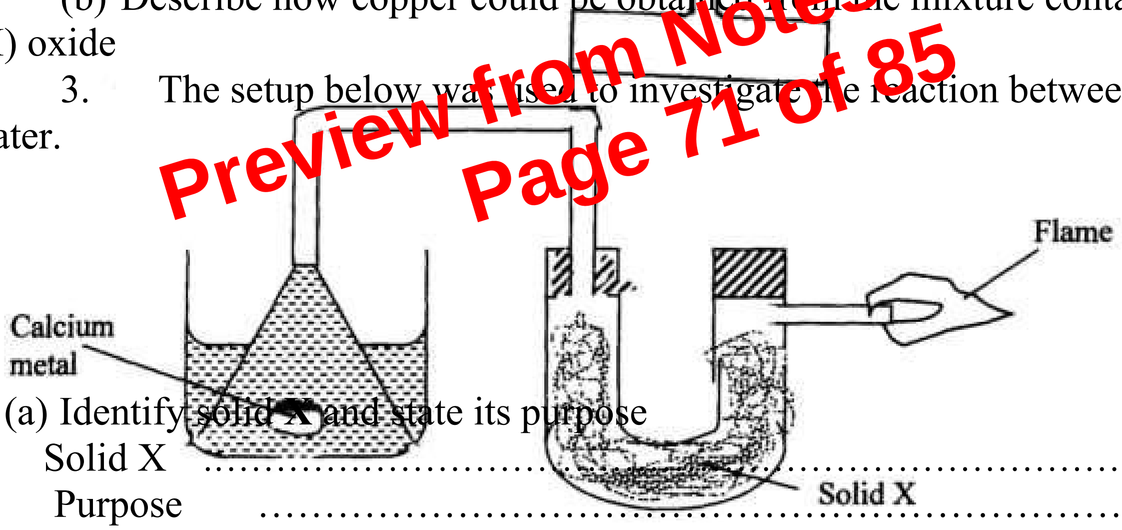
2. In an experiment, dry hydrogen gas was passed over hot copper (II) oxide in a combustion tube as shown in the diagram below:



(a) Complete the diagram to show how the other product, substance R could be collected in the laboratory.

(b) Describe how copper could be obtained from the mixture containing copper (II) oxide

3. The setup below was used to investigate the reaction between metals and water.



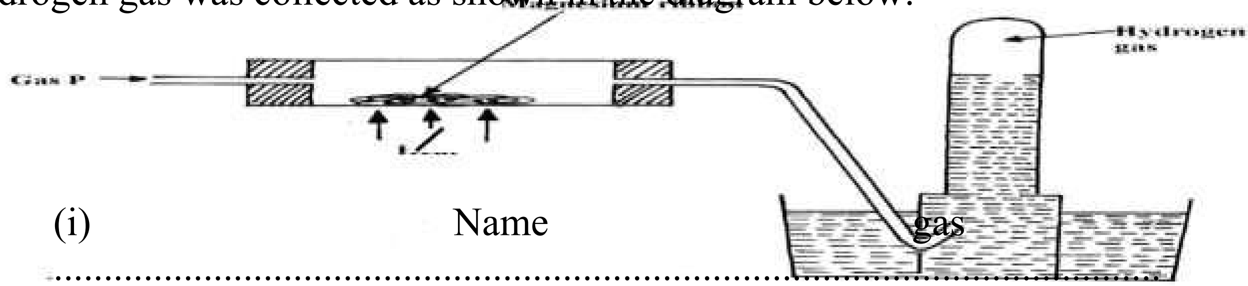
(a) Identify solid X and state its purpose

Solid X ……………………………………………………………………..

Purpose ……………………………………………………………………..

(b) Write a chemical equation for the reaction that produces the flame.

4. Gas **P** was passed over heated magnesium ribbon and hydrogen gas was collected as shown in the diagram below:



(i) Name gas **P**

……………………………………………………………………………………………………

$Fe(s) + 2HCl(aq) \rightarrow FeCl_2(aq) + H_2(g)$

4. Aluminium + Hydrochloric acid -> Aluminium chloride + Hydrogen

$2Al(s) + 3HCl(aq) \rightarrow AlCl_3(aq) + 3H_2(g)$

5. Magnesium + Sulphuric (VI) acid -> Magnesium sulphate (VI) + Hydrogen

$Mg(s) + H_2SO_4(aq) \rightarrow MgSO_4(aq) + H_2(g)$

6. Zinc + Sulphuric (VI) acid -> Zinc sulphate (VI) + Hydrogen

$Zn(s) + H_2SO_4(aq) \rightarrow ZnSO_4(aq) + H_2(g)$

7. Iron + Sulphuric (VI) acid -> Iron (II) sulphate (VI) + Hydrogen $Fe(s) + H_2SO_4(aq) \rightarrow FeSO_4(aq) + H_2(g)$

8. Aluminium + Sulphuric (VI) acid -> Aluminium sulphate (VI) + Hydrogen

$2Al(s) + 3H_2SO_4(aq \rightarrow Al_2(SO_4)_3(aq + 3H_2(g)$

2. **Reaction of metal carbonates and hydrogen carbonates with mineral acids**.

All acids react with carbonates and hydrogen carbonates to form salt, water and produce /evolve carbon (IV) oxide gas.

Metal carbonate + Acid -> Salt + Water+ Carbon(IV)oxide gas

Metal hydrogen carbonate + Acid -> Salt + Water + Carbon (IV) oxide gas

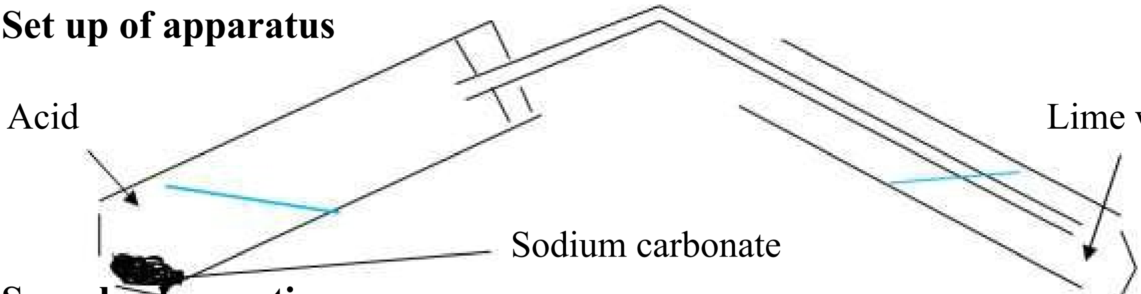
Experiment: **reaction of metal carbonates and hydrogen carbonates with mineral acids.**

(a)Place 5cm3 of dilute hydrochloric acid in a small test tube. Add half spatula full of sodium carbonate. Stopper the test tube using a cork with delivery tube directed into lime water. Record the observations made. Test the gas also with burning splint.

(b)Repeat the procedure in (a) above using Zinc carbonate, Calcium carbonate, copper carbonate, sodium hydrogen carbonate, Potassium hydrogen carbonate in place of Sodium carbonate.

(c)Repeat the procedure in (a) then (b) using dilute sulphuric (VI) acid in place of dilute hydrochloric acid.

Set up of apparatus



Sample observations

(i) effervescence/bubbles produced/fizzing in all cases.

(ii) Colourless gas produced in all cases.

(iii) Gas produced forms a white precipitate with lime water.

Explanation

All metal carbonate/hydrogen carbonate reacts with dilute acids to produce bubbles of carbon (IV) oxide gas. Carbon (IV) oxide gas is a colourless gas that extinguishes a burning splint. When carbon (IV) oxide gas is bubbled in lime water, a white precipitate is formed.

Chemical equations

1. Sodium carbonate +Hydrochloric acid -> Sodium chloride + Carbon (IV) Oxide+ Water

$Na_2CO_3(s)$ + $2HCl$ (aq) -> $2NaCl$ (aq) + $H_2O(g)$ + CO_2 (g)

2. Calcium carbonate +Hydrochloric acid -> Calcium chloride + Carbon (IV) Oxide+ Water

$CaCO_3(s)$ + $2HCl$ (aq) -> $CaCl_2$ (aq) + $H_2O(g)$ + CO_2 (g)

3. Magnesium carbonate +Hydrochloric acid ->Magnesium chloride + Carbon (IV) Oxide+ Water

$MgCO_3(s)$ + $2HCl$ (aq) -> $MgCl_2$ (aq) + H_2O (g) + CO_2 (g)

4. Copper carbonate +Hydrochloric acid ->Copper (II) chloride + Carbon (IV) Oxide+ Water

$CuCO_3(s)$ + $2HCl$ (aq) -> $CuCl_2$ (aq) + H_2O (g) + CO_2 (g)

5. Copper carbonate +Sulphuric (VI) acid ->Copper (II) sulphate (VI) + Carbon (IV) Oxide+ Water

$CuCO_3(s)$ + H_2SO_4 (aq) -> $CuSO_4$ (aq) + H_2O (g) + CO_2 (g)

6. Zinc carbonate +Sulphuric (VI) acid ->Zinc sulphate (VI) + Carbon (IV) Oxide+ Water

$ZnCO_3(s)$ + H_2SO_4 (aq) -> $ZnSO_4$ (aq) + H_2O (g) + CO_2 (g)

7. Sodium hydrogen carbonate +Sulphuric (VI) acid ->Sodium sulphate (VI) + Carbon (IV) Oxide+ Water

$NaHCO_3(s)$ + H_2SO_4 (aq) -> Na_2SO_4 (aq) + H_2O (g) + CO_2 (g)

8. Potassium hydrogen carbonate +Sulphuric (VI) acid ->Potassium sulphate (VI) + Carbon (IV) Oxide+ Water

$KHCO_3(s)$ + H_2SO_4 (aq) -> K_2SO_4 (aq) + H_2O (g) + CO_2 (g)

9. Potassium hydrogen carbonate +Hydrochloric acid ->Potassium chloride + Carbon (IV) Oxide+ Water

$KHCO_3(s)$ + HCl (aq) -> KCl (aq) + H_2O (g) + CO_2 (g)

10. Sodium hydrogen carbonate +Hydrochloric acid ->Sodium chloride + Carbon (IV) Oxide+ Water

$NaHCO_3(s)$ + HCl (aq) -> $NaCl$ (aq) + H_2O (g) + CO_2 (g)

3. Neutralization by bases/alkalis

All acids react with bases to form a salt and water only. The reaction of an acid with metal oxides/hydroxides (bases) to salt and water only is called neutralization reaction. Since no effervescence/bubbling/fizzing take place during neutralization:

(i) The reaction with alkalis requires a suitable indicator. The colour of the indicator changes when all the acid has reacted with the soluble solution of the alkali (metal oxides/ hydroxides).

(ii) Excess of the base is added to ensure all the acid reacts. The excess acid is then filtered off.

Experiment 1: reaction of alkali with mineral acids.

(i)Place about 5cm3 of dilute hydrochloric acid in a boiling tube. Add one drop of phenolphthalein indicator. Using a dropper/teat pipette, add dilute sodium hydroxide dropwise until there is a colour change.

(ii)Repeat the procedure with dilute sulphuric (VI) acid instead of hydrochloric acid. (iii)Repeat the procedure with potassium hydroxide instead of sodium hydroxide. **Sample observation**:

Colour of phenolphthalein change from colourless to **pink** in all cases.

Explanation

Bases/alkalis neutralize acids. Acids and bases/alkalis are colourless. A suitable indicator like phenolphthalein change colour **to pink,** when all the acid has been neutralized by the bases/alkalis. Phenolphthalein change colour **from pink,** to colourless when all the bases/alkalis has been neutralized by the acid.

Chemical equation

Sodium oxide + Hydrochloric acid -> Sodium chloride + Water

$Na_2O(s)$ + HCl -> $NaCl(aq)$ + $H_2O(l)$

Potassium oxide + Hydrochloric acid -> Potassium chloride + Water

$K_2O(s)$ + HCl -> $KCl(aq)$ + $H_2O(l)$

Sodium hydroxide + Hydrochloric acid -> Sodium chloride + Water

$NaOH(s)$ + HCl -> $NaCl(aq)$ + $H_2O(l)$

Ammonia solution + Hydrochloric acid -> Ammonium chloride + Water

$NH_4OH(s)$ + HCl -> $NH_4Cl\ (aq)$ + $H_2O\ (l)$

Potassium hydroxide + Hydrochloric acid -> Potassium chloride + Water

$KOH(s)$ + HCl -> $KCl(aq)$ + $H_2O(l)$

Sodium hydroxide + sulphuric (VI)acid -> Sodium sulphate(VI) + Water

$2NaOH(s)$ + H_2SO_4 -> $Na_2SO_4\ (aq)$ + $2H_2O\ (l)$

Potassium hydroxide + sulphuric (VI) acid -> Potassium sulphate (VI) + Water

$2KOH(s)$ + H_2SO_4 -> $K_2SO_4\ (aq)$ + $2H_2O\ (l)$

Ammonia solution + sulphuric (VI) acid -> Ammonium sulphate (VI) + Water

$2NH_4OH(s)$ + H_2SO_4 -> $(NH4)_2SO_4\ (aq)$ + $2H_2O\ (l)$

Magnesium hydroxide + sulphuric (VI) acid -> Magnesium sulphate (VI) + Water

$Mg\ (OH)_2(s)$ + H_2SO_4 -> $MgSO_4\ (aq)$ + $2H_2O(l)$ Magnesium hydroxide + Hydrochloric acid -> Magnesium chloride + Water

$Mg\ (OH)_2(s)$ + $HCl(aq)$ -> $MgCl_2\ (aq)$ + $2H_2O(l)$