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Acids, Bases and Salts

In the Chapter

- Acid-base indicators are dyes or mixtures of dyes which are used to show the presence of acids and bases.
- Acidic nature of a substance is because of the formation of $\text{H}^+(\text{aq.})$ ions in solution. Formation of $\text{OH}^-(\text{aq.})$ ions in solution is responsible for the basic nature of a substance.
- When an acid reacts with a metal, then hydrogen gas is evolved and a corresponding salt is formed.
- When a base reacts with a metal, along with the evolution of hydrogen gas a salt is made which has a negative ion composed of the metal and oxygen.
- When an acid reacts with a metal carbonate or metal hydrogencarbonate, it produces the corresponding salt, carbon dioxide gas and water.
- Acidic and basic solutions in water conduct electricity because they give hydrogen and hydroxide ions respectively.
- The strength of an acid or an alkali can be tested by using a scale known as the pH scale (0-14) which gives the measure of hydrogen ion concentration in a solution.
- A neutral solution has a pH of exactly 7, while an acidic solution contains a pH less than 7 and a basic solution a pH more than 7.
- Mixing concentrated acids or bases with water is a highly exothermic process.
- Living beings carry out their metabolic activities within an optimal pH range.
- Acids and bases neutralise each other to make corresponding salts and water.
- Water of crystallisation is the fixed number of water molecules chemically attached to each formula unit of a salt in its crystalline form.
- Salts have various uses in our daily life and in industries.

Intext Exercises

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1. You have been provided with three test tubes. One of them contains distilled water and the other two contain an acidic solution and a basic solution, respectively. If you are given only red litmus paper, how will you identify the contents of each test tube?

Ans. For self activity.

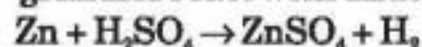
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1. Why should curd and sour substances not be kept in brass and copper vessels?

Ans. Curd and sour substance contain acids. Acids react with metals to produce salt and hydrogen gas. Therefore, if such substances are kept in copper container, then the acid will react and the container will be corroded.

2. Which gas is usually liberated when an acid reacts with a metal? Illustrate with an example. How will you test for the presence of this gas?

Ans. When an acid reacts with a metal, then hydrogen gas is evolved. For example, Zinc granules react with dilute sulphuric acid and form zinc sulphate and hydrogen.



We can test the presence of this gas by burning it with a candle which produces a pop sound.

3. Metal compound A reacts with dilute hydrochloric acid to produce effervescence. The gas evolved extinguishes a burning candle. Write a balanced chemical equation for the reaction if one of the compounds formed is calcium chloride.

Ans. $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2$

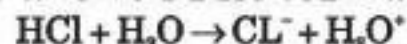
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1. Why do HCl, HNO₃, etc. show acidic characters in aqueous solutions while solutions of compounds like alcohol and glucose do not show acidic character?

Ans. HCl, HNO₃, etc. contain releasable H⁺ ion. When these are dissolved in water, the H⁺ ion gets separated and shows acidic character. In glucose or alcohol, there is no releasable H⁺ ion.

2. Why does an aqueous solution of an acid conduct electricity?

Ans. When it is dissolved in water, acid dissociate to produce ions e.g.,



These ions are responsible for electrical conductivity.

3. Why does dry HCl gas not change the colour of the dry litmus paper?

Ans. Dry HCl does not dissociate to form H⁺ ions. Thus, it does not show acidic character.

4. While diluting an acid, why is it recommended that the acid should be added to water and not water to the acid?

Ans. Dissolving of an acid or a base in water is a highly exothermic process. Care must be taken while mixing concentrated sulphuric acid or nitric acid with water. The acid must always be poured slowly to water with constant stirring. If water is added to a concentrated acid then the heat generated may cause the mixture to splash out and cause burns. The glass container may also break because of excessive local heating.

5. How is the concentration of hydronium ions (H₃O⁺) affected when a solution of an acid is diluted?

Ans. Concentration of H₃O⁺ ion decreases.

6. How is the concentration of hydroxide ions (OH^-) affected when excess base is dissolved in a solution of sodium hydroxide?

Ans. Concentration of OH^- group increases.

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1. You have two solutions, A and B. The pH of solution A is 6 and pH of solution B is 8. Which solution has more hydrogen ion concentration? Which of this is acidic and which one is basic?

Ans. Solution A contains more H^+ ion concentration. Solution A is acidic while solution B is basic.

2. What effect does the concentration of $\text{H}^+(\text{aq})$ ions have on the nature of the solution?

Ans. As the concentration of H^+ ions increases the solution becomes more acidic.

3. Do basic solutions also have $\text{H}^+(\text{aq})$ ions? If yes, then why are these basic?

Ans. This H^+ ion comes from water.

4. Under what soil condition do you think a farmer would treat the soil of his fields with quick lime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate)?

Ans. If the farmer finds his soil turned acidic then he should use the bases to neutralise it.

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1. What is the common name of the compound CaOCl_2 ?

Ans. Bleaching power.

2. Name the substance which on treatment with chlorine yields bleaching powder.

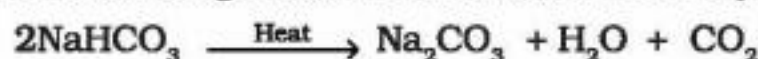
Ans. Dry slaked lime $[\text{Ca}(\text{OH})_2]$.

3. Name the sodium compound which is used for softening hard water.

Ans. Washing soda or sodium carbonate (Na_2CO_3).

4. What will happen if a solution of sodium hydrocarbonate is heated? Give the equation of the reaction involved.

Ans. The following reaction occurs when sodium hydrocarbon is heated during cooking :



5. Write an equation to show the reaction between Plaster of Paris and water.

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

Exercise

1. A solution turns red litmus blue, its pH is likely to be

(a) 1 (b) 4 (c) 5 (d) 10

Ans. (d) 10

2. A solution reacts with crushed egg-shells to give a gas that turns lime-water milky. The solution contains

(a) NaCl (b) HCl
(c) LiCl (d) KCl

Ans. (b) HCl

3. 10 mL of a solution of NaOH is found to be completely neutralised by 8 mL of a given solution of HCl . If we take 20 mL of the same solution of NaOH , the amount

HCl solution (the same solution as before) required to neutralise it will be

- (a) 4 mL (b) 8 mL
(c) 12 mL (d) 16 mL

Ans. (d) 16 mL.

4. Which one of the following types of medicines is used for treating indigestion?

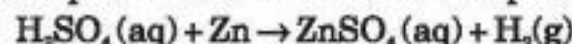
- (a) Antibiotic (b) Analgesic
(c) Antacid (d) Antiseptic

Ans. (c) Antacid

5. Write word equations and then balanced equations for the reaction taking place when-

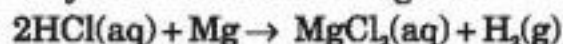
(a) dilute sulphuric acid reacts with zinc granules.

Ans. dil. Sulphuric acid + Zinc → Zinc sulphate + Hydrogen gas.



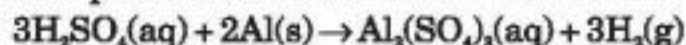
(b) dilute hydrochloric acid reacts with magnesium ribbon.

Ans. dil. Hydrochloric acid + Magnesium → Magnesium chloride + Hydrogen gas



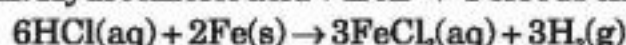
(c) dilute sulphuric acid reacts with aluminium powder.

Ans. dil. Sulphuric acid + Aluminium → Aluminium sulphate + Hydrogen gas



(d) dilute hydrochloric acid reacts with iron filings.

Ans. dil. Hydrochloric acid + Iron → Ferrous chloride + Hydrogen gas.

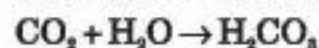


6. Compounds such as alcohols and glucose also contain hydrogen but are not categorised as acids. Describe an activity to prove it.

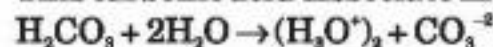
Ans. For self activity.

7. Why does distilled water not conduct electricity, whereas rain water does?

Ans. Distilled water does not dissociate into ions. Therefore, it does not conduct electricity. Rain water has dissolved CO_2 in it which becomes carbonic acid.



This carbonic acid dissociate into ions.



These ions are responsible for electrical conductivity of rain water.

8. Why do acids not show acidic behaviour in the absence of water?

Ans. In absence of water, acids do not dissociate. Thus, they do not show acidic behaviour.

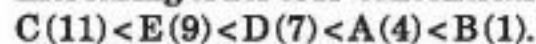
9. Five solutions A,B,C,D and E when tested with universal indicator showed pH as 4,1,11,7 and 9, respectively. Which solution is

- (a) neutral?
(b) strongly alkaline?
(c) strongly acidic?
(d) weakly acidic?
(e) weakly alkaline?

Arrange the pH in increasing order of hydrogen-ion concentration.

Ans. (a) D, (b) C, (c) B, (d) A, (e) E.

Increasing order of H^+ concentration will be :



10. Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid (HCl) is added to test tube A, while acetic acid (CH_3COOH) is added to test tube B. In which test tube will the fizzing occur more vigorously and why?

Ans. In test tube A, fizzing takes place more vigorously because HCl is a strong acid and dissociate

more.

- 11. Fresh milk has a pH of 6. How do you think the pH will change as it turns into curd? Explain your answer.**

Ans. Curd is sour which shows its pH will decrease from 6.

- 12. A milkman adds a very small amount of baking soda to fresh milk.**

(a) Why does he shift the pH of the fresh milk from 6 to slightly alkaline?

(b) Why does this milk take a long time to set as curd?

Ans. (a) Baking soda is alkaline which causes the alkalinity of milk.

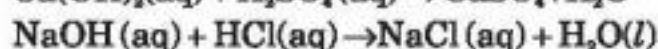
(b) Curd requires acidic condition to set.

- 13. Plaster of Paris should be stored in a moisture-proof container. Explain why?**

Ans. Plaster of Paris easily absorbs water and forms hard gypsum. So, if Plaster of Paris is not kept in a moisture proof container, then all Plaster of Paris will get turned into gypsum.

- 14. What is a neutralisation reaction? Give two examples.**

Ans. The reaction between an acid and a base to produce a salt and water is called a neutralisation reaction.



- 15. Give two important uses of washing soda and baking soda.**

Uses of Washing Soda :

Ans. (i) Sodium carbonate (washing soda) is used in glass, paper and soap industries.

(ii) It is used in the manufacture of sodium compounds like borax.

Uses of baking soda :

(i) Sodium hydrogencarbonate is also an ingredient in antacids. Being alkaline, it neutralises excess acid in the stomach and provides relief.

(ii) It is also used in soda acid fire extinguishers.

Additional Questions

- 1. Name the gas evolved when acids react with metals such as zinc iron.**

Ans. Hydrogen gas.

- 2. Identify the acid and base from which sodium nitrate may be obtained.**

Ans. Nitric Acid (HNO_3) and Sodium Hydroxide (NaOH)

- 3. During summer season a milkman usually adds a very small amount of baking soda to fresh milk. Give one reason.**

Ans. To preserve milk and to avoid to fermentation and to increase the pH from 6 to slightly alkaline.

- 4. Name two natural indicators.**

Ans. Litmus and turmeric

- 5. Name the acid present in oranges and lemon.**

Ans. Citric acid.

- 6. Name the acid present in bee-sting.**

Ans. Formic Acid.

- 7. Write the chemical name and formula of bleaching power.**

Ans. Calcium oxychloride, CaOCl_2 .

- 8. What are bases ? State two properties of bases. How are bases different from alkalies?**

Ans. A base may be defined as a substance which dissociates to give OH^- ions in aqueous solution.

Properties : 1. They turn red litmus solution blue.

2. They turn methyl orange yellow.

Bases may or may not be soluble in water. Only the water soluble bases are alkalies.

9. 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?

Ans. The bacteria present in mouth produce acids by the degradation of sugar and food particles present in the mouth after eating. The acid so produce corrodes tooth enamel (calcium phosphate). In order to prevent tooth decay, clean the mouth after eating food and use alkaline tooth paste.

10. What is 'Baking powder'? How does it make the cake, soft and spongy?

Ans. Baking powder is mixture of baking soda and tartaric acid or citric acid.

When baking powder is heated, baking soda decomposes to give carbon dioxide and sodium carbonate, CO_2 gas causes breads and cakes to rise and make it soft and spongy. Tartaric acid neutralises sodium carbonate.

11. How does the flow of acid rain water into a river make the survival of aquatic life in the river difficult?

Ans. Acid rain water has pH less than 5.6 and when this water flows into river, it lowers its pH and hence makes the survival of aquatic life in river difficult.

12. Describe an activity to show that acids produce ions only in aqueous solutions.

Ans. Heat a pinch of solid sodium chloride with some conc. H_2SO_4 in a test tube. Pass the gas (HCl) evolved on a dry blue litmus paper, no change in colour takes place. Now pass the gas through blue litmus solution, it turns red. This is because in aqueous solution H^+ ions are produced which turn blue litmus solution red.

13. Give three uses of caustic soda (NaOH).

Ans. 1. It is used in the manufacture of soaps and detergents.
2. It is used in paper industry.
3. It is used in the manufacture of artificial fibres.

14. What is the biological importance of pH?

Ans. These are : (a) Our body works within the pH range of 7.0 to 7.8.

(b) When the pH of rain water becomes less than 5.6, it is called acid rain. When this water flows into the rivers, the survival of aquatic life becomes difficult due to decrease in pH.

(c) Living organisms can survive in a narrow pH range.

15. Give four uses of bleaching powder.

Ans. 1. It is used as an oxidising agent in many chemical industries.
2. It is used for disinfecting drinking water.
3. It is used for bleaching wood pulp in paper factories.
4. It is used for bleaching cotton and linen in the textile industry.

16. How will you test for the gas which is liberated when hydrochloric acid reacts with an active metal?

Ans. Hydrogen gas is produced which burns with a pop sound.

17. From amongst the metals sodium, calcium, aluminium, copper and magnesium, name the metal :

(i) which reacts with water only on boiling and

(ii) another which does not react even with steam.

Ans. (i) Magnesium

(ii) Copper.

18. Give important uses of Plaster of Paris.

Ans. 1. Plaster of Paris is used for producing moulds for toys, pottery, ceramics, etc.
2. It is used as a fire proofing material.

- 3. It is used for making statues, models and other decorative materials.
- 4. It is used in medical applications known as plasters for setting broken and fractured bones in the right position and in dentistry.
- 5. It is used for making smooth surfaces and ornate designs on walls and ceilings.

19. State the chemical property in each case on which the following uses of baking soda are based :

- (i) as an antacid.
- (ii) as a constituent of baking powder.

Ans. (i) It is alkaline and neutralizes excess acid in the stomach. Therefore, it is used as an antacid.

(ii) Baking powder contains baking soda and tartaric acid. When baking powder is heated, sodium hydrogen carbonate decomposes to give CO_2 and sodium carbonate. CO_2 causes breads and cakes to rise.

20. Name the acid present in sour milk or curd.

Ans. Lactic acid.

Multiple Choice Questions

1. Pick out the true statement :

- (a) pH of a neutral aqueous solution is 7
- (b) pH of an acidic solution is more than 7
- (c) pH of an alkaline solution is less than 7
- (d) all of these.

Ans. (a) pH of a neutral aqueous solution is 7

2. pH of a solution is 10. This indicates that solution is :

- (a) basic
- (b) neutral
- (c) acidic
- (d) None of these.

Ans. (a) basic

3. Tooth enamel contains :

- (a) Calcium carbonate
- (b) Calcium sulphate
- (c) Calcium phosphate
- (d) Calcium chloride

Ans. (b) Calcium sulphate

4. pH of pure water at 25°C is :

- (a) 7
- (b) Less than 7
- (c) More than 7
- (d) None of these

Ans. (a) 7

5. Which of the following has the lowest pH value ?

- (a) 1.0 M NaHCO_3 solution
- (b) 1.0 M HCl solution
- (c) 1.0 M CH_3COOH solution
- (d) 1.0 M NaOH solution

Ans. (b) 1.0 M HCl solution

6. **0.01 mole H_2SO_4 was dissolved in 2 litres of the solution. The pH of the solution will be :**

(a) 1
(b) 2
(c) 3
(d) 4

Ans. (b) 2.

7. **An aqueous solution of sodium bicarbonate is diluted, its pH :**

(a) increase
(b) decrease
(c) remains the same
(d) cannot be predicted.

Ans. (a) increase

8. **Which of the following solutions has pH greater than 7 ?**

(a) Lemon juice
(b) Dilute ethanoic acid
(c) Dilute hydrochloric acid
(d) Dil. NaHCO_3 solution.

Ans. (d) Dil. NaHCO_3 solution.

9. **pH of two solutions A and B are 8 and 12 respectively. This means that :**

(a) solution B is 10,000 times more basic than A.
(b) solution B is 1.5 times more basic than A.
(c) solution A is 1.5 times more basic than B.
(d) solution A is 10,000 times more basic than B

Ans. (a) solution B is 10,000 times more basic than A.

10. **How many times a solution of pH-3 be dilute to get a solution of pH-6 ?**

(a) 1000 times
(b) 100 times
(c) 10 times
(d) two times

Ans. (a) 1000 times.

11. **Four solutions I, II, III and IV were given to a student to test their acidic or basic nature by using a pH paper. He observed that the colour of pH paper turned to red, blue, green and orange, respectively when dipped in four solutions.**

(a) I and IV are acidic.
(b) I, II and III are acidic
(c) II and IV are basic
(d) II, III and IV are basic.

Ans. (a) I and IV are acidic.

12. **Four students are given colourless liquids A, B, C of water, lemon juice and a mixture of water and lemon juice, respectively. After testing these liquids with pH paper following sequences in colour change of pH paper were reported :**

i. Blue, Red and Green
ii. Orange, Green and Green
iii. Green, Red and Red
iv. Red, Red and Green

The correct sequence of colours observed is :

(a) iii

- (b) i
- (c) iv
- (d) ii.

Ans. (a) iii.

13. When a few drop of dil. HCl are added to solid sodium carbonate, the gas evolved is:

- (a) SO_2
- (b) CO_2
- (c) H_2
- (d) NH_3

Ans. (b) CO_2

14. When we add a few drops of blue litmus solution to a test tube containing dil HCl:

- (a) It may remain blue or turn red depending upon whether the solution of HCl is dilute or concentrated.
- (b) The solution will remain blue
- (c) The solution turns red
- (d) The blue colour will disappear

Ans. (b) The solution will remain blue

15. When a few drops of red litmus solution are added to a test tube containing NaOH solution it turns blue. This show that NaOH solution is:

- (a) acidic
- (b) basic
- (c) neutral
- (d) none of these

Ans. (b) basic

16. Which of the following statements about sodium hydroxide and sodium carbonate is correct?

- (a) Both turn blue litmus red.
- (b) Sodium hydroxide turns blue litmus red while sodium carbonate turns red litmus blue
- (c) Sodium hydroxide turns red litmus blue while sodium carbonate turns blue litmus red.
- (d) Both turn red litmus blue.

Ans. (d) Both turn red litmus blue.

17. A student added dilute NaOH to a test tube containing zinc granules and heated the contents. It was observed that:

- (a) A colourless gas evolved.
- (b) Bubbles started rising up in the test tube
- (c) Solution remained colourless and transparent.
- (d) Zinc granules became red.

Ans. (d) Zinc granules became red.

18. A student added dilute HCl to a test tube containing zinc granules and made following observations:

- i. The zinc surface became dull and black.
- ii. A gas evolved which burnt with a pop sound.
- iii. The solution remained colourless.

The correct observations are:

- (a) i and ii
- (b) i and iii
- (c) ii and iii
- (d) i, ii and iii

Ans. (d) i, ii and iii