11. Chemical Reactions

Part-A

1. Question

$Zn + 2HCl \rightarrow ZnCl_2 + H_2\uparrow$

The above reaction is an example of _____.

A. Combination reaction

B. Double displacement reaction

C. Displacement reaction

D. Decomposition reaction

Answer

The above reaction is an example of displacement reaction as in the above reaction the elemental Zinc is displacing hydrogen from the compound of hydrochloric acid which is released in the form of hydrogen gas. The Zinc then combines with Chlorine to form Zinc Chloride.

2. Question

A reddish brown coloured element ‘X’ on heating in air, becomes a black coloured compound ‘Y’. X and Y are_____ and _____(Cu, CuO / Pb, PbO).

Answer

Cu,CuO

Copper (element ‘X’) is reddish brown in colour which upon heating in air reacts with the oxygen present in it or gets oxidised to form Copper(II) oxide(compound ‘Y’) which is black in colour.

Copper

3. Question

A student tests the pH of pure water using a pH paper. It shows green colour. If a pH paper is used after adding lemon juice to water, what colour will he observe?

(Green / Red / Yellow)

Answer

Red

Lemon juice is acidic in nature hence it will turn the colour of the pH paper red. Now a sample of pure water

is chemically neutral in nature and hence when we put lemon juice to water then the solution would also become acidic and upon testing the solution of lemon juice and water we would observe a red colour in the pH paper.

4. Question

Chemical volcano is an example of _____.

(combination reaction / decomposition reaction)

Answer

decomposition reaction

The phenomena of chemical volcano occurs when ammonium dichromate decomposes at a very high temperature. At very high temperature ammonium dichromate decomposes into green vapours which is then evolved along with the steam produced during the course of the reaction. This evolution of green vapours along with the steam gives an image as that of a volcanic eruption and hence known as chemical volcano.

5. Question

When crystals of lead nitrate on heating strongly produces _____ gas and the colour of the gas is _____.

Answer

Nitrogen dioxide(NO_2), reddish brown

Lead nitrate on heating strongly decomposes or undergoes a decomposition reaction to produce lead oxide , nitrogen dioxide and oxygen. It is this nitrogen dioxide gas which is being produced during the reaction which is evolved and is reddish brown in colour.

6. Question

When aqueous solution of silver nitrate and sodium chloride are mixed, _____ precipitate is immediately formed (white / yellow / red).

Answer

white

When an aqueous solution of silver nitrate ($AgNO_3$) is mixed with an aqueous solution of sodium chloride (NaCl), a white precipitate of silver chloride (AgCl) is formed which is indicated by the following chemical reaction.

$AgNO_3(aq) + NaCl(aq) \rightarrow AgCl(s) + NaNO_3(aq)$

The above reaction is an example of a double displacement reaction.

7. Question

Aluminium can displace Zinc metal from aqueous solution of Zinc sulphate because_____

(zinc is more reactive than aluminium / aluminium is more reactive than zinc).

Answer

aluminium is more reactive than zinc

A metal can replace or displace another metal from its salt solution only when the added metal is more reactive than the metal already present in the form of salt solution. Here, Aluminium is able to displace Zinc metal from aqueous solution of Zinc sulphate which clearly implies that aluminium is more reactive than Zinc.

8. Question

To protect tooth decay, we are advised to brush our teeth regularly. The nature of the tooth paste commonly used is _____ in nature.

Answer

basic

Tooth decay occurs in the condition when the environment of our mouth becomes acidic or more precisely when the pH of our mouth falls below 5.5. The acidic conditions are suitable for the microorganisms to act on our enamel and corrode them leading to tooth decay. Hence, in order to protect our mouth from tooth decay we use toothpastes which are basic nature so that they help in neutralizing the excess acid present in our mouth and prevent tooth decay.

9. Question

Vinegar is present in acetic acid. Curd contains _____ acid.

(Lactic acid / Tartaric acid).

Answer

Lactic acid

Curd contains lactic acid which is responsible for the sour taste of the curd as acids have their characteristic property of being sour in taste.

10. Question

$p^H = - \log_{10} [H+]$. The p^H of a solution containing hydrogen ion concentration of

0.001M solution is _____ (3 / 11 / 14)

Answer

3

We are given that the hydrogen ion concentration $[H^+]$ is 0.001M

We know that : -

$p^H = - \log_{10} [H+]$

$\Rightarrow p^H = - \log_{10}[0.001]$

$\Rightarrow p^H = - \log_{10}[10^{-3}]$

$\Rightarrow p^H = -(-3) \log_{10}[10]$

(As $\log_{10}[10] = 1$)

$\Rightarrow p^H = 3 \times 1$

$\Rightarrow p^H = 3$

Part-B

1. Question

What type of chemical reaction takes place when i) limestone is heated?

ii) a magnesium ribbon is burnt in air?

Answer

(i) When limestone is heated the category of chemical reraction which takes place is decomposition reaction as during this reaction the limestone decomposes to form Calcium oxide with the liberation of carbon dioxide according to the following equation : -

$CaCO_3 \rightarrow CaO + CO_2\uparrow$ (Reaction is taking place when heat is provided to limestone)

(ii) When a magnesium ribbon is burnt in air the category of chemical reaction which takes place is Combination reaction. During the reaction when we burn magnesium in the presence of air Magnesium combines with oxygen from the air to form a single product namely magnesium oxide as the product. Hence, it is a combination reaction and follows the following equation: -

$2Mg + O_2 \rightarrow 2MgO$

2. Question

The pH values of certain familiar substances are given below:

Substance	p^H value
Blood	7.4
Baking soda	8.2
Vinegar	2.5
Household ammonia	12

Analyse the data in the table and answer the following questions:

i) Which substances are acidic in nature?

ii) Which substances are basic in nature?

Answer

(i) A substance is treated as acidic in nature when its p^H falls below 7 i.e $p^H < 7$ in the table given in the question the only substance whose $p^H < 7$ is Vinegar. Hence, Vinegar is acidic in nature.

(ii) A substance is treated as basic in nature when its p^H is above 7 i.e $p^H > 7$ in the table given in the question the substances whose $p^H > 7$ are Blood(slightly basic), Baking soda and Household ammonia. Hence, Blood, Baking soda and Household ammonia are basic in nature.

3. Question

Why does the colour of copper sulphate change when an iron nail is kept in it? Justify your answer.

Answer

According to principle a more reactive element can displace a less reactive element from it's compound. Iron is more reactive than copper hence when we place iron nails in a solution of copper sulphate the blue colour of the copper sulphate solution changes to green colour and the portion of the iron nail which was dip in the solution acquires a brown colour. This is because iron being more reactive than copper displaces copper from the copper sulphate solution and form ferrous sulphate and the displaced copper gets deposited on the portion of the nail which is dipped in the solution giving a brown colour. The following reaction takes place : -

$CuSO_4 + Fe \rightarrow FeSO_4 + Cu$

4. Question

The hydroxide ion concentration of a solution is 1.0 x 10 –8M. What is the pH of the solution?

Answer

Given:

The hydroxide ion concentration of a solution=$[OH^-]=1.0 \times 10^{-8}M$

We know that : -

$p^{OH} = - \log_{10} [OH^-]$

$\Rightarrow p^{OH} = - \log_{10}[1.0 \times 10^{-8}]$

$\Rightarrow p^{OH} = -[\log_{10}1.0 + \log_{10}10^{-8}]$

Now, $\log_{10}1.0 = 0$

$\Rightarrow p^{OH} = -[0 + (-8) \log_{10}10]$

Now, $\log_{10}10 = 1$

$\Rightarrow p^{OH} = -[0-8]$

$\Rightarrow p^{OH} = -[-8]$

$\Rightarrow p^{OH} = 8$

According to relation : -

$P^H + p^{OH} = 14$

$\Rightarrow P^H = 14 - p^{OH}$

$\Rightarrow P^H = 14 - 8$

$\Rightarrow P^H = 6$

Hence, pH of the solution is 6.

5. Question

Equal lengths of magnesium ribbons are taken in test tubes A and B. Hydrochloric acid is added to test tube A, while acetic acid is added to test tube B. The amount and concentration taken for both the acids are same. In which test tube does the reaction occur more vigourously and why?

Answer

We know that the nature of the reactant influences the rate of reaction. Out of Hydrochloric acid and acetic acid Hydrochloric acid is more reactive than acetic acid due to which in the test tube containing Hydrochloric acid and ribbon the rate of reaction would be much faster than in the test tube containing acetic acid and ribbon. Hence in the test tube A the reaction will occur more vigourously due to the reason mentioned above.

6. Question

Two acids ‘A’ and ‘B’ were kept in beakers. Acid ‘A’ undergoes partial dissociation in water, whereas acid ‘B’ undergoes complete dissociation in water.

i) Of the two acids ‘A’ and ‘B’ , which is weak acid and which is strong acid?

ii) What is a weak acid?

iii) What is a strong acid?

iv) Give one example each.

Answer

(i) We know that a strong acid undergoes complete dissociation in water whereas a weak acid undergoes only partial dissociation in water. In the case as mentioned in the question the acid ‘A’ undergoes partial dissociation in water, whereas acid ‘B’ undergoes complete dissociation in water. Hence, acid A is a weak acid and acid B is a comparatively strong acid.

(ii) Weak acids are those chemical species which undergoes only partial dissociation in water and is not able to dissociate completely to release all of its H^+ ions.

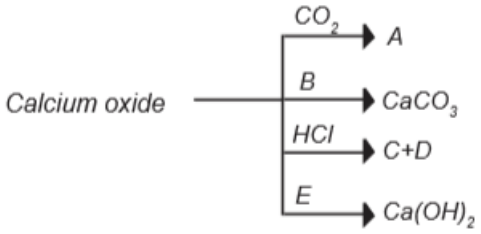
(iii) Strong acids are those chemical species which undergoes complete dissociation in water and are able to dissociate completely to release all of its H^+ ions.

(iv) An example of weak acid is – acetic acid.

An example of a strong acid is – Sulphuric acid

7. Question

Observe the given chemical change and answer the following:



i) Identify ‘A’ and ‘B’.

ii) Write the commercial name of calcium hydroxide.

iii) Identify products ‘C’ and 'D' , when HCl is allowed to react with calcium oxide.

iv) Say whether calcium oxide is acidic or basic.

Answer

(i) A is Calcium carbonate ($CaCO_3$) and B is carbon dioxide (CO_2). Both of these are obtained from the following reaction : -

$CaO \xrightarrow{CO_2} CaCO_3$

(ii) The commercial name of calcium hydroxide is slaked lime.

(iii) The products ‘C’ and 'D' , when HCl is allowed to react with calcium oxide are Calcium chloride($CaCl_2$) and water(H_2O).

(iv) Calcium oxide is basic, it could be understood by its reaction with an acid as in the above case with hydrochloric acid. With hydrochloric acid it reacts to form a salt(Calcium chloride($CaCl_2$)) and water in the same way as a base reacts with an acid to form salt and water. Hence calcium oxide is basic

8. Question

Take copper nitrate in a test tube and heat it over the flame.

i) What is the colour of cupric nitrate?

ii) What do you observe?

iii) Name the type of reaction that takes place.

iv) Write the balanced equation.

Answer

(i) The colour of cupric nitrate is deep blue green colour.

(ii) When copper nitrate is heated in a test tube it loses the water molecule or the water of crystallisation present in it and then when it is further heated it decomposes to give Copper oxide, nitrogen dioxide and oxygen. It would be observed during the reaction that a reddish brown colour gas(nitrogen dioxide) is evolved.

(iii) The above reaction is a type of decomposition reaction.

(iv) The balanced equation is : -

$2Cu(NO_3)_2 \xrightarrow{\Delta} 2CuO + 4NO_2\uparrow + O_2\uparrow$

9. Question

Identify the wrong statements and correct them.

i) Sodium benzoate is used in food preservative.

ii) Nitric acid is not used as fertilizer in agriculture.

iii) Sulphuric acid is called the king of chemicals.

iv) The PH of acid is greater than 7.

v) Acetic acid is used in aerated drinks.

Answer

(i) Sodium benzoate is used in food preservative. This statement is correct.

(ii) Nitric acid is not used as fertilizer in agriculture. This is a wrong statement and the correct statement is Nitric acid is used as fertilizer not directly but nitric acid id used in the production of ammonium nitrate which is then used as a fertilizer.

(iii) Sulphuric acid is called the king of chemicals. This is a is correct statement.

(iv) The PH of acid is greater than 7. This is a wrong statement and the correct statement is The PH of acid is less than 7.

(v) Acetic acid is used in aerated drinks. This is a wrong statement and the correct statement is Carbonic acid is used in aerated drinks.

10. Question

Redox reactions are reactions during which electron transfer takes place. Here

magnesium atom transfers two electrons one each to the two chlorine atoms.

i) What are the products of this reaction?

ii) Write the balanced equation for the complete reaction.

iii) Which element is being oxidized?

iv) Which element is being reduced?

v) Write the reduction part of the reaction.

Answer

(i) The product of this reaction is – $MgCl_2$

(ii) The balanced equation for the complete reaction is : -

$Mg_{(s)} + Cl_{2(g)} \rightarrow MgCl_{2(s)}$

(iii) In this reaction magnesium is the element which is being oxidised as it is losing two electrons and gets converted to a stable cation Mg^{2+}.

(iv) In this reaction chlorine is the element which is getting reduced as the two chlorine atoms accepts one electron each and gets convert into anion Cl^-.

(v) Reduction part of the reaction is : -

$2Cl + 2e^- \rightarrow 2Cl^-$

11. Question

Suggest a reason for each observation given below.

i) In fireworks, powdered magnesium is used rather than magnesium ribbon.

ii) Zinc and dilute H_2SO_4 react much more quickly when a few drops of copper sulphate solutions are added.

iii) The reaction between magnesium carbonate and dilute hydrochloric acid speeds

up when some concentrated HCl is added.

Answer

(i) We know that the rate of a reaction depends on the surface area available for the reaction to take place. The more the surface area more will be the rate of the reaction. Powdered magnesium is having more surface area than magnesium ribbon hence powdered magnesium is used rather than magnesium ribbon in fireworks so that the rate of the reaction is more.

(ii) We know that a catalyst is a substance which increases the rate of a reaction without itself getting reacted. In the reaction of Zinc and dilute H_2SO_4 copper sulphate solution acts as a catalyst and increases the rate of the reaction.

(iii) The rate of a chemical reaction increases as the concentration of the reactants increases hence the reaction between magnesium carbonate and dilute hydrochloric acid speeds up when some concentrated HCl is added as by doing so we are increasing the concentration of the reactants.

12. Question

Sodium hydroxide and hydrochloric acid react as shown in this equation.

$NaOH + HCl \rightarrow NaCl + H_2O$

(aq) (aq) (aq) (l)

i) Which type of chemical reaction is this?

ii) The reaction is exothermic. Explain what that means.

iii) Differentiate exothermic reaction and endothermic reaction.

iv) What happens to the temperature of the solution as the chemicals react?

Answer

(i) This is a type of neutralisation reaction in which an acid reacts with base to form salt and water.

(ii) It is said that the reaction is exothermic which means that the reaction proceeds with evolution of heat energy.

(iii)

Exothermic	Endothermic
A reaction that releases energy from the system in the form of heat.	A reaction that the system absorbs energy from its surrounding in the form of heat.
Energy is released in the form of heat, electricity, light or sound.	Energy is absorbed in the form of heat.
Product has lesser energy than the reactants	Product has more energy than the reactants
Example- Rusting iron, explosions, nuclear fission	Example- Melting ice, evaporation,

(iv) The temperature of the solution increases as the chemicals reacts.

13. Question

Take two conical flasks. Label them as I and II. Take a small amount of copper sulphate solution in the first conical flask. Take a small amount of granulated zinc in the second conical flask. Allow the copper sulphate solution to react with the zinc.

i) Name the type of reaction.

ii) Say whether the metal zinc is more reactive or less reactive.

iii) Write the complete and balanced reaction.

iv) Say whether this change is reversible or irreversible.

Answer

(i) This reaction comes under the category of displacement reactions.

(ii) A metal is said to be more reactive if it is able to displace another metal from its compound or salt solution. Here, Zinc had displaced Cu from the compound of Copper Sulphate. Hence, Zinc is more reactive.

(iii) The complete and balanced reaction equation is : -

$Zn(s) + CuSO_4(aq) \rightarrow Cu(s) + ZnSO_4$ (aq)

(iv) This change is irreversible as we would not be able to reverse the reaction to get back the reactants from the products under similar conditions.

14. Question

Relate the information given in all the four columns of the table.

Compound	Chemical formula	Chemical name	Use
1. Washing soda	$CaOCl_2$	calcium sulphate hemihydrate	for making statues
2. Baking soda	Na_2CO_3	sodium bicarbonate	softening of hard water
3. Bleaching powder	$CaSO_4 . ½ H_2O$	sodium carbonate	for making cake
4. Plaster of paris	$NaHCO_3$	calcium oxy chloride	Bleaching

Answer

Compound	Chemical formula	Chemical name	Use
1. Washing soda	Na_2CO_3	sodium carbonate	softening of hard water
2. Baking soda	$NaHCO_3$	sodium bicarbonate	for making cake
3. Bleaching powder	$CaOCl_2$	calcium oxy chloride	Bleaching
4. Plaster of paris	$CaSO_4 . ½ H_2O$	calcium sulphate hemihydrate	for making statues

15. Question

When lead powder is added to copper chloride solution, a displacement reaction occurs and solid copper is formed.

i) Write the equation for the reaction.

ii) Why does the displacement reaction occur?

Answer

(i) The equation for the reaction is : -

$Pb(s) + CuCl_2(aq) \rightarrow PbCl_2(aq) + Cu(s)$

(ii) The displacement reaction occurs because Lead is more reactive then Copper and hence it is able to displace Copper from its salt solution and form compound.

16. Question

When zinc and copper (II) sulphate are heated together, the following redox reaction occurs:

$Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

(s) (aq) (aq) (s)

i) What does the word redox stand for?

ii) Show how electrons are transferred in the reaction.

iii) Write the ionic equation for the redox reaction.

Answer

(i) Redox stands for those reactions in which oxidation and reduction takes place simultaneously.

(ii) The scheme of elctron transfer in this reaction could be understood from the following equation : -

$Zn \rightarrow Zn^{2+} + 2e^-$

The stable ionic species the force of attraction between which forms the compound $CuSO_4$ are Cu^{2+} and SO_4^{2-}.

Now the electrons which are liberated by Zn are accepted by Cu^{2+} which is then displaced from the compound to form the elemental copper and the sulphate anion left (SO_4^{2-}) then combines with Zn^{2+} already present in the solution to form $ZnSO_4$.

(iii) The ionic equation for the redox reaction is : -

$Zn(s) + Cu^{2+}SO_4^{2-} \rightarrow Zn^{2+} SO_4^{2-} + Cu(s)$

17. Question

If a substance gains oxygen during a reaction, it is being oxidized. If it loses oxygen, it is being reduced. Oxidation and Reduction always take place together, so that if one substance is oxidized, another is reduced. Using this idea, say which substance is oxidised and which substance is reduced in each reaction.

i) $Mg + O_2 \rightarrow 2MgO$

(s) (g) (s)

ii) $ZnO + C \rightarrow Zn + CO$

iii) $Fe_2 O_3 + 3CO \rightarrow 2Fe + 3CO_2$

iv) $Cr_2O_3 + 2Al \rightarrow + 2Cr + Al_2O_3$

Answer

(i) $Mg + O_2 \rightarrow 2MgO$

As oxidation is the process of addition of oxygen and in the above reaction which is a combination reaction oxygen is being added to magnesium to form magnesium oxide. Hence, Magneium is oxidised in the above reaction.

(ii) $ZnO + C \rightarrow Zn + CO$

In the above reaction which could be treated as a single displacement reaction oxygen is being removed from the compound Zinc Oxide i.e. Zinc is losing the oxygen atom and Carbon is gaining the oxygen atom. Hence, Zinc is oxidized and Carbon is reduced in the above reaction.

(iii) $Fe_2 O_3 + 3CO \rightarrow 2Fe + 3CO_2$

In the above reaction, Iron is losing the oxygen atom and Carbon is gaining the oxygen atom. As oxidation processes in which a substance gains oxygen during a reaction and reduction is a process in which a substance losses oxygen during a reaction. Hence, in the above reaction Iron is reduced and Carbon is oxidised.

(iv) $Cr_2O_3 + 2Al \rightarrow + 2Cr + Al_2O_3$

In the above reaction Chromium is losing oxygen and Aluminium is gaining the oxygen atoms. Hence, Chromium is being reduced and Aluminium is oxidised.

18. Question

The hydrogen ion concentration of a solution is 1 X 10 -8 M

i) What is the PH of the solution?

ii) What is the POH of the solution?

iii) Is the given solution, acidic or basic?.

Answer

(i) We are given that the hydrogen ion concentration of a solution is = $[H^+] = 1 \text{ X } 10^{-8}$ M

We know that : -

$p^H = - \log_{10} [H^+]$

$\Rightarrow p^H = - \log_{10} [1 \text{ X } 10^{-8}]$

$\Rightarrow p^H = -[\log_{10}1 + \log_{10}10^{-8}]$

Now, $\log_{10}1 = 0$

$\Rightarrow p^H = -[0 + (-8) \log_{10}10]$

Now, $\log_{10}10 = 1$

$\Rightarrow p^H = -[0-8]$

$\Rightarrow p^H = -[-8]$

$\Rightarrow p^H = 8$

Hence, the p^H of the solution is 8.

(ii) According to relation we have : -

$P^H + p^{OH} = 14$

$\Rightarrow 8 + p^{OH} = 14$

$\Rightarrow p^{OH} = 14 – 8$

$\Rightarrow p^{OH} = 6$

Hence, the pO^H of the solution is 6.

(iii) As the p^H of the solution is 8 which is greater than 7. Hence, the given solution is basic.