

Chemical Equilibria:

1. Conceptual MCQ

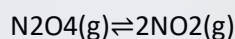
At equilibrium, which of the following statements is always true?

- (A) The concentrations of reactants and products are always equal.
- (B) The forward and reverse reaction rates are equal.
- (C) The reaction stops completely.
- (D) The equilibrium constant changes with the initial concentrations.

Answer: (B) The forward and reverse reaction rates are equal.

2. Numerical NAT

For the reaction:



The equilibrium constant K_p at 25°C is **0.144**. If the total pressure at equilibrium is **1 atm**, calculate the partial pressure (in atm) of **NO₂** at equilibrium.

Answer: 0.401 atm

(Solution involves solving for P_{NO_2} using equilibrium expressions.)

3. Thermodynamics MCQ

For an endothermic reaction, how does an increase in temperature affect the equilibrium position?

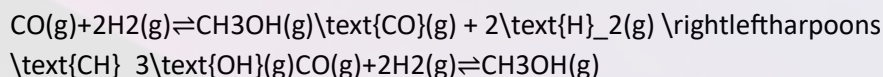
- (A) Shifts the equilibrium to the left
- (B) Shifts the equilibrium to the right
- (C) No effect on equilibrium position
- (D) Decreases the equilibrium constant

Answer: (B) Shifts the equilibrium to the right

(According to Le Chatelier's principle, an increase in temperature favors the endothermic direction.)

4. Le Chatelier's Principle MCQ

For the reaction:



What will happen if the pressure of the system is increased by decreasing the volume?

- (A) More methanol is formed
- (B) More CO and H₂ are formed
- (C) No change in equilibrium composition
- (D) The equilibrium constant changes

Answer: (A) More methanol is formed

(Since methanol formation decreases the number of gas molecules, increasing pressure shifts equilibrium toward CH_3OH .)

5. Calculation-Based MCQ

For the reaction:



The equilibrium constant K_c at 400°C is **50**. If the initial concentrations of H_2 and I_2 are **0.5 M** each, and no HI is present initially, what is the equilibrium concentration of **HI**?

- (A) 0.98 M
- (B) 0.45 M
- (C) 1.0 M
- (D) 0.90 M

Answer: (C) **1.0 M**

(Solution involves solving the quadratic equation from the ICE table.)