3. Acid Base Chemistry

Acids:
- Sour
- Acid pH = 0 - 7
- Substances that release H+ ions when dissolved in water. Examples: HCl, HNO3
- Strong acids: 0 - 4 pH
- Weak acids: 3 - 6 pH
- Corrosive to metals
- Changes litmus from red to blue
- Proton donors
- Examples: HCl, HNO3
- H+ ions

Bases:
- Bitter
- Base pH = 7 - 14
- Substances that release hydroxide ions (OH-) into a solution. Examples: NaOH, KOH
- Strong bases: 10 - 14 pH
- Weak bases: 8 - 10 pH
- Slippery
- Solutions that have an excess of OH- ions
- Proton acceptors
- Examples: Ca(OH)2
- OH- ions

Detergents:
- Sodium hydroxide (NaOH)
- Takes ions

Litmus:
- Don’t change the color of litmus

Vinegar:
- Strong: 0 - 4 pH
- Weak: 3 - 6 pH
- Substances that release proton ions (H+ ions) when dissolved in water
- Used to conduct electricity

Stomach acid:
- Helps break down food
- Changes litmus from red to blue
- Strong acid

Lemons:
- Strong: 0 - 4 pH
- Weak: 3 - 6 pH
- Weak acid
- Contain citric acid
- Used to conduct electricity

Soda:
- Strong: 0 - 4 pH
- Weak: 3 - 6 pH
- Weak acid
- Used to conduct electricity

Antacid:
- Strong: 0 - 4 pH
- Weak: 3 - 6 pH
- Weak acid
- Used to conduct electricity
Q.I (A) Fill in the blanks :
1. Acids turn ....................... litmus ....................... .
2. Bases turn ....................... litmus ....................... .
3. Mixture of several indicators is called as ....................... indicator.
4. ....................... helps in determining the hydrogen ion concentration in the solution.
5. In pH scale, 0 is ....................... .
6. In pH scale, 14 is ....................... .
7. In pH scale, 7 indicates ....................... .
8. pH of pure water is ....................... .
9. Tamarind has a ....................... taste.
10. The human body works within the pH range of ....................... .
11. ....................... gas burns with a pop sound making a little explosion.
12. Reactivity of base with non-metallic oxide is an example of ....................... reaction.
13. Phenolphthalein indicator turns ....................... in the basic medium.
14. Presence of chlorides and sulphates of Ca, Mg makes water ....................... .
15. Most of the acidic substances are ....................... in taste.
16. Phenolphthalein is ....................... type of indicator.
17. The strength of basic substance is represented by ....................... .
18. pH scale ranges between ....................... to ....................... .
19. Acid and base react to form ....................... and ....................... .
20. Sodium or potassium salt of higher fatty acids are ....................... .
21. In FeSO₄, 7H₂O, 7H₂O represents as ....................... .
22. 10% NaCl is known as ....................... .

Answers :
1. blue, red
2. red, blue
3. universal
4. pH scale
5. most acidic
6. most basic
7. neutral
8. 7
9. sour
10. 7.35 to 7.45
11. Hydrogen
12. neutralisation
13. pink
14. hard
15. sour
16. synthetic
17. pOH
18. 0, 14
19. salt, water
20. soap
21. water of crystallization
22. brine

Q.I (B) Match the following :

1. Column I Column II
   (i) Ant (a) Blue litmus red
   (ii) Nettle plant (b) Red litmus blue
   (iii) Acid (c) Formic acid
   (iv) Base (d) Stinging hair

Ans. (i - c), (ii - d), (iii - a), (iv - b).

2. Column I Column II
   (i) Hydronium ion (a) Brown
   (ii) Sodium chloride (b) Baking soda
   (iii) Impure NaCl (c) H₃O⁺
   (iv) Sodium bicarbonate (d) Neutral salt

Ans. (i - c), (ii - d), (iii - a), (iv - b).
Q.I (C) State whether the following statements are true or false. If false, write the corrected statement:
1. When the pH value is between 0 to 7, the solution is acidic.
   Ans. True.
2. A substance having pH value 7 will have effect on litmus paper.
   Ans. False. A substance having pH value 7 will have no effect on litmus paper.
3. Bases are sweet to taste.
   Ans. False. Bases are bitter to taste.
4. Carbon dioxide is a non-metallic oxide.
   Ans. True.
5. Hydrogen ions cannot exist alone, it always combines with water and form hydronium ion.
   Ans. True.
6. Sodium chloride is a neutral salt.
   Ans. True.
7. The dehydration of copper sulphate is a reversible process.
   Ans. True.

Q.I (D) Find the odd man out:
1. Sodium carbonate, Copper sulphate, Sodium bicarbonate.
   Ans. Sodium bicarbonate as it does not contain water of crystallization.
2. Eosin, Phenolphthalein, Litmus, Sodium chloride
   Ans. Sodium chloride as others are indicators.

Q.I (E) Write the correlated terms:
1. Sodium carbonate : Washing soda :: Sodium bicarbonate : ....................... .
   Ans. Baking soda.
   Ans. Bitter.

Q.I (F) Classify the following into acids, bases and salt:
   Hydrochloric acid, sodium chloride, sodium hydroxide, calcium hydroxide,
   acetic acid, formic acid, magnesium chloride
   Ans. Acid : Hydrochloric acid, acetic acid, formic acid.
   Base : Sodium hydroxide, calcium hydroxide.
   Salt : Sodium chloride, magnesium chloride.

Q.I (G) Give the names of the acids present in the following:

<table>
<thead>
<tr>
<th>Substance</th>
<th>Acid</th>
<th>Substance</th>
<th>Acid</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Tamarind</td>
<td>Tartaric acid</td>
<td>5. Milk</td>
<td>Lactic acid</td>
</tr>
<tr>
<td>2. Butter</td>
<td>Butyric acid</td>
<td>6. Orange</td>
<td>Citric acid</td>
</tr>
<tr>
<td>(Butanioc acid)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. Roots of plant valerum</td>
<td>Valine</td>
<td>7. Red ants</td>
<td>Formic acid</td>
</tr>
<tr>
<td>4. Lemon</td>
<td>Citric acid</td>
<td>8. Honey bee</td>
<td>Melittin</td>
</tr>
</tbody>
</table>

Q.II Define the following:
1. Acids.
   Ans. Substances which are sour to taste have acidic ingredients and their solution are called acids.
2. Bases.
   Ans. Substances that are bitter to taste are bases.
3. **Indicators.**  
**Ans.** An indicator is a dye that changes colour when it is put into an acid or a base.

4. **Universal indicator**  
**Ans.** Mixture of several indicators is known as universal indicator.

5. **Strong acid.**  
**Ans.** An acid that is completely ionized in water and thus produces a large amount of hydrogen ions (H\(^+\)) is called as strong acid.

6. **Weak acid.**  
**Ans.** When acids in aqueous solution give less number of H\(^+\) ions is called as a weak acid.

7. **Strong base**  
**Ans.** When acids in aqueous solution give more number of H\(^+\) ions is called as a strong acid.

8. **Weak base.**  
**Ans.** When base in aqueous give less number of OH\(^-\) ions is called as weak base.

9. **Alkali.**  
**Ans.** The base that dissolves in water is called alkali.

10. **Water of crystallization.**  
**Ans.** They are fixed number of water molecules present in the crystal structure.

11. **Soap.**  
**Ans.** When oils or fats are boiled with aqueous solution of sodium or potassium hydroxide, then sodium or potassium salt of carboxylic acids are obtained. These salts are known as soap.

12. **Saponification.**  
**Ans.** The process of alkaline hydrolysis of oils or fats is known as saponification.

MEMORISE:  
- **Polar covalent bond**: A covalent bond with partial ionic character is called as polar covalent bond.  
- **Salts**: Salts are formed when acids react with bases.  
  - The salts of nitric acid are called nitrates.  
  - The salts of carbonic acid are called carbonates.  
  - The salts of acetic acid are called acetates and so on.  

Q.III (A) **Give scientific reasons:**

1. **An aqueous solution of sodium chloride conducts electricity.**  
**Ans.**  
1. A substance shows conduction of electricity due to the movement of ions or electrons.
2. In aqueous solution, sodium chloride splits into sodium ions (Na\(^+\)) and chloride ions (Cl\(^-\)).
\[
\text{NaCl}_{(aq)} \rightarrow \text{Na}^{+}_{(aq)} + \text{Cl}^{-}_{(aq)}
\]
3. These ions are free to move in the solution. Hence, aqueous solution of sodium chloride conducts electricity.

2. **Pure gaseous HCl is a bad conductor of electricity but in water it forms a conducting solution.**  
**Ans.**  
1. Gaseous HCl in the absence of water does not form ions.
2. But when it is dissolved in water, it undergoes ionisation as follows:
\[
\text{HCl}_{(aq)} \rightarrow \text{H}^{+}_{(aq)} + \text{Cl}^{-}_{(aq)}
\]
3. Hence due to the presence of H\(^+\) and Cl\(^-\) ions, in water, it becomes a conducting solution.
3. **Sodium bicarbonate is used in antacid medicines.**

   Ans. 1. Sodium bicarbonate is alkaline in nature. When it is taken, it undergoes hydrolysis to give sodium hydroxide in the stomach. Thus sodium hydroxide neutralizes the hydrochloric acid produced by gastric juice and gives relief to the patient from acidity.

   \[
   \text{NaHCO}_3 + \text{H}_2\text{O} \rightarrow \text{NaOH + H}_2\text{CO}_3
   \]

   \[
   \text{NaOH + HCl} \rightarrow \text{NaCl + H}_2\text{O}
   \]

   2. So, sodium bicarbonate is used in antacid medicines.

**MEMORISE:**

Milk of magnesia (magnesium hydroxide) is also used as an antacid.

- Extra Information.

4. **Acids are stored in containers made of glass or ceramic.**

   Ans. 1. Acids are never stored in metal container as they gradually corrode and eat up the metal container.

   2. Containers made of glass or ceramic are not attacked by acids.

   3. So, acids are stored in containers made of glass or ceramic.

5. **The dilution of a concentrated acid should always be done by adding concentrated acid to water and not by adding water to acid.**

   Ans. 1. The reaction of acid and water is an exothermic reaction.

   2. When concentrated acid is added to water for preparing dilute acid, then heat is evolved gradually and easily absorbed by the large amount of water.

   3. If water is added to concentrated acid to dilute it, then a large amount of heat is evolved at once. This heat changes some of the water to steam explosively which can splash the acid on our face or clothes and cause acid burns. Even the glass container may break due to excessive heating.

   4. So, the dilution of a concentrated acid should always be done by adding concentrated acid to water and not by adding water to acid.

6. **Baking powder is used in preparation of cakes and breads in bakery industry.**

   Ans. 1. Baking powder consists of sodium bicarbonate (baking soda) and a mild edible acid like tartaric acid or citric acid.

   2. When baking powder (mixed in the dough for preparing cakes and bread) is heated, sodium bicarbonate breaks down to give carbon dioxide and sodium carbonate.

   3. The carbon dioxide produced causes the bread and cakes to rise. This makes them light and spongy.

   4. Tartaric acid or citric acid present in baking powder reacts with sodium carbonate and neutralizes it.

7. **Sodium bicarbonate is used in fire extinguishers.**

   Ans. 1. The fire extinguisher contains a solution of sodium bicarbonate in water and sulphuric acid in a separate container inside it.

   2. When the fire extinguisher is operated by pressing the knob on it, the sulphuric acid gets mixed with sodium bicarbonate solution producing a lot of carbon dioxide gas.

   \[
   2\text{NaHCO}_3 + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O} + 2\text{CO}_2 \uparrow
   \]

   3. Carbon dioxide gas is neither combustible nor helps combustion. It is heavier than air and cuts off the supply of oxygen from air and hence extinguishes the fire.

   4. Hence, sodium bicarbonate is used in fire extinguishers.

8. **Bleaching powder has a strong smell of chlorine.**

   Ans. 1. Bleaching powder is a white powder.
2. When bleaching powder is exposed to air, CO\(_2\) from air decomposes the powder slowly to produce chlorine.
\[
\text{CaOCl}_2(s) + \text{CO}_2(g) \rightarrow \text{CaCO}_3(s) + \text{Cl}_2(g)
\]
Bleaching powder Carbon dioxide Calcium carbonate Chlorine

3. So, bleaching powder has a strong smell of chlorine.

**MEMORISE:**
The quality of bleaching powder is measured by the amount of chlorine it liberates on treatment with hydrochloric acid.
Standard bleaching powder contains 35% active chlorine.
Amount of chlorine evolved by action of acids on bleaching powder is called as available chlorine.
Commercial bleaching powder is often contaminated with unreacted slaked lime. Hence, the percentage of available chlorine is lower than that represented by formula of bleaching powder. – Extra Information.

9. **Copper sulphate is heated in air.**

**Ans.**
1. Copper sulphate contains water of crystallization (CuSO\(_4\), 5H\(_2\)O).
2. The blue colour and crystalline nature of copper sulphate is due to water of crystallization.
3. On heating it, it loses the water of crystallization and hence loses the blue colour and crystalline shape and changes to white anhydrous powder.

\[
\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \xrightarrow{\Delta} \text{CuSO}_4 + 5\text{H}_2\text{O}↑
\]
Hydrated blue Anhydrous Water (goes away)
copper sulphate copper sulphate (white)

**MEMORISE:**
Water of crystallization gives a crystalline structure(shape) and colour in certain compounds.
The water of crystallization is separated from the main compound by a comma. – Extra Information.

10. **Water is added to anhydrous copper sulphate.**

**Ans.**
When water is added to anhydrous copper sulphate, it gets hydrated and turns blue due to the formation of hydrated copper sulphate.

\[
\text{CuSO}_4 + 5\text{H}_2\text{O} \rightarrow \text{CuSO}_4 \cdot 5\text{H}_2\text{O}
\]
Anhydrous copper sulphate Hydrated copper sulphate
white colour blue colour

Q.III (B) **Answer the following questions in short:**

1. **What are indicators?**

**Ans.**
1. An indicator is a dye that changes colour when it is put into acid or a base. An indicator gives different colours in acid and base. Thus an indicator tells us if the given substance is an acid or base by changing its colour. The three common indicators are: Litmus, Methyl orange, phenolphthalein.
2. The most common indicators used for testing acids and bases in the laboratory is litmus that is a natural indicator. Litmus paper is obtained from a plant called as lichens(division thallophyta). It can be used as litmus solution or litmus paper. Litmus can be blue litmus and red litmus. Acids turn blue litmus red and bases turn blue litmus red.

**MEMORISE:**
Litmus is a natural indicator whose neutral colour is purple. It is made into blue litmus and red litmus for the sake of convenience in detecting colour change when an acid or base is added. – Extra Information.
2. **What are olfactory indicators?**

**Ans.**

1. The term olfactory means relating to sense of smell. Those substances whose smell changes in acidic or basic solution are called as olfactory indicators. It works on the principle that when an acid or base is added to it, its characteristic smell cannot be detected. Onion and vanilla extract are olfactory indicators.

2. Eg.: Onion has a characteristic smell. When a basic solution like sodium hydroxide solution is added to a cloth strip treated with onions, then the onion smell cannot be detected. An acidic solution like hydrochloric acid, does not destroy the smell of onions. This is used as a test for acids and bases.

3. Vanilla extract has a characteristic pleasant smell. If a basic solution like sodium hydroxide is added to vanilla extract, then we cannot detect the characteristic smell of vanilla. An acidic solution like hydrochloric acid, does not destroy the vanilla extract. This is used as a test for acids and bases.

*3. **What is a universal indicator?**

**Ans.**

1. The common indicators like litmus can tell us whether the given substance is an acid or a base. But they cannot tell whether the given substance is a strong acid, weak acid, strong base or a weak base. Thus to obtain an idea of how acidic or basic a substance is, universal indicator is used.

2. It is a mixture of many different indicators (or dyes) which give different colours at different pH values of the entire pH scale. Just like litmus, universal indicator can be used in the form of solution or in the form of universal paper indicator.

3. When an acid or base solution is added to the universal indicator, the indicator produces a new colour. The colour produced by universal indicator is used to find the pH value of acid or base by matching the colour with colours on pH colour chart. Thus by knowing the pH value, we can make out if the given solution is strong acid, weak acid, strong base, weak base. The colours produced by universal indicator at various pH values are given below:

<table>
<thead>
<tr>
<th>pH</th>
<th>Colour</th>
<th>pH</th>
<th>Colour</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>Dark red</td>
<td>8</td>
<td>Greenish blue</td>
</tr>
<tr>
<td>1</td>
<td>Red</td>
<td>9</td>
<td>Blue</td>
</tr>
<tr>
<td>2</td>
<td>Red</td>
<td>10</td>
<td>Navy blue</td>
</tr>
<tr>
<td>3</td>
<td>Orange Red</td>
<td>11</td>
<td>Purple</td>
</tr>
<tr>
<td>4</td>
<td>Orange</td>
<td>12</td>
<td>Dark purple</td>
</tr>
<tr>
<td>5</td>
<td>Orange yellow</td>
<td>13</td>
<td>Violet</td>
</tr>
<tr>
<td>6</td>
<td>Greenish yellow</td>
<td>14</td>
<td>Violet</td>
</tr>
<tr>
<td>7</td>
<td>Green</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4. Eg.: if on putting a drop of solution on the universal indicator and if it turns dark red, its pH will be 0 and so it is a strong acid.

*4. **Write a short note on indicators with proper example.**

**Ans.**

1. An indicator is a dye that changes colour when it is put into acid or a base. An indicator gives different colours in acid and base. Thus an indicator tells us if the given substance is an acid or base by changing its colour. The three common indicators are: Litmus, methyl orange, phenolphthalein.

**Natural indicators**: The most common indicators used for testing acids and bases in the laboratory is litmus that is a natural indicator. Litmus paper is obtained from a plant called as lichens (division thallophyta). Other examples are beetroot, turmeric, rose petals etc.
**Synthetic indicator**: The indicator that is artificially prepared is called as synthetic indicator. Eg: Phenolphthalein, eosin, methyl orange are synthetic indicators.

**Universal indicator**: The common indicators like litmus can tell us whether the given substance is an acid or a base. But they cannot tell whether the given substance is a strong acid, weak acid, strong base or a weak base. Thus to obtain an idea of how acidic or basic a substance is, universal indicator is used.

2. It is a mixture of many different indicators(or dyes) which give different colours at different pH values of the entire pH scale. Just like litmus, universal indicator can be used in the form of solution or in the form of universal paper indicator.

3. When an acid or base solution is added to the universal indicator, the indicator produces a new colour. The colour produced by universal indicator is used to find the pH value of acid or base by matching the colour with colours on pH colour chart.

**Olfactory indicator**: The term olfactory means relating to sense of smell. Those substances whose smell changes in acidic or basic solution are called as olfactory indicators. It works on the principle that when an acid or base is added to it, its characteristic smell cannot be detected. Onion and vanilla extract are olfactory indicators.

Eg. : Onion has a characteristic smell. When a basic solution like sodium hydroxide solution is added to a cloth strip treated with onions, then the onion smell cannot be detected. An acidic solution like hydrochloric acid, does not destroy the smell of onions. This is used as a test for acids and bases.

5. **What are strong acids?**

   **Ans.** 1. An acid which is completely ionized in water and thus produces a large amount of hydrogen ions is called as strong acid. Eg: hydrochloric acid is completely ionized in water, so it is a strong acid.
   
   \[ \text{HCl}_{(aq)} \rightarrow \text{H}^{+}_{(aq)} + \text{Cl}^{-}_{(aq)} \]

   2. Sulphuric acid and nitric acid are also strong acids as they get fully ionized in water to produce large amount of hydrogen ions.

   3. The word strong refers to the degree of ionization and not to the concentration of acid. Due to large number of hydrogen ions, strong acids react rapidly with other substances.

   4. They also have a high electrical conductivity.

6. **What are weak acids?**

   **Ans.** 1. An acid which is partially ionized in water and thus produces a small amount of hydrogen ions is called as weak acid. Eg: acetic acid is partially ionized in water, so it is a weak acid.

   \[ \text{CH}_3\text{COOH}_{(aq)} \rightarrow \text{H}^{+}_{(aq)} + \text{CH}_3\text{COO}^{-}_{(aq)} \]

   Acetic acid Hydrogen ion Acetate ion

   2. Sulphurous(H$_2$SO$_3$) acid and carbonic(H$_2$CO$_3$) acid are also weak acids as they get partially ionized in water to produce small amount of hydrogen ions.

   3. Due to small number of hydrogen ions, weak acids react quite slowly with other substances.

   4. They also have a low electrical conductivity.
7. **What are strong bases?**

**Ans.** A base which is completely ionized in water and thus produces a large amount of hydroxide ions is called as strong base or strong alkali. Eg.: Sodium hydroxide (NaOH) and potassium hydroxide (KOH) are strong bases. This is because they completely ionize on dissolving in water to produce a large amount of hydroxide ions (OH\(^-\)).

8. **What are weak bases?**

**Ans.** A base which is partially ionized in water and thus produces a small amount of hydroxide ions is called as weak base or weak alkali. Eg: Ammonium hydroxide (NH\(_4\)OH), calcium hydroxide Ca(OH)\(_2\) and magnesium hydroxide Mg(OH)\(_2\) are weak bases. This is because they partially ionize on dissolving in water to produce a small amount of hydroxide ions (OH\(^-\)).

9. **Prove that non-metallic oxides are acidic in nature.**

**Ans.**

1. When carbon dioxide is passed through lime water, it turns milky due to the formation of white precipitate of calcium carbonate.

\[
\text{Ca(OH)}_2(aq) + \text{CO}_2(g) \rightarrow \text{CaCO}_3(s) \downarrow + \text{H}_2\text{O}(l)
\]

Base   | Salt       | Water
---|---|---
Calcium hydroxide | Carbon dioxide | Calcium carbonate

2. Thus this is a neutralization reaction where a base reacts with non-metallic oxide (CO\(_2\)) to form salt and water proving that non-metal oxides are acidic in nature.

*10. **Write a short note on neutralization reaction.**

**Ans.**

1. When a base reacts with acid, then a salt and water is formed. This is called as neutralization reaction.

2. Eg.:

   (a) When hydrochloric acid reacts with sodium hydroxide, sodium chloride and water are formed.

\[
\text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}
\]

Acid | Base | Salt | Water
---|---|---|---
Hydrochloric acid | Sodium hydroxide | Sodium chloride | Water

(b) When carbon dioxide is passed through lime water, it turns milky due to the formation of white precipitate of calcium carbonate.

\[
\text{Ca(OH)}_2(aq) + \text{CO}_2(g) \rightarrow \text{CaCO}_3(s) \downarrow + \text{H}_2\text{O}(l)
\]

Base   | Acid       | Salt       | Water
---|---|---|---
Calcium hydroxide | Carbon dioxide | Calcium carbonate

3. Thus this is a neutralization reaction where base reacts with acidic non-metallic oxide (CO\(_2\)) to form salt and water.

11. **Explain the properties of salt.**

**Ans.**

1. Salts are usually solids.
2. They have high melting point and boiling point.
3. Salts are usually soluble in water.
4. Like acids and bases, solutions of salts in water conduct electricity i.e salts are electrolytes. Salt solutions conduct electricity due to the presence of ions in them.
5. Salts are ionic compounds. Every salt has a positively charged ions (cations) and negatively charged ions (anions).
6. Eg.: Sodium chloride (NaCl), Calcium chloride (CaCl\(_2\)).
12. **What do the solution of salts of strong acid and strong bases give?**

**Ans.**
1. The salt of strong acid and strong base gives neutral solution (having pH 7).
2. Eg.: Sodium chloride salt is formed by the action of strong acid hydrochloric acid and a strong base, sodium hydroxide. As it is formed from a strong acid and strong base, the aqueous solution of sodium chloride is neutral.
3. Another such example is potassium sulphate ($K_2SO_4$).

13. **Write the physical properties of baking soda.**

**Ans.**
1. It is a white amorphous powder.
2. It is soluble in water.
3. The solution of sodium bicarbonate in water is alkaline and turns red litmus blue.

*14. **What are the uses of baking soda? or State applications of baking soda?**

**Ans.**
1. It is used as a medicine (antacid). When it is taken, it undergoes hydrolysis to give sodium hydroxide in the stomach. Thus sodium hydroxide neutralizes the hydrochloric acid produced by gastric juice and gives relief to the patient from acidity.

\[ \text{NaHCO}_3 + \text{H}_2\text{O} \rightarrow \text{NaOH} + \text{H}_2\text{CO}_3 \]

\[ \text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O} \]

2. It is used as a constituent in baking powder, used to prepare bread and cakes to make them light and spongy.
3. It is used in fire extinguishers.
4. It is used to prepare $\text{CO}_2$ gas.

15. **Write the physical properties of washing soda.**

**Ans.**
1. It is a white crystalline solid.
2. It is readily soluble in water.
3. On heating or exposure to air, it loses its water of crystallization and forms a white amorphous powder.
4. It turns red litmus blue indicating its basic nature.

16. **Write the uses of washing soda.**

**Ans.**
1. It is used in washing clothes as a cleansing agent.
2. It is used for softening of hard water to soft water.
3. It is used in refining of petroleum.
4. It is used in manufacturing detergent powder, paper and glass.

17. **State the physical properties of bleaching powder.**

**Ans.**
1. It is a white powder and has a strong smell of chlorine.
2. It is fairly soluble in water.

18. **State the uses of bleaching powder.**

**Ans.**
1. It is used to disinfect water.
2. It is used for bleaching cotton and linen in textile industry and bleaching wood pulp in paper industry. It is also used for bleaching washed clothes in laundary, the bleaching action is due to chlorine released by it.
3. It is used as an oxidizing agent in many chemical industries.
4. It is used to prepare organic solvent chloroform which is also used as an anaesthetic.
Q.IV  Distinguish between :

1. Acid and Base.

<table>
<thead>
<tr>
<th>Acid</th>
<th>Base</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Substances which are sour to taste have acidic ingredients and their solutions are called acids.</td>
<td>1. Substances which are bitter to taste have basic ingredients and their solutions are called bases.</td>
</tr>
<tr>
<td>2. Acids are those substances which when dissolved in water give hydrogen ions.</td>
<td>2. Bases are those substances which when dissolved in water give hydroxyl ions.</td>
</tr>
</tbody>
</table>
| 3. Acid reacts with metals to form metal chloride and hydrogen gas is liberated.  

\[ \text{Mg}_{(s)} + 2\text{HCl}_{(aq)} \rightarrow \text{MgCl}_2(aq) + \text{H}_2(g) \]  
4. Acids turn blue litmus red. | 3. Bases react with some metals to form hydrogen gas.  

\[ 2\text{NaOH}_{(aq)} + \text{Zn}_{(s)} \rightarrow \text{Na}_2\text{ZnO}_2 + \text{H}_2(g) \]  
4. Bases turn red litmus blue. |

2. Washing soda and Baking soda.

<table>
<thead>
<tr>
<th>Washing soda</th>
<th>Baking soda</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. It is sodium carbonate.</td>
<td>1. It is sodium bicarbonate or sodium hydrogen carbonate.</td>
</tr>
<tr>
<td>2. Its molecular formula is Na$_2$CO$_3$ (10\text{H}_2\text{O}).</td>
<td>2. Its molecular formula is NaHCO$_3$.</td>
</tr>
<tr>
<td>3. It is a crystalline substance.</td>
<td>3. It is an amorphous powder.</td>
</tr>
<tr>
<td>4. It is used in manufacturing soaps and detergent.</td>
<td>4. It is used in bakery for making cakes and bread light and spongy.</td>
</tr>
</tbody>
</table>

Q.V  Answer the following in detail :

*1. Explain the pH scale.

Ans. 1. The strength of an acid or base is measured on a scale of numbers called pH scale that has values from 0 to 14. pH scale helps in measuring hydrogen ion concentration in solutions. In pH, p stands for "potenz" (means "strength" in German). The scale reads from 0 (zero) (most acidic) to 14 (most basic). The value of pH indicates acidic or basic nature of a solution. The strength of base is represented by pOH.

2. When the pH value is in between 0 to 7, the solution is acidic in nature.

3. At value 7, the solution is neutral and between 7 to 14 the nature of the solution becomes alkaline/basic.

4. The pH of a solution is inversely proportional to the concentration of hydrogen ions in it. i.e. a solution having a high concentration of hydrogen ions has a low pH value.

<table>
<thead>
<tr>
<th>Acidic</th>
<th>Neutral</th>
<th>Basic</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>7</td>
<td>14</td>
</tr>
</tbody>
</table>

Most acidic  Most basic

★  MEMORISE :

In 1909, Sorenson devised the pH scale. pH is a pure number and has no units.  

– Extra Information.

2. Explain the importance of pH in everyday life.

Ans. 1. pH our digestive system :

Our stomach produces hydrochloric acid (pH about 1.4) which helps in digesting our food without harming our stomach. Sometimes excess of acid is produced for various reasons that causes indigestion causing pain. In order to cure indigestion, bases are taken as antacid. Antacids
are mild bases having no toxic effect on our body. Bases being basic in nature, antacids react with excess acid in the stomach and neutralize it. Eg: Magnesium Hydroxide (Milk of magnesia) and sodium bicarbonate (baking soda).

2. **pH change as the cause of tooth decay:**
   When we eat food containing sugar, then bacteria present in mouth break down sugar and produce lactic acid. This acid lowers the pH in the mouth making it acidic. Tooth decay starts when pH of acid formed in mouth falls below 5.5. This is because the acid becomes strong enough to attack the enamel of our teeth and corrode it that sets in tooth decay. Though tooth enamel is made of calcium phosphate that is the hardest material in our body, but it starts corroding when the pH of the mouth is lower than 5.5.

3. Many tooth paste contain bases to neutralize the mouth acid and prevent tooth decay.

4. Most of the plants grow best when pH of soil is close to 7. If the soil is too acidic or too basic, plants grow badly or don’t grow at all. If the soil is too acidic then it is treated with materials like quick lime(calcium oxide) or slaked lime(calcium hydroxide) to reduce the acidity. If the soil is too alkaline, it can be reduced by adding decaying organic matter.

3. **State the properties of bases.**
   **Ans.**
   1. Bases have bitter taste.
   2. Bases feel soapy to touch.
   3. Bases turn red litmus blue.
   4. Basic solutions conduct electricity.
   5. Bases react with some metals to give hydrogen gas.
      Eg: When zinc reacts with sodium hydroxide, it gives water sodium zinctate,
      \[
      \text{Zn}(s) + 2\text{NaOH}(aq) \rightarrow \text{Na}_2\text{ZnO}_2(aq) + \text{H}_2(g)
      \]
      Zinc Sodium hydroxide Sodium zinctate Hydrogen
   6. Bases react with acids to form salt and water. This reaction is called as neutralization reaction.
      Eg: When hydrochloric acid reacts with sodium hydroxide, sodium chloride and water are formed.
      \[
      \text{HCl} + \text{NaOH} \rightarrow \text{NaCl} + \text{H}_2\text{O}
      \]
      Acid Base Salt Water
      Hydrochloric acid Sodium hydroxide Sodium chloride Water
   7. Bases react with non-metal oxides to form salt and water.
      Eg: When carbon dioxide is passed through lime water, it turns milky due to the formation of white precipitate of calcium carbonate.
      \[
      \text{Ca(OH)}_2(aq) + \text{CO}_2(g) \rightarrow \text{CaCO}_3(s) + \text{H}_2\text{O}(l)
      \]
      Base (Acidic) Salt Water
      Calcium hydroxide Carbon dioxide Calcium carbonate Water
      Thus this is a neutralization reaction where by base reacts with non-metallic oxide (CO\text{2}) to form salt and water proving that metal oxides are acidic in nature.

4. **State the properties of acids.**
   **Ans.**
   1. Acids have a sour taste.
   2. Acids turn blue litmus red.
   3. Acid solutions conduct electricity.
   4. Acids are corrosive i.e they can cause severe burns on the skin and attack and eat up materials like cloth, wood, metal etc.
   5. Acids react with metals to form hydrogen gas.
Eg. : When zinc reacts with dilute hydrochloric acid to give zinc chloride and hydrogen gas.

\[
\text{Zn(s)} + 2\text{HCl(aq)} \rightarrow \text{ZnCl}_2(aq) + \text{H}_2(g)
\]

5. Write a short note on sodium chloride.

**Ans.**

1. The strong acid HCl and strong base NaOH react together to form salt sodium chloride i.e NaCl

\[
\text{NaCl}_{(s)} + \text{aq} \rightarrow \text{Na}^{+}_{(aq)} + \text{Cl}^{-}_{(aq)}
\]

Impure sodium chloride is brown in colour and is known as rock salt while purified sodium chloride is colourless, crystalline ionic compound, it is fundamental ionic compound used in preparation of other salts as Na$_2$CO$_3$, NaHCO$_3$ etc.

2. Electrolysis of NaCl in solution and in fused state yield different products.

(a) When electricity is passed through solution of sodium chloride, which is termed as brine (10% NaCl), it decomposes to form sodium hydroxide, an important basic compound.

\[
2\text{NaCl}_{(aq)} + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}_{(aq)} + \text{Cl}_2(g) + \text{H}_2(g)
\]

Cl$_2$(g) is liberated at anode and H$_2$(g) at cathode respectively.

(b) Salt when heated at high temperature, the molten state is termed as fused state NaCl is able to conduct electricity even in fused state. During electrolysis Cl$_2$(g) is liberated at anode and sodium is deposited at cathode.

6. How do metal carbonates react with acid?

**Ans.**

Metal carbonates react with dil acid to give carbon dioxide gas. The examples are given below:

1. Aluminium carbonate reacts with dilute hydrochloric acid.

When aluminium carbonate reacts with dilute hydrochloric acid to give aluminium chloride, water and carbon dioxide gas is liberated.

\[
\text{Al}_2(\text{CO}_3)_3(aq) + 6\text{HCl}(aq) \rightarrow 2\text{AlCl}_3(aq) + 3\text{H}_2\text{O}(l) + 3\text{CO}_2(g)
\]

2. Sodium carbonate reacts with dilute hydrochloric acid.

When sodium carbonate reacts with dilute hydrochloric acid to give sodium chloride, water and carbon dioxide gas is liberated.

\[
\text{Na}_2\text{CO}_3(s) + 2\text{HCl}(aq) \rightarrow 2\text{NaCl}(aq) + \text{H}_2\text{O}(l) + \text{CO}_2(g)
\]
Write a short note on water of crystallization with examples.

Ans. 1. It is defined as fixed number of water molecules present in crystal structure. It is responsible for crystalline structure (shape) and colour in certain compounds.

2. The salts that contain water of crystallization is called as hydrated salt.
   Eg. : \( \text{CuSO}_4 \cdot 5\text{H}_2\text{O} \) : Copper sulphate pentahydrate, it contains 5 molecules of water of crystallization.
   \( \text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O} \) : Sodium carbonate decahydrate, it contains 10 molecules of water of crystallization.
   \( \text{FeSO}_4 \cdot 7\text{H}_2\text{O} \) : Ferrous sulphate heptahydrate, it contains 7 molecules of water of crystallization.
   \( \text{ZnSO}_4 \cdot 7\text{H}_2\text{O} \) : Zinc sulphate heptahydrate, it contains 7 molecules of water of crystallization.

**MEMORISE :**
The phenomenon in which a crystalline substance loses its water of crystallization on exposure to air is called as efflorescence.

Q.VI Answer the following questions in one sentence each:

1. Name a few natural indicators.
   Ans. Turmeric (blue dye), litmus (purple dye), red cabbage extract (red dye), rose-petals, beetroot are natural indicators.

2. Name two synthetic indicators.
   Ans. Phenolphthalein, eosin, methyl orange are synthetic indicators.

**MEMORISE :**
The neutral colour of methyl orange is orange.
Methyl orange gives red colour in acid solution.
Methyl orange gives yellow colour in basic solution.
The neutral colour of phenolphthalein is colourless.
It is colourless in acidic solution.
It is pink in basic solution.

3. Name the acid base indicator extracted from lichens.
   Ans. Litmus is the acid-base indicator extracted from lichens.

4. If the concentration of \( \text{OH} \) is increased, what will it increase or decrease?
   Ans. \( \text{pH} \) will increase if the concentration of \( \text{OH} \) increases.

5. When will the strength of acid increase?
   Ans. The strength of acid will increase when concentration of \( \text{H}^+ \) ions increases in the solution.

6. Why is jaggery used along with tamarind while cooking?
   Ans. Jaggery is used with tamarind to maintain the \( \text{pH} \) of our body.

7. What is the formula of red oxide?
   Ans. \( \text{CuO} \) copper oxide is red oxide.

8. What are alkali?
   Ans. The base that dissolves in water is called as alkali.

9. What do acids generate in aqueous medium?
   Ans. Acids generate hydrogen ions, \( \text{H}^+ \) ions in aqueous medium.

10. What do bases generate in aqueous medium?
    Ans. Bases generate hydroxyl ions, \( \text{OH}^- \) ions in aqueous medium.

11. What is the common name of sodium hydrogen carbonate or sodium bicarbonate?
    Ans. The common name of sodium hydrogen carbonate or sodium bicarbonate is baking soda.
12. What is bleaching powder also called as?
Ans. Bleaching powder is also called as chloride of lime.

13. Name a few compounds having water of crystallization.
Ans. CuSO₄.5H₂O : Copper sulphate pentahydrate
Na₂CO₃.10H₂O: Sodium carbonate decahydrate
FeSO₄.7H₂O : Ferrous sulphate heptahydrate
ZnSO₄.7H₂O : Zinc sulphate heptahydrate

14. What are anhydrous substances?
Ans. Crystalline substances lose water of crystallization on heating or on exposure to air and turn into white amorphous powder.

15. What is hydronium ion?
Ans. Hydrogen ions cannot exist alone. They always combine with water to form hydronium ion.
\[ H^+ + H_2O \rightarrow H_3O^+ \]

Q.VII Explain the following chemical reactions with the help of balanced equations:

1. Aluminium reacts with dilute hydrochloric acid.
Ans. When aluminium reacts rapidly with dilute hydrochloric acid to give aluminium chloride and hydrogen gas.
\[ 2Al(s) + 6HCl(aq) \rightarrow 2AlCl₃(aq) + 3H₂(g) \uparrow \]

2. Iron reacts with dilute hydrochloric acid.
Ans. When iron reacts with cold dilute hydrochloric acid to give iron(II) chloride and hydrogen gas.
\[ Fe(s) + 2HCl(aq) \rightarrow FeCl₂(aq) + H₂(g) \uparrow \]

3. Aluminium reacts with sodium hydroxide.
Ans. When aluminium reacts with sodium hydroxide, it gives water soluble sodium aluminate and hydrogen gas is liberated.
\[ 2Al(s) + 2NaOH(aq) + 2H₂O \rightarrow Na₂Al₂O₄(aq) + 3H₂ \uparrow \]

4. Zinc reacts with sodium hydroxide.
Ans. When zinc reacts with sodium hydroxide, it gives water sodium zincate, zincate and hydrogen.
\[ Zn(s) + 2NaOH(aq) \rightarrow Na₂ZnO₂(aq) + H₂ \uparrow \]

★ MEMORISE:
Aluminium at first reacts slowly with dilute hydrochloric acid due to the presence of a tough protective layer of aluminium oxide on its surface. But when the thin outer oxide layer gets dissolved in acid, the fresh aluminium metal is exposed which reacts rapidly with dilute hydrochloric acid.

– Extra Information.

★ MEMORISE:
Copper, Silver, Gold do not react with dilute acids.

– Extra Information.

★ MEMORISE:
Copper does not react with sulphuric acid.

– Extra Information.
5. Sodium carbonate reacts with dilute hydrochloric acid.

Ans. When sodium carbonate reacts with dilute hydrochloric acid to give sodium chloride, water and carbon dioxide gas is liberated.

\[ \text{Na}_2\text{CO}_3(s) + 2\text{HCl(aq)} \rightarrow 2\text{NaCl(aq)} + \text{H}_2\text{O(l)} + \text{CO}_2\uparrow(g) \]

Sodium carbonate Hydrochloric acid Sodium Water Carbon dioxide

6. Baking soda (sodium hydrogen carbonate) reacts with dilute hydrochloric acid.

Ans. When sodium bicarbonate (sodium hydrogen carbonate) reacts with dilute hydrochloric acid to give sodium chloride, water and carbon dioxide gas is liberated.

\[ \text{NaHCO}_3(s) + \text{HCl(aq)} \rightarrow \text{NaCl(aq)} + \text{H}_2\text{O(l)} + \text{CO}_2\uparrow (g) \]

Sodium bicarbonate Hydrochloric acid Sodium Water Carbon dioxide

7. Carbon dioxide is passed through lime water. OR

Carbon dioxide is passed through a solution of chalk in water.

Ans. When carbon dioxide is passed through lime water, it turns milky due to the formation of white precipitate of calcium carbonate.

\[ \text{Ca(OH)}_2(aq) + \text{CO}_2(g) \rightarrow \text{CaCO}_3(s) \downarrow + \text{H}_2\text{O(l)} \]

Calcium hydroxide Calcium Water Carbon dioxide carbonate

8. Copper oxide reacts with dilute hydrochloric acid.

Ans. When copper chloride reacts with dilute hydrochloric acid to give a blue solution of copper chloride.

\[ \text{CuO(s)} + 2\text{HCl(aq)} \rightarrow \text{CuCl}_2(aq) + \text{H}_2\text{O(l)} \]

Copper oxide Hydrochloric acid Copper chloride Water

9. Copper chloride reacts with dilute sulphuric acid.

Ans. When copper chloride reacts with dilute sulphuric acid, copper sulphate and hydrogen chloride gas is evolved.

\[ \text{CuCl}_2(aq) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{CuSO}_4(aq) + 2\text{HCl(g)} \]

Copper chloride Sulphuric acid Copper sulphate Hydrogen chloride

10. Sodium bicarbonate is heated.

Ans. When sodium bicarbonate is heated, it decomposes to form sodium carbonate, water and carbon dioxide gas is evolved.

\[ 2\text{NaHCO}_3(s) \rightarrow \Delta \rightarrow \text{Na}_2\text{CO}_3(s) + \text{H}_2\text{O(l)} + \text{CO}_2\uparrow(g) \]

Sodium bicarbonate Sodium carbonate Water Carbon dioxide

11. Sodium carbonate is treated with dilute sulphuric acid.

Ans. When sodium chloride is treated with dilute sulphuric acid, it gives sodium sulphate, water and carbon dioxide gas is evolved with effervescence.

\[ \text{Na}_2\text{CO}_3(aq) + \text{H}_2\text{SO}_4(aq) \rightarrow \text{Na}_2\text{SO}_4(aq) + \text{H}_2\text{O(l)} + \text{CO}_2\uparrow(g) \]

Sodium carbonate Sulphuric acid Sodium sulphate Water Carbon dioxide

12. Bleaching powder is exposed to air.

Ans. When bleaching powder is exposed to air, CO₂ from air decomposes the powder slowly to produce chlorine.

\[ \text{CaOCl}_2(s) + \text{CO}_2(g) \rightarrow \text{CaCO}_3(s) + \text{Cl}_2\uparrow (g) \]

Bleaching powder Carbon Calcium Chlorine
13. When dry slaked lime reacts with chlorine gas.
Ans. When dry slaked lime reacts with chlorine gas to give bleaching powder.
\[
\text{Ca(OH)}_2(s) + \text{Cl}_2(g) \rightarrow \text{CaOCl}_2(aq) + \text{H}_2\text{O}(l)
\]
Calcium Chlorine Bleaching Water
hydroxide powder

14. What do salts of strong acids and weak bases give?
Ans. 1. The salt of strong acid and weak base gives acidic solution (having pH less than 7).
2. Eg. : Ammonium Chloride (NH₄Cl) is the salt of strong acid hydrochloric acid and weak base ammonium hydroxide. As it is formed from a strong acid and weak base, the aqueous solution of ammonium chloride is acidic.
3. Another such example is ammonium sulphate (NH₄)₂SO₄.

15. What do solution of salts of weak acids and strong bases give?
Ans. 1. The salt of weak acid and strong base gives basic solution (having pH more than 7).
2. Eg. : sodium carbonate (Na₂CO₃) is the salt of strong base sodium hydroxide and weak acid carbonic acid (H₂CO₃).
3. Another such an example is sodium acetate(CH₃COONa)

★ MEMORISE :
Bleaching powder is also called as calcium oxy chloride.
Metal + Acid → Salt + Hydrogen gas
Metal + Base → Salt + Hydrogen gas
Metal carbonate + Acid → Salt + Water + CO₂ (metal hydrogen carbonate)
Metal oxide + Acid → Salt and water
Carbonate/bicarbonate + dil. acid → Salt + Water + CO₂

– Extra Information.

<table>
<thead>
<tr>
<th>Solution</th>
<th>pH</th>
</tr>
</thead>
<tbody>
<tr>
<td>Conc HCl</td>
<td>0</td>
</tr>
<tr>
<td>Dil HCl</td>
<td>1.0</td>
</tr>
<tr>
<td>Gastric juices</td>
<td>1.4</td>
</tr>
<tr>
<td>Lemon juice</td>
<td>2.5</td>
</tr>
<tr>
<td>Vinegar</td>
<td>4.0</td>
</tr>
<tr>
<td>Tomato juice</td>
<td>4.1</td>
</tr>
<tr>
<td>Coffee</td>
<td>5.0</td>
</tr>
<tr>
<td>Milk</td>
<td>6.5</td>
</tr>
<tr>
<td>Soft drinks</td>
<td>6.0</td>
</tr>
<tr>
<td>Pure water</td>
<td>7.0</td>
</tr>
<tr>
<td>Saliva (before meals)</td>
<td>7.4</td>
</tr>
<tr>
<td>Salive (after meals)</td>
<td>5.8</td>
</tr>
<tr>
<td>Blood</td>
<td>7.4</td>
</tr>
<tr>
<td>Toothpaste</td>
<td>8.0</td>
</tr>
<tr>
<td>Milk of magnesia</td>
<td>10.5</td>
</tr>
<tr>
<td>Dil sodium hydroxide</td>
<td>13.0</td>
</tr>
<tr>
<td>Conc sodium hydroxide</td>
<td>14.0</td>
</tr>
</tbody>
</table>
ACTIVITY BASED QUESTIONS

ACTIVITY : 3.1

Q. Prepare the extract of red rose petals, turmeric, beet root and indigo. Keep the extract in 4 watch glasses. Cut small strips of white paper. Dip strips in each extract several times. Dry them thoroughly. Then take five small china dishes with five solutions of lemon juice, common salt, baking soda, vinegar and edible oil. Dip one strip in one solution and note the change in colour.

Ans. When strip made from rose petal and it is dipped in
1. Common salt : Colour doesn't change.
2. Baking soda : Colour changes to green.
3. Vinegar : Colour changes to red.
4. Edible oil : Colour changes to green.

ACTIVITY : 3.2

Q. Collect samples of vinegar, lime juice, NH₄OH (ammonium hydroxide) and hydrochloric acid. Add one drop of phenolphthalein, methyl orange and a litmus paper into each solution and note the observations. Tabulate the result in the following table.

<table>
<thead>
<tr>
<th>Sample solution</th>
<th>Red litmus</th>
<th>Blue litmus</th>
<th>Phenol phthalein</th>
<th>Methyl orange</th>
<th>Nature of solution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinegar</td>
<td></td>
<td>Turns red</td>
<td></td>
<td></td>
<td>Acidic</td>
</tr>
<tr>
<td>Lime juice</td>
<td>Remains red</td>
<td>Turns red</td>
<td>Colourless</td>
<td>Turns red</td>
<td>Acidic</td>
</tr>
<tr>
<td>NH₄OH</td>
<td>Turns blue</td>
<td>Remains blue</td>
<td>Turns pink</td>
<td>Turns yellow</td>
<td>Basic</td>
</tr>
<tr>
<td>HCl</td>
<td>Remains red</td>
<td>Turns red</td>
<td>Colourless</td>
<td>Turns red</td>
<td>Acidic</td>
</tr>
</tbody>
</table>

Ans.  | Sample solution | Red litmus | Blue litmus | Phenol phthalein | Methyl orange | Nature of solution |
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>Vinegar</td>
<td>Remains red</td>
<td>Turns red</td>
<td>Colourless</td>
<td>Turns red</td>
<td>Acidic</td>
<td></td>
</tr>
<tr>
<td>Lime juice</td>
<td>Remains red</td>
<td>Turns red</td>
<td>Colourless</td>
<td>Turns red</td>
<td>Acidic</td>
<td></td>
</tr>
<tr>
<td>NH₄OH</td>
<td>Turns blue</td>
<td>Remains blue</td>
<td>Turns pink</td>
<td>Turns yellow</td>
<td>Basic</td>
<td></td>
</tr>
<tr>
<td>HCl</td>
<td>Remains red</td>
<td>Turns red</td>
<td>Colourless</td>
<td>Turns red</td>
<td>Acidic</td>
<td></td>
</tr>
</tbody>
</table>

ACTIVITY : 3.3

Q. Take a few drops of Eucalyptus (nilgiri) oil in two test tubes each. To one of the test tubes add dilute HCl and to the other, add dil NaOH. Shake the test tube well and check the odour. You can choose some more substances with typical odour and analyse them. There are certain substances whose odour changes in acidic or basic medium. These substances are known as olfactory indicators.

Ans. Nilgiri or Eucalyptus oil which is an olfactory indicator helps us to identify whether the substance is acidic or basic. When dilute HCl is added to nilgiri oil, smell of nilgiri remains as it is; but when dilute NaOH is added to nilgiri oil, smell of oil goes away. This tells us acidic medium has no affect with olfactory indicators.
ACTIVITY : 3.4

Q. Collect samples of kokam extract, palak extract, any aerated drink, tomato juice, dil. HNO₃, dil. KOH, prepared tea, ginger with honey and butter milk in test tubes and add two drops of universal indicator to each. Note change in colour and also pH using the scale on the Universal Indicator bottle.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Original colour</th>
<th>Colour after addition of universal indicator</th>
<th>pH value</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kokam extract</td>
<td>Orange</td>
<td>Orange</td>
<td>4.5</td>
<td>Acidic</td>
</tr>
<tr>
<td>Palak extract</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Aerated extract</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Tomato juice</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dil. HNO₃</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dil. KOH</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Prepared tea</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ginger juice + Honey</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Butter milk</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Ans.

<table>
<thead>
<tr>
<th>Sample</th>
<th>Original colour</th>
<th>Colour after addition of universal indicator</th>
<th>pH value</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Kokam extract</td>
<td>Pink</td>
<td>Orange</td>
<td>4.5</td>
<td>Acidic</td>
</tr>
<tr>
<td>Palak extract</td>
<td>Green</td>
<td>Light green</td>
<td>6.5</td>
<td>Acidic</td>
</tr>
<tr>
<td>Aerated extract</td>
<td>Brown</td>
<td>Greenish yellow</td>
<td>6.0</td>
<td>Acidic</td>
</tr>
<tr>
<td>Tomato juice</td>
<td>Red</td>
<td>Orange</td>
<td>4.1</td>
<td>Acidic</td>
</tr>
<tr>
<td>Dil. HNO₃</td>
<td>Colourless</td>
<td>Orange red</td>
<td>3</td>
<td>Acidic</td>
</tr>
<tr>
<td>Dil. KOH</td>
<td>Colourless</td>
<td>Violet</td>
<td>14</td>
<td>Basic</td>
</tr>
<tr>
<td>Prepared tea</td>
<td>Brown</td>
<td>Orange yellow</td>
<td>5</td>
<td>Acidic</td>
</tr>
<tr>
<td>Ginger juice + Honey</td>
<td>Brown</td>
<td>Yellow</td>
<td>5.5</td>
<td>Acidic</td>
</tr>
<tr>
<td>Butter milk</td>
<td>White</td>
<td>Greenish yellow</td>
<td>6.5</td>
<td>Acidic</td>
</tr>
</tbody>
</table>

ACTIVITY : 3.6

Q. Collect sample of rain water. Add to it a few drops of universal indicator. Note the colour change and also pH. What is the nature of rain water ?

Ans. When you add universal indicator to rain water it turns orangish red, indicating pH value is between 0 to 7, which tell us rain water is acidic in nature.

ACTIVITY : 3.7

Q. Collect your own saliva sample in the morning before you brush your teeth. Collect one more sample and test its pH with universal indicator after you brush. What will happen if pH is below 5.5 ?

Ans. When we test the salival sample in the morning before brushing our teeth with universal indicator, it turns orangish red, indicating pH value is 5.5 i.e. between 0 to 7, which tells us saliva is acidic, as it is acidic it can
cause both decay. So we brush our teeth with paste, as soon as we do that and then test the saliva sample with universal indicator solution turns bluish indicating pH value is between 7 to 14, indicating that solution is basic in nature.

**ACTIVITY : 3.8**

Q. Collect various soil samples. Mix it with water and filter. Collect the filtrate in test tubes and test with universal indicator. Make a list of plants growing in that area.

Ans. Certains crops for proper growth require acidic soil, some require basic soil, so pH scale helps us to know whether the soil is acidic or basic.

**ACTIVITY : 3.9**

Q. Take a boiling test tube. Choose a proper stopper through which you can fix a gas passing tube. Take few pieces of Mg ribbon. Add dilute HCl to it. Take burning candle near the gas passing tube. What do you observe now ?

Repeat the same experiment with zinc and copper granules, using other acids such as dil H$_2$SO$_4$, dil HNO$_3$, CH$_3$COOH. What will you observe when iron nails are treated with conc. HCl ?

Ans. When we take burning candle near the gas passing tube, we hear a pop sound, this is because of release of hydrogen gas. When acid reacts with metal it gives corresponding salt and hydrogen gas. So if zinc and copper granules react with acids such as dil H$_2$SO$_4$, dil HNO$_3$, CH$_3$COOH it will give corresponding salt and hydrogen gas.

**ACTIVITY : 3.10**

Q. Take a few pieces of Al ribbon in a test tube add 3-5 ml of sodium hydroxide to the test tube and warm. Observe and repeat the process with Mg metal.

Ans. When Al ribbon is treated with NaOH, we get sodiummeta-aluminate and hydrogen gas is released.

When Mg metal is treated with NaOH, we get Na$_2$MgO$_2$ (Sodium magnesiate) and hydrogen gas is released.

**ACTIVITY : 3.11**

Q. Take 2 gm of Aluminium carbonate in boiling test tube, add dil HCl to it. Do not allow the gas to escape. Through the delivery tube allow the gas to pass through decanted solution of chalk with H$_2$O. What are your observation ?

Ans. Al$_2$(CO$_3$)$_3$ + 6HCl $\rightarrow$ 2AlCl$_3$ + 3H$_2$O + 3CO$_2$ ↑

During this reaction carbon dioxide gas is released, this gas when passed through decanted solution of chalk with H$_2$O it turns milky due to formation.
ACTIVITY : 3.12

Q. Take a small amount of red oxide (primer used before paint). Add to it a few drops of dil. HCl. What do you observe ? What is chemical formula of red oxide ?

Ans. When dil. HCl is added to red oxide i.e. (primer used before paint). We observe that the colour of the solution becomes blue. This is due to the formation of copper chloride.

\[ \text{CuO} + 2\text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2\text{O} \]

ACTIVITY : 3.13

Q. Take about 2-3 ml of dil. HCl in boiling test tube. Add to it 1-2 drops of phenolphthalein as indicator. Note the colour. Add NaOH solution drop by drop to the test tube. Is there any colour change ? Why do you think the colour has changed ? If you add dil. HCl to the solution, will you be able to note any colour change ?

Ans. When we take dil. HCl and add phenolphthalein as indicator solution remains colourless. Now when we start adding NaOH solution drop by drop solutions colour slowly starts turning pinkish. The change in colour has occurred because NaOH which is a base when added to acid i.e. HCl, it neutralized the acid and gave us salt and water.

ACTIVITY : 3.14

Q. Take 25 ml of sugal solutions in 100 ml beaker. Dip two carbon electrodes. Connect the electrodes to two terminals of a 6 volt battery through a bulb and switch. What do you observe ? If you repeat the same experiment with dil. HCl, methyl alcohol, dil. H₂SO₄, what happens ?

Glowing of the bulb indicated flow of electric current through the solution. Bulb will not glow in case of glucose and methyl alcohol, because in these solutions ions are not formed.

<table>
<thead>
<tr>
<th>Type of solution</th>
<th>Result (Whether bulb glows or not)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Sugar solution</td>
<td>Bulb doesn’t glow</td>
</tr>
<tr>
<td>2. Dil HCl</td>
<td>Bulb glows</td>
</tr>
<tr>
<td>3. Methyl alcohol</td>
<td>Bulb doesn’t glow</td>
</tr>
<tr>
<td>4. Dil H₂SO₄</td>
<td>Bulb glows</td>
</tr>
<tr>
<td>5. Ca (OH)₂</td>
<td>Bulb glows</td>
</tr>
<tr>
<td>6. NaOH</td>
<td>Bulb glows</td>
</tr>
</tbody>
</table>

ACTIVITY : 3.15

Q. Take 0.5 gm of copper chloride salt in a test tube. Add to it few drops of conc. H₂SO₄. Test the gas evolved with wet and dry litmus papers. Which state, wet or dry, will show change in colour with litmus ? What precautions will need to be taken in humid condition ?

Ans. When gas evolved which is HCl is tested with dry litmus paper there is no effect, but when the same gas tested with wet litmus paper it turns red. This is because acid behaves as acid in aqueous medium itself.
**ACTIVITY : 3.16**

Q. Prepare saturated solutions to these salts add 2-3 drops of universal indicator to it. Note the observations.

<table>
<thead>
<tr>
<th>Salt</th>
<th>Original colour</th>
<th>Colour after addition of universal indicator</th>
<th>pH value</th>
<th>Nature</th>
</tr>
</thead>
<tbody>
<tr>
<td>Common salt</td>
<td>Colourless</td>
<td>Algal green</td>
<td>7</td>
<td>Neutral</td>
</tr>
<tr>
<td>Soap</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Washing soda</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Baking soda</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bleaching powder</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>POP</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**Ans.**

<table>
<thead>
<tr>
<th>Salt</th>
<th>Original colour</th>
<th>Colour after addition of universal indicator</th>
<th>pH value</th>
<th>Nature</th>
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<tr>
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<td>7</td>
<td>Neutral</td>
</tr>
<tr>
<td>Soap</td>
<td>White</td>
<td>Greenish blue</td>
<td></td>
<td>Basic</td>
</tr>
<tr>
<td>Washing soda</td>
<td>White</td>
<td>Bluish</td>
<td></td>
<td>Basic</td>
</tr>
<tr>
<td>Baking soda</td>
<td>White</td>
<td>Bluish</td>
<td></td>
<td>Basic</td>
</tr>
<tr>
<td>Bleaching powder</td>
<td>White</td>
<td>Bluish</td>
<td></td>
<td>Basic</td>
</tr>
<tr>
<td>POP</td>
<td>White</td>
<td>Bluish</td>
<td></td>
<td>Basic</td>
</tr>
</tbody>
</table>

**ACTIVITY : 3.17**

Q. Take few crystals of copper sulphate in a boiling test tube. Heat the test tube. What is the colour of copper sulphate after you heat it ? What else do you observe on inner side of the test tube ?

**Ans.** Copper sulphate CuSO₄·5H₂O is blue crystalline salt, but when heated its blue colour fades away, because 5H₂O molecules gets evaporated and this fix number of water molecules is responsible for its colour.
1. What are strong and weak bases?
   **Ans.** Bases which ionize in water to give large amount of hydroxide ions (OH)\(^{-}\) are called strong bases. Bases which ionize in water to give small amount of hydroxide ions (OH)\(^{-}\) are called weak bases.

2. You are provided with three test tubes. One has water, the other two contain acid and alkali in it. Using methyl orange, will you be able to identify them? How?
   **Ans.**
   - Methyl orange added to water → No change in colour.
   - Methyl orange added to acid → Acid turns pink.
   - Methyl orange added to alkali → Alkali turns yellow.

3. If the concentration of OH\(^{-}\) is increased, what will it increase or decrease?
   **Ans.** If the concentration of OH\(^{-}\) is increased, the pH will increase and the solution becomes more alkaline.

4. When will the strength of an acid increase?
   **Ans.** The strength of an acid increases with increase in concentration of hydrogen ions (H\(^{+}\)).

---

**QUESTIONS & ANSWERS (TEXTBOOK PAGE NO. 26)**

1. What will be the reaction of metal oxide with alkali?
   **Do they react with alkali? If not why?**
   **Ans.** Metal oxides do not react with alkali. Metal oxides are basic in nature so there will be no reaction of metal oxides with alkali.
1. A few crystals of blue substance are taken in a test-tube. Droplets of water emerge on the inner surface of the test tube on heating the substance.
   (a) What are the droplets of water called as?
   (b) Substance left in the test tube after heating is called as ........

Ans. (a) Water of crystallization.
   (b) Anhydrous substance.

2. What would happen if
   (a) a few drops of strongly smelling eucalyptus oil was treated with vinegar.
   (b) the rain water mixing with river water was found to be having pH less than 7.
   (c) sonal brushes her teeth with the best quality toothpaste everyday.
   (d) electrolysis is carried out on sodium chloride solution.
   (e) copper sulphate is heated.

Ans. (a) Vinegar is an acid strong odour of eucalyptus oil remain as it is in acid.
   (b) That means river water is acidic in nature and it will damages to those who drink it or destroys the plants and bushes come in contact with it.
   (c) The toothpastes contains substance basic in nature. The food particles in the mouth are degraded by bacteria to produce acid with pH below 6. Base in toothpaste neutralizes the same.
   (d) Sodium is deposited at cathode and Cl₂ gas is liberated at anode.
   (e) Copper sulphate looses water molecule on heating these water molecules are known as water of crystallization and we get anhydrous copper sulphate.

3. State substance X and Y are metals or metal oxides.
   (a) Substance X when combine with acid forms salt and water.
   (b) Substance Y when combine with acid forms salt and Hydrogen gas.

Ans. (a) Metal oxide.
   (b) Metal.

4. Ram and Shyam want to prepare dilute H₂SO₄. Ram added concentrated H₂SO₄ to water slowly with constant stirring and cooling water. And Shyam added water to conc. H₂SO₄. Name the student who was correct and why?

Ans. Ram was correct. The reaction is exothermic. If water is added to conc. H₂SO₄ the heat generated may cause the mixture to splash out and cause burns. the glass container may also break due to excessive local heating.
The burning sensation we get from chilli peppers is because of a chemical called Capsaicin.

A bee sting is acidic and a wasp sting is alkali. To treat a sting by one of these you should use the opposite type of chemical.

**GLOSSARY**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dye</td>
<td>Generally be described as a coloured substance that has an affinity to the substrate to which it is being applied.</td>
</tr>
<tr>
<td>Eucalyptus oil</td>
<td>Generic name for distilled oil from the leaf of eucalyptus.</td>
</tr>
<tr>
<td>Vinegar</td>
<td>It contains acetic acid that is an organic acid that gives vinegar its sour taste and pungent smell.</td>
</tr>
<tr>
<td>Effervescence</td>
<td>Escape of gas from an aqueous solution and the foaming or fizzing that results from a release of the gas.</td>
</tr>
<tr>
<td>Anhydrous salt</td>
<td>A salt that does not contain any water of crystallization is called as anhydrous salt.</td>
</tr>
<tr>
<td>Disinfectant</td>
<td>Destruction of harmful bacteria with the help of chemicals like bleaching powder, formaldehyde etc.</td>
</tr>
</tbody>
</table>

**AMAZING FACTS**

- The burning sensation we get from chilli peppers is because of a chemical called Capsaicin.
- A bee sting is acidic and a wasp sting is alkali. To treat a sting by one of these you should use the opposite type of chemical.
CHAPTER 3: ACID BASE CHEMISTRY

Q.I [A] Fill in the blanks:
1. Most of the acidic substances are ....................... in taste.
2. Phenolphthalein is ....................... type of indicator.
3. Sodium or potassium salt of higher fatty acids are ....................... .
4. 10% NaCl is known as ....................... .

Q.I [B] Match the columns:

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydronium ion</td>
<td>(a) Brown</td>
</tr>
<tr>
<td>Sodium chloride</td>
<td>(b) Baking soda</td>
</tr>
<tr>
<td>Impure NaCl</td>
<td>(c) H$_3$O$^+$</td>
</tr>
<tr>
<td>Sodium bicarbonate</td>
<td>(d) Neutral salt</td>
</tr>
</tbody>
</table>

Q.II [A] Give scientific reasons: (Any Two)
1. Baking powder is used in preparation of cakes and breads in bakery industry.
2. Pure gaseous HCl is a bad conductor of electricity but in water it forms a conducting solution.
3. Bleaching powder has a strong smell of chlorine.

Q.II [B] Distinguish between:
1. Washing soda and Baking soda.

Q.III [A] Answer in brief: (Any One)
1. State the properties of acids.
2. Write a short note on water of crystallization with examples.

Q.III [B] Write answer in short: (Any One)
1. State the uses of bleaching powder.
2. What are the uses of baking soda? or State applications of baking soda?

Q.IV Explain the following chemical reactions with the help of balanced equation: (Any Three)
1. Aluminium reacts with dilute hydrochloric acid.
2. Iron reacts with dilute hydrochloric acid.
3. Baking soda (sodium hydrogen carbonate) reacts with dilute hydrochloric acid.
4. Copper chloride reacts with dilute sulphuric acid.

Q.V [A] Answer the following in one sentence each:
1. Name a few natural indicators.
2. What do acids generate in aqueous medium?
3. What is bleaching powder also called as?
4. What are anhydrous substances?
5. What is the formula of red oxide?

Q.V [B] Define the following:
1. Saponification.
2. Universal indicator

Best Of Luck