METALS AND NON-METALS

There are 116 elements known at present. On the basis of their properties elements can be divided into two main groups i.e. metals and non-metals. Out of 116 elements, 94 elements are metals and 22 elements are non-metals.

(1) METALS - are those elements which form positive ions by losing electrons e.g. Iron, Sodium etc.

PHYSICAL PROPERTIES OF METALS - (i) Metals are MALLEABLE, i.e. can be beaten into thin sheet with a hammer without breaking it. Gold and silver are most malleable metals.

(ii) Metals are DUCTILE i.e. can be drawn into thin wires Gold and silver are the most ductile elements.

(iii) Metals are GOOD CONDUCTOR OF HEAT. When metal is heated, its atoms gain energy and vibrate more vigorously. This energy is transferred to the electrons which can move through metal. They transfer their energy to other electrons and atoms and thus heat is conducted. Silver is the best conductor of heat followed by copper and aluminium. Lead and mercury are the poorest conductor of heat. The cooking utensils, boilers etc. are made up of copper and aluminium as they are good conductor of heat.

(iv) Metals are GOOD CONDUCTOR OF ELECTRICITY. because they have electrons which are free to move. and thus offer little resistance to flow of current. Silver and copper are the best conductor of electricity while mercury has very high resistance. The electric wires that carry current in our homes have a covering of plastic such as PVC (polyvinyl chloride). PVC is an insulator and does not allow the current to pass through it and thus prevent us from electric shocks.

(v) Metals are LUSTROUS (or shiny) i.e. these have a shining surface and can be polished. The shining appearance of metals makes them useful in making jewellery and decorating items e.g. gold and silver. The shiny appearance of metals makes them good reflector of light. Silver is an excellent reflector of light and hence used in making mirrors.

(vi) Metals are generally HARD except sodium and potassium which are very soft and can be easily cut with a knife.

(vii) Metals are SOLID at room temperature except mercury which is liquid at room temperature.

(viii) Metals have HIGH BOILING AND MELTING POINT except Gallium and Cesium which have very low melting point. These two metals will melt if we keep them on our palm (by absorbing heat of our body).

(ix) Metals have HIGH DENSITIES except sodium and potassium which have low densities.

(x) Metals are SONOROUS i.e. they produce sound when hit with an object. Due to this property, metals are used for making bells and strings (wires) of musical instruments. like sitar and violin.

- **CHEMICAL PROPERTIES OF METALS** —

(i) **REACTION OF METALS WITH OXYGEN** — All metals combine with oxygen to form metal oxide i.e.

$$\text{Metal} + \underset{\text{(from air)}}{\text{oxygen}} \longrightarrow \text{metal oxide}$$

e.g. $4Na + O_2 \rightarrow 2Na_2O$; $4Al + 3O_2 \rightarrow 2Al_2O_3$

$2Cu + O_2 \rightarrow 2CuO$

Different metals show different reactivities towards oxygen. Metals such as sodium and potassium react vigorously with oxygen. They catch fire and start burning when kept open in air. Hence to protect them and to prevent accidental fires, they are kept immersed in kerosene oil

- The metal oxides are basic in nature i.e. they can react with acid to give salt and water. But some metal oxides such as Al_2O_3, ZnO etc show both acidic as well as basic behaviour. They react with both acid as well as base to give salt and water and are known as AMPHOTERIC OXIDE. —

(a) $Al_2O_3 + 6HCl \rightarrow AlCl_3 + 3H_2O$

$Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$
(sodium aluminate)

(b) $ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$

$ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$
(Sodium zincate)

- Most of the metal oxides are insoluble in water but some of these dissolve in water to form ALKALIS e.g. Na_2O and K_2O —

$Na_2O + H_2O \rightarrow 2NaOH$

$K_2O + H_2O \rightarrow 2KOH$

- At ordinary temperature, the surface of metal such as Mg, Al, Zn, Pb etc. is covered with a thin layer of oxide which prevent their further oxidation.
- Silver and gold do not react with oxygen even at high temperature as these are least reactive.

(ii) **REACTION OF METALS WITH WATER** — Metal reacts with water to form metal oxide and hydrogen gas. Metal oxides which are soluble in water dissolves in it to form metal hydroxide i.e.

Metal + water → Metal oxide + hydrogen

metal oxide + water → Metal hydroxide.

- Metals like sodium or potassium react violently with cold water. The reaction is so violent and exothermic that the evolved hydrogen gas immediately catches fire. —. $2Na + 2H_2O \rightarrow 2NaOH + H_2\uparrow$ + energy

$2K + 2H_2O \rightarrow 2KOH + H_2$ + energy.

— The reaction of calcium with water is less violent and heat evolved is not sufficient for H_2 to catch fire —

$$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2\uparrow$$

Calcium starts floating because the bubbles of hydrogen gas formed stick to the surface of the metal.

— Magnesium does not react with cold water but it reacts with hot water to form magnesium hydroxide and hydrogen gas. It also starts floating as the bubbles of hydrogen gas stick to the metal surface —.

$$Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$$

— Metals like Al, Fe and Zn do not react either with cold or hot water. They react with steam to form metal oxide and hydrogen gas —

$$2Al + 3H_2O \rightarrow Al_2O_3 + 3H_2$$
$$3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$$

— Metals such as Pb, Cu, Gold and Ag do not react with water at all.

(iii) <u>REACTION OF METAL WITH DILUTE ACIDS</u> —. Metal reacts with dilute acid to give salt and hydrogen gas —.

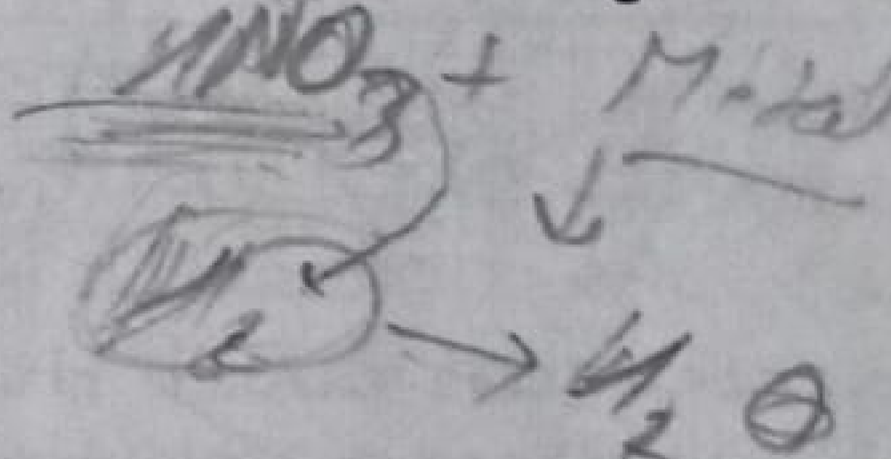
Metal + dilute acid → salt + Hydrogen

e.g. $Mg + 2HCl \rightarrow MgCl_2 + H_2$

$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

$Fe + 2HCl \rightarrow FeCl_2 + H_2$



— hydrogen gas is not evolved when a metal reacts with nitric acid. It is because HNO_3 is a strong oxidising agent. It oxidizes the hydrogen produced to water and itself gets reduced to any of nitrogen oxides (N_2O, NO, NO_2). But Mg and Mn react with very dilute nitric acid to give hydrogen gas —.

$$Mg + 2HNO_3 \rightarrow Mg(NO_3)_2 + H_2$$
$$Mn + 2HNO_3 \rightarrow Mn(NO_3)_2 + H_2$$

— Copper, silver and gold (or the metals placed below hydrogen in the reactivity series) do not react with dilute HCl / H_2SO_4 to produce hydrogen gas.

(iv) <u>REACTION OF METAL WITH OTHER METAL SALT SOLUTIONS</u> — When a more reactive metal is added to the salt solution of a less reactive metal, the more reactive metal displaces the less reactive metal from its salt solution —.

Metal A + Salt solution of B → Salt solution of A + Metal B

e.g. $Zn_{(s)} + CuSO_{4}(aq) \rightarrow ZnSO_{4}(aq) + Cu(s)$
(blue) (Colourless) (reddish brown)

$Fe_{(s)} + CuSO_{4}(aq.) \rightarrow FeSO_{4}(aq.) + Cu(s)$
(blue) (lightgreen) (reddish brown)

Based on the displacement reactions, the following series known as REACTIVITY OR ACTIVITY SERIES has been developed.

REACTIVITY SERIES – is a list of metals arranged in order of their decreasing reactivity.

- Since the metals placed at the bottom of reactivity series (like silver, gold) are less reactive, so they are usually found in free state (native state) in nature.
- Though hydrogen is not a metal but even then it has been placed in the reactivity series of metals. This is due to the fact like metals, hydrogen also lose electron to form positive ion, H^+.

REACTIVITY SERIES OF METALS

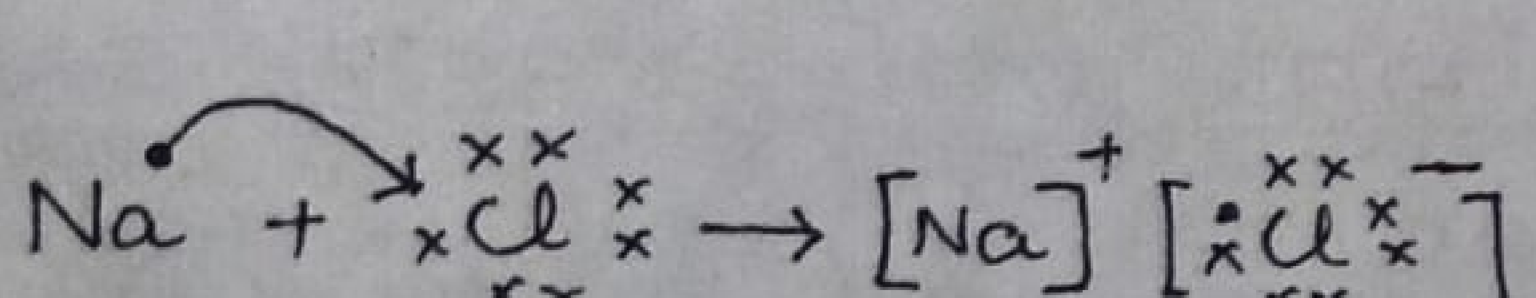
Most reactive
K
Na
Ca
Mg
Al
Zn
Fe
Pb
H
Cu
Hg
Ag
Au
↓ least reactive.

(V) REACTION OF METALS WITH NON METALS – To acquire stability, all atoms tend to complete their octet or duplet (outermost shell with two electrons, if K is the outermost shell). As a result they acquire the nearest noble gas configuration and thus become stable.

When a metal and non metal react with each other, the metal atom loses valence electrons and non metal gains electrons. As a result both the metal and the non metal acquire stable noble gas configuration. The positively charged metal ion formed by the loss of electrons is called CATION and the negatively charged non metal ion formed by gain of electrons is called ANION. The cation and anion being oppositely charged are held together by strong electrostatic force of attraction. The bond formed between them is called IONIC BOND OR ELECTROSTATIC BOND.

e.g. (a) Formation of NaCl – $Na \rightarrow Na^{+} + 1e^{-}$
(2,8,1) (2,8)

$Cl + 1e^{-} \rightarrow Cl^{-}$
(2,8,7) (2,8,8)



(b) Formation of MgO – $Mg \rightarrow Mg^{+2} + 2e$
(2,8,2) (2,8)

$O + 2e \rightarrow O^{-2}$
(2,6) (2,8)

$$Mg: + \overset{\times\times}{O}{}^{\times}_{\times} \rightarrow [Mg^{+2}][:\overset{\times\times}{\underset{\times\times}{O}}{}^{\times}_{\times}]^{-2}$$

(c) Formation of $MgCl_2$ → $\underset{(2,8,2)}{Mg} \rightarrow \underset{(2,8)}{Mg^{+2}} + 2e$; $\underset{(2,8,7)}{Cl} + 1e^- \rightarrow \underset{(2,8,8)}{Cl^-}$

$$Mg: + 2\,{}^{\times}\overset{\times\times}{\underset{\times\times}{Cl}}{}^{\times}_{\times} \rightarrow [Mg^{+2}][{}^{\bullet}_{\times}\overset{\times\times}{\underset{\times\times}{Cl}}{}^{\times}_{\times}]^{-1}_{2}$$

(d) Formation of Na_2O → $\underset{(2,8,1)}{Na} \rightarrow \underset{(2,8)}{Na^+} + 1e^-$; $\underset{(2,6)}{O} + 2e^- \rightarrow \underset{(2,8)}{O^{-2}}$

$$Na^{\bullet},\ Na^{\bullet} + \overset{\times\times}{\underset{\times\times}{O}}{}^{\times}_{\times} \rightarrow [Na^{+1}]_2[:\overset{\times\times}{\underset{\times\times}{O}}{}^{\times}_{\times}]^{-2}$$

- PROPERTIES OF IONIC COMPOUNDS - (i) Ionic compounds are SOLID and are somewhat HARD because of the strong force of attraction between positive and negative ion.

(ii) Ionic compounds have HIGH MELTING AND BOILING POINTS because a considerable amount of energy is needed to break the strong interionic attraction.

(iii) Ionic compounds are generally SOLUBLE IN WATER and INSOLUBLE IN NONPOLAR SOLVENTS such as petrol kerosene, chloroform etc.

(iv) Ionic compounds CONDUCT ELECTRICITY IN MOLTEN STATE OR IN ITS AQUEOUS SOLUTION. In solid state they don't conduct electricity because ions are not free to move due to their rigid structure. However, in molten state, the electrostatic force between the oppositely charged ions is overcome due to the heat. Thus the ions move freely and conduct electricity.

OCCURRENCE OF METALS - The earth's crust is the major source of metals. Most of the metals are quite reactive, therefore, found in the form of their compounds in earth crust. The metals which are present at the bottom of reactivity series like Cu, Ag, Au, Pt are often found in free state. copper and silver are also found in combined state as their sulphides and oxides.

- The compound or the combined form in which a metal occurs naturally in the earth's crust is called MINERAL. Those minerals from which the metal can be extracted conveniently and profitably are called ORES. Thus "all ores are minerals but all the minerals are not ores."

- Ores are mainly present in the form of oxides, carbonates, sulphides and halides. The ores of many metals are oxides because oxygen is a very reactive element and very abundant on the earth. Sulphide ores are mainly present in rocks while halides are mostly present in sea and lakes. This is because sulphides are insoluble in water while halides are soluble in water, therefore, gets washed away with rain water and collected in lakes or sea.

- EXTRACTION OF METALS – The process of obtaining a metal from its ore is called extraction of metal. The various processes involved in the extraction of metal from the ore and refining are known as METALLURGY.

- The three major steps in the extraction of metal from its ore are – (i) concentration of ore
  (ii) conversion of concentrated ore into metal.
  (iii) refining (purification) of impure metal.

(i) Concentration of ores –. (or enrichment of ores) – Ores contain a large amount of impurities such as soil, sand etc. called GANGUE. These impurities must be removed from the ore prior to the extraction of metal. The different processes used for removing the gangue from the ore are based on the difference between physical and chemical properties of gangue and the ore.

(ii) Conversion of concentrated ore into metal –. The extraction of a metal from its concentrated ore is essentially a process of reduction of metal compound present in ore. For this purpose, metals can be grouped into following three categories –. (a) metals with low reactivity
(b) metals of medium reactivity
(c) metals of high reactivity.

Different methods are used for extracting metal belonging to above three categories –.

(a) Extraction of metals with low reactivity –. The metals which are low in reactivity series are extracted by the reduction of their oxides by heat alone. For example, CINNABAR (HgS – an ore of mercury) when heated in air, it is first converted into mercuric oxide (HgO). Mercuric oxide is then reduced to mercury on further heating –.

$$2HgS + 3O_2 \xrightarrow{heat} 2HgO + 2SO_2$$

$$2HgO \xrightarrow{heat} 2Hg + O_2.$$

Similarly, copper can be obtained from its sulphide ore (copper glance; Cu_2S) by just heating in air –.

$$2Cu_2S + 3O_2 \xrightarrow{heat} 2Cu_2O + 2SO_2$$

When about half of Cu_2S is converted into copper oxide, then the supply of air is stopped. In the absence of air, copper oxide formed above reacts with remaining copper sulphide to form copper metal and sulphurdioxide –.

$$Cu_2S + 2Cu_2O \xrightarrow{heat} 6Cu + SO_2.$$

(b) Extraction of metals with medium reactivity — These metals are usually present as sulphides or carbonates. It is easier to convert (or reduce) metal oxide to metal as compared to sulphides and carbonates, therefore, prior to reduction, the sulphide and carbonate ores must be converted into metal oxide. The sulphide ore is converted into oxide by heating in presence of excess of air. This process is known as ROASTING. e.g. —

$$2ZnS + 3O_2 \xrightarrow{heat} 2ZnO + 2SO_2$$

The carbonate ores are changed into oxide by heating strongly in limited air. This process is known as CALCINATION.

e.g. $$ZnCO_3 \xrightarrow{heat} ZnO + CO_2$$

The metal oxide is then reduced to corresponding metal by using suitable reducing agent such as carbon e.g. —

$$ZnO + C \rightarrow Zn + CO$$

Sometimes, displacement reactions can also be used to reduce metal oxide to metal. The highly reactive metals such as Na, Ca, Al etc. are used as reducing agent as these can displace the metal of lower reactivity from their compounds e.g. —

$$3MnO_2 + 4Al \longrightarrow 3Mn + 2Al_2O_3 + heat$$

These reactions are highly exothermic. The amount of heat produced is so large that metals are obtained in molten state. e.g. the reaction of iron oxide with aluminium is used to join railway tracks or cracked machine parts. This reaction is known as THERMIT REACTION. —

$$Fe_2O_3(s) + 2Al(s) \longrightarrow 2Fe(l) + Al_2O_3(s) + heat$$

The molten iron is then poured between the broken iron pieces to weld them (or to join them). This process is known as ALUMINOTHERMY OR THERMITE WELDING.

(c) Extraction of metals with high reactivity — The oxides of highly reactive metals (like Na, K, Ca, Mg & Al) are very stable and cannot be reduced by most common reducing agent, carbon to obtain pure metal. This is because these metals have more affinity for oxygen than carbon so carbon is unable to remove oxygen from these metals.

The highly reactive metals are extracted by electrolytic reduction of their metal chlorides or oxides. For example, during electrolysis of molten sodium chloride, sodium is deposited at cathode and chlorine is liberated at anode. The reactions are —

$$2NaCl \rightarrow 2Na + Cl_2$$

or $$2NaCl \rightarrow 2Na^+ + 2Cl^-$$

At cathode (−ve electrode) : $2Na^+ + 2e \rightarrow 2Na$

At anode (+ve electrode) : $2Cl^- - 2e \rightarrow Cl_2$

For electrolytic reduction, aqueous solution of NaCl cannot be used instead of molten NaCl. because aqueous solution of NaCl on electrolysis will produce H_2 (at cathode), Cl_2 (at anode) and NaOH and not the sodium metal. Similarly, Aluminium can be obtained from electrolysis of molten Al_2O_3 –

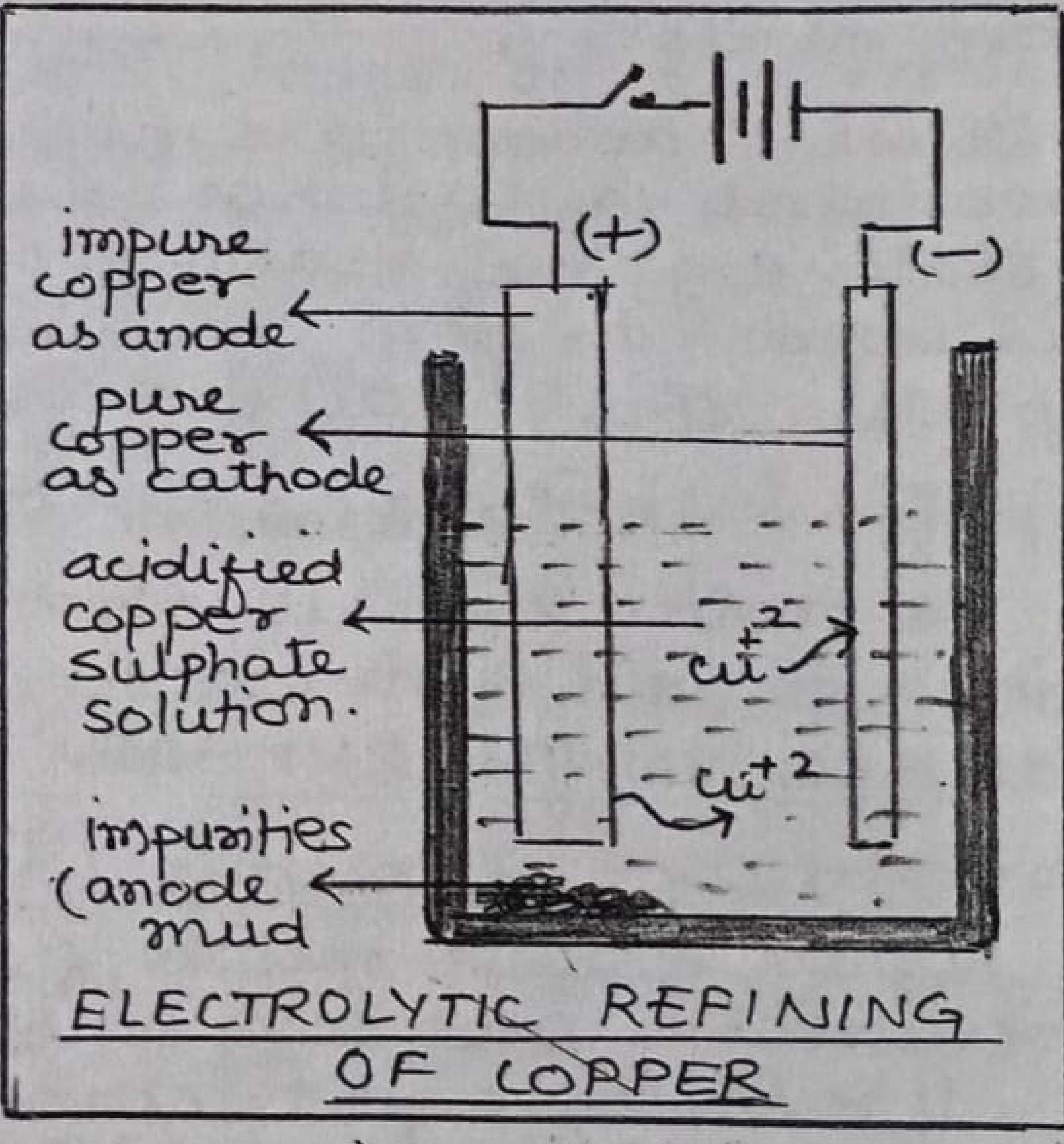
$$2Al_2O_3 \rightarrow 4Al^{+3} + 6O^{-2}.$$

at cathode : $4Al^{+3} + 12e \rightarrow 4Al.$

at anode : $6O^{-2} \rightarrow 3O_2 + 12e$

therefore overall reaction : $2Al_2O_3 \rightarrow 4Al + 3O_2.$

(iii) Refining of metals – The metals prepared by various reduction processes usually contain some impurities, so they are impure. The process of purifying impure metal is called refining of metals. Different refining methods are used for different metals depending upon the nature of metal as well as on the nature of impurities present in it. The most widely used method for refining impure metals is ELECTROLYTIC REFINING. It means refining by electrolysis. Many metals like copper, zinc, tin, nickel, silver, gold etc. are refined electrolytically. For this process, impure metal is used as anode, thin strip of pure metal as cathode and a solution of the metal salt is used as an electrolyte. The apparatus used for electrolytic refining of copper is shown in the figure. The apparatus consists of an electrolytic tank containing acidified copper sulphate solution as electrolyte. A thick block of impure copper metal is made anode and a thin strip of pure copper. On passing electric current, impure copper from the anode dissolves and goes into copper sulphate solution and pure copper from the copper sulphate solution deposits on cathode. As the process goes on, impure anode becomes thinner and thinner whereas pure cathode becomes thicker and thicker. Thus pure copper is obtained at the cathode. The reactions at cathode and anode are as follows –.



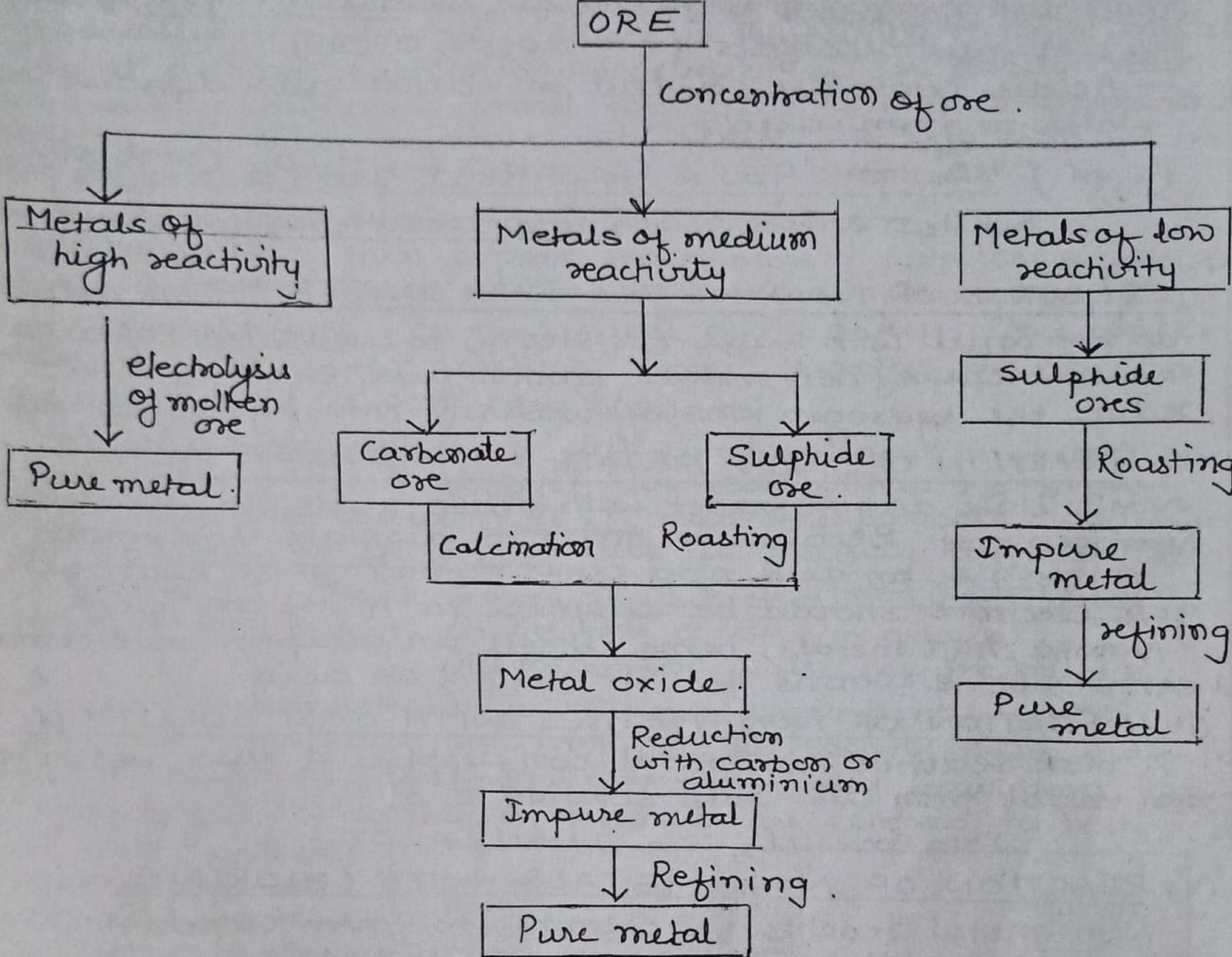
ELECTROLYTIC REFINING OF COPPER

At cathode : $Cu^{+2} + 2e \rightarrow Cu$

and at anode : $Cu - 2e \rightarrow Cu^{+2}$

The soluble impurities go into the solution whereas, the insoluble impurities settle down below the anode and is known as ANODE MUD. Gold and silver metals can be recovered from the anode mud.

A summary of all the steps involved in metallurgy is given in following figure —.



(2) NON METALS — are the elements which form negative ions by gaining electrons e.g. oxygen, nitrogen, chloride etc.

PHYSICAL PROPERTIES OF NON METALS — (i) Non metals are neither malleable nor ductile. Non metals are BRITTLE i.e. break easily.

(ii) Non metals do not conduct electricity & heat as they have no free electrons. Carbon (in the form of graphite) is the only non metal which is a good conductor of electricity and thus used for making electrodes.

(iii) Non metals are NOT LUSTROUS with the exception of Iodine which has shining surface like that of metals.

(iv) Non metals are GENERALLY SOFT except diamond which is extremely hard non metal.

(v) Non metals may be SOLID, LIQUID OR GASES at the room temperature.

(vi) Non metals have LOW DENSITIES.

* (viii) Non metals have low melting and boiling points except diamond.

(vii) Non metals are NON-SONOROUS. *

- CHEMICAL PROPERTIES OF NON-METALS —.

(i) REACTION OF NON METALS WITH OXYGEN — Non metals react with oxygen to form acidic oxides (e.g. CO_2, SO_2 etc). or neutral oxides (e.g. CO, N_2O etc).

- Acidic oxides are covalent in nature and dissolve in water to form acids —.

$C + O_2 \rightarrow CO_2$; $CO_2 + H_2O \rightarrow H_2CO_3$ (carbonic acid)

$S + O_2 \rightarrow SO_2$; $SO_2 + H_2O \rightarrow H_2SO_3$ (sulphurous acid)

(ii) REACTION OF NON-METALS WITH WATER — Non metals do not react with water (or steam) to evolve hydrogen gas. This is because non metals cannot give electrons to reduce the hydrogen ions of water into hydrogen gas.

(iii) REACTION OF NON-METALS WITH DILUTE ACID —.

Non metals do not react with dilute acids to produce hydrogen gas. Because in order to displace hydrogen ion (H^+) of an acid and convert them into hydrogen gas, electrons should be supplied to H^+ of an acid.

Now a non metal, being itself an acceptor of electrons, cannot give electrons to H^+ ion of an acid.

(iv) REACTION OF NON-METALS WITH SALT SOLUTIONS —

A more reactive non metal can displace a less reactive non metal from its salt solution e.g.

$$2NaBr + Cl_2 \rightarrow 2NaCl + Br_2.$$

(V) REACTION OF NON METALS WITH CHLORINE —

Non metal react with chlorine to form covalent chlorides which are non electrolyte (or do not conduct electricity). Non metal chlorides are generally liquids or gases —.

$$H_2 + Cl_2 \rightarrow 2HCl.$$

$$P_4 + 6Cl_2 \rightarrow 4PCl_3$$

$$P_4 + 10Cl_2 \rightarrow 4PCl_5$$

(vi) REACTION OF NON METALS WITH HYDROGEN —

Non metal reacts with hydrogen to form covalent hydrides. eg. $H_2 + S \rightarrow H_2S$.

$$N_2 + 3H_2 \rightarrow 2NH_3$$

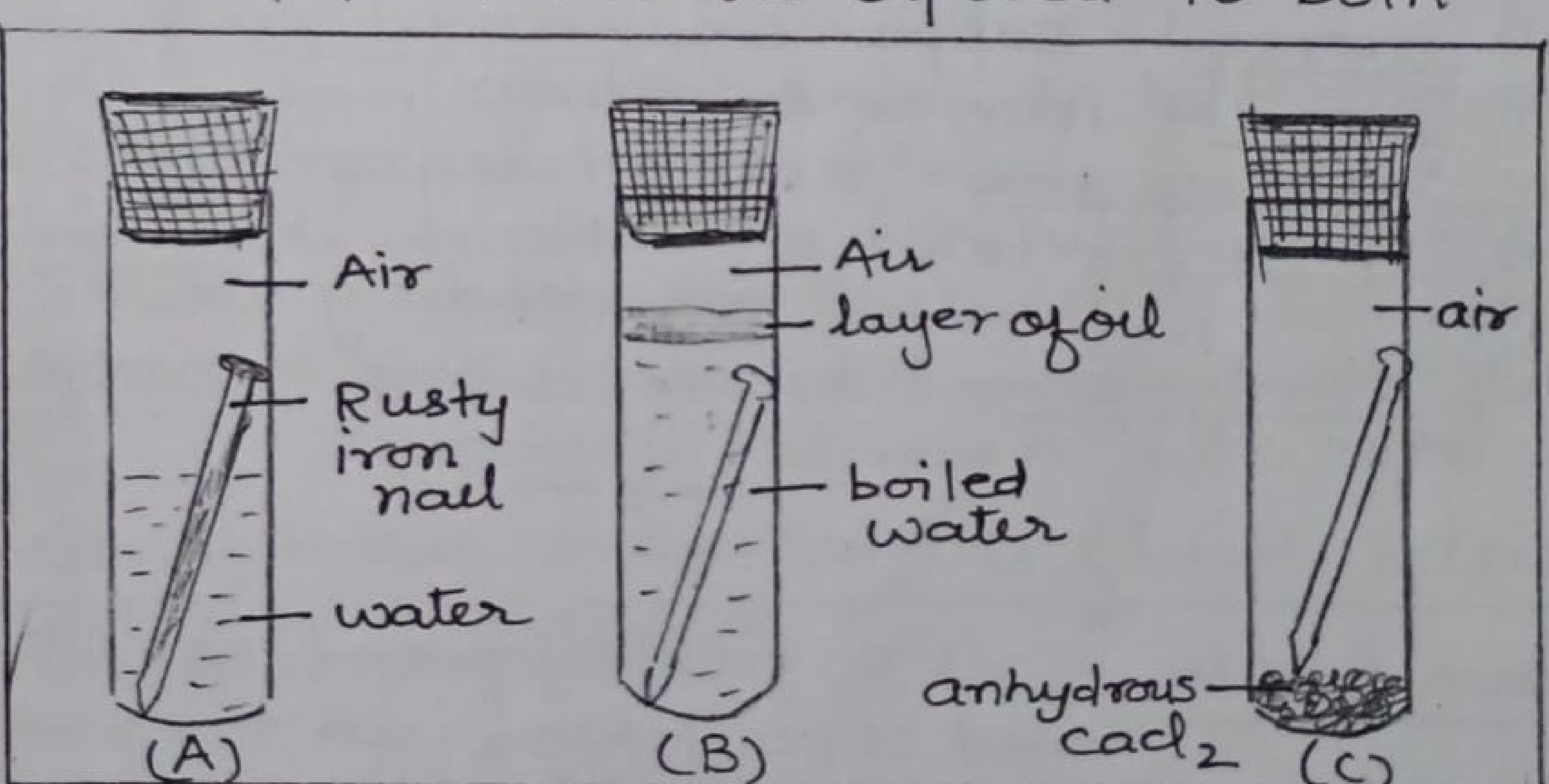
$$2H_2 + O_2 \rightarrow 2H_2O$$

$$C + 2H_2 \rightarrow CH_4.$$

CORROSION — Corrosion is the process in which metals are eaten up gradually by the action of air, moisture or a chemical (such as an acid) on their surface. e.g.

- when silver objects are kept in air, they get tarnished and gradually turned black. Silver is highly unreactive metal so it does not react with the oxygen of air easily. But air usually contains a small amount of sulphur compounds such as H_2S. Silver objects slowly react with H_2S present in air to form a black coating of silver sulphide (Ag_2S).
- when a copper object remains in damp air for a considerable time, then copper reacts slowly with CO_2 and H_2O of air to form a green coating of basic copper carbonate ($CuCO_3 \cdot Cu(OH)_2$) on the surface of the object. Since copper metal is low in the reactivity series, therefore, the corrosion of copper metal is very, very slow.
- when an iron object is left in damp air (or water) for a considerable time, it gets covered with a red-brown flaky substance called RUST, and the process is known as RUSTING OF IRON. The rust is mainly hydrate Iron (III) oxide i.e. $Fe_2O_3 \cdot xH_2O$. The two conditions necessary for rusting of iron are — (i) presence of air (or oxygen)
(ii) presence of water (or moisture).

This can be demonstrated in following experiments. — Take three test tubes and put iron nail in each of them under given conditions (as shown in the figure) and leave them for few days. In test tube A, the nails are exposed to both air and water, so rusting will take place. In test tube B, boiled distilled water is taken as it will not contain any dissolved oxygen. A layer of oil is put over boiled water to prevent the outside air from mixing with boiled water. In this rusting will not take place as only water is present and not the air. In third test tube (C), we put some anhydrous $CaCl_2$ which absorb the moisture present in air. In this also rusting will not take place. due to absence of moisture.



Prevention of rusting — (i) by painting or applying grease/oil (ii) by galvanisation (iii) by tin plating and chromium plating (iv) anodising (v) by making alloys.

Galvanisation is a process of depositing a thin layer of zinc metal on iron object. Zinc is a reactive metal, so the action of air on zinc metal forms a thin coating of zinc oxide all over it. This zinc oxide coating is hard and impervious to air and hence prevents the further corosion of zinc metal.
- The galvanised iron object remains protected against rusting even if the zinc coating is broken. This is because zinc is more easily oxidised than iron. so zinc continues to corrode but the iron object does not rust.

Anodising - is a process of forming thick layer of aluminium oxide on an aluminium object (or iron object) by making it anode during the electrolysis of dil. H_2SO_4. During electrolysis O_2 gas evolved at anode reacts with aluminium object to make a protective oxide layer. The oxide layer can also be dyed to give the object attractive colours.

ALLOYS - An alloy is a homogeneous mixture of two or more metals (or a metal and small amounts of non-metals). It is prepared by first melting the primary metal, and then dissolving the other elements in it in definite proportions. It is then cooled to room temperature.
- The properties of an alloy are different from the properties of their constituent metals. In general alloys
- (i) are stronger/harder than the constituent metal.
  (ii) are more resistant to corrosion.
  (iii) have low melting points than the constituent metals
  (iv) have lower electrical conductivity than pure metal.

- Some of the common alloys are -
(i) Brass - copper and zinc.
(ii) Bronze - copper and tin.
(iii) Steel - iron and carbon
(iv) Stainless steel - iron, nickel and chromium.
(v) Solder - Lead and tin - has low melting point and is used for welding electric wires.
(vi) Amalgam - Mercury + one or more other metals.

— x —

AQUA REGIA - is a freshly prepared mixture of Conc. HCl and conc. HNO_3 in the ratio of 3:1. It is used to dissolve gold and platinum.

Pure gold (i.e. 24 carat gold) is very soft and cannot be used for making jewellery. It is alloyed with either silver or copper to make it hard. In our country, generally 22 carat gold is used for making ornaments. It means that 22 parts of pure gold is alloyed with 2 parts of either copper or silver.