4 TRANSFORMATION OF SUBSTANCE

I. Multiple choice questions: (Tick the correct option).

1. The reaction between magnesium and oxygen is:
   (a) an endothermic reaction (b) an exothermic reaction
   (c) a catalysed reaction (d) a reversible reaction

2. Which reaction represents chemical combination?
   (a) \(2\text{NaHCO}_3 \rightarrow \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2\)
   (b) \(\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2\)
   (c) \(\text{CuSO}_4 + \text{Fe} \rightarrow \text{FeSO}_4 + \text{Cu}\)
   (d) \(\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3\)

3. Which of the following reactions does not take place?
   (a) \(\text{FeSO}_4 + \text{Cu} \rightarrow \text{CuSO}_4 + \text{Fe}\)
   (b) \(\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2\)
   (c) \(\text{Pb(NO}_3)_2 + \text{Mg} \rightarrow \text{Mg(NO}_3)_2 + \text{Pb}\)
   (d) \(\text{ZnSO}_4 + \text{Mg} \rightarrow \text{MgSO}_4 + \text{Zn}\)

4. An atom or a group of atoms is said to be an oxidising agent if it
   (a) loses electrons (b) gains electrons
   (c) neither loses nor gains electrons (d) none of the above

5. Which one is not a biochemical catalyst?
   (a) Chlorophyll (b) Pepsin (c) Manganese dioxide (d) Amylase

6. When a chemical in a solution form or in a fused state breaks into
   simple elements by the passage of electric current, the process is called
   (a) analysis (b) synthesis
   (c) electrolysis (d) electro-decomposition

7. The electrolyte used in silver-plating an article is
   (a) silver nitrate (b) silver sulphate
   (c) silver cyanide (d) sodium silver cyanide

8. The process of separating a mixture of two or more liquids with
   different boiling is called
   (a) filtration (b) distillation (c) fractional distillation (d) decantation
9. Which one of these is a neutralisation reaction?
   (a) \( \text{Cu(OH)}_2 \rightarrow \text{CuO} + \text{H}_2\text{O} \)
   (b) \( \text{CO}_2 + \text{H}_2\text{O} \rightarrow \text{H}_2\text{CO}_3 \)
   (c) \( 2\text{KI} + \text{Pb(NO}_3)_2 \rightarrow 2\text{KNO}_3 + \text{PbI}_2 \)
   (d) \( \text{KOH} + \text{HCl} \rightarrow \text{KCl} + \text{H}_2\text{O} \)

10. Heat energy is required during this reaction.
   (a) Endothermic  
   (b) Exothermic  
   (c) Both (a) and (b)  
   (d) None of the above

11. Which of the following represents a reversible reaction?
   (a) \( \text{A + B} \rightarrow \text{C + D} \)  
   (b) \( \text{A + B} \leftarrow \text{C + D} \)  
   (c) \( \text{A + B} = \text{C + D} \)  
   (d) \( \text{A + B} \rightleftharpoons \text{C + D} \)

12. Thermal decomposition of substances is brought about with the help of
   (a) heat  
   (b) wind  
   (c) water  
   (d) magnetism

13. Loss of electrons occurs when an element is
   (a) reduced  
   (b) oxidised  
   (c) reduced and oxidised  
   (d) none of the above

14. Removal of electron/electrons from an atom is
   (a) reduction  
   (b) oxidation  
   (c) redox  
   (d) none of the above

15. Removal of hydrogen from a compound in a chemical reaction means the compound is being
   (a) oxidised  
   (b) reduced  
   (c) stabilised  
   (d) none of the above

16. A substance that brings about reduction is called
   (a) reducing agent  
   (b) oxidising agent  
   (c) catalyst  
   (d) enzyme

17. Electroplating helps in preventing metals from
   (a) rusting  
   (b) looking bright  
   (c) sublimating  
   (d) none of the above

Ans.  1. (b)  2. (b)  3. (a)  4. (b)  5. (c)  6. (c)  7. (d)  8. (c)  9. (d)  10. (a)  
       11. (d)  12. (a)  13. (b)  14. (b)  15. (a)  16. (a)  17. (a).

II. A. Fill in the blanks with appropriate words.

1. The presence of impurity causes a ............... in the melting point of a substance.

2. The boiling point of a pure liquid at a particular pressure remains .................. .
3. Impure water is distilled to obtain pure water in the laboratory by .................. .
4. The process of a liquid changing into a solid is called .................. .
5. The temperature, at which a solid changes into a liquid, is called its .................. .
6. A change, which alters the composition of a substance, is known as a .................. change.
7. There is no change in the .................. of the substance during a physical change.
8. The reaction in which energy is involved is called a .................. .
9. The boiling point of a pure liquid .................. with the decrease in pressure.
10. When a solid changes to a liquid on melting the .................. remains constant.
11. A mixture of ice and salt is known as .................. .
12. The melting point of pure ice is .................. .
13. The substances that are formed as a result of chemical reactions are called .................. .
14. The symbols or the formulae of the reactants are written on the .................. hand side of the arrow.
15. Molecular weight has .................. unit.
16. An unbalanced equation is called a .................. equation.
17. Magnesium oxide is a .................. of magnesium and oxygen.
18. A reaction in which two or more substances combine to form a single substance is called a .................. reaction.
19. A .................. is a substance which changes the rate of a chemical reaction without undergoing a chemical change.
20. The formation of a solid product from two reactants in their aqueous state is called .................. reaction.
21. When an atom loses electrons .................. takes place.
22. The chemical change involving iron and hydrochloric acid illustrates a .................. reaction.
23. In the type of reaction called .................., two compounds exchange their positive and negative radicals called .................. .
24. A catalyst either .................. or .................. the rate of a chemical change but itself remains .................. at the end of the reaction.
25. An equation must be balanced to comply with the law of ................. .
26. During electrolysis the electrode at which positive ions are discharged is the ................. .
27. Gain of electrons by an atom or ion is known as ................. .
28. The reaction of iron with steam and nitrogen with oxygen are examples of ................. reactions.
29. Two compounds in aqueous solutions, combine to form two new compounds, in which one of the products is insoluble and is called a ................. .
30. The substances which undergo a chemical change are called ................. .
31. Photosynthesis is an ................. reaction.
32. In ................. reactions heat is liberated.
33. ................. reactions proceed in the direction towards the formation of products only.
34. Anions are attracted towards ................. .
35. To separate two miscible liquids by distillation they must have different ................. .

Ans.  1. decrease  2. constant  3. distillation  4. freezing  5. melting point  
6. chemical  7. mass  8. chemical change  9. decreases  10. mass  
11. freezing mixture  12. 0°C  13. products  14. left  15. no  16. skeletal  
22. displacement  23. double decomposition, ions  24. increases, decreases, unchanged  
25. conservation of mass  26. cathode  27. reduction  
28. reversible  29. precipitate  30. reactants  31. endothermic  
32. exothermic  33. Irreversible  34. anode  35. boiling points.

B. Fill in the blanks with appropriate words from the given list. 
[List: combination displacement, neutralisation, double displacement, decomposition, reduction, oxidation, exothermic].
1. The reaction of quicklime with water is an ................. reaction.
2. The chemical reaction between hydrogen and chlorine is a chemical ................. reaction.
3. The decomposition of mercuric oxide on heating is a chemical ................. reaction.
4. The reaction between copper sulphate solution and iron is a chemical ................. reaction.
5. The reaction between an acid solution and a base is a ................. reaction.
6. The reaction between sodium carbonate and copper sulphate solution is a ............... reaction.
7. When sulphur atom gains 2 electrons, ................. of sulphur takes place.
8. When the sodium atom loses 1 electron, ................. of sodium takes place.

**Ans.**

**III. A. State whether the following statements are true or false. If false, write the correct statement.**

1. Reaction between magnesium and iron sulphate solution is a chemical double decomposition.
   **Ans.** False: The reaction between magnesium and iron sulphate is a chemical displacement reaction.

2. The reaction between HCl and ammonia gas is a chemical combination.
   **Ans.** True

3. All metals are oxidising agents as they lose their valence electrons.
   **Ans.** False: All metals are reducing agents as they lose their valence electrons.

4. The process of electrolysis is used for silver-plating a brass cup.
   **Ans.** True

5. A heavy current should be passed through the electrolyte during silver-plating.
   **Ans.** False: A small current should be passed over a longer period of time through the electrolyte during silver-plating.

6. Metals react with acids forming salt and water.
   **Ans.** False: Bases react with acids to form salt and water.

7. In a displacement reaction, a more reactive metal gets replaced by a less reactive metal.
   **Ans.** False: In a displacement reaction a less reactive metal gets replaced by a more reactive metal.

8. Oxidation and reduction takes place simultaneously only in a reversible reaction.
   **Ans.** False: Oxidation and reduction takes place simultaneously in all chemical reactions except double displacement reaction.

9. Reduction is a process in which loss of electrons takes place.
Ans. False: Reduction is a process in which gain of electrons take place.
10. Oxidation is a chemical reaction involving addition of hydrogen to a substance.
Ans. False: Oxidation is a chemical reaction involving addition of oxygen to a substance.
11. During electroplating of an article with a superior metal, the article to be plated is made the cathode i.e., negative electrode of an electrolytic cell.
Ans. True
12. A physical change is temporary and can be reversed by removing the cause of the change.
Ans. True
13. Addition of minerals to pure water results in a decrease in its boiling point.
Ans. False: Addition of minerals to pure water results in an increase in its boiling point.
14. During fractional distillation, the component with higher boiling point distills over first.
Ans. False: During fractional distillation, the component with lower boiling point distills over first.
15. The process of fractional distillation is employed in the purification of water.
Ans. False: The process of distillation is employed in the purification of water.

B. Statements given below are incorrect. Write the correct statements.
1. When an atom of iron loses 2 electrons, it is said to be an oxidising agent.
Ans. When an atom of iron loses 2 electrons, it is said to be a reducing agent.
2. A substance which takes part in a chemical reaction and accelerates the rate of the reaction is called a positive catalyst.
Ans. A substance which does not take part in a chemical reaction and accelerates the rate of the reaction is called a positive catalyst.
3. Amylase present in the saliva helps in the decomposition of proteins.
Ans. Amylase present in saliva helps in the decomposition of starch.
4. Bromide ions discharge at the cathode to form bromine.
Ans. Bromide ions discharge at the anode to form bromine.
5. Silver chloride is an electrolyte used in electroplating silver.
   Ans. Sodium silver cyanide is an electrolyte used in electroplating silver.

6. The melting point of ice formed from tap water is 0°C.
   Ans. The melting point of ice formed from tap water is lower than 0°C.

7. Red lead oxide on heating strongly decomposes to form lead dioxide and oxygen.
   Ans. Red lead on heating strongly decomposes to form lead oxide and oxygen.

8. The reaction between magnesium and oxygen is an endothermic reaction.
   Ans. The reaction between magnesium and oxygen is an exothermic reaction.

9. Copper carbonate on strongly heating leaves behind a green residue of copper oxide.
   Ans. Copper carbonate on strongly heating leaves behind a black residue of copper oxide.

10. Ammonia gas and HCl gas react to form gaseous ammonium chloride.
    Ans. Ammonia gas and HCl gas react to form solid ammonium chloride.

IV. Match the following Columns (A reaction may be of more than one type.)

<table>
<thead>
<tr>
<th>Column A</th>
<th>Column B</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. (2SO_2 + O_2 \rightleftharpoons 2SO_3)</td>
<td>(a) synthesis</td>
</tr>
<tr>
<td>2. (4P + 5O_2 \rightarrow 2P_2O_5)</td>
<td>(b) simple displacement</td>
</tr>
<tr>
<td>3. (\text{CuSO}_4 + 2\text{NH}_4\text{OH} \rightarrow (\text{NH}_4)_2\text{SO}_4 + \text{Cu(OH)}_2)</td>
<td>(c) catalytic</td>
</tr>
<tr>
<td>4. (2\text{Na} + 2\text{H}_2\text{O} \rightarrow 2\text{NaOH} + \text{H}_2)</td>
<td>(d) electrolytic decomposition</td>
</tr>
<tr>
<td>5. (2\text{Ag}_2\text{O} \rightarrow 4\text{Ag} + \text{O}_2)</td>
<td>(e) neutralisation</td>
</tr>
<tr>
<td>6. (\text{H}_2\text{S} + \text{Cl}_2 \rightarrow 2\text{HCl} + \text{S})</td>
<td>(f) reduction</td>
</tr>
<tr>
<td>7. (2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2)</td>
<td>(g) thermal decomposition</td>
</tr>
<tr>
<td>8. (\text{ZnCO}_3 \rightarrow \text{ZnO} + \text{CO}_2)</td>
<td>(h) redox</td>
</tr>
<tr>
<td>9. (2\text{NaOH} + \text{H}_2\text{SO}_4 \rightarrow \text{Na}_2\text{SO}_4 + 2\text{H}_2\text{O})</td>
<td>(i) precipitation</td>
</tr>
<tr>
<td>10. (4\text{NH}_3 + 5\text{O}_2 \rightleftharpoons 4\text{NO} + 6\text{H}_2\text{O})</td>
<td>(j) oxidation</td>
</tr>
</tbody>
</table>

Ans. 1. a, c, j  2. a, j  3. i  4. b  5. g  6. h  7. d  8. g  9. e  10. c
V. Name the following.

1. The electrolyte used during electroplating an article with silver.
2. Two liquid miscible components which can be separated by fractional distillation.
3. The electrode connected to the positive terminal of a battery.
4. An oxidising agent not containing oxygen.
5. A reducing agent containing oxygen.
6. The oxidised product formed when chlorine reacts with hydrogen sulphide.
7. The colour of the precipitate formed when iron [III] chloride reacts with sodium hydroxide.
8. An exothermic reaction between two neutral gases.
9. The type of change involved during addition of salt to water.
10. The promoter used in the conversion of nitrogen to ammonia.
11. A change which may alter some specific physical property, but not the composition of a substance.
12. A black residue left behind when copper carbonate is heated strongly.
13. A reaction in which two substances react to form only one new substance.
14. A substance which accelerates the rate of reaction, but does not take part in a chemical reaction.
15. A reaction in which two soluble compounds in solution form, react to form insoluble substance.
16. A reaction in which iron dissolves in copper sulphate solution.
17. A reaction which proceeds with the absorption of heat energy.
18. A process of separation of two miscible liquids.
19. A process which proceeds with the loss of electrons from an atom/atoms.
20. An ion formed by the gain of electrons in the valence shell of an atom.
21. A metallic compound light green in colour which turns black when it undergoes thermal decomposition.
22. Two gases which react to give another gas and the reaction is endothermic.
23. A metallic hydroxide pale blue in colour.
24. An acid obtained when phosphorus pentoxide reacts with water.
25. The catalyst used in the conversion of sulphur dioxide to sulphur trioxide.

VI. Classify the following.
1. Classify the following reactions as combination, decomposition, displacement, precipitation and neutralisation.
   (i) $\text{CaCO}_3(s) \xrightarrow{\text{heat}} \text{CaO}(s) + \text{CO}_2(g)$
   (ii) $\text{Zn}(s) + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4(s) + \text{H}_2(g)$
   (iii) $\text{AgNO}_3(aq) + \text{NaCl}(aq) \rightarrow \text{AgCl}(s) + \text{NaNO}_3$
   (iv) $\text{NH}_3(g) + \text{HCl}(g) \rightarrow \text{NH}_4\text{Cl}(s)$
   (v) $\text{CuSO}_4(aq) + \text{H}_2\text{S}(g) \rightarrow \text{CuS}(s) + \text{H}_2\text{SO}_4(l)$
   (vi) $\text{Zn}(s) + \text{CuSO}_4(aq) \rightarrow \text{ZnSO}_4(aq) + \text{Cu}(s)$
   (vii) $\text{Ca}(s) + \text{O}_2(g) \xrightarrow{\text{heat}} 2\text{CaO}(s)$
   (viii) $\text{NaOH} + \text{HCl} \rightarrow \text{NaCl} + \text{H}_2\text{O}$
   (ix) $2\text{KOH} + \text{H}_2\text{SO}_4 \rightarrow \text{K}_2\text{SO}_4 + 2\text{H}_2\text{O}$

Ans. (i) Decomposition  (ii) Displacement  (iii) Precipitation  (iv) Combination  (v) Precipitation  (vi) Displacement  (vii) Combination  (viii) Neutralisation  (ix) Neutralisation

2. Classify the following as oxidation or reduction.
   (i) $\text{Fe}^{2+} \rightarrow \text{Fe}^{3+}$  (ii) $\text{Cl} \rightarrow \text{Cl}^-$  (iii) $\text{Na} \rightarrow \text{Na}^+$
   (iv) $\text{Cl}^- \rightarrow \text{Cl}$  (v) $\text{Al}^{3+} \rightarrow \text{Al}$  (vi) $\text{Hg}^{2+} \rightarrow \text{Hg}^+$
   (vii) $\text{O} \rightarrow \text{O}^{2-}$

Ans. (i) Oxidation  (ii) Reduction  (iii) Oxidation  (iv) Oxidation  (v) Reduction  (vi) Reduction  (vii) Reduction

3. Classify the following as a physical or a chemical change.
   (i) Drying of wet clothes
   (ii) Manufacture of salt from sea water
(iii) Making of curd from milk (iv) Butter getting rancid
(v) Growth of a tree (vi) Rusting of iron
(vii) Boiling of water (viii) Burning of paper
(ix) Freezing of water (x) Magnetisation of a piece of iron
(xi) Burning of a piece of magnesium wire
(xii) Dropping sodium in water.

**Ans.**
(i) Physical change (ii) Physical change
(iii) Chemical change (iv) Chemical change
(v) Chemical change (vi) Chemical change
(vii) Physical change (viii) Chemical change
(ix) Physical change (x) Physical change
(xi) Chemical change (xii) Chemical change

**VII. Give reasons for the following.**

1. A chemical equation needs to be balanced.

**Ans.** A chemical equation needs to be balanced since it is just a rearrangement of atoms and atoms are not created or destroyed during a chemical reaction. This is in accordance with the law of conservation of matter.

2. Burning of magnesium in air is a chemical change.

**Ans.** Burning of a substance involves the combination of the substance with oxygen. Thus, it is an oxidation reaction. When magnesium burns, it undergoes oxidation to form magnesium oxide. This is a chemical change.

3. Adding sodium to water is a chemical change.

**Ans.** When sodium is added to water, sodium hydroxide is formed along with hydrogen gas. The reaction cannot be reversed and so it is a chemical change.

4. The reaction between an acid and a base to form salt and water is a double displacement reaction.

**Ans.** When an acid reacts with a base, they mutually exchange their radicals to form two new products – salt and water. Therefore, the above reaction is a double displacement reaction.

5. Seawater has a boiling point of 104°C instead of 100°C.

**Ans.** The presence of impurity increases the boiling point of a liquid. Seawater contains dissolved salts. The presence of these impurities increases the boiling point of water. Thus, seawater has a boiling point of 104°C instead of 100°C.
6. The melting point of ice formed from tap water is not 0°C.
   **Ans.** The presence of impurities causes a decrease in the melting point of a substance. Tapwater contains salts and gases dissolved in it. Therefore, melting point of ice formed from tapwater is not 0°C.

7. Why does ice under a skater’s shoes melt?
   **Ans.** The melting point of a solid decreases with increase in pressure. Increase in pressure causes a rise in temperature. Therefore, ice melts under a skater’s shoes.

8. The melting point of a freezing mixture is about –15°C.
   **Ans.** The presence of impurity causes a decrease in the melting point of a substance. A mixture of ice and salt is called a freezing mixture. The salt present in the mixture decreases the melting point of the freezing mixture to –15°C instead of 0°C.

**VIII. Complete the following equations.**

1. \( \text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2 \)

2. \( \text{H}_2\text{S} + \text{Cl}_2 \rightarrow 2\text{HCl} + \text{S} \)

3. \( \text{CuSO}_4 + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{Cu} \)

4. \( 3\text{Mg} + \text{N}_2 \rightarrow \text{Mg}_3\text{N}_2 \)

5. \( 2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2 \)

6. \( 2\text{FeCl}_2 + \text{Cl}_2 \rightarrow 2\text{FeCl}_3 \)

7. \( \text{Pb} + 2\text{HCl} \rightarrow \text{PbCl}_2 + \text{H}_2 \)

8. \( \text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl} \)

**Ans.**

1. \( \text{Ca} + 2\text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 + \text{H}_2 \)

2. \( \text{H}_2\text{S} + \text{Cl}_2 \rightarrow 2\text{HCl} + \text{S} \)

3. \( \text{CuSO}_4 + \text{Zn} \rightarrow \text{ZnSO}_4 + \text{Cu} \)

4. \( 3\text{Mg} + \text{N}_2 \rightarrow \text{Mg}_3\text{N}_2 \)

5. \( 2\text{KNO}_3 \rightarrow 2\text{KNO}_2 + \text{O}_2 \)

6. \( 2\text{FeCl}_2 + \text{Cl}_2 \rightarrow 2\text{FeCl}_3 \)

7. \( \text{Pb} + 2\text{HCl} \rightarrow \text{PbCl}_2 + \text{H}_2 \)

8. \( \text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl} \)

**IX. Answer the following questions.**

1. Give one example each, which illustrates the following characteristics of a chemical reaction:
   (i) evolution of a gas
   (ii) change of colour
   (iii) formation of a precipitate.

   **Ans.**
   (i) When calcium carbonate is heated strongly, it decomposes to form calcium oxide and gives off carbon dioxide gas.
   \( \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \)
(ii) When green coloured crystals of copper carbonate are strongly heated, it decomposes to form black coloured copper oxide and gives off carbon dioxide gas.
\[ \text{CuCO}_3 \rightarrow \text{CuO} + \text{CO}_2 \] (green) (black)

(iii) When colourless solution of lead nitrate is mixed with colourless potassium iodide solution, a yellow coloured precipitate of lead iodide is obtained.
\[ \text{Pb(NO}_3\text{)}_2 + 2\text{KI} \rightarrow 2\text{KNO}_3 + \text{PbI}_2 \]

2. By giving one example, explain what do you understand by the following terms?
   (i) Exothermic reactions  (ii) Endothermic reactions
   Ans.  (i) The chemical reactions in which heat energy is released are called exothermic reactions. When magnesium is heated it catches fire and burns with a dazzling white light and releases a lot of heat.
   \[ 2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO} + \text{Energy} \]
   (ii) The chemical reactions in which heat energy is absorbed are called endothermic reactions. On heating, sodium bicarbonate swells up to form sodium carbonate, steam and carbon dioxide gas.
   \[ 2\text{NaHCO}_3 \xrightarrow{\text{heat}} \text{Na}_2\text{CO}_3 + \text{H}_2\text{O} + \text{CO}_2 \]

3. (i) Define a chemical reaction.
   (ii) Define the term chemical combination. Support your answer by two examples.
   Ans. (i) When one or more substances undergo a chemical change with the absorption or release of energy and they form one or more new products, the change is known as a chemical change.
   (ii) When two or more elements or compounds combine chemically to form one new product only, the reaction is known as chemical combination.
   \[ \text{Fe} + \text{S} \rightarrow \text{FeS} \]
   \[ \text{H}_2 + \text{Cl}_2 \rightarrow 2\text{HCl} \]

4. Define or explain the following terms and support your answer by two examples.
   (i) Chemical decomposition  (ii) Chemical displacement
   (iii) Precipitation reaction  (iv) Neutralisation reaction
Ans. (i) When a chemical compound decomposes to form two or more new substances, then the chemical reaction is called chemical decomposition.

\[
\begin{align*}
2\text{NaNO}_3 & \xrightarrow{\text{heat}} 2\text{NaNO}_2 + \text{O}_2 \\
2\text{KClO}_3 & \xrightarrow{\text{heat}} 2\text{KCl} + 3\text{O}_2
\end{align*}
\]

(ii) When a more electropositive element displaces a less electropositive element from its aqueous salt solution, the reaction is known as chemical displacement.

\[
\begin{align*}
\text{Fe} + \text{CuSO}_4 & \rightarrow \text{FeSO}_4 + \text{Cu} \\
\text{Zn} + \text{H}_2\text{SO}_4 & \rightarrow \text{ZnSO}_4 + \text{H}_2
\end{align*}
\]

(iii) When aqueous solutions of two compounds react, by exchanging their radicals, such that one of the products formed is an insoluble salt and appears in the form of a precipitate, the reaction is known as precipitation reaction.

\[
\begin{align*}
\text{Pb(NO}_3)_2 + 2\text{KI} & \rightarrow \text{PbI}_2 + 2\text{KNO}_3 \\
\text{Na}_2\text{SO}_4 + \text{BaCl}_2 & \rightarrow 2\text{NaCl} + \text{BaSO}_4
\end{align*}
\]

(iv) When an acid reacts with a base by exchanging their radicals, such that salt and water are the products formed, then the reaction is called neutralisation.

\[
\begin{align*}
2\text{NaOH} + \text{H}_2\text{SO}_4 & \rightarrow \text{Na}_2\text{SO}_4 + \text{H}_2\text{O} \\
\text{ZnO} + 2\text{HCl} & \rightarrow \text{ZnCl}_2 + \text{H}_2\text{O}
\end{align*}
\]

5. (i) By giving one example, explain the terms oxidation and oxidising agent.

(ii) By giving one example, explain the terms reduction and reducing agent.

Ans. (i) When an atom or a group of atoms loses electron/electrons, its oxidation is said to take place.

The atom or group of atoms which gains electrons is said to be an oxidising agent.

\[
\text{Fe} + \text{S} \rightarrow \text{FeS}
\]

The above equation can be represented as:

\[
\begin{align*}
\text{Fe} & \rightarrow 2\text{e}^- \rightarrow \text{Fe}^{2+} \\
\text{S} & \rightarrow 2\text{e}^- \rightarrow \text{S}^{2-}
\end{align*}
\]

An atom of iron loses 2 electrons, so oxidation of iron metal takes place.
Sulphur atom gains two electrons, therefore, sulphur is an oxidising agent.

(ii) When an atom or a group of atoms gains electron/electrons, its reduction is said to take place.

The atom or group of atoms which loses electron/electrons is said to be a reducing agent.

\[ 2Na + Cl_2 \rightarrow 2NaCl \]

The above equation can be represented as:

\[ \begin{align*}
2Na & \quad - \quad 2e^- \\
2Cl & \quad + \quad 2e^- \\
2Na & \quad + \quad Cl_2 \\
\end{align*} \]

Chlorine atoms gain electrons and therefore, reduction of chlorine takes place.

Sodium atoms lose electrons, therefore, sodium is a reducing agent.

6. (i) Define the term catalyst.

(ii) What are (a) positive catalysts (b) negative catalysts? Support your answer with one example each.

(iii) Name three biochemical catalysts found in the human body.

Ans. (i) A substance which changes the rate of a chemical reaction without itself taking part in the reaction is called a catalyst.

(ii) (a) A catalyst which speeds up the rate of a chemical reaction is called a positive catalyst.

\[ 2KClO_3 \rightarrow 2KCl + 3O_2 \]

4 parts of potassium chlorate if mixed with one part of manganese dioxide liberates oxygen at a much faster rate and at a lower temperature than the above reaction.

(b) A catalyst which slows down the rate of a chemical reaction is called a negative catalyst.

Addition of a little alcohol in hydrogen peroxide slows down its decomposition to water and oxygen.

(iii) Amylase is the enzyme present in the saliva which helps in the decomposition of starch into sugar.

Pepsin is the enzyme produced in the stomach which helps in the breaking down of proteins into amino acids.

Trypsin and lipase are the enzymes produced in pancreas which help in breaking down starch, fat and protein into simpler molecules of sugar, glucose and amino acids.
7. Define the following terms:
   (i) electrolyte  (ii) electrolysis  (iii) electrolytic cell
   (iv) cathode  (v) anode  (vi) cation  (vii) anion

Ans. (i) A compound which in the fused state or in aqueous solution conducts electric current so that decomposition of the compound takes place, is known as an electrolyte.
(ii) The process in which a chemical compound in the fused state or in aqueous solution undergoes a chemical change on the passage of electric current is called electrolysis.
(iii) The vessel in which electrolysis is carried out is called an electrolytic cell.
(iv) The electrode connected to the negative terminal of the battery is called the cathode.
(v) The electrode connected to the positive terminal of the battery is called the anode.
(vi) The positively charged ion in the electrolyte, which migrates towards the cathode on the passage of electric current is called a cation.
(vii) The negatively charged ion in the electrolyte, which migrates towards the anode on the passage of electric current is called an anion.

8. (i) What do you understand by the term electroplating?
(ii) State two reasons for electroplating an article.
(iii) Briefly describe how you will electroplate a brass cup with silver.

Ans. (i) The process of depositing a thin and compact layer of a superior metal over an inferior metal by the process of electrolysis is called electroplating.
(ii) (a) To prevent iron or steel articles from rusting.
     (b) To improve the appearance of articles.
(iii) The brass cup is made the cathode, pure silver rod the anode and sodium silver cyanide the electrolyte while silver plating the brass cup.

   Electrolyte: The electrolyte ionises as
   \[
   \text{NaAg(CN)}_2 \rightarrow \text{Na}^+ + \text{Ag}^+ + 2\text{CN}^-
   \]
**Reaction at the cathode:** Silver ions migrate towards the cathode. Here they accept electrons from the cathode to form silver atoms, which deposit on the article.

\[
\text{Ag}^+ + \text{e}^- \rightarrow \text{Ag}
\]

**Reaction at the anode:** Silver atoms ionise by losing electrons to the anode and hence, form silver ions. These silver ions then enter the electrolyte.

\[
\text{Ag} \rightarrow \text{Ag}^+ + \text{e}^-
\]

9. Calculate the amount of calcium oxide formed from 2 g of calcium metal. \([\text{Ca} = 40, \text{O} = 16]\).

**Ans.**

\[
2\text{Ca} + \text{O}_2 \rightarrow 2\text{CaO}
\]

\[
2 \times 40 \quad 2 \times 16 \quad 2(40 + 16)
\]

\[
= 80 \text{ amu} \quad = 32 \text{ amu} \quad = 112 \text{ amu}
\]

80 amu of calcium forms 112 amu of CaO

\[
\therefore 2\text{g of Ca forms } = 2.8 \text{ g of CaO}
\]

10. Calculate the amount of magnesium oxide formed and carbon dioxide liberated when 4.2 g of magnesium carbonate decomposes on strong heating. \([\text{Mg} = 24, \text{C} = 12, \text{O} = 16]\)

**Ans.**

\[
\text{MgCO}_3 \rightarrow \text{MgO} + \text{CO}_2
\]

\[
(24 + 12 + 3 \times 16) \quad (24 + 16) \quad (12 + 2 \times 16)
\]

\[
= 84 \text{ amu} \quad = 40 \text{ amu} \quad = 44 \text{ amu}
\]

84 amu of MgCO_3 forms 40 amu of MgO

\[
\therefore 4.2 \text{ g of MgCO}_3 \text{ forms } \frac{40 \times 4.2}{84} = 2 \text{ g of MgO}
\]

84 amu of MgCO_3 liberates 44 amu of CO_2

\[
\therefore 4.2 \text{ g of MgCO}_3 \text{ liberates } \frac{44 \times 4.2}{84} = 2.2 \text{ g of CO}_2
\]

11. 7.1 g of chlorine reacts completely with iron as shown under.

\[
2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3
\]

Calculate (i) wt. of iron required (ii) wt. of ferric chloride formed. \([\text{Fe} = 56, \text{Cl} = 35.5]\)

**Ans.**

(i) \[
2\text{Fe} + 3\text{Cl}_2 \rightarrow 2\text{FeCl}_3
\]

\[
(2 \times 56) \quad 3(2 \times 35.5) \quad 2(56 + 3 \times 35.5)
\]

\[
= 112 \text{ amu} \quad = 213 \text{ amu} \quad = 325 \text{ amu}
\]
213 amu of Cl₂ combines with 112 amu of Fe

\[ \therefore 7.1 \text{ g of Cl}_2 \text{ combines with } \frac{112 \times 7.1}{213} \text{ g of Fe} \]

= 3.73 g

(ii) 213 amu of Cl₂ forms 325 amu of FeCl₃

\[ 7.1 \text{ amu of Cl}_2 \text{ forms } \frac{325 \times 7.1}{213} = 10.83 \text{ g of FeCl}_3 \]

12. Solve the following problems.

(i) What will be the mass of ferrous sulphide formed when 20 g of pure sulphur reacts with iron?

[Atomic weight of Fe = 56 and S = 32]

(ii) Calculate the mass of oxygen used in the formation of water from 10.2 g of hydrogen.

[Atomic weight of H = 1 and O = 16]

(iii) Calculate the weight of calcium carbonate which decomposes to produce

(a) 50 g of calcium oxide and

(b) 5 g of carbon dioxide.

(iv) Calculate the weight of magnesium oxide when 24 g of magnesium reacts with 32 g of oxygen. Also find the weight of oxygen left unused after the reaction.

Ans. (i) Fe + S → FeS

56 amu 32 amu (56 + 32) = 88 amu

32 amu of S produces 88 amu of FeS

\[ \therefore 20 \text{ g of S produces } \frac{88 \times 20}{32} \text{ g of FeS} \]

= 55 g of FeS

(ii) 2H₂ + O₂ → 2H₂O

2(1 × 2) (2 × 16) 2(1 + 2 + 16)

= 4 amu = 32 amu = 36 amu

4 amu of H₂ requires 32 amu of O₂ to form H₂O

\[ \therefore 10.2 \text{ g of H}_2 \text{ will require } \frac{32 \times 10.2}{4} \text{ g of O}_2 \text{ to form H}_2\text{O} \]

= 81.6 g of O₂

(iii) CaCO₃ → CaO + CO₂

(40 + 12 + 3 × 16) (40 + 16) (12 + 2 × 16)

100 amu = 56 amu = 40 amu
(a) 56 amu CaO is formed from 100 g of CaCO₃
∴ 50 g of CaO is formed from \( \frac{100 \times 50}{56} \) g of CaCO₃
= 89.29 g of CaCO₃

(b) 44 amu CO₂ is liberated by 100 g of CaCO₃
5 g of CO₂ is liberated by \( \frac{100 \times 5}{44} \) g of CaCO₃
= 11.36 g of CaCO₃

(iv) \( 2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO} \)
\[
(2 \times 24) + (2 \times 16) = 2(24 + 16)
= 48 \text{ amu} + 32 \text{ amu} = 80 \text{ amu}
\]
48 amu of Mg forms 80 amu of MgO
∴ 24 amu of Mg forms \( \frac{80 \times 24}{48} \) g of MgO = 40 g of MgO

48 amu of Mg requires 32 amu of O₂ for complete combustion.
∴ 24 g of Mg will require \( \frac{32 \times 24}{48} \) g of O₂ for complete combustion
= 16 g of O₂ for complete combustion
∴ Amount of O₂ left unused = (32 – 16) = 16 g.

13. What are “redox reactions”? What are the characteristic properties of “redox reactions”?
Ans. The reaction in which oxidation and reduction take place simultaneously is known as redox reaction. In this reaction, one substance is oxidised and the other substance is reduced at the same time. All chemical reactions involving loss or gain of electrons are redox reactions.

14. What are the criteria for the purity of water?
Ans. Boiling point of pure water is 100°C at normal atmospheric pressure (76 cm of mercury) and freezing point of pure water under the same condition is 0°C.

15. What is distillation? How will you separate a mixture of ethyl alcohol and water by the process of distillation?
Ans. Distillation is the process of first converting a liquid into its vapour state by heating it and then condensing the vapour back to the liquid state by cooling it.
The mixture of ethyl alcohol and water is separated by fractional distillation. The mixture of liquids is heated, when ethyl alcohol (b.p. 78°C) boils first. The vapour rises up the fractionating column and is cooled when it passes through the tube cooled by a condenser. The condensed vapour is collected in the collecting flask. The more volatile liquid rise into the fractionating column, condense in the column itself and fall back into the flask. Thus, the two liquids are separated.

16. What is a chemical equation? What are its implications?

(i) 200 grams of calcium carbonate is heated strongly. Find the mass of calcium oxide and carbon dioxide thus formed.

(ii) 25.0 gm of zinc carbonate is heated to a constant mass. What weight of zinc oxide is formed?

(iii) What weight of zinc is needed to prepare 5 gm of hydrogen from dilute sulphuric acid?

(iv) What weight of calcium carbonate is required to prepare 11 gm of carbon dioxide by the action of dilute hydrochloric acid?

(v) What minimum weight of water is needed to slake 5 kg of quicklime, assuming that there is no loss of water by evaporation?

(vi) From the equation, \(3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2\), calculate the mass of triferric tetraoxide, when 56 gm of iron is completely reacted with excess of steam.

(vii) How many kg of quicklime can be obtained by heating 500 kg of limestone?

Ans. The chemical equation is a symbolic representation of a chemical reaction with the help of symbols and formula of the elements and compounds involved in that reaction. It tells us about

(a) The reactants taking part in the reaction and the products formed.

(b) It shows the number of molecules and number of atoms of the reactants and products involved in the reaction.

(c) It tells us about the actual amount of reactants and products taking part in the chemical equation.

(d) It shows the chemical composition of the molecules of reactants and products.
(i) \( \text{CaCO}_3 \rightarrow \text{CaO} + \text{CO}_2 \)

\[
\begin{align*}
40 + 12 + 3 \times 16 & = 100 \text{ amu} \\
40 + 16 & = 56 \text{ amu} \\
12 + 2 \times 16 & = 44 \text{ amu}
\end{align*}
\]

100 amu of \text{CaCO}_3 forms 56 amu of \text{CaO}.

\[
\therefore \text{200 g of \text{CaCO}_3 forms } \frac{56 \times 200}{100} \text{ g of \text{CaO}} = 112 \text{ g of \text{CaO}}
\]

100 amu of \text{CaCO}_3 forms 44 amu of \text{CO}_2.

\[
\therefore \text{200 g of \text{CaCO}_3 forms } \frac{44 \times 200}{100} = 88 \text{ g of \text{CO}_2}
\]

(ii) \( \text{ZnCO}_3 \rightarrow \text{ZnO} + \text{CO}_2 \)

\[
\begin{align*}
65 + 12 + 3 \times 16 & = 125 \text{ amu} \\
65 + 16 & = 81 \text{ amu}
\end{align*}
\]

125 amu of \text{ZnCO}_3 produces 81 amu of \text{ZnO}.

\[
\therefore \text{25 g of \text{ZnCO}_3 produces } \frac{81 \times 25}{125} \text{ g of \text{ZnO}} = 16.2 \text{ g of \text{ZnO}}
\]

(iii) \( \text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2 \)

65 amu of zinc is needed to prepare 2 amu of \text{H}_2.

\[
\therefore \text{5 g of \text{H}_2 is prepared from } \frac{65 \times 5}{2} = 162.5 \text{ g of \text{Zn}}
\]

(iv) \( \text{CaCO}_3 + \text{HCl} \rightarrow \text{CaCl}_2 + \text{H}_2\text{O} + \text{CO}_2 \)

\[
\begin{align*}
40 + 12 + 3 \times 16 & = 100 \text{ amu} \\
12 + 2 \times 16 & = 44 \text{ amu}
\end{align*}
\]

44 amu of \text{CO}_2 is prepared from 100 amu of \text{CaCO}_3.

\[
\therefore \text{11 g of \text{CO}_2 is prepared from } \frac{100 \times 11}{44} = 25 \text{ g of \text{CaCO}_3}
\]

(v) \( \text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca(OH)}_2 \)

\[
\begin{align*}
40 + 16 & = 56 \text{ amu} \\
2 \times 1 + 16 & = 18 \text{ amu}
\end{align*}
\]

56 amu of \text{CaO} needs 18 amu of \text{H}_2\text{O}.

\[
\therefore \text{5 kg of \text{CaO needs } } \frac{18 \times 5}{56} \text{ kg of \text{H}_2\text{O}} = 1.607 \text{ kg of \text{H}_2\text{O}}
\]

(vi) \( 3\text{Fe} + 4\text{H}_2\text{O} \rightarrow \text{Fe}_3\text{O}_4 + 4\text{H}_2 \)

\[
\begin{align*}
3 \times 56 \text{ amu} & = 168 \text{ amu} \\
56 \times 3 + 16 \times 4 & = 232 \text{ amu}
\end{align*}
\]
168 amu of Fe produces 232 amu of Fe₃O₄

\[ \therefore 56 \text{ g of Fe produces } \frac{232 \times 56}{168} \text{ g of Fe₃O₄} \]

\[ = 77.33 \text{ g of Fe₃O₄} \]

(vii) \( \text{CaCO}_3 \xrightarrow{\Delta} \text{CaO} + \text{CO}_2 \)

\[ 40 + 12 + 3 \times 16 \quad 40 + 16 \]

\[ = 100 \text{ amu} \quad = 56 \text{ amu} \]

100 amu of limestone (CaCO₃) gives 56 amu of quicklime on heating

\[ \therefore 500 \text{ kg of limestone gives } \frac{56 \times 500}{100} \text{ kg of quicklime on heating} \]

\[ = 280 \text{ kg of quicklime} \]

17. How do the following help in bringing about a chemical change?
   (i) Pressure  
   (ii) light  
   (iii) catalyst  
   (iv) heat.

**Ans.**
   (i) A chemical reaction proceeds at an optimum pressure.
   (ii) Photochemical reactions proceed in the presence of light.
   (iii) **Catalyst:** It alters the rate of a chemical reaction without itself taking part in the reaction.
   (iv) **Heat:** Endothermic reactions proceed with the absorption of heat while exothermic reactions proceed with the evolution of heat.

18. Differentiate between irreversible and reversible reactions.

**Ans.**

**Irreversible reaction**

(i) In this type of reaction only a part of the reactants get converted into products. After a certain stage, the products start converting back into reactants.

(ii) The reaction proceeds in both the forward and backward direction.

**Reversible reaction**

In this type of reactions complete conversion of reactants into products take place.

The reaction proceeds in the forward direction only.
19. Name the substances that are getting oxidised in these reactions.
   (i) \( \text{Cu} + 2\text{H}_2\text{SO}_4 \rightarrow \text{CuSO}_4 + 2\text{H}_2\text{O} + \text{SO}_2 \)
   (ii) \( \text{CuSO}_4 + \text{Mg} \rightarrow \text{Cu} + \text{MgSO}_4 \)
   (iii) \( \text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O} \)
   (iv) \( \text{Cu} + 2\text{HCl} \rightarrow \text{CuCl}_2 + \text{H}_2 \)
   (v) \( 2\text{FeCl}_3 + \text{H}_2\text{S} \rightarrow 2\text{FeCl}_2 + 2\text{HCl} + \text{S} \)

   Ans. (i) \( \text{Cu} \) is getting oxidised to \( \text{CuSO}_4 \).
   (ii) \( \text{Mg} \) is getting oxidised to \( \text{MgSO}_4 \).
   (iii) \( \text{H}_2 \) is getting oxidised to \( \text{H}_2\text{O} \).
   (iv) \( \text{Cu} \) is getting oxidised to \( \text{CuCl}_2 \).
   (v) \( \text{H}_2\text{S} \) is getting oxidised to \( \text{S} \).

20. Name the product formed in each of the following combination reactions.
   (i) Nitrogen and oxygen
   (ii) Phosphorus and oxygen
   (iii) Calcium oxide and water
   (iv) Nitrogen and hydrogen
   (v) Carbon dioxide and water.

   Ans. (i) Nitric oxide  (ii) Phosphorus pentoxide
   (iii) Calcium hydroxide  (iv) Ammonia
   (v) Carbonic acid

21. Name the reactions
   (i) \( A + B \rightarrow AB \)
   (ii) \( AB \rightarrow A + B \)
   (iii) \( AB + C \rightarrow AC + B \)
   (iv) \( AB + CD \rightarrow AD + CB \)

   Ans. (i) Combination reaction  (ii) Decomposition
   (iii) Displacement  (iv) Double Displacement

****