CHEMICAL REACTIONS AND EQUATIONS

NCERT Textbook Questions

Q.1. Why should a magnesium ribbon be cleaned before burning in air?

Ans. A magnesium ribbon is cleaned to remove the protective layer of basic magnesium carbonate from its surface so that it may readily combine with the oxygen of air (on heating).

Q.2. Write the balanced equations for the following chemical reactions:

(*i*) Hydrogen + Chlorine $\longrightarrow$ Hydrogen chloride

(*ii*) Barium chloride + Aluminium sulphate $\longrightarrow$ Barium sulphate + Aluminium chloride

(*iii*) Sodium + Water $\longrightarrow$ Sodium hydroxide + Hydrogen

Ans. (*i*) $H_2 + Cl_2 \longrightarrow 2HCl$

(*ii*) $BaCl_2 + Al_2(SO_4)_3 \longrightarrow 3BaSO_4 + 2AlCl_3$

(*iii*) $2Na + 2H_2O \longrightarrow 2NaOH + H_2$

Q.3. Write balanced chemical equations with state symbols for the following reactions:

(*i*) Solutions of barium chloride and sodium sulphate in water react to give insoluble barium sulphate and the solution of sodium chloride.

(*ii*) Sodium hydroxide solution (in water) reacts with hydrochloric acid solution (in water) to produce sodium chloride solution and water.

Ans. (*i*) $BaCl_2\,(aq) + Na_2SO_4\,(aq) \longrightarrow BaSO_4\,(s) + 2NaCl\,(aq)$

(*ii*) $NaOH\,(aq) + HCl\,(aq) \longrightarrow NaCl\,(aq) + H_2O\,(l)$

Q. 4. A solution of substance X is used for white washing.

(*i*) Name the substance X and write its formula.

(*ii*) Write the reaction of the substance X named in (i) above with water.

Ans. (*i*) The substance whose solution in water we use for white washing is calcium oxide (lime, choona). So, the substance X is calcium oxide. Its formula is CaO.

(*ii*) $CaO(s) + H_2O(l) \longrightarrow Ca(OH)_2\,(s)$

Calcium oxide + Water $\longrightarrow$ Calcium hydroxide

Q. 5. Why is double the amount of a gas collected in one of the test-tubes in the electrolysis of water activity? Name this gas.

Ans. The gas which is collected in double the amount in the electrolysis of water experiment is hydrogen. This is because water (H_2O) contains 2 parts of hydrogen element (as compared to only 1 part of oxygen element).

Q.6. Why does the colour of copper sulphate solution change when an iron nail is dipped in it?

Ans. When an iron nail is dipped in copper sulphate solution, then the blue colour of copper sulphate solutionchanges because iron displaces copper from copper sulphate solution to form a light green solution of iron sulphate.

Q.7. Give an example of a double displacement reaction.

Ans. When silver nitrate solution is added to sodium chloride solution, then a double displacement reaction takesplace in which a white precipitate of silver chloride is formed alongwith sodium nitrate solution.

Q.8. Identify the substances that are oxidised and the substances that are reduced in the following reactions:

(*i*) $4Na\ (s) + O_2\ (g) \longrightarrow 2Na_2O\ (s)$

(*ii*) $CuO\ (s) + H_2\ (g) \longrightarrow Cu\ (s) + H_2O\ (l)$

Ans. (*i*) Substance oxidised: Na; Substance reduced: O_2

(*ii*) Substance oxidised: H_2; Substance reduced: CuO

NCERT Exercises

Q.1. Which of the statements about the reaction below are incorrect?
$2PbO\ (s) + C\ (s) \longrightarrow 2Pb\ (s) + CO_2\ (g)$

(*a*) Lead is getting reduced

(*b*) Carbon dioxide is getting oxidised

(*c*) Carbon is getting oxidised

(*d*) Lead oxide is getting reduced

(*i*) (*a*) and (*b*) (*ii*) (*a*) and (*c*) (*iii*) (*a*), (*b*) and (*c*) (*iv*) all

Ans. (*i*) (*a*) and (*b*)

Q.2. $Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$
The above reaction is an example of a:

(*a*) combination reaction **(*b*) double displacement reaction**

(*c*) decomposition reaction **(*d*) displacement reaction**

Ans. (*d*) displacement reaction

Q.3. What happens when dilute hydrochloric acid is added to iron filings? Tick the correct answer.

(*a*) Hydrogen gas and iron chloride are produced

(*b*) Chlorine gas and iron hydroxide are produced

(*c*) No reaction takes place

(*d*) Iron salt and water are produced

Ans. (*a*) Hydrogen gas and iron chloride are produced

Q.4. What is a balanced chemical equation? Why should chemical equations be balanced?

Ans. A chemical equation having an equal number of atoms of different elements in the reactants and products is called a balanced chemical equation. Here is an example. Zinc reacts with dilute sulphuric acid to form zinc sulphate and hydrogen:

Zn	+	H_2SO_4	$\longrightarrow$	$ZnSO_4$	+	H_2
Zinc		Sulphuric acid		Zinc sulphate		Hydrogen

Now, this equation has an equal number of Zn atoms (1 each), H atoms (2 each), S atoms (1 each), and O atoms (4 each) in reactants and products, so it is a balanced chemical equation.

The chemical equations are balanced to satisfy the law of conservation of mass which says that 'matter (or atoms) can neither be created nor destroyed in a chemical reaction'. So, the total mass of all the elements present in the products of a chemical reaction should be equal to the total mass of all the elements present in the reactants. In other words, the number

of atoms of each element in the products must be equal to the number of atoms of these elements in the reactants.

Q.5. Translate the following statements into chemical equations and then balance them:

(*a*) Hydrogen gas combines with nitrogen to form ammonia.

(*b*) Hydrogen sulphide gas burns in air to give water and sulphur dioxide

(*c*) Barium chloride reacts with aluminium sulphate to give aluminium chloride and a precipitate of barium sulphate.

(*d*) Potassium metal reacts with water to give potassium hydroxide and hydrogen gas.

Ans. (*a*) $3H_2 + N_2 \longrightarrow 2NH_3$

(*b*) $2H_2S + 3O_2 \longrightarrow 2H_2O + 2SO_2$

(*c*) $3BaCl_2 + Al_2(SO_4)_3 \longrightarrow 2AlCl_3 + 3BaSO_4$

(*d*) $2K + 2H_2O \longrightarrow 2KOH + H_2$

Q.6. Balance the following chemical equations:

(*a*) $HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + H_2O$

(*b*) $NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + H_2O$

(*c*) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(*d*) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + HCl$

Ans. (*a*) $2HNO_3 + Ca(OH)_2 \longrightarrow Ca(NO_3)_2 + 2H_2O$

(*b*) $2NaOH + H_2SO_4 \longrightarrow Na_2SO_4 + 2H_2O$

(*c*) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$

(*d*) $BaCl_2 + H_2SO_4 \longrightarrow BaSO_4 + 2HCl$

Q.7. Write the balanced chemical equations for the following reactions:

(*a*) Calcium hydroxide + Carbon dioxide $\longrightarrow$ Calcium carbonate + Water

(*b*) Zinc + Silver nitrate $\longrightarrow$ Zinc nitrate + Silver

(*c*) Aluminium + Copper chloride $\longrightarrow$ Aluminium chloride + Copper

(*d*) Barium chloride + Potassium sulphate $\longrightarrow$ Barium sulphate + Potassium chloride

Ans. (*a*) $Ca(OH)_2 + CO_2 \longrightarrow CaCO_3 + H_2O$

(*b*) $Zn + 2AgNO_3 \longrightarrow Zn(NO_3)_2 + 2Ag$

(*c*) $2Al + 3CuCl_2 \longrightarrow 2AlCl_3 + 3Cu$

(*d*) $BaCl_2 + K_2SO_4 \longrightarrow BaSO_4 + 2KCl$

Q.8. Write the balanced chemical equations for the following and identify the type of reaction in each case:

(*a*) Potassium bromide (aq) + Barium iodide (aq) $\longrightarrow$ Potassium iodide (aq) + Barium bromide (s)

(*b*) Zinc carbonate (s) $\longrightarrow$ Zinc oxide (s) + Carbon dioxide (g)

(*c*) Hydrogen (g) + Chlorine (g) $\longrightarrow$ Hydrogen chloride (g)

(*d*) Magnesium (s) + Hydrochloric acid (aq) $\longrightarrow$ Magnesium chloride (aq) + Hydrogen (g)

Ans. (*a*) $2KBr\,(aq) + BaI_2\,(aq) \longrightarrow 2KI\,(aq) + BaBr_2\,(s)$

This is a double displacement reaction (which is also a precipitation reaction).

(*b*) $ZnCO_3\,(s) \longrightarrow ZnO\,(s) + CO_2\,(g)$

This is a decomposition reaction.

(*c*) $H_2\,(g) + Cl_2\,(g) \longrightarrow 2HCl\,(g)$

This is a combination reaction.

(*d*) $Mg\,(s) + 2HCl\,(aq) \longrightarrow MgCl_2\,(aq) + H_2\,(g)$

This is a displacement reaction.

Q.9. What does one mean by exothermic and endothermic reactions? Give examples.

Ans. Reactions in which heat is evolved are known as exothermic reactions. For example, burning of natural gas and burning of carbon in oxygen are exothermic reactions because heat is produced in these reactions.

Chemical Reactions involved are given below:

$$C(s) + O_2\,(g) \longrightarrow CO_2\,(g) + \text{Heat}$$

Carbon — Oxygen — Carbon dioxide

$$CH_4(g) + 2O_2\,(g) \longrightarrow CO_2(g) + 2H_2O(g) + \text{Heat Energy}$$

Methane (Natural gas) — Oxygen — Carbon dioxide — Water

Reactions in which heat is absorbed are known as endothermic reactions. For example, when calcium carbonate is heated, it decomposes to form calcium oxide and carbon dioxide.

$$CaCO_3(s) + \text{Heat} \longrightarrow CaO(s) + CO_2(g)$$

Clacium carbonate — Clacium oxide — Carbon dioxide

The electrolysis of water to form hydrogen and oxygen is also an endothermic reaction.

$$2H_2O(l) \xrightarrow{\text{Electricity}} 2H_2(g) + O_2(g)$$

Water — Hydrogen — Oxygen

Q.10. Why is respiration considered an exothermic reaction? Explain.

Ans. Respiration is considered an exothermic reaction because energy is released in this process. During respiration, glucose (obtained from the digestion of food) combines with oxygen of

air in the cells of our bodyto form carbon dioxide and water, and energy is released:

$$\underset{\text{Glucose}}{C_6H_{12}O_6\,(aq)} + \underset{\text{Oxygen}}{6O_2\,(g)} \longrightarrow \underset{\text{Carbon dioxide}}{6CO_2\,(g)} + \underset{\text{Water}}{6H_2O\,(l)} + \text{Energy}$$

Q.11. Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

Ans. The decomposition reactions are called the opposite of combination reactions because in a combination reaction two or more substances combine to form a single substance whereas in a decomposition reaction, a single substance splits up to form two or more simpler substances.

(*a*) When hydrogen burns in oxygen, it forms water:

$$2H_2\,(g) + O_2\,(g) \longrightarrow 2H_2O\,(l)$$

In this reaction, two substances hydrogen and oxygen combine to form a single substance water, so this is a combination reaction.

(*b*) When acidified water is electrolysed, hydrogen and oxygen are formed:

$$2H_2O\,(l) \xrightarrow{\text{Electricity}} 2H_2\,(g) + O_2\,(g)$$

Here a single substance water breaks up into two simpler substances, hydrogen and oxygen. So, this is a decomposition reaction. We can see from the above examples that a decomposition reaction is opposite of a combination reaction.

Q.12. Write one equation each for decomposition reactions where energy is supplied in the form of (*a*) heat (*b*) light, and (*c*) electricity.

Ans. (*a*) When calcium carbonate is heated, it decomposes to form calcium oxide and carbon dioxide:

$$CaCO_3\,(s) \xrightarrow{\text{Heat}} CaO\,(s) + CO_2\,(g)$$

In this reaction, energy is supplied in the form of heat.

(*b*) When silver chloride is exposed to sunlight, it decomposes to form silver metal and chlorine gas:

$$2AgCl\,(s) \xrightarrow{\text{Sunlight}} 2Ag\,(s) + Cl_2\,(g)$$

Here energy is supplied in the form of sunlight.

(*c*) When acidified water is electrolysed, it decomposes to form hydrogen and oxygen:

$$2H_2O\,(l) \xrightarrow{\text{Electricity}} 2H_2\,(g) + O_2\,(g)$$

In this case, energy is supplied in the form of electricity.

Q.13. What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Ans. In a displacement reaction, a more reactive element displaces a less reactive element from its compound whereas in a double displacement reaction, two compounds combine by an exchange of ions to form two new compounds.

(*i*) A displacement reaction takes place between copper sulphate solution and zinc to form zinc sulphate solution and copper:

$$CuSO_4\,(aq) + Zn\,(s) \longrightarrow ZnSO_4\,(aq) + Cu\,(s)$$

(*ii*) A double displacement reaction takes place between barium chloride solution and sodium sulphate solution to form a white precipitate of barium sulphate and sodium chloride solution:

$$BaCl_2\,(aq) + Na_2SO_4\,(aq) \longrightarrow BaSO_4\,(s) + 2NaCl\,(aq)$$

Q.14. In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Ans.

$2AgNO_3\,(aq)$	+	$Cu\,(s)$	$\longrightarrow$	$Cu(NO_3)_2\,(aq)$	+	$2Ag\,(s)$
Silver nitrate (solution)		Copper		Copper nitrate (solution)		Silver

Q.15. What do you mean by a precipitation reaction? Explain by giving example.

Ans. Any reaction in which an insoluble solid (called precipitate) is formed that suddenly separates from the solution, is called a precipitation reaction. The reaction between silver nitrate solution and sodium chloride solution to form silver chloride precipitate is an example of a precipitation reaction:

$AgNO_3\,(aq)$	+	$NaCl\,(aq)$	$\longrightarrow$	$AgCl\,(s)$	+	$NaNO_3\,(aq)$
Silver nitrate		Sodium chloride		Silver chloride (White ppt.)		Sodium nitrate

In this reaction, silver chloride is formed as a white, insoluble solid (called precipitate) which separates out suddenly from the solution.

Q.16. Explain the following in terms of gain or loss of oxygen with two examples each:
(*a*) Oxidation (*b*) Reduction

Ans. (*a*) *Oxidation*: The gain of oxygen by a substance in a reaction is called oxidation.

(*i*) When magnesium is burned in air, then magnesium oxide is formed:

$2Mg$	+	O_2	$\longrightarrow$	$2MgO$
Magnesium		Oxygen (From air)		Magnesium oxide

In this reaction, magnesium (Mg) has gained oxygen to form magnesium oxide (MgO), so magnesium is oxidised to magnesium oxide.

(*ii*) When copper oxide is heated with hydrogen, then copper metal and water are formed:

CuO	+	H_2	$\longrightarrow$	Cu	+	H_2O
Copper oxide		Hydrogen		Copper		Water

In this case, hydrogen (H_2) is gaining oxygen to form water (H_2O), so hydrogen is getting oxidised to water.

(*b*) Reduction: The loss of oxygen by a substance in a reaction, is called reduction.

(*i*) When zinc oxide is heated with carbon, then zinc metal and carbon monoxide are formed:

$$ZnO + C \longrightarrow Zn + CO$$

Zinc oxide Carbon Zinc Carbon monoxide

In this reaction, Zinc oxide (ZnO) is losing oxygen to form zinc metal (Zn), therefore, zinc oxide is reduced to zinc.

(*ii*) When iron (III) oxide is heated with aluminium powder, then aluminium oxide and iron metal are formed:

$$Fe_2O_3 + 2Al \longrightarrow Al_2O_3 + 2Fe$$

Iron (III) oxide Aluminium Aluminium oxide Iron

In this case, iron (III) oxide (Fe_2O_3) is losing oxygen to form iron metal (Fe), therefore, iron (III) oxide is reduced to iron.

Q.17. A shiny brown coloured element X on heating in air becomes black in colour. Name the element X and the black coloured compound formed.

Ans. (*i*) The shiny brown coloured element X is copper metal (Cu).

(*ii*) When copper metal is heated in air, it forms a black coloured compound copper oxide. So, the black coloured compound is copper oxide or copper (II) oxide.

Q.18. Why do we apply paint on iron articles?

Ans. Paint is applied on iron articles to prevent their rusting. When a coat of paint is applied to the surface of an iron article, then air and moisture cannot come in contact with the iron metal of the article and hence no rusting takes place.

Q.19. Oil and fat containing food items are flushed with nitrogen. Why?

Ans. The plastic bags containing oil and fat containing food items (such as potato chips) are flushed with an unreactive gas nitrogen so as to prevent them from getting oxidised and turn rancid. This is because in the presence of oxygen of air, the fats and oils present in food items get oxidised forming products having unpleasant smell and taste which turn the foods rancid (making them unfit for eating). When air containing oxygen is replaced by unreactive nitrogen gas, the packed food items do not get spoiled. They remain fresh for a much longer time.

Q.20. Explain the following terms with one example each:

(a) Corrosion (b) Rancidity

Ans. (a) *Corrosion.* The process in which metals are eaten up gradually by the action of air, moisture or a chemical (such as an acid) on their surface, is called corrosion. Rusting of iron is the most common example of corrosion. Rusting involves unwanted oxidation of iron metal which occurs in nature on its own. When an iron object is left in damp air for a considerable time, it gets covered with a red-brown flaky substance called 'rust'. The

corrosion (or rusting) of iron is a continuous process which, if not prevented in time, eats up the whole iron object.

(b) *Rancidity.* Oxidation has damaging effect on foods containing fats and oils. When the food materials prepared in fats and oil are kept for a long time, they start giving unpleasant smell and taste. The condition produced by the aerial oxidation of fats and oil in foods marked by unpleasant smell and taste is called rancidity. Rancidity spoils the food materials prepared in fats and oil which have been kept for a considerable time and makes them unfit for eating. For example, if potato chips prepared in oil are kept exposed to air for a long time, they start giving unpleasant smell and taste due to the oxidation of oil present in them. The potato chips turn rancid and become unfit for eating.