

CHAPTER

2

ACIDS, BASES AND SALTS

Syllabus

Their definitions in terms of furnishing of H^+ and OH^- ions, general properties, examples and uses, concept of pH scale (Definition relating to logarithm not required), importance of pH in everyday life; preparation and uses of Sodium Hydroxide, Bleaching powder, Baking soda, Washing soda and Plaster of Paris.

Trend Analysis

| List of Concept | 2018 | 2019 | | 2020 | |
|--|--------------|--------------|-----------|--------------|-----------|
| | OD/D | OD | D | OD | D |
| Acids, bases and salts and their definitions | 1 Q (3 M) | 1 Q (3 M) | 1 Q (3 M) | 1 Q (1 M) | 1 Q (1 M) |
| Concept of pH scale and its importance in everyday life. | Or 1 Q (3 M) | 1 Q (3 M) | — | — | 1 Q (1 M) |
| Chemical Salts, Preparations, Properties and Uses | | Or 1 Q (3 M) | 1 Q (3 M) | Or 1 Q (3 M) | 1 Q (3 M) |



TOPIC - 1

Acids and Bases



Revision Notes

Introduction

- Acids are sour in taste. They turn blue litmus red. Acids are the substances that furnish H^+ ions in aqueous solution.
- If in an aqueous solution, concentration of acid is low, it is called dilute solution and if concentration of acid is high, it is called concentrated solution.
- Hydrochloric acid is released in stomach to make medium acidic in nature. It leads to coagulation of protein and helps in their digestion. HCl kills bacteria coming in the stomach along with the food.
- When a burning matchstick is brought near the hydrogen gas, it burns with a pop sound.
- When CO_2 gas is passed through lime water, it turns milky. If CO_2 is passed in excess, milkiness disappears.

TOPIC - 1

Acids and Bases

Page No. 20

TOPIC - 2

Salts, Their Properties and Uses

Page No. 30

- There are many natural substances like red onion peels, red cabbage leaves, beetroot extract, coloured petals of some flowers, which are called indicators because they indicate the presence of acid or base by showing the change in colour.
- Acids react with certain metal oxides to form salt and water. Acids react with metal carbonates and hydrogen carbonates to produce carbon dioxide gas.
- Strong bases react with active metals to produce hydrogen gas. Bases react with non-metallic oxides to produce salt and water.
- Both acids and bases conduct free electric current in their aqueous solution due to the presence of free ions.
- Strength of an acid or base depends on the number of H^+ ions or OH^- ions produced by them respectively. More the H^+ ions produced by an acid, stronger is the acid. More the OH^- ions produced by a base, stronger is the base.
- **Indicators:** These are the substances which change their colour / smell in different types of substances.
- **Types of Indicators:**

| | S. No. | Indicator | Smell/Colour In Acid Solution | Smell/Colour In Basic Solution |
|---------------------|--------|----------------------------|-------------------------------|--------------------------------|
| Natural Indicator | 1. | Litmus | Red | Blue |
| | 2. | Red cabbage leaf extract | Red | Green |
| | 3. | Flowers of hydrangea plant | Blue | Pink |
| | 4. | Turmeric | No change | Red |
| Synthetic Indicator | 1. | Phenolphthalein | Colourless | Pink |
| | 2. | Methyl orange | Red | Yellow |
| Olfactory Indicator | 1. | Onion | Characteristic smell | No smell |
| | 2. | Vanilla essence | Retains smell | No smell |
| | 3. | Clove oil | Retains smell | Loses smell |

➤ Chemical Properties of Acids and Bases:

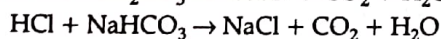
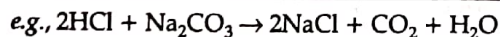
1. Reaction of Metals with:

| Acids | Bases |
|--|---|
| Acid + Metal \rightarrow Salt + Hydrogen gas | Base + Metal \rightarrow Salt + Hydrogen gas |
| e.g., $2HCl + Zn \rightarrow ZnCl_2 + H_2 \uparrow$ (Zinc chloride) | e.g., $2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2 \uparrow$ (Sodium zincate) |

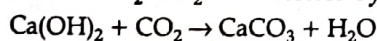
Test for H_2 gas: Hydrogen gas released can be tested by bringing a burning candle near gas bubbles, it bursts with pop sound.

2. Reaction of Metal Carbonates / Metal Hydrogen Carbonates with:

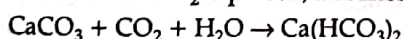
| Acids | Bases |
|---|--|
| Acid + Metal Carbonate / Metal hydrogen Carbonate \downarrow Salt + $CO_2 + H_2O$ | Base + Metal Carbonate / Metal Hydrogen Carbonate \downarrow No Reaction |



Test for CO_2 : CO_2 can be tested by passing it through lime water. Lime water turns milky.

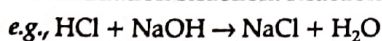


When excess CO_2 is passed, milkiness disappears.



3. Reaction of Acids and Bases With Each Other

Neutralization Reaction: Reaction of acid with base is called neutralization reaction.



➤ **If:**



Scan to know more about this topic



Acid

Scan to know more about this topic



Base

Scan to know more about this topic



Acid-Base Conductivity

Scan to know more about this topic



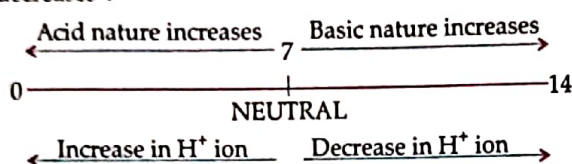
Dilution

Weak Acid + Strong Base \rightarrow Basic salt + H_2O

Strong Acid + Strong Base \rightarrow Neutral salt + H_2O

Weak Acid + Weak Base \rightarrow Neutral salt + H_2O

- > pH of stomach is 1.5-3.0 due to secretion of HCl. In case of indigestion, acidity increases, which can be neutralised by antacids like milk of magnesia.
- > Cold drinks, chocolates and sweets are harmful to tooth. They produce acids in mouth which are responsible for tooth decay.
- > Salts of a strong acid and a strong base are neutral with pH value of 7.
- > Salts have various uses in everyday life and in industries.
- > A salt is soluble if it dissolves in water to give a solution with a concentration of at least 0.1 moles per litre at room temperature.
- > **pH Scale:** A scale for measuring H^+ ion concentration in a solution. p in pH stands for 'potenz' a German word which means power.
 - pH = 7 \rightarrow neutral solution
 - pH < 7 \rightarrow acidic solution
 - pH > 7 \rightarrow basic solution
 - On diluting an acid: pH increases \uparrow
 - On diluting a base: pH decreases \downarrow



> **Importance of pH in everyday life:**

1. Plants and animals are pH sensitive.
 - Our body works within the pH range of 7 - 7.8.
 - When pH of rain water is less than 5.6, it is called acid rain.
 - Plants require a specific pH range for their healthy growth.



Mnemonics

| Concept: Natural indicators | Concept: pH scale |
|--|--|
| Mnemonics: PG.RCT | Mnemonics: Phone lao 7A mein |
| Interpretation: Petunia Geranium Red cabbage Turmeric | Interpretation: pH less than 7 --- Acid |



Objective Type Questions

1 mark each



Multiple Choice Questions

1. An aqueous solution 'A' turns phenolphthalein solution pink. On addition of an aqueous solution 'B' to 'A', the pink colour disappears. The following statement is true for solution 'A' and 'B'.

[Outside Delhi 2020]

- (a) A is strongly basic and B is a weak base.
 - (b) A is strongly acidic and B is a weak acid.
 - (c) A has pH greater than 7 and B has pH less than 7.
 - (d) A has pH less than 7 and B has pH greater than 7.
- Ans. (c) A has pH greater than 7 and B has pH less than 7.

Q. 2. Identify the basic salt from the following salts:

- (a) Na_2CO_3
- (b) NH_4Cl

(c) $NaNO_3$

(d) KCl

[Board SQP, 2020]

Ans. Correct option: (a)

Explanation: Na_2CO_3 is a basic salt.

Q. 3. 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

[NCERT Exemp.]

Ans. Correct option: (c)

Explanation: Vanilla essence can be used as an acid-base indicator by visually impaired students as it is an olfactory indicator whose odour changes in acidic or basic media.

Q. 4. Which of the following is acidic in nature?

- (a) Lime juice (b) Human blood
(c) Lime water (d) Antacid

[NCERT Exemp.]

Ans. Correct option: (a)

Explanation: Lime juice is acidic in nature as the juice is obtained from lime, a citrus fruit. This contains citric acid, and is therefore sour in taste.

Q. 5. 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.

[NCERT Exemp.]

Ans. Correct option: (c)

Explanation: The role of calcium chloride taken in the guard tube is to absorb moisture from the gas. This is because calcium chloride is used as a drying agent which absorbs moisture from the hydrogen chloride (HCl) gas.

Q. 6. Which of the following are present in a dilute aqueous solution of hydrochloric acid?

- (a) $\text{H}_3\text{O}^+ + \text{Cl}^-$ (b) $\text{H}_3\text{O}^+ + \text{OH}^-$
(c) $\text{Cl}^- + \text{OH}^-$ (d) Unionized HCl

[NCERT Exemp.]

Ans. Correct option: (a)

Explanation: In a dilute aqueous solution of hydrochloric acid, $\text{H}_3\text{O}^+ + \text{Cl}^-$ ions are present.

B Assertions and Reasons Type Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
(b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
(c) Assertion (A) is true but reason (R) is false.
(d) Assertion (A) is false but reason (R) is true.

1. Assertion: After white washing the walls, a shiny white finish on walls is obtained after two to three days.

Reason: Calcium Oxide reacts with Carbon dioxide to form Calcium Hydrogen Carbonate which gives shiny white finish. [SQP 2020-2021]

Ans. Correct option: (c)

[CBSE Marking Scheme, 2020]

Explanation: Calcium hydroxide is obtained by reaction of calcium oxide and water.

2. Assertion (A): When zinc is added to dilute hydrochloric acid, hydrogen is given off.

Reason (R): Hydrogen chloride molecules contain hydrochloric acid and hydrogen atoms.

Ans. Correct option: (b)

Explanation: The metal zinc readily reacts with hydrochloric acid to produce hydrogen gas (H_2) and zinc chloride (ZnCl_2).

3. Assertion (A): Gas bubbles are observed when sodium carbonate is added to dilute hydrochloric acid.

Reason (R): Carbon dioxide is given off in the reaction.

Ans. Correct option: (a)

Explanation: Sodium carbonate reacts with excess hydrochloric acid to form sodium chloride, water and carbon dioxide. In this reaction, bubbles of carbon dioxide are observed.

4. Assertion (A): Ammonia solution is an alkali.

Reason (R): Ammonia solution turns blue litmus paper red.

Ans. Correct option: (c)

Explanation: Ammonia solution, which is alkaline, turn the red litmus paper blue.

C Very Short Answer Type Questions

Q. 1. Which is the basic salt from the following salts:

Na_2CO_3 and NH_4Cl [Modified, SQP-2020]

Ans. Na_2CO_3

1

Q. 2. Name both the phenomenon occurring when a small amount of acid is added to water:

[AE] [2020 Delhi]

Ans. Formation of H_3O^+ ions and Dilution.

Q. 3. Two solutions X and Y are tested with universal indicator. Solution X turns orange whereas solution Y turns red. Which of the solutions is a stronger acid? [SQP-4]

Ans. Solution Y is a stronger acid.

1

Q. 4. What happens to pH when milk changes to curd? Why? [Board Term-I Set-C2, 2010]

Ans. When milk changes into curd, its pH will decrease. Because curd contains lactic acid, so H^+ ion concentration increases and thus pH will decrease. 1

Q. 5. Name the gas liberated when an acid reacts with a metal? [U]

Ans. Hydrogen gas.

1

Q. 6. If two solutions of different pH 2 and 5 are given, which will be stronger acid and why?

[Board Term-I Set-A1, 2010]

Ans. pH = 2 as lower the pH, stronger the acid.

1

[AI] Q. 7. Why 1 M HCl has higher concentration of H^+ ions than 1 M CH_3COOH ?

[A] [Board Term-I, Outside Delhi Set II, 2009]

Ans. 1 M HCl has a higher concentration of H^+ ions because when HCl dissolves in water it dissociates completely into ions while CH_3COOH is a weak acid and does not dissociate into ions completely. 1

✓ Short Answer Type Questions-I

2 marks each

Q. 1. A teacher provided acetic acid, water, lemon juice, aqueous solution of sodium hydrogen carbonate and sodium hydroxide to students in the school laboratory to determine the pH values of these substances using pH papers. One of the students reported the pH values of the given substances as 3, 12, 4, 8 and 14 respectively. Which one of these values is not correct? Write its correct value stating the reason. [AE] [Outside Delhi 2019]

Ans. The pH value of water given is incorrect.

Its correct value is 7 since it is neutral in nature.

[CBSE Marking Scheme, 2019] $1 + 1 = 2$

Q. 2. Blue litmus solution is added to two test tubes A and B containing dilute HCl and NaOH solution respectively. In which test tube a colour change will be observed? State the colour change and give its reason. [C]

Q. 3. What is brine? What happens when an electric current is passed through it? Write chemical equation for it. [CBSE Outside Delhi, 2019]

OR

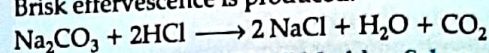
What is observed when 2 mL of dilute hydrochloric acid is added to 1 g of sodium carbonate taken in a clean and dry test tube? Write chemical equation for the reaction involved. [AE] [Delhi, 2019]

Ans. Test Tube A

It changes the colour from blue to red
Hydrochloric acid turns blue litmus red.

OR

Brisk effervescence is produced.



[CBSE Marking Scheme, 2019]

Detailed Answer:

Dilute HCl (Tube A) being acidic in nature will change the colour of blue litmus solution to red. There will be no change in the Tube B containing NaOH solution as NaOH is basic in nature. $1 + 1 = 2$

Topper Answer, 2019

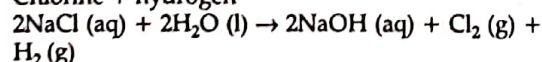
Ans. B. brine is the cold and concentrated solution of sodium chloride.
 D. When electricity is passed through it, the NaCl breaks to give ions in the solution.
 $\text{NaCl} \xrightarrow{\text{electricity}} \text{Na}^+ + \text{Cl}^-$
 Sodium Chloride Sodium ions Chloride ions

Detailed Answer:

The cold and concentrated aqueous solution of sodium chloride is known as brine.

When an electric current passed through brine, hydrogen gas is evolved at the anode, chlorine gas is evolved at the cathode, and sodium hydroxide is formed in the electrolysis solution.

Sodium chloride + water \rightarrow sodium hydroxide + Chlorine + hydrogen



[AI] Q. 4. A liquid has a pH less than 7 which represents an acidic solution.

(i) State the nature of solution, if its pH increases from 7 to 14.

(ii) Mention the ion whose concentration increases with the increase in pH value. [U]

Ans. (i) The nature of solution is basic. As the pH increases from 7 to 14, the strength of alkali also increases. So the nature of solution will be basic. 1

(ii) Hydroxide ion or hydroxyl ion or OH^- ion. 1

COMMONLY MADE ERROR

- Students usually get confused with the pH values.

ANSWERING TIP

- Understand the concept of pH with proper examples.

Q. 5. How is the presence of an acid tested with a strip of red litmus paper? [CBSE 2019]

OR

A student is performing an experiment to study the properties of acetic acid. Answer the following questions:

(i) Name the substance he must add to acetic acid to produce carbon dioxide.

- (ii) Give the relevant chemical equation for the reaction.
 (iii) How would he test CO_2 gas in the laboratory?
 [CBSE, 2018]

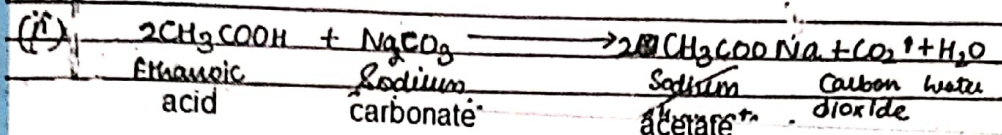
Ans. Red litmus do not show any colour change with acid. So it must be changed to blue litmus by dipping the strip in alkaline solution. Then dip the blue litmus in acidic solution (it will turn red).

OR

Topper Answer, 2019

Ans.

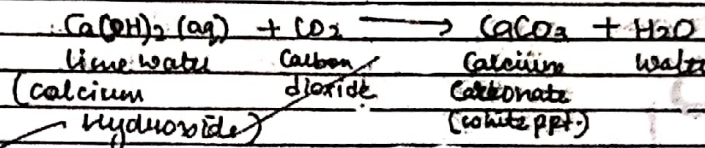
(i) He must add sodium carbonate or sodium hydrogen carbonate to produce carbon dioxide.



(iii) To test CO_2 in a laboratory, bring a burning candle near it, it would extinguish as it is a non supporter of combustion.

OR

Pass it through freshly prepared lime water which turns milky.



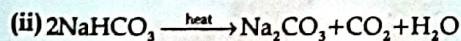
Short Answer Type Questions-II

3 marks each

- Q. 1. A compound 'X' of sodium is used as an antacid and it decomposes on strong heating.
 (i) Name the compound 'X' and give its chemical formula.
 (ii) Write a balanced chemical equation to represent the decomposition of 'X'.
 (iii) Give one use of compound 'X' besides an antacid.

[CBSE SQP, 2020]

Ans. (i) Sodium bicarbonate / Sodium hydrogen carbonate / baking soda and its formula is NaHCO_3



- (iii) It is used in fire extinguisher and for baking.
 (Any one) 1 + 1 + 1

[CBSE Marking Scheme, 2020]

- Q. 2. You are provided with 90 mL of distilled water and 10 mL of concentrated sulphuric acid to prepare dilute sulphuric acid.

(a) What is the correct way of preparing dilute sulphuric acid? Give reason.

- (b) How will the concentration of H_3O^+ ions change on dilution?
 [CBSE SQP, 2020]

Ans. (a) Add 10 mL of concentrated sulphuric acid slowly to 90 mL of water with constant stirring.
 Dilution of acid is a highly exothermic process. If water is added to concentrated sulphuric acid, heat generated causes the mixture to splash leading to burns and the glass container can break.

- (b) Decreases per unit volume. 1 + 1 + 1

[CBSE Marking Scheme, 2020]

Q. 3. (a) While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid?

- (b) Dry hydrogen chloride gas does not change the colour of dry litmus paper. Why?

[CBSE Board Outside Delhi, 2019]

Ans. (a) The process of diluting an acid is highly exothermic, and on the addition of acid to the water the excess heat is absorbed by water.

1 + 1

- (b) Because HCl does not form $\text{H}^+/\text{H}_3\text{O}^+$ ions in dry condition.

[CBSE Marking Scheme, 2019] 1

Detailed Answer:

- (a) Diluting an acid is an exothermic process. When water is added to an acid, the heat generated may cause the mixture to splash out and may cause serious burns. Therefore, it is recommended that acid should be added to water carefully with constant stirring.
- (b) Presence of ions like hydrogen (H^+) ions or hydronium (H_3O^+) ions changes the colour of litmus paper. HCl is able to produce these ions only in the form of aqueous solution. Hence, dry hydrogen chloride gas does not change the colour of dry litmus paper. $1\frac{1}{2} + 1\frac{1}{2}$
- AI Q. 4.** On heating blue coloured powder of copper (II) nitrate in a boiling tube, black copper oxide, O_2 and a brown gas X is formed.

- (a) Identify the type of reaction and the gas X.
 (b) Write balanced chemical equation of the reaction.
 (c) Write the pH range of aqueous solution of the gas X.

Ans. (a) Decomposition / Thermal decomposition $\frac{1}{2}$
 The gas X is NO_2 or (nitrogen dioxide) $\frac{1}{2}$

(b) $2Cu(NO_3)_2 \xrightarrow{\text{heat}} 2CuO + 4NO_2 + O_2$ 1
 (c) Range less than 7 (or 0 - 6.9 pH) 1

Note:

For (b) $\frac{1}{2}$ mark for equation and $\frac{1}{2}$ mark for balancing the equation

[CBSE Marking Scheme, 2019] 1 + 1 + 1

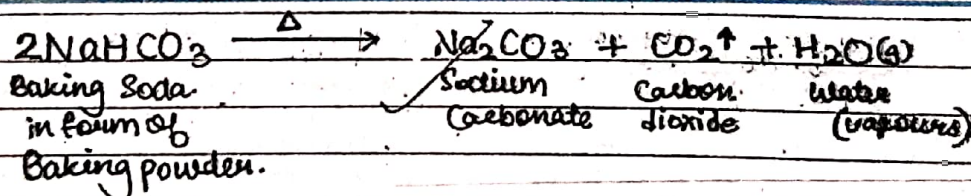
- Q. 5.** A white powder is added while baking cakes to make it soft and spongy. Name its main ingredients. Explain the function of each ingredient. Write the chemical reaction taking place when the powder is heated during baking.

[CBSE, 2019]

Topper Answer, 2019

Ans. ID. The white powder added to cakes is baking powder.
Baking powder is prepared with baking soda i.e. Sodium Hydrogen Carbonate along with a mild acid like Tartaric acid.
 ① Baking soda being a base is bitter and tartaric acid is sour.
 ② When their mixture is added, a neutralisation takes place nullifying the bitter and sour effects.

$$\text{Baking soda} + \text{Tartaric acid} \rightarrow \text{Baking Powder}$$
~~Baking soda is used.~~
Baking soda is mainly for producing effervescence and tartaric acid is used for nullifying the bitter effect of sodium bicarbonate.



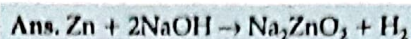
The carbon dioxide released gets trapped in the cake layers and makes it soft and spongy.

- AI Q. 6.** 2 ml of sodium hydroxide solution is added to a few pieces of granulated zinc metal taken in a test

tube. When the contents are warmed, a gas evolves which is bubbled through a soap solution before

testing. Write the equation of the chemical reaction involved and the test to detect the gas. Name the gas which will be evolved when the same metal reacts with dilute solution of a strong acid.

[A + R + U] [Delhi/Outside Delhi, 2018]



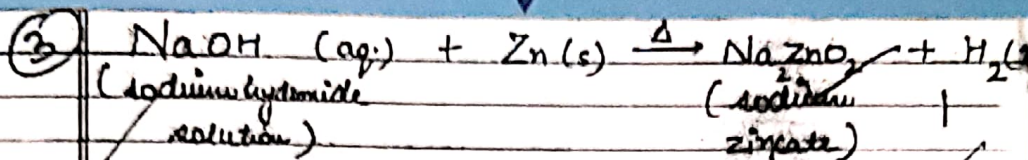
When a burning splinter is brought near the gas, it burns with a Pop Sound.

Gas – Hydrogen / H_2

[CBSE Marking Scheme, 2018] 1 + 1 + 1

Topper Answer, 2018

Ans.



Thus, in this reaction, hydrogen gas is evolved.

As the gas is passed through soap solution, bubbles filled with hydrogen gas come out.

Bring a candle near the bubbles evolved, the bubble bursts & the gas inside it starts burning with a pop sound & extinguishes the candle. This tests the presence of H_2 gas in them.

Even if the zinc metal reacts with a solution of strong acid, hydrogen gas is produced/evolved.
 [Eq. $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$]

COMMONLY MADE ERROR

- Usually students get confused with the liberation of gas during the reaction of zinc with acids and bases.

ANSWERING TIP

- Keenly observe the reactions during practicals, zinc reacts with both acids and bases to give out hydrogen gas but remember the above said reactions are not possible with all metals.

Q. 7.1 g of solid sodium chloride is taken in a clean and dry test tube and 2mL of conc. sulphuric acid is added to it. If the gas evolved is tested first with dry and then with wet blue litmus paper, in which case will the litmus paper change colour? Give reason for your answer. What inference can be drawn about the nature of the evolved gas? Support your answer with chemical equation for the reaction. [U + A] [Comptt. Set-I, II & III, 2018]

Ans. Wet blue litmus paper.

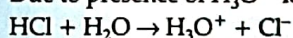
½

When the gas is tested with dry litmus paper, it shows no change in colour. This is because ions are not formed in the absence of water.

But with wet litmus paper hydrogen ions are produced and thus change in colour is observed. It has acidic nature.

Due to presence of H_3O^+ ions

½



1

[CBSE Marking Scheme, 2018]

COMMONLY MADE ERROR

- Students usually get confused with the action of wet or dry litmus paper and reason for the same.

ANSWERING TIP

- The concept of ionization of acids in aqueous medium to give hydrogen or hydronium ions should be kept in mind.

Q. 8. 'Sweet tooth may lead to tooth decay'. Explain why? What is the role of tooth paste in preventing cavities? [AE] [SQP, 2018]

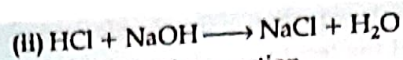
Ans. Sweet tooth leads to tooth decay, which is caused by the action of bacteria on food particles remaining in the mouth and acid is formed. As a result, the pH of the mouth falls below 5.5 and the tooth enamel dissolves resulting in cavities. Toothpastes are generally basic, they neutralize the excess acid produced in the mouth and prevent tooth decay.

[CBSE Marking Scheme, 2018] 3

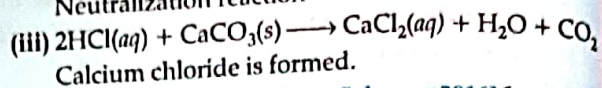
Q. 9. Explain the action of dilute hydrochloric acid on the following with chemical equation:

- (i) Magnesium ribbon
- (ii) Sodium hydroxide
- (iii) Crushed egg shells [A] [Board Term-I, 2016]

Ans. (i) $\text{Mg} + 2\text{HCl} \longrightarrow \text{MgCl}_2 + \text{H}_2$
Hydrogen gas is produced.



Neutralization reaction

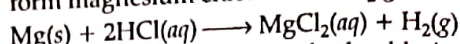


Calcium chloride is formed.

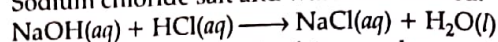
[CBSE Marking Scheme, 2016] 1 + 1 + 1

Detailed Answer:

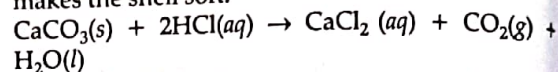
(i) Dilute hydrochloric acid reacts with magnesium to form magnesium chloride and H_2 gas is liberated.



(ii) Reaction between dilute hydrochloric acid and sodium hydroxide is a neutralization reaction. Sodium chloride salt and water are formed.



(iii) Egg shells are made of calcium carbonate, CaCO_3 . Dilute hydrochloric acid dissolves the CaCO_3 and makes the shell soft.



(Crushed egg shell)

1 + 1 + 1

✓ Long Answer Type Questions

5 marks each

Q. 1. Match the following pH values 1, 7, 10, 13 to the solutions given below:

- > Milk of magnesia
- > Gastric juices
- > Brine
- > Aqueous Sodium hydroxide.

Amit and Rita decided to bake a cake and added baking soda to the cake batter. Explain with a balanced reaction, the role of the baking soda. Mention any other use of baking soda. [C]

OR

Four samples A, B, C and D change the colour of pH paper or solution to Green, Reddish-pink, Blue and Orange. Their pH was recorded as 7, 2, 10.5 & 6 respectively.

- (i) Which of the samples has the highest amount of Hydrogen ion concentration? Arrange the four samples in the decreasing order of their pH.
- (ii) Rahul found that the Plaster of Paris, which he stored in a container, has become very hard and lost its binding nature. What is the reason for this? Also, write a chemical equation to represent the reaction taking place.
- (iii) Give any one use of Plaster of Paris other than for plastering or smoothening of walls.

[C] & [AE] [CBSE SQP-2020-21]

Ans. Milk of magnesia 10

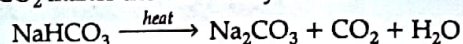
Gastric juices 1

Brine 7

Aqueous Sodium hydroxide 13

Baking soda undergoes thermal decomposition to form Na_2CO_3 , CO_2 and H_2O ;

CO_2 makes the cake fluffy & soft



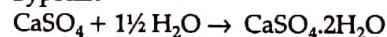
Uses:

Used in fire extinguishers/ antacid to neutralize excess acid in stomach / to neutralize the effect of acid in insect sting. (Any 1)

OR

(i) B (reason: low pH, high H^+ ion concentration) decreasing order: C, A, D, B

(ii) Due to moisture in the atmosphere it is converted into Gypsum



(iii) Making toys/dolls or statues /fixing broken limbs/ making decorative materials.

[CBSE SQP Marking Scheme, 2020]

Q. 2. Write the main difference between an acid and a base. With the help of suitable examples explain the term neutralization and the formation of:

- (i) acidic
- (ii) basic and
- (iii) neutral salts.

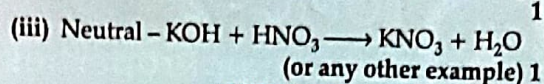
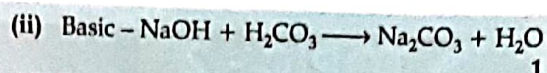
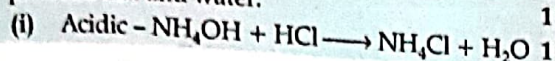
[B] [CBSE Board Delhi Set- III, 2019]

Ans.

| Acid | Base |
|--|---|
| 1. An acid produces H^+ ions in aqueous solution. | A base produces OH^- ions in aqueous solution. |
| 2. Acids are sour in taste. | Bases are bitter in taste. |
| 3. Acids change the colour of blue litmus to red. | Bases change the colour of red litmus to blue. |

1 (Any one)

Neutralization – A reaction of an acid with a base to produce salt and water.



[CBSE Marking Scheme, 2019]

Q. 3. (i) Define pH scale. Draw a figure showing variation of pH with the change in concentration of $\text{H}^+(\text{aq})$ and $\text{OH}^-(\text{aq})$ ions.

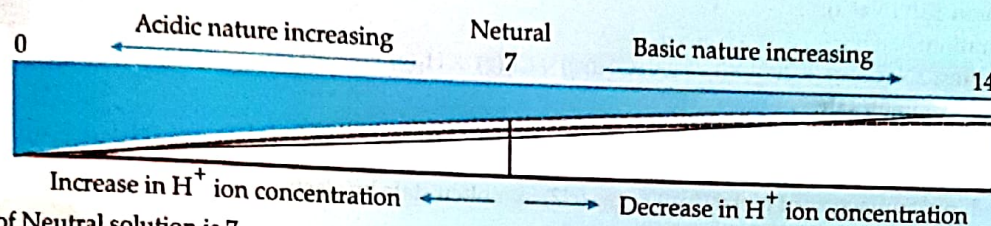
(ii) Mention the range of pH of acidic solution, basic solution and neutral solution respectively.

[R] [Board Term-I, 2016]

[NCERT Exemplar]

Ans. (i) Scale for measuring $[\text{H}^+]$ concentration in a solution is called pH scale.

Refer to below figure:



(ii) pH of Neutral solution is 7.

pH of Acidic solution is 0 to below 7.

pH of Basic solution is above 7 to 14.

[CBSE Marking Scheme, 2016] 1 + 2 + 2

Q. 4. (i) Define universal indicator. For what purpose it is used ?

(ii) Two solutions A and B have pH values of 3.0 and 9.5 respectively. Which of these will turn litmus solution from blue to red and which will turn phenolphthalein from colourless to pink ?

(iii) Water is a neutral substance. What colour will you get when you add a few drops of universal indicator to a test tube containing distilled water ?

[R] [Board Term-I, 2016]

Ans. (i) Universal indicator is a mixture of many different indication (or dyes) which give different colours at different pH values of the entire pH scale. The colour produced by universal indicator is used to find the pH value of acid or base by matching the colour with the colours on pH colour chart.

(ii) Solution A is acidic and will turn litmus solution from blue to red.

Solution B is basic and will turn phenolphthalein from colourless to pink.

(iii) Green colour will be obtained.

[CBSE Marking Scheme, 2016] 2 + 2 + 1

Q. 5. Account for the following:

(i) State the relation between hydrogen ion concentration of an aqueous solution and its pH.

(ii) An aqueous solution has a pH value of 7.0. Is this solution acidic, basic or neutral ?

(iii) Which has a higher pH value, 1 M HCl or 1 M NaOH solution ?

(iv) Tooth enamel is one of the hardest substances in our body. How does it undergo damage due to eating chocolates and sweets ? What should we do to prevent it ?

(v) How do $[\text{H}^+]$ ions exist in water ?

[U] [Board Term-I 2016]

Ans. (i) If H^+ ion concentration is more, pH will be less and vice versa or pH of a solution is inversely proportional to H^+ ion concentration or $\text{pH} = -\log [\text{H}^+]$.

(ii) This solution is neutral.

(iii) 1M NaOH solution.

(iv) When the pH in the mouth is below 5.5, bacteria present in the mouth produce acids by degradation of sugar and corrode the tooth enamel. It can be prevented by using toothpastes which are generally basic.

(v) As hydronium $[\text{H}_3\text{O}]^+$ ion.

[CBSE Marking Scheme, 2016] 1 + 1 + 1 + 1 + 1



TOPIC - 2

Salts, their Properties and Uses



Revision Notes

- **Salts:** Salts are formed when an acid and base reacts with each other.

- **Types of Salts:**

1. **Common Salt (NaCl):**

Preparation: $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$

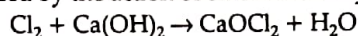
Properties: $2\text{NaCl}(aq) + 2\text{H}_2\text{O}(l) \rightarrow 2\text{NaOH}(aq) + \text{Cl}_2(g) + \text{H}_2(g)$

Uses of common salt:

1. Used in daily food
2. Used as preservative
3. Used in manufacture of metal (Na) & gas (Cl_2) in molten state by electrolysis.

2. **Bleaching Powder (CaOCl_2):**

Preparation: It is produced by the action of chlorine on dry slaked lime.



Properties:

- (a) It has a strong smell of Chlorine.
- (b) Soluble in water.
- (c) It loses Chlorine by the action of carbon di oxide.

Uses:

- (a) Bleaching cotton and linen in textile industry.
- (b) Bleaching wood pulp in paper factories.
- (c) Oxidizing agent in chemical industries.
- (d) Disinfecting drinking water.

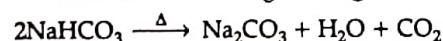
3. **Baking Soda (Sodium hydrogen carbonate) (NaHCO_3):**

Preparation: $\text{NaCl} + \text{H}_2\text{O} + \text{CO}_2 + \text{NH}_3 \rightarrow \text{NH}_4\text{Cl} + \text{NaHCO}_3$
Baking soda

Properties: $2\text{NaHCO}_3 \xrightarrow{\text{Heat}} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2$

It is mild non-corrosive base.

When it is heated during cooking:

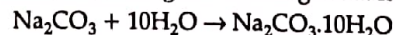


Uses:

- (a) For making baking powder (mixture of baking soda and tartaric acid). When baking powder is heated or mixed with water, CO_2 is produced which causes bread and cake to rise making them soft and spongy.
 $\text{NaHCO}_3 + \text{H}^+ \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{Sodium Salt of an Acid}$
- (b) An ingredient in antacid.
- (c) Used in soda acids, fire extinguishers.

4. **Washing Soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$):**

Preparation: Recrystallization of sodium carbonate gives washing soda. It is a basic salt.



Properties:

- (a) Transparent crystalline solid.
- (b) It has 10 molecules of water of crystallization.
- (c) It dissolves in water and the aqueous solution is alkaline.
- (d) It liberates Carbon di oxide when treated with Hydrochloric acid and Sulphuric acid

Uses:

- (a) In glass, soap and paper industry.
- (b) Manufacture of borax.

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Salt

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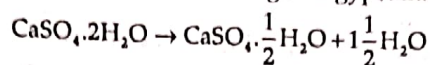
More about salts

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Are crystals dry

- (c) It can be used as cleaning agent
 (d) It can be used for removing permanent hardness of water.
5. **Plaster of Paris (Calcium sulphate hemihydrates) ($\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$):**
Preparation: On heating gypsum $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$ at 373K, it loses water molecules and becomes Plaster of Paris (POP). It is white powder and on mixing with water it changes to gypsum.



Properties: $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O} + 1\frac{1}{2}\text{H}_2\text{O} \rightarrow \text{CaSO}_4 \cdot 2\text{H}_2\text{O}$

Uses:

- (a) Doctors use POP for supporting fractured bones.
 (b) For making toys and material for decoration.

Objective Type Questions

1 mark each

A Multiple Choice Questions

Q. 1. Which of the following salts does not contain water of crystallisation?

- (a) Blue vitriol (b) Baking soda
 (c) Washing soda (d) Gypsum

[NCERT Exemp.]

Ans. Correct option: (b)

Explanation: Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt. Potassium nitrate, barium sulphate, potassium chloride, sodium nitrate, baking soda, etc., are the salts that do not contain water of crystallisation.

Q. 2. 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. [NCERT Exemp.]

Ans. Correct option: (d)

Explanation: Sodium carbonate is a basic salt of weak acid i.e. carbonic acid and a strong base i.e. sodium hydroxide.

Q. 3. 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)

[NCERT Exemp.]

Ans. Correct option: (c)

Explanation: The common salt obtained is an important raw material for various materials of daily use, such as sodium hydroxide, baking soda, washing soda and many more.

Q. 4. 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.

[NCERT Exemp.]

Ans. Correct option: (b)

Explanation: Baking powder is a mixture of baking soda (sodium hydrogen carbonate) and a mild edible acid such as tartaric acid.

B Assertions and Reasons Type Questions

Directions: In the following questions, a statement of assertion (A) is followed by a statement of reason (R). Mark the correct choice as:

- (a) Both assertion (A) and reason (R) are true and reason (R) is the correct explanation of assertion (A).
 (b) Both assertion (A) and reason (R) are true but reason (R) is not the correct explanation of assertion (A).
 (c) Assertion (A) is true but reason (R) is false.
 (d) Assertion (A) is false but reason (R) is true.

Q. 1. Assertion (A): When common salt is kept open, it absorbs moisture from the air.

Reason (R): Common salt contains magnesium chloride.

Ans. Correct option: (a)

Explanation: Magnesium chloride present in common salt is deliquescent substance i.e., it absorbs moisture from the air when kept in open.

Q. 2. Assertion (A): Baking soda creates acidity in the stomach.

Reason (R): Baking soda is alkaline.

Ans. Correct option: (d)

Explanation: Baking soda, being alkaline, neutralises the acidity in the stomach and removes it.

Q. 3. Assertion (A): Plaster of Paris is used by doctors for setting fractured bones.

Reason (R): When Plaster of Paris is mixed with water and applied around the fractured limbs, it sets into a hard mass.

Ans. Correct option: (a)

Explanation: Plaster of Paris when mixed with water and applied around the fractured limbs, it sets in to a hard mass and keeps the bone joints in a fixed position. So, it is commonly used for setting fractured bones.

C Very Short Answer Type Questions

Q. 1. Name two main constituent of baking powder?
[R][CBSE Delhi 2020]

Ans. Sodium hydrogen carbonate (Sodium bicarbonate) and tartaric acid. [CBSE Marking Scheme, 2010]

[R] Q. 2. Name a salt which does not contain water of crystallization. [R]

Ans. Baking soda

COMMONLY MADE ERROR

- Some students write wrong examples such as copper sulphate.

ANSWERING TIP

- Understand the concept of water of crystallisation with proper examples.

Q. 3. Which colour the solution of sodium carbonate will show in litmus? [R]

Ans. The colour of litmus in a solution of sodium carbonate is blue. 1

Q. 4. Write the chemical name for $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$. [R]

Ans. Sodium carbonate decarbohydrate.

Q. 5. Give one word for water soluble base. [AE]

Ans. Alkali.

Q. 6. Give one word for substance which dissociates on dissolving in water to produce hydrogen ions, $[\text{H}]^+$ (aq) ions. [R]

Ans. Acid. 1

Short Answer Type Questions-I**2 marks each**

Q. 1. List two main sources of common salt in nature? Name any two compounds where common salt is used as a raw material? [R]

Ans. Sea water and rock salt

Sodium hydroxide and sodium bicarbonate.

[R] Q. 2. (a) What is the term used for $10\text{H}_2\text{O}$ attached in $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$? What is its function? [C]

(b) Write the chemical equation to explain the preparation of $\text{Na}_2\text{SO}_4 \cdot 10\text{H}_2\text{O}$? [C]

Ans. It is known as water of crystallization.

It imparts shape and colour to the crystal.



[R] Q. 3. Bee-sting leaves a chemical substance that causes pain and irritation. Name the chemical substance. Identify the type of substance which may give relief on the sting area when applied on it. [C]

Ans. Methanoic acid (HCOOH).

Use of Baking soda can give relief on the stung area when applied on it.

Short Answer Type Questions-II**3 marks each**

Q. 1. List the important products of the Chloro-alkali process. Write one important use of each.

OR

How is washing soda prepared from sodium carbonate? Give its chemical equation. State the type of this salt. Name the type of hardness of water which can be removed by it? [R][Delhi 2020]

Ans. Products of chloro-alkali process are: Sodium hydroxide (NaOH), Chlorine gas (Cl_2) and Hydrogen gas (H_2).

Uses of sodium hydroxide: (Any 1)

(i) In the manufacture of paper.

(ii) In making soaps and detergents.

Uses of chlorine gas: (Any 1)

(i) In the production of bleaching powder

(ii) To make plastics (PVC), pesticides, chloroform, paints etc.

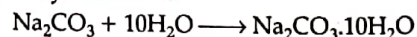
Uses of hydrogen gas: (Any 1)

(i) As fuel for rockets

(ii) In the hydrogenation of oils to obtain vegetable ghee. $1 \times 3 = 3$

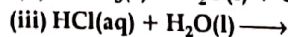
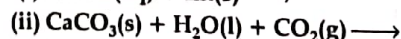
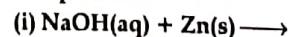
OR

Washing soda is prepared from sodium carbonate by recrystallisation.



Washing soda is a basic salt. It is used for removing permanent hardness of water.

Q. 2. Complete and balance the following chemical equations:



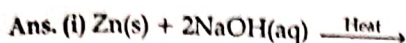
OR

During electrolysis of brine, a gas G is liberated at anode. When this gas G' is passed through slaked lime, a compound 'C' is formed, which is used for disinfecting drinking water.

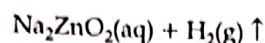
(i) Write formula of 'G' and 'C'.

(ii) State the chemical equation involved.

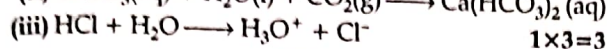
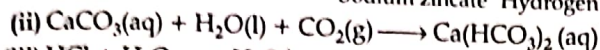
(iii) What is common name of compound 'C'? Give its chemical name. [Outside Delhi, 2020]



Zinc Sodium hydroxide



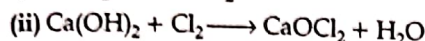
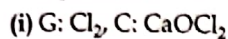
Sodium zincate Hydrogen



OR

Bleaching powder is produced by the action of chlorine on dry slaked lime Ca(OH)_2 .

Chlorine is produced during the electrolysis of aqueous sodium chloride.



(iii) Bleaching powder.

Q. 3. Identify the acid and the base from which sodium chloride is obtained. Which type of salt is it? When is it called rock salt? How is rock salt formed? [CBSE Board Delhi, Set-I, 2019]

Ans. • Acid – Hydrochloric acid/HCl

Base – Sodium hydroxide/NaOH

- Neutral Salt
- When it forms brown crystals combined with impurities.
- Drying up of seas. 1 + ½ + ½ + 1

[CBSE Marking Scheme, 2019]

Q. 4. Identify the acid and base which form sodium hydrogen carbonate. Write chemical equation in support of your answer. State whether this compound is acidic, basic or neutral. Also write its pH value. [CBSE Board Delhi, Set-I, 2019]

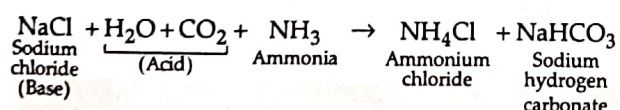
Ans. • Acid — H_2CO_3 ½

• Base — NaOH ½



[CBSE Marking Scheme, 2019]

Detailed Answer:



The compound is basic (weak). Its pH is more than 7. 2+1

Q. 5. How is sodium hydroxide manufactured in industries? Name the process. In this process a gas X is formed as by product. This gas reacts with lime water to give a compound Y, which is used as a bleaching agent in the chemical industry. Identify X and Y and write the chemical equation of the reactions involved.

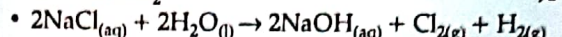
[R] + [A] [CBSE Board Outside Delhi, Set-I, 2019]

Ans. • When electricity is passed through an aqueous solution of sodium chloride (brine). ½

• Chlor – alkali process ½

• X – Cl_2 ½

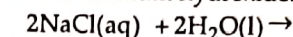
• Y = CaOCl_2 ½



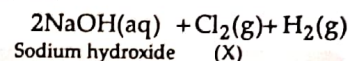
[CBSE Marking Scheme, 2019]

Detailed Answer:

When electricity is passed through an aqueous solution of sodium chloride (brine), it decomposes to form sodium hydroxide.



Sodium chloride

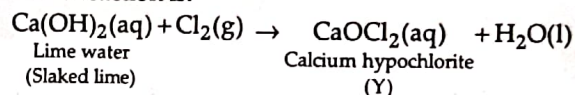


Sodium hydroxide (X)

This process is called as chlor-alkali process.

In the manufacture of sodium hydroxide, hydrogen gas and chlorine gas (X) are formed as byproducts. When chlorine gas (X) reacts with lime water, it forms calcium oxychloride (bleaching powder) Y.

The reaction is:



Y is Calcium oxychloride, which is used as bleaching agent in the chemical industry. 1+1+1

Q. 6. The pH of salt used to make tasty and crispy pakoras is 14. Identify the salt and write a chemical equation for its formation. List its two uses.

[U] + [A] [Delhi, Outside Delhi, 2018]

Ans. NaHCO_3 (Sodium Hydrogen Carbonate/
Sodium bicarbonate)



Uses:

- (i) For making baking powder
- (ii) As ingredient of antacid.
- (iii) Soda-acid fire extinguishers (Any two)

Note: As no salt can have pH = 14, give full credit for any attempt of the candidates.

[CBSE Marking Scheme, 2018] 1 + 1 + 1

COMMONLY MADE ERROR

- Students usually get confused with the formula and preparation of sodium bicarbonate.

ANSWERING TIP

- Learn the chemical formulae and practice all the preparation reactions.

- Q. 7. (a) For the preparation of cakes, baking powder is used. If at home your mother uses baking soda instead of baking powder, how will it affect the taste of the cake and why?
 (b) How is baking soda be converted into baking powder?
 (c) What makes the cake soft and spongy?

[U + A] [Comptt. Set-I, II & III-2018]

Ans. (a) The cake will have a bitter taste because of the formation of Na_2CO_3 /sodium carbonate while baking/heating.

(b) By adding tartaric acid

(c) The liberated CO_2 gas.

[CBSE Marking Scheme, 2018] 1 + 1 + 1

COMMONLY MADE ERROR

- Usually students get confused with baking powder and baking soda.

ANSWERING TIP

- Baking soda is sodium hydrogen carbonate from which baking powder is prepared.

- Q. 8. Identify the compound of calcium which is used for plastering of fractured bones. With the help of chemical equation show how is it prepared and what special precautions should be taken during the preparation of this compound.

[U + A] [CBSE SQP, 2018]

Ans. Plaster of Paris: $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
 Calcium Sulphate Hemihydrate

Preparation:



Precaution:

Gypsum should not be heated above 373 K otherwise it will form CaSO_4 .

[CBSE Marking Scheme, 2018] 3

COMMONLY MADE ERROR

- Students usually get confused with the formula of plaster of paris and gypsum.

ANSWERING TIP

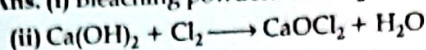
- Learn and practice the molecular formula for POP and Gypsum, its preparation and the condition for the reaction.

- Q. 9. A sanitary worker uses a white chemical having strong smell of chlorine gas to disinfect the water tank.

- Identify the chemical compound, write its chemical formula.
- Give chemical equation for its preparation.
- Write its two uses other than disinfection.

[A] [Board Term-I, 2016]

Ans. (i) Bleaching powder: CaOCl_2



(iii) Two uses other than disinfection are:

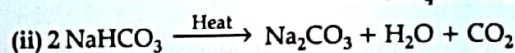
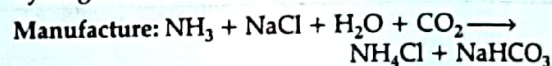
(a) Paper industries (b) Chemical Industries.

[CBSE Marking Scheme, 2016] 1 + 1 + 1

- Q. 10. (i) A white powder is an active ingredient of antacids and is used in preparation of baking powder. Name the compound and explain that how it is manufactured. Give chemical equation.

- (ii) Write a chemical equation to show the effect of heat on this compound. [A] [Board Term-I, 2016]

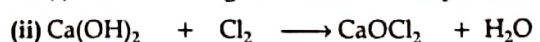
Ans. (i) Compound is NaHCO_3 /baking soda/sodium hydrogen carbonate



[CBSE Marking Scheme, 2016] 1 + 1 + 1

- Q. 11. 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 dry slaked lime to give a compound 'Y' which is used as bleaching agent in textile industry. Identify X and Y. [AE] [Board Term-I, 2015]

Ans. (i) X = Chlorine gas, Y = Calcium oxychloride



(Dry slaked (Chlorine) (Calcium (Water) lime) oxy-chloride)

(Bleaching agent) 1+1+1

COMMONLY MADE ERROR

- Many students do not write the correct name of gas and compound.

ANSWERING TIP

- Practice such questions in which identification of compounds is based on chemical reactions.

✓ Long Answer Type Questions

5 marks each

Q. 1. A metal 'M' is stored under kerosene. It vigorously catches fire, if a small piece of this metal is kept open in air. Dissolution of this metal in water releases great amount of energy and the metal catches fire. The solution so formed turns red litmus blue.

- Name the metal 'M'.
- Write formula of the compound formed when this metal is exposed to air.
- Why is metal 'M' stored under kerosene?
- If oxide of this metal is treated with hydrochloric acid, what would be the products?
- Write balanced equations for:
 - Reaction of 'M' with air.
 - Reaction of 'M' with water.
 - Reaction of metal oxide with hydrochloric acid.

[AE] [Outside Delhi 2020]

Ans. (a) Name of the metal M: sodium (Na).

(b) Formula of the compound formed is Na_2O .

(c) Metals like sodium and potassium react with oxygen so fast that they can catch fire if kept open. Since, they are most reactive metals; they are always kept immersed in kerosene oil to prevent accidental fire.

(d) Sodium oxide reacts with hydrochloric acid to produce sodium chloride and water.

(e) (i) Reaction with air: $4\text{Na} + \text{O}_2 \longrightarrow 2\text{Na}_2\text{O}$

(ii) Reaction with water:
 $2\text{Na(s)} + 2\text{H}_2\text{O(l)} \longrightarrow 2\text{NaOH(aq)} + \text{H}_2\text{(g)}$
 + heat energy

(iii) Reaction of sodium oxide with HCl:

$\text{Na}_2\text{O(s)} + 2\text{HCl(aq)} \longrightarrow 2\text{NaCl(aq)} + \text{H}_2\text{O(l)}$

Q. 2. Write balanced chemical equations for the following statements:

- Bleaching powder is kept open in air.
- Blue crystals of copper sulphate are heated.
- Chlorine gas is passed through dry slaked lime.
- Carbon dioxide gas is passed through lime water.
- NaOH solution is heated with zinc granules.

[A] [Board Term-I, 2016]

Ans. (i) $\text{CaOCl}_2\text{(s)} + \text{CO}_2\text{(g)} \longrightarrow \text{CaCO}_3\text{(s)} + \text{Cl}_2\text{(g)}$
 (Bleaching powder) (Carbon dioxide) (Calcium carbonate)
 (Chlorine)

(ii) $\text{CuSO}_4 \cdot 5\text{H}_2\text{O} \xrightarrow{\text{Heat}} \text{CuSO}_4 + 5\text{H}_2\text{O}$
 (Blue) (White)

(iii) $\text{Ca(OH)}_2 + \text{Cl}_2 \longrightarrow \text{CaOCl}_2 + \text{H}_2\text{O}$
 (Dry slaked lime) (Chlorine) (Bleaching powder)

(iv) $\text{Ca(OH)}_2 + \text{CO}_2 \longrightarrow \text{CaCO}_3 + \text{H}_2\text{O}$
 (Lime water) (Calcium carbonate)
 (Milky)

(v) $2\text{NaOH} + \text{Zn} \xrightarrow{\text{Heat}} \text{Na}_2\text{ZnO}_2 + \text{H}_2$
 (Sodium zincate) (Hydrogen)

[CBSE Marking Scheme, 2016] 1 × 5

[AI] Q. 3. Give suitable reasons for the following statements:

- Rain water conducts electricity but distilled water does not.
- We feel burning sensation in the stomach when we overeat.
- A tarnished copper vessel regains its shine when rubbed with lemon.
- The crystals of washing soda change to white powder on exposure to air.
- An aqueous solution of sodium chloride is neutral but an aqueous solution of sodium carbonate is basic.

[U] [Board Term-I, 2016, 2015, 2014]

Ans. (i) Distilled water does not conduct electricity because it does not contain any ionic compound like acids, bases or salts dissolved in it.

(ii) When we overeat, excess of acid is produced in the stomach which causes burning sensation.

(iii) Copper vessels tarnish due to formation of basic copper carbonate which gets neutralized when rubbed with lemon and the copper vessel regains its shine.

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

(v) Sodium chloride is a salt of strong acid HCl and strong base NaOH, so it is neutral. Sodium carbonate is a salt of weak acid H_2CO_3 and strong base NaOH, so it is basic. 1 + 1 + 1 + 1 + 1

[CBSE Marking Scheme, 2014]

Q. 4. (a) Write the chemical formula of hydrated copper sulphate and anhydrous copper sulphate. Give an activity to illustrate how these two are inter convertible.

(b) Write chemical names and formulae of Plaster of Paris and gypsum. [C] [Board Term-I, 2015]

Ans. (a) Hydrated copper sulphate – $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
 Anhydrous copper sulphate – CuSO_4 .

Activity: (i) Heat a few crystals of copper sulphate in a dry boiling tube.

(ii) Add 2-3 drops of water on the sample of copper sulphate obtained after heating.

After heating, water is removed and salt turns white.

If crystals are moistened again with water, blue colour reappears. Water of crystallization is fixed number of water molecules present in one formulae unit of a salt. Five water molecules are present in one formula unit of copper sulphate.

(b) Calcium sulphate hemihydrate – $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
Calcium sulphate dihydrate – $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$.

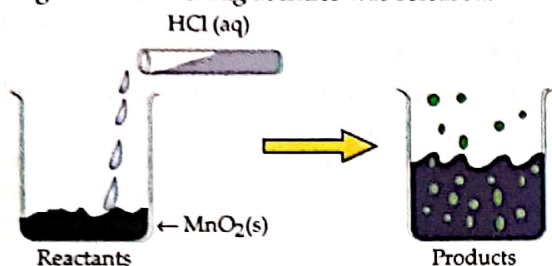
[CBSE Marking Scheme, 2015] 3+2

Visual Case-based Questions

4 marks each

Q. 1. Read the following and answer any four questions from (a) to (e): [CBSE-QB 2021]

The reaction between MnO_2 with HCl is depicted in the following diagram. It was observed that a gas with bleaching abilities was released.



(a) The chemical reaction between MnO_2 and HCl is an example of:

- (i) displacement reaction
- (ii) combination reaction
- (iii) redox reaction
- (iv) decomposition reaction.

(b) Chlorine gas reacts with _____ to form bleaching powder.

- (i) dry Ca(OH)_2
- (ii) dil. solution of Ca(OH)_2
- (iii) conc. solution of Ca(OH)_2
- (iv) dry CaO

(c) Identify the correct statement from the following:

- (i) MnO_2 is getting reduced whereas HCl is getting oxidized
- (ii) MnO_2 is getting oxidized whereas HCl is getting reduced.
- (iii) MnO_2 and HCl both are getting reduced.
- (iv) MnO_2 and HCl both are getting oxidized.

(d) In the above discussed reaction, what is the nature of MnO_2 ?

- (i) Acidic oxide
- (ii) Basic oxide
- (iii) Neutral oxide
- (iv) Amphoteric oxide

(e) What will happen if we take dry HCl gas instead of aqueous solution of HCl ?

- (i) Reaction will occur faster.
- (ii) Reaction will not occur.
- (iii) Reaction rate will be slow
- (iv) Reaction rate will remain the same.

Ans. (a) (iii) redox reaction

(b) (i) dry Ca(OH)_2

(c) (i) MnO_2 is getting reduced whereas HCl is getting oxidized

(d) (ii) Basic oxide

(e) (ii) Reaction will not occur

Q. 2. Read the following and answer any four questions from (a) to (e): [CBSE-QB 2021]

Frothing in Yamuna:

The primary reason behind the formation of the toxic foam is high phosphate content in the wastewater because of detergents used in dyeing industries, dhobi ghat Yamuna's pollution level is so bad that parts of it have been labelled 'dead' as there is no oxygen in it for aquatic life to survive.



(a) Predict the pH value of the water of river Yamuna if the reason for froth is high content of detergents dissolved in it.

- (i) 10-11
- (ii) 5-7
- (iii) 2-5
- (iv) 7

(b) Which of the following statements is correct for the water with detergents dissolved in it?

- (i) low concentration of hydroxide ion (OH^-) and high concentration of hydronium ion (H_3O^+).
- (ii) high concentration of hydroxide ion (OH^-) and low concentration of hydronium ion (H_3O^+).
- (iii) high concentration of hydroxide ion (OH^-) as well as hydronium ion (H_3O^+).
- (iv) equal concentration of both hydroxide ion (OH^-) and hydronium ion (H_3O^+).

(c) The table provides the pH value of four solutions P, Q, R and S

| Solution | pH value |
|----------|----------|
| P | 2 |
| Q | 9 |
| R | 5 |
| S | 11 |

Which of the following correctly represents the solutions in increasing order of their hydronium ion concentration?

- (i) $\text{P} > \text{Q} > \text{R} > \text{S}$
- (ii) $\text{P} > \text{S} > \text{Q} > \text{R}$
- (iii) $\text{S} < \text{Q} < \text{R} < \text{P}$
- (iv) $\text{S} < \text{P} < \text{Q} < \text{R}$

(d) High content of phosphate ion in river Yamuna may lead to:

- decreased level of dissolved oxygen and increased growth of algae
- decreased level of dissolved oxygen and no effect of growth of algae
- increased level of dissolved oxygen and increased growth of algae
- decreased level of dissolved oxygen and decreased growth of algae

(e) If a sample of water containing detergents is provided to you, which of the following methods will you adopt to neutralize it?

- Treating the water with baking soda
- Treating the water with vinegar
- Treating the water with caustic soda
- Treating the water with washing soda

Ans. (a) (i)

(b) (ii)

(c) (iii)

(d) (i)

(e) (ii)

Q. 3. Study the given table and answer the following questions. It shows the pH value of the plaque (which collects around teeth) surrounding the teeth of a child over 3 hrs.

| Time/h | pH |
|--------|-----|
| 0.00 | 7.0 |
| 1.0 | 7.0 |
| 2.0 | 7.1 |
| 3.0 | 7.2 |
| 4.0 | 4.1 |

(a) The three constituents of plaque are

- Acid
- Saliva
- Bacteria
- All of these

(b) The pH which leads to tooth decay?

- above 7
- at 7
- below 5.5
- above 5.5

(c) State the time during the day when condition is most favourable for process of tooth decay.

- 1.0
- 2.0
- 3.0
- 4.0

(d) The nature of toothpastes commonly used to protect tooth decay is:

- acidic
- basic
- neutral
- none of the above

Ans. (a) (iv) The constituents of plaque are acid, saliva, bacteria and food.

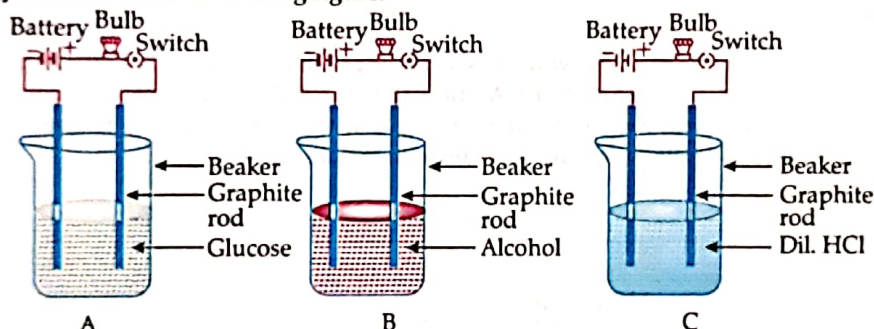
(b) (iii) below 5.5

(c) (iv) Time 4.0, lowest pH indicates the highest amount of acid produced by the bacteria.

(d) (ii) basic

1+1+1+1

Q. 4. Suhana takes three beakers A, B and C filled with aqueous solutions of glucose, alcohol and hydrochloric acid respectively as shown in the following figure:



(a) Which of the following statement is correct in terms of glowing of bulb when the switch is ON?

- Bulb A and B do not glow but bulb C glows.
- Bulb A and C do not glow but bulb B glows.
- Bulb B and C do not glow but bulb A glows.
- All the bulbs glow.

(b) The bulb glows in a solution depending on whether the solution is:

- acidic
- an electrolyte
- basic
- a non electrolyte

(c) Which of the following are present in a dilute aqueous solution of hydrochloric acid?

- $\text{H}_3\text{O}^+ + \text{Cl}^-$
- $\text{H}_3\text{O}^+ + \text{OH}^-$
- $\text{Cl}^- + \text{OH}^-$
- Unionized HCl

(d) Which of the following statement is true if alcohol is replaced with NaOH solution:

- bulb glows in alcohol but not in NaOH solution.
- bulb will glow in NaOH solution but not in alcohol
- bulb does not glow in alcohol and neither will it glow in NaOH solution.
- bulb glows in NaOH solution as well as in alcohol.

Ans. (a) Bulb A and B do not glow but bulb C glows.

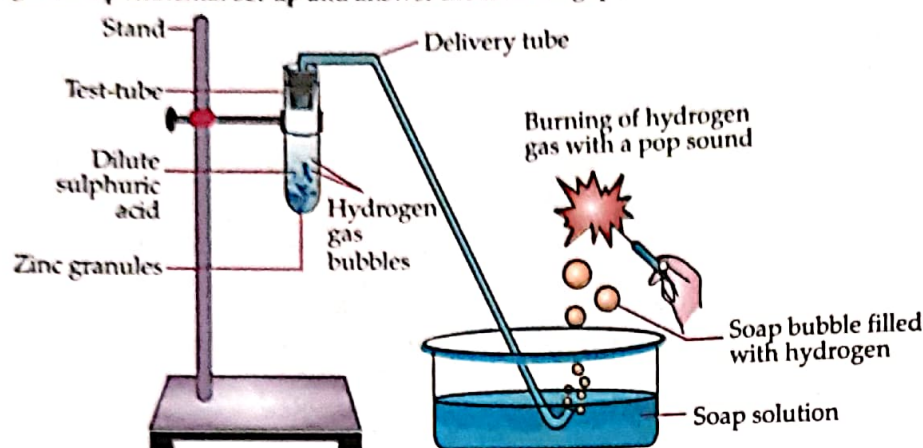
(b) (ii) an electrolyte

(c) (i) In a dilute aqueous solution of hydrochloric acid, $\text{H}_3\text{O}^+ + \text{Cl}^-$ ions are present.

(d) (ii) bulb will glow in NaOH solution but not in alcohol.

1+1+1+1

Q. 5. Study the given experimental set-up and answer the following questions.



- (a) The above experimental set up shows reaction between metal and
- Acid
 - Metal carbonate
 - Metal hydrogen carbonate
 - Metal oxide
- (b) Which gas is liberated during the process?
- Hydrogen gas
 - Carbon dioxide gas
 - Nitrogen gas
 - Hydrogen sulphide gas
- (c) Write the products formed in the above process:
- Zinc sulphate only
 - Only hydrogen gas
 - Zinc sulphate and hydrogen gas
 - Zinc sulphide and hydrogen gas
- (d) A new product sodium zincate is formed if sulphuric acid is replaced with:
- Sodium hydroxide
 - Sodium oxide
 - Zinc oxide
 - water

Ans. (a) (i) It is a reaction between a metal (Zn) and an acid (H_2SO_4)

(b) (i) During the reaction between a metal and an acid, hydrogen gas is released.

(c) (iii) Zinc sulphate and hydrogen gas

(d) (i) Sodium hydroxide 1+1+1+1

Q. 6. P, Q, R are different colourless solids, while S is a colourless solution. They are (in random order) Sodium chloride ($NaCl$), Calcium Carbonate ($CaCO_3$), Acetic acid (CH_3COOH) and Phenolphthalein indicator. Small amount of the above substances were added in pairs (e.g. P with Q; Q with R etc.) to a small amount of water in a test tube. They give the following results as shown in the observation table.

Observation Table:

| | P | Q | R |
|---|------------------|-------------|---------------|
| Q | No reaction | - | No reaction |
| R | Dark Pink Colour | No reaction | - |
| S | No reaction | No reaction | Effervescence |

(a) The chemicals are:

| | P | Q | R | S |
|-------|-----------------|-----------------|-----------------|-----------------|
| (i) | $NaCl$ | $CaCO_3$ | CH_3COOH | Phenolphthalein |
| (ii) | Phenolphthalein | $NaCl$ | $CaCO_3$ | CH_3COOH |
| (iii) | CH_3COOH | Phenolphthalein | $NaCl$ | $CaCO_3$ |
| (iv) | $CaCO_3$ | CH_3COOH | Phenolphthalein | $NaCl$ |

(b) Which of the following reaction is incorrect:

(i) Phenolphthalein (P) + $NaCl$ (Q) \longrightarrow No reaction

(ii) Phenolphthalein + $CaCO_3$ (R) \longrightarrow Alkaline medium (Dark Pink Colour)

(iii) Phenolphthalein + $NaCl$ \longrightarrow Acidic medium (Blue colour)

(iv) $CaCO_3$ (R) + $2CH_3COOH$ (S) \longrightarrow $(CH_3COO)_2Ca$ + CO_2 (effervescence) + $2H_2O$

(c) The chemicals that can be used as an acid-base indicator by a visually impaired student is _____ (Petunia leaves/ Vanilla essence).

(d) If acetic acid and hydrochloric acid of same concentration are taken, HCl is a stronger acid because it contains:

(i) more of Cl^- ions.

- (ii) more of H^+ ions.
- (iii) less of H^+ ions
- (iv) more of CH_3COO^- ions.

Ans. (a) P- Phenolphthalein, Q - NaCl, R - $CaCO_3$, S - CH_3COOH .

(b) (i) Phenolphthalein (P) + NaCl (Q) \rightarrow No reaction

(ii) Phenolphthalein + $CaCO_3$ (R) \rightarrow Alkaline medium (Dark Pink Colour)

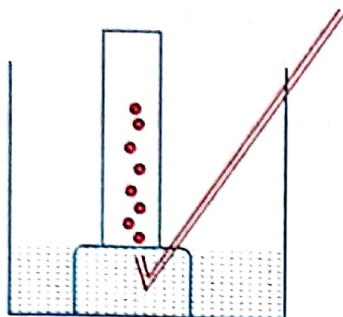
(iii) $CaCO_3$ (R) + $2CH_3COOH$ (S) $\rightarrow (CH_3COO)_2Ca + CO_2$ (effervescence) + $2H_2O$

(c) Vanilla essence can be used as an acid-base indicator by visually impaired students as it is an olfactory indicator whose odour changes in acidic or basic media.

(d) HCl is stronger because it gives rise to more H^+ ions than acetic acid.

1+1+1+1

Q. 7. A metal is treated with dilute sulphuric acid. The gas evolved is collected by the method shown in the figure:



(a) Name the gas evolved:

- (i) Hydrogen (ii) Oxygen
- (iii) Sulphur dioxide gas (iv) Carbon dioxide

(b) Is the gas lighter or heavier than air? How will you test the gas?

(c) If the metal used above is zinc then write the chemical equation for the evolution of gas.

(d) What nature of hydrogen is used as a fuel in rocket:

- (i) solid (ii) liquid
- (iii) gaseous (iv) all of the above

Ans. (a) (i) Hydrogen gas. It is soluble in water.

(b) (i) Lighter than air. When a burning splinter is brought near the gas it burns with a pop sound.

(c) (ii) $Zn(s) + H_2SO_4(dil) \rightarrow ZnSO_4(aq) + H_2(g)\uparrow$

(d) (ii) Liquid 1+1+1+1

Q. 8. Read the passage and answer the following questions.

Suhana wanted her house to be white washed. She bought 10 kg of quicklime from the market and dissolved it in 30 L of water. On adding lime to water, she observed that the water started boiling even when it was not being heated.

(a) Name the product when water is added to quicklime.

- (i) Calcium oxide (ii) Calcium hydroxide
- (iii) Calcium dioxide (iv) Calcium carbonate

(b) The common name for quick lime is:

- (i) Calcium hydroxide (ii) Calcium oxide
- (iii) Calcium dioxide (iv) Calcium carbonate

(c) The correct formula for calcium hydroxide is:

- (i) $Ca(OH)$ (ii) $Ca(OH)_2$
- (iii) $Ca(OH)_2$ (iv) Ca_2OH_2

(d) Which of the following statements is correct about the above reaction based on your observations?

- (i) It is an endothermic reaction.
- (ii) It is an exothermic reaction
- (iii) The pH of the resulting solution will be more than seven.
- (iv) The pH of the resulting solution will be less than seven.

(i) I and II (ii) II and III

(iii) I and IV (iv) III and IV

Ans. (a) (ii) Calcium hydroxide

(b) (ii) Calcium oxide

(c) (iii) $Ca(OH)_2$

(d) (ii) It is an exothermic reaction because heat is given out. The resulting compound is $Ca(OH)_2$ which is basic in nature. So the pH of the resulting solution will be more than seven.

1 + 1+1+1

Q. 9. Read the passage and answer the following questions:

Sanjana while preparing cake used baking soda in small amounts. It helps to make the cake soft and spongy. An aqueous solution of baking soda also turns red litmus blue. It is also used in soda acid extinguisher.

(a) Name the gas produced by the reaction of baking soda and acid which helps as fire extinguisher:

- (i) Carbon monoxide (ii) Carbon dioxide
- (iii) Hydrogen (iv) oxygen

(b) Name the products formed when baking soda is heated:

- (i) sodium sulphate and carbon dioxide gas
- (ii) sodium carbonate and water
- (iii) sodium carbonate, carbon dioxide and water.
- (iv) Sodium oxide carbon dioxide and water.

(c) The pH of baking soda solution is :

- (i) more than 7
- (ii) less than 7
- (iii) equal to 7
- (iv) less than 7 but more than 3.

(d) What is the chemical name for baking soda?

- (i) Sodium carbonate
- (ii) sodium bicarbonate
- (iii) calcium carbonate
- (iv) calcium bicarbonate.

Ans. (a) (ii) Carbon dioxide

(b) (iii) sodium carbonate, carbon dioxide and water.

(c) (i) more than 7

(d) (ii) sodium bicarbonate

Q. 10. Read the passage and answer the following questions.

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 chloro-alkali process.

(a) Identify B:

- (i) Sodium chloride (ii) Sodium hydroxide
- (iii) Carbon dioxide (iv) Sodium carbonate

(b) What type of reaction occurs when B is treated with an acidic oxide?

(i) Neutralisation

(ii) Double decomposition

(iii) Combination

(iv) Displacement

(c) What is the raw material used in chloro-alkali?

(i) aqueous solution of sodium chloride

(ii) sodium chloride in dry form

(iii) sodium hydroxide

(iv) sodium carbonate

(d) When aqueous sodium carbonate (Na_2CO_3) reacts with HCl (aq), it gives

(i) NaOH , H_2 and CO_2

(ii) NaCl , H_2O and CO_2

(iii) NaHCO_3 , H_2 and CO_2

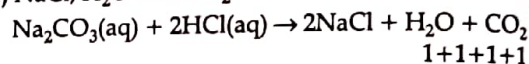
(iv) NaHCO_3 , H_2O and CO_2

Ans. (a) (ii) Sodium hydroxide

(b) (i) Neutralisation

(c) (i) aqueous solution of sodium chloride

(d) (ii) NaCl , H_2O and CO_2



Know the Terms

- **Mineral acids:** The acids which are obtained from minerals are called **mineral acids**.
- **Organic acids:** Acids which are obtained from plants and animals are called **organic acids**.
- **Strong acids:** The acids which ionise almost completely are called **strong acids**, e.g., mineral acids.
- **Weak acids:** The acids which ionise only partially or to a lesser extent are called **weak acids**, e.g., organic acids.
- **Strong bases:** The substances / bases which ionise completely to furnish OH^- ions are called **strong bases**, e.g., KOH , NaOH etc.
- **Weak bases:** The bases which ionize partially are called **weak bases**, e.g., $\text{Mg}(\text{OH})_2$, $\text{Cu}(\text{OH})_2$ etc.
- **Alkalies:** Water soluble bases are called **alkalies**, e.g., NaOH , KOH . Thus, all alkalies are bases but all bases are not alkali.



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