Dev Academy
Yamunanagar (Haryana)

Chapter-1

Chemical Reactions and Equations

Class 10

Revision Notes

SCIENCE

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Part – 1

Chemical Equations

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Chemical Equation

- Chemical equations are symbolic representations of chemical reactions to describe the identities and quantities of reactants and products.

Writing a Chemical Equation :

- The general form of a chemical equation is:

Reactants → Products

- Reactants are the substances present at the start of the reaction.
- Products are the substances formed as a result of the reaction.
- The arrow represents the direction of the reaction, indicating the conversion of reactants into products.
- For example, the combustion of methane can be represented as:

$$CH_{4\,(g)} + 2O_{2\,(g)} \rightarrow CO_{2\,(g)} + 2H_2O_{\,(g)}$$

Information Contained in Chemical Equations :

- Chemical equations can include additional information such as state symbols (s = solid, l = liquid, g = gas, aq. = aqueous) to indicate the physical states of the substances involved, as well as reaction conditions such as temperature, pressure, and catalysts.

The Need for Balancing a Chemical Equation :

- Chemical equations follow the **law of conservation of mass**, which states that matter is neither created nor destroyed during a chemical reaction. Therefore, the number and types of atoms must be balanced on both sides of the equation.
- The common method used for balancing is **Hit and Trial method**.

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Balancing a Chemical Equation

- Let us try to balance the following chemical equation:

$$Fe + H_2O \rightarrow Fe_3O_4 + H_2$$

- Here are the steps to balance a chemical equation:
  - **Step 1:** Draw boxes around each chemical formula. Do not change anything inside the boxes while balancing the equation.

$$\boxed{Fe_{(s)}} + \boxed{H_2O_{(l)}} \rightarrow \boxed{Fe_3O_{4\,(s)}} + \boxed{H_{2\,(g)}}$$

  - **Step 2:** Write hypothetical coefficients (a, b, c, d, etc.) before the chemical formula of each compound. By doing so, consider the chemical equation hypothetically balanced.

$$\mathbf{a}\,\boxed{Fe_{(s)}} + \mathbf{b}\,\boxed{H_2O_{(l)}} \rightarrow \mathbf{c}\,\boxed{Fe_3O_{4\,(s)}} + \mathbf{d}\,\boxed{H_{2\,(g)}}$$

  - **Step 3:** Now, using hypothetical coefficients, calculate the number of atoms of all elements to the left-hand side and right-hand side of the equation.

Iron (Fe)		Oxygen (O)		Hydrogen (H)	
L.H.S.	R.H.S.	L.H.S.	R.H.S.	L.H.S.	R.H.S.
a	**3c**	**b**	**4c**	**2b**	**2d**

  - **Step 4:** As we have assumed the equation to be hypothetically balanced, we can equate the L.H.S. and R.H.S.

Iron (Fe)	Oxygen (O)	Hydrogen (H)
a = 3c	**b = 4c**	**2b = 2d**

  - **Step 5:** Now, try to determine the values of the coefficients (a, b, c, d) by setting one of them as unity (1). Let us consider the value of '**c**' to be unity (**1**). Now, find the value of a, b, and d.

a = 3 × 1 **a = 3**	**b = 4 × 1** **b = 4**	**2 × 4 = 2d** **4 = d**

  - **Step 6:** Now, replace the hypothetical coefficients with these determined values, and you will finally obtain the balanced chemical equation.

$$\mathbf{3}\,\boxed{Fe_{(s)}} + \mathbf{4}\,\boxed{H_2O_{(l)}} \rightarrow \mathbf{1}\,\boxed{Fe_3O_{4\,(s)}} + \mathbf{4}\,\boxed{H_{2\,(g)}}$$

Limitations of Chemical Equations

- A chemical equation does not tell us about the feasibility of a reaction (i.e., whether a reaction will take place or not.)
  - For example: $AgCl + NaNO_3 \rightarrow NaCl + AgNO_3$ [Not feasible]
- Chemical equation does not provide any information about the concentration of products formed during the reaction.
- Chemical equation does not give any actual idea about the rate of a reaction.

Physical Change and Chemical Change

- **Physical Change:**
  It involves alterations in the physical properties (i.e., physical state, shape, size, or phase) of a substance without changing its chemical composition. Physical changes are usually reversible.
  - Example: Changing the state of matter, such as melting, freezing, boiling, or condensing.
- **Chemical Change:**
  Chemical change involves the formation of new substances with different chemical properties. Chemical changes are typically not easily reversible.
  - Example: Combustion of wood or gasoline

  Following changes may be observed during a chemical reaction:
  - Change in temperature
  - Change in colour
  - Formation of a precipitate
  - Formation of bubbles or evolution of gas

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Practice Questions

Q 1.: Balance the following chemical equations.

(a) $CuCO_3 \rightarrow CuO + CO_2$

(b) $Pb(NO_3)_2 \rightarrow PbO + NO_2 + O_2$

(c) $N_2O_5 \rightarrow NO_2 + O_2$

(d) $FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$

(e) $Fe_2O_3 + HCl \rightarrow FeCl_3 + H_2O$

(f) $HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + H_2O$

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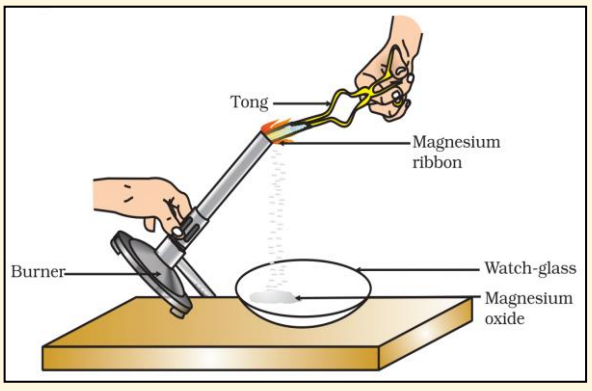
Some Common Chemical Reactions

Burning of Magnesium Ribbon

- When the magnesium ribbon is ignited, it starts to burn with a dazzling white flame, giving rise to a white powder known as magnesium oxide (MgO).
- Chemical equation for the burning of Mg can be represented as:

$$\mathbf{2Mg_{(s)} + O_{2\,(g)} \rightarrow 2MgO_{(s)}}$$

- Magnesium ribbon is often rubbed with sandpaper before burning to remove the thin layer of magnesium oxide (MgO) that forms on its surface over time. Rubbing the ribbon with sandpaper exposes fresh, unoxidized magnesium metal, which readily reacts with oxygen when ignited.



Reaction between Lead nitrate and Potassium iodide

- Imagine two colourless solutions in separate containers.
- In one container, there is a solution of lead nitrate, $Pb(NO_3)_2$, and in the other container, there is a solution of potassium iodide, KI.
- When the two solutions are mixed, a yellow precipitate of lead iodide (PbI_2) starts to form in the solution.
- The yellow precipitate gradually settles at the bottom of the container. Meanwhile, potassium and nitrate ions remain in solution as potassium nitrate.
- The chemical equation for the reaction between lead nitrate and potassium iodide can be represented as:

$$Pb(NO_3)_{2\,(aq.)} + 2KI_{\,(aq.)} \rightarrow PbI_{2\,(s)} + 2KNO_{3\,(aq.)}$$

- The reaction between lead nitrate and potassium iodide is a double displacement reaction.

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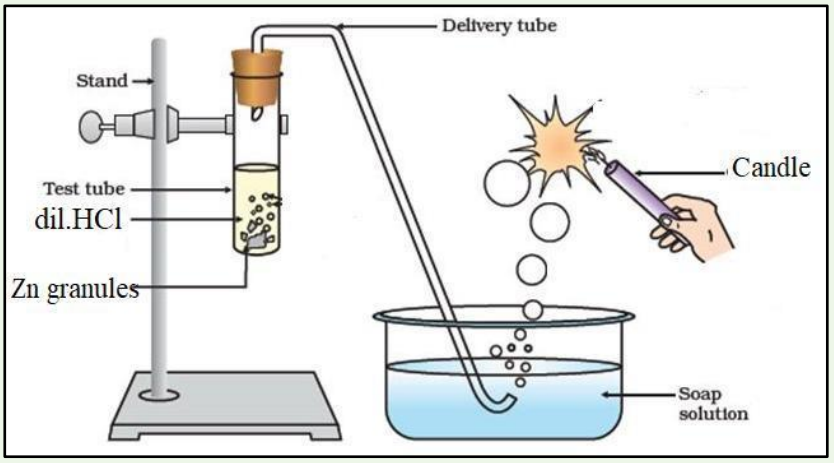
Reaction between Zinc metal and Hydrochloric acid

- As the zinc metal is placed into the test tube filled with hydrochloric acid, bubbles of H_2 gas start to form and rise to the surface of the liquid.
- The chemical equation for the reaction can be represented as:

$$Zn_{(s)} + 2HCl_{(aq.)} \rightarrow ZnCl_{2\,(aq.)} + H_{2\,(g)}$$

- To confirm the presence of hydrogen gas, you can perform "**pop test**." Follow these steps:
  - Pass the gas formed during the reaction through the soap solution.
  - Bring the soap bubbles close to a flame or a lit candle.
  - If the gas is hydrogen, the soap bubble will ignite with a small "pop" sound, indicating the presence of hydrogen gas.



NCERT Questions

1. Why should a magnesium ribbon be cleaned before burning in air?
2. Write the balanced equation for the following chemical reactions.
   (i) Hydrogen + Chlorine → Hydrogen chloride
   (ii) Barium chloride + Aluminium sulphate → Barium sulphate + Aluminium chloride
   (iii) Sodium + Water → Sodium hydroxide + Hydrogen
3. Write a balanced chemical equation 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.

Part – 2
Types of Chemical Reactions

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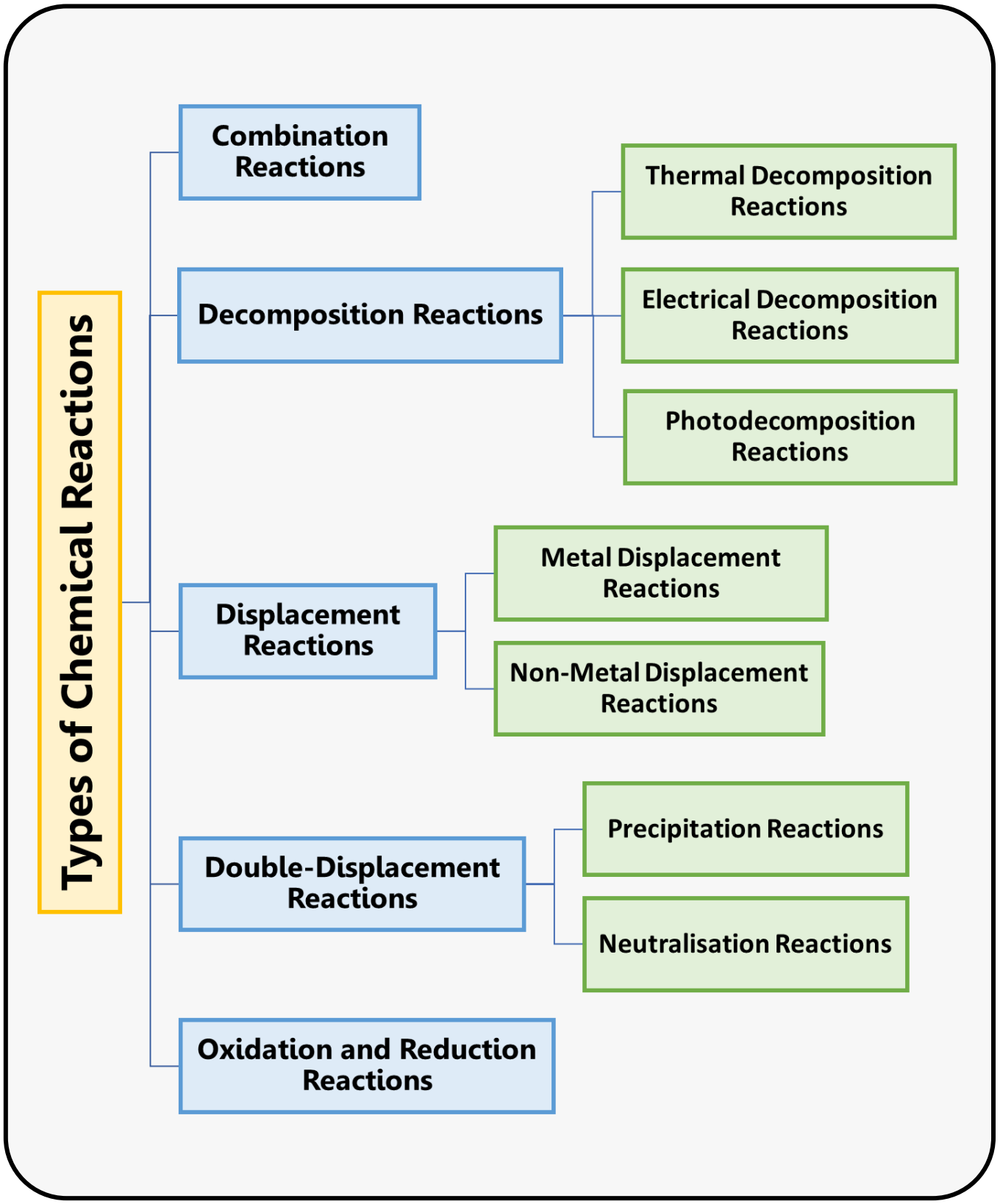

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Combination Reactions

- Combination reactions are chemical reactions where two or more substances (reactant molecules) combine to form a single, more complex product.
- Generally represented as: A + B → AB
- Examples:
  - $2Na_{(s)} + Cl_{2\,(g)} \rightarrow 2NaCl_{(s)}$
  - $2Mg_{(s)} + O_{2\,(g)} \rightarrow 2MgO_{(s)}$
  - $CaO_{(s)} + H_2O_{(l)} \rightarrow Ca(OH)_{2\,(aq.)}$
  - $CO_{2\,(g)} + H_2O_{(l)} \rightarrow H_2CO_{3\,(aq)}$ (Carbonic acid)
  - $N_{2\,(g)} + 3H_{2\,(g)} \rightarrow 2NH_{3\,(g)}$ (Ammonia)

Illustration of some Combination Reactions

Burning of Coal (C)

- During the burning of coal, the carbon present in coal undergoes oxidation by oxygen present in air.
- The reaction is **exothermic**.
- Combustion continues as long as there is a sufficient supply of oxygen.
- The chemical equation can be represented in a simplified form as:

$$\mathbf{C_{(s)} + O_{2\,(g)} \rightarrow CO_{2\,(g)}}$$

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Reaction between Calcium oxide (CaO) and Water (H_2O)

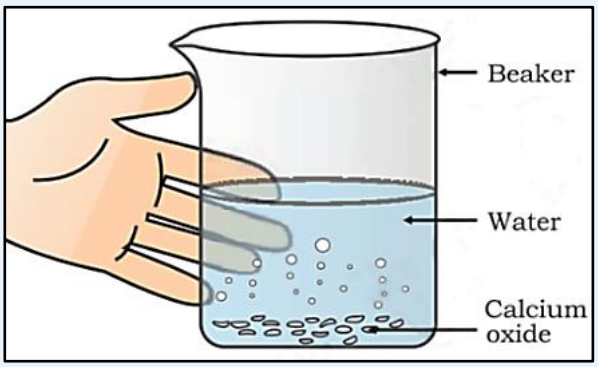
- Calcium oxide (quicklime; CaO) reacts with water (H_2O) to form calcium hydroxide (slaked lime; $Ca(OH)_2$).
- The reaction is **exothermic**.
- The chemical equation for the reaction can be represented as:

$$\mathbf{CaO + H_2O \rightarrow Ca(OH)_2}$$

- A solution of $Ca(OH)_2$ (slaked lime) produced in above reaction is used for **whitewashing** walls. Calcium hydroxide reacts slowly with the carbon dioxide (CO_2) in air to form a thin layer of calcium carbonate ($CaCO_3$) on the walls. Calcium carbonate is formed after two to three days of whitewashing and gives a shiny finish to the walls.

$$\mathbf{Ca(OH)_{2\,(aq)} + CO_{2\,(g)} \rightarrow CaCO_{3\,(s)} + H_2O_{\,(l)}}$$

- It is interesting to note that the chemical formula for marble is also $CaCO_3$.



Burning of Magnesium ribbon (Mg)

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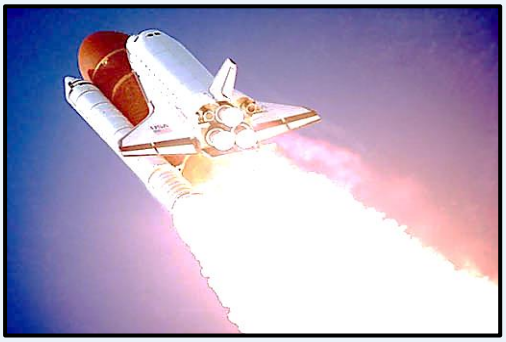
Burning of Hydrogen (H_2)

- The chemical reaction between hydrogen (H_2) and oxygen (O_2) is highly **exothermic**, resulting in the formation of water (H_2O).
- The balanced chemical equation for the reaction between H_2 and O_2 is:

$$\mathbf{2H_{2\,(g)} + O_{2\,(g)} \rightarrow 2H_2O_{\,(g)}}$$

- The combustion of hydrogen with oxygen is not only a chemical reaction but also a source of clean energy because the only byproduct of its combustion is water (H_2O).



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Exothermic Nature of Combination Reactions

- Exothermic reactions are chemical reactions that release energy in the form of heat to the surroundings.
- Many combination reactions tend to be **exothermic**. However, it is important to note that not all combination reactions are necessarily exothermic.
- Some common examples of exothermic reactions include:
  - Combustion Reactions: (Burning of natural gas, fuel, and wood etc.)

$$CH_{4\,(g)} + 2O_{2\,(g)} \rightarrow CO_{2\,(g)} + 2H_2O_{\,(g)}$$

  - Neutralization Reactions: (Reaction between an acid and a base)

$$HCl_{\,(aq)} + NaOH_{\,(aq)} \rightarrow NaCl_{\,(aq)} + H_2O_{\,(l)}$$

  - Oxidation of glucose during cellular respiration in living organisms.
    - The balanced equation for aerobic respiration is as follows:

$$C_6H_{12}O_6 + 6O_2 \rightarrow 6CO_2 + 6H_2O + \text{Energy (ATP)}$$

    - The energy released in above reaction is in the form of adenosine triphosphate (ATP), which serves as primary energy currency in biological system (i.e., cell).
    - The release of energy during respiration can be observed in the form of heat when an organisms respire.
  - The decomposition of vegetable matter into compost is an example of an exothermic reaction. This process is carried out by the action of microorganisms like bacteria and fungi.

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Decomposition Reactions

- Decomposition reactions are chemical reactions in which a single reactant molecule breaks down into two or more simpler product molecules.
- Generally represented as: $AB \rightarrow A + B$
- These reactions generally occur when the reactant compound is unstable.
- Decomposition reactions can occur due to various factors, such as heat, light, electric current or the presence of catalysts.
- Examples:
  - $CaCO_{3\,(s)} \xrightarrow{\text{Heat}} CaO_{(s)} + CO_{2\,(g)}$
  - $2AgBr_{(s)} \xrightarrow{\text{Sunlight}} 2Ag_{(s)} + Br_{2\,(g)}$
  - $2H_2O_{2\,(l)} \xrightarrow{\text{KI}} 2H_2O_{(g)} + O_{2\,(g)}$
  - $2KClO_{3\,(s)} \xrightarrow{\text{Heat}} 2KCl_{(s)} + 3O_{2\,(g)}$

Types of Decomposition Reactions

1. **Thermal Decomposition** occurs when a reactant compound breaks down upon heating.
   - Example: $2FeSO_{4\,(s)} \xrightarrow{\text{Heat}} Fe_2O_{3\,(s)} + SO_{2\,(g)} + SO_{3\,(g)}$
2. **Photo-decomposition** occurs in presence of sunlight energy.
   - Example: $2AgBr_{(s)} \xrightarrow{\text{Sunlight}} 2Ag_{(s)} + Br_{2\,(g)}$
3. **Electrolytic Decomposition** occurs when electric current is passed through an electrolyte solution, leading to the decomposition of the compound into its constituent elements or ions.
   - Example: $2H_2O_{(l)} \xrightarrow{\text{Electric Current (DC), } H^+} 2H_{2\,(g)} + O_{2\,(g)}$

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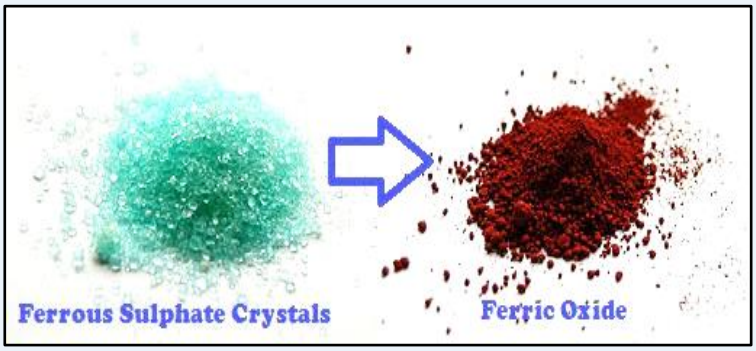
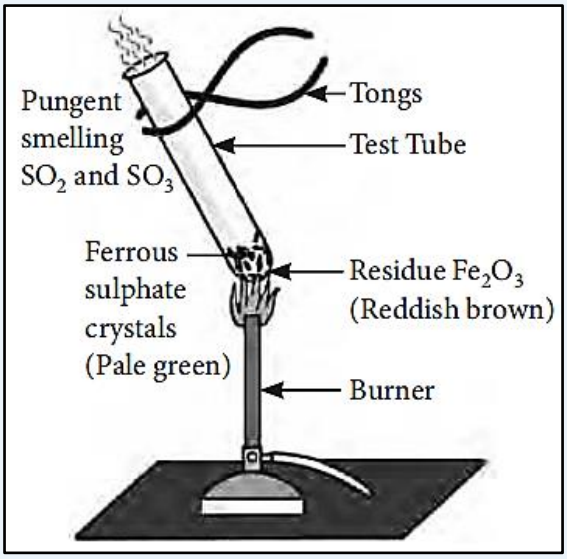
Illustration of some Decomposition Reactions

Thermal Decomposition of Ferrous sulphate ($FeSO_4$)

- Initially, the ferrous sulphate crystals are pale green in colour. However, upon heating, they gradually turn into a reddish-brown colour.
- This change in colour is due to the formation of ferric oxide (Fe_2O_3).
- As the ferrous sulphate ($FeSO_4$) crystals decompose, it releases SO_2 and SO_3 gases. These gases have pungent or suffocating smell.
- This reaction can be represented by the following equation:

$$2FeSO_{4\,(s)} \xrightarrow{\text{Heat}} Fe_2O_{3\,(s)} + SO_{2\,(g)} + SO_{3\,(g)}$$





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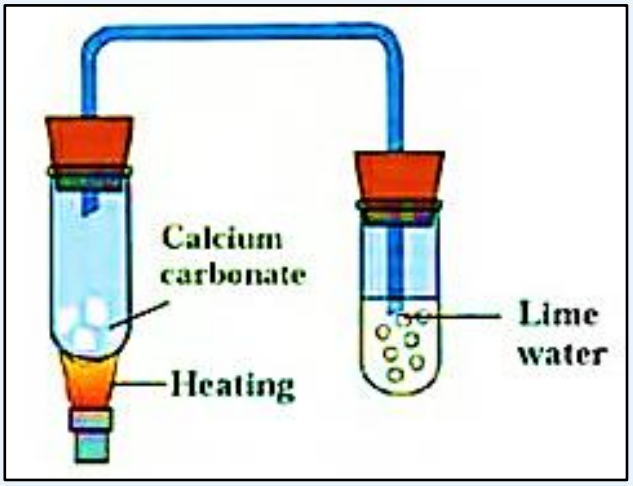
Thermal Decomposition of Calcium carbonate ($CaCO_3$)

- Upon heating, calcium carbonate ($CaCO_3$) breaks down into calcium oxide (CaO), and carbon dioxide gas (CO_2).

$$\underset{\text{Lime stone}}{CaCO_{3\,(s)}} \xrightarrow{\text{Heat}} \underset{\text{Quick Lime}}{CaO_{\,(s)}} + CO_{2\,(g)}$$

- To prove that carbon dioxide gas is produced during the decomposition of calcium carbonate, we can perform a simple experiment.
  - Prepare a solution of lime water ($Ca(OH)_2$). Now, pass the gas generated during the reaction through this lime solution.
    - As the gas enters the lime water, it undergoes a chemical reaction with $Ca(OH)_2$ to form $CaCO_3$. As a result, lime solution turns milky.

$$Ca(OH)_{2\,(aq)} + CO_{2\,(g)} \rightarrow CaCO_{3\,(s)} + H_2O_{\,(l)}$$



Thermal Decomposition of Lead Nitrate [$(Pb(NO_3)_2$]

- Upon Heating, lead nitrate breaks down into three simpler substances: lead(II) oxide (PbO), nitrogen dioxide gas (NO_2), and oxygen gas (O_2).

$$2Pb(NO_3)_{2\,(s)} \xrightarrow{\text{Heat}} 2PbO_{\,(s)} + 4NO_{2\,(g)} + O_{2\,(g)}$$

- Nitrogen dioxide is a reddish-brown gas with a pungent odour.
- Oxygen is a colourless and odourless gas that supports combustion.
- The production of nitrogen dioxide and oxygen gases can be visually represented by observing the change in colour and the release of fumes during the heating of lead nitrate.

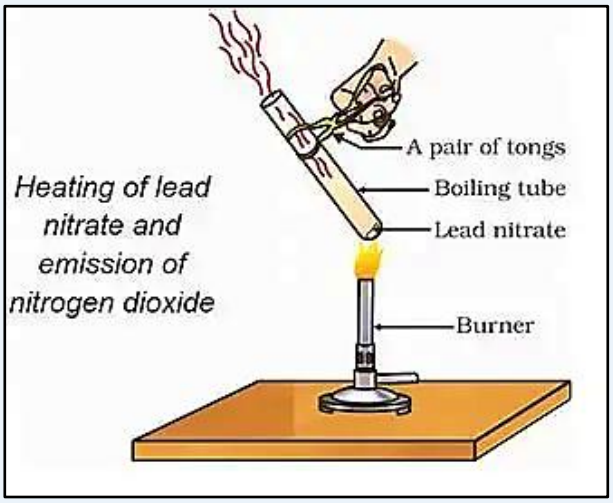


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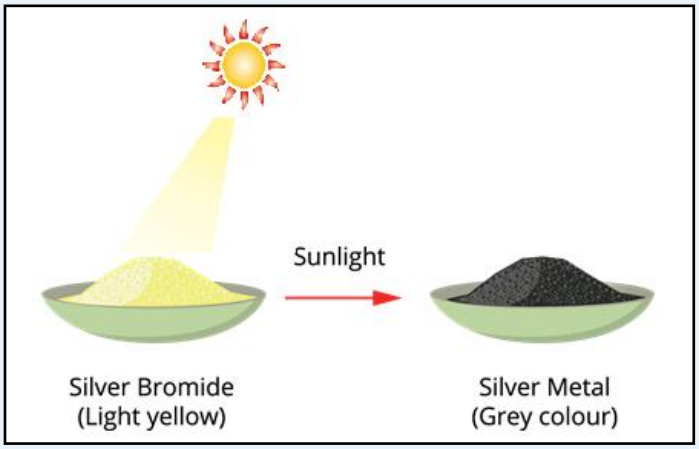
Photo-decomposition of Silver Bromide (AgBr)

- Silver bromide is a photosensitive compound.
- Initially, silver bromide appears as a yellowish-white solid.
- However, upon exposure to light (blue and Uv regions of the spectrum), the silver bromide dissociates or breakdown into black metallic silver (Ag) and elemental bromine gas (Br_2).

$$2AgBr_{(s)} \xrightarrow{\text{Sunlight}} 2Ag_{(s)} + Br_{2(g)}$$

- The photodecomposition of silver bromide plays a crucial role in black and white photography.



- Silver chloride also behave in the same way.
- Initially, silver chloride appears as a white solid.
- However, upon exposure to light (blue and Uv regions of the spectrum), the silver chloride dissociates or breakdown into black metallic silver (Ag) and elemental chlorine gas (Cl_2).

$$2AgCl_{(s)} \xrightarrow{\text{Sunlight}} 2Ag_{(s)} + Cl_{2(g)}$$

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Electrical Decomposition of Water (H_2O)

- When electrical current (DC) passes through the acidified water, the water (H_2O) is decomposed into hydrogen gas (H_2) and oxygen gas (O_2).
- Oxygen gas (O_2) is evolved at the anode (+) and hydrogen gas (H_2) is evolved at the cathode (-).
- The reactions that occur at each electrode are as follows:
  - At cathode (–): The hydrogen gas is evolved.

$$4H^+_{(aq)} + 4e^- \rightarrow 2H_{2\,(g)}$$

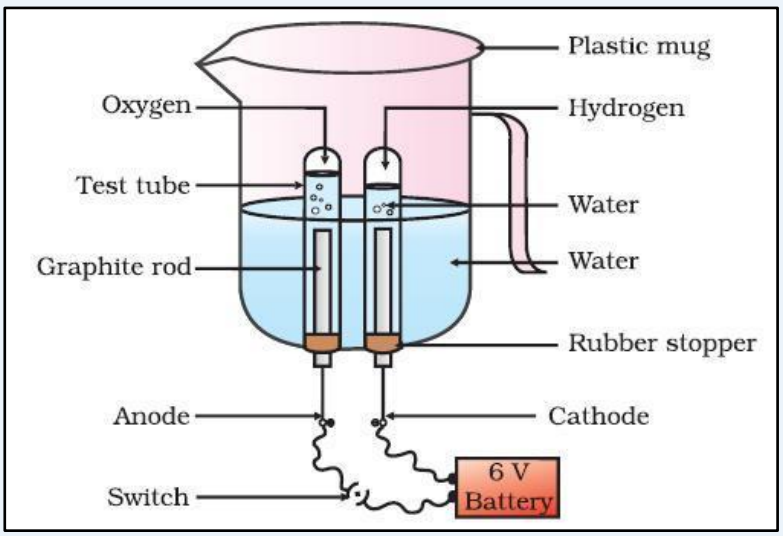
  - At anode (+): The oxygen gas is evolved.

$$2H_2O_{(l)} \rightarrow O_{2\,(g)} + 4H^+_{(aq)} + 4e^-$$

- Overall, the electrolysis of water can be represented as follows:

$$2H_2O_{(l)} \xrightarrow{\text{Electric Current (DC), } H^+} 2H_{2\,(g)} + O_{2\,(g)}$$

- The ratio of the volumes of hydrogen and oxygen gases formed is approximately 2:1, consistent with the stoichiometry of the reaction.



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Electrical Decomposition of Sodium Chloride (NaCl)

- When electrical current (DC) passes through molten sodium chloride, it is decomposed into elemental sodium (Na) and chlorine gas (Cl_2).
- Chlorine gas (Cl_2) is evolved at the anode (+) and Sodium metal (Na) is deposited at the cathode (-).
- Overall, the electrolysis of molten NaCl can be represented as follows:

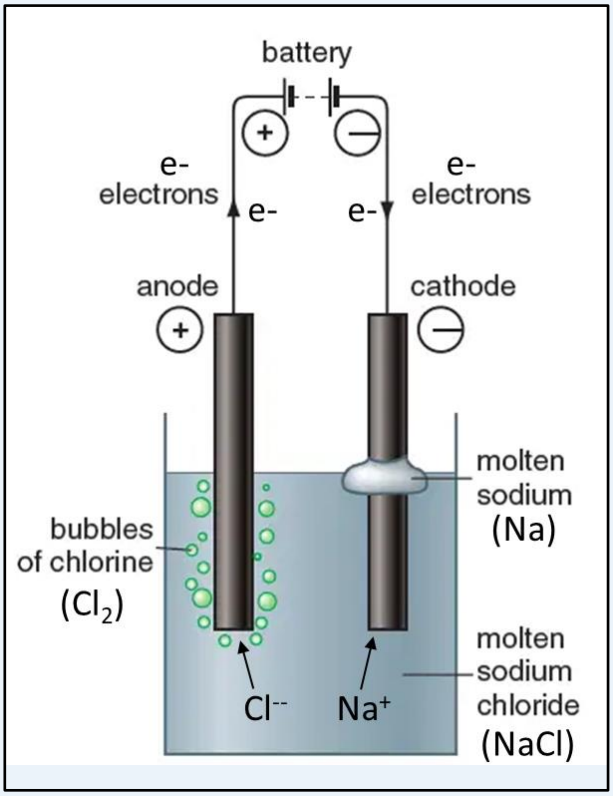
$$2NaCl \xrightarrow{\text{Electric Current (DC)}, H^+} 2Na + Cl_{2\,(g)}$$

- The reactions that occur at each electrode are as follows:
  - At cathode (–): The Sodium metal is deposited at the cathode.

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

  - At anode (+): The Chlorine gas is evolved at the anode.

$$2Cl^{-1} \rightarrow Cl_{2\,(g)} + 2e^-$$



Endothermic Nature of Decomposition Reactions

- The reactions in which energy is absorbed are known as endothermic reactions.
- Decomposition reactions are endothermic because they require an input of energy, whether it be in the form of heat, light, or electricity in order to break-down the reactants.
- However, it is important to note that not all endothermic reactions are necessarily decomposition reactions.
- Other example of endothermic reaction:
  - The reaction between barium hydroxide and ammonium chloride is an endothermic reaction.

$$Ba(OH)_2 + 2NH_4Cl \rightarrow BaCl_2 + 2NH_4OH$$

Upon touching the bottom of the test tube, you may feel a sensation of coldness or a decrease in temperature.

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Displacement Reactions

- Displacement or replacement reactions are a type of chemical reaction in which a more reactive element displaces a less reactive element from its compound.
- Generally represented as: **A** + **B**C → **A**C + **B** : A > B
- Here is a simplified **reactivity series of elements**, arranged in order of decreasing reactivity:

  K > Na > Ca > Mg > Al > Zn > Fe > Pb > H > Cu > Ag > Au

- Examples:

  Fe $_{(s)}$ + **Cu**$SO_{4\,(aq)}$ → **Fe**$SO_{4\,(aq)}$ + **Cu** $_{(s)}$: **Fe** > **Cu**

  $Zn_{(s)} + CuSO_{4\,(aq)} \rightarrow ZnSO_{4\,(aq)} + Cu_{(s)}$: Zn > Cu

  $Pb_{(s)} + CuCl_{2\,(aq)} \rightarrow PbCl_{2\,(aq)} + Cu_{(s)}$: Pb > Cu

  $Zn_{(s)} + PbCl_{2\,(aq)} \rightarrow ZnCl_{2\,(aq)} + Pb_{(s)}$: Zn > Pb

Types of Displacement Reactions

1. **Metal Displacement Reactions:**
   These reactions occur when a more reactive metal displaces a less reactive metal from its compound.
   - Example: $Fe_{(s)} + CuSO_{4\,(aq)} \rightarrow FeSO_{4\,(aq)} + Cu_{(s)}$
2. **Non-metal Displacement Reactions:**
   These reactions occur when a metal or non-metal displaces another non-metal from its compound.
   - Example 1: $Fe_{(s)} + H_2SO_{4\,(aq)} \rightarrow FeSO_{4\,(aq)} + H_{2\,(g)}$
   - Example 2: $Cl_{2\,(g)} + 2KI_{(aq)} \rightarrow 2KCl_{(aq)} + I_{2\,(g)}$

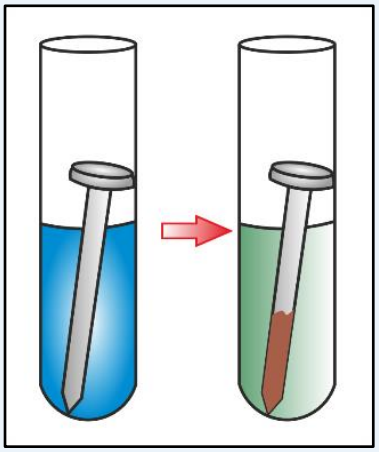
Illustration of Some Displacement Reactions

Iron displaces copper from copper sulphate ($CuSO_4$) solution

- When an iron (Fe) nail is added to a **blue** solution of copper sulphate ($CuSO_4$), iron displaces copper (Cu) from the copper sulphate solution. This leads to the formation of **light green** ferrous sulphate ($FeSO_4$) and solid copper (Cu).

$$\underset{\text{Iron}}{Fe_{(s)}} + \underset{\substack{\text{Copper sulphate}\\ \text{(Blue Colour)}}}{CuSO_{4\,(aq)}} \rightarrow \underset{\substack{\text{Ferrous sulphate}\\ \text{(Green Colour)}}}{FeSO_{4\,(aq)}} + \underset{\text{Copper}}{Cu_{(s)}}$$

- As the reaction continues, the blue colour fades because the concentration of $CuSO_4$ decreases, while a light green colour develops due to increase in the concentration of $FeSO_4$.
- This reaction demonstrates the higher reactivity of Fe compared to Cu.
- Iron (Fe) has a greater tendency to lose electrons and form positive ions, allowing it to replace copper (Cu) in the compound. The displaced copper is seen as a solid precipitate.



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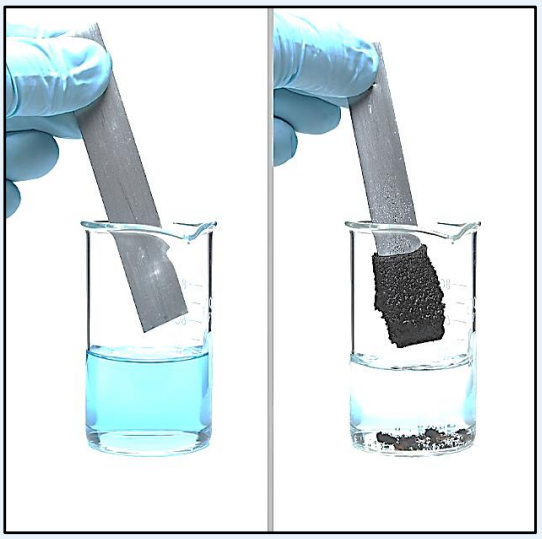
Zinc displaces copper from copper sulphate ($CuSO_4$) solution

- When zinc (Zn) is added to aqueous copper sulphate solution, zinc displaces copper (Cu) from the copper sulphate solution. This results in the formation of aqueous zinc sulphate ($ZnSO_4$) and solid copper (Cu).

$$\underset{\text{Zinc}}{Zn_{(s)}} + \underset{\substack{\text{Copper sulphate}\\\text{(Blue Colour)}}}{CuSO_{4\,(aq)}} \rightarrow \underset{\substack{\text{Zinc sulphate}\\\text{(Colourless)}}}{ZnSO_{4\,(aq)}} + \underset{\text{Copper}}{Cu_{(s)}}$$

- As the reaction continues, the blue colour fades because the concentration of $CuSO_4$ decreases, while a colourless develops due to increase in the concentration of $ZnSO_4$.



Zinc displaces Hydrogen from Hydrogen Chloride solution

Already Explained on Page Number – 7

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Double-Displacement Reactions

- Double-displacement reactions occur when two different compounds exchange their ions when their aqueous solutions are mixed and form new compounds.
- The general format of a double displacement reaction can be represented as:

$$AB + CD \rightarrow AD + CB$$

- Example;

$$BaCl_{2\,(aq)} + Na_2SO_{4\,(aq)} \rightarrow BaSO_{4\,(s)} + 2NaCl_{\,(aq)}$$
$$Pb(NO_3)_{2\,(aq)} + 2KI_{\,(aq)} \rightarrow PbI_{2\,(s)} + 2KNO_{3\,(aq)}$$
$$AgNO_{3\,(aq)} + NaCl_{\,(aq)} \rightarrow AgCl_{\,(s)} + NaNO_{3\,(aq)}$$
$$H_2SO_{4\,(aq)} + 2NaOH_{\,(aq)} \rightarrow Na_2SO_{4\,(aq)} + 2H_2O_{\,(l)}$$

Types of Double-Displacement Reactions

1. **Precipitation Reactions:**
   These reactions involve the formation of an insoluble solid (precipitate) that separates from the solution. The formation of a precipitate is due to the limited solubility of certain compounds in water, causing it to separate as a solid.
   - Example 1: $AgNO_{3\,(aq)} + NaCl_{\,(aq)} \rightarrow \mathbf{AgCl_{\,(s)}} + NaNO_{3\,(aq)}$
   - Example 2: $Pb(NO_3)_{2\,(aq)} + 2KI_{\,(aq)} \rightarrow \mathbf{PbI_{2\,(s)}} + 2KNO_{3\,(aq)}$
2. **Neutralization Reactions:**
   Neutralization reactions occur when an acid and a base react with each other to produce water and a salt
   - Example 1: $H_2SO_{4\,(aq)} + 2NaOH_{\,(aq)} \rightarrow Na_2SO_{4\,(aq)} + 2H_2O_{\,(l)}$
   - Example 2: $HCl_{\,(aq)} + KOH_{\,(aq)} \rightarrow KCl_{\,(aq)} + H_2O_{\,(l)}$

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Illustration of Some Double-Displacement Reactions

Reaction between Sodium sulphate and Barium Chloride

- When the two colourless solutions, sodium sulphate (Na_2SO_4) and barium chloride ($BaCl_2$) are mixed, a white precipitate of barium sulphate ($BaSO_4$) starts to form in the solution and gradually settles at the bottom of the container while sodium chloride (NaCl) remain in solution.
- The chemical equation for the reaction can be represented as:

$$Na_2SO_{4\,(aq.)} + BaCl_{2\,(aq.)} \rightarrow BaSO_{4\,(s)} + 2NaCl_{(aq.)}$$

Reaction between Lead nitrate and Potassium iodide

Already Explained on Page Number – 6

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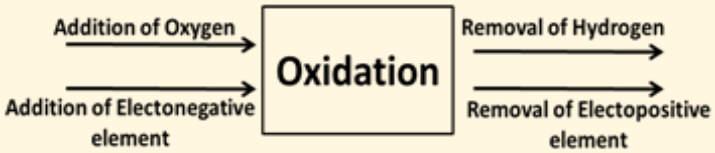
Oxidation and Reduction Reactions

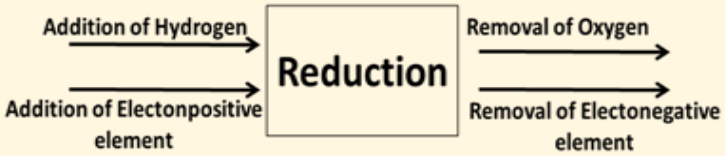
- **Oxidation:**
  The chemical reaction which involves in gain of oxygen or electronegative elements and loss of hydrogen or electropositive elements is called oxidation.



  - Example: When copper (Cu) is heated in air, it reacts with oxygen present in the air to form black coloured copper(II) oxide (CuO) on its surface through oxidation reaction.
    The reaction can be represented as follows:

$$2Cu_{(s)} + O_{2(g)} \xrightarrow{Heat} 2CuO_{(s)}$$

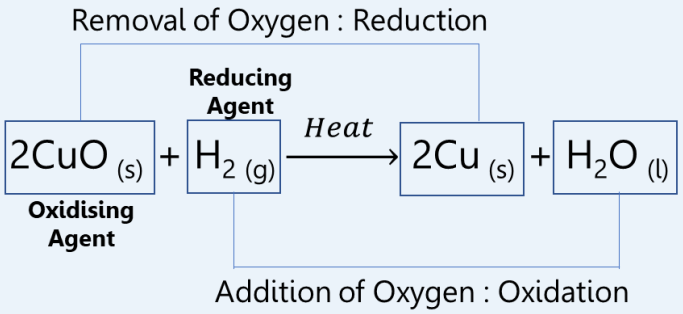
- **Reduction:**
  The chemical reaction which involves in gain of hydrogen or electropositive elements and loss of oxygen or electronegative elements is called reduction.



  - Example: When hydrogen gas is passed over heated black coloured copper(II) oxide (CuO), it turns brown due to formation of copper (Cu) through reduction reaction.
    The reaction can be represented as follows:

$$2CuO_{(s)} + H_{2(g)} \xrightarrow{Heat} 2Cu_{(s)} + H_2O_{(l)}$$

- Oxidation and reduction always occur simultaneously and are interconnected. Hence, they are collectively called **redox reactions**.



- Some other examples of redox reactions are:

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

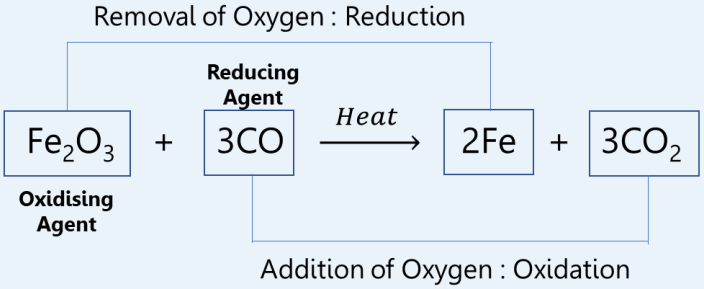
$2Mg + O_2 \rightarrow 2MgO$

$ZnO + C \rightarrow CO + Zn$

$ZnO + CO \rightarrow CO_2 + Zn$

Oxidising Agent and Reducing Agent

- **Oxidising agents or Oxidants** are the chemical substances which oxidise the other chemical substance but itself undergo in reduction.
- **Reducing agents or Reductants** are the chemical substances which reduce the other chemical substance but itself undergo in oxidation.



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Oxidation and Reduction in terms of Electrons

- **Oxidation** involves the loss of electrons. Hence, oxidation state of the reactant molecule increases.

  $Na \rightarrow Na^{+} + e^-$

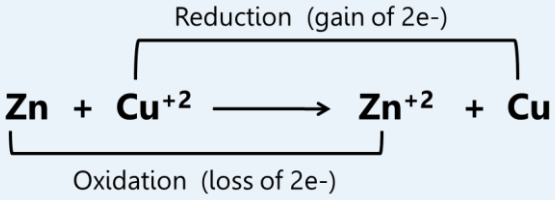
  $Mg \rightarrow Mg^{+2} + 2e^-$

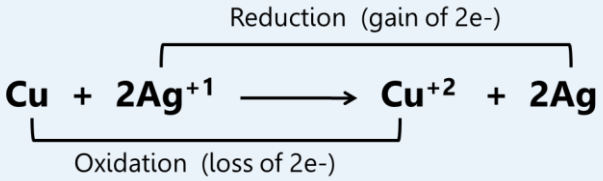
- **Reduction** involves the gain of electrons. Hence, oxidation state of the reactant molecule decreases.

  $Fe^{+3} + 3e^- \rightarrow Fe$

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

- Examples of Redox reaction:

1. 

2. 

NCERT Questions

1. Why does the colour of copper sulphate solution change when an iron nail is dipped in it?
2. Give an example of a double displacement reaction.
3. Identify the substances that are oxidised and the substances that are reduced in the following reactions.

   (i) $4Na_{(s)} + O_{2\,(g)} \rightarrow 2Na_2O_{(s)}$

   (ii) $CuO_{(s)} + H_{2\,(g)} \rightarrow Cu_{(s)} + H_2O_{(l)}$

Part – 3

Effects of Oxidation Reaction in Everyday Life

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Rancidity

- Rancidity refers to the process of deterioration or spoilage of foods containing fats and oils, resulting in undesirable changes in taste, odour, and texture. It is caused by the oxidation of fats and oils.

Methods to Prevent Rancidity

- **By Adding Antioxidants:**
  To prevent the rancidity, antioxidants are often added to foods that contain fats and oils. These antioxidants inhibit the oxidation reactions. Commonly used antioxidants are BHA (Butylated hydroxy anisole) and BHT (Butylated hydroxy toluene)
- **Replacing air by Nitrogen:**
  An interesting example of preventing oxidation can be seen in the production of potato chips. Manufacturers flush the bags of chips with gases such as nitrogen. By replacing the air inside the bag with nitrogen, the oxygen content is reduced, minimizing the chances of oxidation, and ensuring that the chips remain crispy and free from the undesirable effects of rancidity.
- **Vacuum Packing:**
  The process of rancidity can be slowed down by storing food items in airtight containers, thereby minimizing their exposure to air or oxygen.
- **By Keeping Food Items at Low Temperature:**
  When food items containing fats and oils are stored in refrigerator, the oxidation of food is slowed down and therefore, rancidity is retarded.

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Corrosion

- Corrosion is a natural process that occurs when metals react with substances in their environment, such as moisture, gases, or chemicals.
- Corrosion typically results in the formation of oxides, hydroxides, or sulphides on metal's surface, leading to change in its physical and chemical properties.
- If you observe copper and silver objects, you may notice a black coating on silver and the green coating on copper, are examples of corrosion.
    - Black coating on silver is caused by the formation of silver sulphide (Ag_2S) layer on the surface of silver due to the reaction between silver and sulphur compounds present in air (i.e., H_2S and SO_2 etc.)
    - The green coating on copper is caused by the formation of layer of copper carbonate, also known as verdigris ($CuCO_3.Cu(OH)_2$).

Rusting of Iron

- Rusting is a specific type of corrosion that occurs when iron or steel reacts with oxygen in the presence of water or moisture, resulting in the formation of iron oxide (commonly known as rust).
- You may have noticed that when iron articles are new, they have a shiny appearance. However, over time, they develop a reddish-brown powder coating. This process is known as rusting of iron.

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Methods for Prevention of Corrosion

- **Barrier Method**
  Applying a protective layer on the surface of the metal is an effective way to prevent corrosion. This can be achieved through methods such as painting, electroplating, or hot-dip galvanizing. The coating acts as a barrier, preventing direct contact between the metal and corrosive agents in the environment.
- **Galvanization**
  It is a widely used method for protecting metals, particularly iron or steel, from corrosion. It involves coating the metal with a layer of zinc to provide a protective barrier against environmental factors that can cause rusting and deterioration.
- **Anodising**
  It is an electrochemical process in which a metal surface is protected from corrosion by depositing a thick metal oxide layer. Anodising is usually done for non-ferrous metals or alloys. The metals for which anodising can be done are Aluminium, Magnesium, Titanium etc.

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Note

- Several metals exhibit a protective nature against corrosion due to their inherent properties. These metals form a protective layer of metal oxide on their surface, preventing further corrosion.
  Here are some examples: Al, Cr, Mg form their oxides Al_2O_3, Cr_2O_3, MgO respectively on their surface to prevent further corrosion.

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NCERT Textbook Questions

Q1.: Which of the statements about the reaction below are incorrect?

$2PbO_{(s)} + C_{(s)} \rightarrow 2Pb_{(s)} + CO_{2\,(g)}$

(a) Lead is getting reduced.
(b) Carbon dioxide is getting oxidised.
(c) Carbon is getting oxidised.
(d) Lead oxide is getting reduced.

Select Answer;
(i) (a) and (b)
(ii) (a) and (c)
(iii) (a), (b) and (c)
(iv) all

Q2.: $Fe_2O_3 + 2Al \rightarrow Al_2O_3 + 2Fe$

The above reaction is an example of a
(a) combination reaction.
(b) double displacement reaction.
(c) decomposition reaction.
(d) displacement reaction.

Q3.: What happens when dilute hydrochloric acid is added to iron fillings? 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.

Q4.: What is a balanced chemical equation?
Why should chemical equations be balanced?

Q5.: 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.

Q6.: Balance the following chemical equations.

(a) $HNO_3 + Ca(OH)_2 \rightarrow Ca(NO_3)_2 + H_2O$
(b) $NaOH + H_2SO_4 \rightarrow Na_2SO_4 + H_2O$
(c) $NaCl + AgNO_3 \rightarrow AgCl + NaNO_3$
(d) $BaCl_2 + H_2SO_4 \rightarrow BaSO_4 + HCl$

Q7.: Write the balanced chemical equations for the following reactions.

(a) Calcium hydroxide + Carbon dioxide → Calcium carbonate + water
(b) Zinc + Silver nitrate → Zinc nitrate + Silver
(c) Aluminium + Copper chloride → Aluminium chloride + Copper
(d) Barium chloride + Potassium sulphate → Barium sulphate + Potassium chloride

Q8.: Write the balanced chemical equation for the following and identify the type of reaction in each case.

(a) Potassium bromide$_{(aq)}$ + Barium iodide$_{(aq)}$ → Potassium iodide$_{(aq)}$ + Barium bromide$_{(s)}$

(b) Zinc carbonate$_{(s)}$ → Zinc oxide$_{(s)}$ + Carbon dioxide$_{(g)}$

(c) Hydrogen$_{(g)}$ + Chlorine$_{(g)}$ → Hydrogen chloride$_{(g)}$

(d) Magnesium$_{(s)}$ + Hydrochloric acid$_{(aq)}$ → Magnesium chloride$_{(aq)}$ + Hydrogen$_{(g)}$

Q9.: What does one mean by exothermic and endothermic reactions? Give examples.

Q10.: Why is respiration considered an exothermic reaction? Explain

Q11.: Why are decomposition reactions called the opposite of combination reactions? Write equations for these reactions.

Q12.: Write one equation each for decomposition reactions, where energy is supplied in the form of heat, light or electricity

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Q13.: What is the difference between displacement and double displacement reactions? Write equations for these reactions.

Q14.: In the refining of silver, the recovery of silver from silver nitrate solution involved displacement by copper metal. Write down the reaction involved.

Q15.: What do you mean by a precipitation reaction? Explain by giving examples.

Q16.: Explain the following in terms of gain or loss of oxygen with two examples each.
(a) Oxidation
(b) Reduction

Q17.: A shiny brown coloured element 'X' on heating in air becomes black in colour. Name the element 'X' and the black-coloured compound formed.

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Q18.: Why do we apply paint on iron articles?

Q19.: Oil and fat containing food items are flushed with nitrogen. Why?

Q20.: Explain the following terms with one example each.
(a) Corrosion
(b) Rancidity

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NCERT Exemplar Questions

Q1.: Which of the following is not a physical change?
(a) Boiling of water to give water vapour
(b) Melting of ice to give water
(c) Dissolution of salt in water
(d) Combustion of Liquefied Petroleum Gas (LPG)

Q2.: The following reaction is an example of a :

$4NH_{3\,(g)} + 5O_{2\,(g)} \rightarrow 4NO_{(g)} + 6H_2O_{(g)}$

(i) displacement reaction
(ii) combination reaction
(iii) redox reaction
(iv) neutralisation reaction

Select Answer;
(a) (i) and (iv)
(b) (ii) and (iii)
(c) (i) and (iii)
(d) (iii) and (iv)

Q3.: Which of the following statements about the given reaction are correct? $3Fe_{(s)} + 4H_2O_{(g)} \rightarrow Fe_3O_{4\,(s)} + 4H_{2\,(g)}$

(i) Iron metal is getting oxidised
(ii) Water is getting reduced
(iii) Water is acting as reducing agent
(iv) Water is acting as oxidising agent

Select Answer;
(a) (i), (ii) and (iii)
(b) (iii) and (iv)
(c) (i), (ii) and (iv)
(d) (ii) and (iv)

Q4.: Which of the following are exothermic processes?

(i) Reaction of water with quick lime
(ii) Dilution of an acid
(iii) Evaporation of water
(iv) Sublimation of camphor (crystals)

(a) (i) and (ii)
(b) (ii) and (iii)
(c) (i) and (iv)
(d) (iii) and (iv)

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Q5.: Three beakers labelled as A, B and C each containing 25 mL of water were taken. A small amount of NaOH, anhydrous $CuSO_4$ and NaCl were added to the beakers A, B and C respectively. It was observed that there was an increase in the temperature of the solutions contained in beakers A and B, whereas in case of beaker C, the temperature of the solution falls. Which one of the following statement(s) is(are) correct?

(i) In beakers A and B, exothermic process has occurred.
(ii) In beakers A and B, endothermic process has occurred.
(iii) In beaker C exothermic process has occurred.
(iv) In beaker C endothermic process has occurred.

Select Answer;

(a) (i) only
(b) (ii) only
(c) (i) and (iv)
(d) (ii) and (iii)

Q6.: Three beakers labelled as A, B and C each containing 25 mL of water A dilute ferrous sulphate solution was gradually added to the beaker containing acidified permanganate solution. The light purple colour of the solution fades and finally disappears. Which of the following is the correct explanation for the observation?

(a) $KMnO_4$ is an oxidising agent, it oxidises $FeSO_4$
(b) $FeSO_4$ acts as an oxidising agent and oxidises $KMnO_4$
(c) The colour disappears due to dilution; no reaction is involved
(d) $KMnO_4$ is an unstable compound and decomposes in presence of $FeSO_4$ to a colourless compound.

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Q7.: Which among the following is(are) double displacement reaction(s)?

(i) $Pb + CuCl_2 \rightarrow PbCl_2 + Cu$
(ii) $Na_2SO_4 + BaCl_2 \rightarrow BaSO_4 + 2NaCl$
(iii) $C + O_2 \rightarrow CO_2$
(iv) $CH_4 + 2O_2 \rightarrow CO_2 + 2H_2O$

Select Answer;

(a) (i) and (iv) (b) (ii) only
(c) (i) and (ii) (d) (iii) and (iv)

Q8.: 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) decomposition of chlorine gas from silver chloride
(iv) oxidation of silver chloride

Select Answer;

(a) (i) only (b) (i) and (iii)
(c) (ii) and (iii) (d) (iv) only

Q9.: Solid calcium oxide reacts vigorously with water to form calcium hydroxide accompanied by liberation of heat. This process is called slaking of lime. Calcium hydroxide dissolves in water to form its solution called lime water. Which among the following is (are) true about slaking of lime and the solution formed?

(i) It is an endothermic reaction
(ii) It is an exothermic reaction
(iii) The pH of the resulting solution will be more than seven
(iv) The pH of the resulting solution will be less than seven

Select Answer;

(a) (i) and (ii) (b) (ii) and (iii)
(c) (i) and (iv) (d) (iii) and (iv)

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Q10.: Barium chloride on reacting with ammonium sulphate forms barium sulphate and ammonium chloride. Which of the following correctly represents the type of the reaction involved?

(i) Displacement reaction
(ii) Precipitation reaction
(iii) Combination reaction
(iv) Double displacement reaction

Select Answer;

(a) (i) only
(b) (ii) only
(c) (iv) only
(d) (ii) and (iv)

Q11.: Electrolysis of water is a decomposition reaction. The mole ratio of hydrogen and oxygen gases liberated during electrolysis of water is

(a) 1:1
(b) 2:1
(c) 4:1
(d) 1:2

Q12.: Which of the following is(are) an endothermic process(es)?

(i) Dilution of sulphuric acid
(ii) Sublimation of dry ice
(iii) Condensation of water vapours
(iv) Evaporation of water

Select Answer;

(a) (i) and (iii)
(b) (ii) only
(c) (iii) only
(d) (ii) and (iv)

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Q13.: In the double displacement reaction between aqueous potassium iodide and aqueous lead nitrate, a yellow precipitate of lead iodide is formed. While performing the activity if lead nitrate is not available, which of the following can be used in place of lead nitrate?

(a) Lead sulphate (insoluble)
(b) Lead acetate
(c) Ammonium nitrate
(d) Potassium sulphate

Q14.: Which of the following gases can be used for storage of fresh sample of an oil for a long time?

(a) Carbon dioxide or oxygen
(b) Nitrogen or oxygen
(c) Carbon dioxide or helium
(d) Helium or nitrogen

Q15.: The following reaction is used for the preparation of oxygen gas in the laboratory

$$2KClO_{3\,(s)} \xrightarrow{Heat,\ Catalyst} 2KCl_{\,(s)} + 3O_{2\,(g)}$$

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 release of heat
(d) It is a photochemical decomposition reaction and exothermic in nature

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Q16.: Which one of the following processes involve chemical reactions?

(a) Storing of oxygen gas under pressure in a gas cylinder
(b) Liquefaction of air
(c) Keeping petrol in a china dish in the open
(d) Heating copper wire in presence of air at high temp.

Q17.: In which of the following chemical equations, the abbreviations represent the correct states of the reactants and products involved at reaction temperature?

(a) $2H_{2\,(l)} + O_{2\,(l)} \rightarrow 2H_2O_{(g)}$
(b) $2H_{2\,(g)} + O_{2\,(l)} \rightarrow 2H_2O_{(l)}$
(c) $2H_{2\,(g)} + O_{2\,(g)} \rightarrow 2H_2O_{(l)}$
(d) $2H_{2\,(g)} + O_{2\,(g)} \rightarrow 2H_2O_{(g)}$

Q18.: Which of the following are combination reactions?

(i) $2KClO_3 \xrightarrow{Heat} 2KCl + 3O_2$
(ii) $MgO + H_2O \rightarrow Mg(OH)_2$
(iii) $4Al + 3O_2 \rightarrow 2Al_2O_3$
(iv) $Zn + FeSO_4 \rightarrow ZnSO_4 + Fe$

Select Answer;

(a) (i) and (iii)
(b) (iii) and (iv)
(c) (ii) and (iv)
(d) (ii) and (iii)

Q19.: Write the balanced chemical equations for the following reactions and identify the type of reaction in each case.

(a) N_2 gas is treated with H_2 gas at 773K to form NH_3 gas.
(b) NaOH solution is treated with CH_3COOH to form CH_3COONa and water.
(c) Ethanol is warmed with ethanoic acid to form ethyl acetate in the presence of concentrated H_2SO_4
(d) Ethene is burnt in the presence of oxygen to form CO_2 , Water and releases heat and light

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Q20.: Write the balanced chemical equations for the following reactions and identify the type of reaction in each case.
(a) Thermit reaction, iron (III) oxide reacts with aluminium and gives molten iron and aluminium oxide.
(b) Magnesium ribbon is burnt in an atmosphere of N_2 gas to form solid magnesium nitride.
(c) Chlorine gas is passed in an aqueous KI solution to form potassium chloride solution and solid iodine.
(d) Ethanol is burnt in air to form carbon dioxide, water, and releases heat.

Q21.: Complete the missing components/variables given as x and y in the following reactions

(a) $Pb(NO_3)_{2\ (aq)} + 2KI_{(aq)} \rightarrow PbI_{2\ (x)} + 2KNO_{3\ (y)}$
(b) $Cu_{(s)} + 2AgNO_{3\ (aq)} \rightarrow Cu(NO_3)_{2\ (aq)} + x_{(s)}$
(c) $Zn_{(s)} + H_2SO_{4\ (aq)} \rightarrow ZnSO_{4\ (x)} + H_{2\ (y)}$
(d) $CaCO_{3\ (s)} \xrightarrow{x} CaO_{(s)} + CO_{2\ (g)}$

Q22.: Which among the following changes are exothermic or endothermic in nature?

(a) Decomposition of ferrous sulphate
(b) Dilution of sulphuric acid
(c) Dissolution of sodium hydroxide in water
(d) Dissolution of ammonium chloride in water

Q23.: Identify the reducing agent in the following reactions

(a) $4NH_3 + 5O_2 \rightarrow 4NO + 6H_2O$
(b) $H2O + F_2 \rightarrow HF + HOF$
(c) $Fe_2O_3 + 3CO \rightarrow 2Fe + 3CO_2$
(d) $2H_2 + O_2 \rightarrow 2H_2O$

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Q24.: Identify the oxidising agent (oxidant) in the following reactions

(a) $Pb_3O_4 + 8HCl \rightarrow 3PbCl_2 + Cl_2 + 4H_2O$

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

(c) $CuSO_4 + Zn \rightarrow Cu + ZnSO_4$

(d) $V_2O_5 + 5Ca \rightarrow 2V + 5CaO$

(e) $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

(f) $CuO + H_2 \rightarrow Cu + H_2O$

Q25.: Write the balanced chemical equations for the following reactions

(a) Sodium carbonate on reaction with hydrochloric acid in equal molar concentrations gives sodium chloride and sodium hydrogencarbonate.

(b) Sodium hydrogencarbonate on reaction with hydrochloric acid gives sodium chloride, water and liberates carbon dioxide.

(c) Copper sulphate on treatment with potassium iodide precipitates cuprous iodide (Cu_2I_2), liberates iodine gas and forms potassium sulphate.

Q26.: A solution of potassium chloride when mixed with silver nitrate solution, an insoluble white substance is formed. Write the chemical reaction involved and also mention the type of the chemical reaction?

Q27.: Ferrous sulphate decomposes with the evolution of a gas having a characteristic odour of burning sulphur. Write the chemical reaction involved and identify the type of reaction.

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Q28.: Why do fire flies glow at night?

Q29.: Grapes hanging on the plant do not ferment but after being plucked from the plant can be fermented. Under what conditions do these grapes ferment? Is it a chemical or a physical change?

Q30.: Which among the following are physical or chemical changes?

(a) Evaporation of petrol
(b) Burning of Liquefied Petroleum Gas (LPG)
(c) Heating of an iron rod to red hot.
(d) Curdling of milk
(e) Sublimation of solid ammonium chloride

Q31.: During the reaction of some metals with dilute hydrochloric acid, following observations were made.

(a) Silver metal does not show any change
(b) The temperature of the reaction mixture rises when aluminium (Al) is added.
(c) The reaction of sodium metal is found to be highly explosive
(d) Some bubbles of a gas are seen when lead (Pb) is reacted with the acid.

Explain these observations giving suitable reasons.

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Q32.: A substance X, which is an oxide of a group 2 element, is used intensively in the cement industry. This element is present in bones also. On treatment with water, it forms a solution which turns red litmus blue. Identify X and also write the chemical reactions involved.

Q33.: Write a balanced chemical equation for each of the following reactions and also classify them.

(a) Lead acetate solution is treated with dilute hydrochloric acid to form lead chloride and acetic acid solution.

(b) A piece of sodium metal is added to absolute ethanol to form sodium ethoxide and hydrogen gas.

(c) Iron (III) oxide on heating with carbon monoxide gas reacts to form solid iron and liberates carbon dioxide gas.

(d) Hydrogen sulphide gas reacts with oxygen gas to form solid sulphur and liquid water.

Q34.: Why do we store silver chloride in dark coloured bottles?

Q35.: Balance the following chemical equations and identify the type of chemical reaction.

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

(b) $HgO_{(s)} \rightarrow Hg_{(l)} + O_{2\ (g)}$

(c) $Na_{(s)} + S_{(s)} \rightarrow Na_2S_{(s)}$

(d) $TiCl_{4\ (l)} + Mg_{(s)} \rightarrow Ti_{(s)} + MgCl_{2\ (s)}$

(e) $CaO_{(s)} + SiO_{2\ (s)} \rightarrow CaSiO_{3\ (s)}$

(f) $H_2O_{2\ (l)} \rightarrow H_2O_{(l)} + O_{2\ (g)}$

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Q36.: A magnesium ribbon is burnt in oxygen to give a white compound X accompanied by emission of light. If the burning ribbon is now placed in an atmosphere of nitrogen, it continues to burn and forms a compound Y.
(a) Write the chemical formulae of X and Y.
(b) Write a balanced chemical equation,
when X is dissolved in water.

Q37.: Zinc liberates hydrogen gas when reacted with dilute hydrochloric acid, whereas copper does not. Explain why?

Q38.: A silver article generally turns black when kept in the open for a few days. The article when rubbed with toothpaste again starts shining.
(a) Why do silver articles turn black when kept in the open for a few days? Name the phenomenon involved.
(b) Name the black substance formed and give its chemical formula.

Q39.: On heating blue coloured powder of copper (II) nitrate in a boiling tube, copper oxide (black), oxygen gas and a brown gas X is formed
(a) Write a balanced chemical equation of the reaction.
(b) Identity the brown gas X evolved.
(c) Identity the type of reaction.
(d) What could be the pH range of aqueous solution of the gas X?

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Q40.: Give the characteristic tests for the following gases
(a) CO_2
(b) SO_2
(c) O_2
(d) H_2

Q41.: What happens when a piece of
(a) zinc metal is added to copper sulphate solution?
(b) aluminium metal is added to dilute hydrochloric acid?
(c) silver metal is added to copper sulphate solution?
Also, write the balanced chemical equation if the reaction occurs

Q42.: What happens when zinc granules are treated with dilute solution of H_2SO_4 , HCl, HNO_3 , NaCl and NaOH, also write the chemical equations if reaction occurs.

Q43.: On adding a drop of barium chloride solution to an aqueous solution of sodium sulphite, white precipitate is obtained.
(a) Write a balanced chemical equation of the reaction involved
(b) What other name can be given to this precipitation reaction?
(c) On adding dilute hydrochloric acid to the reaction mixture, white precipitate disappears. Why?

Q44.: You are provided with two containers made up of copper and aluminium. You are also provided with solutions of dilute HCl, dilute HNO_3 , $ZnCl_2$ and H_2O. In which of the above containers these solutions can be kept?

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