Language of Chemistry

Points to Remember :

1. A chemical reaction involves the transformation of original substance into an altogether new substance(s).
2. A chemical reaction can be represented with the help of the symbols or the formulae of the elements and the compounds taking part in that reaction. This gives a chemical equation.
3. Certain necessary conditions for a chemical reaction to happen are close contact, solution form, heat, light and catalyst.
4. Characteristics of chemical reactions are change of colour, evolution of a gas, formation of a precipitate, change of state, change of smell and evolution/absorption of heat.
5. A complete chemical equation symbolically represents the reactants, products and their physical states.
6. The substances that react with each other are called reactants and they are represented on the left hand side of the equation. The substances that are formed as a result of the reaction are called products. They are represented on the right hand side of the equation.
7. A chemical equation needs to be balanced to make it follow the law of the conservation of mass.
8. The law of conservation of mass states that mass can be neither created nor destroyed, it can only be transformed from one form to another.
9. A chemical equation gives both qualitative and quantitative information about the reactants and products.

EXERCISE

Question 1.
(a) Define chemical reaction.
(b) What is a chemical equation?
(c) Why do we need to balance chemical equations?
Answer:
(a) Chemical reaction : Any chemical change in matter which involves its transformation into one or more new substances is called a chemical reaction.
(b) Chemical equation : A chemical equation is the symbolic representation of a chemical reaction using the symbols and the formula of the substances involved in the reaction.
(c) A chemical equation needs to be balanced so as to make the number of the atoms of the reactants equal to the number of the atoms of the products.

Question 2.
State four conditions necessary for chemical reactions to take place.
Answer:
Conditions necessary for chemical reactions :

1. Close contact
2. Solution form
3. Heat
4. Light
5. Catalyst

3. Differentiate between :
(a) Reactants and products.

Reactants	Products
1. The substances that react with one another are called reactants. 2. Reactants are written on the left hand side of equation.	1. The new substances formed are called products. 2. Products are written on the right hand side of equation.

(b) Chemical reaction and chemical equation.

Chemical reaction	Chemical Equation
Any chemical change in matter which involves its transformation into one or more new substances is called a chemical reaction.	A chemical equation is the symbolic representation of a chemical reaction using the symbols and the formula of the substances involved in the reaction.

(c) A balanced and a skeletal chemical equation.

Balanced Equation	Skeletal Equation
A balanced chemical equation is one in which the number of atoms each element on the reactant side is equal to the number of atoms of that element on the product side.	In a skeletal equation the number of atoms on reactant side are not equal to number of atoms of product side.

Question 4.

Write word equations for the following skeletal equations:

(a) $KClO_3 \rightarrow KCl + O_2$

(b) $Zn + HCl \rightarrow ZnCl_2 + H_2$

(c) $FeCl_2 + Cl_2 \rightarrow FeCl_3$

(d) $CO + O_2 \rightarrow CO_2$

(e) $Ca + O_2 \rightarrow CaO$

(f) $Na + O_2 \rightarrow Na_2O$

(g) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$

(h) $AgBr \rightarrow Ag + Br_2$

(i) $KNO_2 \rightarrow KNO_2 + O_2$

Answer:

(a) $2KClO_3 \rightarrow 2KCl + 3O_2$

(b) $Zn + 2HCl \rightarrow ZnCl_2 + H_2$

(c) $2FeCl_2 + Cl_2 \rightarrow 2FeCl_3$

(d) $2CO + O_2 \rightarrow 2CO_2$

(e) $2Ca + O_2 \rightarrow 2CaO$

(f) $4Na + O_2 \rightarrow 2Na_2O$

(g) $2NaOH + H_2SO_4 \rightarrow Na_2SO_4 + 2H_2O$

(h) $2AgBr \rightarrow 2Ag + Br_2$

(i) $2KNO_3 \rightarrow 2KN0_2 + O_2$

Question 5.

Balance the following chemical equations :

(a) $FeS + HCl \rightarrow FeCl_2 + H_2S$

(b) $Na_2CO_3 + HCl \rightarrow NaCl + H_2O + CO_2$

(c) $H_2 + O_2 \rightarrow H_2O$

(d) $Na_20 + H_20 \rightarrow NaOH$

Answer:

(a) $FeS + 2HCl \rightarrow FeCl_2 + H_2S$

(b) $Na_2CO_3 + 2HCl \rightarrow 2NaCl + H_2O + CO_2$
(c) $2H_2 + O_2 \rightarrow 2H_2O$
(d) $Na_2O + H_2O \rightarrow 2NaOH$

Question 6.
What information do you get from the equation $H_2 + Cl_2 \rightarrow 2HCl$?
Answer:
(a) Hydrogen and chlorine molecules are the reactants.
(b) They are in gaseous form.
(c) The product is hydrogen chloride gas.
(d) Two molecules of hydrogen chloride are formed.

Question 7.
Write your observations for the following chemical reactions and name the products formed :
(a) When sugar is heated.
(b) When manganese dioxide is added to potassium chlorate and heated.
(c) When dilute acetic acid is poured on baking soda.
(d) When an aqueous solution of sodium chloride is mixed with an aqueous solution of silver nitrate.
(e) When ammonium chloride is heated with sodium hydroxide.
(f) When water is added to quick lime?

Answer:
(a) Black solid mass (charcoal) is formed along with water vapours.
(b) Manganese dioxide acts as a catalyst for the decomposition of potassium chlorate into potassium chloride and oxygen at a lower temperature.
(c) Sodium acetate, CO_2 and water is formed.
(d) A white insoluble solid precipitate of silver chloride is formed along with Sodium nitrate.
(e) When solid ammonium chloride is heated with sodium hydroxide solution, a gas ammonia is evolved which is recognised by its strong pungent smell.

$$\underset{\text{Chloride (solid)}}{\text{Ammonium}} + \underset{\text{hydroxide}}{\text{Sodium}} \xrightarrow{\text{heated}} \underset{\text{chloride (solution)}}{\text{Sodium}} + \text{Water} + \underset{\text{(gas)}}{\text{Ammonia}}$$

(f) When water is added to quick lime, a large amount of heat energy is evolved.

$$\underset{\text{(solid)}}{\text{Calcium oxide}} + \text{Water} \rightarrow \text{Calcium hydroxide} + \text{Heat}$$

Question 8.
Write symbolic representation for the following word equations and balance them :
(a) Calcium carbonate → Calcium oxide + Carbon dioxide
(b) Carbon + Oxygen → Carbon dioxide
(c) Calcium oxide + Water → Calcium hydroxide
(d) Aluminium + Chlorine → Aluminium chloride
(e) Iron + Sulphur → Iron sulphide

Answer:

(*a*) Calcium carbonate → Calcium oxide + Carbon dioxide

$CaCO_3 \rightarrow CaO + CO_2$

(*b*) Carbon + Oxygen → Carbon dioxide

$C + O_2 \rightarrow CO_2$

(*c*) Calcium oxide + Water → Calcium hydroxide

$CaO + H_2O \rightarrow Ca(OH)_2$

(*d*) Aluminium + Chlorine → Aluminium chloride

$2Al + 3Cl_2 \rightarrow 2AlCl_3$

(*e*) Iron + Sulphur → Iron sulphide

$Fe + S \rightarrow FeS.$

OBJECTIVE TYPE QUESTIONS

1. Fill in the blanks:
(a) The substances which undergo chemical change are called **reactants.**
(b) The substances formed as a result of a chemical reaction are called **products.**
(c) During a chemical reaction transfer of **energy** takes place.
(d) The basic conditions necessary for a chemical reaction is **close contact.**
(e) In some chemical reactions an insoluble **precipitate** is formed when two solutions are mixed.

2. Write 'true' or 'false' for the following statements :
(a) No new substance is formed during a chemical reaction : **True**
(b) Hydrogen sulphide has rotten egg smell : **True**
(c) When potassium iodide solution is added to lead acetate solution a red precipitate is formed : **False**
(d) A black residue is formed when sugar is heated : **True**

(e) When iron and sulphur are heated together a grey mass is formed which is attracted by a magnet : **False**
(f) A chemical equation gives only qualitative information of a chemical reaction : **False**

MULTIPLE CHOICE QUESTIONS

1. A chemical equation is a statement that describes a chemical change in terms of
(a) **symbols and formulae**
(b) energy
(c) number of atoms
(d) colours

2. Balancing a chemical equation is based on
(a) **Law of conservation of mass**
(b) Mass of reactants and products
(c) Symbols and formulae
(d) None of the above

3. Copper carbonate when heated, it turns :
(a) Blue
(b) Green
(c) **Black**
(d) Yellow

ADDITIONAL QUESTIONS

1. (a) Define chemical reaction.
(b) What is a chemical equation?
(c) Why do we need to balance chemical equations?

Ans : (a)Chemical reaction : Any chemical change in matter which involves its transformation into one or more new substances is called a chemical reaction.
(b)Chemical equation : A chemical equation is the symbolic representation of a chemical reaction using the symbols and the formula of the substances involved in the reaction.
(c) A chemical equation needs to be balanced so as to make the number of the atoms of the reactants equal to the number of the atoms of the products.

2. State four conditions necessary for a chemical reaction to take place.

Ans: Close contact– For a chemical reaction to take place the reactants should be brought in close contact i.e., they should be mixed,

$$\text{Sodium} + \text{Water} \longrightarrow \text{Sodium hydroxide} + \text{Water}$$

Solution form– Some substances react with eachother only when they are mixed in the solution form, e.g.,

$$\underset{\text{(aq.)}}{\text{Silve nitrate}} + \underset{\text{(aq.)}}{\text{Sodium chloride}} \longrightarrow \underset{\text{(ppt.)}}{\text{Silver nitrate}} + \underset{\text{(aq.)}}{\text{Sodium nitrate}}$$

Heat– Some reactants need to be heated to undergo a chemical change, e.g.,

$$\text{Potassium chlorate} \xrightarrow{\text{heat}} \text{Potassium chloride} + \text{Oxygen}$$

Light– Some reactions take place in the present of light.

$$\text{Carbon dioxide} + \text{Water} \xrightarrow[\text{sun light}]{\text{chlrophyll}} \text{Glucose} + \text{Oxygen}$$

3. Write balanced chemical equations for the reactions represented by word equations in the conditions for chemical reaction.

Ans:

1. $2Na + H_2O \rightarrow 2NaOH + H_2$
2. $AgNO_3 + NaCl \rightarrow AgCl + NaNO_3$
3. $2KClO_3 \rightarrow 2KCl + 3O_2$
4. $6CO_2 + 6H_2O \rightarrow C_6H_{12}O_6 + 6O_2$

4. Balance the following equations :

1. $\mathbf{Fe + O_2 \rightarrow Fe_3O_4}$
2. $\mathbf{Fe + H_2O \rightarrow Fe_3O_4 + H_2}$
3. $\mathbf{N_2 + O_2 \rightarrow NO}$
4. $\mathbf{Pb_3O_4 \rightarrow PbO + O_2}$

Ans:

1. $3Fe + 2O_2 \rightarrow Fe_3O_4$
2. $3\ Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$
3. $N_2 + O_2 \rightarrow 2NO$
4. $2Pb_3O_4 \rightarrow 6PbO + O_2$

5. Balance the following equations. Also name the products formed. The first one is done for you.

1. $\mathbf{NaNO_3 \rightarrow NaNO_2 + O_2}$ **Name of product (s)**

Ans. $2NaNO_3 \rightarrow 2NaNO_2 + O_2$ Sodium nitrite, oxygen

2. $\mathbf{K + Cl_2 \rightarrow KCl}$

Ans. $2K + Cl_2 \rightarrow 2KCl$ Potassium chloride

3. $\mathbf{Ag + S \rightarrow Ag_2 S}$

Ans. $2\,Ag + S \rightarrow Ag_2 S$ Silver sulphide

4. $\mathbf{Mg + O_2 \rightarrow MgO}$

Ans. $2\,Mg + O_2 \rightarrow 2\,MgO$ Magnesium oxide

5. $\mathbf{KClO_3 \rightarrow KCl + O_2}$

Ans. $2\,KClO_3 \rightarrow 2\,KCl + 3O_2$ Potassium chloride, oxygen

6. $\mathbf{H_2O_2 \rightarrow H_2O + O_2}$

Ans. $2\,H_2O_2 \rightarrow 2H_2O + O_2$ Water, oxygen

7. $\mathbf{H_2 + Cl_2 \rightarrow HCl}$

Ans. $H_2 + Cl_2 \rightarrow 2HCl$ Hydrogen chloride

8. $Na + H_2O \rightarrow \mathbf{NaOH + H_2}$

Ans. $2\,Na + 2H_2O \rightarrow 2\,NaOH + H_2$ Sodium hydroxide, Hydrogen

9. $\mathbf{CO + O_2 \rightarrow CO_2}$

Ans. $2\,CO + O_2 \rightarrow 2\,CO_2$ Carbon dioxide

10. $\mathbf{Zn + HCl \rightarrow ZnCl_2 + H_2}$

Ans. $Zn + 2HCl \rightarrow ZnCl_2 + H_2$ Zinc chloride, Hydrogen

11. $\mathbf{K_2O + H_2O \rightarrow KOH}$

Ans. $2\,K_2O + 2\,H_2O \rightarrow 4\,KOH$ Potassium hydroxide

12. $\mathbf{CO_2 + C \rightarrow CO}$

Ans. $CO_2 + C \rightarrow 2CO$ Carbon monoxide

13. $\mathbf{N_2 + H_2 \rightarrow NH_3}$

Ans. $N_2 + 3H_2 \rightarrow 2NH_3$ Ammonia

14. $\mathbf{PbCO_3 \rightarrow PbO + CO_2}$

Ans. $PbCO_3 \rightarrow PbO + CO_2$ Lead (*ii*) oxide, Carbon dioxide

15. $\mathbf{FeCl_2 + Cl_2 \rightarrow FeCl_3}$

Ans. $2\,FeCl_2 + Cl_2 \rightarrow 2FeCl_3$ Ferric chloride

6. State what you would observe when the following substances are heated in a glass test tube: 1. Red lead
2. Copper (II) carbonate Red lead

Ans:

1. $2Pb_3O_4 \rightarrow 6PbO + O_2 \uparrow$
   The dark red lead as red powder changes to yellow colour. The yellow colour residue on further heating sticks to the tube and give reddish colour to glass. A colourless and odourless gas is evolved.
2. $CuCO_3 \rightarrow CuO + CO_2 \uparrow$
   The blue-green powder turns black and a colourless gas is evolved which extinguishes a burning flame.

7. Explain the following reaction with one suitable example for each.
(a) Combination reactions
(b) Decomposition reaction
(c) Displacement reaction
(d) Double decomposition reaction

Ans: (a) Combination reactions : In this reaction two or more substances combine to form a new substance, e.g. Burning of hydrogen in air.
(b) Decomposition reaction : In this reaction a substance breaks up on heating to form two or more simpler substances, e.g. Electrolysis of water.
(c) Displacement reaction: In this reaction a more reactive element displaces a less reactive element from its compound, e.g. Reaction of iron with copper sulphate.
(d)Double decomposition reaction : In this reaction two compounds in solution state react with each other to form two new substances by exchanging their radicals, e.g. Reaction of sodium hydroxide with dilute hydrochloric acid.

8. Name the type of chemical reaction shown by the following equations:

(a) CaCO3 → CaO + CO2
(b) $2Mg + O_2 \rightarrow 2MgO$
(c) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$
(d) $NaOH + HCl \rightarrow NaCl + H_2O$
(e) $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

Ans: (a) $CaCO_3 \rightarrow CaO + CO_2$ => Decomposition reaction
(b) $2Mg + O_2 \rightarrow 2MgO$ => Combination reaction
(c) $Fe + CuSO_4 \rightarrow FeSO_4 + Cu$ => Displacement reaction
(d) $NaOH + HCl \rightarrow NaCl + H_2O$ => Double decomposition reaction
(e) $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$ => Displacement reaction

9. Write your observations and name the products when
(a) Zinc reacts with dilute hydrochloric acid.
(b) ron nails are added to an aqueous solution of copper sulphate.
(c) An aqueous solution of barium chloride is added to dilute sulphuric acid.

Ans : (a) When zinc pieces are added to hydrochloric acid, zinc displaces hydrogen. As a result, zinc chloride and hydrogen gas are produced.
(b) When iron pieces are added to an aqueous solution of copper sulphate iron being more reactive displaces copper from copper sulphate solution to produce ferrous sulphate.
(c) An aqueous solution of barium chloride when mixed with dilute sulphuric acid produces a white insoluble solid barium sulphate and hydrochloric acid.

10. A solution of a substance 'X' is used for white washing.
(a) Name the substance 'X' and write its formula.
(b) Write the reaction of the substance 'X' named in (a) above with water.

Ans :
(a) Calcium oxide CaO
(b) $CaO + H_2O \rightarrow Ca(OH)_2$
quick lime → slaked lime