

## 2. Acids, Base and Salts

### Periodic Test

#### 1. Question

Which one of the following has a higher concentration of  $H^+$  ions? 1M HCl or 1M  $CH_3COOH$ ?

#### Answer

1M HCl has a higher concentration of  $H^+$  ions because it is a comparatively strong acid whereas  $CH_3COOH$  is a weak acid and contains lesser concentration of  $H^+$  ions.

#### 2. Question

Why  $CH_3COOH$  is considered a weak acid whereas HCl is considered as a strong acid?

#### Answer

$CH_3COOH$  is considered a weak acid because when diluted it does not get completely dissociated to liberate the  $H^+$  ions i.e.  $CH_3COOH$  upon dilution liberates a very small amount of  $H^+$  ions and considered a weak acid. HCl on the other hand upon dilution dissociates completely to generate the  $H^+$  ions and liberates a huge amount of  $H^+$  ions per unit volume and hence, considered a strong acid.

#### 3. Question

Which gas is evolved when dil. HCl reacts with metal bicarbonate? How is it recognized?

#### Answer

Carbon dioxide gas is evolved when dil. HCl reacts with metal bicarbonate.

It could be recognized by bringing a burning matchstick to the area where the gas is evolved. It would be observed the matchstick will stop burning.

#### 4. Question

What effect does an increase in concentration of  $H^+$  (aq) ions in a solution have on the pH of a solution?

## **Answer**

The value of pH is inversely related with the concentration of hydrogen ions. Hence, when we increase the concentration of  $H^+$  (aq) ions in a solution the pH of the solution decreases.

## **5. Question**

Name the gas evolved when dil. HCl reacts with an active metal. How is it recognized?

## **Answer**

When dil. HCl reacts with an active metal hydrogen gas is evolved.

It could be recognized by bringing a burning matchstick or candle towards the place from which the gas is being evolved, it would be observed that the matchstick would burn with a pop sound.

## **6. Question**

Why does tooth decay start when the pH of mouth is lower than 5.5?

## **Answer**

When the pH of the mouth falls below 5.5 then our enamel which is composed of calcium phosphate gets corroded leading to tooth decay.

## **7. Question**

How is the pH of a solution of an acid influenced when it is diluted?

## **Answer**

When a solution of an acid is diluted then, the concentration of  $H^+$  ions per unit volume in the solution reduces. Hence, any given sample of the solution now contains a lesser amount of  $H^+$  ions as it was present before dilution. Therefore, the pH of a solution of an acid upon dilution increases.

## **8. Question**

Fresh milk has a pH of 6. When it changes into curd (yoghurt), will its pH value increase or decrease? Why?

## **Answer**

Fresh milk has a pH of 6. When it changes into curd its pH will decrease as curd contains lactic acid making the curd comparatively more acidic in nature than the fresh milk.

## **9. Question**

Arrange the pH values of 0, 2, 4 and 6 in the increasing value of  $H^+$  (aq) ions conc.?

**Answer**

The smaller the pH the more the  $H^+$  (aq) ions concentration would be.

Hence, the pH values of 0, 2, 4 and 6 in the increasing value of  $H^+$  (aq) ions concentration is: -

$$6 < 4 < 2 < 0$$

**10. Question**

Why the flow of acid rainwater into a river make the survival of aquatic life in the river difficult?

**Answer**

The aquatic life survives in an optimum pH value. It is difficult for the aquatic life to maintain their metabolism in a pH value greater or less than the optimum pH value. When acid rainwater flows into a river it makes the river water acidic and disturbs the pH from its optimum value due to which the survival of aquatic life in the river becomes difficult.

**11. Question**

Crystals of  $CuSO_4$  are heated in a test tube for some time.

(a) What is the colour of  $CuSO_4$  crystals:

(i) before heating, and

(ii) after heating?

(b) What is the source of liquid droplets seen on the inner upper side of the test tube during the heating process?

**Answer**

a.

i. The colour of  $CuSO_4$  crystals before heating is blue.

ii. after heating the colour of  $CuSO_4$  crystals changes to white.

b. The source of liquid droplets seen on the inner upper side of the test tube during the heating process is the water of crystallization present in the formula unit of copper sulphate. These water of crystallization upon heating is removed from the formula unit and gets condensed on the inner upper side of the test tube during the heating process as liquid droplets.

## 12. Question

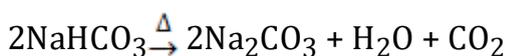
(i) Name the products formed when  $\text{NaHCO}_3$  is heated.

(ii) Write the chemical equation for the reaction involved in the above.

### Answer

i. The products formed when  $\text{NaHCO}_3$  is heated are sodium carbonate water and carbon dioxide.

ii. The chemical equation for the reaction involved above is:-



## 13. Question

Write the name and chemical formula of the calcium compound used for disinfecting drinking water. How is this compound manufactured?

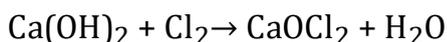
### Answer

i. The name and chemical formula of the calcium compound used for disinfecting drinking water is:-

Chemical name - Calcium oxychloride

Formula -  $\text{CaOCl}_2$

ii. This compound is manufactured by the action of chlorine on dry slaked lime as per the following reaction:

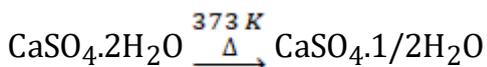


## 14. Question

Show the decomposition of gypsum to P.O.P. and back interconversion of P.O.P. of gypsum.

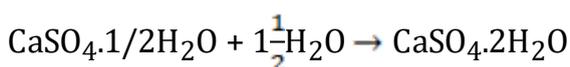
### Answer

The decomposition of gypsum to Plaster Of Paris is as follows:-



Plaster of Paris is prepared by decomposing gypsum at 373K.

Interconversion of Plaster Of Paris into gypsum is as follows:-



### 15. Question

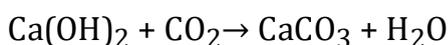
What happens when:

(a) CO<sub>2</sub> is passed through lime water in a limited quantity?

(b) CO<sub>2</sub> is passed through lime water in excess?

### Answer

a. When CO<sub>2</sub> is passed through lime water in a limited quantity than calcium carbonate gets precipitated as a white colour mass at the bottom of the test tube according to the following reaction: -



b. When CO<sub>2</sub> is passed through lime water in excess then the white precipitate initially formed gets dissolved forming Ca(HCO<sub>3</sub>)<sub>2</sub> which is soluble in water as per the following reaction: -



### 16. Question

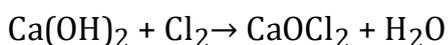
Give a reason to explain why:

(a) bleaching powder smell strongly of chlorine?

(b) bleaching powder does not dissolve completely in water?

### Answer

a. Bleaching powder is produced by the action of chlorine on dry slaked lime according to the following reaction:-



Hence, bleaching powder smell strongly of chlorine.

b. Bleaching powder does not dissolve completely in water because bleaching powder is actually a quite complex molecule. It contains various other heavy calcium salts in it like calcium chloride, calcium hydroxide and calcium hypochlorite. These salts are insoluble in water. Hence, bleaching powder does not dissolve completely in water.

### 17. Question

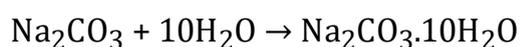
What is the chemical formula for washing soda? How can it be obtained from baking soda? Describe two applications of washing soda.

### Answer

the chemical formula for washing soda is -  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

It is prepared by heating baking soda and then recrystallizing the product so obtained.

The equations related to the above reaction are:-



Two applications of washing soda are:-

1. It is used in glass, soap and paper industries
2. It is used for removing permanent hardness of water.

### 18. Question

What is the difference between litmus solution indicator and universal indicator solution? How synthetic indicators differ from natural indicators?

#### Answer

Litmus solution indicator just shows us whether the given sample is acidic or basic and tells us nothing about the strength of the acid or the base. Blue litmus solution turns red under acidic conditions; red litmus solution turns blue under basic /alkaline conditions.

On the other hand, universal indicator solution tells us or depicts through its colour exactly how much strong an acid or a base is. It has different colours as reference for different pH values from 0 to 14 indicating the strength of the acid or the base.

Natural indicators- The indicators which are prepared from natural substances are known as natural indicator.

Example – litmus, turmeric indicator.

Synthetic indicators – The artificial indicators which are prepared in the lab are known as synthetic indicators.

Example – Phenolphthalein, methyl orange etc.

### 19. Question

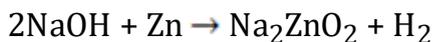
What happens when:

(a) zinc reacts with NaOH

(b) zinc reacts with HCl?

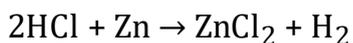
**Answer**

a. When zinc reacts with NaOH the following reaction takes place: -



Hydrogen gas is evolved with the formation of the corresponding salt.

b. When zinc reacts with HCl the following reaction takes place: -



Hydrogen gas is evolved with the formation of the corresponding salt.

**20. Question**

Give two characteristics each of acids and bases.

**Answer**

Two characteristics of acids:-

- i. Acids are sour in taste.
- ii. They produce  $\text{H}^+$  ions upon dilution.

Two characteristics of bases:-

- i. Bases are bitter in taste.
- ii. They produce  $\text{OH}^-$  ions upon dilution.

**21. Question**

Explain chlor-alkali process. Why is it called so?

**Answer**

When electricity is passed through an aqueous solution of sodium chloride, it decomposes to form sodium hydroxide. This process is called chlor-alkali process.

It is called so because the products formed in the reaction are chlorine and sodium hydroxide. Here chlor stands for chlorine and alkali is for sodium hydroxide.

**22. Question**

Give reason why:

- (a) water should not be added to concentrated acid?
- (b) antacids are required when there is pain or irritation in the stomach?

(c) Baking soda should be rubbed on bee-stung area?

**Answer**

a. Water should not be added to concentrated acid because the process of dissolving an acid or a base in water is a highly exothermic one. If water is added to an acid then the heat generated may cause the acid to splash out and cause burns.

b. Pain or irritation is caused in our stomach when there is production of an excess amount of acid in our body. Antacids are basic in nature. Hence antacids are required when there is pain or irritation in the stomach to neutralize the effect of the excess acid.

c. Bee-stung injects acid in our body. Baking soda is a base. Hence, baking soda should be rubbed on bee-stung area to neutralize the effect of the acid.

**23. Question**

What is meant by water of crystallisation? Name four such salts which contain water of crystallisation in them. Why P.O.P. is written as  $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$ ?

**Answer**

Water of crystallization is the fixed number of water molecules present in one formula unit of a substance

Four salts which contain water of crystallization are – copper sulphate, gypsum, Plaster of Paris, washing soda.

P.O.P. is written as  $\text{CaSO}_4 \cdot 1/2\text{H}_2\text{O}$  because two formula unit of  $\text{CaSO}_4$  shares one molecule of water.

**24. Question**

Why  $\text{NaHCO}_3$  is used in soda-acid fire extinguisher as well as for making baking powder.

**Answer**

When  $\text{NaHCO}_3$  is heated or mixed with water a reaction takes place which leads to the evolution of carbon dioxide gas. Now carbon dioxide extinguishes fire very well hence, it is used in soda-acid fire extinguisher and also the carbon dioxide produced during the reaction causes the bread or cake to rise making them soft and spongy. Hence,  $\text{NaHCO}_3$  is used for making baking powder.

**25. Question**

Give reason why:

- (a) tartaric acid is added while making banking powder?
- (b) bleaching powder is used for disinfecting drinking water?
- (c) strong acid and concentrated acid do not mean the same thing?

**Answer**

- a. While making baking powder tartaric acid is being added to it because when this mixture is heated or mixed with water carbon dioxide gas is evolved which causes the bread or cake to rise making them spongy and soft.
- b. Bleaching powder is used for disinfecting drinking water because bleaching powder is an oxidizing agent and helps in removing or killing the germs.
- c. Strong acid means those acids which give a very high  $H^+$  ion concentration upon dilution or those which are able to generate a greater volume of  $H^+$  ions per unit quantity whereas concentrated acid means how many moles of the acid is present in a given quantity of a solvent. Higher concentration means greater amount of the acid per unit of the solvent.

**Comprehensive Exercises (MCQ)**

**1. Question**

With the increase in the concentration of hydrogen ions, the pH value will:

- A. Increase
- B. Decrease
- C. Remain constant
- D. Remain fluctuating

**Answer**

The value of pH is inversely related with the concentration of hydrogen ions. Hence, if the concentration of hydrogen ions then pH decreases.

**2. Question**

The colour of pH paper strip at the pH values of 1, 7, and 14 will be:

- A. Green, red and blue
- B. Red, green and blue
- C. Blue, green and red
- D. Green, blue and red

**Answer**

At the pH value of 1 the pH paper strip is Red, at the pH value of 7 the pH paper strip is green and at the pH value of 14 the pH paper strip is blue in colour.

### **3. Question**

Which of the following is a strong acid?

- A. Ethanoic acid
- B. Citric acid
- C. Tartaric acid
- D. Sulphuric acid

### **Answer**

Sulphuric acid is a strong acid amongst all of the above.

### **4. Question**

Which of the following is a weak acid?

- A. Ethanoic acid
- B. Nitric acid
- C. Sulphuric acid
- D. Hydrochloric acid

### **Answer**

Except ethanoic acid all are strong acids.

### **5. Question**

Which of the following is a mineral acid?

- A. Citric acid
- B. Lactic acid
- C. Oxalic acid
- D. Nitric acid

### **Answer**

Except nitric acid, all the others could be obtained from edible substances.

### **6. Question**

Which of the following contains oxalic acid?

- A. Sour milk
- B. Orange
- C. Tomato
- D. Tamarind

**Answer**

Tomato contains oxalic acid.

**7. Question**

The compound which is used in glass, soap and paper industries is:

- A. Washing soda
- B. Baking soda
- C. Lime water
- D. Bleaching powder

**Answer**

Washing powder has extensive uses and is used in glass, soap and paper industries.

**8. Question**

The formula of Gypsum and Plaster of Paris is:

- A.  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  and  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
- B.  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  and  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
- C.  $\text{CaSO}_4$  and  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$
- D.  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  and  $\text{CaSO}_4 \cdot 3\text{H}_2\text{O}$

**Answer**

The formula of Gypsum is:  $\text{CaSO}_4 \cdot 2\text{H}_2\text{O}$  and plaster of Paris having formula  $\text{CaSO}_4 \cdot \frac{1}{2}\text{H}_2\text{O}$  is obtained upon heating gypsum.

**9. Question**

The compound which is used as an oxidizing agent in many chemical industries is:

- A. Bleaching powder
- B. Washing powder
- C. Baking powder
- D. Quicklime

**Answer**

Bleaching powder which is used as an oxidizing agent in many chemical industries.

**10. Question**

The compound which is used for removing permanent hardness of water is:

- A.  $\text{NaHCO}_3$
- B.  $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$
- C.  $\text{Na}_2\text{CO}_3$
- D.  $\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$

**Answer**

$\text{Na}_2\text{CO}_3 \cdot 10\text{H}_2\text{O}$  commonly known as washing soda is used for removing permanent hardness of water.

**11. Question**

Common salt besides being used in kitchen can also be used as the raw material for making:

- (i) washing soda
  - (ii) bleaching powder
  - (iii) baking soda
  - (iv) slaked lime
- A. (i) and (ii)
  - B. (i), (ii) and (iv)
  - C. (i) and (iii)
  - D. (i), (iii) and (iv)

### Answer

Common salt or Sodium Chloride is used in the manufacturing process of a variety of other salts like washing soda, bleaching powder, slaked lime etc.

### 12. Question

Which of the following are present in a dilute aqueous solution of hydrochloric acid?

- A.  $\text{H}_2\text{O}^+ + \text{Cl}^-$
- B.  $\text{H}_3\text{O}^+ + \text{OH}^-$
- C.  $\text{Cl}^- + \text{OH}^-$
- D. Unionised HCl

### Answer

When HCl is added to water it is dissociated to give  $\text{H}^+$  ions which combines with water molecules to give  $\text{H}_3\text{O}^+$  and  $\text{Cl}^-$  remains after the dissociation in the solution.

### 13. Question

Which of the following statements is correct about an aqueous solution of an acid and of a base?

- (i) Higher the pH, stronger the acid
  - (ii) Higher the pH, weaker the acid
  - (iii) Lower the pH, stronger the base
  - (iv) Lower the pH, weaker the base
- A. (i) and (iii)
  - B. (ii) and (iii)
  - C. (i) and (iv)
  - D. (ii) and (iv)

### Answer

The value of pH is inversely related with the concentration of hydrogen ions. Hence, Higher the pH, weaker the acid and Lower the pH, weaker the base.

### 14. Question

Sodium carbonate is a basic salt because it is a salt of:

- A. Strong acid and strong base
- B. Weak acid and weak base
- C. Strong acid and weak base
- D. Weak acid and strong base

**Answer**

A basic salt is formed when a strong base combines with a weak acid.

**15. Question**

Calcium phosphate is present in tooth enamel. Its nature is:

- A. Basic
- B. Acidic
- C. Neutral
- D. Amphoteric

**Answer**

Calcium phosphate which is present in tooth enamel is basic in nature because the acid produced by the bacteria in our mouth easily corrodes it.

**16. Question**

A sample of soil is mixed with water and allowed to settle. The clear supernatant solution turns the pH paper yellowish-orange. Which of the following would change the colour of this pH paper to greenish-blue?

- A. Lemon juice
- B. Vinegar
- C. Common salt
- D. An antacid

**Answer**

Antacids are basic in nature. Hence, if an antacid is added it would change the colour of this pH paper to greenish-blue.

**17. Question**

Which of the following gives the correct increasing order to acidic strength?

- A. Water < Acetic acid < Hydrochloric acid.
- B. Water < Hydrochloric acid < Acetic acid
- C. Acetic acid < Water < Hydrochloric acid
- D. Hydrochloric acid < Water < Acetic acid

**Answer**

Water is normally neutral, acetic acid is a weak acid and Hydrochloric acid is a strong acid. Hence, the above order.

**18. Question**

What happens when a solution of an acid is mixed with a solution of a base in a test tube?

- (i) The temperature of the solution increases
- (ii) The temperature of the solution decreases
- (iii) The temperature of the solution remains the same
- (iv) Salt formation takes place

- A. (i) only
- B. (i) and (iii)
- C. (ii) and (iii)
- D. (i) and (iv)

**Answer**

When a solution of an acid is mixed with a solution of a base then the temperature of the solution increases as it is an exothermic reaction and the corresponding salt formation takes place.

**Comprehensive Exercises (T/F)**

**1. Question**

Write true or false for the following statements:

The separation of  $H^+$  ion from HCl molecules can occur in the absence of water.

**Answer**

False

The separation of  $H^+$  ion from HCl molecules cannot occur in the absence of water. As in the absence of any solvent, the  $H^+$  would not be able to dissociate from its formula mass.

## 2. Question

Write true or false for the following statements:

Acids give  $H_3O^+$  or  $H^+(aq)$  ion in water.

### Answer

True

A substance is called an acid if it has the ability to produce  $H^+$  ions in the solution. These  $H^+$  ions combine with water molecules to give  $H_3O^+$ . Hence, acids give  $H_3O^+$  or  $H^+(aq)$  ion in water is correct.

## 3. Question

Write true or false for the following statements:

The process of dissolving an acid or a base in water is highly exothermic one.

### Answer

True

The process of dissolving an acid or a base in water is highly exothermic one as a huge amount of heat is evolved during the process owing to the production of  $H^+$  or  $OH^-$  ions.

## 4. Question

Write true or false for the following statements:

Care must be taken while mixing concentrated nitric acid or sulphuric acid with water. The water must always be added slowly to the acid with constant stirring.

### Answer

False

The process should be that acid must be added slowly to water with constant stirring. If water is added slowly to the acid with constant stirring then due to the exothermic reaction going on the acid might splash away from the beaker causing burns.

## 5. Question

Write true or false for the following statements:

Mixing an acid or base with water results in increase in the concentration of ions ( $\text{H}_3\text{O}^+/\text{OH}^-$ ) per unit volume.

**Answer**

True

If water is added slowly to the acid with constant stirring then the heat generated may cause the mixture to splash out and cause burns. Hence, care must be taken while mixing concentrated nitric acid or sulphuric acid with water. The acid must always be added slowly to the water with constant stirring.

### 6. Question

Write true or false for the following statements:

The universal indicator shows same colour at different concentrations of hydrogen ions in a solution.

**Answer**

False

The universal indicator shows different colours at different concentrations of hydrogen ions in a solution.

### 7. Question

Write true or false for the following statements:

On the pH scale, we can measure pH from 0 (very acidic) to 14 (very alkaline).

**Answer**

True

pH scale is being made to act as a reference to check the acidity or basicity of a substance and it shows or measures the pH from 0 (very acidic) to 14 (very alkaline).

### 8. Question

Write true or false for the following statements:

Higher is the hydronium ion concentration, higher is the pH value.

**Answer**

False

The value of pH is inversely related with the concentration of hydrogen ions. Hence, higher is the hydronium ion concentration, lower will be the pH value.

### **9. Question**

Write true or false for the following statements:

Acids that give rise to more  $H^+$  ions are said to be strong acids, and acids that give less  $H^+$  ions are said to be weak acids.

### **Answer**

True

Acidity of a substance is measured with respect to the number of  $H^+$  ions it can generate. Acids that give rise to more  $H^+$  ions are said to be strong acids, and acids that give less  $H^+$  ions are said to be weak acids.

### **10. Question**

Write true or false for the following statements:

When the pH of rainwater is more than 5.6, it is called acid rain.

### **Answer**

False

When the pH of rainwater is less than 5.6, it is called acid rain.