## CHAPTER – 2

# ACIDS, BASES AND SALTS

| Acids | Bases |
|---|---|
| – Sour in taste | – Bitter in taste |
| – Change the blue litmus to red | – Change red litmus to blue |
| – eg. Hydrochloric Acid HCl | eg. Sodium hydroxide NaOH |
| – Sulphuric Acid $H_2SO_4$ | Potassium hydroxide KOH |
| – Nitric Acid $HNO_3$ | Calcium hydroxide $Ca(OH)_2$ |
| – Acetic Acid $CH_3$ COOH | – Ammonium hydroxide $NH_4OH$ |

Some Naturally occuring 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 Acid |

Acid – Base Indicators – Indicate the presence of an acid or base in a solution.

Litmus solution – It is a natural indicator. It is a purple day 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. eg. 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 : Contains only a small amounts of acid and a large amount of water.

Concentrated Acid : A concentrated acid contains a large amount of acid and a small amount of water.

**Chemical Properties of Acids and Bases**

Acid + Metal $\longrightarrow$ Salt + Hydrogen

(Refer activity 2.3 on page No. 19 of NCERT Book)

$2HCl + Zn \longrightarrow ZnCl_2 + H_2$

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

$H_2SO_4 + Zn \longrightarrow ZnSO_4 + H_2$

$2CH_3COOH + Zn \longrightarrow (CH_3COO)_2 Zn + H_2$

**Pop test :** When a buring 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 $\longrightarrow$ Salt + Hydrogen

$NaOH + Zn \longrightarrow Na_2ZnO_2 + H_2$

Sodium Zincate

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

**Action of Acids with metal Carbonates and metal bicarbonates**

Metal Carbonate + Acid $\longrightarrow$ Salt + Carbondioxide + Water

$Na_2CO_{3(s)} + 2HCl_{(aq)} \longrightarrow 2NaCl_{(aq)} + H_2O(l) + CO_{2(g)}$

Metal bicarbonate + Acid $\longrightarrow$ Salt + Carbondioxide + Water

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

**Lime water Test :** On passing the $CO_2$ gas evolved through lime water,

$Ca(OH)_2$ (aq) + $CO_{2(g)} \longrightarrow CaCO_{3(s)} + H_2O(l)$

Lime water — White precipitate

On passing excess $CO_2$ the following reaction takes place

$CaCO_{3(s)} + H_2O_{(l)} + CO_{2(g)} \longrightarrow Ca(HCO_3)_2$ aq

Soluble in water

**Neutralisation Reactions**

Base + Acid $\longrightarrow$ Salt + Water

$NaOH_{(aq)} + HCl_{(aq)} \longrightarrow NaCl_{(aq)} + H_2O(l)$

**Neutralisation reacton** takes place when the effect of a base is nullified by an acid and vice versa to give salt and water.

**Reactions of metal oxides with acids**

Metal Oxide + Acid $\longrightarrow$ Salt + Water

| $CuO$ + | $HCl \longrightarrow$ | $CuCl_2$ + $H_2O$ |
|---|---|---|
| Copperoxide | Hydrochloric acid | Copper chloride + Water |

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

Metallic oxides are said to be basic oxides because they give salt and water on reacting with acids.

**Reaction of Non Metallic Oxide with Base**

Non metallic oxide + Base $\longrightarrow$ Salt + Water

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

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

Refer activity 2.3 on page 22 of NCERT Book

– 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

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

$H_3O^+$ – Hydronium ion.

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

$$H^+ + H_2O \longrightarrow H_3O^+$$

– Bases provide $(OH^-)$ 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 donot dissolve in water. An alkali is a base that dissolves in water. Common alkalis are

NaOH Sodium hydroxide

KOH Potassium hydroxide

$Ca(OH)_2$ Calcium hydroxide

$NH_4OH$ : 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 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 $H_3O+$ or $OH^-$ per unit volume in acids and bases respectively.

**Strength of an Acid or Base**

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

With the help of a universal indicator we can find the strength of an acid or base. This indicator is called PH scale.

pH = Potenz in German means power.

This scale measures from 0 (very acidic) to 14 (very alkaline) 7 Neutral (water in Neutral).

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

Variation of PH

| S. No. | PH Value | Colour of the pH Paper | Nature of Solution | $H^+$ion Conc. | $OH^-$ion Conc. |
|---|---|---|---|---|---|
| 1. | 0 | Dark red | Highly acidic | very high | very low |
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– strong Acids give rise to more $H^+$ions.

eg. HCl, $H_2SO_4$ and $HNO_3$.

– Weak Acids give rise to less $H^+$ ions

eg. $CH_3$ COOH, $H_2$ $CO_3$ (Carbonic acid)

– Strong Bases – Strong bases give rise to more $OH^-$ ions.

eg. NaOH, KOH, $Ca(OH)_2$

– Weak Bases : give rise to less $OH^-$ ions.

eg. $NH_4OH$

**More about Salts**

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 $Na_2 SO_4$ belong to the family of sodium salts as they have the same radicals. Similarly NaCl and KCl belong to the family of chloride salts.

**Importance of pH in our daily life**

Importance of pH in our digestive system – pH level of our body regulates our digestive system. In case of indigestion our stomach produces acid in a very large quantity because of which we feel pain and irritation in our stomach. To get relief from this pain antacids are used. These antacids neutralises the excess acid and we get relief.

pH of Acid Rain : When pH of rain water is less than 5.6 it is called Acid Rain.When this acidic rain flows into rivers these also get acidic, which causes a threat to the survival of aquatic life.

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 than the farmers add suitable fertilizers to it.

Our body functions between the 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 produce acids by degredation of sugar and food particles remaining in the mouth. 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. When we use a weak base like baking soda on it we get relief.

**Neutral Salts :** Strong Acid + Strong base

pH value is 7

eg. NaCl, $CaSO_4$

**Acidic Salts :** Strong Acid + weak base

pH value is less than 7

eq. $NH_4Cl$, $NH_4\ NO_3$

**Basic Salts :** Strong base + weak acid

pH value is more than 7

eg. $CaCO_3$, $CH_3$ COONa

**Chemicals from Common Salt**

– Sodium chloride is called as common salt used in our food. It is derived from seawater.

– Rock Salt is the brown coloured large crystals. This s mined like coal.

– Common Salt is an important raw material for many materials of daily use such as.

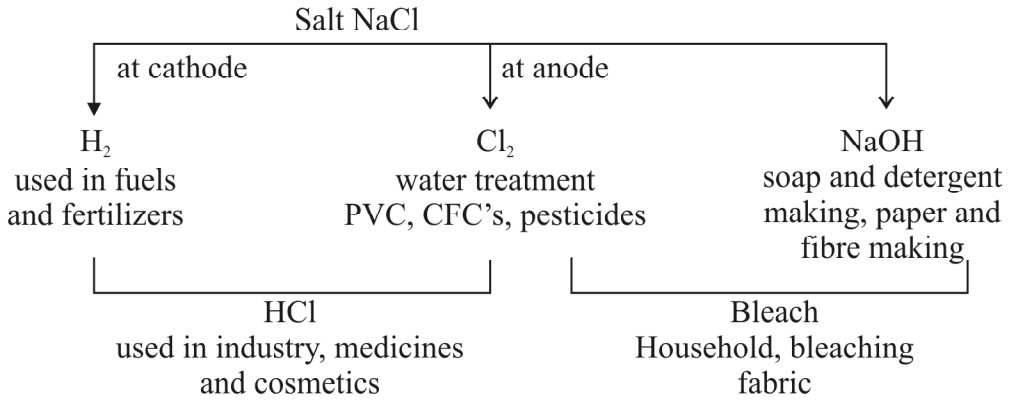
Sodium hydroxide
Washing Soda
Bleaching Power.

**Sodium Hydroxide**

**Preparation :** Prepared by the method called chlor-alkali

Called chlor-alkali because we get chlorine and a base in this.

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



Bleaching Power

Preparation $\longrightarrow$ $Ca(OH)_2$ + $Cl_2$ $\longrightarrow$ $CaOCl_2$ + $H_2O$

calcium hydroxide; chlorine; bleaching power; water

uses in textile, factories and laundry, used as disinfectant

Baking Soda

– Common name – Sodium Hydrogen Carbonate

Preparation $NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$

Sodium chloride; Water; Carbon dioxide; Ammonia; Sodium hydrogen carbonate

On heating $NaHCO_3$ produces :

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

$CO_2$ produced causes dough to rise and make cakes, pastries spongy.

Uses : In household, ingredients of antacid

In making baking power

On heating baking powder produces

$NaHCO_3 + H^+ \longrightarrow CO_2 + H_2O$ + Sodium Salt of acid

Washing Soda

Preparation : Recrystallisation of sodium carbonate

$$Na_2CO_3 + 10H_2O \xrightarrow{Heat} Na_2CO_3.\ 10H_2O$$

Uses

– Used in glass, soap and paper industry
– Cleaning agent for domestic purposes.
– Removal of hardness of water.
– Manufacturere of borax.

Water of crystallisation : Fixed no. of water molecules present in one formula unit of a salt.

– On heating copper sulphate crystals water droplets appear, formula of hydrated copper sulphate – $CuSO_4.\ 5H_2O$.

- gypsum also contains water of crystallisation.
- Formula of gypsum – $CaSO_4.2H_2O$
- On heating gypsum at 373k it becomes $CaSO_4.½H_2O$ is plaster of paris.
- Plaster of Paris is used as plaster for fractured bones.
- When plaster of Paris is mixed with water it changes to gypsum.

$$CaSO_4.½\ H_2O + 1½\ H_2O \longrightarrow CaSO_4.2H_2O$$

Uses of plaster of Paris : Making toys, decorative material and smooth surfaces.

# EXERCISE
## (Question Bank)

**Very Short answer type questions** **(1 mark)**

1. Two solution have pH number 4 and 9 respectively which solution has more $H^+$ ion concentration?
2. Why should cured and sour substances not be kept in brass and copper vessel?
3. What is the chemical name of bleaching powder?
4. Write down the molecular formula for one strong and one weak acid.
5. Explain why plaster of Paris should be stored in a moisture proof container?
6. Name the gas evolved when dil. sulphuric acid acts on sodium carbonate.
7. What is the use of common salt in soap industry?
8. What do you observe when a buring candle is brought near the testube containing hydrogen gas?
9. Name the indicator used to measure pH values over the whole range.
10. Write the formula of washing powder.

**Short Answer Type Questions** **(2 marks)**

1. Write two physical properties of an acid
2. Complete the reaction $CaCO_3 + H_2O \longrightarrow$ name the products formed.

3. A testtube contains solution of NaOH and Phenolphthalein. Why the colour of the solution changes when HCl in added to it.

4. Why metallic oxides are called as basic oxides and non-metallic oxides are calles acidic oxides?

5. In a beakey a solution of HCl is poured and an electric circuit containing bulb is placed systemtically. What happens to the bulb and why?

   What will happen if HCl is repplaced by NaOH?

6, Identify the type of reaction

   H X + M OH $\longrightarrow$ MX + HOH

7. Why all bases are not alkalies but all alkalis are bases?

**Answer the following questions in detail** **(3 marks)**

1. What is acid rain? What is its pH? How does it affect the aquatic life?

2. What happens when a metal react with dilute hydrochloric acid? Write the reaction

   © NaOH + Zn $\longrightarrow$ _____ + _____.

3. What happens when an acid or a base is added to the water? Why does the beaker appear warm? Why should we always add acid or base to the water and not water to the acid or base.

**Answer the following question in detail** **(5 marks)**

1. (a) Write down five products formed with the help of common salt on industrial level.

   (b) Write down the chemical name of these compounds and one use of each of them.

2. Fill in the blanks

   a) Acid + _____ $\longrightarrow$ Salt + Water.

   b) _____ + Metal $\longrightarrow$ Salt + _____

   c) Metal carbonate / metal hydrogen carbonate + acid

   $\longrightarrow$ _____ + _____ + _____.

   d) NaOH $\xrightarrow{H_2O}$ _____ + _____

   e) $Na_2CO_3 + 10H_2O \longrightarrow$ _____.

## CHAPTER – 2

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Some Naturally occuring acids

| | | |
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| Orange | – | Citric Acid |
| Lemon | – | Citric Acid |
| Tamarind | – | Tartaric Acid |
| Tomato | – | Oxalic Acid |
| Sour milk (Curd) | – | Lactic Acid |
| Ant and Nettle sting | – | Methanoic Acid |

Acid – Base Indicators – Indicate the presence of an acid or base in a solution.

Litmus solution – It is a natural indicator. It is a purple day extracted from Lichens. Other examples are Red Cabbage and coloured petals of Petunia and turmeric.

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(Refer activity 2.3 on page No. 19 of NCERT Book)

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

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Soluble in water

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

Metallic oxides are said to be basic oxides because they give salt and water on reacting with acids.

**Reaction of Non Metallic Oxide with Base**

Non metallic oxide + Base $\longrightarrow$ Salt + Water

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

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

Refer activity 2.3 on page 22 of NCERT Book

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

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– Bases provide $(OH^-)$ ions in the presence of water

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

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

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

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– strong Acids give rise to more $H^+$ions.

eg. HCl, $H_2SO_4$ and $HNO_3$.

– Weak Acids give rise to less $H^+$ ions

eg. $CH_3$ COOH, $H_2$ $CO_3$ (Carbonic acid)

– Strong Bases – Strong bases give rise to more $OH^-$ ions.

eg. NaOH, KOH, $Ca(OH)_2$

– Weak Bases : give rise to less $OH^-$ ions.

eg. $NH_4OH$

**More about Salts**

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 $Na_2 SO_4$ belong to the family of sodium salts as they have the same radicals. Similarly NaCl and KCl belong to the family of chloride salts.

**Importance of pH in our daily life**

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**Neutral Salts :** Strong Acid + Strong base

pH value is 7

eg. NaCl, $CaSO_4$

**Acidic Salts :** Strong Acid + weak base

pH value is less than 7

eq. $NH_4Cl$, $NH_4\ NO_3$

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pH value is more than 7

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**Chemicals from Common Salt**

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– Rock Salt is the brown coloured large crystals. This s mined like coal.

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**Sodium Hydroxide**

**Preparation :** Prepared by the method called chlor-alkali

Called chlor-alkali because we get chlorine and a base in this.

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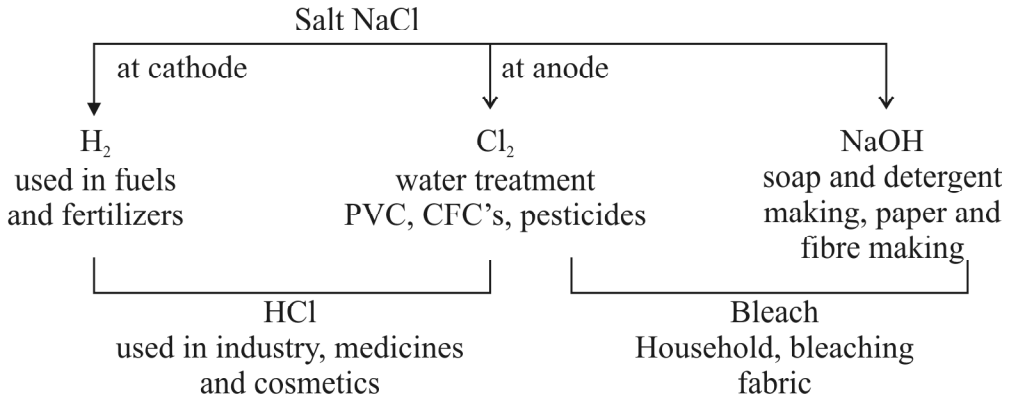

Bleaching Power

Preparation $\longrightarrow$ $Ca(OH)_2$ + $Cl_2$ $\longrightarrow$ $CaOCl_2$ + $H_2O$

calcium hydroxide; chlorine; bleaching power; water

uses in textile, factories and laundry, used as disinfectant

Baking Soda

– Common name – Sodium Hydrogen Carbonate

Preparation $NaCl + H_2O + CO_2 + NH_3 \longrightarrow NH_4Cl + NaHCO_3$

Sodium chloride; Water; Carbon dioxide; Ammonia; Sodium hydrogen carbonate

On heating $NaHCO_3$ produces :

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

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Uses : In household, ingredients of antacid

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On heating baking powder produces

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Preparation : Recrystallisation of sodium carbonate

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Uses

– Used in glass, soap and paper industry
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$$CaSO_4.½\ H_2O + 1½\ H_2O \longrightarrow CaSO_4.2H_2O$$

Uses of plaster of Paris : Making toys, decorative material and smooth surfaces.

# EXERCISE
## (Question Bank)

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3. A testtube contains solution of NaOH and Phenolphthalein. Why the colour of the solution changes when HCl in added to it.

4. Why metallic oxides are called as basic oxides and non-metallic oxides are calles acidic oxides?

5. In a beakey a solution of HCl is poured and an electric circuit containing bulb is placed systemtically. What happens to the bulb and why?

   What will happen if HCl is repplaced by NaOH?

6, Identify the type of reaction

   H X + M OH $\longrightarrow$ MX + HOH

7. Why all bases are not alkalies but all alkalis are bases?

**Answer the following questions in detail** **(3 marks)**

1. What is acid rain? What is its pH? How does it affect the aquatic life?

2. What happens when a metal react with dilute hydrochloric acid? Write the reaction

   © NaOH + Zn $\longrightarrow$ _____ + _____.

3. What happens when an acid or a base is added to the water? Why does the beaker appear warm? Why should we always add acid or base to the water and not water to the acid or base.

**Answer the following question in detail** **(5 marks)**

1. (a) Write down five products formed with the help of common salt on industrial level.

   (b) Write down the chemical name of these compounds and one use of each of them.

2. Fill in the blanks

   a) Acid + _____ $\longrightarrow$ Salt + Water.

   b) _____ + Metal $\longrightarrow$ Salt + _____

   c) Metal carbonate / metal hydrogen carbonate + acid

   $\longrightarrow$ _____ + _____ + _____.

   d) NaOH $\xrightarrow{H_2O}$ _____ + _____

   e) $Na_2CO_3 + 10H_2O \longrightarrow$ _____.

# CBSE Test Paper 01

## Chapter 02 Acid Base and Salt

1. Electrolysis of brine solution produces chlorine gas and hydrogen at **(1)**
   a. Anode and cathode, respectively.
   b. Both at cathode
   c. Cathode and anode respectively
   d. Both at Anode
2. Name the substance which on treatment with chlorine yields bleaching powder. **(1)**
   a. CaO
   b. $Ca(OH)_2$
   c. CuO
   d. $CaCo_3$
3. Which one of the following is not required to find the pH of a solution? **(1)**
   a. Litmus paper
   b. Standard pH value chart
   c. pH paper
   d. Universal indicator
4. A blue litmus paper was first dipped in dil. HCl and then in dil. NaOH solution. It was observed that the colour of the litmus paper **(1)**
   a. changed first to red and then to blue
   b. changed to red
   c. remained blue in both the solutions
   d. changed first to red and then to blue
5. Under what soil condition do you think a farmer would spread or treat the soil of his fields with quick lime (CaO) or slaked time $(CaCO_3)$ ? **(1)**
   a. When the pH of the soil increases
   b. When the nutrients of the soil is lost
   c. When the pH of the soil decreases
   d. All of these
6. An aqueous solution turns red litmus solution blue. Excess addition of which solution

would reverse the change? **(1)**

7. Give one example of natural indicator. **(1)**

8. Although acetic acid is highly soluble in water but still it is a weak acid. Explain why? **(1)**

9. Why is sodium hydrogen carbonate an essential ingredient in most antacids? **(1)**

10. Why acids are not stored in metal containers? **(3)**

11. 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 ion concentration? Which of this is acidic and which one is basic? **(3)**

12. Write some uses of caustic soda? **(3)**

13. i. A chemical compound X is used in glass and soap industry. Identify the compound and give its chemical formula.
    ii. How many molecules of water of crystallisation are present in compound X?
    iii. How will you prepare the above compound starting from sodium chloride? Write all relevant equations involved in the process. **(3)**

14. Give important properties of bases (alkalies). **(5)**

15. 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? **(5)**

## CBSE Test Paper 01

## Chapter 02 Acid Base and Salt

### Answers

1. a. Anode and cathode, respectively.

   **Explanation:** On electrolysis, brine (sodium chloride solution) produces hydrogen gas at the cathode and chlorine gas at the anode.
   The half-equations for the reactions are:

   At the cathode: $2\ H^+(aq) + 2\ e^- \rightarrow H_2(g)$

   At the anode: $2\ Cl^-(aq); \rightarrow Cl_2(g) + 2\ e^-$

   Overall process: $2\ NaCl\ (or\ KCl) + 2\ H_2O \rightarrow Cl_2 + H_2 + 2\ NaOH\ (or\ KOH)$

   The solution left provides sodium hydroxide (a strong alkali).

2. b. $Ca(OH)_2$

   **Explanation:** Bleaching powder is prepared by passing chlorine gas over dry slaked lime.

   $$\underset{\text{slaked lime}}{Ca(OH)_2} + Cl_2 \rightarrow \underset{\text{bleaching powder}}{CaOCl_2} + H_2O$$

3. a. Litmus paper

   **Explanation:** Litmus paper cannot be used to find the pH of a solution.

4. d. changed first to red and then to blue

   **Explanation:** Blue paper turn in red indicate the sample is acidic. Blue paper that does not change color indicates the sample is a base. HCl is acidic and NaOH is base, So, dil. HCl turns blue litmus red which becomes blue again in NaOH.

5. c. When the pH of the soil decreases

   **Explanation:** When the pH of the soil becomes acidic, slaked lime or quick lime is added to neutralise the soil.

6. Changing of red litmus to blue indicates that the solution is basic. So to neutralise the basic solution an acid should be added. To revert the colour change that is to change blue litmus red, excess of acid needs to be added so that the solution becomes acidic.

7. Indicators obtained from natural sources are called natural indicators. Litmus, turmeric, red cabbage, China rose, etc. are some common natural indicators used widely to show the acidic or basic character of substances.

8. The strength of an acid depends upon the extent of ionization. Acetic acid is highly soluble in water but it dissociates partially in the aqueous solution to produce a small amount of H+ ions and, therefore, considered as a weak acid.

9. Sodium hydrogen carbonate is slightly alkaline in nature that's why it is an essential ingredient in most antacids.

10. Acids cannot be stored in metal containers as they will react with the metal, forming metal salt and liberating Hydrogen gas. Containers made of glass are ideal for storage of acid due to its chemical inertness.

11. In solution A, $[H^+(aq)] = 10^{-6}$ M

    In solution B, $[H^+(aq)] = 10^{-8}$ M

    The pH value of a solution varies from 0 to 14. The pH value is 0 for a very strong acid and the pH value is 14 for a very strong base. The pH value is 7 for a neutral solution. Hence A is acidic and B is basic in nature. The concentration of hydrogen ion decreases from pH value of 0 to 14 therefore A has more hydrogen ion concentration.

12. Three uses of caustic soda:

    a. It is used in paper industry.
    b. It is used in manufacture of soap and detergents.
    c. It is used in the manufacture of artificial fibres.
    d. It is used as a cleansing agent and in the manufacturing of washing soda.
    e. Sometimes, sodium hydroxide is also used as a reagent in the laboratories.
    f. It is used in the preparation of soda lime.
    g. It is used in the extraction of aluminium by purifying bauxite.

13. i. The compound (X) is washing soda. Its chemical formula is $Na_2CO_3 .10H_2O$

    ii. Ten molecules of water of crystallisation are present in this compound.

    iii. Ammonia and carbon dioxide gas in passed through brine (or concentrated sodium chloride solution) then a mixture of $NaHCO_3$ and $NH_4Cl$ is formed.

$NaCl\ (s) + NH_3\ (g) + CO_2(g) + H_2O(l) \rightarrow NaHCO_3\ (s) + NH_4CI(g)$

On Heating $NaHCO_3$, sodium carbonate is formed releasing water and carbon dioxide

$2NaHCO_3\ (s) \xrightarrow{\triangle} Na_2CO_3\ (s) + H_2O(l) + CO_2(g)$

Anhydrous sodium carbonate (also known as soda ash) is dissolved in water. The solution is recrystallized and upon cooling, it gives hydrated sodium carbonate (called washing soda).

$$Na_2CO_3\ (s)\ +\ 10H_2O(l)\ \rightarrow \underset{Washing\ soda}{Na_2CO_3\ .10H_2O(s)}$$

14. i. Bases are soapy to touch and have bitter taste.

ii. They change the colour of indicators.

| Indicator | Colour change |
|---|---|
| Litmus | From red to blue |
| Phenolphthalein | From colourless to pink |
| Methyl orange | From orange to yellow |

iii. They act as electrolytes.

iv. They have a corrosive action on the skin.

v. Action with ammonium salts : When they are warmed with an ammonium salt, ammonia gas is produced.

e.g. $NH_4Cl + NaOH \rightarrow NaCl + H_2O + NH_3\uparrow$

vi. They absorb carbon dioxide from the air to form carbonates.

$2NaOH + CO_2 \rightarrow Na_2CO_3 + H_2O$

$2KOH + CO_2 \rightarrow K_2CO_3 + H_2O$

vii. They neutralise acids to from salt and water

$Ca(OH)_2 + 2HCl \rightarrow CaCl_2 + 2H_2O$

$Fe(OH)_2 + 2HCl \rightarrow FeCl_2 + 2H_2O$

viii. Action of heat : All bases except NaOH decompose on heating to give oxides.

$Ca(OH)_2 \xrightarrow{Heat} CaO + H_2O$

$2Al(OH)_3 \xrightarrow{Heat} Al_2O_3 + 3H_2O$

ix. Precipitation reactions : When added to the solutions of the salts of the heavy

metals viz. copper, iron, zinc, etc. the bases produce insoluble metal hydroxides as precipitates.

$CuSO_{4(aq)} + 2NH_4OH \rightarrow (NH_4)_2SO_4 + Cu(OH)_2\downarrow$ (pale blue)

$ZnSO_{4(aq)} + 2NaOH_{(aq)} \rightarrow Na_2SO_{4(aq)} + Zn(OH)_2 \downarrow$ (white)

x. Amphoteric nature : The hydroxides of zinc, aluminium and lead are amphoteric i.e. they can act as weak bases as well as weak acids.

a. As weak bases :

$Zn(OH)_2 + 2HCl\ (dil) \rightarrow ZnCl_2(aq) + 2H_2O$

$Al(OH_3)(s) + 3HCl(dil) \rightarrow AlCl_3(aq) + 3H_2O$

b. As weak acids

$Al(OH_3)(s) + 2NaOH(aq) \rightarrow \underset{Sodium\ meta\ aluminate}{NaAlO_2(aq)} + 2H_2O$

$Zn(OH)_2(s) + 2NaOH\ (aq) \rightarrow \underset{Sodium\ zincate}{Na_2ZnO_2(aq)} + 2H_2O$

15. The following table gives the formulae of the given salts, and the acids and bases from which these salts may be obtained**:**

| S.No. | Salts | Formula | Family | Acid and Base |
|---|---|---|---|---|
| 1. | Potassium sulphate | $K_2SO_4$ | Potassium salts | $H_2SO_4$ and KOH |
| 2. | Sodium sulphate | $Na_2SO_4$ | Sodium salts | $H_2SO_4$ and NaOH |
| 3. | Calcium sulphate | $CaSO_4$ | Calcium salts | $H_2SO_4$ and $Ca(OH)_2$ |
| 4. | Magnesium sulphate | $MgSO_4$ | Magnesium salts | $H_2SO_4$ and $Mg(OH)_2$ |
| 5. | Copper sulphate | $CuSO_4$ | Copper salts | $H_2SO_4$ and $Cu(OH)_2$ |
| 6. | Sodium chloride | NaCl | Chloride salts | HCl and NaOH |
| 7. | Sodium nitrate | $NaNO_3$ | Nitrate salts | $HNO_3$ and NaOH |
| 8. | Sodium carbonate | $Na_2CO_3$ | Carbonate salts | $H_2CO_3$ and NaOH |
| 9. | Ammonium chloride | $NH_4Cl$ | Chloride salts | HCl and $NH_4OH$ |