CHEMISTRY STUDY MATERIALS FOR CLASS 10
(NCERT Based Revision of Chapter -03)

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METALS AND NON-METALS

REACTION OF METALS WITH WATER:

Metals form respective metal hydroxide and hydrogen gas when react with water.

Metal + Water → Metal hydroxide + Hydrogen

Most of the metals do not react with water. However, alkali metals react vigorously with water.

Examples:

- Reaction of sodium metal with water: Sodium metal forms sodium hydroxide and liberates hydrogen gas along with lot of heat when reacts with water.

  $Na + H_2O \rightarrow NaOH + H_2$

- Reaction of aluminium metal with water: Reaction of aluminium metal with cold water is too slow to come into notice. But when steam is passed over aluminium metal; aluminium oxide and hydrogen gas are produced.

  $2Al + 3H_2O \rightarrow Al_2O_3 + 2H_2$

- Reaction of zinc metal with water: Zinc metal produces zinc oxide and hydrogen gas when steam is passed over it. Zinc does not react with cold water.

  $Zn + H_2O \rightarrow ZnO + H_2$

- Reaction of Iron with water: Reaction of iron with cold water is very slow and come into notice after a long time. Iron forms rust (iron oxide) when reacts with moisture present in atmosphere.

  Iron oxide and hydrogen gas are formed by passing of steam over iron metal.

  $3Fe + 4H_2O \rightarrow Fe_3O_4 + 4H_2$

- Reaction of potassium metal with water: Potassium metal forms potassium hydroxide and liberates hydrogen gas along with lot of heat when reacts with water.

  $K + H_2O \rightarrow KOH + H_2$

- Reaction of calcium metal with water: Calcium forms calcium hydroxide along with hydrogen gas and heat when reacts with water.

$$Ca + 2H_2O \rightarrow Ca(OH)_2 + H_2$$

- Reaction of magnesium metal with water: Magnesium metal reacts with water slowly and forms magnesium hydroxide and hydrogen gas.

$$Mg + 2H_2O \rightarrow Mg(OH)_2 + H_2$$

- When steam is passed over magnesium metal, magnesium oxide and hydrogen gas are formed.

$$Mg + H_2O \rightarrow MgO + H_2$$

REACTION OF METALS WITH DILUTE ACID:

Metals form respective salts when react with dilute acid.

Metal + dil. acid → Metal salt + Hydrogen

Examples:

- Reaction of aluminium with dilute hydrochloric acid: Aluminium chloride and hydrogen gas are formed.

$$2Al + 6HCl \rightarrow 2AlCl_3 + 3H_2$$

- Reaction of zinc with dilute sulphuric acid: Zinc sulphate and hydrogen gas are formed when zinc reacts with dilute sulphuric acid. This method is used in laboratory to produce hydrogen gas.

$$Zn + H_2SO_4 \rightarrow ZnSO_4 + H_2$$

- Reaction of sodium metal with dilute acid: Sodium metal gives sodium chloride and hydrogen gas when react with dilute hydrochloric acid.

$$2Na + 2HCl \rightarrow 2NaCl + H_2$$

- Reaction of potassium with dilute sulphuric acid: Potassium sulphate and hydrogen gas are formed when potassium reacts with dilute sulphuric acid.

$$2K + H_2SO_4 \rightarrow K_2SO_4 + H_2$$

- Reaction of magnesium metal with dilute hydrochloric acid: Magnesium chloride and hydrogen gas are formed when magnesium reacts with dilute hydrochloric acid. $Mg + 2HCl \rightarrow MgCl_2 + H_2$

Copper, gold and silver are known as noble metals. These do not react with water or dilute acids.

WEIGHT (Light) (Heavy)

Metal		Reaction with AIR	Reaction with WATER	Reaction with ACIDS
Potassium	K	Burn vigorously to form metal oxides	React with **cold water H_2O (l)** to form $H_{2\,(g)}$ and (metal)$OH_{(aq)}$	Strong reaction with **diluted acid (aq)** to form $H_{2\,(g)}$. Metal replaces H in compound to form a salt.
Sodium	Na			
Calcium	Ca	Burn with decreasing vigour down the series to form metal oxides	Only reacts with **steam $H_2O(g)$** to form $H_{2\,(g)}$ and metal oxide	
Magnesium	Mg			
Aluminium	Al			
Zinc	Zn			
Iron	Fe			
Lead	Pb	React slowly (when heated) to form an oxide layer	No reaction	React with **concentrated acid (l)**. Metal replaces H to make a salt. Some of the acid decomposes into $NO_{2\,(g)}$ and $H_2O_{\,(l)}$.
Copper	Cu			
Mercury	Hg			
Silver	Ag	No reaction		No reaction
Gold	Au			

METAL OXIDES: CHEMICAL PROPERTIES

Metal oxides are basic in nature. Aqueous solution of metal oxides turns red litmus blue.

REACTION OF METAL OXIDES WITH WATER:

Most of the metal oxides are insoluble in water. Alkali metal oxides are soluble in water. Alkali metal oxides give strong base when dissolved in water.

Examples:

- Reaction of sodium oxide with water: Sodium oxide gives sodium hydroxide when reacts with water.

$$Na_2O + H_2O \rightarrow 2NaOH$$

- Reaction of magnesium oxide with water: Magnesium oxide gives magnesium hydroxide with water.

  $MgO + H_2O \rightarrow Mg(OH)_2$

- Reaction of potassium oxide with water: Potassium oxide gives potassium hydroxide when reacts with water.

  $K_2O + H_2O \rightarrow 2KOH$

- Reaction of zinc oxide and aluminium oxide: Aluminium oxide and zinc oxide are insoluble in water. Aluminium oxide and zinc oxide are amphoteric in nature. An amphoteric substance shows both acidic and basic character. It reacts with base like acid and reacts with acid like a base.

  When zinc oxide reacts with sodium hydroxide, it behaves like an acid. In this reaction, sodium zincate and water are formed.

  $ZnO + 2NaOH \rightarrow Na_2ZnO_2 + H_2O$

- Zinc oxide behaves like a base when reacts with acid. Zinc oxide gives zinc chloride and water on reaction with hydrochloric acid.

  $ZnO + 2HCl \rightarrow ZnCl_2 + H_2O$

- In similar way aluminium oxide behaves like a base when reacts with an acid and behaves like an acid when reacts with a base.

- Aluminium oxide gives sodium aluminate along with water when reacts with sodium hydroxide.

  $Al_2O_3 + 2NaOH \rightarrow 2NaAlO_2 + H_2O$

- Aluminium oxide gives aluminium chloride along with water when it reacts with hydrochloric acid.

  $Al_2O_3 + 6HCl \rightarrow 2AlCl_3 + 3H_2O$

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