Chemical Reactions & Equations

Check Point 01

Q. 1. What is the name given for the substance that reacts and forms in a chemical reaction?

Answer: The substances which react are called Reactants of a chemical reaction. The substances which are formed are called Products of a chemical reaction.

Q. 2. State the law of conservation of mass.

Answer: "Mass can neither be created nor be destroyed in a chemical reaction"- This is known as the law of conservation of mass.

Q. 3. Write the skeletal equation and balanced equation for the following reaction:

Potassium bromide (aq) + Barium iodide (aq) → Potassium iodide (aq) + Barium bromide (s)

Answer: Skeletal Equation: $KBr(aq) + BaI_2(aq) \rightarrow KI(aq) + BaBr_2(s)$

Balanced Equation: $2KBr(aq) + BaI_2(aq) \rightarrow 2KI(aq) + BaBr_2(s)$

Verification:

There are 2 atoms of K present in LHS and 2 atoms in RHS. Similarly, atoms of I, Br, Ba are also the same in both sides. This is what a balanced equation means.

Q. 4. Balance the following chemical equations:

(i) $Mg(OH)_2 + HCl \rightarrow MgCl_2 + H_2O$
(ii) $N_2 + H_2 \rightarrow NH_3$
(iii) $P_4 + O_2 \rightarrow P_2O_5$

Answer: (i) $Mg(OH)_2 + 2HCl \rightarrow MgCl_2 + 2H_2O$

(ii) $N_2 + 3H_2 \rightarrow 2NH_3$

(iii) $P_4 + 5O_2 \rightarrow 2P_2O_5$

Reason: Number of atoms on both sides of the equation should be equal for balanced equations.

Q. 5. Which of the following reactions is balanced, A or B?

A: $2NaCl + 2H_2O \xrightarrow{\text{Electric current}} 2NaOH + 2Cl_2 + H_2$

B: $Ca(OH)_2 + Cl_2 \rightarrow CaOCl_2 + H_2O$

Answer: Equation B is Balanced.

Reason: In equation, A number of Cl atoms in LHS is 2 But in RHS number of atoms is 4. Hence it is not balanced. But in equation B number of each atom in LHS is equal to number of that atom in RHS.

Q. 6. What do the symbols (aq) and (s) indicate in a balanced chemical equation?

Answer: These symbols refer to the phase of reactants and products which take part in the reaction. (aq) represents aqueous phase which means that this substance is in dissolved in water. (s) represents solid phase.

Check Point 02

Q. 1. Identify the type of reaction:

(i) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

(ii) $2NaCl(l) \xrightarrow{\text{Electric current}} 2Na(s) + Cl_2(g)$

(iii) $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

Answer: (i) $CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$: This is an example of Exothermic reaction because it leads to release of HEAT as can be seen water is given in gaseous form.

(ii) $2NaCl(l) \xrightarrow{\text{Electric current}} 2Na(s) + Cl_2(g)$: This is the example of Decomposition reaction of common salt using electricity. This reaction is also called Electrolysis of Bryn solution.

(iii) $MnO_2 + 4HCl \rightarrow MnCl_2 + 2H_2O + Cl_2$

This reaction is the example of a redox reaction. Because MnO2 has donated its oxygen atoms and hence got reduced. Also, Chlorine is converted into Cl^- to form Cl_2 and hence get oxidised. Since both oxidation and reduction has taken place. This is a redox reaction.

Q. 2. What happens when hydrogen gas is added to copper oxide?

Answer: When Hydrogen gas is added to copper oxide reduction of copper oxide to metallic copper takes Place. Following is the Reaction:

$CuO + H_2 \rightarrow Cu + H_2O$: Reduction of Copper oxide

Q. 3. Name one reaction which is accompanied by the evolution of heat.

Answer: All reactions which are Exothermic are accompanied by evolution of heat. One such example is burning of methane. Reaction is as Follows:

$CH_4(g) + 2O_2(g) \rightarrow CO_2(g) + 2H_2O(g)$

Q. 4. Name the type of reaction for the following:

(i) Vegetable matter changing into compost.
(ii) Burning of natural gas.

Answer: i) Vegetable matter is changed into compost by microorganisms using Decomposition Reactions. The complex organic material of which Vegetable matter is made up of is broken down into simpler molecules during this process.

ii) Burning of natural gas leads to evolution of heat hence it is an example of an exothermic reaction. In this reaction Natural gas is also oxidized into CO_2 Hence it is also an example of redox reaction.

Q. 5. Write the four factors responsible for the corrosion of iron.

Answer: Following four factors are responsible for corrosion of Iron:

i) Moisture: Moisture reacts with iron to form rust(Mixture of Iron oxide and water)

ii) Oxygen: Oxygen reacts with iron to form Iron oxide which on combining with moisture becomes rust

iii) Poor maintenance: Poor maintenance leads to continuous exposure of iron to moisture and air which causes rust.

iv) Poorly built iron substances: If other substances like carbon, are not mixed while making iron substances in proper proportions, It gets rusted.

Q. 6. Name one element in which corrosion is not proved to be wasteful.

Answer: In the case of Aluminium, Corrosion is not harmful. Because the new layer of corroded aluminium it-self act as a prevention for further corrosion.

Chapter Exercise

Q. 1. What is breaking and making of bonds in chemical reaction called?

Answer: Breaking of bonds is called as Bond Dissociation [Dissociate means to break]. Bond Dissociation is an endothermic reaction which means that energy is absorbed in breaking of a bond.

Making of a bond is called as Bond Formation. This reaction is exothermic in nature which means that energy is given off or liberated while the formation of bonds.

Q. 2. Which product is formed when carbon dioxide and water react in the same ratio?

Answer: Carbon Dioxide when dissolved in water leads to the formation of a weak acid which is called carbonic acid.

Reaction is as follows:

$CO_2 + H_2O \rightarrow H_2CO_3$

Q. 3. Give an example of a reaction which is double displacement reaction as well as precipitation reaction?

Answer: Double Displacement Reaction is a type of chemical reaction in which anions and cations of the reacting compounds exchange their positions to form different compounds.

The precipitation reaction is a type of reaction in which one of the reactants is solvent and one of the products formed is insoluble in the solvent.

So the example of double displacement and precipitation reaction is as follows:

$AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
White
Ppt.

Q. 4. Which kind of chemical reaction takes place when an electric current is passed through fused lead bromide?

Answer: When an electric current is passed through fused lead bromide, lead bromide being an ionic compound gets dissociated into lead and bromide ions.

The reaction is as follows:

$PbBr_2 \rightarrow Pb^{2+} + 2Br^-$
Lead Bromide — Lead Ions — Bromide Ion

Q. 5. Silver article gets black coating. Name the phenomenon.

Answer: Whenever a metal is exposed to air and water for a long time it gets surrounded by a layer due to any type of chemical reactions and gets corroded. This process is called corrosion. So when a silver article gets a black coating, the phenomenon is called as corrosion.

Q. 6. Write any two chemical reactions in which water acts as a reducing and oxidising agent respectively.

Answer: The reaction based on reducing property of water is as follows:

$F + H_2O \rightarrow HF + O_2$

In the above reaction fluorine reacts with water to form hydrogen fluoride and oxygen gas is liberated.

The reaction based on oxidizing property of water is as follows:

$Al + H_2O \rightarrow Al_2O_3 + H_2$

In the above reaction aluminum reacts with water to aluminum oxide and hydrogen gas is liberated.

Q. 7. Identify the type of chemical reaction in the following:

(i) A + B → C
(ii) A + BC → AC + B
(iii) A → B + C
(iv) AB +CD → AD +CB

Answer: (i) This reaction is a type of combination reaction in which reactants combine to form a single product.

(ii) This reaction is a type of displacement type of reaction in which a reactive reactant displaces the less reactive element from the compound.

In the above reaction reactant A displaces B from the compound BC to form a new compound AC.

(iii) This reaction is a decomposition reaction in which compound A gets dissociated or broken down to form simple products B and C.

(iv) Double Displacement Reaction is a type of chemical reaction in which anions and cations of the reacting compounds exchange their positions to form different compounds.

This reaction is a double displacement type of reaction.

Q. 8. Why is hydrogen peroxide kept in coloured bottles?

Answer: Hydrogen Peroxide or H_2O_2 is a highly reactive compound which gets dissociated in the presence of light to form water and oxygen.

To prevent this dissociation reaction, H_2O_2 is stored in coloured bottles to prevent light from entering the bottles.

Q. 9. A shiny brown coin made up of an element turned black on heating. What was the element of the coin and what is the black compound formed?

Answer: From the description, it can be concluded that the element of the coin is copper.

On being heated copper gets oxidized due to the presence of oxygen in air which results in the formation of copper oxide (precisely cupric oxide) which is black in color.

The reaction is as follows:

$2Cu + O_2 \rightarrow 2CuO$

Q. 10. Marble statues often slowly get corroded when kept in open for a long time. Give a suitable explanation.

Answer: Taj Mahal is an example of corrosion of marble. The discoloration of its marble is due to corrosion.

Air primarily consists of various pollutant gases like carbon dioxide, nitrogen dioxide, Sulphur dioxide etc which mix with moisture in air to form acids such as carbonic acid, nitric acid and sulphuric acid. This acid comes down as acid rain and causes corrosion of marble statues and monuments. Marble which is composed of calcium carbonate reacts with the different acids which is given as follow:-

$CO_2 + H_2O + CaCO_3 \rightarrow Ca(HCO_3)$.

$CaCO_3 + H_2SO_4 \rightarrow CaSO_4 + CO + H_2O$.

The compound formed are water soluble and are easily washed away. Thus blackening of marble surface is the corrosion of marble surface due to the formation of side products of calcium.

Q. 11. What is the difference between skeletal equation and balanced chemical equation? Give example.

Answer: The difference between skeletal equation and balanced chemical equation is as follows:

Skeletal Equation	Balanced Equation
• The number of atoms of each element is not same.	• The number of atoms of each element is same.
• These equations are needed to be balanced.	• These equations are not needed to be balanced.
• Mass is not same on the both sides of equation.	• Mass is same on the both sides of equation.
• E.g. $Mg + O_2 \rightarrow MgO$	• E.g. $3Fe + 4H_2O \rightarrow Fe_3O_4$

Q. 12. Complete the missing components/variables given as reactant and product in the following reactions:

(i) BaCl2 + 'X' → +BaSO4↓
(ii) Cu + AgNO3→ Cu(NO3)2 + 'Y'
(iii) $CaCO3 \xrightarrow{'Z'} CaO + CO2$

Answer: (i) To get the missing component we have to think that in product we got sulphate salt (BaSO4) so in reactant there must be some other sulphate must be present so that double displacement reaction could happen.

So, the complete reaction is:

$BaCl_2$ + **'Na_2So_4'** → **NaCl** + $BaSO_4\downarrow$

(ii) In this reaction, we can clearly see displacement reaction is taking place in which copper displaces silver nitrate and forms copper nitrate and silver.

So, the complete reaction is: $Cu + AgNO_3 \rightarrow Cu(NO_3)_2 + 'Ag'$

(iii) We can guess after seeing this reaction that it must be decomposition reaction as a single reactant breaks into 2 products bus there is only one thing missing i.e. heat is not written on the arrow now it is thermal decomposition reaction.

So, the complete reaction is: $CaCO_3 \xrightarrow{heat} CaO + CO_2$

Q. 13. What is redox reaction? Identify the substance oxidized and the substance reduced in the following reactions.

(i) $CuO + H_2 \rightarrow Cu + H_2O$
(ii) $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

Answer: The substance which gains oxygen or loses hydrogen during the reaction, it is said to be oxidised and the substance which loses oxygen or gains hydrogen during the reaction, it is said to be reduced.

i) $CuO + H_2 \rightarrow Cu + H_2O$

In the following reaction copper oxide loses oxygen and forms copper so copper is reduced and hydrogen gains oxygen and forms water so hydrogen is oxidised.

ii) $MnO_2 + 4HCl \rightarrow MnCl_2 + Cl_2 + 2H_2O$

In the following reaction HCl is oxidised to Cl2 as it loses hydrogen and MnO_2 is reduced to $MnCl_2$ as it loses oxygen.

Q. 14. Zinc oxide reacts with carbon, on heating to form zinc metal and carbon monoxide. Write a balanced chemical equation for this reaction. Name

(i) Oxidising agent
(ii) The reducing agent in this reaction.

Answer: The reaction mentioned in the question is as follows:

$ZnO + C \xrightarrow{heat} Zn + CO$

The oxidising agent is the substance which oxidises other substance and gets reduced.

Reducing agent is the substance which reduces other substance and gets oxidised.

i) In the reaction zinc oxide (ZnO) is oxidising agent as it oxidises the carbon to carbon monoxide (CO) and zinc oxide gets reduced to zinc.

ii) Carbon is the reducing agent as it reduces zinc oxide to zinc and gets oxidised to carbon monoxide.

Q. 15. With the help of an activity; demonstrate how do we know that a chemical reaction has taken place?

Answer: For a chemical reaction to take place some chemical change must occur. So, here is the activity to demonstrate a chemical reaction:

Step-1: Take a magnesium ribbon around 2cm long by rubbing it with sand paper.

Step-2: Hold it with tongs.

Step-3: Burn the ribbon and collect the ash in a watch glass which is white in pair.

Precaution must be taken while performing the experiment to keep the burning ribbon far away from eye. The experiment should be under some expert supervision.

In the activity we observed that magnesium ribbon burns with a white flames and changes into white powder. This powder is magnesium oxide.

There was a change in state, change in colour, change in temperature all of these are chemical changes and this proves that chemical reaction takes places here in which magnesium was converted into magnesium dioxide.

Q. 16. A water-insoluble substance X on reaction with dilute hydrochloric acid released a colourless and odourless gas accompanied by brisk effervescence. When the gas passed through water, the solution obtained turns blue litmus red. On bubbling the gas through lime water, it initially became milky and milkiness disappeared when the gas was passed in excess. Identify the substance X. Write the chemical equation of the reaction involved.

Answer: Here we will first find out the gas. It is stated that this gas turns lime water milky so it is sure that the gas is carbon dioxide (CO_2).

When CO_2 reacts with water then carbonic aid is formed (H_2CO_3), which turns blue litmus red.

$CO_2 + H_2O \rightarrow H_2CO_3$

When CO_2 is passed through lime water ($Ca(OH)_2$) it turns it milky and on excess passing of carbon dioxide it forms calcium bicarbonate which forms a colourless solution, so the reaction is:

$Ca(OH)_2 + CO_2 \rightarrow CaCO_3 + H_2O$

On passing in an excess amount

$CaCO_3 + H_2O + CO_2 \rightarrow Ca(HCO_3)_2$

For the identification of substance X, we know that in product carbon dioxide is there so there must be something of carbon must be there in reactant and X is water-insoluble so it should be calcium carbonate that is insoluble. So the reaction is:

$CaCO_3 + 2HCl \rightarrow CaCl_2 + H_2O + CO_2$

X= $CaCO_3$

Q. 17. On the occasion of Diwali, Rohan used solution of calcium hydroxide (slaked) for white washing walls. After two or three days of white washing a compound is formed. This formed compound gives a shiny appearance to the walls. Read the above passage and answer the following questions.

(i) What is the chemical name of compound formed after 2-3 days of white washing?
(ii) Write the chemical reaction occurring during calcium hydroxide to a shiny appearance to the walls.
(iii) Name the type of reaction.

Answer: Slaked lime is the common name used for calcium hydroxide $Ca(OH)_2$. It is formed by the reaction of quick lime CaO with water.

(i) The chemical name of compound formed is calcium carbonate.

Explanation: The calcium hydroxide used for white washing the walls reacts with the carbon dioxide (CO_2) present in the air to form Calcium carbonate ($CaCO_3$) which gives shiny appearance to the walls.

(ii) The chemical reaction occurring during the conversion of slaked lime (calcium hydroxide) to calcium carbonate which gives the shiny appearance to the walls is as follows:

$$Ca(OH)_2(aq) + CO_2(g) \rightarrow CaCO_3(s) + H_2O(l)$$

(iii) The Type of reaction is exothermic.

Explanation: A reaction which involves the release of heat when the product formation takes place is known as an exothermic reaction. The reaction of calcium hydroxide (base) with CO_2 (acidic non-metal oxide) is a neutralization reaction in which heat is evolved. Thus it is an exothermic reaction.

Challengers

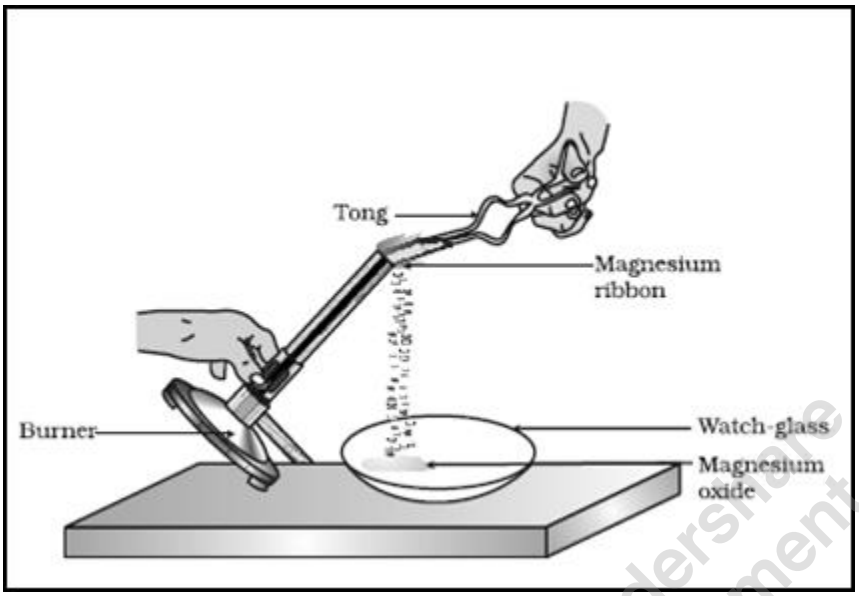
Q. 1. Which one of the following involves a chemical reaction?

A. Evaporation of water
B. Storing of nitrogen gas under pressure
C. Keeping petrol in a China dish in open
D. Heating magnesium wire in the presence of air at high temperature

Answer: When the identity and nature of the product are different from that of the reactants then this change is known as chemical change and whenever a chemical change takes place, we can say that a chemical reaction has occurred. In the first three

options, only the physical state of the water, nitrogen and petrol changes thus they are physical changes. But when magnesium wire is heated in the presence of air, formation of a new substance (MgO) takes place. The chemical reaction involved is as follows:

$$2Mg + O_2 \rightarrow 2MgO$$



Q. 2. Ethane (C_2H_6) on complete combustion gave CO_2 and water. It shows that the results are in accordance with the law of conservation of mass. Then, the coefficient of oxygen is equal to

A. 3
B. 5/2
C. 2
D. 7/2

Answer: According to law of conservation of mass, the mass of the elements on the product side should be equal to the mass of the elements on reactant side. In simple words, the number of atoms of each element should be same on the both sides. This can be achieved by balancing a chemical reaction.

Unbalanced chemical equation for combustion of ethane:

$$C_2H_6 + O_2 \rightarrow CO_2 + H_2O$$

The balanced chemical equation:

$$C_2H_6 + \frac{7}{2}O_2 \rightarrow 2CO_2 + 3H_2O$$

From the balanced chemical equation, we can observe that the coefficient of O2 is $\frac{7}{2}$.

Q. 3. A powdered salt (X) in a dry test tube was heated that evolves brown fumes of nitrogen dioxide and a yellow residue of lead oxide is also formed. The salt (X) is

A. $MgCO_3$

B. $Pb(NO_3)_2$

C. $(NH_4)_2SO_4$

D. $CaCO_3$

Answer: The salt (X) is undergoing thermal decomposition reaction as it breaks to give multiple products on heating. Release of brown fumed Nitrogen dioxide (NO_2) gas indicates that the salt is a nitrate salt. Moreover formation of a yellow lead oxide (PbO) residue indicates that the salt is a lead salt. Thus the salt is Lead Nitrate. The thermal decomposition reaction involved is:

$2Pb(NO_3)2 \rightarrow 2PbO + 4NO_2 + O_2$

Q. 4. A reddish brown coloured metal used in electric wires, when powdered and heated strongly in an open China dish, its colour rums black. When hydrogen gas is passed over this black substance, it regains its original colour. Based on this information, the metal and black coloured substances are

A. copper and copper nitrate
B. silver and silver oxide
C. copper and copper oxide
D. aluminium and aluminium oxide

Answer: The only reddish brown colour metal among the given options is copper. When copper powder is heated in a china dish it gets oxidized and turns black due to the formation of copper oxide (CuO). The reaction involved is:

$2CuO + O_2 \rightarrow 2CuO$

When H2 gas is passed over CuO, it gets reduced to Cu and thus regains its original colour.

$CuO + H_2 \rightarrow Cu + H_2O$

Q. 5. When dilute sulphuric acid is added to pieces of iron sulphide, hydrogen sulphide gas is produced and soluble ferrous sulphate is formed. The type of chemical reaction involved is

A. decomposition reaction
B. combination reaction

C. displacement reaction
D. double displacement reaction

Answer: Dilute sulphuric acid: dil. H_2SO_4

Iron sulphide: FeS

Hydrogen sulphide: H2S

Ferrous sulphate: $FeSO_4$

The reaction involved can be written as:

$FeS + H_2SO_4 \rightarrow FeSO_4 + H_2S$

We can see that there is the exchange of SO_4^{2-} and S^{2-} ions in the reactants. Thus it is a double displacement reaction.

Q. 6. Following reaction is used for the preparation of oxygen gas in the laboratory. Heat

$$2KClO_3(s) \xrightarrow[\text{Catalyst}]{\text{Heat}} 2KCl(s) + 3O_2(g)$$

Which of the following statement(s) is (are) correct about the reaction?

A. It is a decomposition reaction and endothermic in nature.
B. It is a combination reaction.
C. It is a decomposition reaction and accompanied by the release of heat.
D. It is a photochemical decomposition reaction and exothermic in nature.

Answer: Since the reaction involves the breaking down of a single reactant molecule into multiple products, it is a decomposition reaction. Moreover it involves the absorption of heat, so it is also an endothermic reaction.

Q. 7. A metal 'M' reacts with an acid according to the equation.

$M + H^+ \rightarrow M^{3+} + H_2$.

Which of the following is correct for metal M?

A. Calcium
B. Aluminium
C. Barium
D. Potassium

Answer: Among the given metals, only aluminium has a stable +3 oxidation state. Aluminium reacts with acid to produce a metal salt and H_2 gas. For example: Al reacts with HCl to give $AlCl_3$ and H_2 gas.

Reaction:

$Al + HCl \rightarrow AlCl_3 + H_2$
$(M) \quad (H^+) \quad (M^{3+})$

Q. 8. Which among the following statement (s) is/are true? Exposure of silver chloride to sunlight for a long duration turns grey due to

(i) The formation of silver by decomposition of silver chloride.
(ii) Sublimation of silver chloride.
(iii) Evolution of chlorine gas from silver chloride. (iv) Oxidation of silver chloride.

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

Answer: When silver chloride is exposed to sunlight it undergoes decomposition and turns grey due to the formation of silver metal which provides the grey colour. Although Cl_2 gas is also evolved but, it is not responsible for grey colour.

Reaction involved is:

$2AgCl \rightarrow 2Ag + Cl_2$