Passage 3

N_2O_3 is an unstable oxide of nitrogen and it decomposes into $NO(g)$ and $NO_2(g)$ where $NO_2(g)$ is further dimerise into N_2O_4 as

(i) $N_2O_3(g) \rightleftharpoons NO_2(g) + NO(g)$; $K_{p_1} = 2.5$ bar

(ii) $2NO_2(g) \rightleftharpoons N_2O_4(g)$; K_{p_2}

A flask is initially filled with pure $N_2O_3(g)$ having pressure 2 bar and equilibria was established.

At equilibrium partial pressure of $NO(g)$ was found to be 1.5 bar.

1. The equilibrium partial pressure of $N_2O_3(g)$ is:

(a) 0.5 bar (b) 1.0 bar (c) 1.5 bar (d) 0.1 bar

2. The equilibrium partial pressure of $NO_2(g)$ is:

(a) 0.066 bar (b) 0.133 bar (c) 0.423 bar (d) 0.83 bar

3. The value of K_{p_2} is:

(a) 0.16 bar^{-1} (b) 0.32 bar^{-1} (c) 0.48 bar^{-1} (d) 0.64 bar^{-1}

$$N_2O_3(g) \rightleftharpoons NO_2(g) + NO(g) \; ; \quad K_{p_1} = 2.5 \text{ bar}$$

$$2NO_2(g) \rightleftharpoons N_2O_4(g) \qquad ; \quad K_{p_2}$$

$x - y \qquad\qquad y/2$

$$P_{NO} = x = 1.5 \text{ b}$$

$$\therefore \quad K_{p_1} = \frac{P_{NO} \cdot P_{NO_2}}{P_{N_2O_3}}$$

$$2.5 = \frac{x(x-y)}{2-x} = \frac{1.5(1.5-y)}{2-1.5} = 4.5 - 3y$$

$$\Rightarrow \quad y = \frac{2}{3} \text{ bar}$$

(1) $P_{N_2O_3} = 2 - x = 2 - 1.5 = 0.5$ b

(2) $P_{NO_2} = x - y = 1.5 - \frac{2}{3} = \frac{2.5}{3}$ b

(3) $K_{p_2} = \frac{y}{2(x-y)^2} = \frac{2/3}{2\left(\frac{2.5}{3}\right)^2} = 0.48 \text{ bar}^{-1}$