NCERT Solutions for Class 10

Science

Chapter 2 Acid, bases and salts

Intext exercise 1

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: Red litmus paper is an indicator for bases and can turn blue in the presence of a base.

Let us mark the given three test tubes as **A**, **B**, and **C.** Put the given red litmus paper in each solution. If the colour of red litmus paper changes to blue (suppose in test tube **A**), then it is a base and if there is no colour change, then it is either acidic or neutral.

Now, a drop of the solution from test tube **A** is put on the red litmus paper. Same process is repeated with solution **B** and **C**. If either of them changes colour to blue, then it is basic (let's suppose **B**) Therefore, out of three, one is eliminated as a base.

Out of the remaining two (**A** and **C**), any solution can be acidic or neutral. To test them for acidic or neutral, a drop of basic solution is mixed with a drop of each of the remaining two solutions separately and then the nature of the drops of the mixtures is checked. If the colour of red litmus turns blue, then the second solution is neutral (**C**) and if there is no change in colour, then the second solution is acidic (**A**). This is because acidic and basic solutions neutralise each other. In this way the contents of each test tube can be identified.

Intext Exercise 2

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

Ans: Curd contains lactic acid and other sour substances also contain some acids. So, when they are kept in brass and copper vessels, the acid present in curd and sour substances react with the metal to liberate hydrogen gas and harmful products which spoil the food.

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: Hydrogen gas is liberated when an acid reacts with a metal.

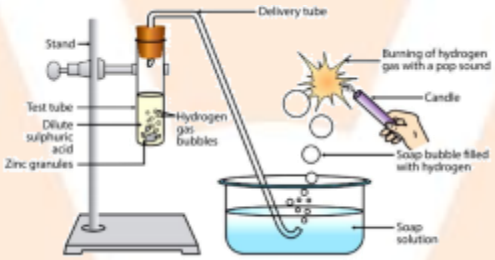
For example:

- Take some pieces of zinc granules in a test tube and add dilute H_2SO_4 to it.
- Shake it and pass the gas produced into a soap solution.
- Bubbles are formed in the soap solution.
- These soap bubbles contain hydrogen gas.
- The chemical equation of the reaction is:

$$H_2SO_4 + Zn \rightarrow ZnSO_4 + H_2 \uparrow$$

Identification test:

Hydrogen gas is identified by bringing a burning candle near the soap bubbles. The candle will burn with 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: Calcium carbonate is a metal compound that reacts with dilute hydrochloric acid to produce calcium chloride, carbon dioxide and water. Carbon dioxide produced has the ability to extinguish a burning candle as it will remove the oxygen supply. The balanced chemical equation for the reaction is:

$$\underset{\text{calcium carbonate}}{CaCO_{3(s)}} + \underset{\text{hydrochloric acid}}{2HCl_{(aq)}} \rightarrow \underset{\text{calcium chloride}}{CaCl_{2(aq)}} + \underset{\text{carbon dioxide}}{CO_{2(g)}} + \underset{\text{water}}{H_2O_{(l)}}$$

Intent Exercise 3

1. Why do HCl, HNO_3, etc., show acidic characters in aqueous solutions while solutions of compounds like alcohol and glucose do not show acidic character?

Ans: The acidic character of any compound is due to the presence of the hydronium ions $\left(H_3O^+\right)$ or hydrogen ions $\left(H^+\right)$ in any solution. In an aqueous solution HCl and HNO_3 gets dissociated and forms hydrogen ions. The hydrogen ions combine with H_2O to form hydronium ions. The reaction is as follows:

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

$$H^+ + H_2O \rightarrow H_3O^+$$

Due to the presence of hydronium ions HCl, HNO_3, etc., show acidic characters. However, the aqueous solutions of glucose and alcohol contain hydrogen, but it cannot dissociate in water to form hydrogen ions. Therefore, they do not show acidic character.

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

Ans: Acids have the tendency to dissociate into hydronium ions $\left(H_3O^+\right)$ or hydrogen ions $\left(H^+\right)$ in an aqueous solution. Due to the movement of these ions , the solution can conduct electricity. Hence, an aqueous solution of an acid can conduct electricity.

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

Ans: The acidic nature is due to the presence of hydronium $\left(H_3O^+\right)$ or hydrogen $\left(H^+\right)$ ions in aqueous solution. Dry HCl gas does not contain hydronium or hydrogen ions as only in aqueous solution an acid can dissociate to give ions. The colour of the litmus paper is changes by the hydrogen ions. So, in this case there will be no colour change due to dryness of the HCl gas and the litmus paper.

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

Ans: It is always recommended that acid should be added to water in order to dilute the acid; because the process of dissolving an acid in water is exothermic that releases heat. If water is added to the acid, then a large amount of heat is

generated due to which the mixture spills out and causes burns and injuries that may cause accident.

5. How is the concentration of hydronium ions $\left(H_3O^+\right)$ affected when a solution of an acid is diluted?

Ans: When a solution of an acid is diluted, then water is added to that solution. Dilution results in the concentration of hydronium ions $\left(H_3O^+\right)$ per unit volume to get decreased and thus the strength of the acid also decreases.

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

Ans: When an excess of a base is dissolved in a solution, the solution becomes concentrated. This would result in the increase in the concentration of hydroxide ions $\left(OH^-\right)$ per unit volume and the strength of the base will increase.

Intext Exercise 4

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: The pH less than 7 (pH < 7) indicates an acidic solution, while pH greater than 7 (pH > 7) indicates a basic solution. Therefore, the solution with pH = 6 will be acidic and it has more hydrogen ion $\left(H^+\right)$ concentration than the solution of pH = 8 that will be a basic solution. The solution of pH = 8 has more hydroxide ion $\left(OH^-\right)$ concentration.

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

Ans: When the hydrogen ion $\left(H^+\right)$ concentration increases, the solution becomes more acidic. While a decrease of hydrogen ion in the solution makes the solution less acidic and increases the basicity of the solution.

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

Ans: Yes, basic solution also contains $\left(H^{+}_{(aq)}\right)$ ions. However, their concentration is less as compared to the concentration of hydroxide $\left(OH^{-}\right)$ ions that make the solution basic.

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: Quick lime (calcium oxide) or slaked lime (calcium hydroxide) or chalk (calcium carbonate) is considered a good base. If the soil is acidic which is improper for cultivation, then to increase the basicity of soil, the farmer would treat the soil with these compounds.

Intext Exercise 5

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

Ans: The common name of the given compound $CaOCl_2$ is bleaching powder.

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

Ans: The compound called calcium hydroxide $Ca(OH)_2$ on treatment with chlorine, yields bleaching powder.

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

Ans: Washing soda $\left(Na_2CO_3.10H_2O\right)$ is the sodium compound that is used for softening hard water.

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

Ans: When a solution of sodium hydrocarbonate or sodium hydrogen carbonate is heated then sodium carbonate and water are formed with the evolution of carbon dioxide gas.

The equation is as follows:

$$\underset{\text{sodium hydrogen carbonate}}{2NaHCO_3} \xrightarrow{\Delta} \underset{\text{sodium carbonate}}{Na_2CO_3} + \underset{\text{water}}{H_2O} + \underset{\text{carbon dioxide}}{CO_2}\uparrow$$

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

Ans: The chemical equation can be represented as:

$$\underset{\text{plaster of paris}}{CaSO_4.\frac{1}{2}H_2O} + 1\frac{1}{2}\underset{\text{water}}{H_2O} \rightarrow \underset{\text{gypsum}}{CaSO_4.2H_2O}$$

NCERT Exercises

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

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

Ans: (d). Bases turn red litmus blue. Basic solution has a pH > 7. Since, the solution turns red litmus blue, its pH would likely be 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) The solution contains HCl (acid) which reacts with crushed egg-shells to give a gas (carbon dioxide) that turns lime-water milky. Egg shell contains calcium carbonate (base).

$$\underset{\text{calcium carbonate}}{CaCO_{3(s)}} + \underset{\text{hydrochloric acid}}{2HCl_{(aq)}} \rightarrow \underset{\text{calcium chloride}}{CaCl_{2(aq)}} + \underset{\text{carbon dioxide}}{CO_{2(g)}} + \underset{\text{water}}{H_2O_{(l)}}$$

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) 8mL
c) 12 mL
d) 16 mL

Ans: (d) 16 mL

10 mL of a solution of NaOH neutralises 8 mL of a solution of HCl. Thus, 20 mL of a solution of NaOH neutralises, $\frac{10}{8} \times \frac{20}{?}$ mL =16 mL of HCl solution.

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 is commonly used for treating indigestion.

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

a) dilute sulphuric acid reacts with zinc granules.
Ans: Word equation: Sulphuric acid + Zinc → Zinc sulphate + Hydrogen
Balanced equation: $H_2SO_{4(aq)} + Zn_{(s)} \rightarrow ZnSO_{4(aq)} + H_{2(g)} \uparrow$

b) dilute hydrochloric acid reacts with magnesium ribbon.
Ans: Word equation: Hydrochloric acid + Magnesium → Magnesium chloride + Hydrogen
Balanced equation: $2HCl + Mg_{(s)} \rightarrow MgCl_{2(aq)} + H_{2(g)} \uparrow$

c) dilute sulphuric acid reacts with aluminium powder.
Ans: Word equation: Sulphuric acid + Aluminium → Aluminium sulphate + Hydrogen
Balanced equation: $3H_2SO_{4(aq)} + 2Al_{(s)} \rightarrow Al_2(SO_4)_{3(aq)} + 3H_{2(g)} \uparrow$

d) dilute hydrochloric acid reacts with iron filings.
Ans: Word equation: Hydrochloric acid + Iron → Ferric chloride + Hydrogen
Balanced equation: $6HCl + 2Fe_{(s)} \rightarrow 2FeCl_{3(aq)} + 3H_{2(g)} \uparrow$

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

Ans:

Activity:

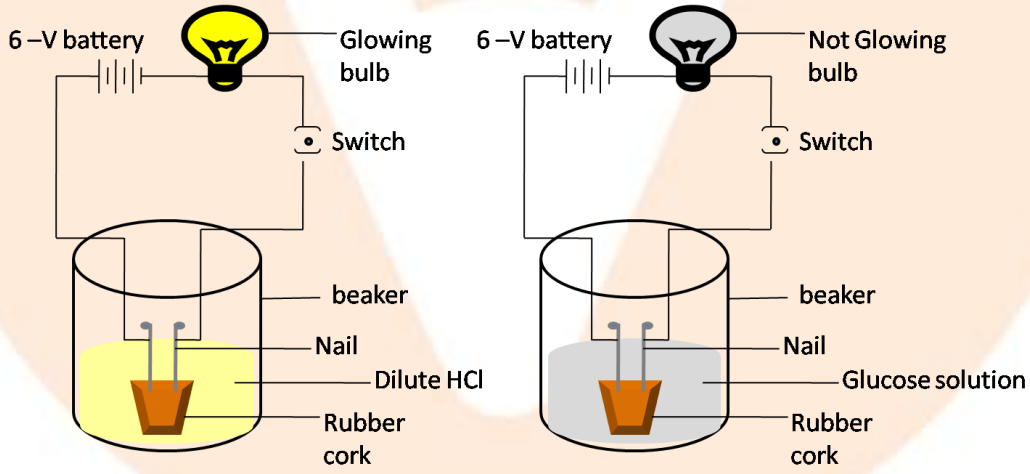
- Two nails are fitted on a cork kept in a 100 mL beaker.
- The nails are then connected to the terminals of a 6-volt battery through a bulb and a switch.
- Some dilute HCl is poured in the beaker and the current is switched on.
- The same experiment is then performed with glucose solution and alcohol solution.

Observations:

The bulb glows in the HCl solution and does not glow in the glucose or alcohol solution.

Result:

In aqueous solution, HCl dissociates into H^+ and Cl^- ions. These ions conduct electricity in the solution resulting in the glowing of the bulb. On the other hand, the glucose or alcohol solution does not dissociate into ions. Therefore, the bulb does not glow.



Conclusion:

All acids contain hydrogen but not all compounds containing hydrogen are acids. So, alcohols and glucose contain hydrogen, but they are not categorised as acids.

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

Ans: Distilled water is a pure form of water which is free from ionic species. Therefore, it does not conduct electricity. Rain water is an impure form of water that contains many ionic species like acids and thus, it conducts electricity.

8. Why do acids not show acidic behaviour in the absence of water?
Ans: Acids can only dissociate in aqueous solution to liberate hydrogen ions which are responsible for the acidic behaviour. Acids do not show acidic behaviour in the absence of water because the dissociation of hydrogen ions from an acid occurs in the presence of water only.

9. Five solutions A, B, C, D and E when tested with universal indicators 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) **Neutral:** Solution D with pH=7
b) **Strongly alkaline**: Solution C with pH=11
c) **Strongly acidic**: Solution B with pH=1
d) **Weakly acidic**: Solution A with pH=4
e) **Weakly alkaline**: Solution E with pH=9
The pH can be arranged in the increasing order of the concentration of hydrogen ions as: $11 < 9 < 7 < 4 < 1$

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: The fizzing occurs strongly in test tube A, in which hydrochloric acid (HCl) is added. This is because HCl is a stronger acid than acetic acid (CH_3COOH) and generates more hydrogen (H^+) ions. Therefore, HCl produces hydrogen gas at a faster rate due to which fizzing occurs.

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: The pH of fresh milk is 6. As it changes into curd, the pH will decrease because curd contains lactic acid which reduces the pH.

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?
Ans: In alkaline condition, milk does not set as curd easily due to the formation of lactic acid as in the acidic condition.

(b) Why does this milk take a long time to set as curd?
Ans: Since, this milk is slightly basic than normal milk, acids produced to set the curd are neutralised by the base added to the milk. Thus, it takes a longer time for the curd to set.

13. Plaster of Paris should be stored in a moisture-proof container. Explain why?
Ans: Plaster of Paris (POP) should be stored in a moisture-proof container because it is a powdery mass that can absorb water or moisture to form a hard solid mass known as gypsum. The reaction takes place as follows:

$$\underset{\text{plaster of paris}}{CaSO_4.\frac{1}{2}H_2O} + 1\frac{1}{2}\underset{\text{water}}{H_2O} \rightarrow \underset{\text{gypsum (hard solid)}}{CaSO_4.2H_2O}$$

14. What is a neutralisation reaction? Give two examples.
Ans: Neutralisation reaction: A reaction in which an acid and base react with each other to form a salt and water is known as a neutralization reaction. For example:
i. $\underset{\text{base}}{NaOH} + \underset{\text{acid}}{HCl} \rightarrow \underset{\text{salt}}{NaCl} + \underset{\text{water}}{H_2O}$
ii. During indigestion (caused due to the production of excess acid in the stomach), we take an antacid (milk of magnesia, $Mg(OH)_2$ which is basic in nature). The antacid neutralises the excess of acids and thus gives relief from indigestion.
$Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$

15. Give two important uses of washing soda and baking soda.
Ans: Uses of washing soda are:
(a) It is used to remove permanent hardness of water.
(b) It is used in glass, soap, and paper industries.
Uses of baking soda are:
(a) It is used as baking powder. Baking powder is a mixture of baking soda and

tartaric acid. Baking powder makes bread or cake fluffy.
(b) It is used in soda-acid fire extinguishers.