

## CHEMICAL REACTIONS AND EQUATIONS

**Chemical reactions** – they are the processes in which new substances with new properties are formed. It involves breaking of old chemical bonds and making of new chemical bonds. Only rearrangement of atoms takes place in a chemical reaction.

**Reactants** – substances which take place in a chemical reaction.

**Products** – new substances produced as a result of chemical reaction.

### **Burning of magnesium ribbon –**

- Mg is a very reactive metal. It forms MgO when it reacts with O<sub>2</sub>. A layer of MgO is stable and prevents the further reaction of Mg with O<sub>2</sub>. Therefore Mg ribbon is cleaned with sandpaper to remove this layer before burning.
- When Mg is burned it produces dazzling white flame and forms a white powder MgO
- $2\text{Mg} + \text{O}_2 \rightarrow 2\text{MgO}$

### **Characteristics of a chemical reaction**

#### **1. Evolution of a gas**

- $\text{Zn} + \text{dil H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2$
- $\text{Na}_2\text{CO}_3 + 2\text{HCl} \rightarrow 2\text{NaCl} + \text{CO}_2 + \text{H}_2\text{O}$
- $\text{CaCO}_3 + 2\text{HCl} \rightarrow \text{CaCl}_2 + \text{CO}_2 + \text{H}_2\text{O}$
- $\text{Zn} + 2\text{HCl} \rightarrow \text{ZnCl}_2 + \text{H}_2$

#### **2. Formation of a precipitate**

- A precipitate is a solid product which separates out from the solution during a chemical reaction.
- $\text{Pb}(\text{NO}_3)_2 + 2\text{KI} \rightarrow \text{PbI}_2 + 2\text{KNO}_3$  (yellow ppt of PbI<sub>2</sub>)
- $\text{BaCl}_2 + \text{H}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{HCl}$  (white ppt of BaSO<sub>4</sub>)
- $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$  (white ppt of AgCl)
- $\text{Na}_2\text{SO}_4 + \text{BaCl}_2 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$  (white ppt of BaSO<sub>4</sub>)

### 3. Change in colour

- Rust is brown in colour whereas iron is black in colour
- $\text{Pb}(\text{NO}_3)_2 + 2\text{KI} \rightarrow \text{PbI}_2 + 2\text{KNO}_3$  where reactants are colourless and yellow ppt is formed in products
- When we add lemon juice to Potassium permanganate, the purple colour of Potassium permanganate fades away and solution becomes colourless.

### 4. Change in temperature

- $\text{Zn} + \text{H}_2\text{SO}_4 \rightarrow \text{ZnSO}_4 + \text{H}_2 + \text{heat}$
- $\text{N}_2 + \text{O}_2 + \text{heat} \rightarrow 2\text{NO}$
- $\text{CaO} + \text{H}_2\text{O} \rightarrow \text{Ca}(\text{OH})_2 + \text{heat}$
- $\text{Ba}(\text{OH})_2 + \text{NH}_4\text{Cl} \rightarrow \text{BaCl}_2 + \text{NH}_3 + \text{H}_2\text{O}$  (endothermic)

### 5. Change in state

- Solid wax burns to form water vapour and  $\text{CO}_2$
- Petrol burns to form water vapour and  $\text{CO}_2$

## Exothermic and endothermic reactions

1. **Exothermic reactions** - Those reactions in which heat is evolved are exothermic reactions.

- $\text{CH}_4 + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \text{heat}$
- $\text{C} + \text{O}_2 \rightarrow \text{CO}_2 + \text{heat}$
- All combustion reactions are exothermic.
- Respiration is exothermic



2. **Endothermic reactions** - Those reactions in which heat is absorbed are known as endothermic reactions.

- $\text{N}_2 + \text{O}_2 + \text{heat} \rightarrow 2\text{NO}$

All decomposition reactions are endothermic.

## Chemical equations

The method of representing a chemical reaction with the help of symbols and formulae of the substances involved in it is known as chemical equation.

**Balanced chemical equations** have equal number of atoms of different elements in reactants and products.

**Unbalanced chemical equations** have unequal number of atoms of different elements in reactants and products.

## TYPES OF CHEMICAL REACTIONS

### 1. COMBINATION REACTIONS

- The reactions in which two or more substances combine to form a single substance under suitable conditions,
- $C + O_2 \rightarrow CO_2$
- $2H_2 + O_2 \rightarrow 2H_2O$
- $H_2 + Cl_2 \rightarrow 2HCl$
- $Fe + S \rightarrow FeS$

### 2. DECOMPOSITION REACTIONS

- The reactions in which a single compound splits into two or more simple substances under suitable conditions.
  - They are mostly endothermic in nature. Energy in the form of heat, light or electricity is generally absorbed to break the bonds in the reacting substances.
- a) **Thermal decomposition** – when a decomposition reaction is carried out by heating, it is called thermal decomposition.
- $CaCO_3 \rightarrow CaO + CO_2$
  - $2FeSO_4 \rightarrow Fe_2O_3 + SO_2 + SO_3$  (where  $FeSO_4$  is green in colour and  $Fe_2O_3$  is brown in colour)
  - $2Pb(NO_3)_2 \rightarrow 2PbO + 4NO_2$  (lead nitrate is colourless and lead oxide is yellow whereas nitrogen dioxide gas is brown in colour)
- b) **Electrolytic decomposition** – when a decomposition reaction is carried out by passing electricity.

- $2\text{H}_2\text{O} \rightarrow 2\text{H}_2 + \text{O}_2$
- $2\text{NaCl} \rightarrow 2\text{Na} + \text{Cl}_2$
- $2\text{Al}_2\text{O}_3 \rightarrow 4\text{Al} + 3\text{O}_2$

c) **Photo decomposition** – when a decomposition reaction is carried out in the presence of light.

- $2\text{AgCl} \rightarrow 2\text{Ag} + \text{Cl}_2$
- $2\text{AgBr} \rightarrow 2\text{Ag} + \text{Br}_2$

### USES OF DECOMPOSITION

- Proteins get decomposed to form aminoacids in our body.
- Digestion of food is decomposition
- Electrolytic decomposition is used to extract metals from their compounds

### 3. DISPLACEMENT REACTIONS

- Those reactions in which one element takes the place of another element in a compound. A more reactive element displaces a less reactive element from its compound.
- $\text{CuSO}_4 + \text{Zn} \rightarrow \text{ZnSO}_4$
- $\text{CuSO}_4 + \text{Fe} \rightarrow \text{FeSO}_4 + \text{Cu}$  (Copper sulphate is blue in colour whereas iron sulphate is green in colour)

### 4. DOUBLE DISPLACEMENT

- Reactions in which the compounds react by an exchange of ions to form new compounds
- $\text{AgNO}_3 + \text{NaCl} \rightarrow \text{AgCl} + \text{NaNO}_3$
- $\text{Pb}(\text{NO}_3)_2 + 2\text{KI} \rightarrow \text{PbI}_2 + 2\text{KNO}_3$
- $\text{BaCl}_2 + \text{Na}_2\text{SO}_4 \rightarrow \text{BaSO}_4 + 2\text{NaCl}$

### 5. OXIDATION AND REDUCTION REACTIONS (REDOX)

- The addition of oxygen to a substance or the removal of Hydrogen from a substance is called oxidation.
- The addition of hydrogen to a substance or the removal of oxygen from a substance is called reduction.

- The substance which gives oxygen or removes hydrogen for oxidation is called oxidising agent.
- The substance which gives hydrogen or removes oxygen for reduction is called reducing agent.
- $\text{CuO} + \text{H}_2 \rightarrow \text{Cu} + \text{H}_2\text{O}$        $\text{CuO}$  is reduced to  $\text{Cu}$  and  $\text{H}_2$  is oxidised to  $\text{H}_2\text{O}$
- $\text{H}_2\text{S} + \text{Cl}_2 \rightarrow \text{S} + 2\text{HCl}$        $\text{H}_2\text{S}$  is oxidised to  $\text{S}$  and  $\text{Cl}_2$  is reduced to  $\text{HCl}$

### REACTIVITY SERIES

K  
Na  
Ba  
Ca  
Mg  
Al  
Zn  
Fe  
Sn  
Pb  
H  
Cu  
Mn  
Hg  
Ag  
Au  
Pt

