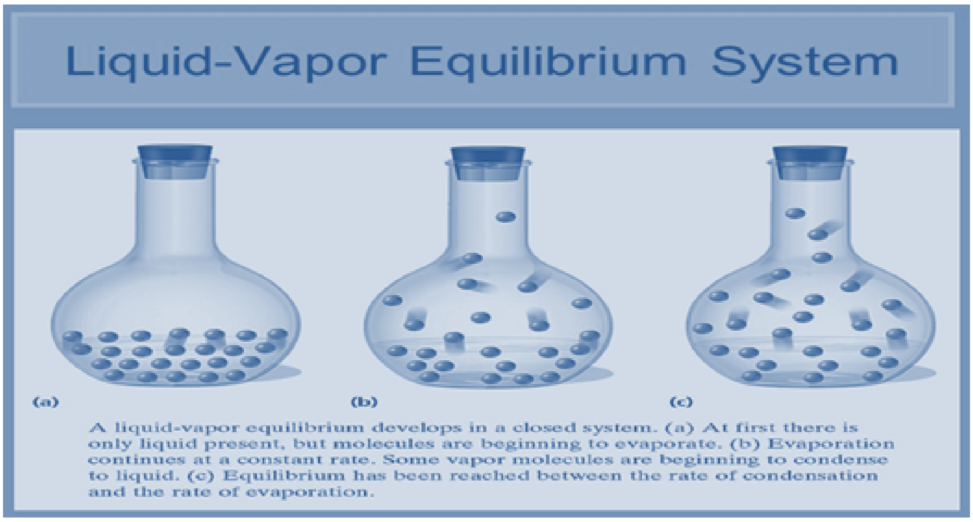
Chemistry Class 11 NCERT Solutions: Chapter 7 Equilibrium Part 1

Q: 1. A liquid is in equilibrium with its vapour in a sealed container at a fixed temperature. The volume of the container is suddenly increased.



(A) What is the initial effect of the change on vapour pressure?

(B) How do rates of evaporation and condensation change initially?

(C) What happens when equilibrium is restored finally and what will be the final vapour pressure?

Answer:

(A) If the volume of the container is suddenly increased, then vapour pressure would decrease initially. This is because the amount of vapour remains the same, but the volume increases suddenly. As a result, the same amount of vapour is distributed in a larger volume.

(B) Since the temperature is constant, the rate of evaporation also remains constant. When the volume of the container is increased, the density of the vapour phase decreases. As a result, the rate of collisions of the vapour particles also decreases. Hence, the rate of condensation decreases initially.

(C) When equilibrium is restored finally, the rate of evaporation becomes equal to the rate of condensation. In this case, only the volume changes while the temperature remains constant. The vapour pressure depends on temperature and not on volume. Hence, final vapour pressure will be equal to the original vapour pressure of the system.

Q: 2. What is K_c for the following equilibrium when the equilibrium concentration of each substance is: $[SO_2] = 0.60M, [O_2] = 0.82M \text{and} [SO_3] = 1.90M$?

$$2SO_2\ (g) + O_2\ (g) \longleftrightarrow 2SO_3\ (g)$$

Answer:

The equilibrium constant (K_c) for the give reaction is:

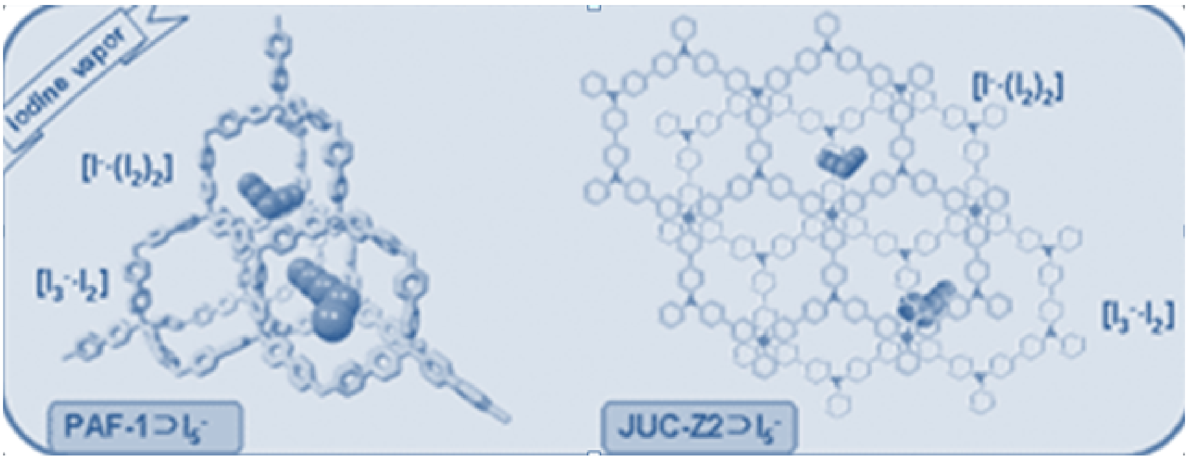
$$K_c = \frac{[SO_3]^2}{[SO_2]^2\ [O_2]}$$

$$= \frac{(1.90)^2}{M^2 (0.60)^2\ (0.821)\ M^3}$$

$$= 12.239 M^{-1}\ \text{(approximately)}$$

Hence, K_c for the equilibrium is $12.239M^{-1}$

Q: 3. At a certain temperature and total pressure of $10^5 Pa$, iodine vapour contains 40% by volume of I atoms



$$I_2\ (g) \longleftrightarrow 21\ (g)$$

Calculate K_p for the equilibrium.

Answer:

Partial pressure of I atoms,

$$p_1 = \frac{40}{100} \times p_{\text{total}}$$

$$= \frac{40}{100} \times 10^5$$

$$= 4 \times 10^4\, Pa$$

Partial pressure of I_2 molecules,

$$p_{1\,2} = \frac{60}{100} \times P_{\text{total}}$$

$$= \frac{60}{100} \times 10^5$$

$$= 6 \times 10^4\, Pa$$

Now, for the given reaction,

$$K_p = \frac{(pI)^2}{p_{1\,2}}$$

$$= \frac{\left(4 \times 10^4\right)^2 Pa^2}{6 \times 10^4\, Pa}$$

$$= 2.67 \times 10^4\, Pa$$

Q: 4. Write the expression for the equilibrium constant, K_c for each of the following reactions:

(i) $2NOCl\,(g) \longleftrightarrow 2\text{NO}\,(g) + Cl_2\,(g)$

Determining K

$2\ NOCl(g) \rightleftharpoons 2\ NO(g) + Cl_2(g)$

	[NOCl]	[NO]	$[Cl_2]$
Before	2.00	0	0
Change	-0.66	+0.66	+0.33
Equilibrium	1.34	0.66	0.33

$$K = \frac{[NO]^2[Cl_2]}{[NOCl]^2}$$

(ii) $2Cu(NO_3)_2\,(s) \longleftrightarrow 2CuO\,(s) + 4NO_2\,(g) + O_2\,(g)$

(iii) $CH_3COOC_2H_5\,(aq) + H_2O\,(l) \longleftrightarrow CH_3COOH\,(aq) + C_2H_5OH\,(aq)$

(iv) $Fe^{3+}\,(aq) + 3OH^-\,(aq) \longleftrightarrow Fe(OH)_3\,(s)$

(v) $I_2\ (s) + 5F_2 \longleftrightarrow 2IF_5$

Answer:

(i) $K_c = \frac{\left[NO_{(g)}\right]^2 [Cl_2\ (g)]}{\left[NOCl_{(g)}\right]^2}$

(ii) $K_c = \frac{\left[CuO_g\right]^2 \left[NO_{2(g)}\right]^4 \left[O_{2(g)}\right]}{\left[Cu(NO_3)_{2(g)}\right]^2}$

(iii) $K_c = \frac{\left[CH_3COOH_{(aq)}\right] \left[C_2H_5OH_{(aq)}\right]}{\left[CH_3COOC_2H_{5(aq)}\right] \left[H_2O_{(l)}\right]} = \frac{\left[CH_3COOH_{(aq)}\right] \left[C_2H_5OH_{(aq)}\right]}{[CH_3COOC_2H_5\ (aq)]}$

(iv) $K_c = \frac{\left[Fe(OH)_{3(s)}\right]}{\left[Fe^{3+}{}_{(aq)}\right] \left[OH^-_{(aq)}\right]^3}$

$= \frac{1}{\left[Fe^{3+}{}_{(aq)}\right] \left[OH^-_{(aq)}\right]^3}$

(v) $K_c = \frac{[IF_5]^2}{\left[I_{2(s)}\right] [F_2]^5}$

$= \frac{[IF_5]^2}{[F_2]^5}$