



Chemistry 10

Chapter 9 - Chemical Equilibrium

Exercise - Short Questions

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1. What are irreversible reactions? Give a few characteristics of them?

The reactions, in which the products do not recombine to form reactants, are called irreversible reactions.

Characteristics

- They are supposed to complete
- They are represented by putting a single arrow between the reactants and products.
- Dynamic equilibrium never established in irreversible reactions

2. Define chemical equilibrium state.

When the rate of the forward reaction is the same as the rate of reverse reaction, the

Composition of the reaction mixture remains constant, it is called a chemical equilibrium state.


Two types of equilibrium are:

- Static equilibrium.
- Dynamic equilibrium

3. Give the characteristics of reversible reaction.

reactions in which the products can recombine to form reactants are called reversible reactions.

characteristics

- These reactions never go to completion.
- They are represented by a double arrow  between reactants and products.
- These reactions proceed in both ways, i.e., they consist of two reactions; forward and reverse.

4. How is dynamic equilibrium established?

When reaction does not stop, only the rates of forward and reverse reactions become equal to each other but take place in opposite directions. This is called dynamic equilibrium state. Dynamic means reaction is still continuing.

At dynamic equilibrium state:

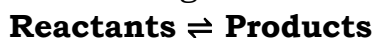
Rate of forward reaction = Rate of reverse reaction

5. Why at equilibrium state reaction does not stop?

At equilibrium state, a reaction does not stop. Forward and reverse reactions keep on taking place at the same rate but in opposite direction

6. Why is equilibrium state attainable from either way?

An equilibrium state is attainable from either way, i.e. starting from reactants or from products. Because it may start from reactant to give products while products recombine to give reactant again.



7. What is relationship between active mass and rate of reaction?

According to law of mass action "the rate of a reaction is directly proportional to the product of the active masses of the reacting substances".

Rate of reaction \propto product of the active masses of the reacting substances

8. Derive equilibrium constant expression for the synthesis of ammonia from nitrogen and hydrogen.



The rate of forward reaction $R_f = K_f [\text{N}_2] [\text{H}_2]^3$

The rate of reverse reaction $R_r = K_r [\text{NH}_3]^2$

The expression for the equilibrium constant for this reaction is

$$K_c = \frac{[\text{NH}_3]^2}{[\text{N}_2][\text{H}_2]^3}$$

9. Write the equilibrium constant expression for the following reactions:



The expression for the equilibrium constant for this reaction is

$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$



The expression for the equilibrium constant for this reaction is

$$K_c = \frac{[\text{CO}][\text{H}_2]^3}{[\text{CH}_4][\text{H}_2\text{O}]}$$

10. How direction of a reaction can be predicted?

Direction of a reaction at a particular moment can be predicted by inserting the concentration of the reactants and products at that particular moment in the equilibrium expression.

The direction of a reaction can be predicted by comparing Q_c and K_c

If $Q_c < K_c$; the reaction goes from left to right, i.e., in forward direction to attain equilibrium.

If $Q_c > K_c$; the reaction goes from right to left, i.e., in reverse direction to attain equilibrium.

If $Q_c = K_c$; forward and reverse reactions take place at equal rates i.e., equilibrium has been attained.

11. How can you know that a reaction has achieved an equilibrium state?

If $Q_c = K_c$; forward and reverse reactions take place at equal rates i.e., equilibrium has been attained.

12. What are the characteristics of a reaction that establishes equilibrium state at once?

- i. In these reaction the equilibrium has established with a very small conversion of reactants to products.
- ii. These reaction never goes to completion.
- iii. For these reaction value of K_c is very small

13. If reaction quotient Q_c of a reaction is more than K_c , what will be the direction of the reaction?

If $Q_c > K_c$; the reaction goes from right to left, i.e., in reverse direction to attain equilibrium.

14. An industry was established based upon a reversible reaction. It failed to achieve products on commercial level. Can you point out the basic reasons of its failure being a chemist?

If an industry was established based upon a reversible reaction, it cannot achieved desired commercial products because product again converted into reactants.