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CHEMISTRY 9th (New Book)

CHAPTER NO 6 — Equilibrium

Exercise: Multiple Choice Questions

1.	The equilibrium point will be reached very soon.	2.	N_2 and O_2
3.	Both containers will have the same composition of mixtures.	4.	Heating at high temperature in an open vessel
5.	The concentrations of all the reactants and products should become constant.	6.	Because the gas is dissolved under pressure, it comes out when pressure is decreased.
7.	The backward reaction will be favored.	8.	If the activation energy of the forward reaction is comparable to that of the backward reaction.
9.	They are useful only when equilibrium lies far to the right side.	10.	They will remain constant.

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Q#2: Short Questions

i. Difference Between Dynamic and Static Equilibrium;

Dynamic Equilibrium	Static Equilibrium
When the rate of forward and reverse reactions becomes equal but continues to proceed in opposite directions, it is called dynamic equilibrium.	When the reaction stops completely, it is called static equilibrium.

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ii. How will the following reversible reaction be affected if its temperature is increased?

$$2H_2O \longrightarrow 2H_2 + O_2$$

This is an endothermic reaction, so increasing the temperature favors the forward reaction. More products (H_2 and O_2) are produced.

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iii. How can you get the maximum yield in a reversible reaction?

Methods to get maximum yield:

1. Adding one or more of the reacting species.
2. Withdrawing one or more of the product species.
3. Changing the temperature of the reaction.
4. By using a catalyst.
5. Changing the pressure (if reactants or products are in gaseous state).

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iv. How can you decrease the time to attain equilibrium in a reversible reaction?

Effect of Catalyst:

A catalyst increases the rates of both forward and backward reactions. If a reversible reaction is carried out in the presence of a catalyst, it decreases the time taken to reach equilibrium.

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v. What is the effect of increasing pressure on the reaction:

$$N_2 + O_2 \rightleftharpoons 2NO$$

Here, two moles of reactants produce two moles of products. So, there is **no effect of pressure**. Pressure changes only affect
reactions where the number of moles of reactants and products are unequal.

Q#3: Constructed Response Questions

i. Why are some reactions irreversible while others are reversible?

The reversibility of a reaction depends on the nature of reactants, products, and energy changes.

- **Irreversible Reactions:**
  (a) Complete conversion of reactants into products.
  (b) Formation of a stable product.
  (c) Large energy release.
- **Reversible Reactions:**
  (a) Dynamic equilibrium is established.
  (b) Similar stability between reactants and products.
  (c) Influence of conditions (temperature, pressure).

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ii. Why are combustion reactions generally irreversible? Reason:

- **Large energy release:** Combustion is highly exothermic (heat and light). The reverse requires enormous energy input, so it is unfavorable.
- **Formation of stable products:** Combustion produces very stable products such as CO_2 and H_2O, which are difficult to break down.
- **Gas evolution:** CO_2 and H_2O vapors escape as gases, removing them from the reaction mixture and preventing the reverse reaction.

iii. Can you make an irreversible reaction reversible and vice versa?

- **Making an Irreversible Reaction Reversible:**
  Some irreversible reactions can become reversible by changing reaction conditions (temperature, pressure, catalyst).
  Example:
  The decomposition of calcium carbonate can become reversible if CO_2 is kept under pressure.

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$$CaCO_3 \rightarrow CaO + CO_2$$

Making a Reversible Reaction Irreversible:

A reversible reaction can be made irreversible by removing products (e.g., releasing a gas, forming a precipitate).
Example:
Removing ammonia (NH_3) from the Haber process forces the reaction forward.

iv. How do you know if a reaction is reversible or irreversible?

- **Irreversible reaction:** Goes to completion; no reactant species left.
- **Reversible reaction:** Does not go to completion; products react to form reactants again.

v. Do the phase changes in water (solid ↔ liquid ↔ vapour) show reversibility?

Yes. Phase changes are purely physical phenomena and are **reversible**.

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Examples:

1. Ice (solid) melts to liquid water, and water can freeze back to ice.
2. Water (liquid) evaporates to vapors, and vapor condenses to water.