# ACIDS, BASES AND SALTS

## NCERT Textbook Questions

**Q.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.** (*i*) Put the red litmus paper in all the test-tubes, turn by turn. The solution which turns red litmus to blue will be a basic solution. The blue litmus paper formed here can now be used to test the acidic solution.

(*ii*) Put the blue litmus paper in the remaining two test tubes, one by one. The solution which turns the blue litmus paper to red will be the acidic solution.

(*iii*) The solution which has no effect on any litmus paper will be neutral and hence it will be distilled water.

**Q.2. Why should curd and sour substances not be kept in brass and copper vessels?**

**Ans.** Curd and other sour substances contain acids which can react with the metals of brass and copper vessels to form toxic (poisonous) metal compounds which can cause food poisoning and damage our health.

**Q.3. Which gas is usually liberated when an acid reacts with a metal? Illustrate with the help of an example. How will you test the presence of this gas?**

**Ans.** When an acid reacts with a metal, then hydrogen gas is liberated. For example, when dilute sulphuric acid reacts with zinc granules, then hydrogen gas is liberated and zinc sulphate solution is formed:

$$\underset{\text{Zinc}}{Zn\,(s)} + \underset{\text{Sulphuric acid}}{H_2SO_4\,(aq)} \longrightarrow \underset{\text{Zinc sulphate}}{ZnSO_4\,(aq)} + \underset{\text{Hydrogen}}{H_2\,(g)}$$

The presence of hydrogen gas is tested by burning it. When a lighted match stick is brought near a gas jar containing hydrogen gas, it burns with a 'pop' sound making a little explosion.

**Q.4. 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.** The gas that extinguishes a burning candle is carbon dioxide which is formed by the action of dilute hydrochloric acid on a metal carbonate or a metal hydrogen carbonate and produces effervescence. Since one of the compounds formed is calcium chloride, it shows that the

metal compound is calcium carbonate (It cannot be calcium hydrogen carbonate because calcium hydrogen carbonate is found only in solution, it is too unstable to exist as a solid). Thus, the metal compound A is calcium carbonate ($CaCO_3$). Calcium carbonate reacts with dilute hydrochloric acid to form calcium chloride, carbon dioxide and water.

Chemical Equation:

$$\underset{\text{Calcium carbonate}}{CaCO_3(s)} + \underset{\text{Hydrochloric acid}}{2HCl\,(aq)} \longrightarrow \underset{\text{Calcium chloride}}{CaCl_2\,(aq)} + \underset{\text{Carbon dioxide}}{CO_2\,(g)} + \underset{\text{Water}}{H_2O(l)}$$

**Q.5. Why do HCl, $HNO_3$, etc., show acidic character in aqueous solutions while solutions of compounds likealcohol and glucose do not show acidic character?**

**Ans.** The acidic character of a substance is due to the presence of hydrogen ions [$H^+$ (aq) ions] in its aqueous solution (water solution). HCl and $HNO_3$ show acidic properties because they produce hydrogen ions when dissolved in water. The solutions of compounds like alcohol and glucose do not show acidic character because they do not ionise (or dissociate) in water to produce hydrogen ions.

**Q.6. Why does an aqueous solution of an acid conduct electricity?**

**Ans.** The aqueous solution of an acid conducts electricity due to the presence of charged particles called 'ions'in it. For example, when hydrochloric acid (HCl) is dissolved in water, then its aqueous solution contains hydrogen ions [$H^+$ (aq)] and chloride ions [$Cl^-$ (aq)]. These ions carry electric current. So, due to the presence of $H^+$ (aq) ions and $Cl^-$ (aq) ions, a water solution of hydrochloric acid conducts electricity.

**Q.7. Why does dry HCl gas not change the colour of dry litmus paper?**

**Ans.** Dry HCl gas does not change the colour of dry litmus paper because it has no hydrogen ions, $H^+$ (aq) ions, in it which can impart acidic properties to it.

**Q.8. While diluting an acid, why is it recommended that the acid should be added to water and not water tothe acid?**

**Ans.** A concentrated acid is diluted by adding water to it. The process of mixing water to a concentrated acid is highly exothermic in which a large amount of heat is evolved.

(i) When the concentrated acid is added to water, then the heat is evolved gradually and easily absorbedby the large amount of water.

(ii) If water is added to concentrated acid, then a large amount of heat is evolved at once. This heat changessome of the water to steam explosively which can splash the acid on our face or clothes and cause acidburns.

**Q.9. How is the concentration of hydronium ions ($H_3O^+$) affected when the solution of an acid is diluted?**

**Ans.** On diluting an acid, the concentration of hydronium ions ($H_3O^+$) in it decreases.

**Q.10. How is the concentration of hydroxide ions ($OH^-$) affected when excess of base is dissolved in a solution of sodium hydroxide?**

**Ans.** On dissolving more sodium hydroxide base in the same solution, the concentration of hydroxide ions ($OH^-$) increases.

**Q.11. 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 these is acidic and which one basic?**

**Ans.** We know that the pH of a solution is inversely proportional to its hydrogen ion concentration. This means that the solution having lower pH will have more hydrogen ion concentration. In this case, solution A (having a lower pH of 6) will have more hydrogen ion concentration. Solution A is acidic and the solution B is basic.

**Q.12. What effect does the concentration of $H^+$ (aq) ions have on the nature of the solution?**

**Ans.** Higher the concentration of $H^+$(aq) ions in a solution, more acidic the solution will be.

**Q.13. Do basic solutions also have $H^+$ (aq) ions? If yes, then why are these basic?**

**Ans.** Even the basic solutions have hydrogen ions [$H^+$ (aq) ions] in them which come from the ionisation of waterin which the base is dissolved. They are basic because the concentration of hydroxide ions [$OH^-$ ions] in them is much more than the concentration of hydrogen ions.

**Q.14. Under what soil condition do you think a farmer would treat the soil of his fields with quicklime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate)?**

**Ans.** A farmer would treat the soil of his fields with quicklime (calcium oxide), or slaked lime (calcium hydroxide) or chalk (calcium carbonate) if the soil is too acidic having a low pH value. All these materials are bases and hence react with the excess acid present in the soil and reduce its acidity.

**Q.15. What is the common name of the compound $CaOCl_2$?**

**Ans.** Bleaching powder.

**Q.16. Name the substance which on treatment with chlorine yields bleaching powder.**

**Ans.** Slaked lime.

**Q.17. Name the sodium compound which is used for softening hard water.**

**Ans.** Sodium carbonate (Washing soda).

**Q.18. What will happen if a solution of sodium hydrogencarbonate is heated? Give the equation of the reaction involved.**

**Ans.** When a solution of sodium hydrogencarbonate is heated, it decomposes to form sodium carbonate with the evolution of carbon dioxide gas. The equation of the reaction involved is:

$$2NaHCO_3 \longrightarrow Na_2CO_3 + CO_2 + H_2O$$

Sodium hydrogencarbonate — Sodium carbonate — Carbon dioxide — Water

**Q.19. Write an equation to show the reaction between Plaster of Paris and water.**

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

Plaster of Paris — Water — Gypsum (sets as hard mass)

## NCERT Exercises

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

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

**Ans.** (*d*) 10

**Q.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

**Q.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 of 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

**Q.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

**Q.5. Write word equations and then balanced equations for the reactions taking place when:**

**(*a*) dilute sulphuric acid reacts with zinc granules**

**(*b*) dilute hydrochloric acid reacts with magnesium ribbon**

**(*c*) dilute sulphuric acid reacts with aluminium powder**

**(*d*) dilute hydrochloric acid reacts with iron filings**

**Ans.** (*a*) Sulphuric acid + Zinc $\longrightarrow$ Zinc sulphate + Hydrogen

$H_2SO_4 + Zn \longrightarrow ZnSO_4 + H_2$

(*b*) Hydrochloric acid + Magnesium $\longrightarrow$ Magnesium chloride + Hydrogen

$2HCl + Mg \longrightarrow MgCl_2 + H_2$

(*c*) Sulphuric acid + Aluminium $\longrightarrow$ Aluminium sulphate + Hydrogen

$3H_2SO_4 + 2Al \longrightarrow Al_2(SO_4)_3 + 3H_2$

(*d*) Hydrochloric acid + Iron $\longrightarrow$ Iron (II) chloride + Hydrogen

$2HCl + Fe \longrightarrow FeCl_2 + H_2$

**Q.6. Compounds such as alcohol and glucose also contain hydrogen but are not categorised as acids. Why?**
**Describe an activity to prove it.**

**Ans.** Only those compounds containing hydrogen are considered to be acids which dissolve in water to produce hydrogen ions, $H^+$ (aq). The hydrogen containing compounds such as alcohol and glucose are not categorised as acids because they do not ionize to produce hydrogen ions, $H^+$ (aq), when dissolved in water. This is proved by the fact that the aqueous solutions of alcohol and glucose do not conduct electricity.

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

**Ans.** Distilled water does not conduct electricity because it does not contain any ionic compounds (like acids, bases or salts) dissolved in it. When rain water falls to the earth through the atmosphere, it dissolves an acidic gas 'carbon dioxide' from the air and forms some carbonic acid ($H_2CO_3$). Carbonic acid ($H_2CO_3$) provides some hydrogen ions [$H^+$ (aq) ions] and carbonate ions [$CO_3^{2-}$ (aq) ions] to rain water. Due to the presence of these ions, rain water conducts electricity.

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

**Ans.** The acidic behaviour of acids is due to the presence of hydrogen ions, $H^+$ (aq) ions. The acids produce hydrogen ions only on dissolving in water. In the absence of water, acids do not produce hydrogen ions and hence do not show acidic behaviour.

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

**(*a*) Which solution is (*i*) neutral (*ii*) strongly alkaline (*iii*) strongly acidic (*iv*) weakly acidic, and (*v*) weakly alkaline?**

**(*b*) Arrange the pH values in the increasing order of hydrogen ion concentration.**

**Ans.** (*a*) (*i*) neutral: D (pH =7); (ii) strongly alkaline: C (pH=11); (iii) strongly acidic: B (pH=1); (iv) weakly acidic: A (pH=4); (v) weakly alkaline: E (pH =9)

(*b*) The solution having highest pH (11) will have the minimum hydrogen ion concentration whereas the solution having the least pH (1) will have the maximum hydrogen ion concentration. So, the given solutions can be arranged in the increasing order of their hydrogen ion concentrations as follows:

C (pH = 11) < E (pH = 9) < D (pH = 7) < A (pH = 4) < B (pH =1)

**Q.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.** Hydrochloric acid (HCl) is a strong acid whereas acetic acid ($CH_3COOH$) is a weak acid. Being a strong acid, the hydrochloric solution contains a much greater amount of hydrogen ions in it due to which the fizzing will occur more vigorously in test tube A (containing hydrochloric acid). This fizzing is due to the evolution of hydrogen gas which is formed by the action of acid on the magnesium metal (of magnesium ribbon).

**Q.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.** As the milk turns into curd, its pH will fall below 6 (it will become more acidic). This is because an acid (lactic acid) is produced when milk turns into curd.

**Q.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 longer time to set as curd?**

**Ans.** (*a*) Fresh milk is slightly acidic naturally. Fresh milk is made slightly alkaline by adding a little of baking soda so that it may not get sour easily due to the formation of lactic acid in it.

(*b*) The slightly alkaline milk takes a longer time to set into curd because the lactic acid being formed during curdling has to first neutralise the alkali present in it.

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

**Ans.** Plaster of Paris should be stored in a moisture-proof container because the presence of moisture (or water) can cause its slow setting by bringing about its hydration. This will make the plaster of Paris useless after some time.

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

**Ans.** The reaction between an acid and a base to form salt and water is called a neutralisation reaction. That is:

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

The examples of neutralisation reactions are as follows:

(*i*) Sodium hydroxide reacts with sulphuric acid to form sodium sulphate and water:

$$2NaOH\,(aq) + H_2SO_4\,(aq) \longrightarrow Na_2SO_4\,(aq) + 2H_2O\,(l)$$

Sodium hydroxide (Base) + Sulphuric acid (Acid) → Sodium sulphate (Salt) + Water

(*ii*) Magnesium hydroxide reacts with hydrochloric acid to form magnesium chloride and water:

$$Mg(OH)_2\,(aq) + 2HCl\,(aq) \longrightarrow MgCl_2\,(aq) + 2H_2O\,(l)$$

Magnesium hydroxide (Base) + Hydrochloric acid (Acid) → Magnesium chloride (Salt) + Water

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

**Ans.** (*a*) *Uses of washing soda:*

(*i*) Washing soda is used as a cleansing agent for domestic purposes like washing clothes.

(*ii*) Washing soda is used for removing permanent hardness of water.