

Acids, Bases and Salts

Question 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?

Solution:- If the colour of red litmus paper gets changed to blue, then it is a base and if there is no colour change, then it is either acidic or neutral. Thus, basic solution can be easily identified.

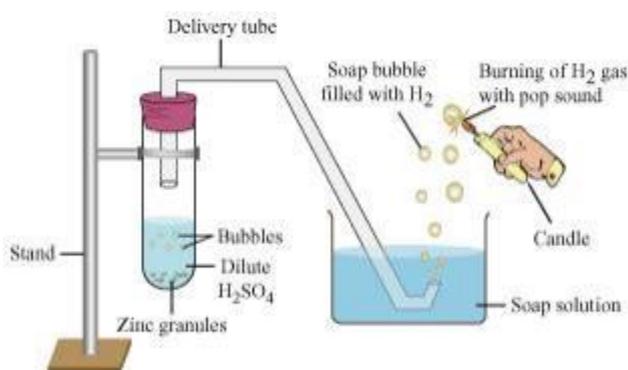
Let us mark the three test tubes as A, B, and C. A drop of the solution in A is put on the red litmus paper. Same is repeated with solution B and C. If either of them changes colour to blue, then it is basic. Therefore, out of three, one is eliminated. Out of the remaining two, any one can be acidic or neutral. Now 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 and if there is no change in colour, then the second solution is acidic. This is because acidic and basic solutions neutralize each other. Hence, we can distinguish between the three types of solutions.

Question 2: Why should curd and sour substances not be kept in brass and copper vessels?

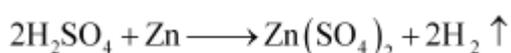
Solutions:- Curd and other sour substances contain acids. Therefore, when they are kept in brass and copper vessels, the metal reacts with the acid to liberate hydrogen gas and harmful products, thereby spoiling the food.

Question 3: 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?

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



Take few pieces of zinc granules and add 5 ml of dilute H₂SO₄. Shake it and pass the gas produced into a soap solution. The bubbles of the soap solution are formed. These soap bubbles contain hydrogen gas.

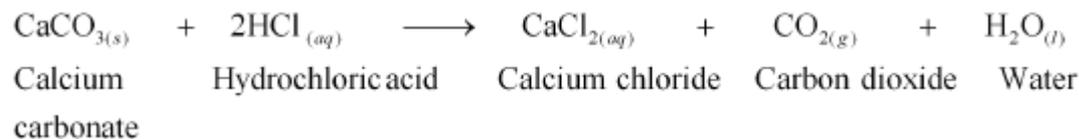


We can test the evolved hydrogen gas by its burning with a pop sound when a candle is brought near the soap bubbles.

Question 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.

Solutions:-



Question 5: Why do HCl, HNO₃, etc., show acidic characters in aqueous solutions while solutions of compounds like alcohol and glucose do not show acidic character?

Solutions:- The dissociation of HCl or HNO₃ to form hydrogen ions always occurs in the presence of water. Hydrogen ions (H⁺) combine with H₂O to form hydronium ions (H₃O⁺).

The reaction is as follows:



Although aqueous solutions of glucose and alcohol contain hydrogen, these cannot dissociate in water to form hydrogen ions. Hence, they do not show acidic character.

Question 6: Why does an aqueous solution of an acid conduct electricity?

Answer: Acids dissociate in aqueous solutions to form ions. These ions are responsible for conduction of electricity.

Question 7: Why does dry HCl gas not change the colour of the dry litmus paper?

Answer: Colour of the litmus paper is changed by the hydrogen ions. Dry HCl gas does not contain H⁺ ions. It is only in the aqueous solution that an acid dissociates to give ions. Since in this case, neither HCl is in the aqueous form nor the litmus paper is wet, therefore, the colour of the litmus paper does not change.

Since the process of dissolving an acid in water is exothermic, it is always recommended that acid should be added to water. If it is done the other way, then it is possible that because of the large amount of heat generated, the mixture splashes out and causes burns.

Question 8: How is the concentration of hydronium ions (H₃O⁺) affected when a solution of an acid is diluted?

Answer: When an acid is diluted, the concentration of hydronium ions (H₃O⁺) per unit volume decreases. This means that the strength of the acid decreases.

Question 9: How is the concentration of hydroxide ions (OH⁻) affected when excess base is dissolved in a solution of sodium hydroxide?

Answer: The concentration of hydroxide ions (OH^-) would increase when excess base is dissolved in a solution of sodium hydroxide.

Question 10: 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?

Solutions:- A pH value of less than 7 indicates an acidic solution, while greater than 7 indicates a basic solution. Therefore, the solution with pH = 6 is acidic and has more hydrogen ion concentration than the solution of pH = 8 which is basic.

Question 11: What effect does the concentration of $\text{H}^+_{(aq)}$ ions have on the nature of the solution?

Answer: Concentration of $\text{H}^+_{(aq)}$ can have a varied effect on the nature of the solution. With an increase in H^+ ion concentration, the solution becomes more acidic, while a decrease of H^+ ion causes an increase in the basicity of the solution.

Question 12: Do basic solutions also have $\text{H}^+_{(aq)}$ ions? If yes, then why are these basic?

Answer: Yes, basic solution also has $\text{H}^+_{(aq)}$ ions. However, their concentration is less as compared to the concentration of OH^- ions that makes the solution basic.

Question 13: 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)?

Answer: If the soil is acidic and improper for cultivation, then to increase the basicity of soil, the farmer would treat the soil with quick lime or slaked lime or chalk.

Question 14: What is the common name of the compound CaOCl_2 ?

Solutions:- The common name of the compound CaOCl_2 is bleaching powder.

Question 15: Name the substance which on treatment with chlorine yields bleaching powder?

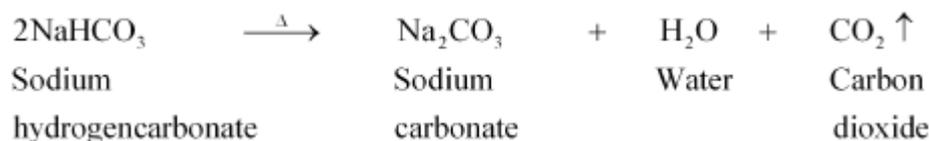
Answer: Calcium hydroxide [$\text{Ca}(\text{OH})_2$], on treatment with chlorine, yields bleaching powder.

Question 16: Name the sodium compound which is used for softening hard water.

Answer: Washing soda ($\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$) is used for softening hard water.

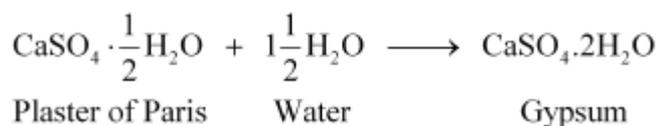
Question 17:- What will happen if a solution of sodium hydrocarbonate is heated? Give the equation of the reaction involved.

Answer: When a solution of sodium hydrocarbonate (sodium hydrogencarbonate) is heated, sodium carbonate and water are formed with the evolution of carbon dioxide gas.



Question 18: Write an equation to show the reaction between Plaster of Paris and water.

Answer: The chemical equation for the reaction of Plaster of Paris and water can be represented as



Question 19: A solution turns red litmus blue, its pH is likely to be

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

Answer: (d) Bases turn red litmus blue and acids turn blue litmus red. Basic solution has a pH value more than 7. Since the solution turns red litmus blue, its pH is likely to be 10.

Question 20: 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

Answer: (b) The solution contains HCl.

Question 21: 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

Answer: (d) 16 mL of HCl solution will be required.

Question 22: Which one of the following types of medicines is used for treating indigestion?

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

Answer: (c) Antacid is used for treating indigestion.

Question 23: Write word equations and then balanced equations for the reaction 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.

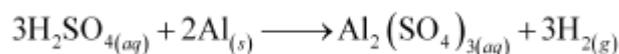
Answer: (a) Sulphuric acid + Zinc \rightarrow Zinc sulphate + Hydrogen



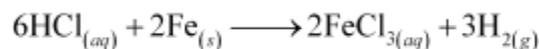
(b) Hydrochloric acid + Magnesium \rightarrow Magnesium chloride + Hydrogen



(c) Sulphuric acid + Aluminium \rightarrow Aluminium sulphate + Hydrogen



(d) Hydrochloric acid + Iron \rightarrow Ferric chloride + Hydrogen

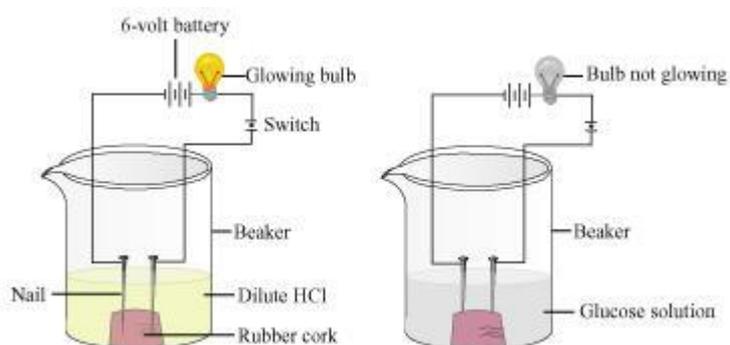


Question 24: Compounds such as alcohols and glucose also contain hydrogen but are not categorized as acids. Describe an activity to prove it.

Answer: Two nails are fitted on a cork and are kept it in a 100 mL beaker. The nails are then connected to the two 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:

It will be observed that the bulb glows in the HCl solution and does not glow in the glucose solution.



Result:

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 solution does not dissociate into ions. Therefore, it does not conduct electricity.

Conclusion:

From this activity, it can be concluded that all acids contain hydrogen but not all compounds containing hydrogen are acids.

That is why, though alcohols and glucose contain hydrogen, they are not categorised as acids.

Question 25: Why does distilled water not conduct electricity, whereas rain water does?

Answer: Distilled water is a pure form of water and is devoid of any ionic species. Therefore, it does not conduct electricity. Rain water, being an impure form of water, contains many ionic species such as acids and therefore it conducts electricity.

Question 26: Why do acids not show acidic behaviour in the absence of water?

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. It is the hydrogen ions that are responsible for the acidic behaviour.

Question 27: 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?

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

(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: $11 < 9 < 7 < 4 < 1$

Question 28: 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 (CH₃COOH) is added to test tube B. In which test tube will the fizzing occur more vigorously and why?

Answer: The fizzing will occur strongly in test tube A, in which hydrochloric acid (HCl) is added. This is because HCl is a stronger acid than CH₃COOH and therefore produces hydrogen gas at a

(1) Washing soda:

- (a) It is used in glass, soap, and paper industries.
- (b) It is used to remove permanent hardness of water.

(2) Baking soda:

- (a) It is used as baking powder. Baking powder is a mixture of baking soda and a mild acid known as tartaric acid. When it is heated or mixed in water, it releases CO_2 that makes bread or cake fluffy.
- (b) It is used in soda-acid fire extinguishers.