

Acids, Bases and Salts

Class 10 - CBSE Science | Chapter 2 | Worksheet & Test Paper

15 MCQs | 8 board questions | 6 practice problems

Video lesson, notes and an interactive quiz: learn.ultimatetools.io

SECTION A - Multiple Choice Questions (1 mark each)

1. Blue litmus paper is dipped in a solution and turns red. The solution is:

- (a) Basic
- (b) Acidic
- (c) Neutral
- (d) An alkali

2. A gas evolved when dilute HCl reacts with zinc burns with a 'pop' sound. The gas is:

- (a) Oxygen
- (b) Carbon dioxide
- (c) Hydrogen
- (d) Chlorine

3. A colourless gas evolved when dilute HCl is added to sodium carbonate turns lime water milky. The gas is:

- (a) Hydrogen
- (b) Carbon dioxide
- (c) Oxygen
- (d) Nitrogen

4. Phenolphthalein in a basic solution is:

- (a) Colourless
- (b) Red
- (c) Yellow
- (d) Pink

5. The pH of a neutral solution such as pure water is:

- (a) 0
- (b) 7
- (c) 10
- (d) 14

6. Tooth decay begins when the pH of the mouth falls below:

- (a) 7.0
- (b) 6.5
- (c) 5.5
- (d) 4.0

7. Rain is called acid rain when its pH is below:

- (a) 7.0
- (b) 6.5
- (c) 5.6
- (d) 3.0

8. Which of the following is a WEAK acid?

- (a) HCl
- (b) H₂SO₄
- (c) HNO₃
- (d) CH₃COOH

9. An aqueous solution of NH₄Cl will have a pH:

- (a) Equal to 7
- (b) Less than 7
- (c) Greater than 7
- (d) Exactly 14

10. In the chlor-alkali process, the gas liberated at the anode is:

- (a) Hydrogen
- (b) Oxygen
- (c) Chlorine
- (d) Carbon dioxide

11. The chemical formula of bleaching powder is:

- (a) CaOCl_2
- (b) CaCO_3
- (c) Ca(OH)_2
- (d) $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$

12. Baking soda is chemically:

- (a) Sodium carbonate
- (b) Sodium hydrogencarbonate
- (c) Sodium chloride
- (d) Calcium carbonate

13. The number of water molecules of crystallisation in washing soda is:

- (a) 2
- (b) 5
- (c) 7
- (d) 10

14. Plaster of Paris is obtained by heating gypsum to about:

- (a) 273 K
- (b) 373 K
- (c) 573 K
- (d) 1000 K

15. While diluting a concentrated acid, the correct method is to:

- (a) Add water to the acid quickly
- (b) Add acid to water slowly with stirring
- (c) Mix them in any order
- (d) Heat the acid first

SECTION B - Board-style Questions

1. Why should curd and other sour substances not be kept in brass and copper vessels? [2 marks]

2. Write the balanced chemical equation for the chlor-alkali process and name the products obtained at the anode and at the cathode. [3 marks]

3. What is baking powder? How does it make a cake soft and spongy? [3 marks]

4. Why does dry hydrogen chloride gas not change the colour of dry litmus paper? [2 marks]

5. The aqueous solution of sodium chloride is neutral, but that of sodium carbonate is basic. Explain. [3 marks]

6. What is meant by water of crystallisation? What happens when blue copper sulphate crystals are heated? Write what you observe. [3 marks]

7. A milkman adds a very small amount of baking soda to fresh milk. (a) Why does he shift the pH from 6 to slightly alkaline? (b) Why does this milk take a longer time to set as curd? [3 marks]

8. Why should plaster of Paris be stored in a moisture-proof container? [2 marks]

SECTION C - Practice Problems

1. Write the balanced chemical equation for the reaction of zinc with sodium hydroxide solution, and name the salt formed.

Hint: This is a base reacting with a metal - the products are a salt and hydrogen gas.

2. A colourless gas is evolved when dilute hydrochloric acid is added to sodium carbonate. Name the gas, describe the test to identify it, and write the equation for the test.

Hint: Metal carbonate + acid gives three products - one of them is a gas that reacts with lime water.

3. Arrange these in increasing order of pH: lemon juice, sodium hydroxide solution, pure water, milk of magnesia, gastric juice.

Hint: Strong acids sit near 0 and strong bases near 14. For the two acids, ask which one contains a strong mineral acid and which contains a weak organic acid.

4. A salt X dissolves in water to give a solution of pH 11. Which type of acid and base formed X? Give one example of such a salt.

Hint: Compare pH 11 with 7 - is the solution acidic or basic? Now recall the rule that links a salt's pH to the strengths of the acid and base it came from.

5. Write the equation for obtaining plaster of Paris from gypsum, and the equation for the setting of plaster of Paris.

Hint: One is a heating reaction at 373 K; the other simply adds the water back.

6. Fresh milk has a pH of 6. When it turns into curd, does the pH increase or decrease? Give a reason.

Hint: Curd tastes sour - what does sourness indicate?

ANSWER KEY

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Section A - MCQ answers

1. (b) Acidic

Blue litmus turning red is the standard test for an acid.

2. (c) Hydrogen

Acid + metal $\rightarrow$ salt + hydrogen; the pop sound with a burning candle is the confirmatory test for H_2 .

3. (b) Carbon dioxide

Acid + carbonate gives CO_2 , and $CO_2 + Ca(OH)_2 \rightarrow CaCO_3$ (white, insoluble) + H_2O , making lime water milky.

4. (d) Pink

Phenolphthalein is colourless in acid and pink in base.

5. (b) 7

pH 7 is neutral; below 7 is acidic, above 7 is basic.

6. (c) 5.5

Below pH 5.5 the tooth enamel starts to corrode; a basic toothpaste neutralises the excess acid.

7. (c) 5.6

Rain water with pH less than 5.6 is acid rain; it makes river water acidic and harms aquatic life.

8. (d) CH_3COOH

Ethanoic (acetic) acid ionises only partially in water, so it is a weak acid; the other three are strong acids.

9. (b) Less than 7

NH_4Cl comes from a strong acid (HCl) and a weak base (NH_4OH), so its solution is acidic - pH below 7.

10. (c) Chlorine

Chlorine is released at the anode, hydrogen at the cathode, and sodium hydroxide remains in solution.

11. (a) $CaOCl_2$

Bleaching powder (calcium oxychloride) is made by passing chlorine over dry slaked lime.

12. (b) Sodium hydrogencarbonate

Baking soda is $NaHCO_3$, sodium hydrogencarbonate - a mild non-corrosive base.

13. (d) 10

Washing soda is $Na_2CO_3 \cdot 10H_2O$ - ten water molecules per formula unit.

14. (b) 373 K

At 373 K gypsum ($CaSO_4 \cdot 2H_2O$) loses water and becomes $CaSO_4 \cdot \frac{1}{2}H_2O$, plaster of Paris.

15. (b) Add acid to water slowly with stirring

The dilution is highly exothermic - adding water to acid can make the mixture splash out. Always add acid to water slowly while stirring.

Section B - Model answers

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

Curd and other sour foods contain acids (mainly lactic acid). These acids react with the copper and zinc of brass and copper vessels to form toxic metal salts, such as copper lactate. Eating food contaminated with these compounds can cause food poisoning, so sour substances are stored in glass, stainless steel or earthen containers instead.

2. Write the balanced chemical equation for the chlor-alkali process and name the products obtained at the anode and at the cathode.

$2NaCl(aq) + 2H_2O(l) \rightarrow 2NaOH(aq) + Cl_2(g) + H_2(g)$. Chlorine gas (Cl_2) is obtained at the anode and hydrogen gas (H_2) at the cathode; sodium hydroxide solution is formed near the cathode. It is called the chlor-alkali process because the products are chlorine and an alkali ($NaOH$).

3. What is baking powder? How does it make a cake soft and spongy?

Baking powder is a mixture of baking soda (sodium hydrogencarbonate) and a mild edible acid such as tartaric acid. On heating during baking, the baking soda produces carbon dioxide: $2NaHCO_3 \rightarrow Na_2CO_3 + H_2O + CO_2$. The CO_2 bubbles get trapped in the batter and make the cake rise, becoming soft and spongy. The tartaric acid neutralises the sodium carbonate formed, so the cake does not taste bitter.

4. Why does dry hydrogen chloride gas not change the colour of dry litmus paper?

An acid shows acidic behaviour only when it produces hydrogen ions (H^+) in water. Dry HCl gas has no water available, so it cannot ionise to release H^+ ions, and therefore it does not change the colour of dry litmus paper. In the presence of moisture it ionises and turns blue litmus red.

5. The aqueous solution of sodium chloride is neutral, but that of sodium carbonate is basic. Explain.

The pH of a salt solution depends on the strength of the acid and base that formed it. Sodium chloride is formed from a strong acid (HCl) and a strong base (NaOH); both are equally strong so the solution is neutral with pH 7. Sodium carbonate is formed from a weak acid (carbonic acid, H_2CO_3) and a strong base (NaOH); the stronger partner dominates, so the solution is basic with pH greater than 7.

6. What is meant by water of crystallisation? What happens when blue copper sulphate crystals are heated? Write what you observe.

Water of crystallisation is the fixed number of water molecules present in one formula unit of a salt, for example $CuSO_4 \cdot 5H_2O$. On heating blue copper sulphate crystals, the water of crystallisation is removed and the crystals turn white (anhydrous copper sulphate): $CuSO_4 \cdot 5H_2O \xrightarrow{\text{heat}} CuSO_4 + 5H_2O$. Droplets of water are also seen condensing on the cooler inner sides of the boiling tube, proving the crystals contained water. If water is added again, the blue colour returns.

7. A milkman adds a very small amount of baking soda to fresh milk. (a) Why does he shift the pH from 6 to slightly alkaline? (b) Why does this milk take a longer time to set as curd?

(a) Fresh milk has a pH of about 6, i.e. it is slightly acidic. The baking soda added is a mild base, and it neutralises the lactic acid produced by bacteria. This keeps the milk from becoming acidic, so it does not turn sour quickly and stays fresh longer. (b) For the same reason, the curd takes longer to set: the lactic acid formed must first neutralise all the added base before the milk can become acidic enough to curdle.

8. Why should plaster of Paris be stored in a moisture-proof container?

Plaster of Paris ($CaSO_4 \cdot \frac{1}{2}H_2O$) reacts with moisture in the air and gets converted into hard, solid gypsum ($CaSO_4 \cdot 2H_2O$). If it absorbs moisture during storage it will set into a hard lump and become useless, so it must be kept in a moisture-proof container.

Section C - Solutions

1. Write the balanced chemical equation for the reaction of zinc with sodium hydroxide solution, and name the salt formed.

$2NaOH + Zn \rightarrow Na_2ZnO_2 + H_2$ (gas). The salt formed is sodium zincate.

2. A colourless gas is evolved when dilute hydrochloric acid is added to sodium carbonate. Name the gas, describe the test to identify it, and write the equation for the test.

The gas is carbon dioxide. Test: pass it through lime water - the lime water turns milky. $Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$. (With excess CO_2 the milkiness disappears as soluble $Ca(HCO_3)_2$ forms.)

3. Arrange these in increasing order of pH: lemon juice, sodium hydroxide solution, pure water, milk of magnesia, gastric juice.

gastric juice (~ 1.2) < lemon juice (~ 2.2) < pure water (7) < milk of magnesia (~ 10) < sodium hydroxide solution (~ 14). Gastric juice contains hydrochloric acid - a STRONG mineral acid that ionises completely - so it is more acidic than lemon juice, which contains the weak organic citric acid.

4. A salt X dissolves in water to give a solution of pH 11. Which type of acid and base formed X? Give one example of such a salt.

X is formed from a WEAK acid and a STRONG base, so its solution is basic (pH > 7). Example: sodium carbonate (Na_2CO_3) or sodium ethanoate (CH_3COONa).

5. Write the equation for obtaining plaster of Paris from gypsum, and the equation for the setting of plaster of Paris.

Formation: $CaSO_4 \cdot 2H_2O \xrightarrow{373\text{ K}} CaSO_4 \cdot \frac{1}{2}H_2O + \frac{3}{2}H_2O$. Setting: $CaSO_4 \cdot \frac{1}{2}H_2O + \frac{11}{2}H_2O \rightarrow CaSO_4 \cdot 2H_2O$ (hard, solid gypsum).

6. Fresh milk has a pH of 6. When it turns into curd, does the pH increase or decrease? Give a reason.

The pH decreases (becomes lower than 6). Bacteria convert lactose into lactic acid, and the extra acid means more H^+ ions, so the pH falls and the curd tastes sour.

