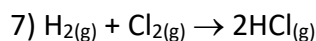
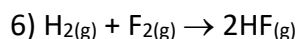
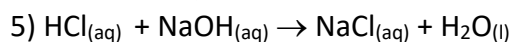
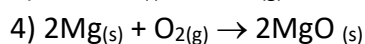
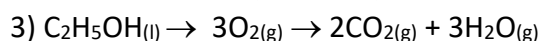
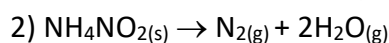

Chemical Process

- Based on the direction of their occurrence Chemical reactions are two types.
- **Irreversible reactions:** in these reactions reactants are converted into products and products cannot be converted into reactants.
- These are unidirectional as they occur in one direction. i.e. Reactants \rightarrow products.
- These are denoted by single arrow mark.
- These reactions almost go for completion i.e. reactants are almost completely convert into products.
- Precipitation – ionic reactions, explosive reactions, strong acid – strong base neutralisation reactions, combustion- reactions are irreversible.

Eg :1) $2\text{KClO}_{3(s)} \rightarrow 2\text{KCl}_{(s)} + 3\text{O}_{2(g)}$



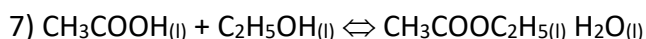
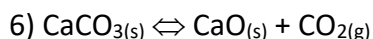
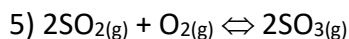
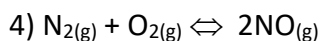
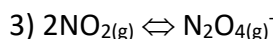
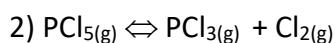
Reversible reactions :

- A reaction is said to be reversible, if both the forward and the backward reactions are taking place simultaneously under the given experimental conditions.
- Reactants giving rise to products is known as forward reaction.
- Products giving rise to reactants is known as reverse reaction (or) backward reaction.
- Reversible reactions are represented by writing a pair of half headed – arrows pointing in opposite directions in between the reactants and products.

Reactants \rightleftharpoons products

- A reverse reaction does not go to completion.
- Most of the reversible reactions are carried in the closed vessels.

Eg : 1) $\text{H}_{2(g)} + \text{I}_{2(g)} \rightleftharpoons 2\text{HI}_{(g)}$



Equilibrium State :

- The stage or state at which the rate of forward reaction is equal to the rate of the reverse reaction in a reversible reaction is known as the equilibrium stage or state.
 - The chemical equilibrium is considered as dynamic equilibrium because the forward and the reverse reactions continue to take place simultaneously at this stage also.
 - Equilibrium is established in
-

i) a reversible reaction ii) in a closed vessel

- In the beginning in a reversible reaction the rate of forward reaction is more since the concentration of reactants is more.
- As time proceeds the rate of forward reaction decreases as the concentrations of reactants decreases.
- In the beginning in a reversible reaction the rate of backward reaction is absolutely zero because the concentration of products is zero.
- AS time proceeds the rate of backward reaction increases since the concentrations of products also increases.
- At one stage the rate of forward reaction becomes equal to rate of backward reaction and no further change occurs in the concentration of reactions or products.
- At equilibrium, the concentration of reactants and products may not be equal but they remain constant.

Characteristics of chemical equilibrium :

- The rate of the forward reaction is equal to the rate of the reverse reaction.
 - The concentrations of the reactants and the products remain unchanged with time.
 - The observable properties such as pressure, concentration, density, colour also remain unchanged with time.
 - The attainment of chemical equilibrium can be recognised by the constancy in some macroscopic potteries like pressure, concentration, density, color etc.
 - The equilibrium is dynamic in nature. Both the forward reaction and the reverse reaction continue to take place simultaneously with equal rates.
 - A catalyst does not alter the state of equilibrium or the composition of the chemical substances of the reaction at the equilibrium. It only speeds up the attainment of the equilibrium.
 - Chemical equilibrium can be established from either side of the reversible reaction.
 - Chemical equilibrium can be homogeneous or heterogeneous and also ionic or molecular.
 - The factors such as pressure, concentration temperature presence of inert gas influence the position of the equilibrium.
 - At equilibrium, the value of Gibbs free energy change (ΔG) is zero ($\Delta G = 0$).
 - At equilibrium, ΔS is maximum.
 - The equilibrium does not tell us how long it takes for a reaction to attain equilibrium.
 - Once equilibrium is reached, it continues forever until the conditions like pressure, temperature, concentration etc, are altered.
 - At equilibrium the concentration of reactants may be equal or less or more than the concentration of products.
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