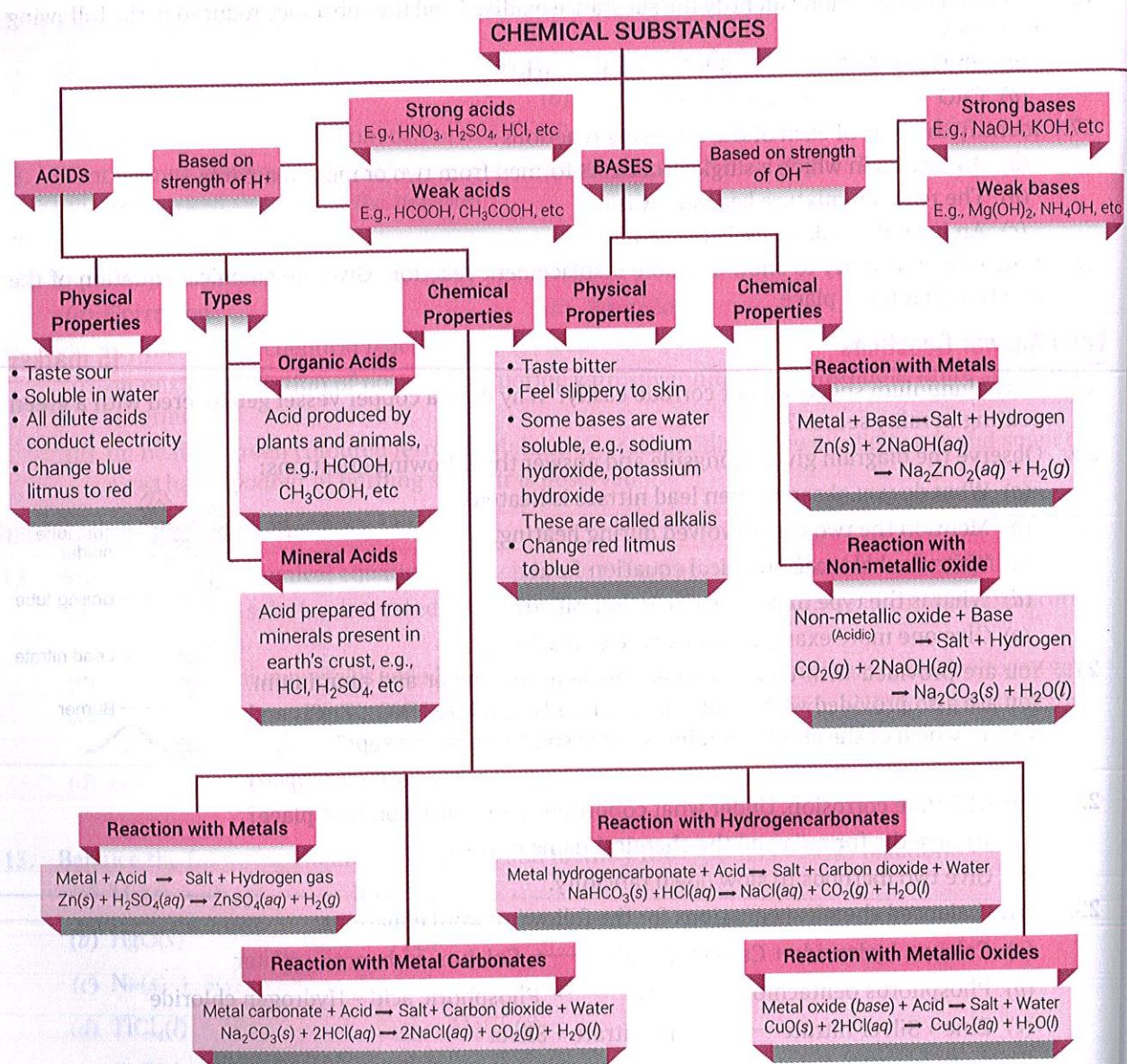


# ACIDS, BASES AND SALTS

## BASIC CONCEPTS – A FLOW CHART



### INDICATORS

**Natural**  
E.g., litmus

**Olfactory**  
E.g., onion

**Synthetic**  
E.g., phenolphthalein

Indicator	Colour in Acid	Colour in Alkali
Litmus	Red	Blue
Methyl orange	Pinkish red	Yellow
Phenolphthalein	Colourless	Pink

### pH Scale

- Scale for measuring hydrogen ion concentration in a solution
- For acidic solution,  $pH < 7$
- For neutral solution,  $pH = 7$
- For basic solution,  $pH > 7$

### Salts

Formed by neutralisation reaction  
 $Acid + Base \rightarrow Salt + Water$   
 $HA + MOH \rightarrow MA + HOH$   
 $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$   
 $HNO_3(l) + KOH(aq) \rightarrow KNO_3(aq) + H_2O(l)$

Important Compounds	Chemical name	Chemical formula	Preparation	Uses
Common Salt	Sodium chloride	$NaCl$	By combination reaction of sodium hydroxide and hydrochloric acid $NaOH(aq) + HCl(aq) \rightarrow NaCl(aq) + H_2O(l)$	(i) As raw material for making many chemicals (ii) In cooking food
Caustic Soda	Sodium hydroxide	$NaOH$	By passing electricity through concentrated sodium chloride (brine) solution $2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$	(i) In detergents and soaps (ii) In paper making (iii) In bleach manufacture (iv) In bauxite purification to extract aluminium
Washing Soda	Sodium carbonate decahydrate	$Na_2CO_3 \cdot 10H_2O$	By recrystallisation of sodium carbonate in water $Na_2CO_3 + 10H_2O \rightarrow Na_2CO_3 \cdot 10H_2O$	(i) Softening hard water (ii) In washing clothes (iii) In paper, paint and textile industry (iv) Manufacturing glass, borax and caustic soda extract
Baking Soda	Sodium hydrogen carbonate	$NaHCO_3$	On reacting cold concentrated sodium chloride (brine) solution with ammonia and carbon dioxide $NaCl + NH_3 + CO_2 + H_2O \rightarrow NaHCO_3 + NH_4Cl$	(i) Preparing baking powder (ii) Manufacture of soda water (iii) In fire extinguishers (iv) As an antacid in medicine
Bleaching Powder	Calcium oxychloride	$CaOCl_2$	By passing chlorine gas over dry slaked lime $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$	(i) For bleaching cotton textile (ii) For disinfecting drinking water (iii) As an oxidising agent in chemical industry (iv) Manufacturing chloroform
Plaster of Paris	Calcium sulphate hemihydrate	$CaSO_4 \cdot \frac{1}{2}H_2O$	By heating gypsum at 373K $CaSO_4 \cdot 2H_2O \xrightarrow{373K} CaSO_4 \cdot \frac{1}{2}H_2O + 1\frac{1}{2}H_2O$	(i) For making statues, models, toys, etc (ii) For making fireproof materials (iii) For setting fractured bones

## MORE POINTS TO REMEMBER

- ❑ **Indicators:** These are substances that tell us whether a substance is acidic or basic by the change in their colour. There are some substances whose odour changes in acidic or basic medium. These are called **olfactory indicators**.
- ❑ An alkali is a base that dissolves in water. They are soapy to touch, bitter and corrosive.
- ❑ When acids dissolve in water, the hydrogen is released into the solution as  $H^+(aq)$  or  $H_3O^+$  ions. It is  $H^+(aq)$  or  $H_3O^+$  ions that make a solution acidic. Formation of  $OH^-(aq)$  ions in solution is responsible for the basic nature of a substance.

Water and neutral solutions	Equal concentrations of $H^+$ and $OH^-$ .
Acidic solutions	Greater concentration of $H^+$ than water.
Alkaline solutions	Greater concentration of $OH^-$ than water.

- ❑ **Water of Crystallisation:** The fixed number of water molecules chemically attached to each formula unit of a salt in its crystalline form is called water of crystallisation. The salts which contain water of crystallisation are called hydrated salts, e.g.,  $CuSO_4 \cdot 5H_2O$ .
- ❑ The acid must always be added slowly to water with constant stirring. If water is added to a concentrated acid, the heat generated may cause the mixture to splash out and cause burns. The glass container may also break due to excessive local heating.
- ❑ Strength of acids and bases can be compared by:

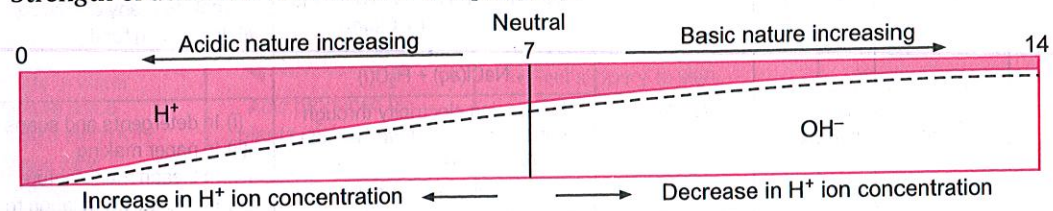


Fig. Variation of pH with the change in concentration of  $H^+(aq)$  and  $OH^-(aq)$  ions

- ❑ Salts of a strong acid and a strong base are neutral with pH value of 7. On the other hand, salts of a strong acid and weak base are acidic with pH value less than 7 and those of a strong base and weak acid are basic in nature, with pH value more than 7.

## NCERT Intext Questions

**Q. 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 paper, how will you identify the contents of each test tube?

- Ans.** (a) Put the red litmus paper turn by turn in each of the three test tubes. The solution which turns the red litmus paper to blue will be a basic solution. Here, the blue litmus paper formed can now be used to test the acidic solution.
- (b) Put this blue litmus paper in the remaining two test tubes, one by one. The solution which turns the blue litmus paper to red will be the acidic solution.
- (c) The solution which has no effect on any litmus paper will be neutral and hence, it will be distilled water.

**Q. 2.** Why should curd and sour substances not be kept in brass and copper vessels?

**Ans.** Curd and other sour substances should not be kept in brass and copper vessels. This is because curd and other sour substances contain acids which can react with these vessels to form poisonous compounds that can cause food poisoning and damage health.

**Q. 3.** Which gas is usually liberated when an acid reacts with a metal? Illustrate with an example. How will you test the presence of this gas?

**Ans.** When a metal reacts with an acid, usually hydrogen gas is liberated. For example, zinc reacts with dilute sulphuric acid as follows:



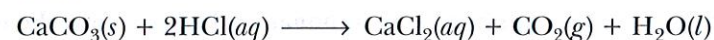
The hydrogen gas evolved can be tested by passing the gas through soap solution and then bringing a burning candle near the soap bubble filled with the gas. The soap bubble bursts and the hydrogen gas burns with a pop sound.

**Q. 4.** A metal compound A reacts with dilute hydrochloric acid to produce effervescence. 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.** The gas that extinguishes a burning candle is carbon dioxide. It is formed by the action of dilute hydrochloric acid on a metal carbonate or metal hydrogencarbonate and produces effervescence. Since one of the compounds formed is calcium chloride, this shows that the metal compound is calcium carbonate. It cannot be calcium hydrogencarbonate because calcium hydrogencarbonate is found in solution.

Thus, the metal compound A is calcium carbonate ( $CaCO_3$ ).

Calcium carbonate reacts with dilute hydrochloric acid to form calcium chloride, carbon dioxide and water.



**Q. 5.** Why do  $HCl$ ,  $HNO_3$ , etc. show acidic character in aqueous solutions while solutions of compounds like  $C_2H_5OH$  and glucose do not show acidic character?

**Ans.**  $HCl$ ,  $HNO_3$ , etc., ionise in the aqueous solution to produce  $H_3O^+$  ions. Hence, they show acidic character. Compounds like  $C_2H_5OH$  and glucose do not ionise in the aqueous solution to give  $H_3O^+$  ions, i.e., hydrogen present in them is non-ionisable. Hence, they do not show acidic character.

**Q. 6.** Why does an aqueous solution of an acid conduct electricity?

**Ans.** An acid in the aqueous solution ionises to produce  $H_3O^+$  ions and the corresponding negative ions. For example,  $HCl$  gives  $H^+$  and  $Cl^-$  ions. Due to the presence of ions in the solution, it conducts electricity.

**Q. 7.** Why does dry  $HCl$  gas not change the colour of the dry litmus paper?

**Ans.** Dry  $HCl$  gas does not change the colour of dry litmus paper because it does not produce  $H_3O^+$  ion.

**Q. 8.** While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid?

**Ans.** Dilution of concentrated acid with water is a highly exothermic process. If water is added into acid, the heat produced is so large that the solution may splash out and the beaker in which it is carried out may break due to excessive heating. Hence, dilution is done by adding acid into water.

**Q. 9.** How is the concentration of hydronium ions ( $H_3O^+$ ) affected, when a solution of an acid is diluted?

**Ans.** When a solution of an acid is diluted, the concentration of hydronium ions ( $H_3O^+$ ) per unit volume decreases.

**Q. 10.** How is the concentration of hydroxide ions ( $OH^-$ ) affected, when excess base is dissolved in a solution of sodium hydroxide?

**Ans.** On dissolving excess base in a solution of sodium hydroxide, concentration of  $OH^-$  ions per unit volume in the solution increases.

**Q. 11.** You have two solutions A and B. The pH of the solution A is 6 and pH of solution B is 8. Which solution has more hydrogen ion concentration? Which of these is acidic and which one is basic?

**Ans.** The pH of a solution is inversely proportional to its hydrogen ion concentration. This means that the solution having lower pH will have more hydrogen ion concentration. Thus, solution A will have more hydrogen ion concentration.

A solution with  $\text{pH} < 7$  is acidic. Hence, solution A is acidic.

A solution with  $\text{pH} > 7$  is basic. Hence, solution B is basic.

**Q. 12.** What effect does the concentration of  $\text{H}^+(\text{aq})$  ions have on the acidic nature of the solution?

**Ans.** Water contains exactly the same number of  $\text{H}^+$  and  $\text{OH}^-$  ions. Acidic solution contains more hydrogen ions than water. Higher the concentration of  $\text{H}^+$  ions in a solution, more acidic is the solution.

**Q. 13.** Do basic solutions also have  $\text{H}^+(\text{aq})$  ions? If yes, then why are these basic?

**Ans.** Basic solutions also have  $\text{H}^+$  ions in addition to  $\text{OH}^-$  ions. They are basic because in these solutions,  $\text{OH}^-$  ion concentration is greater than  $\text{H}^+$  ion concentration.

**Q. 14.** Under what soil condition do you think a farmer would treat the soil of his field with quick lime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate)?

**Ans.** Most of the plants grow best when the pH of the soil is close to 7. If the soil is too acidic or too basic, the plants grow badly or do not grow at all. As quick lime, slaked lime or chalk are all alkaline substances, these would be added to the soil by the farmer when the soil is highly acidic.

**Q. 15.** What is the common name of the compound  $\text{CaOCl}_2$ ?

**Ans.** Bleaching powder.

**Q. 16.** Name the substances which on treatment with chlorine yields bleaching powder.

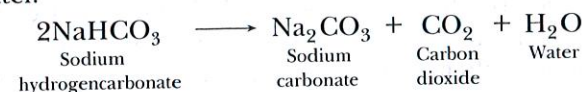
**Ans.** Dry slaked lime  $\text{Ca}(\text{OH})_2$ .

**Q. 17.** Name the sodium compound which is used for softening hard water.

**Ans.** Washing soda (sodium carbonate).

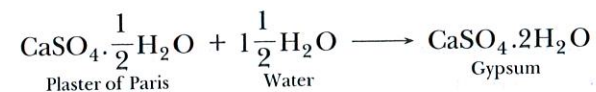
**Q. 18.** What will happen if a solution of sodium hydrogencarbonate is heated? Give the equation of the reaction involved.

**Ans.** Sodium hydrogencarbonate on heating decomposes to give sodium carbonate, carbon dioxide and water.



**Q. 19.** Write an equation to show the reaction between Plaster of Paris and water.

**Ans.** Plaster of Paris ( $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ ) on mixing with water, changes into gypsum ( $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ ), which sets to a hard mass in about half an hour.



## NCERT Exercises

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

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

**Ans.** The solution which turns red litmus blue is basic. Its pH should be greater than 7. Therefore, the correct answer is (d).

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

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

**Ans.** Egg-shells contain calcium carbonate which reacts with HCl to give out  $\text{CO}_2$  which turns lime water milky. Hence, the correct answer is (b).

**Q. 3.** 10 mL of a solution of NaOH is found to be completely neutralised by 8 mL of a given solution of HCl. If we take 20 mL of the same solution of NaOH, the amount of HCl solution (the same solution as before) is required to be neutralised. It will be

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

**Ans.** If we take double the amount of the NaOH solution, the amount of the HCl solution required to neutralise it, is also double. Hence, the correct answer is (d).

**Q. 4.** Which one of the following type of medicines is used for treating indigestion?

- (a) Antibiotic                      (b) Analgesic                      (c) Antacid                      (d) Antiseptic

**Ans.** The indigestion is due to excess of acid produced in the stomach. The medicine used to neutralise it is called antacid. Hence, the correct answer is (c).

**Q. 5.** Write word-equations and then balanced equations for the reactions 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 aluminium powder.  
 (d) dilute hydrochloric acid reacts with iron filings.

**Ans.** (a) Sulphuric acid(aq) + Zinc(s)  $\longrightarrow$  Zinc sulphate(aq) + Hydrogen(g)



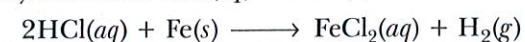
(b) Hydrochloric acid(aq) + Magnesium(s)  $\longrightarrow$  Magnesium chloride(aq) + Hydrogen(g)



(c) Sulphuric acid(aq) + Aluminium(s)  $\longrightarrow$  Aluminium sulphate(aq) + Hydrogen(g)



(d) Hydrochloric acid(aq) + Iron(s)  $\longrightarrow$  Iron chloride(aq) + Hydrogen(g)



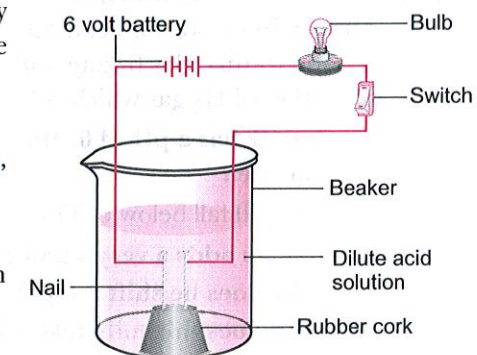
**Q. 6.** Compounds such as alcohols and glucose also contain hydrogen but are not categorised as acids. Describe an activity to prove it.

**Ans.** Although alcohols and glucose contain hydrogen, they are not ionised to give  $\text{H}^+$  ions in solution. So, they are not considered as acid.

**Activity:**

- Collect solutions of hydrochloric acid, sulphuric acid, glucose and alcohol.
- Take a beaker of 100 mL.
- Now, take a cork and fix two nails on it as shown in figure.
- Place this cork in the beaker.
- Connect the nails to the two terminals of a 6 volt battery through a bulb and a switch.
- Now, pour dilute  $\text{H}_2\text{SO}_4$  in the beaker so that the nails are immersed in the acid. Switch on the current.
- Repeat the experiment with dilute hydrochloric acid, glucose and alcohol solutions.
- What do you observe?
- Does the bulb glow in all cases?

It is observed that the bulb will glow in case of hydrochloric acid and sulphuric acid, but not in the case of alcohol and glucose.



**Q. 7.** Why does distilled water not conduct electricity, whereas rain water does?

**Ans.** Distilled water does not conduct electricity because it does not contain any ionic compounds like acids, bases or salts, dissolved in it. Rain water, while falling to the earth through the atmosphere, dissolves acidic gases like  $\text{CO}_2$ ,  $\text{SO}_2$ , etc. from the air and form acids like carbonic acid ( $\text{H}_2\text{CO}_3$ ), sulphurous acid ( $\text{H}_2\text{SO}_3$ ), etc. These acids provide hydrogen ions ( $\text{H}^+$ ) to rain water. So, due to the presence of these acids, the rain water conducts electricity.

**Q. 8.** Why do acids not show acidic behaviour in the absence of water?

**Ans.** Acidic nature of a substance is due to the formation of  $\text{H}^+(\text{aq})$  ions in solution. Hydrogen ions are produced in the presence of water. The separation of  $\text{H}^+$  ions from acid like HCl molecule cannot occur in the absence of water. So, acids do not show acidic behaviour in the absence of water.

**Q. 9.** Five solutions A, B, C, D and E when tested with universal indicator 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?

Arrange the pH in increasing order of hydrogen ion concentration.

**Ans.**

	Nature	pH	Solution
(a)	Neutral	7	D
(b)	Strongly alkaline	11	C
(c)	Strongly acidic	1	B
(d)	Weakly acidic	4	A
(e)	Weakly alkaline	9	E

Arrangement of the pH in increasing order of hydrogen ion concentration is as follows:

$$11 < 9 < 7 < 4 < 1$$

**Q. 10.** Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid (HCl) is added to test tube A while acetic acid ( $\text{CH}_3\text{COOH}$ ) is added to test tube B. In which test tube, will the fizzing occur more vigorously and why?

**Ans.** We know that hydrochloric acid (HCl) is a strong acid and acetic acid ( $\text{CH}_3\text{COOH}$ ) is a weak acid. Being a strong acid, HCl solution contains a much greater amount of hydrogen ions in it. Due to this, the fizzing will occur more vigorously in test tube A. The fizzing is due to the evolution of  $\text{H}_2$  gas which is formed by the action of acid on the magnesium ribbon.

**Q. 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.** The pH will fall below 6. This is because lactic acid (an acid) is produced when milk sets into curd.

**Q. 12.** A milkman adds a very small amount of baking soda to fresh milk.

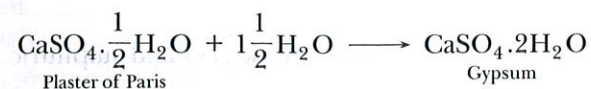
- (a) Why does he shift the pH of the fresh milk from 6 to slightly alkaline?  
(b) Why does this milk take a long time to set as curd?

**Ans.** (a) Milk is made slightly alkaline so that it may not get sour easily due to the formation of lactic acid in it.

(b) The alkaline milk takes a longer time to set into curd because the lactic acid formed has to first neutralise the alkali present in it.

**Q. 13.** Plaster of Paris should be stored in a moisture-proof container. Explain why.

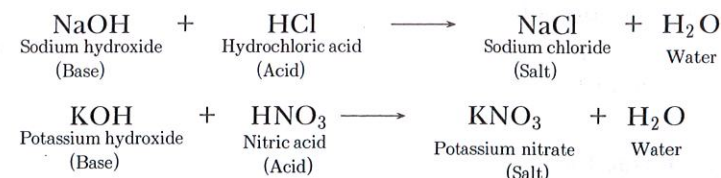
**Ans.** Plaster of Paris is a white powder and on mixing with water, it changes to gypsum giving a hard solid mass.



Hence, it should be stored in a moisture-proof container.

**Q. 14.** What is a neutralisation reaction? Give two examples of such type of reactions.

**Ans.** All bases react with acids to form salt and water. Such type of reactions are called neutralisation reactions.



**Q. 15.** Give two important uses of washing soda and baking soda.

**Ans.** (i) Washing soda ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ )

Uses: (a) Softening hard water.

(b) In paper, paints and textile industries.

(ii) Baking soda ( $\text{NaHCO}_3$ )

Uses: (a) Preparation of baking powder and soda water.

(b) In fire extinguishers.

## VERY SHORT ANSWER QUESTIONS

[1 mark]

**Q. 1.** Two solutions A and B have pH values of 5 and 8 respectively. Which solution will be basic in nature?

**Ans.** Solution B

**Q. 2.** If a few drops of a concentrated acid accidentally spills over the hand of a student, what should be done? [NCERT Exemplar]

**Ans.** The hand should be washed immediately with plenty of water and a paste of sodium hydrogencarbonate (a base) must be applied to neutralise the acid.

**Q. 3.** If someone is suffering from the problem of acidity after overeating; which of the following would you suggest as a remedy?

Lemon juice, Baking soda solution or Vinegar.

**Ans.** Baking soda solution because it is basic in nature and hence neutralises the excess acid present in the stomach.

**Q. 4.** Arrange the following in the increasing order of acidic strength.

Acetic acid, water and hydrochloric acid

**Ans.** Water < acetic acid < hydrochloric acid.

**Q. 5.** Why does tooth decay start when the pH of mouth is lower than 5.5?

**Ans.** Tooth starts decaying when the pH of our mouth is lower than 5.5. This is because below this pH value, the medium of the mouth becomes more acidic due to which tooth enamel corrodes at a faster rate.

**Q. 6.** Two solutions X and Y have pH values of 3.0 and 9.5 respectively. Which of these will turn litmus solution from blue to red and which will turn phenolphthalein from colourless to pink?

**Ans.** X will turn blue litmus to red because it is acidic in nature having pH value less than 7. Y will turn phenolphthalein from colourless to pink because it is basic in nature having pH value greater than 7.

**Q. 7.** Why aqueous ammonia solution considered a base although ammonia does not contain hydroxyl ( $\text{OH}^-$ ) ion?

**Ans.** Ammonia dissolves in water as follows:



The hydroxyl ions produced in the solution are responsible for basic character of ammonia.

Q. 8. A knife, which is used to cut a fruit, was immediately dipped into water containing drops of blue litmus solution. The colour of the solution changes to red, what is the nature of the fruit?

Ans. The fruit is acidic as it turns blue litmus solution to red.

Q. 9. Explain why an aqueous solution of ammonium chloride is acidic in nature.

Ans. Ammonium chloride ( $\text{NH}_4\text{Cl}$ ) is the salt of a strong acid, hydrochloric acid ( $\text{HCl}$ ), and a weak base ammonium hydroxide ( $\text{NH}_4\text{OH}$ ), so an aqueous solution of ammonium chloride is acidic in nature.

Q. 10. What are the products formed when an acid reacts with a base? [CCE 2014]

Ans. Acid reacts with a base to form salt and water.

Q. 11. Fresh milk has a pH of 6. When it changes into curd (yogurt), will its pH value increase or decrease? Why?

Ans. When milk changes into curd (yogurt), its pH value decreases. This is because during curd formation, lactic acid is produced which makes it acidic.

Q. 12. A white chemical compound becomes hard on mixing proper quantity of water. It is also used in surgery to maintain joints in a fixed position. Name the chemical compound.

Ans. Plaster of Paris (Calcium sulphate hemihydrate).

Q. 13. Which one of these has a higher concentration of  $\text{H}^+$  ions?

1M  $\text{HCl}$  or 1M  $\text{CH}_3\text{COOH}$

Ans. 1 M  $\text{HCl}$  has a higher concentration of  $\text{H}^+$  ions because it is a stronger acid than  $\text{CH}_3\text{COOH}$ .

Q. 14. In addition to sodium hydrogencarbonate, baking powder contains a substance 'X'. Name the substance 'X'.

Ans. Tartaric acid.

Q. 15. What is the commercial name of calcium sulphate hemihydrate?

Ans. Plaster of Paris.

Q. 16. Name the substance obtained by the action of chlorine on dry slaked lime.

Ans. Bleaching powder.

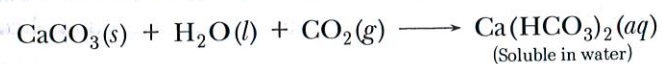
Q. 17. How many molecules of water of crystallisation are there in

(i) Plaster of Paris (ii) washing soda crystals? [CCE 2013]

Ans. (i)  $\frac{1}{2}$  (ii) 10.

Q. 18. Why does the milkiness disappear on passing excess of carbon dioxide to lime water?

Ans. When carbon dioxide is passed in excess, calcium carbonate (which appears milky) gets converted into calcium hydrogencarbonate which is soluble. Hence, the milkiness disappears.



Q. 19. An aqueous solution turns red litmus solution blue. Excess addition of which solution would reverse the change—ammonium hydroxide solution or hydrochloric acid?

Ans. Hydrochloric acid because adding excess acid to the base would turn blue litmus solution red.

Q. 20. Plaster of Paris should be stored in moisture proof container. Explain why.

Ans. Plaster of Paris reacts with moisture and gets hardened due to formation of gypsum so it is stored in moisture proof container.

Q. 21. Why is the electrolysis of a concentrated solution of sodium chloride known as chlor-alkali process?

Ans. It is because of the products formed: chlor for chlorine and alkali for sodium hydroxide.

## SHORT ANSWER QUESTIONS-I

[2 marks]

Q. 1. What is an olfactory indicator? Name two such indicators.

Ans. Those substances whose smell (or odour) changes in acidic or basic solutions are called olfactory indicators. Onion and vanilla extract are olfactory indicators.

Q. 2. Name the acid present in the following:

[CBSE Delhi 2015]

(i) Tomato (ii) Vinegar (iii) Tamarind

Ans. (i) Citric acid (ii) Acetic acid (iii) Tartaric acid

Q. 3. List in tabular form two differences between an acid and a base based on their chemical properties. [CCE 2015]

Ans.

Acids	Bases
1. $\text{H}^+$ ions are released in aqueous solution.	1. $\text{OH}^-$ ions are released in aqueous solution.
2. Reacts with metal carbonates to liberate $\text{CO}_2$ gas.	2. No reaction takes place with metal carbonates.

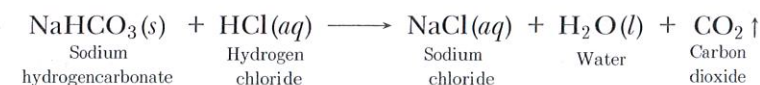
Q. 4. What happens when a cold and concentrated solution of sodium chloride reacts with ammonia and carbon dioxide? Write the equation of the reaction which takes place.

Ans. When a cold and concentrated solution of sodium chloride reacts with ammonia and carbon dioxide, sodium hydrogencarbonate (baking soda) and ammonium chloride is formed.

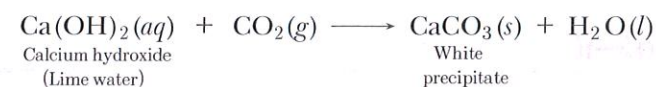


Q. 5. Name the gas evolved when dilute  $\text{HCl}$  reacts with sodium hydrogen carbonate. How is it recognised?

Ans.  $\text{CO}_2$  gas is evolved. The reaction is as follows:



When the produced gas is passed through lime water, lime water turns milky which confirms that the evolved gas is  $\text{CO}_2$ .



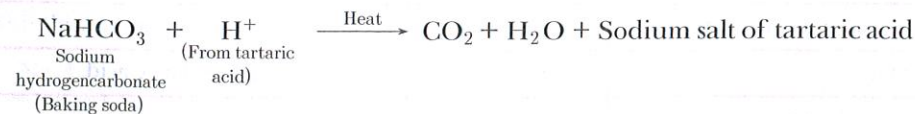
Q. 6. The pH of soil A is 7.5 while that of soil B is 4.5. Which of the two soils should be treated with powdered chalk to adjust its pH and why?

Ans. Soil B having pH 4.5 should be treated with powdered chalk to adjust its pH. Soil B is too acidic. Its acidity can be reduced by adding powdered chalk ( $\text{CaCO}_3$ ), which is a base.

Q. 7. What is 'baking powder'? How does it make the cake soft and spongy?

Ans. Baking powder is a mixture of baking soda ( $\text{NaHCO}_3$ ) and an edible acid like tartaric acid.

Baking powder on heating produces carbon dioxide gas which causes bread or cake to rise making it soft and spongy.



Q. 8. The conditions preferred by some plants are shown in the table below:

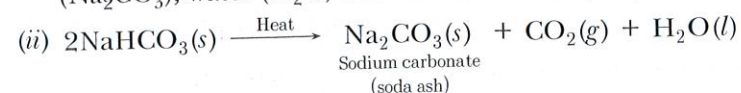
Plant	Apple	Potato	Black currant	Mint	Onion	Strawberry	Lettuce
pH	5.0–6.5	4.5–6.0	6.0–8.0	7.0–8.0	6.0–7.0	5.0–7.0	6.0–7.0

- (a) Which plants grow well over the largest range of pH values?  
 (b) Which plant can grow in the most acidic soil?  
 (c) Which plant can grow in the basic soil only?  
 (d) What is the pH range for onion to grow well?

Ans. (a) Black currant and strawberry  
 (b) Potato (4.5 – 6.0)  
 (c) Mint (7.0 – 8.0)  
 (d) 6.0 – 7.0

Q. 9. (i) Name the products formed when sodium hydrogencarbonate is heated.  
 (ii) Write the chemical equation for the reaction involved in it.

Ans. (i) On heating sodium hydrogencarbonate (NaHCO<sub>3</sub>), it decomposes to form sodium carbonate (Na<sub>2</sub>CO<sub>3</sub>), water (H<sub>2</sub>O) and carbon dioxide (CO<sub>2</sub>).

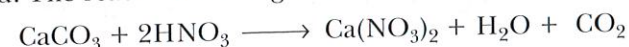


Q. 10. Name the acid present in an ant sting and give its chemical formula. Also give the common method to get relief from the discomfort caused by the ant sting. [NCERT Exemplar]

Ans. The acid present in an ant sting is methanoic acid (formic acid). The chemical formula is HCOOH. To get relief, one should apply any available basic salt, e.g., baking soda (NaHCO<sub>3</sub>) on it.

Q. 11. What happens when nitric acid is added to an eggshell? [NCERT Exemplar]

Ans. Eggshells contain calcium carbonate. When nitric acid is added to it, carbon dioxide gas is evolved. The reaction can be given as



## SHORT ANSWER QUESTIONS-II

[3 marks]

Q. 1. What will be the action of the following substances on litmus paper?

Dry HCl gas, Moistened NH<sub>3</sub> gas, Lemon juice, Carbonated soft drink, Curd, Soap solution. [NCERT Exemplar]

Ans.

Substance	Action on Litmus Paper
Dry HCl gas	No change
Moistened NH <sub>3</sub> gas	Turns red to blue as it is basic.
Lemon juice	Turns blue to red because it contains citric acid.
Carbonated soft drink	Turns blue to red because it contains carbonic acid.
Curd	Turns blue to red because it contains lactic acid.
Soap solution	Turns red to blue as it is basic.

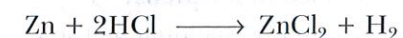
Q. 2. A student prepared solutions of (i) an acid and (ii) a base in two separate beakers. She forgot to label the solutions and litmus paper is not available in the laboratory. Since both the solutions are colourless, how will she distinguish between the two? [NCERT Exemplar]

Ans. In the absence of litmus paper, any indicator like methyl orange, phenolphthalein can be used. Natural indicator like turmeric can also be used.

Indicator	Colour in acidic solution	Colour in basic solution
Methyl Orange	Pinkish red	Yellow
Phenolphthalein	Colourless	Pink
Turmeric	Yellow	Reddish brown

Q. 3. When zinc metal is treated with a dilute solution of a strong acid, a gas is evolved, which is utilised in the hydrogenation of oil. Name the gas evolved. Write the chemical equation of the reaction and also write a test to detect the gas formed. [NCERT Exemplar]

Ans. When zinc reacts with dilute solution of strong acid, it forms salt and hydrogen gas is evolved.



When a burning splinter is brought near the mouth of the test tube, the gas burns with a pop sound.

Q. 4. Which acid is produced in our stomach? What happens if there is an excess of acid in the stomach? How can its effect be cured? [CCE 2014]

Ans. Hydrochloric acid is produced in our stomach. The excess acid in the stomach causes indigestion which produces pain and irritation. This effect can be cured by using antacids. Antacids (a group of mild bases) react with excess acid in the stomach and neutralise it.

Q. 5. To the three solutions listed below, a few drops of phenolphthalein and blue litmus were added separately. Specify the colour change in each case, if any:

Name of the solution	Colour change with phenolphthalein	Colour change with blue litmus
(a) Sodium carbonate		
(b) Hydrochloric acid		
(c) Sodium chloride		

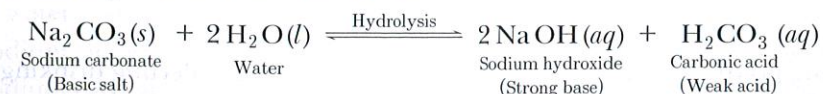
Ans.

Name of the solution	Colour change with phenolphthalein	Colour change with blue litmus
(a) Sodium carbonate	Turns pink	No change
(b) Hydrochloric acid	No change	Turns red
(c) Sodium chloride	No change	No change

Q. 6. A salt X when dissolved in distilled water gives a clear solution which turns red litmus blue. Explain this phenomenon.

Ans. Basic solutions turn red litmus paper blue. The salt of a weak acid and a strong base gives a basic solution. So, the given salt X is the salt of a weak acid and a strong base.

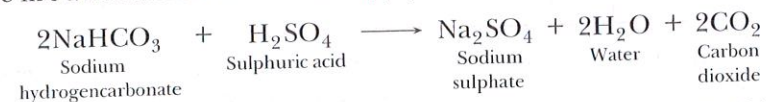
Example: When sodium carbonate is dissolved in water, it gets hydrolysed to some extent and forms sodium hydroxide and carbonic acid.



Being a strong base, sodium hydroxide is fully ionised and gives a large amount of hydroxide ions ( $\text{OH}^-$ ). Carbonic acid is a weak acid which is only slightly ionised and hence, gives a small amount of hydrogen ions ( $\text{H}^+$ ). The  $\text{H}^+$  ions produced by carbonic acid neutralises only a small amount of  $\text{OH}^-$  ions produced by sodium hydroxide and the rest amount of  $\text{OH}^-$  ions are present in the solution. Hence, the  $\text{Na}_2\text{CO}_3$  solution is basic in nature. It turns red litmus blue.

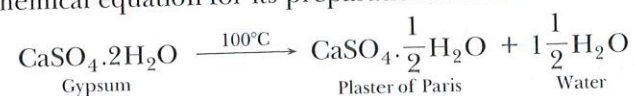
**Q. 7. With the help of a chemical equation, explain how a soda-acid fire extinguisher helps in putting out a fire.**

**Ans.** Soda-acid fire extinguisher contains sodium bicarbonate and sulphuric acid, which are in separate containers in them. When knob of the fire extinguisher is pressed, then sulphuric acid mixes with sodium bicarbonate solution and produces a lot of  $\text{CO}_2$  gas, which forms a blanket over the fire and cuts it off from the supply of the air to the burning substance and the fire stops.



**Q. 8. A compound which is prepared from gypsum has the property of hardening when mixed with a proper quantity of water. Identify the compound. Write the chemical equation for its preparation. For what purpose is it used in hospitals?**

**Ans.** The compound prepared from gypsum on heating it at  $100^\circ\text{C}$ , is known as Plaster of Paris. Its chemical formula is  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ . Hence, its chemical name is calcium sulphate hemihydrate. The chemical equation for its preparation is as follows:

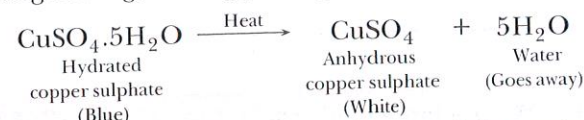


Plaster of Paris is used in hospitals mainly as plaster for supporting fractured bones in the right position. In dentistry, it is used for making casts.

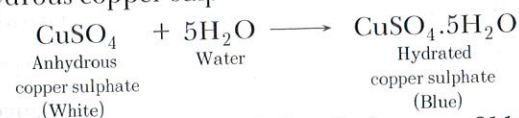
**Q. 9. What is meant by water of crystallisation? Explain that the crystalline salts contain water of crystallisation.** [CBSE Delhi 2016]

**Ans.** Water of crystallisation is a fixed number of water molecules present in one formula unit of a salt. One formula unit of copper sulphate contains five water molecules ( $5\text{H}_2\text{O}$ ). The water molecules which form part of the structure of a crystal are called water of crystallisation. When hydrated salts are heated strongly, they lose their water of crystallisation.

On strong heating, blue copper sulphate crystals turn white (due to the loss of water of crystallisation).

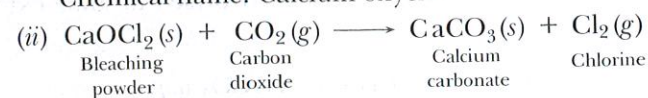


Anhydrous copper sulphate turns blue on adding water.



**Q. 10. (i) Write the formula and chemical name of bleaching powder.  
(ii) Write the chemical equation to represent the action of atmospheric  $\text{CO}_2$  gas on bleaching powder when left exposed in open.  
(iii) State for what purpose is bleaching powder used in water treatment plants.**

**Ans. (i)** Chemical formula:  $\text{CaOCl}_2$   
Chemical name: Calcium oxychloride



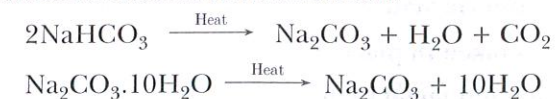
**(iii)** Bleaching powder is used in water treatment plants for disinfecting drinking water to make it free of germs.

**Q. 11. How would you distinguish between baking powder and washing soda by heating?**

[NCERT Exemplar]

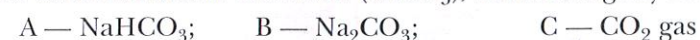
**Ans.** The chemical formula of baking powder is sodium hydrogencarbonate ( $\text{NaHCO}_3$ ); whereas, that of washing soda is sodium carbonate ( $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$ ).

Sodium hydrogencarbonate on heating gives  $\text{CO}_2$  gas which will turn lime water milky whereas no such gas is obtained from sodium carbonate.



**Q. 12. Salt A commonly used in bakery products on heating gets converted into another salt B which itself is used for removal of hardness of water and a gas C is evolved. The gas C when passed through lime water, turns it milky. Identify A, B and C.** [NCERT Exemplar]

**Ans.** Baking powder ( $\text{NaHCO}_3$ ), salt A is commonly used in bakery products. On heating, it forms sodium carbonate ( $\text{Na}_2\text{CO}_3$ ), B and  $\text{CO}_2$  gas, C is evolved. When  $\text{CO}_2$  gas is passed through lime water it forms calcium carbonate ( $\text{CaCO}_3$ ), which is slightly soluble in water making it milky.



**Q. 13. What are strong and weak acids? In the following list of acids, separate strong acids from weak acids: Hydrochloric acid, citric acid, acetic acid, nitric acid, formic acid, sulphuric acid.**

[NCERT Exemplar]

**Ans.** In aqueous solutions, strong acids ionise completely and provide high concentration of hydronium ions. On the other hand, weak acids are partially ionised and an aqueous solution of same molar concentration provides a much smaller concentration of  $\text{H}_3\text{O}^+$  ions.

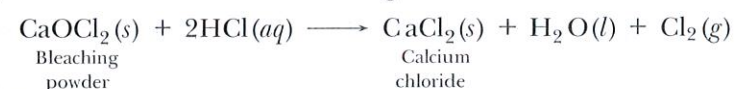
Strong acids—Hydrochloric acid, sulphuric acid, nitric acid.

Weak acids—Citric acid, acetic acid, formic acid.

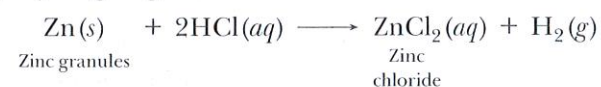
**Q. 14. What happens when dilute hydrochloric acid is added to the following and write balanced chemical equations**

(i) Bleaching powder (ii) Zinc granules (iii) Baking soda [CCE 2016]

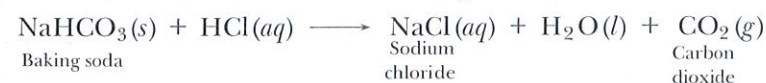
**Ans. (i)** Calcium chloride and chlorine gas are formed.



(ii) Hydrogen gas is evolved.



(iii) Sodium chloride and carbon dioxide gas are formed.



**Q. 15. Give suitable reason for the following statements:**

(i) We feel burning sensation in the stomach when we overeat.

(ii) The crystals of washing soda change to white powder on exposure to air.

(iii) An aqueous solution of sodium chloride is neutral but an aqueous solution of sodium carbonate is basic. [CCE 2016]

**Ans. (i)** When we overeat excess of acid is produced in the stomach which causes burning sensation.

(ii) Washing soda is sodium carbonate decahydrate which when exposed to air loses 10 molecules of water and changes to white powder.

(iii) Sodium chloride is a salt of strong acid  $\text{HCl}$  and strong base  $\text{NaOH}$ , so it is neutral. Sodium carbonate is a salt of weak acid  $\text{H}_2\text{CO}_3$  and strong base  $\text{NaOH}$ , so it is basic.

## LONG ANSWER QUESTIONS

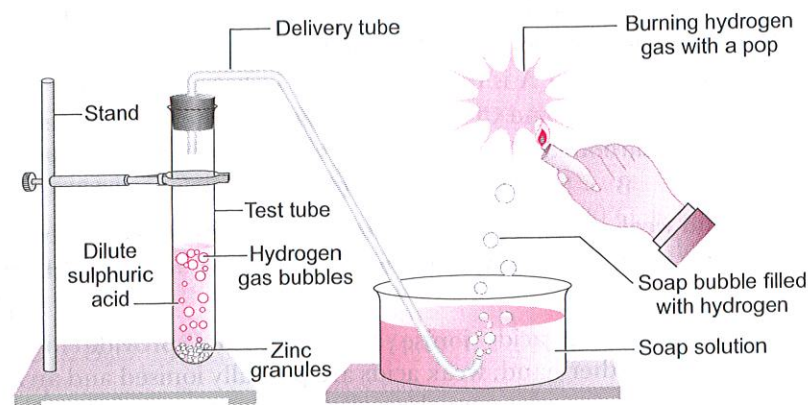
[5 marks]

Q. 1. (i) In the following schematic diagram for the preparation of hydrogen gas as shown in figure, what would happen if following changes are made?

- In place of zinc granules, same amount of zinc dust is taken in the test tube.
- Instead of dilute sulphuric acid, dilute hydrochloric acid is taken.
- Sodium hydroxide is taken in place of dilute sulphuric acid and the tube is heated.

(ii) How do metal carbonates and metal hydrogencarbonates react with acids?

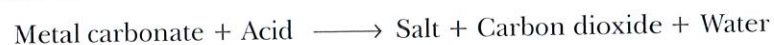
[NCERT Exemplar]



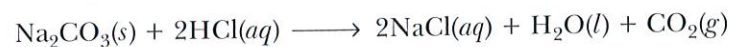
- Ans. (i) (a) Hydrogen gas will evolve with greater speed.  
 (b) Almost same amount of gas is evolved.  
 (c) If sodium hydroxide is taken, hydrogen gas will be evolved.



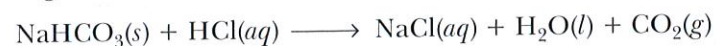
(ii) All metal carbonates and hydrogencarbonates react with acids to form a corresponding salt, carbon dioxide and water.



For example, sodium carbonate reacts with dilute hydrochloric acid as follows:



Sodium hydrogencarbonate reacts with dilute hydrochloric acid as follows:

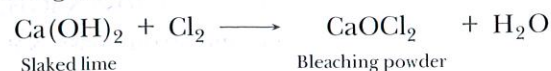


Q. 2. A metal carbonate X on reacting with an acid gives a gas which when passed through a solution Y gives the carbonate back. On the other hand, a gas G that is obtained at anode during electrolysis of brine is passed on dry Y, it gives a compound Z, used for disinfecting drinking water. Identify X, Y, G and Z.

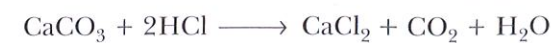
[NCERT Exemplar]

Ans. The gas evolved at anode during electrolysis of brine is chlorine (G).

When chlorine gas is passed through dry  $\text{Ca}(\text{OH})_2$  (Y) produces bleaching powder (Z) used for disinfecting drinking water.



Since Y and Z are calcium salts, therefore X is also a calcium salt and is calcium carbonate.



Q. 3. Write the formulae of the salts given below.

Potassium sulphate, sodium sulphate, calcium sulphate, magnesium sulphate, copper sulphate, sodium chloride, sodium nitrate, sodium carbonate and ammonium chloride.

Identify the acids and bases from which the above salts may be obtained. How many families can you identify among these salts?

Ans. The formulae of the given salts and the acids and bases from which these salts may be obtained are given in the following table.

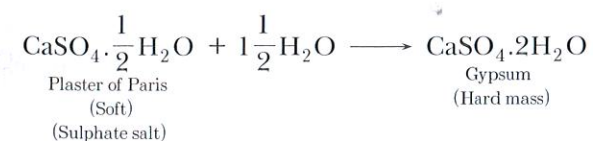
S.No.	Salts	Formula	Family	Acid and Base
1.	Potassium sulphate	$\text{K}_2\text{SO}_4$	Potassium salts	$\text{H}_2\text{SO}_4$ and $\text{KOH}$
2.	Sodium sulphate	$\text{Na}_2\text{SO}_4$	Sodium salts	$\text{H}_2\text{SO}_4$ and $\text{NaOH}$
3.	Calcium sulphate	$\text{CaSO}_4$	Calcium salts	$\text{H}_2\text{SO}_4$ and $\text{Ca}(\text{OH})_2$
4.	Magnesium sulphate	$\text{MgSO}_4$	Magnesium salts	$\text{H}_2\text{SO}_4$ and $\text{Mg}(\text{OH})_2$
5.	Copper sulphate	$\text{CuSO}_4$	Copper salts	$\text{H}_2\text{SO}_4$ and $\text{Cu}(\text{OH})_2$
6.	Sodium chloride	$\text{NaCl}$	Chloride salts	$\text{HCl}$ and $\text{NaOH}$
7.	Sodium nitrate	$\text{NaNO}_3$	Nitrate salts	$\text{HNO}_3$ and $\text{NaOH}$
8.	Sodium carbonate	$\text{Na}_2\text{CO}_3$	Carbonate salts	$\text{H}_2\text{CO}_3$ and $\text{NaOH}$
9.	Ammonium chloride	$\text{NH}_4\text{Cl}$	Chloride salts	$\text{HCl}$ and $\text{NH}_4\text{OH}$

Q. 4. A sulphate salt of Group 2 element of the Periodic Table is a white, soft substance, which can be moulded into different shapes by making its dough. When this compound is left in open for some time, it becomes a solid mass and cannot be used for moulding purposes. Identify the sulphate salt and state why does it show such a behaviour. Give the reaction involved.

[NCERT Exemplar]

Ans. The substance which is used for making different shapes is Plaster of Paris. Its chemical name is calcium sulphate hemihydrate ( $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$ ). The two formula unit of  $\text{CaSO}_4$  share one molecule of water. As a result, it is soft.

When it is left open for some time, it absorbs moisture from the atmosphere and forms gypsum, which is a hard solid mass.



## HOTS (Higher Order Thinking Skills)

**Q. 1.** Why is acetic acid called a weak acid though there are four hydrogen atoms in the molecule?

**Ans.** Though acetic acid has four hydrogen atoms, only one of the four hydrogen atoms is released as  $H^+$  ion in solution. So, it is a weak acid.

**Q. 2.** In one of the industrial processes used for manufacture of sodium hydroxide, a gas X is formed as by-product. The gas X reacts with lime water to give a compound Y which is used as a bleaching agent in chemical industry. Identify X and Y giving the chemical equation of the reactions involved. [NCERT Exemplar]

**Ans.** In the manufacture of sodium hydroxide, hydrogen gas and chlorine gas (X) are formed as by-products. When chlorine gas (X) reacts with lime water, it forms calcium oxychloride (bleaching powder) Y. The reactions are



X —  $Cl_2$  (Chlorine gas)



Lime water

Y — Calcium oxychloride (bleaching powder)

**Q. 3.** A baker found that the cake prepared by him is hard and small in size. Which ingredient do you think that he might have forgotten to add that would have caused the cake to rise and become light? Give reason.

**Ans.** The baker might have forgotten to add baking powder. Baking powder is a mixture of baking soda (sodium hydrogencarbonate) and a mild edible acid such as tartaric acid. When this baking powder is added with water, then sodium hydrogencarbonate ( $NaHCO_3$ ) reacts with tartaric acid to evolve carbon dioxide gas. This  $CO_2$  gas causes the cake to rise and become soft and spongy.

**Q. 4.** A dry pellet of a common base B, when kept in open absorbs moisture and turns sticky. The compound is also a by-product of chlor-alkali process. Identify B. What type of reaction occurs when B is treated with an acidic oxide? Write a balanced chemical equation for one such solution. [NCERT Exemplar]

**Ans.** Sodium hydroxide ( $NaOH$ ) is a commonly used base and is hygroscopic, that is, it absorbs moisture from the atmosphere and becomes sticky.

The acidic oxides react with base to give salt and water. The reaction between  $NaOH$  and  $CO_2$  can be given as



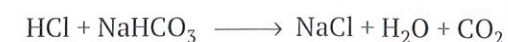
**Q. 5.** A compound 'A' is used in fire extinguishers, as an antacid and its small amount is also used in making bakery items. Identify the compound and also explain the reason for above mentioned uses of the compound 'A'.

**Ans.** Compound 'A' is sodium hydrogencarbonate— $NaHCO_3$ .

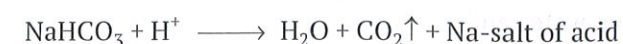
(i) It is used in fire extinguishers because it produces  $CO_2$  gas on reaction with acid.



(ii) It is used as an antacid because it neutralises excess acid ( $HCl$ ) present in stomach.



(iii) It is used in making bakery items because on reaction with acid it produces  $CO_2$  gas which makes bread, cakes, etc., soft and spongy.



## Proficiency Exercise

### Very Short Answer Questions

[1 mark]

1. What are indicators? Give two examples each of natural and artificial indicators.
2. Write the common name of  $CaOCl_2$ .
3. Name the gas evolved when  $NaOH$  reacts with zinc.
4. Why are toothpaste basic in nature?
5. Name the acid present in an ant sting.
6. Aqueous solution of an acid conducts electricity. Give reason.

### Short Answer Questions—I

[2 marks]

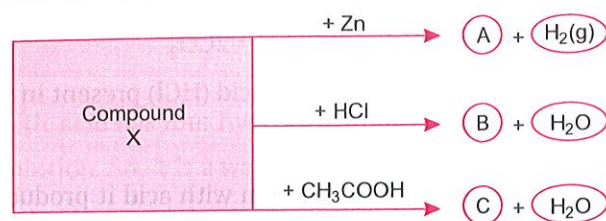
7. Effervescences are formed when the batter for cake is heated. Which substance is present in batter? Name the gas evolved. Write the chemical equation involved.
8. What is universal indicator? Give its use.
9. While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid?
10. Write the name and formula of each of the following
  - (a) an acidic salt
  - (b) a basic salt.
11. Justify the statement 'plants and animals are pH sensitive' by giving two examples.

### Short Answer Questions—II

[3 marks]

12. What are the products formed when an acid reacts with a base? What is the type of reaction? Give one example and name the salt obtained.

13. Identify the compound X on the basis of the reactions given below. Also, write the name and chemical formulae of A, B and C.



[NCERT Exemplar]

14. A gas X reacts with lime water and forms a compound Y which is used as a bleaching agent in chemical industry. Identify X and Y. Give the chemical equation of the reaction involved.
15. (a) A solution has a pH of 7 (seven). Explain how you would
- increase its pH
  - decrease its pH
- (b) What can you say about the pH of a solution that liberate CO<sub>2</sub> from sodium carbonate? Write the balanced chemical equation for the reaction.
16. Fill in the missing data in the given table:

	Name of the Salt	Formula	Salt obtained from	
			Base	Acid
(i)	Ammonium chloride	NH <sub>4</sub> Cl	NH <sub>4</sub> OH	—
(ii)	Copper sulphate	—	—	H <sub>2</sub> SO <sub>4</sub>
(iii)	Sodium chloride	NaCl	NaOH	—
(iv)	Magnesium nitrate	Mg(NO <sub>3</sub> ) <sub>2</sub>	—	HNO <sub>3</sub>
(v)	Potassium sulphate	K <sub>2</sub> SO <sub>4</sub>	—	—
(vi)	Calcium nitrate	Ca(NO <sub>3</sub> ) <sub>2</sub>	Ca(OH) <sub>2</sub>	—

[NCERT Exemplar]

### Long Answer Questions

[5 marks]

17. (a) You are provided with three test tubes A, B, C which contain distilled water, acidic and basic solutions. If you are given blue litmus paper only, how will you identify the nature of the solutions in three test tubes?
- (b) How will you prove that a given salt is a carbonate of a metal?
18. (a) For each of the compound A and B, suggest a suitable method of its preparation along with the balanced chemical equations.
- A is bleaching powder
  - B is gypsum
- (b) Mention two uses of bleaching powder.

19. A compound 'X' is bitter to taste. It is a compound of washing powder and reacts with dilute HCl to produce brisk effervescence due to a colourless and odourless gas 'Y' which turns lime water milky due to the formation of 'Z' when excess of CO<sub>2</sub> is passed, milkiness disappears due to formation of 'P'. Identify 'X', 'Y', 'Z' and 'P'. Write the equations involved in the formation of Y, Z and P.

20. For making cake, baking powder is taken. If at home your mother uses baking soda instead of baking powder in cake.

- How will it affect the taste of the cake and why?
- How can baking soda be converted into baking powder?
- What is the role of tartaric acid added to baking soda?

[NCERT Exemplar]

