# Soch badlo by MAK

# Chemistry chapter 09

# SLO Questions

Q1. Differentiate between reversible and irreversible reactions.

| Reversible reactions | Irreversible reactions |
|---|---|
| **Definition** | |
| 1. The reactions in which the products can be changed/decomposed back to the reactants are called reversible reactions. | 1. The reactions in which the products cannot be converted/decomposed back to the reactants are called irreversible reactions. |
| **Completion of reaction** | |
| 2. These reactions never go to completion. | 2. These reactions are completed. |
| **Representation (arrow head)** | |
| 3. The equation of these reactions is represented by double headed arrow. $\rightleftharpoons$ | 3. The equations of these reactions are represented by single headed arrow. $(\longrightarrow)$ |
| **Forward/reverse direction** | |
| 4. These reactions occur in both directions. | 4. These reactions occur only in forward direction. |
| **Examples** | |
| 5. $2SO_2 + O_2 \rightleftharpoons 2SO_3$<br>$N_2 + 3H_2 \rightleftharpoons 2NH_3$ | 5. $2Mg + O_2 \longrightarrow 2MgO$<br>$C + O_2 \longrightarrow CO_2$ |

Q2. Differentiate between forward and reverse reactions. **OR** Differentiate between the macroscopic characteristics of forward and reverse reaction.

| Forward reaction | Reverse reaction |
|---|---|
| **Definition** | |
| A reaction in which the products are produced from the reactants is called a Forward reaction. | A reaction in which the products are converted/decomposed back to the reactants is called a Reverse reaction. |
| **Direction of the reaction** | |
| It is written from left to right. | It is written from right to left. |
| **Production of substance** | |
| Reactants produce products. | Products are changed back to the reactants. |
| **Rate of reaction** | |
| The rate of reaction is fastest in the beginning and gradually slows down. | The rate is zero in the beginning and gradually speeds up. |
| **Examples** | |
| $2NO + O_2 \rightleftharpoons 2NO_2$ | |
| $2NO + O_2 \longrightarrow 2NO_2$ | $2NO_2 \longrightarrow 2NO + O_2$ |

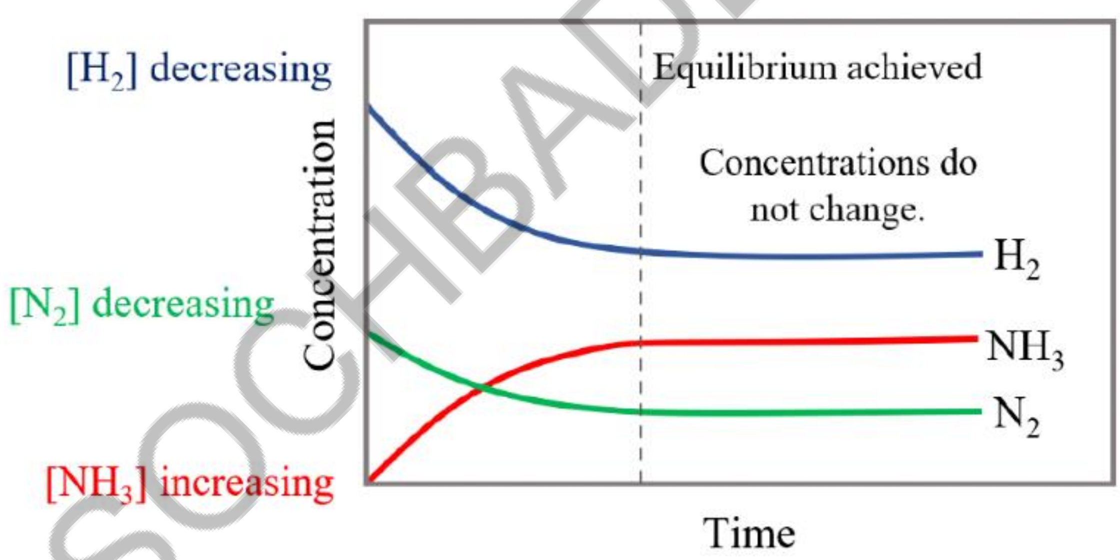
Q3. Why chemical equilibrium is also called Dynamic equilibrium?

Ans. **Chemical Equilibrium:** "A state of chemical reaction in which forward and reverse reactions take place at the same rate is called Chemical Equilibrium."

**Reason:** Chemical equilibrium is also known as Dynamic equilibrium because reactions do not stop when they come to equilibrium state. The individual molecules keep on reacting continuously. But there is not change in the actual amounts of reactants and products. This means concentration of reactants and products become constant at equilibrium stage.

**Example:** $3\ H_2(g) + N_2(g) \leftrightarrows 2\ NH_3$

**Graph:**




The dotted line shows the point when the concentrations of reactants and products do not change because the rates of the forward and reverse reactions are equal, and this is when the equilibrium is reached.

Q4. Why Kc is independent of initial concentration of reactants?

Ans. **Equilibrium constant (Kc):** Equilibrium constant is defined as the ratio of the product of concentration of products to the product of concentration of reactants at equilibrium.

**Reason:** The equilibrium constant (Kc) is independent of initial reactant concentrations because it represents the fixed ratio of product to reactant concentrations at equilibrium for a given reaction at a specific temperature. Regardless of the starting amounts of reactants, the system will adjust to maintain this ratio. Kc depends only on temperature and not on how much of each substance is initially present.

**Example:** $3\ H_2(g) + N_2(g) \leftrightarrows 2\ NH_3$

In this reaction, even if the concentration of the reactants ($H_2$ and $N_2$) is increased, it won't disturb the Kc because Kc doesn't depend upon the concentration of the products and reactants.

Q5. Why kc depends upon temperature?

Ans. **Equilibrium constant (Kc):** Equilibrium constant is defined as the ratio of the product of concentration of products to the product of concentration of reactants at equilibrium.

**Reason:** Kc is dependent on temperature. Any change in temperature can alter the equilibrium constant because it affects the rates of forward and reverse reactions differently. However, at a fixed temperature, Kc remains constant irrespective of the initial concentrations of the reactants and products.

**Example:** $3\ H_2(g) + N_2(g) \leftrightarrows 2\ NH_3$

In this example, if we increase the temperature of the reaction, the equilibrium constant will be different for it as compared to the equilibrium constant of the reaction at initial temperature. This is because the equilibrium constant is the ratio of the products and reactants at equilibrium that can be disturbed/influenced by the change in temperature.

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Q6. How Kc can predict direction of chemical reaction?

Ans. **Direction of reaction:**

At any particular time, direction of reaction can be predicted by means of ratio of Kc.

**Kc = [product]/[reactant] = Ratio**

There are three possibilities:

- If the ratio < Kc then it is a forward reaction at any point.
- If the ratio > Kc then it is a reverse reaction.
- If the ratio = Kc then it is at equilibrium.

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Q7. How kc predicts extent of chemical reaction?

Ans. **Prediction of extent of reaction:**

**Kc is very small:**

Reaction doesn't not proceed appreciably in the forward direction. The reaction is at the beginning.

**Kc is very large:**

Reaction is completed in the forward direction and it will now move in backward direction. Reaction is half completed or near to completion.

**Kc is neither very large nor very small:**

Kc is close to 1. Thus, the reaction is at equilibrium / near to equilibrium and it contain appreciable amount of reactant and product.

# Numerical

Q8. At equilibrium a mixture of $N_2$, $H_2$, and $NH_3$ gas at 500°C is determined to consists of 0.602 mol/dm$^3$ of $N_2$, 0.420 mol/dm$^3$ of $H_2$, and 0.113 mol/dm$^3$ of $NH_3$. What is the equilibrium constant for the reaction at this temperature?

$$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_3$$

Ans. **Given:**

$[N_2] = 0.602$ mol/dm$^3$

$[H_2] = 0.420$ mol/dm$^3$

$[NH_3] = 0.113$ mol/dm$_3$

**Required:**

Kc=?

**Formula:**

Kc= [product]/[reactant]

**Solution:**

Applying the above formula,

$Kc = [NH_3]^2 / [N_2][H_2]^3$

$Kc = [0.113]^2 / [0.602]\ [0.420]^3$

$Kc = 0.286$

**Result:**

So, the value of the equilibrium constant is 0.286