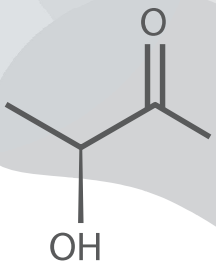
2 Acid, Bases and Salts



MULTIPLE CHOICE QUESTIONS (MCQs)

Q.1. What happens when the solution of an acid is mixed with the solution of a base in a test tube?

(I) The temperature of the solution increases.

(II) The temperature of the solution decreases.

(III) The temperature of the solution remains the same.

(IV) Salt formation takes place.

(a) Only (I) **(b) (I) and (III)**

(c) (II) and (III) **(d) (I) and (IV)**

Ans. *(d) (I) and (IV)*

Explanation: When an acid reacts with a base, a neutral salt is formed by the neutralisation process. As the neutralisation process is an exothermic reaction, the temperature of the solution increases.

$$\text{Acid} + \text{Base} \rightarrow \text{Salt} + \text{Water}$$

Related Theory

➥ *An acid reacts with a base to form salt and water. This reaction is called the neutralisation reaction. Such a reaction is always exothermic in nature. Hence, the temperature of the solution increases.*

➥ *In an exothermic reaction, heat is liberated, thereby increasing the temperature.*

Q.2. An aqueous solution turns red litmus solution blue. Excess addition of which of the following solution would reverse the change?

(a) Baking powder

(b) Lime

(c) Ammonium hydroxide solution

(d) Hydrochloric acid **[CBSE 2017, 13]**

Ans. *(d) Hydrochloric acid*

Explanation: The aqueous solution is a base, as it turns the red litmus solution blue. An acidic solution such as hydrochloric acid would reverse the change. In contrast, hydrochloric acid (HCl) would turn the blue litmus solution red.

Related Theory

➥ *Ammonium hydroxide solution, lime and baking powder are basic compounds. So, these substances would not be able to reverse the change. These substances would only change red litmus solution to blue.*

Q.3. During the preparation of hydrogen chloride gas on a humid day, the gas is usually passed through the guard tube containing calcium chloride. The role of calcium chloride taken in the guard tube is to:

(a) absorb the evolved gas.

(b) moisten the gas.

(c) absorb moisture from the gas.

(d) absorb Cl^- ions from the evolved gas.

Ans. *(c) absorb moisture from the gas.*

Explanation: Calcium chloride ($CaCl_2$) is a good dehydrating agent. It absorbs moisture or water content from the gas, making it dry.

Related Theory

➥ *Calcium chloride is widely used as a desiccant for drying gases and liquid hydrocarbons in many industries because of its water absorbing ability.*

Q.4. Which of the following salts does not contain water of crystallisation?

(a) Blue vitriol **(b) Baking soda**

(c) Washing soda **(d) Gypsum**

[CBSE 2015]

Ans. *(b) Baking soda*

Explanation:

Blue vitriol = $CuSO_4.5H_2O$

Baking soda = $NaHCO_3$

Washing soda = $Na_2CO_3.10H_2O$

Gypsum = $CaSO_4.2H_2O$

Baking soda's formula does not show any association with water molecules. Baking soda appears as a white powder, while blue vitriol, washing soda and gypsum usually appear as crystalline salts.

Definition

➥ *The number of water molecules that are attached to a molecule of salt is called its water of crystallisation. It is also known as the water of hydration. This is necessary to maintain the crystalline structure of a salt.*

➥ *The salts that contain water of crystallisation are called hydrated salts.*

Q.5. Sodium carbonate is a basic salt because it is a salt of:

(a) strong acid and strong base

(b) weak acid and weak base

(c) strong acid and weak base

(d) weak acid and strong base

[CBSE 2019]

Ans. *(d) weak acid and strong base*

Explanation: Sodium carbonate (Na_2CO_3) is the salt of carbonic acid (H_2CO_3) and sodium hydroxide (NaOH). Here, sodium hydroxide is a strong base and carbonic acid is a weak acid.

$$\underset{\text{(Sodium hydroxide)}}{2NaOH_{(aq)}} + \underset{\text{(Carbonic acid)}}{H_2CO_{3(aq)}} \rightarrow \underset{\text{(Sodium carbonate) (salt)}}{Na_2CO_{3(aq)}} + \underset{\text{(Water)}}{2H_2O_{(l)}}$$

Related Theory

➥ *The salt formed by the combination of a weak acid and a strong base is basic in nature. Basic salts have pH more than 7.*

Q.6. Calcium phosphate is present in tooth enamel. Its nature is:

(a) basic **(b) acidic**

(c) neutral **(d) amphoteric**

[CBSE 2014, 13]

Ans. *(a) basic*

Explanation: Calcium phosphate $Ca_3(PO_4)_2$ is a basic salt, as it is formed by the combination of a weak acid (phosphoric acid) and a slightly stronger base (calcium hydroxide).

$$\underset{\text{(Calcium hydroxide)}}{3Ca(OH)_2} + \underset{\text{(Phosporic acid)}}{2H_3PO_4} \rightarrow \underset{\text{(Calcium phosphate)}}{Ca_3(PO_4)_2} + 6H_2O$$

Related Theory

➥ *Bacteria feed on sugars commonly found in food and produce acids in the mouth, decreasing the pH level to 5.5 or lower, thus eroding the enamel that is basic in nature.*

Q.7. A sample of soil is mixed with water and allowed to settle. The clear supernatant solution turns the pH paper yellowish-orange. Which of the following would change the colour of this pH paper to greenish-blue?

(a) Lemon juice **(b) Vinegar**

(c) Common salt **(d) An antacid**

[CBSE 2017]

Ans. *(d) An antacid*

Explanation: A weak base turns the pH paper greenish-blue. Antacids usually contain weak bases such as $Mg(OH)_2$. So, an antacid would change the colour of this pH paper to greenish-blue. Lemon juice and vinegar contain acid and common salt is a neutral salt.

Q.8. Which of the following gives the correct increasing order of acid strength?

(a) Water < acetic acid < hydrochloric acid

(b) Water < hydrochloric acid < acetic acid

(c) Acetic acid < water < hydrochloric acid

(d) Hydrochloric acid < water < acetic acid

Ans. *(a) Water < acetic acid < hydrochloric acid*

Explanation: The increasing order of acid strength is water < acetic acid < hydrochloric acid. Hydrochloric acid is a strong acid that ionises completely in water.

A solution of hydrochloric acid will have a much higher concentration of H^+ ions and hence, a lower pH level. That's why it is a strong acid. Acetic acid is an organic acid and ionises only partially in water.

That's why it is a weak acid. Water is almost neutral in nature. In pure water, the number of positive hydrogen ions is equal to the number of negative hydroxide ions.

Q.9. If a few drops of a concentrated acid accidentally spills over the hand of a student, what should be done?

(a) Wash the hand with a saline solution.

(b) Wash the hand immediately with plenty of water and apply a paste of sodium hydrogen carbonate.

(c) After washing with plenty of water, apply a solution of sodium hydroxide on the hand.

(d) Neutralise the acid with a strong alkali.

[CBSE 2014]

Ans. *(b) Wash the hand immediately with plenty of water and apply a paste of sodium hydrogen carbonate.*

Explanation: In such an accident, washing the hands with water will dilute the acid and wash it out. Any remaining acid will be neutralised with sodium hydrogen carbonate (baking soda), as it is a base. This will minimise the damage caused by acid on the skin.

Remember, too strong a base (like NaOH) can be corrosive and may not neutralise the acid.

Q.10. Sodium hydrogen carbonate when added to acetic acid evolves a gas. Which of the following statements are true about the gas evolved?

(I) It turns lime water milky.

(II) It extinguishes a burning splinter.

(III) It dissolves in a solution of sodium hydroxide.

(IV) It has a pungent odour.

(a) (I) and (II) **(b) (I), (II) and (III)**

(c) (II), (III) and (IV) **(d) (I) and (IV)**

[CBSE 2013]

Ans. *(b) (I), (II) and (III)*

Explanation: The reaction of sodium hydrogen carbonate with acetic acid forms sodium acetate and water with carbon dioxide (CO_2) gas.

$$\underset{\text{(Sodium hydrogen carbonate)}}{NaHCO_{3(aq)}} + \underset{\text{(Acetic acid)}}{CH_3COOH_{(aq)}} \rightarrow \underset{\text{(Sodium acetate)}}{CH_3COONa_{(aq)}} + CO_{2(g)} + H_2O_{(l)}$$

CO_2 does not have a pungent smell, but it supports all the other three properties: it turns lime water milky, is a non-supporter of combustion and is absorbed by strong alkalis such as NaOH.

Caution

Students might get confused in options (a) and (b), as generally carbon dioxide does not dissolve in sodium hydroxide, but it combines with sodium hydroxide to form sodium carbonate, which has the ability to dissolve in water.

Q.11. Common salt besides being used in kitchen can also be used as the raw material for making:

(I) Washing soda **(II) Bleaching powder**

(III) Baking soda **(IV) Slaked lime**

(a) (I) and (II) **(b) (I), (II) and (IV)**

(c) (I) and (III) **(d) (I), (III) and (IV)**

Ans. *(c) (I) and (III)*

Explanation: Common salt (NaCl) is formed after a reaction between hydrochloric acid (HCl) and sodium hydroxide (NaOH). It serves as an important raw material for the production of various chemical compounds, such as caustic soda (sodium hydroxide), washing soda (sodium carbonate) and baking soda (sodium bicarbonate), used in various industries. The chlorine gas obtained is used for making bleaching powder (calcium oxychloride).

Q.12. One of the constituents of baking powder is sodium hydrogen carbonate. The other constituent is:

(a) hydrochloric acid **(b) tartaric acid**

(c) acetic acid **(d) sulphuric acid**

[CBSE 2020, 19, 17]

Ans. *(b) tartaric acid*

Explanation: Baking powder consists of sodium hydrogen carbonate and tartaric acid. Sodium hydrogen carbonate gives CO_2, which makes cake soft and fluffy. Tartaric acid neutralises the bitterness produced due to sodium carbonate.

$$\underset{\text{(Sodium hydrogen carbonate)}}{2NaHCO_{3(s)}} \xrightarrow{\text{Heat}} \underset{\text{(Sodium carbonate)}}{Na_2CO_{3(s)}} + \underset{\text{(Carbon dioxide)}}{CO_{2(g)}} + \underset{\text{(Water)}}{H_2O_{(l)}}$$

Q.13. To protect tooth decay we are advised to brush our teeth regularly. The nature of the toothpaste commonly used is:

(a) acidic **(b) neutral**

(c) basic **(d) corrosive**

[CBSE 2014, 13]

Ans. *(c) basic*

Explanation: The tooth paste commonly used is alkaline or basic in nature, as it contains mild bases such as sodium fluoride or sodium bicarbonate in its composition.

The base reacts with the acid formed during tooth decay and neutralises its bad effects, thus, preventing tooth decay. So, they can neutralise the effect of extra acids present in the mouth cavity, which are mainly responsible for tooth decay.

Related Theory

When we eat sweet things, the pH of our mouth falls below 5.5 (moderately acidic) as the oral bacteria releases lactic acid while acting on sugars. The acidic conditions are capable of corroding the enamel, which is made up of calcium phosphate. This causes the tooth to decay.

Q.14. Which of the following statements is correct about an aqueous solution of an acid and a base?

(I) The higher the pH, the stronger the acid.

(II) The higher the pH, the weaker the acid.

(III) The lower the pH, the stronger the base.

(IV) The lower the pH, the weaker the base.

(a) (I) and (III) **(b) (II) and (III)**

(c) (I) and (IV) **(d) (II) and (IV)**

Ans. *(d) (II) and (IV)*

Explanation: When the pH of an aqueous solution is higher, its acidic properties are weak. Thus, it is a base. When the pH an aqueous solution is lower, its basic properties are weak. Thus, it is an acid.

Concept Applied

A pH scale is used to measure the acidic and basic strength of an aqueous solution. This scale is marked from 0 to 14. A solution is neutral if its pH value is 7. An acidic solution has a pH less than 7. This means that an acidic solution has more concentration of H^+ ions. A basic solution has a pH more than 7. This means a basic solution has more concentration of OH^- ions.

Q.15. The pH of the gastric juices released during digestion is:

(a) less than 7 **(b) more than 7**

(c) equal to 7 **(d) equal to 0**

[CBSE 2020, 14]

Ans. *(a) less than 7*

Explanation: When we eat, our stomach releases hydrochloric acid, which helps in the process of digestion. Acids always have a pH less than 7. The pH of the stomach varies between 1 and 5. The pH of the stomach and the acid present in the stomach need not necessarily be the same.

Q.16. Which of the following phenomena occur, when a small amount of acid is added to water?

(I) Ionisation **(II) Neutralisation**

(III) Dilution **(IV) Salt formation**

(a) (I) and (II) **(b) (I) and (III)**

(c) (II) and (III) **(d) (II) and (IV)**

Ans. *(b) (I) and (III)*

Explanation: When a small amount of acid, such as hydrochloric acid, is added to water, individual ions of the acid are dissociated. This process is known as ionisation. Here, hydrochloric acid separates into positively charged hydrogen ions and negatively charged chloride ions.

$$HCl_{(aq)} \rightarrow H^+ + Cl^-$$

$$H_2O + H^+ \rightarrow \underset{\text{(Hydronium ion)}}{H_3O^+}$$

The mixing of an acid with water is also called dilution. The addition of water results in a decrease in the concentration of ions (H_3O^+) per unit volume.

Q.17. Which one of the following can be used as an acid-base indicator by a visually impaired student?

(a) Litmus **(b) Turmeric**

(c) Vanilla essence **(d) Petunia leaves**

[CBSE 2014]

Ans. *(c) Vanilla essence*

Explanation: Vanilla essence (an olfactory indicator) has a characteristic pleasant smell that differs when added to acids and bases, respectively.

When added to a basic solution such as sodium hydroxide solution, the characteristic smell of vanilla essence vanishes. When added to an acidic solution such as hydrochloric acid, however, the characteristic pleasant smell of vanilla essence remains. This is how it helps visually impaired students to identify acids and bases.

Q.18. Which of the following substances will NOT give carbon dioxide on treatment with dilute acid?

(a) Marble **(b) Limestone**

(c) Baking soda **(d) Lime** **[CBSE 2013]**

Ans. *(d) Lime*

Explanation: Lime (CaO) is the base that reacts with a dilute acid such as HCl to form a salt called calcium chloride. It is an exothermic reaction that releases water but no carbon dioxide. Marble, limestone ($CaCO_3$) and baking soda ($NaHCO_3$) react with HCl to release CO_2.

Q.19. Which of the following is acidic in nature?

(a) Lime juice **(b) Human blood**

(c) Lime water **(d) Antacid**

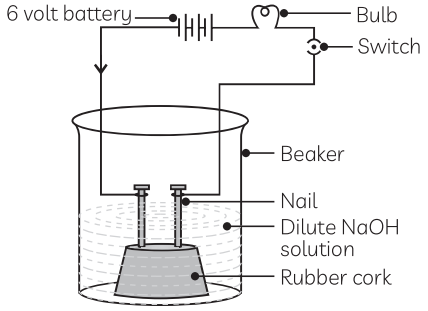
[CBSE 2016]

Ans. *(a) Lime juice*

Explanation: Lime juice contains citric acid, so it is acidic in nature.

Human blood is slightly basic (*i.e.*, has a pH of 7.8). Lime water, baking soda and antacid are also basic in nature as they contain more hydroxide (OH^-) ions.

Q.20. In an attempt to demonstrate electrical conductivity through an electrolyte, the following apparatus (figure) was set up.



Which among the following statement(s) is/ are correct?

(I) Bulb will not glow because electrolyte is not acidic.

(II) Bulb will glow because NaOH is a strong base and furnishes ions for conduction.

(III) Bulb will not glow because circuit is incomplete.

(IV) Bulb will not glow because it depends upon the type of electrolytic solution.

(a) (I) and (III) **(b) (II) and (IV)**

(c) Only (II) **(d) Only (IV)**

[CBSE 2019, 16]

Ans. *(c) Only (II)*

Explanation: The bulb will glow because NaOH is a strong base that dissociates completely in water to furnish OH^- and Na^+ ions. It thus acts as a strong electrolyte and conducts electricity.

Strong acids and bases are good conductors of electricity.

$$NaOH \rightarrow Na^+ + OH^-$$

Related Theory

➥ *Strong acids or bases ionise completely in aqueous solution to release ions.*

Q.21. Which of the following is used for dissolution of gold?

(a) Hydrochloric acid (b) Sulphuric acid

(c) Nitric acid (d) Aquaregia

Ans. *(d) Aqua-regia*

Explanation: Aqua-regia is used for the dissolution of gold. It is a solution of concentrated HNO_3 and concentrated HCl in the ratio of 1:3. Thus, this solution is strongly acidic and is used to dissolve gold.

Aqua-regia = [conc. HNO_3 + conc. HCl]

(1 : 3)

Q.22. Which of the following is NOT a mineral acid?

(a) Hydrochloric acid (b) Citric acid

(c) Sulphuric acid (d) Nitric acid

Ans. *(b) Citric acid*

Explanation: Citric acid is not a mineral acid. It is an organic acid or edible acid that is derived from organic compounds.

Differentiation

➥ *Mineral acids are mainly prepared from the minerals present in Earth's crust, so they are also called inorganic acids, like HCl (hydrochloric acid), H_2SO_4 (sulphuric acid) and HNO_3 (nitric acid). These acids dissolve in water to produce H^+ ions.*

➥ *Organic acids are produced from plants or animals and contain carbon atoms. Example: Acetic acid, citric acid and organic acids are corrosive in nature.*

Q.23. Which among the following is NOT a base?

(a) NaOH (b) KOH

(c) NH_4OH (d) C_2H_5OH

Ans. *(d) C_2H_5OH*

Explanation: C_2H_5OH is not a base. C_2H_5OH is an organic compound with –OH functional group that is known as alcohol. It cannot produce OH^- ions in its solution. It cannot dissociate ions in a solution. Thus, it cannot be a basic compound.

Q.24. Which of the following statements is NOT correct?

(a) All metal carbonates react with acid to give salt, water and carbon dioxide.

(b) All metal oxides react with water to give salt and acid.

(c) Some metals react with acids to give salt and hydrogen.

(d) Some non-metal oxides react with water to form an acid.

Ans. *(b) All metal oxides react with water to give salt and acid.*

Explanation: Not all metal oxides are insoluble in water. Some metal oxides such as Na_2O and CaO dissolve in water to form alkalis. When Na_2O reacts with water, NaOH is formed.

$$Na_2O_{(s)} + H_2O_{(l)} \rightarrow 2NaOH_{(aq)}$$

Q.25. Match the chemical substances given in column A with their appropriate application given in column B.

Column A	Column B
(A) Bleaching powder	(i) Preparation of glass
(B) Baking soda	(ii) Production of H_2 and Cl_2
(C) Washing soda	(iii) Decolourisation
(D) Sodium chloride	(iv) Antacid

Options:

	(A)	(B)	(C)	(D)
(a)	(ii)	(i)	(iv)	(iii)
(b)	(iii)	(ii)	(iv)	(i)
(c)	(iii)	(iv)	(i)	(ii)
(d)	(ii)	(iv)	(i)	(iii)

[CBSE 2018, 15, 10]

Ans. *(c) A-(iii); B- (iv); (C)-(i); (D)-(ii)*

Explanation:

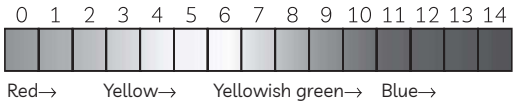
(A) Bleaching powder ($CaOCl_2$): Used for bleaching or decolourisation of clothes. It decomposes on reaction with water and releases chlorine, which acts as oxidising, bleaching and disinfecting agent.

(B) Baking soda ($NaHCO_3$): Used as an antacid for relieving stomach acidity.

(C) Washing soda (Na_2CO_3): Used in preparation of glass, soap and paper in industries.

(D) Sodium chloride (NaCl): Used for production of H_2 and Cl_2 gases. Aqueous sodium chloride yields hydrogen and chlorine on electrolysis .

Q.26. Equal volumes of hydrochloric acid and sodium hydroxide solutions of the same concentration are mixed and the pH of the resulting solution is checked with a pH paper. What would be the color obtained? (You may use color guide in the figure given below).



(a) Red (b) Yellow

(c) Yellowish green (d) Blue

[CBSE 2019]

Ans. *(c) Yellowish green*

Explanation: Hydrochloric acid is a strong acid, while sodium hydroxide is a strong base. So, mixing of strong acid and strong base will form a neutral salt and water, giving the pH value as 7.

$$\underset{\text{(Strong acid)}}{HCl} + \underset{\text{(Strong base)}}{NaOH} \rightarrow \underset{\text{(Sodium chloride) (Neutral)}}{NaCl} + H_2O$$

The aqueous solution of NaCl is neutral with a pH of 7. The colour of the solution obtained will be yellowish green.

Related Theory

When equal volumes of hydrochloric acid (strong acid) and sodium hydroxide (strong base) solution of the same concentration are mixed, the result obtained is a salt and water. This is a neutralisation reaction.

Q.27. Which of the following is/are true when $HCl_{(g)}$ is passed through water?

(I) It does not ionise in the solution as it is a covalent compound.

(II) It ionises in the solution.

(III) It gives both hydrogen and hydroxyl ions in the solution.

(IV) It forms hydronium ion in the solution due to the combination of hydrogen ion with water molecule.

(a) Only (I) **(b) Only (III)**

(c) (II) and (IV) **(d) (III) and (IV)**

[CBSE 2017, 13]

Ans. *(c) (II) and (IV)*

Explanation: HCl, being a polar covalent compound, easily ionises in water to form hydronium (H_3O^+) and chloride ions (Cl^-). HCl (a strong acid) ionises completely in water to produce H^+ and Cl^- ions. H^+ ion combines with water molecules to produce hydronium ions.

$$HCl_{(aq)} \rightarrow H^+ + Cl^-$$

$$\underset{\text{(Hydronium ion)}}{H^+ + H_2O \rightarrow H_3O^+}$$

Q.28. Which of the following statements is true for acids?

(a) Bitter and change red litmus to blue.

(b) Sour and change red litmus to blue.

(c) Sour and change blue litmus to red.

(d) Bitter and change blue litmus to red.

Ans. *(c) Sour and change blue litmus to red.*

Explanation: Acids turn blue litmus solution to red. They have a sour taste, as in the case of vinegar and some are corrosive in nature. On the other hand, bases turn red litmus solution to blue. Bases are bitter in taste, as in the case of baking soda and are slippery to touch.

Q.29. Which of the following are present in a dilute aqueous solution of hydrochloric acid?

(a) $H_3O^+ + Cl^-$ **(b) $H_3O^+ + OH^-$**

(c) $Cl^- + OH^-$ **(d) Unionised HCl**

[CBSE 2016, 13]

Ans. *(a) $H_3O^+ + Cl^-$*

Explanation: A strong acid like HCl dissociates completely in its aqueous solution and forms hydronium ions with its respective anion.

$$HCl_{(aq)} \rightarrow H^+ + Cl^-$$

$$\underset{\text{(Hydronium ion)}}{H_2O + H^+ \rightarrow H_3O^+}$$

Q.30. Identify the correct representation of reaction occurring during Chlor-alkali process.

(a) $2NaCl_{(l)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(l)} + Cl_{2(g)} + H_{2(g)}$

(b) $2NaCl_{(l)} + 2H_2O_{(aq)} \rightarrow 2NaOH_{(aq)} + Cl_{2(g)} + H_{2(aq)}$

(c) $2NaCl_{(aq)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + Cl_{2(aq)} + H_{2(aq)}$

(d) $2NaCl_{(aq)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + Cl_{2(g)} + H_{2(g)}$

Ans. *(d) $2NaCl_{(aq)} + 2H_2O_{(l)} \rightarrow 2NaOH_{(aq)} + Cl_{2(g)} + H_{2(g)}$*

Explanation: Chlor-alkali process is an industrial process that is used to form sodium hydroxide by the electrolysis of an aqueous solution of sodium chloride, NaCl (commonly known as brine). It forms sodium hydroxide with hydrogen and chlorine gas as byproducts.

SHORT ANSWER TYPE QUESTIONS (SA)

Q.31. Match the acids given in column I with their correct source given in column II.

Column I	Column II
(A) Lactic acid	(i) Tomato
(B) Acetic acid	(ii) Lemon
(C) Citric acid	(iii) Vinegar
(D) Oxalic acid	(iv) Curd

Ans.

Column I	Column II
(A) Lactic acid	(iv) Curd
(B) Acetic acid	(iii) Vinegar
(C) Citric acid	(ii) Lemon
(D) Oxalic acid	(i) Tomato

Explanation:

Lactic acid sources: Lactic acid is found in products, such as cheese, yogurt, soya sauce and pickled vegetables.

Acetic acid sources: Acetic acid is found in condiments, such as ketchup, mayonnaise and mustard.

Citric acid sources: Citric acid is found in citrus fruits, like lemons, limes and pineapples.

Oxalic acid sources: Oxalic acid is found in food articles, like spinach, cabbage broccoli, parsley, tomatoes.

Q.32. Match the important chemicals given in column I with the chemical formulae given in column II.

Column I	Column II
(A) Plaster of paris	(i) $Ca(OH)_2$
(B) Gypsum	(ii) $CaSO_4.\frac{1}{2}H_2O$
(C) Bleaching powder	(iii) $CaSO_4.2H_2O$
(D) Slaked lime	(iv) $CaOCl_2$

[CBSE 2017, 16]

Ans.

Column I	Column II
(A) Plaster of paris	(ii) $CaSO_4.\frac{1}{2}H_2O$
(B) Gypsum	(iii) $CaSO_4.2H_2O$
(C) Bleaching powder	(iv) $CaOCl_2$
(D) Slaked lime	(i) $Ca(OH)_2$

Q.33. 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 and Soap solution.

Ans. (1) **Dry HCl gas:** It will show no effect on litmus paper, as no ionisation will occur in gaseous state. This is because litmus paper changes colour only if ions, such as hydrogen (H^+) or hydronium (H_3O^+) ions are present in a solution. HCl can only furnish ions when it reacts with water. Thus, dry HCl gas does not change the colour of litmus paper.

(2) **Moistened NH_3 gas:** It is alkaline or basic in nature, so red litmus will turn blue.

(3) **Lemon juice:** It contains citric acid; therefore it turns blue litmus red.

(4) **Carbonated soft drinks:** They have carbonic acid, which is a weak acid and can turn blue litmus red.

(5) **Curd:** It contains lactic acid, so blue litmus will turn red.

(6) **Soap solution:** They are alkaline or basic in nature and can turn red litmus blue.

Related Theory

➥ *Saponification is a process where sodium hydroxide is used to create soap, which is a base with a pH of 13. Therefore, soaps are alkaline in nature.*

Q.34. Name the acid present in an ant sting and give its chemical formula. Also, give the common method to get relief from the discomfort caused by the ant sting. [CBSE 2017]

Ans. The acid present in an ant sting is formic acid, which is also named methanoic acid. The chemical formula for formic acid is HCOOH.

It is acidic in nature, so an alkaline compound like wet baking soda $NaHCO_3$ can be used to neutralise its effect. To get relief from the discomfort caused by the ant stings, apply baking soda on the affected area. Baking soda is basic in nature and it reacts with acid to produce neutral salt.

Q.35. What happens when nitric acid is added to an egg shell? [CBSE 2020, 17, 16]

Ans. Calcium carbonate is the main component of an egg shell, so when we add nitric acid to an egg shell, it reacts with calcium carbonate to form soluble calcium nitrate and water with brisk effervescence of carbon dioxide gas.

The chemical equation for this reaction is:

$$\underset{\text{(Calcium carbonate)}}{CaCO_{3(s)}} + \underset{\text{(Nitric acid)}}{2HNO_{3(aq)}} \rightarrow \underset{\text{(Calcium nitrate)}}{Ca(NO_3)_{2(aq)}} + \underset{\text{(Carbon dioxide)}}{CO_{2(g)}} + \underset{\text{(Water)}}{H_2O_{(l)}}$$

Q.36. A student prepared solutions of (I) an acid and (II) a base in two separate beakers. She forgot to label the solutions and litmus paper is not available in the laboratory. Since, both the solutions are colourless, how will she distinguish between the two?

[CBSE 2017]

Ans. In the absence of litmus paper, other natural or synthetic substances can be used to test acids and bases. Such substances are called indicators. Indicators such as methyl orange and phenolphthalein can be used to test the nature of a solution.

These indicators show changes in their colour in acidic, neutral and basic solutions. We can also use natural indicators, such as turmeric and grape juice. A few indicators with characteristic colour change are shown below:

pH Indicator	Colour in acidic medium	Colour in neutral medium	Colour in basic medium
Litmus	Red	Purple	Blue
Phenol red	Yellow	Red	Red
Phenol-phthalein	Colourless	Colourless	Pink

pH Indicator	Colour in acidic medium	Colour in neutral medium	Colour in basic medium
Methyl orange	Red/Pink	Orange	Yellow
Turmeric	Yellow	Yellow	Reddish brown
Red cabbage juice	Red	Purple	Bluish green

Q.37. How would you distinguish between baking powder and washing soda by heating?

[CBSE 2019, 15]

Ans. Baking soda is sodium hydrogen carbonate ($NaHCO_3$).

Baking soda ($NaHCO_3$) on heating, produces carbon dioxide (CO_2). Carbon dioxide turns lime water milky. It can also extinguish a burning matchstick.

$$\underset{\text{(Baking soda)}}{2NaHCO_{3(s)}} \xrightarrow{\text{Heat}} \underset{\text{(Sodium carbonate)}}{Na_2CO_{3(s)}} + H_2O_{(g)} + CO_{2(g)}$$

Washing soda is sodium carbonate decahydrate ($Na_2CO_3.10H_2O$), which means there are 10 water molecules present with crystal, hence, named as water of crystallisation.

Heating washing soda ($Na_2CO_3.10H_2O$) does not produce any gas and hence, there is no effect on lime water or a burning matchstick.

The water of crystallisation in washing soda is released due to heating and the salt becomes anhydrous white powder called soda ash.

$$\underset{\text{(Washing soda)}}{Na_2CO_3.10H_2O_{(s)}} \xrightarrow{\text{Heat}} \underset{\text{(Sodium carbonate)}}{Na_2CO_{3(s)}} + 10H_2O_{(g)}$$

Q.38. Salt A, commonly used in bakery products, on heating gets converted into another salt B, which itself is used for the removal of the 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.

[CBSE 2019, 15]

Ans. Salt A that is used in bakery product is baking soda or sodium hydrogen carbonate ($NaHCO_3$).

On heating of baking soda, sodium carbonate is formed with evolution of carbon dioxide gas.

$$\underset{\text{(Baking soda)}}{2NaHCO_{3(s)}} \rightarrow \underset{\text{(Sodium carbonate)}}{Na_2CO_{3(s)}} + H_2O_{(g)} + CO_{2(g)}$$

Salt B is sodium carbonate Na_2CO_3, as sodium carbonate is used to remove the hardness of water. Gas C is carbon dioxide (CO_2) that gives lime test in which it turns lime water milky.

Q.39. In one of the industrial processes for manufacture of sodium hydroxide, a gas X is formed as by product. The gas X reacts with lime water to give a compound Y which is used as a bleaching agent in chemical industry. Identify X and Y, giving the chemical equation of the reactions involved.

[CBSE 2018, 16, 10]

Ans. Sodium hydroxide (NaOH) is manufactured by the electrolysis of an aqueous solution of sodium chloride, which forms hydrogen gas (H_2) and chlorine gas (Cl_2) as byproducts.

The reaction of chlorine gas with lime water forms bleaching powder ($CaOCl_2$).

Thus, X is Cl_2 gas and Y is calcium oxychloride ($CaOCl_2$).

The equation for the preparation of sodium hydroxide (NaOH) and bleaching powder ($CaOCl_2$), is given below:

(1) $\underset{\text{(Sodium chloride)}}{2NaCl_{(aq)}} + 2H_2O_{(l)} \rightarrow \underset{\text{(Sodium hydroxide)}}{2NaOH_{(aq)}} + Cl_{2(g)} + H_{2(g)}$

(2) $\underset{\text{(Lime water)}}{Ca(OH)_{2(aq)}} + Cl_{2(g)} \rightarrow \underset{\text{(Bleaching powder)}}{CaOCl_{2(s)(aq)}} + H_2O_{(l)}$

Q.40. Fill in the missing data in the given table.

Name of the salt	Formula	Salt obtained from	
		Base	Acid
Ammonium chloride	**NH_4Cl**	**NH_4OH**	**—**
Copper sulphate	**—**	**—**	**H_2SO_4**
Sodium chloride	**NaCl**	**NaOH**	**—**
Magnesium nitrate	**$Mg(NO_3)_2$**	**—**	**HNO_3**
Potassium sulphate	**K_2SO_4**	**—**	**—**
Calcium nitrate	**$Ca(NO_3)_2$**	**$Ca(OH)_2$**	**—**

Ans.

Name of the salt	Formula	Salt obtained from	
		Base	Acid
Ammonium chloride	NH_4Cl	NH_4OH	**HCl**
Copper sulphate	**$CuSO_4$**	**$Cu(OH)_2$**	H_2SO_4
Sodium chloride	NaCl	NaOH	**HCl**
Magnesium nitrate	$Mg(NO_3)_2$	**$Mg(OH)_2$**	HNO_3

Potassium sulphate	K_2SO_4	**KOH**	**H_2SO_4**
Calcium nitrate	$Ca(NO_3)_2$	$Ca(OH)_2$	HNO_3

(1) Acid: HCl

$NH_4OH_{(aq)} + HCl_{(aq)} \rightarrow NH_4Cl_{(aq)} + H_2O_{(l)}$

(Ammonium hydroxide) (Hydrochloric acid)

(2) Formula: $CuSO_4$ and base: $Cu(OH)_2$

$H_2SO_{4(aq)} + Cu(OH)_{2(s)} \rightarrow CuSO_{4(aq)} + 2H_2O_{(l)}$

(Sulphuric acid) (Copper hydroxide)

(3) Acid: HCl

$NaOH_{(aq)} + HCl_{(aq)} \rightarrow NaCl_{(aq)} + H_2O_{(l)}$

(Sodium hydroxide) (Hydrochloric acid)

(4) Base: $Mg(OH)_2$

$Mg(OH)_{2(aq)} + 2HNO_{3(aq)} \rightarrow Mg(NO_3)_{2(aq)} + 2H_2O_{(l)}$

(Magnesium hydroxide) (Nitric acid)

(5) Base: KOH and Acid: H_2SO_4

$2KOH_{(aq)} + H_2SO_{4(aq)} \rightarrow K_2SO_{4(aq)} + 2H_2O_{(l)}$

(Potassium hydroxide) (Sulphuric acid)

(6) Acid: HNO_3

$Ca(OH)_{2(aq)} + 2HNO_{3(aq)} \rightarrow Ca(NO_3)_{2(aq)} + 2H_2O_{(l)}$

(Calcium hydroxide) (Nitric acid)

Q.41. What are strong and weak acids? In the following list of acids, separate strong acids from weak acids:

Hydrochloric acid, Citric acid, Acetic acid, Nitric acid, Formic acid, Sulphuric acid

[CBSE 2016, 13]

Ans. Strong acids: Acids that dissociate into hydrogen ions completely in an aqueous solution are strong acids. These hydrogen ions attach themselves to the water molecules, producing a high concentration of H_3O^+ ions. Acids, such as HCl, H_2SO_4 and HNO_3 are strong acids.

Weak acids: Acids that do not dissociate completely into hydrogen ions in an aqueous solution are weak acids. Weak acids get partially ionised and an aqueous solution of the same molar concentration provides a much smaller concentration of H_3O^+ ions. Acids such as acetic acid and carbonic acid are weak acids.

Strong Acid	Weak Acid
Hydrochloric acid	Citric acid
Sulphuric acid	Acetic acid
Nitric acid	Formic acid

Q.42. When zinc metal is treated with a dilute solution of a strong acid, a gas is evolved, which is utilized 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.

[CBSE 2018, 15]

Ans. Zinc is a metallic element. Metals react with dilute solutions of strong acids to form respective salts and hydrogen gas.

The reaction of zinc with a dilute solution of strong acid like HCl forms zinc chloride ($ZnCl_2$) and hydrogen gas is evolved.

$Zn_{(s)} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + H_{2(g)}$

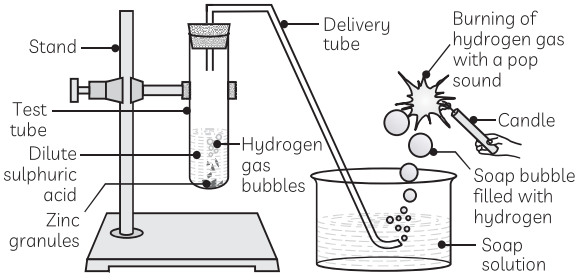
(Zinc) (Hydrochloric acid) (Zinc chloride)

Hydrogen gas is used in the hydrogenation of vegetable oil.

To test the presence of H_2 gas, bring a burning splinter or a matchstick near the mouth of the test tube, you will see that the gas burns with a pop sound.

LONG ANSWER TYPE QUESTIONS (LA)

Q.43. In the following schematic diagram for the preparation of hydrogen gas, what would happen if the following changes are made?



(A) In place of zinc granules, the 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 test tube is heated. **[CBSE 2018, 15]**

Ans. (A) When the same amount of zinc dust is taken in the test tube in place of zinc granules, the reaction rate is comparatively

faster because zinc dust has a larger surface area than zinc granules. Also, the hydrogen gas will evolve with greater speed when zinc dust is used in place of zinc granules.

(B) With dilute hydrochloric acid, zinc chloride is formed instead of zinc sulphate. Almost the same amount of hydrogen gas is evolved in both the cases, as both hydrochloric acid and sulphuric acid are strong acids

$$\underset{\text{(zinc)}}{Zn_{(s)}} + \underset{\text{(Hydrochloric acid)}}{2HCl_{(aq)}} \rightarrow \underset{\text{(Zinc chloride)}}{ZnCl_{2(aq)}} + H_{2(g)}$$

(C) Copper is a less reactive metal and does not react with dilute acids, so there will be no reaction between copper turnings and dilute HCl. Hydrogen gas will not evolve. Copper does not react with dilute acids of H_2SO_4 or HCl under normal conditions because copper lies at a lower position in the reactivity series.

(D) If sodium hydroxide is taken in place of dilute sulphuric acid and the test tube is heated, sodium zincate (Na_2ZnO_2) is formed along with hydrogen gas. The heating of test tube will just increase the rate of reaction, thus, increasing the formation of hydrogen gas.

$$\underset{\text{(Zinc)}}{Zn_{(s)}} + \underset{\text{(Sodium hydroxide)}}{2NaOH_{(aq)}} \rightarrow \underset{\text{(Sodium zincate)}}{Na_2ZnO_{2(aq)}} + H_{2(g)}$$

Q.44. Baking powder is used for baking a cake. If your mother uses baking soda instead of baking powder in cake:

(A) How will it affect the taste of the cake and why?

(B) How can baking soda be converted into baking powder?

(C) What is the role of tartaric acid added to baking soda? [CBSE 2017, 13]

Ans. (A) Baking soda is sodium hydrogen carbonate, which decomposes to sodium carbonate, water and carbon dioxide on heating. Baking powder is a mixture of sodium hydrogen carbonate with tartaric acid, which readily reacts with sodium carbonate and neutralises it.

While making cake, if baking soda is used instead of baking powder, the cake will taste bitter. Baking soda ($NaHCO_3$) is a base and we know that bases are bitter.

In the case of baking powder, tartaric acid neutralises the bitter taste of baking soda. On heating, baking powder produces sodium carbonate, carbon dioxide and water.

$$2NaHCO_{3(s)} + \text{Heat} \rightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$$

Therefore, the use of baking soda will give a bitter taste to the cake due to the presence of sodium carbonate.

(B) Baking soda can be converted into baking powder by the addition of an appropriate amount of tartaric acid to it.

(C) The role of tartaric acid is to neutralise sodium carbonate and the cake will not taste bitter.

Q.45. A metal carbonate X on reacting with an acid gives a gas which when passed through a solution Y gives the carbonate back. On the other hand, a gas G, that is obtained at anode during electrolysis of brine, is passed on dry Y; it gives a compound Z, used for disinfecting drinking water. Identify X, Y, G and Z. [CBSE 2016, 13]

Ans. X is calcium carbonate $CaCO_3$. When calcium carbonate reacts with an acid, such as hydrochloric acid, carbon dioxide is released.

$$CaCO_{3(s)} + 2HCl_{(aq)} \rightarrow CaCl_{2(aq)} + H_2O_{(l)} + CO_{2(g)}$$

Solution Y is lime water $Ca(OH)_2$. When CO_2 is passed through lime water, it turns milky due to the formation of calcium carbonate.

$$\underset{\text{Y}}{Ca(OH)_{2(aq)}} + CO_{2(g)} \rightarrow \underset{\text{X (Precipitates)}}{CaCO_{3(s)}} + H_2O_{(l)}$$

Brine is a saturated solution of sodium chloride (NaCl). Electrolysis of brine forms hydrogen gas at cathode and chlorine gas at anode.

$$2NaCl_{(aq)} + 2H_2O_{(l)} \xrightarrow{\text{Electrolysis}} 2NaOH_{(aq)} + \underset{\text{G}}{Cl_{2(g)}} + H_{2(g)}$$

When chlorine gas is passed through dry slaked lime, $Ca(OH)_2$ (Y), it produces bleaching powder (Z). Bleaching powder is used for disinfecting drinking water.

$$Ca(OH)_{2(aq)} + Cl_{2(g)} \rightarrow \underset{\text{Z}}{CaOCl_{2(aq)}} + H_2O_{(l)}$$

Hence, Z is calcium oxychloride ($CaOCl_2$) or bleaching powder.

(1) Metal carbonate X is calcium carbonate.

(2) Solution Y is lime water (calcium hydroxide).

(3) Gas G is chlorine gas.

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

(5) Compound Z is bleaching powder (calcium oxychloride).

Q.46. A dry pellet of a common base B when kept in open absorbs moisture and turns sticky. The compound is also a product of chlor-alkali process. Identify B. What type of reaction occurs when B is treated with an acidic oxide? Write a balanced chemical equation for one such solution. [CBSE 2018]

Ans. Base B is sodium hydroxide (NaOH). Dry pellets of sodium hydroxide (NaOH) absorb moisture from the atmosphere and become sticky. It is also a byproduct of the Chlor-alkali process. Chlor-alkali process is the electrolysis of brine (saturated solution of sodium hydroxide) that forms aqueous sodium hydroxide with hydrogen gas and chlorine gas.

The acidic oxide such as CO_2 reacts with a base such as NaOH to give salt (sodium carbonate) and water. Such a reaction is called neutralisation reaction.

$$\underset{\text{(Sodium hydroxide) (B)}}{2NaOH_{(s)}} + CO_{2(g)} \rightarrow \underset{\text{(Sodium carbonate)}}{Na_2CO_{3(s)}} + H_2O_{(l)}$$

Thus, B is NaOH and reaction of NaOH with acidic oxide is called a neutralisation reaction.

Q.47. A sulphate salt of group 2 element of the periodic table is a white, soft substance, which can be molded 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 used for molding purposes. Identify the sulphate salt and why does it show such a behaviour? Give the reaction involved. [CBSE 2017, 16]

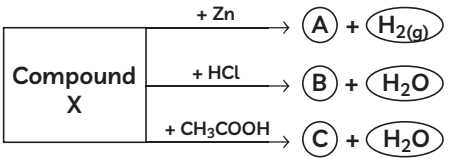
Ans. The group 2 element is calcium. The sulphate salt which can be molded into different shapes by making its dough is calcium sulphate hemi-hydrate ($CaSO_{4.1/2}H_2O$). It is commonly known as plaster of paris. Here, two molecules of calcium sulphate share one molecule of water.

Because of the presence of water of crystallisation, it is soft.

It readily reacts with atmospheric moisture and forms hard solid mass. This solid mass is known as gypsum ($CaSO_4.2H_2O$). The conversion of Plaster of Paris to gypsum can be represented as given below:

$$\underset{\text{(Plaster of Paris) (Soft) (Sulphate salt)}}{CaSO_4.1/2H_2O} + \underset{\text{(Water)}}{1½H_2O} \rightarrow \underset{\text{(Gypsum) (Hard mass)}}{CaSO_4.2H_2O}$$

Q.48. Identify the compound X on the basis of the reactions given below. Also, write the name and chemical formulae of A, B and C.



[CBSE 2018, 16]

Ans. X must be a compound that forms water with acids. It means it must be a base that reacts with acids to form salt and water. This base also reacts with zinc metal and releases hydrogen gas. So, it must be NaOH (sodium hydroxide).

$$\underset{x}{2NaOH_{(aq)}} + Zn_{(s)} \rightarrow \underset{\text{(Sodium zincate) (A)}}{Na_2ZnO_{2(aq)}} + H_{2(g)}$$

$$\underset{x}{NaOH_{(aq)}} + HCl_{(aq)} \rightarrow \underset{\text{(Sodium chloride) (B)}}{NaCl_{(aq)}} + H_2O_{(l)}$$

$$\underset{x}{NaOH_{(aq)}} + CH_3COOH_{(aq)} \rightarrow \underset{\text{(Sodium acetate) (C)}}{CH_3COONa_{(aq)}} + H_2O_{(l)}$$

X — NaOH (Sodium hydroxide)

A — Na_2ZnO_2 (Sodium zincate)

B — NaCl (Sodium chloride)

C — CH_3COONa (Sodium acetate)

MULTIPLE CHOICE QUESTIONS (MCQs)

*** ALL QUESTIONS CARRY 1 MARK EACH.**

Q.1. Which of the following solutions in water does not conduct electricity?

(a) Hydrochloric acid (b) Sodium chloride
(c) Glucose (d) Sulphuric acid

Ans. *(c) Glucose*

Explanation: The aqueous solution of an acid conducts electricity because of the presence of charged particles called 'ions' in it. When hydrochloric acid (HCl) is dissolved in water, its aqueous solution contains hydrogen ions (H^+) and chloride ions (Cl^-). Similarly, H_2SO_4 dissociates into (H^+) and (SO_4^{2-}) ions and common salt (NaCl) dissociates into sodium (Na^+) ion and chloride (Cl^-) ion. These are all strong electrolytes. They completely dissociate in an aqueous solution and produce current-carrying ions.

On the other hand, a hydrogen-containing compound such as glucose is not categorised as an electrolyte because it does not produce ions when dissolved in water, and hence, does not conduct electricity. Therefore, the answer is glucose.

Q.2. Which of the following will turn phenolphthalein pink?

(a) $NaOH_{(aq)}$ (b) $HCl_{(aq)}$

(c) $CH_3COOH_{(aq)}$ (d) H_2O

Ans. *(a) $NaOH_{(aq)}$*

Explanation: Phenolphthalein solution is a colourless indicator which gives pink colour in a basic solution. Phenolphthalein solution remains colourless in acidic solution as well as in neutral solution. NaOH is basic in nature, HCl and CH_3COOH are acidic while H_2O is neutral. Therefore, if we add a few drops of sodium hydroxide solution, the mixture will become basic and a pink colour will appear.

Q.3. For the given question, two statements are given - one is labelled Assertion (A) and the other labelled Reason (R). Select the correct option to the question given below:

Assertion (A): Acids should be used carefully.

Reason(R): All acids are corrosive in nature.

(a) Both (A) and (R) are true and (R) is the correct explanation of (A).

(b) Both (A) and (R) are true but (R) is not the correct explanation of (A).

(c) (A) is true but (R) is false.

(d) (A) is false but (R) is true.

Ans. *(a) Both (A) and (R) are true and (R) is the correct explanation of (A).*

Explanation: Acids are highly reactive and can burn almost any thin object, including clothing, paper, skin, hair, plastic, and so on. That's why, it's always best to use acids with caution.

VERY SHORT ANSWER YPE QUESTIONS (VSA)

*** ALL QUESTIONS CARRY 2 MARKS EACH.**

Q.4. What do you understand by olfactory indicators?

Ans. The substances whose smell changes in acidic or basic solutions are called olfactory indicators. An olfactory indicator usually works on the principle that when an acid or base is added to it, it loses its characteristic smell. Onion and vanilla extract are examples of olfactory indicators.

Related Theory

When a basic solution such as sodium hydroxide solution is added to an onion-treated cloth strip, the smell of onion is not detected. However, an acidic solution such as hydrochloric acid does not destroy the smell of onion. This can be used as a test to differentiate between acids and bases.

Q.5. Give the chemical name of the compound present in tooth enamel. What is the nature of this compound?

Ans. The tooth enamel is made of calcium phosphate $Ca_3(PO_4)_2$. It is basic in nature. It starts getting corroded when the pH in the mouth is slightly acidic. This is the reason why toothpaste contains bases to neutralise the acid in the mouth.

SHORT ANSWER TYPE QUESTIONS (SA)

*** ALL QUESTIONS CARRY 3 MARKS EACH.**

Q.6. Hydrochloric acid reacts with a metal X to form a gas Y, which burns with a 'pop' sound. Sodium hydroxide solution also reacts with same metal X to form same gas Y.

Name X and Y.

Write the chemical equation of the reaction of metal X with (I) HCl and (II) NaOH solution.

Ans. When an acid reacts with a metal, then salt and hydrogen gas are formed.

$$\text{Metal} + \text{Acid} \rightarrow \text{Salt} + H_2 \text{ gas}$$

$$\underset{X}{Zn_{(s)}} + 2HCl_{(aq)} \rightarrow ZnCl_{2(aq)} + \underset{Y}{H_{2(g)}}$$

Similarly, when sodium hydroxide reacts with zinc metal, hydrogen gas is formed.

$$\underset{\text{(Sodium hydroxide) (Base)}}{2NaOH_{(aq)}} + \underset{\text{(Zinc)}}{Zn_{(s)}} \xrightarrow{\text{Heat}} \underset{\text{(Sodium zincate) (Salt)}}{Na_2ZnO_{2(aq)}} + \underset{\text{(Hydrogen gas)}}{H_{2(g)}}$$

Thus, X is zinc metal and Y is hydrogen gas.

Q.7. Varun took a sample A and added dilute hydrochloric acid to it. A colourless, odorless gas X was evolved which turned lime water milky.

(A) Identify sample A and the gas X evolved.

(B) Write a chemical equation to explain the reaction between sample A and hydrochloric acid.

(C) Why does the gas X turn lime water milky?

Ans. (A) We know that acid reacts with a metal carbonate or metal hydrogencarbonate to form a salt, carbon dioxide gas and water. This carbon dioxide gas when passed through lime water turns it milky in appearance. With this statement, we can say that sample A is either metal carbonate or metal hydrogencarbonate and gas X is carbon dioxide gas.

(B) Let us now see the possible reactions of dilute hydrochloric acid with a metal carbonate and metal hydrogencarbonate:

Metal Carbonate:

$$\underset{\text{(Sodium carbonate)}}{Na_2CO_{3(aq)}} + \underset{\text{(Hydrochloric acid)}}{2HCl_{(aq)}} \rightarrow \underset{\text{(Sodium chloride)}}{2NaCl_{(aq)}} + \underset{\text{(Carbon dioxide)}}{CO_{2(g)}} + \underset{\text{(Water)}}{H_2O_{(l)}}$$

Metal Hydrogen Carbonate

$$\underset{\text{(Sodium hydrogen carbonate)}}{NaHCO_{3(s)}} + \underset{\text{(Hydrochloric acid)}}{HCl_{(aq)}} \rightarrow \underset{\text{(Sodium chloride)}}{NaCl_{(aq)}} + \underset{\text{(Carbon dioxide)}}{CO_{2(g)}} + \underset{\text{(Water)}}{H_2O_{(l)}}$$

(C) This carbon dioxide gas reacts with lime water as follows:

$$\underset{\substack{\text{(Calcium hydroxide)}\\\text{(Lime water)}}}{Ca(OH)_{2(aq)}} + \underset{\text{(Carbon dioxide)}}{CO_{2(g)}} \rightarrow \underset{\substack{\text{(Calcium carbonate)}\\\text{(White ppt.)}}}{CaCO_{3(s)}} + \underset{\text{(Water)}}{H_2O_{(l)}}$$

The lime water turns milky due to the formation of a white precipitate of calcium carbonate as shown in the above equation.

LONG ANSWER TY E QUESTIONS (LA)

*** ALL QUESTIONS CARRY 5 MARKS EACH.**

Q.8. A white powder is used by doctors to support fractured bones.

(A) Write the name and chemical formula of the powder.

(B) How is this prepared?

(C) When this white powder is mixed with water, a hard solid mass is obtained. Write a balanced chemical equation for the change.

(D) Give one more use of this powder.

Ans. (A) The white powder used by doctors to support fractured bones is called Plaster of Paris. It is chemically called calcium sulphate hemihydrate or calcium sulphate half-hydrate. The chemical formula of Plaster of Paris is $CaSO_4.1/2H_2O$.

(B) Plaster of Paris is prepared from gypsum. Chemically, gypsum is calcium sulphate dihydrate, $CaSO_4.2H_2O$. Plaster of Paris is prepared by heating gypsum ($CaSO_4.2H_2O$) to a temperature of 100°C in kiln. When gypsum is heated to a temperature of 100°C, it loses three-fourth of its water of crystallisation and forms plaster of Paris:

$$\underset{\text{(Gypsum)}}{CaSO_4.2H_2O} \xrightarrow[100°C]{\text{Heat to}} \underset{\text{(Plaster of Paris)}}{CaSO_4.1/2H_2O} + \underset{\text{(Water)}}{3/2H_2O}$$

(C) $$\underset{\text{(Plaster of Paris)}}{CaSO_4.1/2H_2O} + 1½\underset{\text{(Water)}}{H_2O} \rightarrow \underset{\substack{\text{(Gypsum)}\\\text{(Sets as hard mass)}}}{CaSO_4.2H_2O}$$

(D) Apart from setting fractured bones, plaster of Paris is used in chemistry laboratories for sealing air-gaps in apparatus where air-tight arrangement is required.

Q.9. (A) Why does acidic solution conduct electricity?

(B) Can basic solution conduct electricity?

(C) Can separation of H^+ ions in acids take place when HCl is added to a non-aqueous solution?

(D) While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid?

Ans. (A) The aqueous solution of an acid conducts electricity due to the presence of charged particles called ions in it. For example, when hydrochloric acid (HCl) is dissolved in water, its solution contains hydrogen ions, $H^+_{(aq)}$ and chloride ions, $Cl^-_{(aq)}$.

These ions can carry electric current. So, due to the presence of $H^+_{(aq)}$ ions and $Cl^-_{(aq)}$ ions, a solution of hydrochloric acid conducts electricity.

(B) When a base is dissolved in water, it splits up into ions. Due to the presence of ions, the solutions of bases can conduct electricity.

(C) No, separation of H^+ ions does not take place when HCl is added to a non-aqueous solution. An acid always ionises on dissolving in water to produce hydrogen ions.

(D) A concentrated acid is always diluted by adding water to it. The process of mixing water to a concentrated acid is a highly exothermic process. In this process, a large amount of heat is evolved.

Related Theory

- *When concentrated acid is added slowly to excess water, the heat is evolved gradually and easily absorbed by the large amount of water.*
- *If water is added to excess concentrated acid, a large amount of heat is evolved suddenly. This heat uses some of the water to steam explosively. This results in a splash of acid on our body and causes acid burns.*