Class 10 Science

Notes

Chapter 2 Acids Bases and Salts

Indicators: Indicators are substances which indicate the acidic or basic nature of the solution by the colour change.
Types of Indicator: There are many types of indicators. Some common types of indicators are:

1. Natural Indicators: 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.
Litmus: Litmus is obtained from lichens. The solution of litmus is purple in colour. Litmus paper comes in two colours- blue and red.
An acid turns blue litmus paper red.
A base turns red litmus paper blue.

Indicator	Original Colour	Acid	Base
Red litmus	Red	No Change	Blue
Blue litmus	Blue	Red	No change
Turmeric	Yellow	No Change	Reddish brown
Red cabbage juice	Purple	Reddish	Greenish yellow
Phenolphthalein	Colourless	Colourless	Pink
Methyl Orange	Orange	Red	Yellow
Onion	n/a	No change	Smell vanishes
Vanilla	n/a	No change	Smell vanishes

Turmeric: Turmeric is another natural indicator. Turmeric is yellow in colour. Turmeric solution or paper turns reddish brown with base. Turmeric does not change colour with acid.

Red Cabbage: The juice of red cabbage is originally purple in colour. Juice of red cabbage turns reddish with acid and turns greenish with base.

2. Olfactory Indicator: Substances which change their smell when mixed with acid or base are known as Olfactory Indicators. For example; Onion, vanilla etc.
Onion: Paste or juice of onion loses its smell when added with base. It does not change its smell with acid.
Vanilla: The smell of vanilla vanishes with base, but its smell does not vanish with an acid.
Olfactory Indicators are used to ensure the participation of visually impaired students in the laboratory.

3. Synthetic Indicator: Indicators that are synthesized in the laboratory are known as Synthetic Indicators. For example; Phenolphthalein, methyl orange, etc.
Phenolphthalein is a colourless liquid. It remains colourless with acid but turns into pink with a base.
Methyl orange is originally orange in colour. It turns into the red with acid and turns into yellow with base.

Acids: Acids are sour in taste, turn blue litmus red, and dissolve in water to release H^+ ions.

Organic Acids and their Sources	
Acids	**Sources**
Acetic acid	**Vinegar**
Ascorbic acid	**Guava, amla**
Citric acid	**Lemon, orange and other citrus fruits**
Lactic acid	**Sour milk, curd**
Methanoic acid	**Ant sting, nettle sting**
Oxalic acid	**Tomato**
Tartaric acid	**Tamarind**

Example: Sulphuric acid (H_2SO_4), Acetic Acid (CH_3COOH), Nitric Acid (HNO_3) etc.
Properties of Acids:

Acids have a sour taste.

Turns blue litmus red.

Acid solution conducts electricity.

Release H^+ ions in aqueous solution.

Types of Acids: Acids are divided into two types on the basis of their occurrence i.e., Natural acids and Mineral acids.
(i) Natural Acids: Acids which are obtained from natural sources are called Natural Acids or Organic Acids.
Examples:
Methanoic acid (HCOOH)
Acetic acid (CH_3COOH)
Oxalic acid ($C_2H_2O_4$) etc.

(ii) Mineral Acids: Acids that are prepared from minerals are known as Mineral Acids Example; Inorganic acids, man-made acids or synthetic acid are also known as Mineral Acids.
Example:
Hydrochloric acid (HCl)
Sulphuric acid (H_2SO_4)
Nitric acid (HNO_3)
Carbonic acid (H_2CO_3)
Phosphoric acid (H_3PO_4) etc.

Chemical Properties of Acid:
(i) Reaction of acids with metal: Acids give hydrogen gas along with respective salt when they react with a metal.
Metal + Acid → Salt + Hydrogen
Examples:
Hydrogen gas and zinc chloride are formed when hydrochloric acid reacts with zinc metal.

$$\underset{\text{Zinc sulphate}}{Zn(s)} + \underset{\text{Hydrochloric acid}}{2HCl(aq)} \longrightarrow \underset{\text{Zinc chloride}}{ZnCl_2(aq)} + \underset{\text{Hydrogen}}{H_2(g)}$$

Hydrogen gas and sodium sulphate are formed when sulphuric acid reacts with sodium metal.

$$\underset{\text{Sodium}}{2Na(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4(aq)} \longrightarrow \underset{\text{Sodium sulphate}}{Na_2SO_4(aq)} + \underset{\text{Hydrogen}}{H_2(g)}$$

Test For Hydrogen Gas: The gas evolved after reaction of acid with metal can be tested by bringing a lighted candle near it. If the gas bums with a pop sound, then it confirms the evolution of hydrogen gas. Burning with pop sound is the characteristic test for hydrogen gas.

(ii) Reaction of acids with metal carbonate: Acids give carbon dioxide gas and respective salts along with water when they react with metal carbonates.
Metal carbonate + Acid → Salt + Carbon dioxide + Water
Examples:
Hydrochloric acid gives carbon dioxide gas, sodium chloride along with water when reacts with sodium carbonate.

$$\underset{\text{Sodium carbonate}}{Na_2CO_3(aq)} + \underset{\text{Hydrochloric acid}}{2HCl(aq)} \longrightarrow \underset{\text{Sodium chloride}}{2NaCl(aq)} + \underset{\text{Carbon dioxide}}{CO_2(g)} + \underset{\text{Water}}{H_2O(l)}$$

Sulphuric acid gives calcium sulphate, carbon dioxide gas, calcium sulphate and water when it reacts with calcium carbonate

$$\underset{\text{Calcium carbonate}}{CaCO_3(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4(aq)} \longrightarrow \underset{\text{Calcium sulphate}}{CaSO_4(aq)} + \underset{\text{Carbon dioxide}}{CO_2(g)} + \underset{\text{Water}}{H_2O(l)}$$

Nitric acid gives sodium nitrate, water and carbon dioxide gas when it reacts with sodium carbonate.

$$\underset{\text{Nitric acid}}{2HNO_3(aq)} + \underset{\text{Sodium carbonate}}{Na_2CO_3(aq)} \longrightarrow \underset{\text{Sodium nitrate}}{Na_2NO_3(aq)} + \underset{\text{Water}}{H_2O(g)} + \underset{\text{Carbon dioxide}}{CO_2(l)}$$

(iii) Reaction of acid with hydrogen carbonates (bicarbonates): Acids give carbon dioxide gas, respective salt and water when they react with metal hydrogen carbonate.
Acid + Metal hydrogen carbonate → Salt + Carbon dioxide + Water
Example:
Sulphuric acid gives sodium sulphate, Carbon dioxide gas and water when it reacts with sodium bicarbonate.

$$2NaHCO_3(aq) + H_2SO_4(aq) \longrightarrow NaCl(aq) + CO_2(g) + H_2O(l)$$

Sodium bicarbonate — Sulphuric acid — Sodium chloride — Carbon dioxide — Water

Test For Evolution of Carbon Dioxide Gas: Carbon dioxide turns lime water milky when passed through it. This is the characteristic test for carbon dioxide gas.
The gas evolved because of reaction of the acid with metal carbonate or metal hydrogen carbonate turns lime water milky. This shows that the gas is carbon dioxide gas. This happens because of the formation of a white precipitate of calcium carbonate.

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

Calcium hydroxide — Carbon dioxide — Calcium carbonate (Milky) — Water

$$CaCO_3(s) + CO_2(g) + H_2O(l) \longrightarrow Ca(HCO_3)_2(aq)$$

Calcium carbonate — Carbon dioxide — Water — Calcium hydrogen carbonate

But when excess of carbon dioxide is passed through lime water, it makes milky colour of lime water disappear. This happens because of formation of calcium hydrogen carbonate. As calcium hydrogen carbonate is soluble in water, thus, the milky colour of solution mixture disappears.

Common in Acids: Acids give hydrogen gas when they react with metal. This shows that all acids contains hydrogen. For example; Hydrochloric acid (HCl), sulphuric acid (H_2SO_4), nitric acid (HNO_3), etc.
When an acid is dissolved in water, it dissociates hydrogen. The dissociation of hydrogen ion in aqueous solution is the common property in all acids. Because of the dissociation of hydrogen ion in aqueous solution, an acid shows acidic behaviour.
Examples:
Hydrochloric acid (HCl) gives hydrogen ion (H^+) and chloride ion (Cl^-) when it is dissolved in water.

$$HCl(aq) \longrightarrow H^+(aq) + Cl^-(aq)$$

Hydrochloric acid — Hydrogen ion — Chloride ion

Acetic acid (CH_3COOH) gives acetate ion ($CH3COO^-$) and hydrogen ion (H^+).

$$CH_3COOH\ (aq) \longrightarrow CH_3COO^-(aq) + H^+(aq)$$

Acetic acid — Acetate ion — Hydrogen ion

Acids

Strong Acids
An acid which is completely ionised in water and produces (H^+) is called Strong Acid.
Examples: Hydrochloric acid (HCl), Sulphuric acid (H_2SO_4), Nitric acid (HNO_3)

Weak Acids
An acid which is partially ionised in water and thus produces a small amount of hydrogen ions (H^+) is called a Weak Acid.
Example: Acetic acid (CH_3COOH), Carbonic acid (H_2CO_3)

When a concentrated solution of acid is diluted by mixing water, then the concentration of Hydrogen ions (H^+) or hydronium ion (H_3O^-) per unit volume decreases.

Bases: Bases are bitter in taste, have soapy touch, turn red litmus blue and give hydroxide ions (OH^-) in aqueous solution.
Examples: Sodium hydroxide (caustic soda) – NaOH
Calcium hydroxide – $Ca(OH)_2$
Potassium hydroxide (caustic potash) – (KOH)

Properties of Bases:

Have a bitter taste.

Soapy to touch.

Turns red litmus blue.

Conducts electricity in solution.

Release OH^- ions in Aqueous Solution

Types of bases: Bases can be divided in two types – Water soluble and Water-insoluble.
The hydroxide of alkali and alkaline earth metals are soluble in water. These are also known as alkali.
For example; sodium hydroxide, magnesium hydroxide, calcium hydroxide, etc. Alkali is considered a strong base.

Chemical properties of bases:
(i) Reaction of Base with Metals: When alkali (base) reacts with metal, it produces salt and hydrogen gas.
Alkali + Metal → Salt + Hydrogen
Examples: Sodium hydroxide gives hydrogen gas and sodium zincate when reacts with zinc metal.

$$2NaOH(aq) + Zn(s) \longrightarrow Na_2ZnO_2(aq) + H_2(g)$$
Sodium hydroxide — Zinc — Sodium zincate — Hydrogen

Sodium aluminate and hydrogen gas are formed when sodium hydroxide reacts with aluminium metal.

$$2NaOH(aq) + 2Al(s) + 2H_2O(l) \longrightarrow 2NaAlO_2(aq) + 3H_2(g)$$
Sodium hydroxide — Aluminium — Water — Sodium aluminate — Hydrogen

(ii) Reaction of Base with Oxides of Non-metals: Non-metal oxides are acidic in nature. For example; carbon dioxide is a non-metal oxide. When carbon dioxide is dissolved in water it produces carbonic acid.
Therefore, when a base reacts with non-metal oxide, both neutralize each other resulting respective salt and water.
Base + Non-metal oxide → Salt + Water
(Non-metal oxides are acidic in nature)
Examples:
Sodium hydroxide gives sodium carbonate and water when it reacts with carbon dioxide.

$$2NaOH(aq) + CO_2(g) \longrightarrow Na_2CO_3(aq) + H_2O(l)$$
Sodium hydroxide — Carbon dioxide — Sodium Carbonate — Water

Calcium hydroxide gives calcium carbonate and water when it reacts with carbon dioxide.

$$Ca(OH)_2(aq) + CO_2(g) \longrightarrow CaCO_3(s) + H_2O(l)$$
Calcium hydroxide — Carbon dioxide — Calcium carbonate (salt) — Water

(iii) Neutralisation Reaction: An acid neutralizes a base when they react with each other and respective salt and water are formed.
Acid + Base → Salt + Water
Since, the reaction between acid and base both neutralize each other, hence, it is also known as Neutralization Reaction.
Examples: Sodium chloride and water are formed when hydrochloric acid reacts with sodium hydroxide (a strong base).

$$HCl(aq) + NaOH(aq) \longrightarrow NaCl(aq) + H_2O(l)$$
Hydrochloric acid — Sodium hydroxide — Sodium chloride — Water

In a similar way, calcium chloride is formed along with water when hydrochloric acid reacts with calcium hydroxide (a base).

$$2HCl(aq) + Ca(OH)_2(aq) \longrightarrow CaCl_2(aq) + 2H_2O(l)$$
Hydrochloric acid — Calcium hydroxide — Calcium chloride — Water

(iv) Reaction of Acid with Metal Oxides: Metal oxides are basic in nature. Thus, when an acid reacts with a metal oxide both neutralize each other. In this reaction, the respective salt and water are formed.

Acid + Metal Oxide → Salt + Water
(Metal oxides are basic in nature)
Examples:
Calcium is a metal, thus, calcium oxide is a metallic oxide which is basic in nature. When an acid, such as hydrochloric acid, reacts with calcium oxide, neutralization reaction takes place and calcium chloride, along with water is formed.

$$2HCl(aq) + CaO(s) \longrightarrow CaCl_2(aq) + H_2O(l)$$

Hydrochloric acid — Calcium oxide — Calcium chloride — Water

Similarly, when sulphuric acid reacts with zinc oxide, zinc sulphate and water are formed.

$$H_2SO_4(aq) + ZnO(aq) \longrightarrow ZnCl_2(aq) + H_2O(l)$$

Sulphuric acid — Zinc oxide — Zinc chloride — Water

Common in all bases: A base dissociates hydroxide ion in water, which is responsible for the basic behaviour of a compound.
Example: When sodium hydroxide is dissolved in water, it dissociates hydroxide ion and sodium ion.

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

Sodium hydroxide — Sodium ion — Hydroxide ion

Similarly, when potassium hydroxide is dissolved in water, it dissociates hydroxide ion and potassium ion.

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

Potassium hydroxide — Potassium ion — Hydroxide ion

Thus, the base shows its basic character because of dissociation of hydroxide ion.

Neutralisation Reaction: When an acid reacts with a base, the hydrogen ion of acid combines with the hydroxide ion of base and forms water. As these ions combine together and form water instead of remaining free, thus, both neutralize each other.

$$OH^-(aq) + H^+(aq) \longrightarrow H_2O(l)$$

Hydroxide ion — Hydrogen ion — Water

Example: When sodium hydroxide (a base) reacts with hydrochloric acid, sodium hydroxide breaks into a sodium ion and hydroxide ion and hydrochloric acid breaks into hydrogen ion and chloride ion.
Hydrogen ion and hydroxide ion combine together and form water, while sodium ion and chloride ion combine together and form sodium chloride.

$$NaOH(aq) + HCl(aq) \longrightarrow OH^-(aq) + Na^+(aq) + Cl^-(aq) \longrightarrow NaCl(aq) + H_2O(l)$$

Sodium hydroxide — Hydrochloric acid — Hydroxide ion — Sodium ion — Chloride ion — Sodium chloride — Water

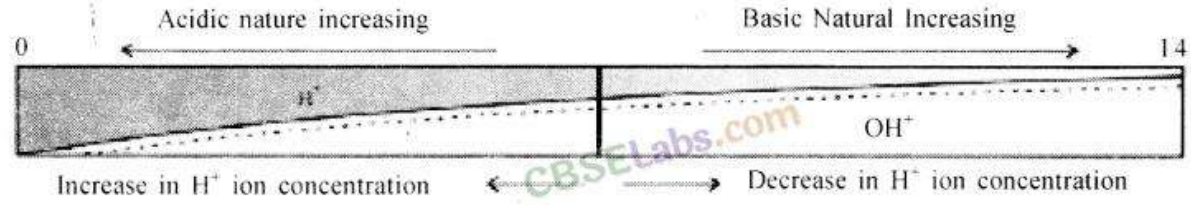
Dilution of Acid and Base: The concentration of hydrogen ion in an acid and hydroxide ion in a base, per unit volume, shows the concentration of acid or base.

By mixing of acid to water, the concentration of hydrogen ion per unit volume decreases. Similarly, by addition of base to water, the concentration of hydroxide ion per unit volume decreases. This process of addition of acid or base to water is called Dilution and the acid or base is called Diluted.

The dilution of acid or base is exothermic. Thus, acid or base is always added to water and water is never added to acid or base. If water is added to a concentrated acid or base, a lot of heat is generated, which may cause splashing out of acid or base and may cause severe damage as concentrated acid and base are highly corrosive.

Strength of Acid and Base: Acids in which complete dissociation of hydrogen ion takes place are called Strong Acids. Similarly, bases in which complete dissociation of hydroxide ion takes place are called Strong Bases.
In mineral acid, such as hydrochloric acid, sulphuric acid, nitric acid, etc. hydrogen ion dissociates completely and hence, they are considered as strong acids. Since inorganic acids hydrogen ions do not dissociate completely, so they are weak

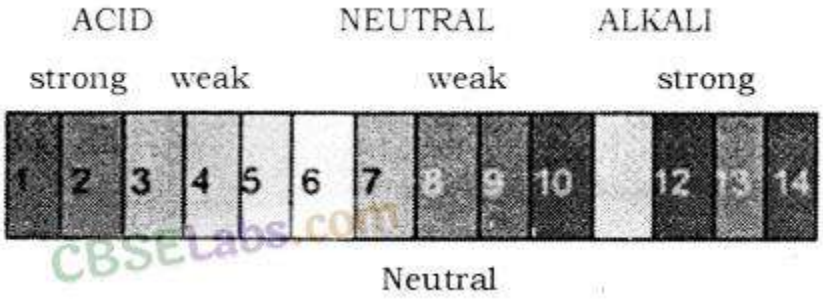
acids.



For water or neutral solutions : pH = 7
For acidic solutions : pH < 7
For basic solution : pH > 7

Universal Indicator: Using a litmus paper, phenolphthalein, methyl orange, etc. only the acidic or basic character of a solution can be determined, but the use of these indicators does not give the idea about the strength of acid or base. So, to get the strength as well as acidic and basic nature of a given solution universal indicator is used.

Universal indicator shows different colour over the range of pH value from 1 to 14 for a given solution. Universal indicator is available both in the form of strips and solution. Universal indicator is the combination of many indicators, such as water, propanol, phenolphthalein, sodium salt, sodium hydroxide, methyl red, bromothymol blue monosodium salt, and thymol blue monosodium salt. The colour matching chart is supplied with a universal indicator which shows the different colours for different values of pH.



pH value shown by different colours role of pH everyday life:
(i) pH in our digestive system: Dilute HCl (Hydrochloric acid) helps in digestion of food (proteins) in our stomach. Excess acid in stomach causes acidity (indigestion). Antacids like magnesium hydroxide [$Mg(OH)_2$] also known as milk of magnesia and sodium hydrogen carbonate (baking soda) are used to neutralize excess acid.

(ii) Tooth decay caused by acids: The bacteria present in our mouth converts the sugar into acids. When the pH of acid formed in the mouth falls below 5.5, tooth-decaying starts. The excess acid has to be removed by cleaning the teeth with a good quality toothpaste because these kinds of toothpaste are alkaline in nature.

(iii) Soil of pH and plant growth: Most of the plants have a healthy growth when the soil has a specific pH (close to 7) range which should be neither alkaline nor highly acidic. Therefore,

Compound 'X' is Sodium hydroxide (NaOH).

Compound 'A' is Zinc sulphate ($ZnSO_4$).

Compound 'B' is Sodium chloride (NaCl).

Compound 'C' is Sodium acetate (CH_3COONa)

Salts: Salts are the ionic compounds which are produced after the neutralization reaction between acid and base. Salts are electrically neutral. There are number of salts but sodium chloride is the most common among them. Sodium chloride is also known as table salt or common salt. Sodium chloride is used to enhance the taste of food.

Characteristics of salt:

Most of the salts are crystalline soild.

Salts may be transparent or opaque.

Most of the salts are soluble in water.

Solution of the salts conducts electricity in their molten state also.

The salt may be salty, sour, sweet, bitter and umami (savoury).

Neutral salts are odourless.

Salts can be colourless or coloured.

Family of Salt: Salts having common acidic or basic radicals are said to belong to the same family.
Example:
(i) Sodium chloride (NaCl) and Calcium chloride ($CaCl_2$) belongs to chloride family.
(ii) Calcium chloride ($CaCl_2$) and Calcium sulphate ($CaSO_4$) belongs to calcium family.
(iii) Zinc chloride ($ZnCl_2$) and Zinc sulphate ($ZnSO_4$) belongs to the zinc family.

Neutral, Acidic and Basic Salts:
(i) Neutral Salt: Salts produced because of reaction between a strong acid and strong base are neutral in nature. The pH value of such salts is equal to 7, i.e. neutral.
Example : Sodium chloride, Sodium sulphate. Postassium chloride, etc.

Sodium chloride (NaCl): It is formed after the reaction between hydrochloric acid (a strong acid) and sodium hydroxide (a strong base).

$$\underset{\text{Sodium hydroxide}}{NaOH\,(aq)} + \underset{\text{Hydrochloric acid}}{HCl\,(aq)} \longrightarrow \underset{\text{Sodium chloride}}{NaCl\,(aq)} + \underset{\text{Water}}{H_2O(l)}$$

Sodium Sulphate (Na_2SO_4): It is formed after the reaction between sodium hydroxide (a strong base) and sulphuric acid (a strong acid).

$$\underset{\text{Sodium hydroxide}}{2NaOH\,(aq)} + \underset{\text{Sulphuric acid}}{H_2SO_4(aq)} \longrightarrow \underset{\text{Sodium sulphate}}{Na_2SO_4(aq)} + \underset{\text{Water}}{2H_2O(l)}$$

Potassium Chloride (KCl): It is formed after the reaction between potassium hydroxide (a strong base) and hydrochloric acid (a strong acid).

$$\underset{\text{Potassium hydroxide}}{KOH(aq)} + \underset{\text{Hydrochloric acid}}{HCl(aq)} \longrightarrow \underset{\text{Potassium chloride}}{KCl(aq)} + \underset{\text{Water}}{H_2O(l)}$$

(ii) Acidic Salts: Salts which are formed after the reaction between a strong acid and weak base are called Acidic salts. The pH value of acidic salt is lower than 7. For example Ammonium sulphate, Ammonium chloride, etc.
Ammonium chloride is formed after reaction between hydrochloric acid (a strong acid) and ammonium hydroxide (a weak base).

$$\underset{\text{Ammonium hydroxide}}{NH_4OH(aq)} + \underset{\text{Hydrochloric acid}}{HCl(aq)} \longrightarrow \underset{\text{Ammonium chloride}}{NH_4Cl(aq)} + \underset{\text{Water}}{H_2O(l)}$$

Ammonium sulphate is formed after reaction between ammonium hydroxide (a weak base) and sulphuric acid (a strong acid).

$$\underset{\text{Ammonium hydroxide}}{2NH_4OH(aq)} + \underset{\text{Sulphuric acid}}{H_2SO_4(aq)} \longrightarrow \underset{\text{Ammonium sulphate}}{(NH_4)_2SO_4(aq)} + \underset{\text{Water}}{2H_2O(l)}$$

(iii) Basic Salts: Salts which are formed after the reaction between a weak acid and strong base are called Basic Salts. For example; Sodium carbonate, Sodium acetate, etc.
Sodium carbonate is formed after the reaction between sodium hydroxide (a strong base) and carbonic acid (a weak acid).

$$\underset{\text{Carbonic acid}}{H_2CO_3(aq)} + \underset{\text{Sodium hydroxide}}{2NaOH(aq)} \longrightarrow \underset{\text{Sodium carbonate}}{Na_2CO_3} + \underset{\text{Water}}{H_2O(l)}$$

Sodium acetate is formed after the reaction between a strong base, sodium hydroxide (a strong base) and acetic acid, (a weak acid).

$$\underset{\text{Acetic acid}}{CH_3COOH(aq)} + \underset{\text{Sodium hydroxide}}{NaOH(aq)} \longrightarrow \underset{\text{Sodium acetate}}{CH_3COONa(aq)} + \underset{\text{Water}}{H_2O(l)}$$

Cause of formation of acidic, basic and neutral salts:

When a strong acid reacts with a weak base, the base is unable to fully neutralize the acid. Due to this, an acidic salt is formed.

When a strong base reacts with a weak acid, the acid is unable to fully neutralize the base. Due to this, a basic salt is formed.

When equally strong acid and a base react, they fully neutralize each other. Due to this, a neutral salt is formed.

pH value of salt:

Neutral salt: The pH value of a neutral salt is almost equal to 7.

Acidic salt: The pH value of an acidic salt is less than 7.

Basic salt: The pH value of a basic salt is more than 7.

Some Important Chemical Compounds
1. Common Salt (Sodium Chloride): Sodium chloride (NaCl) is also known as Common or Table Salt. It is formed after the reaction between sodium hydroxide and hydrochloric acid. It is a neutral salt. The pH value of sodium chloride is about 7. Sodium chloride is used to enhance the taste of food. Sodium chloride is used in the manufacturing of many chemicals.

Important chemical from sodium chloride
Sodium Hydroxide (NaOH): Sodium hydroxide is a strong base. It is also known as caustic soda. It is obtained by the electrolytic decomposition of solution of sodium chloride (brine). In the process of electrolytic decomposition of brine (aqueous solution of sodium chloride), brine decomposes to form sodium hydroxide. In this process, chlorine is obtained at anode and hydrogen gas is obtained at cathode as by products. This whole process is known as Chlor – Alkali process.

$$\underset{\text{Sodium chloride}}{2NaCl(aq)} + \underset{\text{Water}}{2H_2O(l)} \rightarrow \underset{\text{Sodium hydroxide}}{2NaOH(aq)} + \underset{\text{Chlorine}}{Cl_2(g)} + \underset{\text{Hydrogen}}{H_2(g)}$$

Use of products after the electrolysis of brine:

Hydrogen gas is used as fuel, margarine, in making of ammonia for fertilizer, etc.

Chlorine gas is used in water treatment, manufacturing of PVC, disinfectants, CFC, pesticides. It is also used in the manufacturing of bleaching powder and hydrochloric acid.

Sodium hydroxide is used for degreasing of metals, manufacturing of paper, soap, detergents, artificial fibres, bleach, etc.

2. Bleaching Powder ($CaOCl_2$): Bleaching powder is also known as chloride of lime. It is a solid and yellowish white in colour. Bleaching powder can be easily identified by the strong smell of chlorine.
When calcium hydroxide (slaked lime) reacts with chlorine, it gives calcium oxychloride (bleaching powder) and water is formed.

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

Slaked lime — Chlorine — Bleaching powder — Water

Aqueous solution of bleaching powder is basic in nature. The term bleach means removal of colour. Bleaching powder is often used as bleaching agent. It works because of oxidation. Chlorine in the bleaching powder is responsible for bleaching effect.

Use of Bleaching Powder:

Bleaching powder is used as disinfectant to clean water, moss remover, weed killers, etc.

Bleaching powder is used for bleaching of cotton in textile industry, bleaching of wood pulp in paper industry.

Bleaching powder is used as oxidizing agent in many industries, such as textiles industry, paper industry, etc.

3. Baking Soda ($NaHCO_3$): Baking soda is another important product which can be obtained using byproducts of chlor – alkali process. The chemical name of baking soda is sodium hydrogen carbonate ($NaHCO_3$) or sodium bicarbonate. Bread soda, cooking soda, bicarbonate of soda, sodium bicarb, bicarb of soda or simply bicarb, etc. are some other names of baking soda.

Preparation Method: Baking soda is obtained by the reaction of brine with carbon dioxide and ammonia. This is known as Solvay process.

$$\underbrace{NaCl + H_2O}_{\text{Brain}} + CO_2 + NH_3 + \longrightarrow NH_4Cl + NaHCO_3$$

Sodium chloride — Water — Carbon dioxide — Ammonia — Ammonium chloride — Sodium bicarbonate

In this process, calcium carbonate is used as the source of CO_2 and the resultant calcium oxide is used to recover ammonia from ammonium chloride.

Properties of Sodium Bicarbonate:

Sodium bicarbonate is white crystalline solid, but it appears as fine powder.

Sodium hydrogen carbonate is amphoteric in nature.

Sodium hydrogen carbonate is sparingly soluble in water.

Thermal decomposition of sodium hydrogen carbonate (baking soda).

When baking soda is heated, it decomposes into sodium carbonate, carbon dioxide and water.
$2NaHCO_3$ + heat → $Na_2CO_3 + CO_2 + H_2O$

Sodium carbonate formed after thermal decomposition of sodium hydrogen carbonate decomposes into sodium oxide and carbon dioxide on further heating.
$Na_2CO_3 \rightarrow Na_2O + CO_2$
This reaction is known as Dehydration reaction.

Use of Baking Soda:

Baking soda is used in making of baking powder, which is used in cooking as it produces carbon dioxide which makes the batter soft and spongy.

Baking soda is used as an antacid.

Baking soda is used in toothpaste which makes the teeth white and plaque free.

Baking soda is used in cleansing of ornaments made of silver.

Since sodium hydrogen carbonate gives carbon dioxide and sodium oxide on strong heating, thus, it, is used as a fire extinguisher.

Baking Powder: Baking powder produces carbon dioxide on heating, so it is used in cooking to make the batter spongy. Although, baking soda also produces carbon dioxide on heating, but it is not used in cooking because on heating, baking soda produces sodium carbonate along with carbon dioxide. The sodium carbonate, thus, produced, makes the taste bitter.

$$\underset{\text{Sodium hydrogen carbonate (baking soda)}}{NaHCO_3} + \text{Heat} \longrightarrow \underset{\text{Sodium carbonate}}{Na_2CO_3} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O}$$

Baking powder is the mixture of baking soda and a mild edible acid. Generally, tartaric acid is mixed with baking soda to make baking powder.

$$\underset{\text{Baking soda}}{NaHCO_3} + \underset{\text{Tartaric acid}}{C_4H_6O_6} \longrightarrow \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} + \underset{\text{Sodium tartrate}}{Na_2C_4H_4O_6}$$

When baking powder is heated, sodium hydrogen carbonate ($NaHCO_3$) decomposes to give CO_2 and sodium carbonate (Na_2CO_3). CO_2 causes bread and cake fluffy. Tartaric acid helps to remove bitter taste due to formation of Na_2CO_3.

4. Washing Soda (Sodium Carbonate)
Preparation Method: Sodium carbonate is manufactured by the thermal decomposition of sodium hydrogen carbonate obtained by Solvay process.

$$\underset{\text{Sodium chloride}}{NaCl} + \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Ammonia}}{NH_3} + \underset{\text{Water}}{H_2O} \longrightarrow \underset{\text{Ammonium chloride}}{NH_4Cl} + \underset{\text{Sodium bicarbonate}}{NaHCO_3}$$

$$\underset{\text{Sodium bicarbonate}}{NaHCO_3} \xrightarrow{\text{Heat}} \underset{\text{Carbon dioxide}}{CO_2} + \underset{\text{Water}}{H_2O} + \underset{\text{Sodium carbonate (anhydrous)}}{Na_2CO_3}$$

The sodium carbonate obtained in this process is dry. It is called Soda ash or Anhydrous sodium carbonate. Washing soda is obtained by rehydration of anhydrous sodium carbonate.

$$\underset{\text{Sodium carbonate}}{NaCO_3} + 10H_2O \longrightarrow \underset{\text{Sodium carbonate (Hydrated)}}{Na_2CO_3.10H_2O}$$

Since there are 10 water molecules in washing soda, hence, it is known as Sodium Bicarbonate Decahydrate.
Sodium carbonate is a crystalline solid and it is soluble in water when most of the carbonates are insoluble in water.

Use of sodium carbonate:

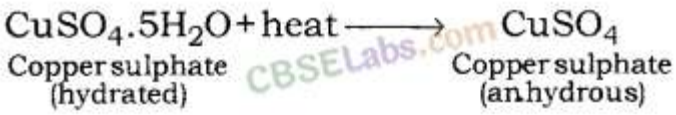
It is used in the cleaning of cloths, especially in rural areas.

In the making of detergent cake and powder.

In removing the permanent hardness of water.

It is used in glass and paper industries.

The water of Crystallization: Many salts contain water molecule and are known as Hydrated Salts. The water molecule present in salt is known as Water of crystallization.
Examples:
Copper sulphate pentahydrate ($CuSO_4.5H_2O$): Blue colour of copper sulphate is due to presence of 5 molecules of water. When copper sulphate is heated, it loses water molecules and turns: into grey – white colour, which is known as anhydrous copper sulphate. After adding water, anhydrous copper sulphate becomes blue again.



Acids: Substances which turn blue litmus solution red are called acids. Acids are sour in taste.

Bases: Substances which change red litmus solution blue are called bases. They are bitter in taste.

Mineral Acids: Acids which are obtained from minerals like sulphates, nitrates, chlorides etc. are called mineral acids, example, H_2SO_4 (Sulphuric acid), HNO_3 (Nitric acid) and HCl (Hydrochloric acid).

Organic Acids: Acids which are obtained from plants and animals are called organic acids. Example citric acid, ascorbic acid, tartaric acid, lactic acid, acetic acid.

Hydronium Ions: They are formed by the reaction of H^+ (from acid) and H_2O. It is because H^+ is unstable.

Universal Indicator: A universal indicator is a mixture of indicators which shows a gradual but well-marked series of colour changes over a very wide range of change in concentration of H^+ ions.

Strong Acids: Acids which dissociate into ions completely are called strong acids. Example, H_2SO_4, HCl.

Weak Acids: Acids which do not dissociate into ions completely are called weak acids. Example, citric acid, acetic acid.

Chemical Properties of Acids:

Acids react with active metals to give salt and hydrogen gas.

Acids react with metal carbonates and metal hydrogen carbonates to give salt, water and carbon dioxide.

Acids react with bases to give salt and water. This reaction is called a neutralization reaction.

Acids react with metal oxides to give salt and water.

Chemical Properties of Bases:

Reaction with metals: Certain metals such as zinc, aluminium and tin react with alkali solutions on heating and hydrogen gas is evolved.

Reaction with acids: Bases react with acids to form salt and water.

Indicators: Indicators are substances which indicate the acidic or basic nature of the solution by their colour change.

pH Scale: A scale for measuring hydrogen ion concentration in a solution.
The pH of a solution is defined as the negative logarithm of hydrogen ion concentration in moles per litre.
$pH = -\log [H^+]$
$pH = -\log [H_3O^+]$
where $[H^+]$ or $[H_3O^+]$ represents concentrations of hydrogen ions in a solution.

The pH of a neutral solution is 7.

The pH of an acidic solution is < 7.

The pH of a basic solution is > 7.

Some Important Compounds and their Uses:

Common Name	Chemical name	Chemical formula	Uses
Washing soda	Sodium carbonate decahydrate	$Na_2CO_3 . 10H_2O$	Manufacture of borax, caustic soda, softening of hard water.
Baking soda	Sodium hydrogen carbonate	$NaHCO_3$	Used as antacid, ingredient of baking powder.
Bleaching powder	Calcium oxychloride	$CaOCl_2$	Bleaching clothes, used as oxidizing agent, disinfecting water, manufacture of chloroform.
Plaster of Paris	Calcium sulphate hemihydrate	$CaSO_4 . {}^1/_2H_2O$	Plastering fractured bones, making toys, decorative materials, statues.

Equations of Acids, Bases and Salts:

Acid + Metal → Salt + Hydrogen gas
$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2$

Base + Metal → Salt + Hydrogen gas
$2NaOH + Zn \rightarrow Na_2ZnO_2$ (Sodium zincate) + H_2

Base + Acid → Salt + Water
$NaOH\ (aq) + HCl\ (aq) \rightarrow NaCl\ (aq) + H_2O\ (l)$

Acids give hydronium ions in water
$HCl + H_2O \rightarrow H_3O^+ + Cl^-$

Bases generate OH- ions in water
$NaOH\ (aq) + H_2O \rightarrow Na^+\ (aq) + O^-\ (aq)$

Reactions Of Important Chemical Compounds:

Preparation of Bleaching powder: By the action of chlorine on dry slaked lime
$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

On heating, baking soda liberates CO_2

$$2NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + H_2O + CO_2$$

$$Na_2CO_3 + 10H_2O \longrightarrow Na_2CO_3 . 10H_2O$$

Washing soda — Sodium carbonatedecahydrate

Preparation of Plaster of Paris:

$$CaSO_4 2H_2O \xrightarrow{373\ K\ (Heat)} CaSO_4 . {}^1/_2H_2O + 1{}^1/_2H_2O$$

On mixing plaster of Paris with water, gypsum is obtained

$$CaSO_4 . {}^1/_2H_2O + 1{}^1/_2H_2O \longrightarrow CaSO_4 . 2H_2O$$

Very Short Answer Type

Question 1.
Write a balanced chemical equation for the reaction between sodium carbonate and hydrochloric acid indicating the physical state of the reactants and products. [Foreign 2010]
Answer:
$Na_2CO_3(s) + 2HCl\ (ag) \rightarrow 2NaCl\ (aq) + CO_2(g) + H_2O\ (l)$

Question 2.
During summer season, a milkman usually adds a small amount of baking soda to fresh milk. Give reason. [CBSE Sample Paper 2009]
Answer:
A milkman adds a very small amount of baking soda so as to prevent spoilage of milk. It leads to change in the pH which does not allow bacteria and enzymes to act and milk does not become sour due to fermentation.

Question 3.
What is the difference between slaked lime and lime water? [CBSE 2010]
Answer:
A suspension of $Ca(OH)_2$ in water is called slaked lime. Water containing traces of $Ca(OH)_2$ is called lime water.

Question 4.
Which acid is present in sour milk or curd?
Answer:
Lactic acid.

Question 5.
Why is potassium iodide added into common salt to use it as table salt?
Answer:
The iodide present in the salt prevents thyroid disorders.

Question 6.
What are the pH values of distilled water and common salt solution? [CBSE 2010]
Answer:
Both are neutral and have pH close to 7.

Question 7.
A dry pellet of a common base B, when kept in open absorbs moisture and turns sticky. The compound is also a by-product of chloralkali process. Identify B. What type of reaction occurs when B is treated with an acidic oxide? Write a balanced chemical equation for one such solution. [NCERT Exemplar]
Answer:
Dry pellets of sodium hydroxide absorb moisture and turn sticky when kept in open which is also a by-product of chloralkali process.

When sodium hydroxide is treated with an acidic oxide it produces salt and water.

$$\underset{\text{Base}}{NaOH\,(aq)} + \underset{\text{Acid}}{HCl\,(aq)} \longrightarrow \underset{\text{Salt}}{NaCl\,(aq)} + \underset{\text{Water}}{H_2O\,(g)}$$

Question 8.
Which bases are called alkalies? Give an example of an alkali. [CBSE 2009, 2010]
Answer:
Soluble bases are called alkalies. For example, sodium hydroxide (NaOH).

Question 9.
A knife, which is used to cut a fruit, was immediately dipped into water containing drops of blue litmus solution. If the colour of the solution is changed to red, what inference can be drawn about the nature of the fruit and why? [CBSE 2011]
Answer:
Since the colour of the blue litmus has changed to red, this means that the fruit juice is acidic in nature.

Question 10.
How do H^+ ions exist in water?
Answer:
H^+ ions in water combine with water (H_2O) molecules and exist as H_3O^+ ion, called hydronium ion.

Question 11.
What should be done as remedy if stung by leaves of nettle plant in the wild?
Answer:
The area should be rubbed with the leaf of dock plant.

Question 12.
What happens when nitric acid is added to egg shell? [NCERT Exemplar]

Answer:
Egg shell is made of calcium carbonate. When nitric acid is added to egg shell calcium nitrate, carbon dioxide and water are formed.
$CaCO_3 + 2HNO_3 \rightarrow Ca(NO_3)_2 + CO_2 + H_2O$

Question 13.
What is the concentration of H^+ ion in pure water?
Answer:
10^{-7}

Question 14.
Which one of these has a higher concentration of H^+ ions? 1 M HCl or 1 M CH_3COOH. [CBSE 2009]
Answer:
1 M HCl has higher concentration of H^+ ions.

Question 15.
Name an example of olfactory indicators.
Answer:
Vanilla.

Question 16.
Name the chemical substance present in thick white and yellowish clouds present in the atmosphere of Venus.
Answer:
Sulphuric acid.

Question 17.
What is acid rain?
Answer:
Rainwater having pH less than 5.6, is called acid rain.

Question 18.
Name the hardest substance in the body.
Answer:
Tooth enamel (Calcium phosphate).

Question 19.
The pH of three solutions A, B and C are 4, 9 and 6 respectively. Arrange them in increasing order of acidic strength. [CBSE 2010]
Answer:
The increasing order of acidic strength is : B < C < A.

Question 20.
Name the chemist who had given the pH scale.
Answer:
S.P.L. Sorensen (1909).

Question 21.
Name the acid present in tomato.
Answer:
Oxalic acid.

Question 22.
Acidic and basic solutions in water conduct electricity. Why?
Answer:
Because they produce hydrogen and hydroxide ions respectively.

Question 23.
What would be the colour of litmus in a solution of sodium carbonate? [CBSE 2009]
Answer:
Red litmus will change to blue in sodium carbonate solution.

Question 24.
The pH of a sample of vegetable soup was found to be 6.5. How is this soup likely to taste?

Answer:
The taste will be slightly sour as it is weakly acidic.

Question 25.
Name the chemical substance which is used in the manufacture of soap as well as used as a preservative in pickles.
Answer:
Sodium chloride (NaCl).

Question 26.
There are two jars A and B containing food materials. Food in jar 'A' is pickled with acetic acid while 'B' is not. Food of which of jar will stale first? Explain. Name two synthetic indicators which are used to test acids and bases.
Answer:
Food in jar 'B' will stale first because it will undergo oxidation and will also be attacked by microorganisms.
Synthetic indicators: Phenolphthalein, methyl orange.

Question 27.
What is the chemical formula of soda ash?
Answer:
Na_2CO_3

Question 28.
Name the substance used for disinfecting drinking water supply.
Answer:
Bleaching powder.

Question 29.
Name a chemical substance which can be used to detect the presence of moisture in a liquid.
Answer:
Anhydrous copper sulphate.

Question 30.
What is meant by water of crystallisation?
Answer:
Water of crystallisation is the fixed number of water molecules chemically attached to each formula unit of a salt in its crystalline form.

Question 31.
Which one is a stronger acid, with pH = 5 or with pH = 2?
Answer:
The acid with pH = 2 is a stronger acid.

Question 32.
Fresh milk has a pH of 6. When it changes into curd (yogurt), will its pH value increases or decrease? Why?
Answer:
Its pH will decrease because curd (yogurt) is sour in taste due to presence of acid in it.

Short Answer Type I

Question 1.
How would you distinguish between baking powder and washing soda by heating? [NCERT Exemplar]
Answer:
Baking soda ($NaHCO_3$) gives carbon dioxide and water vapour on heating at very low temperature. The gas so formed turns lime water milky, which confirms the presence of carbon dioxide gas.

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

When washing soda (Na_2CO_3) is heated it does not produce carbon dioxide even at high temperatures, but gives off its water of crystallisation to become anhydrous salt.

$$Na_2CO_3 \cdot 10H_2O \xrightarrow{\text{Heat}} Na_2CO_3 + 10H_2O$$

Question 2.
A sulphate salt of Group 2 element of the Periodic Table is a white, soft substance, which can be moulded into different shapes by making its dough. When this compound is left in the open for some time, it becomes a solid mass and cannot be

Properties	***Acids***	***Bases***
1. Taste	**Sour**	**Bitter**
2. Action on litmus paper	**They turn blue litmus paper red**	**They turn red litmus paper blue.**
3. Action with phenolphthalein	**No action**	**They turn phenolphthalein pink.**
4. Action with carbonates and bicarbonates	**They decompose carbonates and bicarbonates to liberate carbon dioxide.**	**No action**

used for moulding purposes. Identify the sulphate salt and why does it show such a behaviour? Give the reaction involved. [NCERT Exemplar]
Answer:
Calcium belongs to group 2. Calcium sulphate is a white soft substance. It is known as Plaster of Paris, which can be moulded into different shapes by making its dough.

When Plaster of Paris is left for some time in the open, it turns into a solid mass because of reaction with moisture present in the atmosphere. The solid mass so formed is known as gypsum and cannot be further used for moulding.

$$\underset{\text{Plaster of Paris}}{CaSO_4\frac{1}{2}H_2O} + \underset{\text{Water}}{\frac{1}{2}H_2O} \longrightarrow \underset{\text{Gypsum (Sets as hard mass)}}{CaSO_4 \cdot 2H_2O}$$

The above said group 2 element is calcium sulpahte.

Question 3.
Name the acid present in ant sting and give its chemical formula. Also give the common method to get relief from the discomfort caused by the ant sting. [NCERT Exemplar]
Answer:
The acid present in ant sting: Methanoic acid
Chemical Formula of methanoic acid: HCOOH
Method to get relief from the discomfort caused by the ant sting: Rubbing baking soda over the area of ant sting.
Explanation: Rubbing baking soda (a base) over ant sting neutralises the methanoic acid present in the ant sting and gives relief from pain.

Question 4.
List two differences between acids and bases on the basis of chemical properties.
Answer:
(i) Dilute acids like HCl and H_2SO_4 evolve H_2 gas on reacting with metals like Zn, Mg and Ca, etc. and dilute bases do not evolve hydrogen gas.

(ii) Acids react with oxides of metals while bases react with oxides of non-metals.

Question 5.
List four main differences between acids and bases.
Answer:

Question 6.
Mention the terms defined by the following sentences:
(a) A soluble base
(b) The insoluble solid formed when two solution are mixed together.

Answer:
(a) Alkali
(b) Precipitate.

Question 7.
Name the product formed in each case when:
(a) hydrochloric acid reacts with caustic soda.
(b) granulated zinc reacts with caustic soda.
Answer:
(a) The product formed is a mixture of sodium chloride and water.
$NaOH\ (ag) + HCl\ (ag) \rightarrow NaCl\ (ag) + H_2O$

(b) The product formed is a mixture of sodium zincate and hydrogen gas.
$Zn\ (s) + 2NaOH\ (ag) \rightarrow Na_2ZnO_2\ (ag) + H_2(g)$

Question 8.
Explain why sodium hydroxide solution cannot be kept in aluminium containers? Write equation for the reaction that may take place for the same.
Answer:
Sodium hydroxide solution reacts with aluminium to form sodium metaaluminate and hydrogen is evolved. Therefore, it cannot be kept in a container made of aluminium.

$$2Al(s) + 2NaOH(aq) + 2H_2O \longrightarrow \underset{\text{Sodium metaaluminate}}{2NaAlO_2(aq)} + 3H_2O$$

Question 9.
How can you obtain the following gases by using dilute acid and one other substance?
(a) hydrogen
(b) carbon dioxide.
Answer:
(a) $Fe + H_2SO_4(dil.) \rightarrow FeSO_4 + H_2(g)$
$Mg + 2HCl(dil.) \rightarrow MgCl_2 + H_2(g)$

(b) $Na_2CO_3 + 2HCl(dil.) \rightarrow 2NaCl + H_2O + CO_2(g)$
$NaHCO_3 + HCl(dil.) \rightarrow NaCl + H_2O + CO_2(g)$

Question 10.
A solution of HCl is taken in a beaker and an electric circuit with a bulb is set up with the solution in series. What happens to the bulb and why?
Answer:
The bulb will start glowing. Glowing of the bulb indicates that there is a flow of electric current through the solution. Electric current is carried through the solution by ions.

Since the cation present in acids is H^+, this suggests that acids produce hydrogen ions, $H^+(ag)$, in solution, which are responsible for carrying current through the solution.

Question 11.
If 280 g of washing soda crystals are left in dry air for some time, a loss of weight of 162 g occurs. How can you account for this?
Answer:
Washing soda ($Na_2CO_3 . 10H_2O$) is an efflorescent substance (if exposed to air, it loses most of its water of crystallisation). 280 g of washing soda lose 162 g of its water of crystallisation.

Question 12.
A sample of bleaching powder was kept in an air tight container. After a month, it lost some of its chlorine content. How will you account for it?
Answer:
Bleaching powder if kept even in an air tight container, will slowly decompose on its own and form calcium chlorate and calcium chloride. The reaction is called auto oxidation. This will result in decrease in its chlorine contents.

$$\underset{\text{Bleaching powder}}{6CaOCl_2} \longrightarrow \underset{\text{Calcium chlorate}}{Ca(ClO_3)_2} + \underset{\text{Calcium chloride}}{5CaCl_2}$$

Question 13.
A compound which is prepared from gypsum has the property of hardening when mixed with proper quantity of water. Identify the compound. Write chemical equation to prepare the compound. Mention one important use of the compound.
Answer:
The compound is Plaster of Paris ($CaSO_4$. 12 H_2O). It is formed from gypsum ($CaSO_4$. 12 H_2O) upon heating to a temperature of 373 K. It changes back to gypsum on adding water. Plaster of Paris is used for setting fractured bones.

$$\underset{\text{Gypsum}}{CaSO_4.2H_2O} \xrightarrow{\text{Heat}} \underset{\text{Plaster of Paris}}{CaSO_4.\frac{1}{2}H_2O} + \frac{3}{2}H_2O$$

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

Question 14.
A white powder is added while baking breads and cakes to make them soft and fluffy. Write the name of the powder. Name its main ingredients. Explain the function of each ingredient. Write the chemical reaction taking place when the powder is heated during baking. [CBSE 2012, 2013]
Answer:
The white powder is known as baking powder. The main ingredients are baking soda ($NaHCO_3$) and tartaric acid ($C_4H_6O_6$).

Question 15.
Explain giving reasons:
(i) Tartaric acid is a component of baking powder used in making cakes.
(ii) Gypsum ($CaSO_4$. 2H_2O) is used in the manufacture of cement.
Answer:
(i) Role of tartaric acid in baking powder (mixture of tartaric acid and sodium hydrogencarbonate) is to neutralise sodium carbonate formed upon heating sodium hydrogencarbonate.

$$\underset{\text{Sodium hydrogencarbonate}}{2NaHCO_3} \xrightarrow{\text{Heat}} \underset{\text{Sodium carbonate}}{Na_2CO_3} + H_2O + CO_2$$

In case it is not done, cake will be better and sodium carbonate will also have injurious side effects.

(ii) The role of gypsum ($CaSO_4$.2H_2O) in the manufacture of cement is to slow down the process of setting of cement.

Short Answer Type II

Question 1.
What will be the action of the following substances on litmus paper?
Dry HCl gas, moistened NH_3 gas, lemon juice, carbonated soft drink, curd, soap solution. [NCERT Exemplar]
Answer:
Dry HCl gas: No action
Moistened NH_3 gas: Turns red litmus blue.
Lemon juice: Turns blue litmus red.
Carbonated soft drink: Turns blue litmus red.
Curd: Turns blue litmus red.
Soap solution: Turns red litmus blue.

Explanation:

Dry HCl gas does not liberate hydrogen ion, hence no action takes place with litmus paper.

NH_3 gas forms ammonium hydroxide with water which turns red litmus paper blue.

Lemon juice is citric acid, so it turns blue litmus paper red.

Carbonate soft drink contains carbon dioxide dissolved in water. Carbon dioxide forms carbonic acid with water; which turns blue litmus paper red.

Curd contains lactic acid and hence turns blue litmus paper red.

Soap solution is basic in nature hence it turns red litmus paper blue.

Question 2.
When zinc metal is treated with a dilute solution of a strong acid, a gas is evolved, which is utilised in the hydrogenation of oil. Name the gas evolved. Write the chemical equation of the reaction involved and also write a test to detect the gas formed. [NCERT Exemplar]
Answer:
Zinc metal gives hydrogen gas when it is treated with dilute sulphuric acid. Hydrogen gas is utilised in hydrogenation of oil.
Therefore, the gas evolved is hydrogen.

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4} + \underset{\text{Hydrogen}}{H_2}$$

Test for hydrogen gas: When a burning candle is brought near hydrogen gas, it bums with a pop sound which confirms the presence of hydrogen gas.

Question 3.
(i) Identify the compound of calcium which is a yellowish powder and is used for disinfecting drinking water. Write its chemical name and formulae.
(ii) Write the balanced chemical equation of chlor-alkali process. [CBSE 2012, 2014]
Answer:
(i) The yellowish white solid is known as bleaching powder. Chemically, it is calcium oxychloride or calcium hypochlorite. Its chemical formula is $CaOCl_2$.

(ii) Chemical equation for chlor-alkali process is

$$2NaCl + 2H_2O \xrightarrow[\text{current}]{\text{Electric}} 2NaOH + H_2 + Cl_2$$

Question 4.
Explain with suitable reason
(a) Ferric chloride is stored in air tight bottles.
(b) On exposure to atmosphere, Glaublar's salt loses weight while quicklime gains weight.
(c) Common salt (containing traces of magnesium chloride) becomes sticky during the monsoons.
Answer:
(a) Because ferric chloride is deliquescent in nature.
(b) Glaubar's salt is efflorescent and loses water of crystallisation whereas quick lime is hygroscopic in nature and absorbs moisture from the air.
(c) This is because magnesium chloride is deliquescent and absorbs moisture from the atmospheric air and becomes moist.

Question 5.
(a) A solution has a pH of 7. Explain how you would
(i) increases its pH
(ii) decrease its pH
(b) If a solution changes the colour of litmus from red to blue, what can you say about its pH?
(c) What can you say about the pH of a solution that liberates CO_2 from sodium carbonate?
Answer:
(a) (i) By adding some alkali like NaOH
(ii) By adding some acid like HCl

(b) Since the solution changes the colour of litmus from red to blue it is alkaline and hence it has pH > 7.

(c) Since the solution liberates CO_2 from sodium carbonate, it should be acidic and has pH < 7.

Question 6.
A compound which is prepared from gypsum has the property of hardening when mixed with proper quantity of water.
(i) Identify the compound.
(ii) Write the chemical equation for its preparation.
(iii) Mention one important use of this compound.
Answer:
(i) Plaster of Paris

$$(ii)\ CaSO_4 . 2H_2O \xrightarrow{373\ K} CaSO_4 . \frac{1}{2}H_2O + \frac{3}{2}H_2O$$

(iii) It is used for plastering fractured bones.

Question 7.
Write any three chemical properties of acids.
Answer:
(i) They react with metals to give out hydrogen gas, for example,

$$\underset{\text{(Metal)}}{Zn} + \underset{\text{Hydrochloric acid}}{2HCl} \longrightarrow \underset{\text{Zinc chloride}}{ZnCl_2} + \underset{\text{Hydrogen}}{H_2}$$

(ii) They react with bases to form salt and water, for example,

$$\underset{\text{(Base)}}{\underset{\text{Sodium hydroxide}}{2NaOH}} + \underset{\text{Sulphuric acid}}{H_2SO_4} \longrightarrow \underset{\text{Sodium sulphate}}{Na_2SO_4} + \underset{\text{Water}}{2H_2O}$$

(iii) They react with metal carbonates to liberate carbon dioxide gas.

$$\underset{\text{(Metal carbonate)}}{\underset{\text{Sodium carbonate}}{Na_2CO_3}} + \underset{\text{acid}}{\underset{\text{Hydrochloric}}{2HCl}} \longrightarrow \underset{\text{chloride}}{\underset{\text{Sodium}}{2NaCl}} + \underset{\text{Water}}{H_2O} + \underset{\text{dioxide}}{\underset{\text{Carbon}}{CO_2}}$$

Question 8.
Classify the solutions of the following as acids, bases and salts:
Ammonium hydroxide, barium chloride, sodium chloride, sodium hydroxide, sulphuric acid and nitric acid.
Answer:

Acids	***Bases***	***Salts***
1. Sulphuric acid	**Ammonium hydroxide**	**Barium chloride**
2. Nitric acid	**Sodium hydroxide**	**Sodium chloride**

Question 9.
You are given two solutions A and B. The pH of solution A is 6 and pH of solution B is 8.
(i) Which solution is acidic and which is basic?
(ii) Which solution has more H+ ion concentration?
(iii) Why is HCl a stronger acid than acetic acid? [CBSE 2011]
Answer:
(i) The solution with pH 6 is acidic while the solution with pH 8 is basic.
(ii) The solution with pH 6 has more H^+ ion concentration.
(iii) HCl is a stronger acid than CH_3COOH since its degree of dissociation (α) is more or it releases more H+ ions in solution than acetic acid.

Question 10.
What is tooth enamel chemically? State the conditions when it starts corroding. What happens when food particles left in the mouth after eating degrade? Why do doctors suggest use of powder/tooth paste to prevent tooth decay? [CBSE 20011, 2014]
Answer:
(i) The tooth enamel is chemically calcium phosphate with the formula $Ca_3(PO_4)_2$. It is quite hard.
(ii) The enamel starts corroding when the pH inside our mouth falls below 5.5 because the saliva present in the mouth becomes acidic.
(iii) The bacteria present in the mouth breakdown the food particles into acids which damage our teeth by corroding them.
(iv) The contents of the tooth paste are of basic nature. They neutralise the excess acid present. As a result, the corrosion of enamel and decay of teeth are checked.

Question 11.
(a) Write the name given to bases that are highly soluble in water. Give an example.
(b) How is tooth decay related to pH? How can it be prevented?
(c) Why does bee sting cause pain and irritation? Rubbing of baking soda on the sting area gives relief. How?
Answer:
(a) Alkali, for example, NaOH (Sodium hydroxide).

(b) Lower the pH, more will be tooth decay. Acid formed in the mouth reacts with enamel which is made up of [$Ca_3(PO_4)_2$] and causes tooth decay.
It can be prevented by brushing our teeth after every meal.

(c) A bee injects formic acid into the skin when it stings which causes pain and irritation. Sodium hydrogencarbonate (baking soda) neutralises formic acid giving relief.

Question 12.
Mention the colour changes observed when the following indicators are added to acids:
(i) Alkaline phenolphthalein solution
(ii) Methyl orange solution
(iii) Neutral litmus solution
Answer:
(i) It gets decolourised
(ii) It turns red or pink
(iii) It turns red.

Question 13.
Choosing only substances from the list given in the box below, write equations for the reactions which you would use in the laboratory to obtain:
(a) Sodium sulphate
(b) Iron (II) sulphate
(c) Zinc carbonate.
Dilute sulphuric acid, copper, iron, copper carbonate, sodium, zinc, sodium carbonate
Answer:
(a) Sodium sulphate
$Na_2CO_3 + H_2SO_4$ (dil.) $\rightarrow Na_2SO_4 + H_2O + CO_2$ (g)

(b) Iron (II) sulphate
Pe + H_2SO_4 (dil.) $\rightarrow FeSO_4 + H_2$ (g)

(c) Zinc carbonate
Zn + $CuCO_3 \rightarrow ZnCO_3$ + Cu

Question 14.
What is dilution? What precaution should be taken during dilution of a strong acid like sulphuric acid?
Answer:
Dilution is a process in which concentration of a substance decreases by addition of a solvent. Care must be taken while mixing concentrated sulphuric acid with water as the process is a highly exothermic one. The acid must always be added slowly to water with constant stirring. If water is added to a concentrated acid, the heat generated may cause the mixture to splash out and cause burns. The glass container may also break due to excessive local heating.

Question 15.
Write balanced equations to satisfy each statement:
(a) Acid + Chloride → Salt + Hydrochloric acid gas
(b) Acid + Carbonate → Salt + Water + Carbon dioxide
(c) Acid + Sulphite → Salt + Water + Sulphur dioxide
Answer:
(a) $H_2SO_4 + NaCl \rightarrow NaHSO_4 + HCl$ (g)
(b) $2HCl + Na_2CO_3 \rightarrow 2NaCl + H_2O + CO_2$ (g)
(c) $2HCl + CaSO_3 \rightarrow CaCl_2 + H_2O + SO_2$ (g)

Long Answer Type

Question 1.
What are strong and weak acids? In the following list of acids, separate strong acids from weak acids. [NCERT Exemplar]
Hydrochloric acid, citric acid, acetic acid, nitric acid, formic acid, sulphuric acid.
Answer:
Strong acid: Strong acids ionise completely in their aqueous solutions to produce a large number of hydrogen ions. Mineral acids are generally strong acids.

Weak acid: Weak acids do not ionise completely in their aqueous solution. Organic acids are generally weak acids.

Strong acid: Hydrochloric acid, nitric acid, sulphuric acid
Weak acid: Citric acid, acetic acid, formic acid

Question 2.
(i) Explain, why is hydrochloric acid a strong acid and acetic acid, a weak acid? How can it be verified?
(ii) Explain, why aqueous solution of an acid conducts electricity?
(iii) You have four solutions A, B, C and D. The pH of solution A is 6, B is 9, C is 12 and D is 7.
(a) Identify the most acidic and most basic solutions.
(b) Arrange the above four solutions in the increasing order of H+ ion concentration.
(c) State the change in colour of pH paper on dipping in solution C and D. [CBSE 2012, 2013]
Answer:
(i) Hydrochloric acid (HCl) is a stronger acid than acetic acid (CH_3COOH) because it dissociates completely into H^+ and Cl^- ions in aqueous solution. In order to verify this, add a few drops of universal indicator solution in the test tubes containing the acids. It acquires red colour in hydrochloric acid and yellow in acetic acid which confirms that hydrochloric acid is a stronger acid.

(ii) An aqueous solution of an acid releases ions in aqueous solutions. These ions conduct electricity.

(iii) (a) Most acidic is A (pH = 6) and most basic is C (pH = 12).
(b) The increasing order of H^+ ion concentration is : C < B < D < A.
(c) The pH paper acquires dark purple colour in solution C and green in solution D.

Question 3.
Fill the missing data in the following table:

Name of the salt	Formula of salt	Constituting	
		Base	Acid
1. Ammonium chloride	NH_4Cl	NH_4OH	—
2. Copper sulphate	—	—	H_2SO_4
3. Sodium chloride	NaCl	NaOH	—
4. Magnesium nitrate	$Mg(NO_3)_2$	—	—
5. Potassium sulphate	—	—	—

Answer:

Name of the salt	Formula of salt	Constituting	
		Base	Acid
1. Ammonium chloride	NH_4Cl	NH_4OH	HCl
2. Copper sulphate	$CuSO_4$	$Cu(OH)_2$	H_2SO_4
3. Sodium chloride	NaCl	NaOH	HCl
4. Magnesium nitrate	$Mg(NO_3)_2$	$Mg(OH)_2$	HNO_3
5. Potassium sulphate	K_2SO_4	KOH	H_2SO_4

Question 4.
(a) Explain how antacids give relief from acidity. Write the name of one such antacid.
(b) Fresh milk has a pH of 6. How does the pH change as it turns to curd? Explain your answer.
(c) A milkman adds a very small amount of baking soda to fresh milk. Why does this milk take a longer time to set as curd?
(d) Mention the nature of toothpastes. How do they prevent tooth decay?
Answer:
(a) Our stomach produces hydrochloric acid that helps in digestion of food. During indigestion, our stomach produces excess acid. Antacids neutralise the excess of acid produced and gives relief from hyperacidity. Milk of magnesia (magnesium hydroxide) is one of such antacid.

(b) pH will decrease as it turns to curd because curd is acidic due to the presence of lactic acid.

(c) It takes longer time to set as curd as the presence of baking soda (sodium hydrogen carbonate) makes the milk basic and it does not allow it to become acidic easily.

(d) Toothpastes are basic in nature. They neutralise the acid formed in mouth which causes tooth decay.

Question 5.
(a) Explain the following chemical properties of acids with the help of balanced chemical equations only.
(i) when an acid reacts with a metal carbonate
(ii) when an acid reacts with a metal bicarbonate
(iii) when an acid reacts with a metal oxide.
(b) You are given three solutions A, B and C with pH values 2, 10 and 13 respectively. Write which solution has more hydrogen ion concentration among the three and state the nature 'acidic or basic' of each solution.
Answer:
(a) (i) $CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$
(ii) $NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$
(iii) $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$

(b) 'A' has maximum $[H_3O^+]$ equal 10^{-2} mol L^{-1}
'A' acidic whereas B and C are basic in nature.

Question 6.
Complete the following reaction:
(i) $2NaCl(aq) + 2H_2O(l) \rightarrow$
(ii) $Ca(OH)_2 + Cl_2 \rightarrow$
(iii) $NaCl + H_2O + CO_2 + NH_3 \rightarrow$
(iv) $2NaHCO_3 \xrightarrow{\text{Heat}}$
(v) $Na_2CO_3 + 10H_2O$
Answer:
(i) $2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$

(ii) $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

(iii) $NaCl + H_2O + CO_2 + NH_3 \longrightarrow \underset{\text{(Ammonium chloride)}}{NH_4Cl} + \underset{\text{(Sodium hydrogencarbonate)}}{NaHCO_3}$

(iv) $\underset{\text{(Sodium hydrogencarbonate)}}{2NaHCO_3} \xrightarrow{\text{Heat}} \underset{\text{(Sodium carbonate)}}{Na_2CO_3} + H_2O + CO_2$

(v) $\underset{\text{(Sodium carbonate)}}{Na_2CO_3} + 10H_2O \longrightarrow Na_2CO_3 . 10H_2O$

Acids Bases and Salts HOTS Questions With Answers

Question 1.
A student prepared solutions of (i) an acid and (ii) a base in two separate beakers. She forgot to label the solutions and litmus paper was not available in the laboratory. Since both the solutions were colourless, how would she distinguish between the two? [NCERT Exemplar]
Answer:
While answering this question, we need to make certain assumptions. Let us assume that laboratory has all the necessary items but no litmus paper. We can use phenolphthalein to check which of the beakers contains acid and which one contains a base. Apart from that, we can also use other natural indicators; like China rose or turmeric.

Question 2.
Salt A commonly used in bakery products on heating gets converted into another salt B which itself is used for removal of hardness of water and a gas C is evolved. The gas C when passed through lime water, turns it milky. Identify A, B and C. [NCERT Exemplar]
Answer:
Baking powder which is a salt used in bakery products. It give sodium carbonate and carbon dioxide gas on heating. Sodium carbonate is used to remove hardness of water. Carbon dioxide turns lime water milky.

$$2NaHCO_3 \xrightarrow{\text{Heat}} Na_2CO_3 + CO_2 + H_2O$$

Therefore,

Salt A, which is sodium bicarbonate and used as baking powder.

Salt B is sodium carbonate, which is used to remove hardness of water.

The C is carbon dioxicje gas which turns lime water milky.

Question 3.
In one of the industrial processes used for manufacture of sodium hydroxide, a gas X is formed as by product. The gas X reacts with lime water to give a compound Y which is used as bleaching agent in chemical industry. Identify X and Y giving the chemical equation of the reactions involved. [NCERT Exemplar]
Answer:
Sodium chloride is used in the manufacture of sodium hydroxide by the Chlor-Alkali process. In this process chlorine and hydrogen gas are formed as by products along with sodium hydroxide. Chlorine gas reacts with lime water to produce bleaching power which is used as bleaching agent in chemical industries.

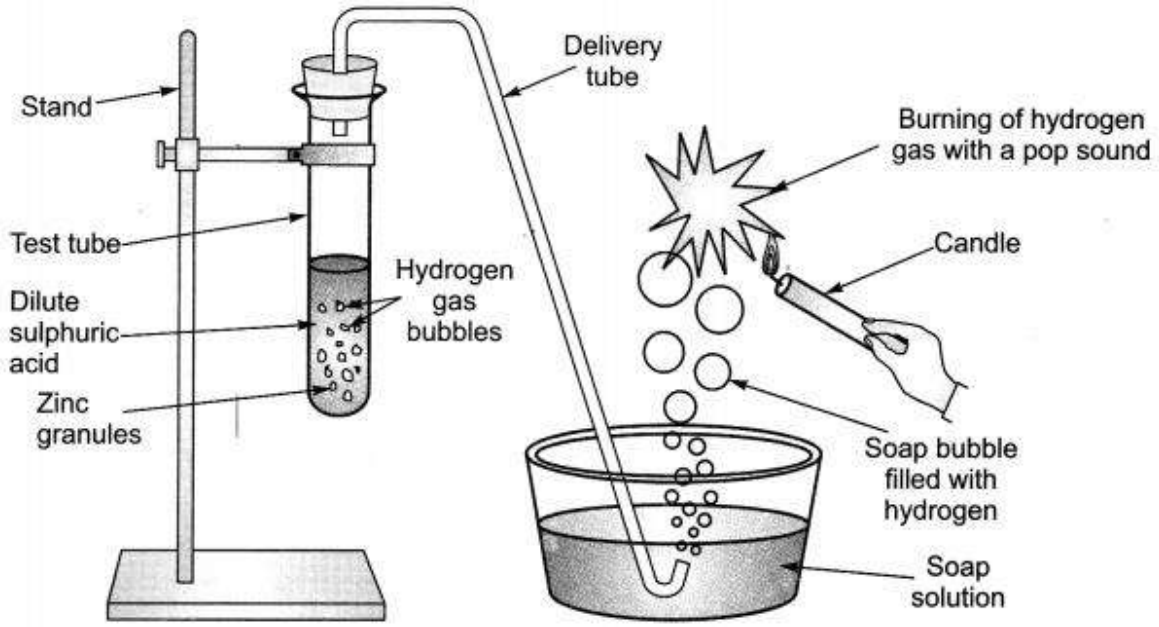
$$\underset{\substack{\text{Calcium hydroxide}\\\text{(Lime water)}}}{Ca(OH)_2(aq)} + \underset{\text{Chlorine}}{Cl_2} \longrightarrow \underset{\substack{\text{Calcium oxychloride}\\\text{(Bleaching powder)}}}{CaOCl_2} + \underset{\text{Water}}{H_2O}$$

Therefore,

The gas 'X' is chlorine.

Compound Y is calcium oxychloride which is commonly known as bleaching powder and used as bleaching agent in chemical industries.

Question 4.
In the following schematic diagram for the preparation of hydrogen gas as shown in Figure. What would happen if following changes are made? [NCERT Exemplar]
Answer:



(a) In place of zinc granules, same amount of zinc dust is taken in the test tube.
(b) Instead of dilute sulphuric acid, dilute hydrochloric acid is taken.
(c) In place of zinc, copper turnings are taken.
(d) Sodium hydroxide is taken in place of dilute sulphuric acid and the tube is heated.
Answer:
(a) When zinc dust is taken instead of zinc granules to react with sulphuric acid, hydrogen gas is formed. But the rate of reaction increases in the case of zinc dust compared to zinc granules, because of increased surface area of zinc dust which increases the rate of reaction.

Thus, when zinc dust is used in the place of zinc granules, hydrogen gas is produced at a faster rate.

(b) Zinc granules give hydrogen gas; along with zinc chloride; when they react with hydrochloric acid.

$$\underset{\text{Zinc}}{Zn} + \underset{\text{Hydrochloric acid}}{2HCl} \longrightarrow \underset{\text{Zinc chloride}}{ZnCl_2} + \underset{\text{Hydrogen}}{H_2}$$

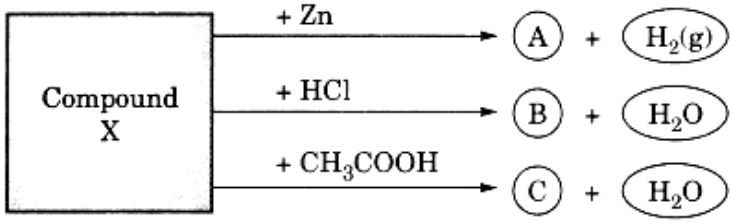
Thus, when hydrochloric acid is used in place of sulphuric acid, zinc chloride is formed instead of zinc sulphate; along with hydrogen gas and the reaction takes place at the same rate.

(c) Copper does not react with dilute acids under normal conditions because copper lies at lower position in the reactivity series and does not displace hydrogen from dilute acids.
Thus, if copper turnings are taken in place of zinc granules, no reaction will take place.

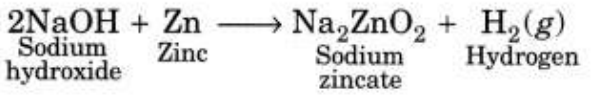
(d) If sodium hydroxide is taken in place of dilute sulphuric acid and the tube is heated, sodium zincate is formed along with hydrogen gas. Heating the test tube will increase the rate of formation of hydrogen gas as heating the reaction mixture increases the rate of reaction.

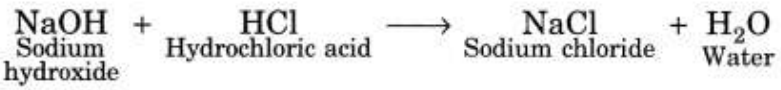
$$\underset{\text{Zinc}}{Zn} + \underset{\text{Sodium hydroxide}}{2NaOH} \xrightarrow{\text{Heat}} \underset{\text{Sodium zincate}}{Na_2ZnO_2} + \underset{\text{Hydrogen}}{H_2}$$

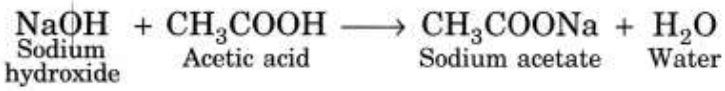
Question 5.
Identify the compound X on the basis of the reactions given below. Also, write the name and chemical formulae of A, B and C. [NCERT Exemplar]
Answer:



Answer:







Therefore,

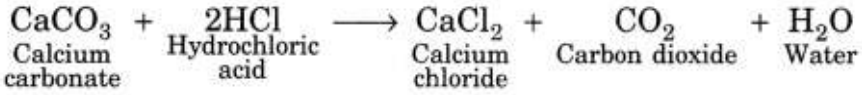
Compound "X' is sodium hydroxide (NaOH).

Compound 'A' is zinc sulphate ($ZnSO_4$).

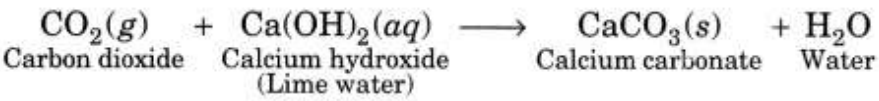
Compound 'B' is sodium chloride (NaCl).

Compound 'C' is sodium acetate (CH_3COONa).

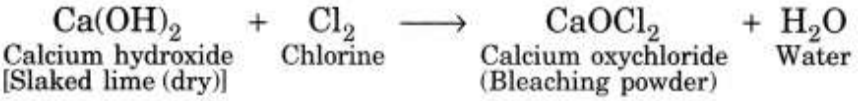
Question 6.
A metal carbonate X on reacting with an acid gives a gas which when passed through a solution Y gives the carbonate back. On the other hand, a gas G that is obtained at the anode during electrolysis of brine is passed on dry Y, it gives a compound Z, used for disinfecting drinking water. Identity X, Y, G and Z. [NCERT Exemplar]
Answer:
Calcium carbonate gives carbon dioxide gas when it reacts with hydrochloric acid.



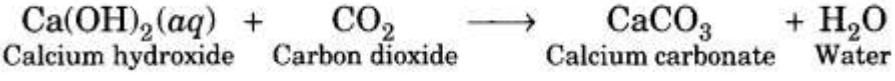
Carbon dioxide turns lime water milky when passed through it because of formation of calcium carbonate. When carbon dioxide; so formed; is passed through lime water, it turns milky because of the formation of calcium carbonate.



On electrolysis of brine, chlorine gas is produced at the anode. Therefore G is Cl_2.
Bleaching powder is used in disinfecting drinking water.
Therefore Z can be $CaOCl_2$.
When chlorine is passed through dry calcium hydroxide [$Ca(OH)_2$], bleaching powder $CaOCl_2$ is formed.



Therefore, Y is calcium hydroxide, $Ca(OH)_2$.
Since Y reacts with a gas to give a carbonate, the gas is CO_2 and the carbonate is $CaCO_3$.



Therefore, the metal carbonate X is calcium carbonate, $CaCO_3$.
Therefore,

Metal carbonate 'X' is calcium carbonate.

Solution 'Y is lime water (Calcium hydroxide).

Gas 'G' is chlorine gas.

Dry Y' is dry calcium hydroxide (dry slaked lime).

Compound 'Z' is bleaching powder (Calcium oxychloride).

Question 7.
A substance X used as an antacid reacts with hydrochloric acid to produce a gas Y which is used in extinguishers.
(a) Name the substances X and Y.
(b) Write a balanced equation of the reaction between X and hydrochloric acid. [CBSE 2011]
Answer:
(a) Substance X is sodium hydrogencarbonate (X) and the gas evolved Y is carbon dioxide.
(b)

$$\underset{(X)}{NaHCO_3(aq)} + HCl\,(aq) \longrightarrow NaCl(aq) + H_2O(aq) + \underset{(Y)}{CO_2(g)}$$

Question 8.
You are provided with the following materials in your laboratory:
Answer:
Hydrochloric acid (HCl), sulphuric acid, (H_2SO_4), nitric acid (HNO_3), acetic acid (CH_3COOH), sodium hydroxide (NaOH), potassium hydroxide (KOH), calcium hydroxide [$Ca(OH)_2$], magnesium hydroxide [$Mg(OH)_3$] and ammonium hydroxide (NH_4OH).
If we test each of the above solutions one by one with a drop of the following indicators, what colour change will you observe?
Red litmus, blue litmus, phenophthalein, methyl orange.
Answer:
Acidic substances: HCl, H_2SO_4, HNO_3, CH_3COOH
They will turn blue litmus red and methyl orange red. There will be no effect on red litmus and phenolphthalein.

Basic substances: NaOH, KOH, $Ca(OH)_2$, $Mg(OH)_2$, NH_4OH. They will turn red litmus blue and phenolphthalein pink. There will be no effect on blue litmus and methyl orange.

Question 9.
The crystals of a compound A on keeping in air get converted into a white powder. Its solution in water gives blue colour with red litmus. It is used to remove permanent hardness from water.
(a) Identify the substance. Write chemical formula for its crystalline form.
(b) From the given information, identify the nature of the substance.
(c) Write two more uses of the substance. [CBSE 2013]
Answer:
(a) The substance is washing soda. Its chemical formula is $Na_2CO_3.10H_2O$.
(b) Since the aqueous solution of the substance in water turns red litmus blue, it is of basic nature.
(c) (i) It is used in laundry for washing clothes.
(ii) It is used in the manufacture of glass, paper and chemicals like caustic soda (NaOH), and borax ($Na_2B_4O_7$), etc.

Question 10.
A substance X is used as a building material and is insoluble in water. When reacted with dilute HCl, it produces a gas which turns lime water milky. Predict the substance. Write the chemical equations evolved.
Answer:
The substance is probably calcium carbonate ($CaCO_3$), also called lime stone or marble. It is used as a building material. On reacting with dilute HCl, it evolves CO_2 gas which turns lime water milky.

$$\underset{(X)}{CaCO_3(s)} + 2HCl(aq) \longrightarrow CaCl_2(aq) + H_2O(aq) + CO_2(g)$$

$$\underset{\text{Lime water}}{Ca(OH)_2(s)} + CO_2(g) \longrightarrow \underset{\text{(Milky)}}{CaCO_3(s)} + H_2O(aq)$$

Question 11.
When electricity is passed through a common salt solution, sodium hydroxide is produced along with the liberation of two gases 'X' and T. The gas 'X' burns with a pop sound whereas T is used for disinfecting drinking water. [CBSE 2011]
(i) Identify X and Y.
(ii) Give the chemical equation for the reaction stated above.
(iii) State the reaction of Y with dry slaked lime.
Answer:
(i) The gas X' is H_2 and gas 'Y' is Cl_2.
(ii) The chemical equation for the reaction is:

$$2NaCl(aq) + 2H_2O(l) \xrightarrow{\text{(Electric current)}} 2NaOH\,(aq) + H_2(g) + Cl_2(g)$$

(iii) Cl_2 reacts with slaked lime to form bleaching powder.
$Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

Value Based

Question 1.
Aman is fond of eating fast foods and chat. He was suffering from a stomach pain and indigestion for a number of days. Doctor advised him to take antacid tablet after each meal and avoid spicy and junk food. He followed the advice and was cured rapidly.
(i) What is an antacid?
(ii) How are antacid tablets helpful in such indigestion? Justify by the relevant chemical reaction.
(iii) Mention the values exhibited by Aman and the doctor.
Answer:
(i) Antacid is a substance which can neutralise acidity in the stomach.
(ii) The antacid tablets or gels contain base like $NaHCO_3$ or $Mg(OH)_2$ which neutralise the effect of excess HCl released in the stomach as
$NaHCO_3 + HCl \rightarrow NaCl + H_2O + CO_2$
(iii) Knowledge of Chemistry, caring.

Question 2.
Ayush has cold drinks, chocolates and sweets every day. His teeth were getting damaged. His science teacher asked him to brush his teeth after every meal as well as after eating sweets.
(i) How do the teeth get damaged due to eating chocolates and sweets?
(ii) Brushing of teeth is helpful and prevent tooth decay. Justify.
(iii) Mention the values exhibited by the science teacher.
Answer:
(i) On eating sweets/chocolates the pH of mouth becomes less than 5.5, so tooth enamel gets corroded and tooth decay starts.
(ii) Using toothpaste, which is basic in nature can neutralise the excess acid formed in the mouth and prevent tooth decay.
(iii) Caring, helpful nature, knowledge of Chemistry.

Question 3.
Mohan and Priyanka were playing in the garden. Priyanka was stung by a bee and started crying and returned home. Her mother immediately observed the affected area and applied a thin coating of toothpaste as first aid, then took her to the nearest doctor.
(i) Why did Priyanka cry?
(ii) Name the chemical substance present in bee sting.
(iii) How is toothpaste effective in such incident?
(iv) Mention the values exhibited by Priyanka's mother.
Answer:
(i) Priyanka cried because the bee injected an acid while stinging which caused pain and irritation.
(ii) Formic acid or Methanoic acid (HCOOH)
(iii) Toothpaste is basic in nature so it neutralise the effect of formic acid and gives relief.
(iv) Knowledge of Chemistry, caring nature.

Question 4.
Manshi is a student of class X in a city school. There was a tall tree at the edge of the garden having a large honeycomb attached to it. Some students were playing cricket in the school playground. Suddenly the cricket ball hit the honeycomb due to which a large number of honey-bees started flying here and there. Manshi was stung on her face by a honey-bee. The sting was so painful that Manshi started crying. One of her classmates Shanti quickly got some baking soda and made a paste of it with water. Then she applied the paste on the stung area of the face. On rubbing baking soda solution, Manshi felt a lot of relief from the pain.
(a) What kind of liquid is injected into the skin when honey-bee strings?
(b) Why did rubbing baking soda solution on the stung area of skin give relief from pain?
(c) What type of chemical reaction takes place when baking soda solution is rubbed on the area stung by honey-bee?
(d) What values are exhibited by Shanti and the classmates?
Answer:
(a) Honey-bee sting injects an acidic liquid into the skin.

(b) Baking soda is a mild base. Being a base, baking soda solution neutralises the acidic liquid injected by honey-bee sting and neutralises its effect. This gives relief from pain.

(c) Neutralisation reaction (between an acid and a base)

(d) The values displayed by Shanti and classmates are

Awareness

Knowledge of Chemistry and

Desire to remove the suffering of others.