पुना International School

Shree Swaminarayan Gurukul, Zundal

Class -X

Science (Chemistry)

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SCIENCE

Class X

NCERT

SCIENCE

Textbook for Class X

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CHAPTER- 01
CHEMICAL REACTION AND EQUATIONS

Chemical Reaction: Whenever a chemical change occurs we can say that a chemical reaction (permanent change) has taken place which can be expressed symbolically by a **chemical equation.**

e.g. Food gets digested in our body

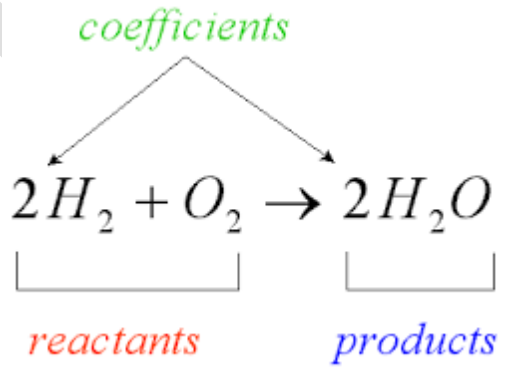
- Rusting of iron.

magnesium is burnt in air to form magnesium oxide. This chemical reaction can be represented as

$2Mg+O_2 \rightarrow 2MgO$

- We can observe or recognise a chemical reaction by observing change in state, colour, by evolution of gas or by change in temperature.
- Physical state of the reactants and the products are mentioned to make chemical reaction more informative. e.g. we use (g) for gas, (l) for liquid, (s) for solid and (aq) for aqueous.

Balanced Equation: A balanced equation is one in which the number of atoms on the reactant and product sides are equal.



Balancing Equation: We balance a chemical equation so that no. of atoms of each element involved in the reaction remains the same at the reactant and product side.

$Fe+H_2O \rightarrow FeO+H_2$

$3Fe+4H_2O \rightarrow Fe_3O_4+4H_2$

Types of Reaction

I. Combination Reaction:– The reaction in which two or more substances combine to form a new single substance.
e.g.

$$CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2(aq)}$$

Calcium Oxide Quick lime	Water	Calcium hydroxide (slaked lime)

- $Ca(OH)_2$ slaked lime is used for white washing walls. It reacts with CO_2 to form Calcium Carbonate and gives a shiny finish to the walls

$Ca(OH)_{2(aq)}+CO_{2(g)} \rightarrow CaCO_{3(s)}+H_2O(l)$

Calcium Hydroxide Calcium Carbonate

(ii) Burning of Coal

$C_{(2)}+O_{2(g)} \rightarrow CO_{2(g)}$+heat+ light

(iii) Formation of water

$2H_{2(g)}+O_{2(g)} \rightarrow 2H_2O(l)$

Exothermic Reactions : Reaction in which heat is released along with the formation of products.

eg.. $CH_{4(g)}+2O_{2(g)} \rightarrow CO_{2(g)}+2H_2O_{(g)}$

Endothermic Reaction :The reactions which require energy in form of heat, light or electricity are called endothermic reaction

eg.. $2Ba(OH)_2+NH_4Cl \rightarrow 2BaCl_2+NH_4OH$

II. Decomposition Reactions :The reaction in which a single substance decomposes to give two or more substances. De composition reactions can be of three types:

DECOMPOSITION REACTIONS :-

1. **Thermal Decompostition** :-When a decomposition reaction is carried out by heating

$eg\ \ 2\ FeSO_{4(s)} \xrightarrow{Heat} Fe_2O_{3(s)} + SO_{2(g)} + SO_{3(g)}$

Ferrous Sulphate *Ferric Oxide*

Green Colur → *Reddish brown Colour*

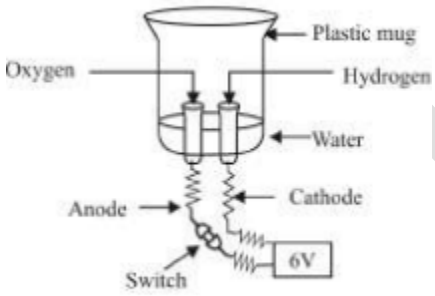
$CaCO_{3(s)} \xrightarrow{Heat} CaO_{(s)} + CO_{2(g)}$

$Pb(NO_3)_{2(s)} \xrightarrow{Heat} PbO_{(s)} + 4NO_{2(g)} + O_{2(g)}$

Lead Nitrate LeadoxideNitrogen Oxygen

White colour → *Brown colour* *dioxide*

1. **Electrolytic Decomposition** :- When a decomposition reaction is carried out by electric current,
2. .$H_{2(l)}$– electric current → $2H_{2(g)}+O_{2(g)}$



$e.g.\ \ 2AgCl_{(s)} \xrightarrow{sunlight} 2Ag_{(s)} + Cl_{2(g)}$

White colour ⟶ *grey clour*

Silver bromide behaves similarly

$2Ag\ Br \xrightarrow{Sunlight} 2Ag(s) + Br_2(g)$

The above two reactions are used in black and white photography

- Silver bromide behaves similarly

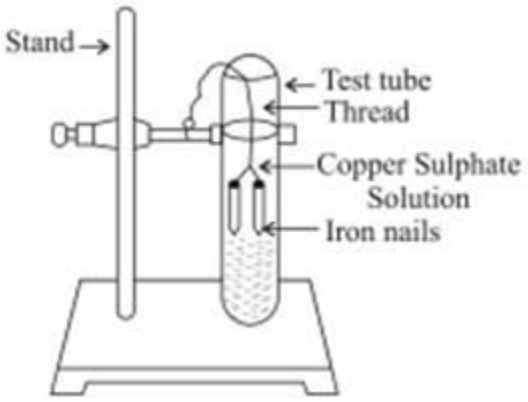
2AgBr– Sunlight → 2Ag(s)+Br2(g)

III. **Displacement Reaction**:The chemical reaction in which an element displaces another element from its solution

$Fe_{(s)}+CuSO_{4(aq)} \rightarrow FeSO_4+Cu_{(s)}$

Copper (aq)

Sulphate Iron Sulphate



Fe being more reactive than Cu displaces it from $CuSO_4$

$$Zn_{(s)} + CuSO_4 \rightarrow ZnSO_4 + Cu_{(s)}$$
$$(aq) \qquad (aq)$$
$$Copper \quad Zinc$$
$$Sulphate \quad Sulphate$$

$$Pb_{(2)} + CuCl_2 \rightarrow PbCl_2 + Cu^{(s)}$$
$$(aq) \qquad (aq)$$
$$Copper \quad Lead$$
$$Chloride \quad Chloride$$

- Zinc and lead are more reactive elements than copper. They displace copper from its compounds.

IV. **Double Displacement Reaction** :The reaction in which two different atoms or group of atoms are mutually exchanged

$$e.g..Na_2SO_4 + BaCl_2 \rightarrow BaSO_{4(s)} + 2NaCl$$
$$(aq) \qquad (aq) \qquad (aq)$$

Sodium Sulphate | Barium Chloride | Barium Sulphate | Sodium Chloride

A white substance is formed due to above reaction. The insoluble substance i.e., $BaSO_4$ is called precipitate.

Precipitation Reaction – Any reaction that produces a precipitate is called a precipitation reaction.

$$\underset{\substack{(aq)\\ Lead\ Nitrate}}{e.g.\,Pb(NO_3)_2} + \underset{\substack{(aq)\\ Potassium\ Iodide}}{2KI} \rightarrow \underset{\substack{(aq)\\ Lead\ Iodide}}{PbI_2}\downarrow + \underset{Potassium\ Nitrate}{2KNO_3}$$

the downward facing arrown represents the formation of precipitate.

V. **Oxidation** :Oxidation is the gain of oxygen or loss of hydrogen

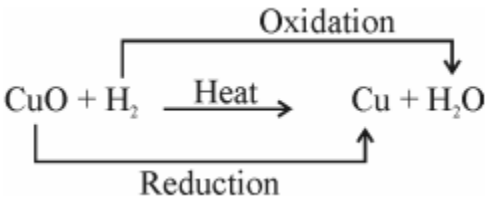
e.g. $2Cu + O_2 \xrightarrow{Heat} 2CuO$

When copper is heated a black colour appears. If this CuO is reactedwith hydrogen gas then again Cu becomes brown as reverse reaction takes place

$CuO + H_2 \xrightarrow{Heat} Cu + H_2O$

VI. **Reduction** : Reduction is the loss of oxygen or gain of hydrogen.

- **Redox Reaction** : The reaction in which one reactant gets oxidised while other gets reduced



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

$MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

- Corrosion :When a metal is attacked by substances around it such as moisture, acids etc.

(i) Rusting of iron. i.e Reddish brown coating on iron of Fe_2O_3 is formed.

(ii) Black coating on Silver.

Rusting of iron can be prevented by painting, oiling the surface or by galvanisation.

- Rancidity **:**When fats and oils are oxidised they become rancidand their smell and taste change.
- Antioxidants are added to foods containing fats and oil.

e.g. N_2 is added to packet of chips to prevent oxidation of fats and oils.

Intext Exercise:-

(Page No. 6)

1. Why should a magnesium ribbon be cleaned before burning in air?
Ans. Magnesium ribbon is cleaned before burning to remove the protective layer of basic magnesium carbonate from the surface of magnesium ribbon.

2. Write the balance equation for the following reactions Give reasons for the following reactions?
i. Hydrogen + Chlorine → Hydrogen chloride
ii. Barium chloride + Aluminium sulphate → Barium sulphate + Aluminium chloride
iii. Sodium + water → Sodium hydroxide + water
Ans. The chemical equations are as follows-
i. $H_2 + Cl_2 \rightarrow 2HCl$.
ii. $3BaCl_2 + Al_2(SO_4)_3 \rightarrow 3BaSO_4 + 2AlCl_3$.
iii. $2Na + 2H_2O \rightarrow 2NaOH + H_2$.

3. Write the balanced chemical equation with state symbols for the following reactions?
i. Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and solution of sodium chloride.
ii. Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.
Ans. Balance chemical reaction with state symbols are as follows-

$$i.\ BaCl_2\,(aq) + Na_2SO_4\,(aq) \rightarrow BaSO_4\,(s) + 2NaCl\ (aq)$$

$$ii.\ NaOH\ (aq) + HCl\ (aq) \rightarrow NaCl\ (aq) + H_2O$$

(Page No. 10)

1. A solution of a substance 'X' is used for white washing
i. Name the substance 'X' and writes its formula.
ii. Write the reaction of the substance 'X' named in (i) above with water
Ans. i. The substance whose solution is water is used for white washing is calcium oxide. Its formula is CaO.

ii. $CaO_{(s)} + H_2O_{(l)} \rightarrow\rightarrow Ca(OH)_{2(aq)}$

2. Why the amount of gas collected in one of the tubes in Activity 1.7 double of the amount collected in the other? Name this gas.
Ans. The gas which is collected in double the amount in the electrolysis of water experiment is hydrogen. This is because water contains 2 parts of hydrogen element as compared to only 1 part of oxygen element.

(Page No. 13)
1. Why does the colour of copper sulphate solution change when an iron nail is dipped in it?
Ans. When iron nail is dipped in copper sulphate solution, than iron sulphate solution and copper solution and copper metal are formed:

$$CuSO_4\,(aq) \; + \; Fe\;(s) \rightarrow FeSO_4\,(aq) \; + \; Cu\;(s)$$

In this reaction, iron displaces copper from copper sulphate solution. The deep blue colour of copper sulphate fades due to the formation of light green solution of iron sulphate.

2. Give an example of a double displacement reaction other than the one given in Activity 1.10.
Ans. An example of double displacement reaction is

$$Pb(NO_3)_2\,(aq) \; + \; 2KI\;(aq) \rightarrow PbI_2\,(s) \; + \; 2KNO_3\,(aq)$$

3. Identify the substances that are oxidized and the substances that are reduced in the following reactions.

$$i. \quad 4Na\;(s) \; + \; O_2\,(g) \rightarrow 2Na_2O\;(s)$$

$$ii. \quad CuO\;(s) \; + \; H_2 \rightarrow Cu\;(s) \; + \; H_2O\;(\mathrm{l})$$

Ans. (i). $4Na \; + \; O_2 \rightarrow 2Na_2O$

In this reaction, Na is oxidized because it combines with O_2 to form Na_2O. O_2 is reduced because it is converted into Na_2O.

(ii). $CuO \; + \; H_2 \rightarrow Cu \; + \; H_2O$

In this reaction, CuO is reduced because it loses oxygen. H_2 is oxidized because it combines with oxygen of CuO to form water

Textbook exercises;-
1. Which of the following statement about the reaction below are incorrect?

$$2PbO\;(s) \; + \; C\;(s) \; \rightarrow 2Pb\;(s) \; + \; CO_2\,(g)$$

(a) Lead is getting reduced.

(b) Carbon dioxide is getting oxidized
(c) Lead oxide is getting oxidized
(d) Lead is getting reduced
i. (a) and (b)
ii. (a) and (c)
iii. (a), (b) and (c)
iv. All
Ans. As statement (a) and (b) are incorrect, answer (i) is correct.

2. $Fe_2O_3+2Al \rightarrow Al_2O_3+2Fe$
The above reaction is an example of a
(a) combination reaction
(b) double displacement reaction
(c) decomposition reaction
(d) displacement reaction
Ans. This is an example of displacement reaction because Fe in FeO_3 has been displaced by Al. Hence correct answer is (d).

3. What happens when dilute hydrochloric acid is added to iron filling? Tick the correct answer
(a) Hydrogen gas and iron chloride are produced.
(b) Chlorine gas and iron hydroxide are produced
(c) No reaction takes place
(d) Iron salt and water are produced
Ans. Answer (a) is correct.

4. What is balanced chemical equation? Why should chemical equation be balanced?
Ans. The reaction in which the number of atoms of each element is equal on the reactant side and product side is called balanced equation.
Chemical reaction should be balanced because only a balanced equation tells us the relative quantities of different reactants and products involved in the reaction.

5. Translate the following statements into chemical equations and then balance them.
(a) Hydrogen gas combines with nitrogen to form ammonia.
(b) Hydrogen sulphide gas burns in air to give water and Sulpher dioxide.
(c) Barium chloride reacts with aluminum sulphate to give aluminum chloride and precipitate of barium sulphate
Ans. (a). $H_2 + N_2 \rightarrow NH_3$

$3H_2 + N_2 \rightarrow 2NH_3$

(b). $H_2S + O_2 \rightarrow H_2O + SO_2$

$2H_2S + 3O_2 \rightarrow 2H_2O + 2SO_2$

(c). $BaCl_2 + Al_2(SO_4)_3 \rightarrow AlCl_3 + BaSO_4$

$3BaCl_2 + Al_2(SO_4)_3 \rightarrow 2AlCl_3 + 3BaSO_4$

(d). $K + H_2O \rightarrow KOH + H_2$

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

6. Balance the following chemical equations:

(a) $HNO_3+Ca(OH)_2 \rightarrow Ca(NO_3)_2+H_2O$

(b) $NaOH+H_2SO_4 \rightarrow Na_2SO_4+H_2O$

(c) $NaCl+AgNO_3 \rightarrow AgCl+NaNO_3$

(d) $BaCl_2+H_2SO_4 \rightarrow BaSO_4+HCl$

Ans. Balanced chemical equation are:

(a) $2HNO_3+Ca(OH)_2 \rightarrow Ca(NO_3)_2+2H_2O$

(b) $2NaOH+H_2SO_4 \rightarrow Na_2SO_4+2H_2O$

(c) $NaCl+AgNO_3 \rightarrow AgCl+NaNO_3$

(d) $BaCl_2+H_2SO_4 \rightarrow BaSO_4+2HCl$

7. Write the balanced chemical equations for the following reactions.

(a) Calcium hydroxide + Carbon dioxide → Calcium carbonate + Water

(b) Zinc + Silver nitrate → Zinc nitrate + Silver

(c) Aluminum + Copper chloride → Aluminum chloride +Copper

(d) Barium chloride + Potassium sulphate → Barium sulphate + potassium chloride

Ans. Balanced chemical equation for reactions are:

(a) $Ca(OH)_2+CO_2 \rightarrow CaCO_3+H_2O$

(b) $Zn+2AgNO_3 \rightarrow Zn(NO_3)_2+2Ag$

(c) $2Al+3CuCl_2 \rightarrow 2AlCl_3+3Cu$

(d) $BaCl_2+K_2SO_4 \rightarrow BaSO_4+2KCl$

8. Write the balanced chemical equation for the following and identify the type of reaction in each case.

(a) Potassium bromide (s) + Barium iodide (aq) → Potassium iodide (aq) + Barium bromide(s)

(b) Zinc carbonate (s) → Zinc oxide (s) + Carbon dioxide (g)

(c) Hydrogen (g) + Chlorine (g) → Hydrogen chloride (g)

(d) Magnesium (s) + Hydrochloric acid (aq) → Magnesium chloride (aq) + Hydrogen (g)

Ans. Balanced equations are:

(a) $2KBr_{(aq)}+BaI_{2(aq)} \rightarrow 2KI_{(aq)}+BaBr_{2(s)}$ Double Displacement Reaction

(b) $ZnCO_{3(s)} \rightarrow ZnO_{(s)} + CO_{2(g)}$; Decomposition Reaction
(c) $H_{2(g)} + Cl_{2(g)} \rightarrow 2HCl$; Combination Reaction
(d) $Mg_{(s)} + 2HCl_{(aq)} \rightarrow MgCl_{2(aq)} + H_{2(g)}$; Displacement Reaction

9. What does one mean by exothermic and endothermic reactions? Give examples.
Ans. A reaction in which energy is released in the form of heat or light is called exothermic reaction. Example of exothermic reaction are:

a. $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O + heat$

b. $2Al + FeO_3 \rightarrow Al_2O_3 + Fe + heat$

A reaction in which energy is absorbed from the surrounding and cooling is produced is called endothermic reaction. Example of endothermic reaction are:

a. $CaCO_3 \rightarrow CaO + CO_2$

b. $N_2 + O_2 \rightarrow 2NO$

10. Why respiration is considered an exothermic reaction? Explain.
Ans. During respiration, we inhale oxygen from the atmosphere which reacts with glucose in your body cells to produce carbon dioxide and water.

$C_6H_{12}O_6\,(aq) + 6O_2 \rightarrow 6CO_2\,(g) + 6H_2O\ (l) + heat$

Heat is liberated in this process; hence respiration is considered an exothermic reaction.

11. Why decomposition reactions are called the opposite of combination reactions? Write equations for these reactions.
Ans. $NH_4Cl\ (s) \rightarrow HCl\ (g) + NH_3\,(g)$
In a decomposition reaction, a single substance breaks down into two or more substances while in a combination reaction, two or more substances react to produce one substance. Therefore, decomposition reactions are called opposite of combination reactions.
Example of decomposition reaction: Example of combination reaction:

$CaO\ (s) + CO_2\,(g) \rightarrow CaCO_3\,(s)$

12. Write one equation each for decomposition reactions where energy is supplied in the form of heat, light or electricity.
Ans. Decomposition by heat:

$CaCO_3\,(S) + heat \rightarrow CaO\ (s) + CO_2\,(g)$

Decomposition by electricity:

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

Decomposition by light:

$$2AgBr\ (s) + light \rightarrow 2Ag\ (s) + Br_2$$

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13. What is difference between displacement and double displacement reactions? Write equations for these reactions.

Ans. In displacement reaction, more reactive element displaces the less reactive element from its compound. For example

$$Zn\ (s) + CuSO_4\ (aq) \rightarrow ZnSO_4\ (aq) + Cu\ (s)$$

But in double displacement reaction, exchange of ions takes place. For example

$$HCl\ (aq) + AgNO_3\ (aq) \rightarrow AgCl\ (s) + HNO_3\ (aq)$$

14. In refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Ans. The reaction involved is:

$AgNO_{3(aq)} + Cu_{(s)} \rightarrow\rightarrow Cu(NO_3)_{2(aq)} + 2\ Ag_{(s)}$

Copper + SilverNitrate $\rightarrow\rightarrow$ CopperNitrate + Silver

15. What do you mean by a precipitation reaction? Explain by giving examples.

Ans. A chemical reaction in which an insoluble substance (precipitate) is formed is called precipitation reaction. For example

$$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$$

16. Explain the following in terms of gain and loss of oxygen with two examples each?

a. Oxidation

b. Reduction

Ans. Oxidation- addition of oxygen or removal of hydrogen in a chemical reaction is called oxidation reaction. For example

$$2Cu + O_2 \rightarrow 2CuO$$

$$4Al + 3O_2 \rightarrow 2Al_2O_3$$

Reduction- addition of hydrogen or removal of oxygen in a chemical reaction is called oxidation reaction. For example

$$CuO + H_2 \rightarrow Cu + H_2O$$

$$H_2S + Cl_2 \rightarrow 2HCl + S$$

17. A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black coloured compound formed.
Ans. The brown coloured element 'X ' is copper. On heating in air it forms copper oxide, which is black in colour.

$$2CuS + O_2 \rightarrow 2CuO$$

18. Why do we apply paint on iron articles?
Ans. We apply paint on iron articles to prevent rusting. Iron articles do not come in contact of atmospheric oxygen and moisture and thus the rusting is prevented.

19. Oil and fat containing food items are flushed with nitrogen. Why?
Ans. Oil and fat containing items get rancid due to oxidation with atmospheric oxygen. To prevent rancidity food items are flushed with nitrogen. Nitrogen do not reacts with oil and fat containing items.

20. Explain the following terms with one example each.
a. Corrosion
b. Rancidity.
Ans. Corrosion- action of air, water, acid or other substance on metal surface to form oxides and carbonates is called corrosion. Corrosion of iron is called rusting. Green coating on copper and black coating on silver is examples of corrosion.
Rancidity-change in smell of food item containing fat and oil when kept open for longer time due to oxidation is called rancidity. To prevent rancidity food items are flushed with nitrogen or kept in airtight containers.

CHAPTER – 2
ACIDS, BASES AND SALTS

Acids	**Bases**
Sour in taste Derived from Greek word' ACIDUS'	Bitter in taste
Changes blue litmus into red	Changes red litmus into blue
e.g. Hydrochloric acid HCl	e.g. Sodium hydroxide NaOH
Sulphuric acid H_2SO_4	Potassium hydroxide KOH
Nitric acidHNO_3	Calcium hydroxide$Ca(OH)_2$
Acetic acidCH_3COOH	Ammonium hydroxide

- Some naturally occurring acids

Vinegar	Acetic Acid
Orange	Citric Acid
Lemon	Citric Acid
Tamarind	Tartaric Acid
Tomato	Oxalic Acid
Sour milk (Curd)	Lactic Acid
Ant and Nettle sting	Methanoic Ac

- Acid – Base Indicator:Substances which indicate the presence of an acid or base in a solution.
- Litmus solution – It is a natural indicator. It is a purple dye extracted from Lichens. Other examples are Red Cabbage and coloured petals of Petunia and turmeric.
- Olfactory indicators : Show odour changes in acidic or basic media. E.g. onion and clove .
- Acid – Base Indicators

S.No.	Name of the Indicator	Colour Change With Acid	Colour Change with Base
A.	Blue litmus solution	To red	No change

B.	Red litmus solution	No change	To blue
C.	Turmeric	No change	To red
D.	Methyl orange	To red	To yellow
E.	Phenolphthalein (colourless)	No change	To pink

- Dilute Acid : A dilute acid contains a small amount of acid (lower concentration of hydronium ions)and a large amount of water.
- Concentrated Acid :A concentrated acid contains a large amount of acid (higher concentration of hydronium ions)and a small amount of water.
- Chemical Properties of Acids and Bases

1. Reaction with metal

$Acid + Metal \rightarrow Salt + Hydrogen$

$2HCl + Zn \rightarrow ZnCl_2 + H_2$

$2HNO_3 + Zn \rightarrow Zn(NO_3)_2 + H_2$

$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$

$2CH_3COOH + Zn \rightarrow (CH_3COO)_2Zn + H_2$

- **Pop test** : When a burning candle is brought near a test tube containing hydrogen gas it burns with a 'Pop' sound. This test is conducted for examining the presence of hydrogen gas.
- Base + Metal →→ Salt + Hydrogen

$NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

SodiumZincate

Note– Such reactions are not possible with all the metals.

- **Actions of Acids with metal Carbonates and metal bicarbonates**

$MetalCarbonate + Acid \rightarrow Salt + Carbondioxide + Water$

$Na_2CO_3(aq) \rightarrow 2NaCl(aq) + CO_2(g) + H_2O(l)$

$Metalbicarnonate + Acid \rightarrow Salt + Carbondioxide + Water$

$NaHCO_3 + HCl \rightarrow NaCl + CO_2 + H_2O$

- **Lime water Test** : On passing the evolved CO_2 gas through lime water, we find that lime water turns milky.

$Ca(OH)2(aq) + CO2(g) \rightarrow CaCO3(s) + H2O(l)$

Limewater Whiteprecipitate

- CO_2 the following reaction takes place

$CaCO3(s) + H2O(l) + CO2(g) \rightarrow Ca(HCO3)2aq$(solublein water)

- **Reaction of acids and bases with each other to give salt and water are called Neutralisation Reactions**

Base+Acid→Salt+Water

e.g. $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H2O(l)$

- **Reactions of metal oxides with acids**

MetalOxide+Acid→Salt+Water

$CuO + HCl \rightarrow CuCl2 + H2O$

Copperoxide Hydrochloricacid CopperChloride Water

Note : Appearance of blue green colour of the solution because of formation of $CuCl_2$.

Metallic oxides are said to be basic in nature because they give salt and water on reacting with acids.Some metallic oxides react with both acids and base and are called AMPHOTERIC OXIDES.

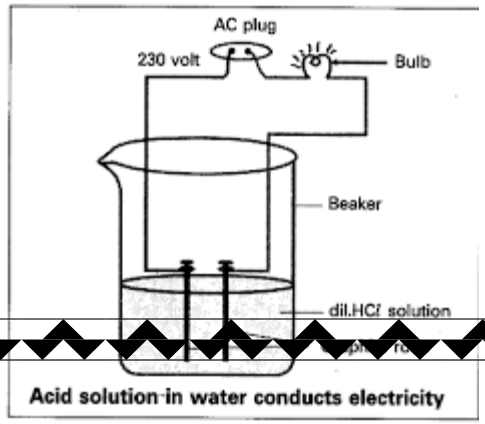
- **Reaction of Non Metallic Oxide with Base**

Non-metallic oxide+ Base→→ Salt + Water

$CO_2 + Ca(OH)_2 \rightarrow CaCO_3 + H_2O$

Note : Non Metallic oxides are said to be acidic in nature because on reacting with a base they produce salt and water.

- All acidic solutions conduct electricity because of formation of $(H^+)(H+)$ions in aq. solution.



Acid solution in water conducts electricity

- Glowing of bulb indicates that there is a flow of electric current through the solution.
- **Acids or bases in a Water Solution**

Acids produce H^+ ions in the presence of water

$HCl + H_2O \rightarrow H_3O^+ + Cl^-$

H_3O^+ : Hydronium ion.

H^+ion cannot exist alone. It exists as $H^+(aq)$or(H_3O^+) hydronium ion.

i.e. Base provide $OH^-(aq)$ ions in the presence of water

$NaOH(s) \xrightarrow{H_2O} Na^+(aq) + OH^-(aq)$

$KOH(s) \xrightarrow{H_2O} K^+(aq) + OH^-(aq)$

$Mg(OH)_{2(s)} \xrightarrow{H_2O} Mg^{2+}(aq) + 2OH^-(aq)$

- **Alkalis**

All bases do not dissolve in water. An alkali is a base that dissolves in water.Common alkalis are

- NaOH Sodium hydroxide
- KOH Potassium hydroxide
- Calcium hydroxide
- Ammonium hydroxide

Note : All alkalis are bases but all bases are not alkalis.

- Precaution must be taken while mixing acid or base with water. The acid must always be added to water with constant stirring as it is a highly exothermic reaction.

When an acid or a base is mixed with water they become dilute. This results in the decrease in the concentration of per unit volume in acids and bases respectively,i.e. no. of H^+ionH^+ion and OH^-ionOH^-ion reduces.

- **Strength of an Acid or Base**

  Strength of acids and bases depends on the no. of H^+ ion and OH^- ion produced respectively.

With the help of a universal indicator we can find the strength of an acid or base as it shows different colours at different concentrations of hydrogen ions in a solution.

A scale for measuring hydrogen ion conc. in a solution called pH scale has been developed.

pH= Potenz in German means power.

This scale measures from 0 (very acidic) to 14 (very alkaline) 7 indicates

Neutral pH (water is neutral).

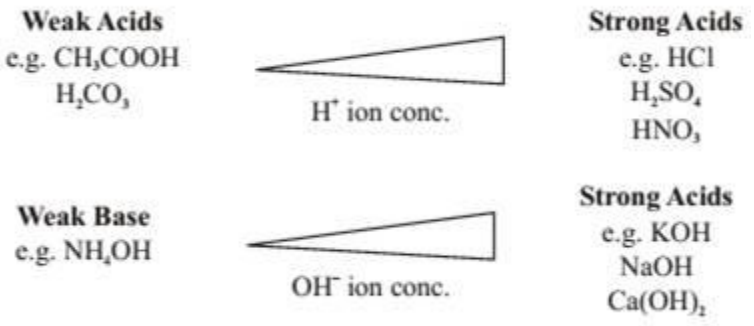
pH paper : Is a paper which is used for measuring pH

Variation of PH

S. No. PH Colour of the Nature of Solution H^+ ion H+ion Conc. OH^- ion OH−ion Conc.

Value pH Paper

1.	0	Dark red	Highly acidic	Very high	Very low
2.	4	Orange or yellow	Acidic	High	Low
3.	7	Green	Neutral	Equal	Equal
4.	10	Bluish green or blue	Alkaline	Low	High
5.	14	Dark blue or violet	highly basic	very low	Very high



Importance of pH in our daily life

- **Importance of pH in our digestive system** – Our stomach produces hydrochloric acid. This dilute hydrochloric acid help in digestion of food. In case of indigestion our stomach produces acid in a very large quantity because of which we feel pain and irritation in our stomach (ACIDITY).To get relief from this pain ,antacids are used. These antacids neutralize the excess acid because they are basic in nature and we get relief.
- **pH of Acid Rain** : When pH of rain water is less than 5.6 it is called acid rain. Flow of acidic rain in water bodies makes them acidic causing a threat to the survival of aquatic life.It also results in damage of structures made with marble like Taj Mahal.
- **pH of Soil** : Plants require a specific range of pH for their healthy growth. If pH of soil of any particular place is less or more than normal then the farmers add suitable chemicals to it. The addition of these chemicals of presences of excessive damage the nutrients of the soil and decrease its natural fertility.
- Our body functions between the pH range of 7.0 to 7.8. Living organisms can survive only in the narrow range of pH change.
- Tooth decay and pH : Bacteria present in the mouth produces acids by degradation of sugar and food particles remaining in the mouth. Tooth decay begins below the pH 5.6. Using toothpaste which is generally basic, can neutralise the excess acid and prevent tooth decay.
- Bee sting or Nettle sting contains methanoic acid which causes pain and irritation. Using a weak base like baking soda neutralises the acid giving relief.

Salts and their Derivation

S. No.	Name of Salt	Formula	Derived from	Derived from
1.	Potassium Sulphate	K_2SO_4	KOH	H_2SO_4
2.	Sodium Sulphate	Na_2SO_4	NaOH	H_2SO_4
3.	Sodium Chloride	NaCl	NaOH	HCl
4.	Ammonium Chloride	NH_4Cl	NH_4OH	HCl

Note : NaCl andNa_2SO_4belong to the family of sodium salts as they have the same radicals. Similarly NaCl and KCl belong to the family of chloride salts.

Neutral Salts : Strong Acid + Strong base

pH value is 7

e.g.NaCl, $CaSO_44$

Acidic Salts : Strong Acid + weak base

pH value is less than 7

eq.NH_4Cl,NH_4NO_3

Basic Salts : Strong base + weak acid

pH value is more than 7

e.g.$CaCO_3$,CH_3COONa

- **NaCl**

Sodium chloride is called as common salt. It is derived from sea water.

Rock Salt is mined like coal, is brown coloured and crystalline is shape.

Preparation :

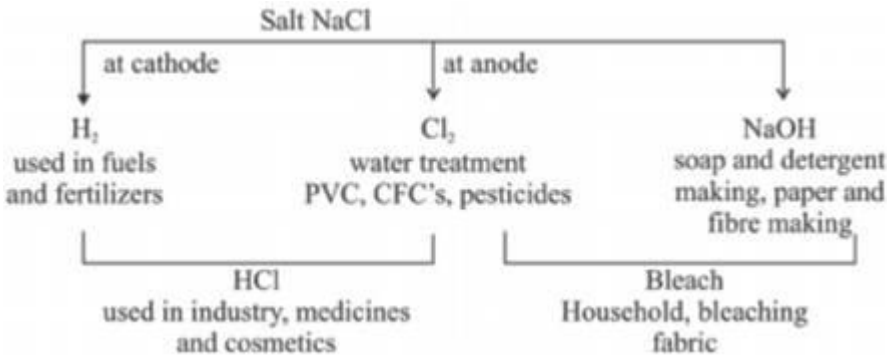
Sodium chloride is obtained by mining the deposits and brine solution is obtained by passing water into the deposits. Hence the salts get dissolved then the solution is pumped out. Evaporation of the sea water is one of the major processes used to obtain salt . The crystals obtained usually consists of impurities such as calcium sulphate, sodium sulphate etc. Pure crystals are obtained by dissolving the salts with little water and filtering the solution.

Uses

- Common salt is an important raw material for many materials of daily use such as.
- Sodium hydroxide
- Washing Soda
- Bleaching Power.
- 2. Used in our food as a preservative and provides flavour to food.
- 3. Used in industries
- **Sodium Hydroxide** : NaOH, Common Name – caustic soda.

Preparation : Prepared by the method called chlor-alkali process. It is called so because we get chlorine and an alkali (NaOH) in this process.

$2NaCl_{(aq)}+2H_2O(l)\rightarrow 2NaOH_{(aq)}+Cl_{2(g)}+H_{2(g)}$



- Calcium oxy chloride -- $CaOCl_2$
- The chlorine gas released in brine formation is used to prepare bleach.

$Ca(OH)_{2 Calcium Hydroxide} + Cl_{2 Chlorine} \rightarrow CaOCl_{2 bleaching powder} + H_2O_{Water}$

Uses

(1) for bleaching cotton and linen in textile industries,wood pulp in paper industry,

(2) Used as disinfectant of water

{3} Used as an oxidising agent.

III. Sodium Hydrogen Carbonate – $NaHCO_3$

Common name – Baking Soda. It is mild corrosive base

Preparation :

1. Used in baking/cooking

Heating $NaHCO_3 + H_2O + CO_2$

$NaHCO_3 \xrightarrow{heat} Na_2CO_3 + H_2O + CO_2$

1. produced causes dough to rise and help to make cakes and pastries spongy.

2.Used as ingredients of antacids

3.For preparinf baking soda(baking powder+mild edible acid)

4. Used in soda-acid extinguishers.

Washing Soda

Preparation :Recrystallisation of sodium carbonate.

$Na_2CO_3 + 10H_2O \rightarrow \text{Heat } Na_2CO_3.10H_2O$

It is a basic salt used in

- manufacture of Borax.
- `glass,soap and paper industries
- cleansing agent for domestic purposes.
- removing permanent hardness of water.

Water of Crytallization: fixed number of water molecules present in on formula unit of a salt.

Eg:

- $CuSO_4.5H_2O$
- $CaSO_4.2H_2O$
- $CaSO_4.1/2H_2O$

Plaster of Paris

$CaSO_4.2H_2O \xrightarrow{373K} CaSO_4 \frac{1}{2} H_2O$

When Plaster of Paris is mixed with water it changes to gypsum.

$CaSO_4.\frac{1}{2}H_2O + 1\frac{1}{2}H_2O \rightarrow CaSO_4.2H_2O$

POP GYPSUM

Making toys, decorative material and smoothening surfaces,

plaster for fractured bones.

Intext Exercise :-

Page No. 18

1. You have been provided with three test tubes. One of them contains distilled water and the other two contain an acidic solution and a basic solution, respectively. If you are given only red litmus solution, how will you identify the contents of each test tube?
Ans. A few drops of red litmus solution is added to each test tube. Red colour will become light in the test tube containing water. Colour will turn blue in test tube containing basic solution. Red colour will become dark in the test tube containing acidic solution.

Page No. 22

1. Why should curd and sour substance not be kept in brass and copper vessels.
Ans. Brass and copper vessels contain copper and zinc metal that reacts with acids present in curd and sour substance forming soluble salts. These salts are poisonous in nature and make curd unfit for consumption.
2. Which gas is usually liberated when an acid reacts with a metal? Illustrate with an example. How will you test for the presence of this gas?
Ans. Usually hydrogen gas is liberated when an acid reacts with a metal. For example
$Zn + 2HCl \rightarrow\rightarrow ZnCl_2 + H_2$
When a burning candle or matchstick is bought near hydrogen gas it burns with pop sound.
3. Metal compound 'A' reacts with dilute hydrochloric acid to produce efferenvescence. The gas evolved extinguishes a burning candle. Write a balanced chemical equation for the reaction, if one of the compounds formed is calcium chloride.
Ans. As one of the compounds formed is calcium chloride, metal compound 'A' is salt of calcium.

Burning candle is extinguished by carbon dioxide so carbon dioxide gas is produced by reaction of 'A' with hydrochloric acid.
Carbon dioxide is produced by action of HCl on carbonate that means 'A' is calcium carbonate.
$CaCO_3 + 2HCl \rightarrow CaCl_2 + CO_2 + H_2O$

Page No. 25

1. Why do HCl, HNO_3 etc. show acidic characters in aqueous solution while solutions of compounds like alcohol and glucose do not show acidic character?
Ans. Compounds like HCl and HNO_3 release hydrogen ions in solution, therefore they show acidic character.
While compounds like alcohol and glucose do not release hydrogen ions. Therefore, they do not show acidic properties.

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2. Why does an aqueous solution of an acid conduct electricity?
Ans. Electricity is conducted in a solution by ions. Acid release H^+ ions in a solution so, it conducts electricity.
3. Why does dry HCl gas not change the colour of the dry litmus paper?
Ans. Colour of litmus paper changes only when it come in contact of H^+ ions and H^+ ions is produced only when HCl gas comes in contact with water. Therefore dry HCl do not change the colour of dry litmus paper.
4. While diluting an acid, why it is recommended that the acid should be added to water and not water to the acid?
Ans. Addition of water to acid is an exothermic reaction. If we add water to acid lot of heat is produced that may breaks the glass container or sprout to burns the person adding it.
But when acid is added to water with constant stirring, the heat produced is absorbed by water and no harm occurs. 5. How is concentration of hydronium ions (H_3O^+) affected when a solution of acid is diluted?
Ans. Concentration of hydronium ions decreased when the solution of an acid is diluted.

6. How is concentration of hydroxide ions (OH^-) affected when excess base is dissolved in a solution of sodium hydroxide?
Ans. Excess base dissolved in a solution of sodium hydroxide will release more hydroxide (OH^-) ions. Therefore, concentration of hydroxide ions (OH^-) will increase.

Page No. 28

1. You have two solutions 'A' and 'B'. The pH of solution 'A' is 6 and pH of solution 'B' is 8. Which solution has more hydrogen ions concentration? Which is acidic and which one is basic?

Ans. A solution having pH less than 7 is acidic and that having pH more than 7 is basic. So, solution 'A' is acid and 'B' is basic. Naturally 'A 'which is acidic has greater concentration of hydrogen ions concentrations.

2. What effect does the concentration of H^+ ions have on the nature of the solution?
Ans. Higher the concentration of H^+ ions, greater is the acidic nature of the solution.

3. Do basic solutions also have H^+ ions? If yes, then why are these basic?
Ans. Acidic and basic solutions both have H^+ ions. The difference is that in acids H^+ ions concentration is more than OH^- ions concentration while in basic solution OH^- ions concentration is more than H^+ ions concentration.
4. Under what soil condition do you think a farmer would treat the soil of his field with quicklime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate).
Ans. The farmer would treat the soil of his field with quicklime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate) when field has become acidic to neutralize the effect of acid.

Page No. 33

1. What is the common name of the compound $CaOCl_2$?
Ans. Bleaching powder.

2. Name the substance which on treatment with chlorine yields bleaching powder.
Ans. Slaked lime or calcium hydroxide.

3. Name the sodium compound which is used for softening hard water.
Ans. Sodium carbonate is used for softening hard water.

4. What will happen if a solution of sodium hydrogen carbonate is heated? Give the equation of reaction involved.
Ans. Sodium hydrogen carbonate solution on heating gives sodium carbonate, carbon dioxide and water.

$$2NaHCO_3 + \ heat \rightarrow Na_2CO_3 + \ CO_2 + H_2O$$

5. Write an equation to show the reaction between plaster of Paris and water.
Ans. The reaction between plaster of Paris and water is as follows:

$$\frac{CaSO_4.1}{2H_2O} \ + \ \frac{3}{2} \ H_2O \rightarrow CaSO_4.2H_2O$$

Textbook Exercises:-

1. A solution turns red litmus blue, its pH is likely to be

(a) 1 (b) 4 (c) 5 (d) 10

Ans. (d) 10

2. A solution reacts with crushed egg-shells to give a gas that turns lime-water milkey. The solution contains

(a) NaCl (b) HCl (c) LiCl (d) KCl

Ans. (b) HCl

3. 10 mL of a solution of NaOH is found to be completely neutralized by 8 mL of a given solution of HCl. If we take 20 mL of same solution of NaOH, the amount of HCl solution required to neutralize it will be

(a) 4 mL (b) 8 mL (c) 12 mL (d) 16 mL

Ans. (d) 16 mL

4. Which one of the following types of medicines is used for treating indigestion?

(a) Antibiotics (b) Analgesic

(c) Antacid (d) Antiseptic

Ans. (c) Antacid

5. Write word equations and then balanced equations for the reaction taking place when:

(a) Dilute Sulphuric acid reacts with zinc granules.

(b) Dilute hydrochloric acid reacts with magnesium ribbon.

(c) Dilute Sulphuric acid reacts with aluminum powder

(d) Dilute hydrochloric acid reacts with iron fillings.

Ans. $Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$

(a) Zinc + Sulphuric acid $\rightarrow$ Zinc sulphate +Hydrogen

(b) Magnesium + Hydrochloric acid $\rightarrow$ magnesium chloride +Hydrogen gas

$Mg + 2HCl \rightarrow MgCl_2 + H_2$

(c) Aluminum + Sulphuric acid $\rightarrow$ Aluminum sulphate +Hydrogen gas

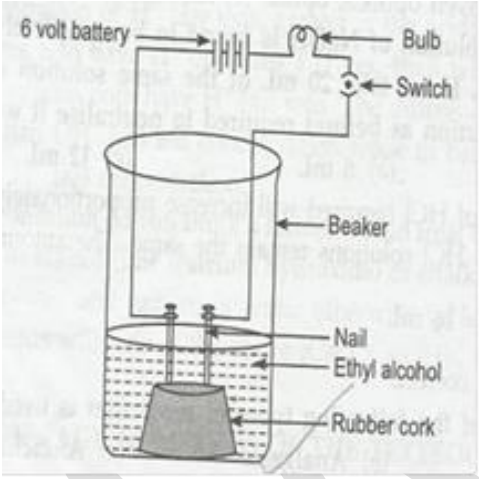
$2Al + 3H_2SO_4 \rightarrow Al_2(SO_4)_3 + 3H_2$

(d) Iron + Hydrochloric acid $\rightarrow$ Iron chloride +Hydrogen

$Fe + 2HCl \rightarrow FeCl_2 + H_2$

6. Compound such as alcohols and glucose also contain hydrogen but are not categorized as acids. Describe an activity.

Ans. Alcohol and glucose both contain hydrogen but not categorized as acids. This can be proved by following activity.



Material required: - Beaker, nails, battery, connecting wires, bulb, switch and alcohols.
Procedure:
1. Set up the experiment as follows
2. Take ethyl alcohol in the beaker in the beaker.
3. When the switch is turned on, the bulb does not glow.
4. Take glucose solution in place of alcohols but bulb does not glow.

7. Why does distilled water not conduct electricity, where as rain water does?
Ans. Rain water contains small amount of acid because of which it conducts electricity. Distilled water is pure water. It does not contain ions. Therefore, it does not conduct electricity.

8. Why do acids not show acidic behavior in the absence of water?
Ans. Acids produce hydrogen ions or hydronium ions only in presence of water. Therefore, it shows acidic behavior only presence of water.

9. Five solutions A, B, C, D and E when tested with universal indicators showed pH as 4, 1, 11, 7 and 9 respectively. Which solution is:
(a) neutral?
(b) strongly alkaline?
(c) strongly acidic
(d) weakly acidic?
(e) weakly alkaline
Ans. (a) D (b) C (c) B (d) A (e) E

10. Equal lengths of magnesium ribbons are taken in test tubes A and B. hydrochloric acid is added to test tube A, while acetic acid is added to test B. In which test tube will the fizzing occur more vigorously and why?
Ans. HCl is stronger acid than CH_3COOH. Therefore, H^+ ions concentration in test tube A will be more than that in test tube B. hence, reaction will take place faster in test tube A than in test tube B. so, fizzing will occur more vigorously in test tube B.

11. Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd? Explain your answer.
Ans. Bacteria change the fresh milk into curd by producing lactic acid. Because of the presence of lactic acid in curd, the pH will come down from 6 to lower value.

12. A milkman adds a very small amount of baking soda to fresh milk.
(a) Why does he shift the pH of the milk from 6 to slightly alkaline?
(b) Why does this milk take a long time to set a curd?
Ans. (a) The pH of milk changes from 6 to slightly alkaline on addition of a very small amount of baking soda. This is because sodium hydrogen carbonate (baking soda) is basic in nature. This prevents the milk from souring.
(b) Lactic acid formed as a result of fermentation is neutralized by sodium hydrogen carbonate. This prolongs the time taken by milk to set as curd.

13. Plaster of Paris should be stored in moisture-proof container. Explain why?
Ans. Plaster of Paris reacts with moisture to form gypsum and sets to a hard mass. Therefore, it should be stored in moisture-proof container.

14. What is a neutralization reaction? Give two examples.
Ans. The reaction between an acid and a base to give salt and water is called neutralization reaction.
For example:

$$NaOH + HCl \rightarrow NaCl + H_2O$$

$$KOH + HNO_3 \rightarrow K NO_3 + H_2O$$

15. Give two important uses of washing soda and baking soda.
Ans. Uses of washing soda:
(i) As cleansing agent.
(ii) Removing permanent hardness of water.

(iii) Used in glass, soap and paper industries.

Uses of baking soda:

(i) For making baking powder.

(ii) As ingredient of antacid.

CHAPTER – 3
METALS AND NON-METALS

- **About 118 elements are known today. There are more than 90 metals,22 non metals and a few metalloids.**
- **Sodium (Na), potassium (K), magnesium(Mg), aluminium(Al),calcium(Ca), Iron(Fe), Barium(Ba) are some metals.**
- **Oxygen(O), hydrogen(H), nitrogen(N), sulphur(S), hosphorus(P),fluorine(F), chlorine(Cl), bromine(Br), iodine(I) are some non-metals.**

	Metals		Non-metals
1.	Generally solid except Hg(present in liquid form).	1.	Can be solid, liquid organs e.g., C is solid, Br (liq), H_{22}(gas)
2.	Ductile, Malleable (drawn into wires) (beaten into sheets)	2.	Non-ductile, non-Malleable
3.	Sonorous (produces sound)	3.	Non-sonorous
4.	Lustrous (have natural shine)	4.	Non-lustrous except Iodine.
5.	High Melting Point except Ce and Ga	5.	Lower M.P. than metals.
6.	Generally good conductors of heat and electricity except Pb and Hg.	6.	Bad conductors of heat and electricity except Graphite (form of C)
7.	High density except Na and K	7.	Low densities except Diamond (form of C)
8.	Reactive	8.	Not very reactive.
9.	Ionic bonding is present,	9.	Covalent/Hydrogen bonding is present

- Metals form basic oxides e.g., Magnesium oxide(MgO), while non-metals form acidic oxides e.g., SO_2,CO_2 .
- Ag and Cu are best conductors of electricity.
- Metals and Non-metals can be distinguished on the basis of their physical and chemical properties.
- Some elements show the properties of both metals and non-metals and are called metalloids.

Chemical Properties of Metals Reaction with air : Different metals show different reactivities towards oxygen present in air. Metal+oxygen→Metal Oxide

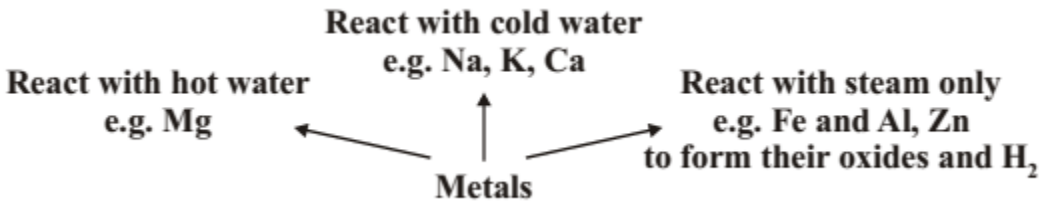
- Some metals like Na and K are kept immersed in kerosene oil as they react vigorously with air and catch fire.

- Some metals like Mg, Al, Zn, Pb react slowly with air and form a protective layer.
- Mg can also burning air with a white dazzling light to form its oxide
- Fe and Cu don't burn in air but combine with oxygen to form oxide.Iron filings burn when sprinkled over flame.
- Metals like silver, platinum and gold don't burn or react with air.

e.g.. $2Na+{}^{1}/_{2}O_2 \rightarrow Na_2O$
$2Mg+O_2 \rightarrow 2MgO$
$2Cu+O_2 \rightarrow 2CuO$
$4Al+3O_2 \rightarrow 2Al_2O_3$

Usually metal oxides are basic in nature,but some metal oxides show both acidic and basic nature. Amphoteric Oxides :metal oxides which react with both acids as well as bases to form salt and water e.g. Al_2O_3,ZnO.Al2O3,ZnO.
eg.. $Al_2O_3+HCl \rightarrow AlCl_3+H_2O$
$Al_2O_3+NaOH \rightarrow NaAlO_3+H_2O$

REACTION WITH WATER : Metal oxides on reaction with water form alkalis.



$Na+HO_2 \rightarrow NaOH+H_2$

$K+HO_2 \rightarrow KOH+H_2$

$Ca+HO_2 \rightarrow Ca(OH)_2+H_2$

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

In case of Ca and Mg, the metal starts floating due to bubbles of hydrogen gas sticking to its surface.

$Al+H_2O \rightarrow Al_2O_3+H_2$

$Fe+H_2O \rightarrow Fe_3O_4+H_2$

Inert metals like Au and Ag do not react with water.

Metal oxide+water→MetalHydroxide

Note: Try Balancing the above Chemical equations yourself

REACTION WITH ACIDS
Metal +dilute acid→→ Salt + Hydrogen gas

metals react with dilute hydrochloric acid and dilute sulphuric acid to form chlorides. $Fe+2HCL \rightarrow FeCl_2+H_2$

$Mg+2HCl \rightarrow MgCl_2+H_2$

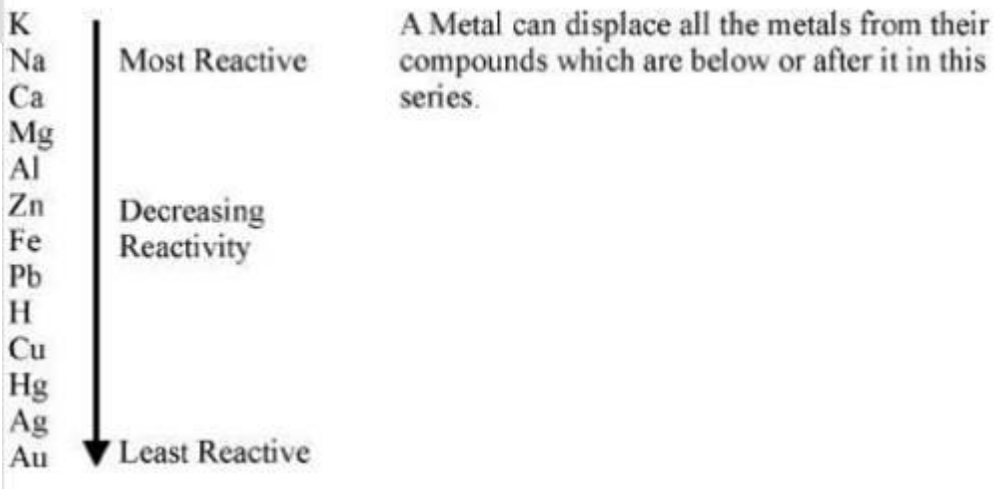
$Zn+2HCl \rightarrow ZnCl_2+H_2$

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

Note : Copper, mercury and silver don't react with dilute acids.

Hydrogen gas produced is oxidised to water. This happens because $HNO_3HNO3$is a strong oxidising agent when metals react with nitric acid(HNO_3).(HNO3). But Mg and Mn, react with very dilute nitric acid to evolve hydrogen gas. 4. Reaction of metals with other metal salts
: MetalA+SaltsolutionofB→ SaltSolutionofA+MetalBMetalA+SaltsolutionofB→ SaltSolutionofA+MetalB

All metals are not equally reactive. Reactive metals can displace less reactive metals from their compounds in solution. This forms the basis of reactivity series of metals. Reactivity series is a list of metals arranged in order of their decreasing activities.



$Fe+CuSO_4 \rightarrow FeSO4+Cu$ $Zn+CuSO_4 \rightarrow ZnSO4+Cu$

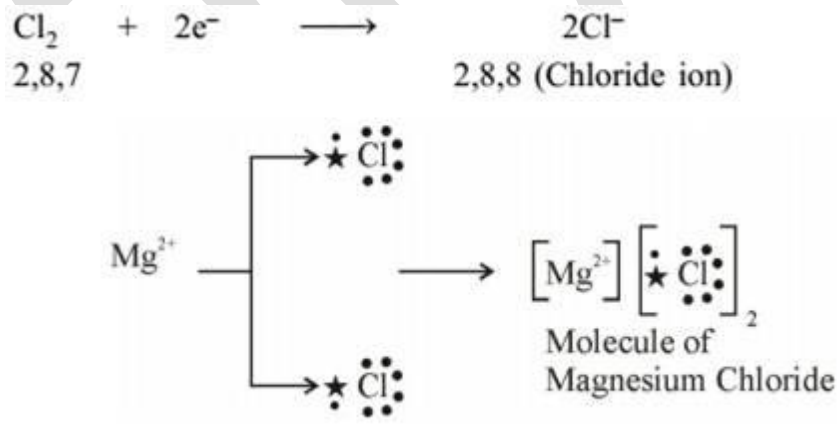
REACTION OF NON-METALS :

reaction with oxygen	non-metals form acidic oxides Eg:$C+O_2 \rightarrow CO_2$
reaction with water	non-metals do not react with water because they cannot release electrons.
reaction with dilute acids	no reaction
reaction with salt solutions	a more reactive non-metal will displace less reactive non-metal from its salt solution.
reaction with chlorine	chloride is formed. Eg;$H_2(g)+Cl_2 \rightarrow 2HCl$
reactions with hydrogen	hydrides are formed. $H_2 + S(l) \rightarrow H_2S$

Reaction between Metals and Non-Metals

- Reactivity of elements can be understood as a tendency to attain a completely filled valence shell.
- Atom of metals can lose electrons from valence shells to form cations(+ve ions).
- Atom of non-metals gain electrons in valence shell to form anions (–ve ions).
- Oppositely charged ions attract each other and are held by strong electrostatic forces of attraction forming ionic compounds.

Formation of $MgCl_2$ $Mg \rightarrow Mg^{2+} + 2e^-$ 2,8, 22,8 (Magnesium ion)



Properties of Ionic Compounds

- Are solid and mostly brittle.
- Have high melting and boiling points. More energy is required to break the strong inter-ionic attraction.
- Generally soluble in water and insoluble in kerosene, petrol.

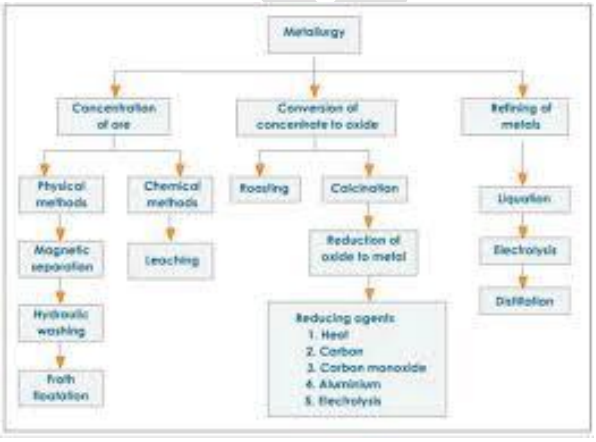
- Conduct electricity in solution and in molten state. In both cases, free ions are formed and conduct electricity.

Occurrence of Metals Minerals : Elements or compounds occurring naturally are minerals. ORES : Mineral from which metal can be profitably extracted is an ore. For example, sulphide ore, oxide ore, carbonate ore.

- Metals at the bottom of activity series like gold, platinum, silver, copper generally occur in free state. But copper and silver also occur as sulphide and oxide ores.
- Metals of medium reactivity (Zn, Fe, Pb etc.) occur mainly as oxides,sulphides or carbonates.
- Metals of high reactivity (K, Na, Ca, Mg and Al) are very reactive and are thus found in combined state.

GANGUE : the commercially valueless materiallike soil,sand, etc. in which ore is found.called gangue. The gangue is removed from the ore. Various Methods to remove gangue: 1.GRAVITY SEPARATION 2.FROTH FLOATATION 3.MAGNETIC SEPARATION

METALLURGY : Step-wise process of obtaining metal from its ore.
I. *Enrichment of ore
II. *Obtaining metal from enriched ore.
III. *Refining of impure metal to obtain pure metal.
Enrichment of Ores : It is the process of the removal of impurities such as soil, sand etc. from the ore prior to extraction of the metal. Different separation techniques are used based on physical or chemical properties of ore. Extracting Metals from the Enriched Ore



Metal	Name of ore	Chemical name of main mineral in ore	Formula
sodium	rock salt	sodium chloride	NaCl
calcium	limestone	calcium carbonate	$CaCO_3$
magnesium	magnesite	magnesium carbonate	$MgCO_3$
aluminium	bauxite	aluminium oxide	Al_2O_3
zinc	zinc blende	zinc sulphide	ZnS
iron	haematite magnetite	iron(III) oxide black iron oxide (iron(II), (III) oxide)	Fe_2O_3 Fe_3O_4
tin	cassiterite	tin(IV) oxide	SnO_2
lead	galena	lead(II) sulphide	PbS
copper	copper pyrite or chalcopyrite	mixture of copper(II) sulphide and iron sulphide	$CuFeS_2$ (CuS + FeS)
mercury	cinnabar	mercury(II) sulphide	HgS

Main minerals of metal ores

Extracting Metals Low in the Activity Series : By heating the ores in air at high temperature.

e.g.*Mercury from cinnabar

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

$2HgO \xrightarrow{Heat} 2Hg+O_2$

e.g. *Copper from copper sulphide $Cu_2S+3O_2 \xrightarrow{Heat} 2Cu_2O_2SO_2$

$2Cu_2S+Cu_2S \xrightarrow{Heat} 6Cu+SO_2$

Extracting Metals in the Middle of Activity Series : *Metals are easier to obtain from oxide ores, thus, sulphide and carbonate ores are converted into oxides.

*Metal ore heated strongly in excess of air (**Roasting)**

e.g.. $2ZnS+3O_2 \xrightarrow{Heat} 2ZnO+2SO_2$

Metal ore heated strongly in limited or no supply of air (Calcination)

e.g.. $ZnSO_3 \xrightarrow{Heat} ZnO+CO_2$

Reduction of Metal Oxide :

USING COKE : Coke as a reducing agent.

$ZnO+C \xrightarrow{Heat} Zn+CO$

USING DISPLACEMENT REACTION : highly reactive metal like Na, Ca and Al are used to displace metals of lower reactivity from their compounds. These displacement reactions are highly exothermic.

$MnO_2+4Al \xrightarrow{Heat} 3Mn+2Al_2O_3+heat$

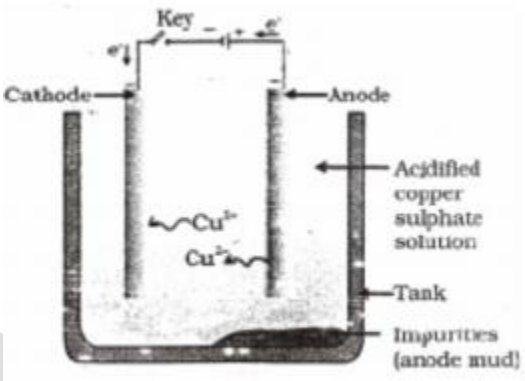
$Fe_2O_3+2Al \xrightarrow{Heat} 2Fe+Al_2O_3+heat$

Thermite Reaction : Reduction of a metal oxide to form metal by using Al powder as a reducing agent. This process is used to join broken pieces of heavy iron objects or welding. Extracting Metals at the Top of Activity Series

- These metals have more affinity for oxygen than carbon so they cannot be obtained from their compounds by reducing with carbon.
- So are obtained by electrolytic reduction. e.g.Sodium is obtained by electrolysis of its molten chloride $NaCl \rightarrow Na^{+} + Cl^{-}$

As electricity is passed through the solution metal gets deposited at cathode and non-metal at anode. At cathode : e.g. $Na^{+} + e^{-} \rightarrow Na$ At anode : $2Cl^{-} \rightarrow Cl_2 + 2e^{-}$

III. Refining of Metals Impurities present in the obtained metal can be removed by electrolytic refining. Copper is obtained using this method. Following are present inside the electrolytic tank. Anode – slab of *impure* copper Cathode– slab of **pure** copper Solution – aqueous solution of copper sulphate with some dilute sulphuric acid From anode copper ions are released in the solution and equivalent amount of copper from solution is deposited at cathode. Insoluble impurities containing silver and gold gets deposited at the bottom of anode as anode mud.



Corrosion Metals are attacked by substances in surroundings like moisture and acids. Silver - it reacts with sulphur in air to our form silver sulphide and articles become black. Copper - reacts with moist carbon dioxide in air and gains a green coat of copper carbonate. Iron-acquires a coating of a brown flaky substance called rust. Both air and moisture are necessary for rusting of iron. Rust is hydrated Iron (III) oxide i.e. $Fe_2O_3.xH_2O$

Prevention of Corrosion Rusting of iron is prevented by painting, oiling, greasing, galvanizing, chrome plating, anodising and making alloys.

In galvanization, iron or steel is coated with a layer of zinc because oxide thus formed is impervious to air and moisture thus protects further layers from corrosion.

Alloys: These are homogeneous mixture of metals with metals or non-metals. Adding small amount of carbon makes iron hard and strong.

Some examples of alloys are following ;
1. Steel : Hard Iron and carbon.Used for construction of roads, railways, other infrastructure, appliances

2. Stainless steel :Hard Rust Free Iron, nickel and chromium. Used in utensils.

3. Brass :Low electrical conductivity Copper and zinc.used for decoration for its bright gold-like appearance and in locks,gears ,plumbing and electrical appliances.

4. Bronze: than pure metal Copper and tin. used to make coins, springs, turbines and blades.

5. Solder : Low MP, used to weld wires Lead and tin. used to create a permanent bond between metal work pieces

6. Amalgam :Used by dentists. Mercury and any other metal

Intext Exercise :-

Page No. 40

1. Give an example of metal which
(i) is a liquid at room temperature.
(ii) can be easily cut with knife.
(iii) is best conductor of heat.
(iv) is poor conductor of heat.
Ans. (i) Mercury **(ii)** Sodium **(iii)** Silver **(iv)** Lead

2. Explain the meaning of malleable and ductile.
Ans. A substance that can be beaten into thin sheets is said to be malleable. For example, iron, copper etc.
A substance that can be drawn into wires is called ductile. For example, gold, silver etc.

Page No. 46

1. Why is sodium kept immersed in kerosene oil?
Ans. Sodium reacts so vigorously with oxygen that it catches fire when kept in the opens. Hence, to protect accidental fires, it is kept immersed in kerosene oil.

2. Write equation for the reaction of
(i) Iron with steam
(ii) Calcium and potassium with water
Ans.
(i) $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$
(ii) $Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$
$2K + 2H_2O \rightarrow 2KOH + H_2$

3. Samples of four metals A, B, C and D were taken and added to the following solution one by one. The results obtained have been tabulated as follows:

Metal	Iron(II)sulphate	Copper(II)sulphate	Zinc sulphate	Silver nitrate
A	No reaction	Displacement	---	----
B	Displacement	---	No reaction	----
C	No reaction	No reaction	No reaction	Displacement
D	No reaction	No reaction	No reaction	No reaction

Use the table given above to answer the f0llowing questions about metals A,B,C and D.

(i) Which is the most reactive metal?

(ii) What would you observe if B is added to a solution of Copper(II) sulphate?

(iii) Arrange the metals A, B,C and D in order of decreasing reactivity.

Ans. (i) B is the most reactive metal

(ii) If B is added to a solution of copper (II) sulphate, displacement reaction will take place. Blue colour of copper sulphate will fade and red –brown copper will settle down.

(iii) The decreasing order of reactivity is:

B> A> C >D

4. Which gas is produced when dilute hydrochloric acid is added to reactive metal?

Ans. Hydrogen gas is produced when dilute hydrochloric acid is added to a reactive metal.

5. What would you observe when zinc is added to a solution of iron(II) sulphate? Write the chemical reaction that takes place.

Ans. As zinc is more reactive than iron, displacement reaction will take place

$$Zn + FeSO_4 \rightarrow ZnSO_4 + Fe$$

Page No. 49

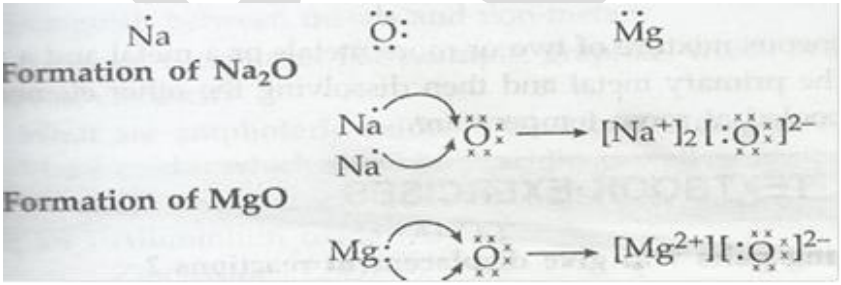
1. (i) Write the electro-dot structures for sodium, oxygen, and magnesium.

(ii) Show the formation of Na_2O and MgO by the transfer of electrons.

(iii) What are the ions present in these compounds?

Ans. (i) Electron-dot structure for sodium, oxygen and magnesium are

(ii)



(iii) Ions present in Na_2O are Na^+ and O^{2-}

Ions present in MgO are Mg^{2+} and O^{2-}

2. Why do ionic compounds have high melting points?

Ans. There are strong forces of attraction between oppositely charged ions in ionic compounds. Considerable amount of energy is required to break strong inter-ionic force of attraction. Therefore, they have high melting points.

Page No. 53

1. Define the following terms:
(i) Minerals
(ii) Ores and
(iii) Gangue
Ans. (i) Minerals- the element or compounds which occur naturally in the earth crest are known as minerals.
(ii) Ores- Minerals from which metal can be extracted profitably and easily are called ores.
(iii) Gangue- Impurities such as soil and sand which are present in the minerals are called gangue.

2. Name two metals which are found in nature in the free state.
Ans. Gold and Platinum

3. What chemical process is used for obtaining a metal from its oxide?
Ans. A metal is obtained from its oxide by the process of reduction.

Page No. 55
1. Metallic oxide of zinc, magnesium and copper were heated with following metals:

Metal	Zinc	Magnesium	copper
Zinc oxide			
Magnesium oxide			
Copper oxide			

In which case will you find displacement reactions taking place?
Ans. Based on the activity series of metals, the displacement reactions will take place as below:

Metal	Zinc	Magnesium	copper
Zinc oxide	No reaction	Displacement	No reaction
Magnesium oxide	No reaction	No reaction	No reaction
Copper oxide	Displacement	Displacement	No reaction

2. Which metals do not corrode easily?
Ans. Metals which are placed at the bottom of activity series like silver, gold, platinum do not corrode easily.

3. What are alloys?
Ans. An alloy is homogenous mixture of two or more metals or metal and non-metal. It is obtained by first melting primary metal and then dissolving the other element in it in definite proportion.

TEXTBOOK EXERCISES:-
1. Which of the following pairs will give displacement reactions?
(a) NaCl solution and copper metal
(b) $MgCl_2$ solution and aluminum
(c) $FeSO_4$ solution and silver metal
(d) $AgNO_3$ solution and copper
Ans. (d) $AgNO_3$ solution and copper

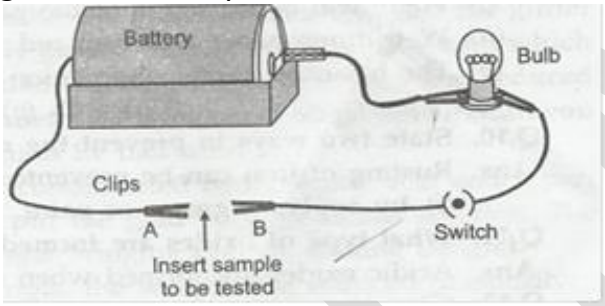
2. Which of the following method is suitable for preventing an iron fry pan from rusting?
(a) Applying grease
(b) applying paint
(c) Applying coating of zinc
(d) All of the above
Ans. (c) Applying coating of zinc

3. An element reacts with oxygen to give a compound with a high melting point. This compound is also soluble in water. The element is likely to be
(a) Calcium
(b) Carbon
(c) Silicon
(d) Iron
Ans. (a) Calcium

4. Food cans are coated with tin and not zinc because
(a) Zinc is costlier than tin
(b) Zinc has higher melting point

(c) Zinc is more reactive than tin
(d) Zinc is less reactive than tin
Ans. (c) Zinc is more reactive than tin

5. You are given a hammer, a battery, a bulb, wires and switch.
(a) How could you use them to distinguish between samples of metals and non-metals?
(b) Asses the usefulness of these tests in distinguishing between metals and non-metals?
Ans. (a) Place the sample on an iron block. Strike with hammer. If the sample takes the shape of a sheet, it is a metal. If it breaks into pieces, it is a non-metal.
Set up the arrangement by using a bulb, a battery, wires and switch. Insert the samples of metals and non-metals in the clips one by one and turn the switch on. If the bulb glows, the sample is a metal, if not, then the sample is non-metal.



(b) The above two methods can, in general, be used to distinguish between metals and non-metals.

6. What are amphoteric oxides? Give two examples of amphoteric oxides.
Ans. Metal oxides which show both acidic as well as basic behavior are called amphoteric oxides. Such metal oxides react with both acids and bases.
Example: Aluminum oxide, zinc oxide

7. Name two metals which will displace hydrogen from dilute acids, and two metals which will not.
Ans. Magnesium and zinc metals displace hydrogen from dilute acids. Copper and silver do not displace hydrogen from dilute acids.

8. In the electrolytic refining of a metal M, what would you take as the anode, the cathode and the electrolyte?
Ans. Impure metal M is made the anode, thin strips of pure metal M as cathode and a salt solution of metal M as electrolyte.

9. Pratyush took Sulpher powder on spatula and heated it. He collected the gas evolved by inverting a test tube over it as shown in fig. 3.12 below:
(a) What will be the action of gas on
(i) Dry litmus paper?
(ii) Moist litmus paper?
(b)Write a balanced chemical equation for the reaction taking place.
Ans. (a) Sulphur is a non-metal. Oxides of non-metals are acidic. In this case sulphur dioxide is produced which is acidic.
(i) No action of the gas
(ii) wet litmus paper will turn red.
(b) $S\,(s)\ + O_2\,(g) \rightarrow SO_2\,(g)$

10. State two ways to prevent the rusting of iron.
Ans. Rusting of iron can be prevented by
(i) By applying grease or paint.
(ii) By galvanizing

11. What types of oxides are formed when non-metals combine with oxygen?
Ans. Acidic oxides are formed when non-metals combine with oxygen.

12. Give reasons:
(a) Platinum, gold and silver are used to make jewellery.
(b) Sodium, potassium and lithium are stored under oil.
(c) Aluminum is highly reactive metal, yet it is used to make utensils for cooking.
(d) Carbonate and sulphides ores are usually converted into oxides during the process of extraction.
Ans. (a) These metals are un-reactive. They do not react with oxygen and other gases present in air and with moisture. Thus, their shine is maintained. That is why these metals are used to make jewellery.
(b) Reaction of sodium, potassium and lithium with oxygen is so violent that they catch fire. To prevent accidental fire, they are stored under kerosene oil.
(c) This is because aluminum is a good conductor of heat. Aluminum forms a layer of aluminum oxide at high temperature which is prevent the further corrosion.
(d) It is easier to reduce oxide than the carbonates and sulphide to the metals.

13. You must have seen tarnished copper vessels being cleaned with lemon or tamarind juice. Explain why these sour substances are effective in cleaning the vessels.

Ans. Copper, on keeping in air reacts with atmospheric carbon dioxide to form a green layer of copper carbonate. Copper carbonate reacts with citric acid present in lemon or tartaric acid present in tamarind to form soluble copper citrate or copper tartarate. The vessels are thus cleaned using water.

14. Differentiate between metal and non-metal on the basis of their chemical properties.

Ans. Metals and non-metals can be differentiated on the basis of following chemical properties.

Metals	Non-metals
1. Metals displace hydrogen from water.	1. Non-metal do not displace hydrogen from water.
2. Metals are basic oxide.	2. Non-metals are acidic oxides.
3. Metals displace hydrogen from dilute acids.	3. Non-metals displace hydrogen from dilute acids.
4. Metals form ionic chlorides with chlorine.	4. Non-metals form covalent chlorides with chlorine.

15. A man went door to door posing as a goldsmith. He promised to bring back the glitter of the old and dull ornaments. An unsuspecting lady gave a set of gold bangles to him which he dipped in a particular solution. The bangles sparkled like new but their weight was reduced drastically. The lady was upset but after a futile argument the man beat a hasty retreat. Can you play the detective to find out the nature of the solution he had used?

Ans. Aqua regia, which is a mixture of 3 parts concentrated HCl and part of concentrated nitric acid dissolves gold. The man put the gold bangles in this solution. The outer dirty layer of gold bangles dissolved in aqua regia bring out the shining bangles.

As the outer layer of bangles dissolved in aqua regia, the weight was reduced drastically.

16. Give reasons, why copper is used to make hot water tanks and not steel (an alloy of iron).

Ans. Electrical conductivity of a metal is decreased when it is alloyed with another metal or non-metal. Thus, the electrical conductivity of steel is much less than that of pure. That is why copper is used to make hot water tanks and not steel.