पु॰ना International School

Shree Swaminarayan Gurukul, Zundal

Class -X

Science(Chemistry)

Specimen Copy

Year- 2022-23

SCIENCE

Class X

NCERT

SCIENCE

Textbook for Class X

INDEX

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

$Acid + Metal \rightarrow Salt + Hydrogen$

$2HCl + Zn \rightarrow ZnCl_2 + H_2$

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

$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$

$2CH_3COOH + Zn \rightarrow Zn(CH3COO)_2 + H_2$

- **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

$NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$

Sodium Zincate

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

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

Metal Carbonate + Acid→ Salt + Carbon dioxide +

Water

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

Metal bicarbonate +Acid→ Salt + Carbon dioxide +

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.

$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$

Limewater Whiteprecipitate

- CO_2 the following reaction takes place

$CaCO_3(s) + H_2O(l) + CO_2(g) \rightarrow Ca(HCO_3)_2$ (soluble in water)

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

Neutralization Reactions

Base +Acid → Salt + Water

E.g. $NaOH(aq)+HCl(aq) \rightarrow NaCl(aq)+H_2O(l)$

- **Reactions of metal oxides with acids**

MetalOxide +Acid →Sal + Water

CuO	+	HCl	→	$CuCl_2$	+	H_2O
Copperoxide		Hydrochloricacid		CopperChloride		Water

Note : Appearance of blue green color of the solution because of formation of $CuCl2$.

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.

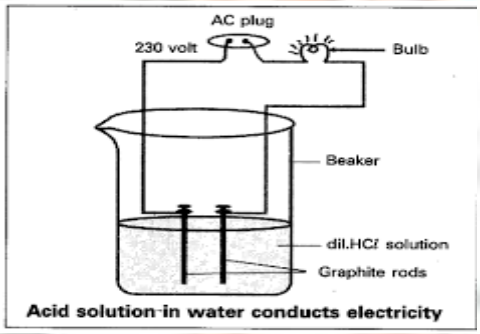
- **Reaction of Non Metallic Oxide with Base**

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 basethey 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

$HCl + H_2O \rightarrow H3O^+ + Cl^-$

H_3O^+: Hydronium ion.

H^+ 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

$NaOH(s) + H_2O \longrightarrow Na^+(aq) + OH^-(aq)$

$KOH(s) + H_2O \longrightarrow K^+(aq) + OH^-(aq)$

$Mg(OH)_2(s) + H_2O \longrightarrow Mg^{2+}(aq) + 2OH^-(aq)$

- **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^+ ion H^+ ion and OH^- ion OH^- 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 colors 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= Potenza in German means power.

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

Neutral pH (water is neutral).

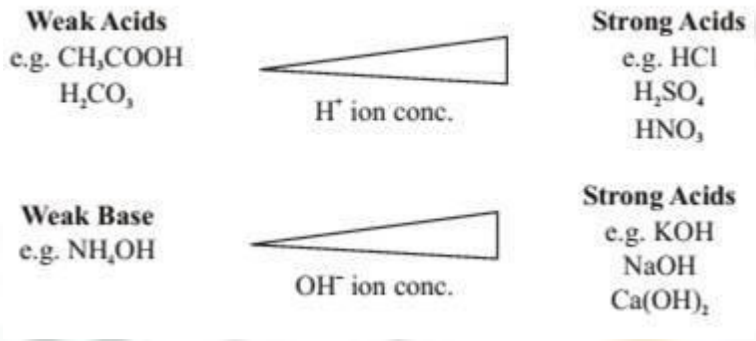
pH paper : Is a paper which is used for measuring pH

Variation of PH

S. No. pH Color 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 helps in digestion of food. In case of indigestion our stomachproduces 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 damages the nutrients of the soil and decreases its natural fertility.
- Our body functions between the pH ranges of 7.0 to 7.8. Living organisms can surviveonly 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 neutralize 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 neutralizes 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 and Na_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, CaSO4

Acidic Salts: Strong Acid + weak base

pH value is less than 7eq.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 colored and crystalline is shape.

Preparation:

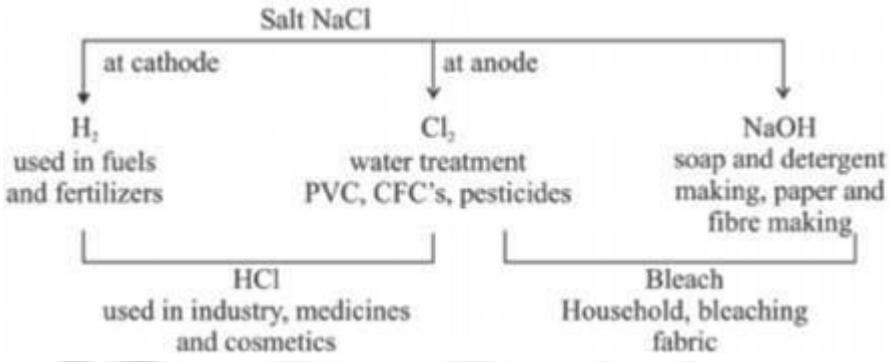
Sodium chloride is obtained by mining the deposits and brine solution is obtained by passing water into the deposits. Hence the salts get dissolved then the solution is pumped out. Evaporation of the sea water is one of the major processes used to obtain salt . The crystals obtained usually consists 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 chloro-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 oxidizing agent.

III. Sodium Hydrogen Carbonate - $NaHCO3$

Common name - Baking Soda. It is mild corrosive base

Preparation :

1. Used in baking/cooking

Heating $NaHCO3+H2O+CO2$

$NaHCO3 \xrightarrow{heat} Na2CO3+H2O+CO2$

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.

$Na_2CO_3 + 10H_2O \rightarrow$ 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.

$CaSO_4.\frac{1}{2}H_2O + 11/2H_2O \rightarrow CaSO_4.2H_2O$
POP GYPSUM

Making toys, decorative material and smoothening surfaces,

plaster for fractured bones.

In text 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

$Zn + 2HCl \rightarrow ZnCl_2 + H_2$

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.

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.

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

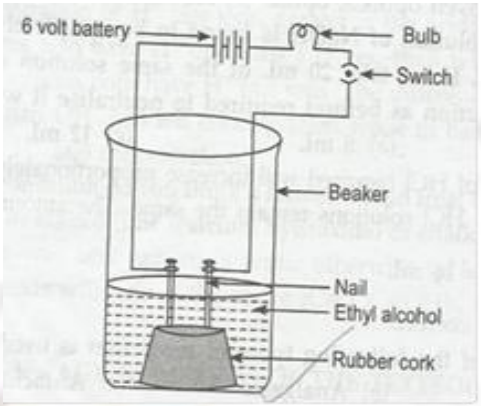
(a) Zinc + Sulphuric acid $\rightarrow$ Zinc sulphate +Hydrogen

(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.