PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 40

Total Marks : 26

Max. Time : 28 min.

Topic : Chemical Equilibrium

Type of Questions			M.M., Min.
Single choice Objective ('–1' negative marking) Q.1 to Q.6		(3 marks, 3 min.)	[18, 18]
Subjective Questions ('–1' negative marking) Q.7 to Q.8		(4 marks, 5 min.)	[8, 10]

1. $CH_3–CO–CH_3(g) \rightleftharpoons CH_3–CH_3(g) + CO(g)$

Initial pressure of CH_3COCH_3 is 100 mm. When equilibrium is set up, mole fraction of CO(g) is 1/3. Hence value of K_p for given reaction is :

(A) 100 mm (B) 50 mm (C) 25 mm (D) 0.6 mm

2. The degree of dissociation of N_2O_4 (α) obeying the equilibrium,

N_2O_4 (g) $\rightleftharpoons$ $2NO_2$ (g), is approximately related to the presure at equilibrium by :

(A) $\alpha \propto P$ (B) $\alpha \propto \frac{1}{\sqrt{P}}$ (C) $\alpha \propto \frac{1}{P^2}$ (D) $\alpha \propto \frac{1}{P^4}$

3. Two moles of HI were heated in a sealed tube at 440°C till the given equilibrium was reached. HI was found to be 20% decomposed. The equilibrium constant for dissociation is :

$$2HI\ (g) \rightleftharpoons H_2\ (g) + I_2\ (g)$$

(A) $\frac{1}{16}$ (B) $\frac{1}{32}$ (C) $\frac{1}{64}$ (D) $\frac{1}{128}$

4. In the following reaction, 3A (g) + B (g) $\rightleftharpoons$ 2C (g) + D (g),

Initial moles of B is double of A. At equilibrium, moles of A and C are equal. Hence % dissociation of B is :

(A) 10% (B) 20% (C) 40% (D) 5%

5. For the equilibrium $N_2O_4 \rightleftharpoons 2NO_2$ in gaseous phase, NO_2 is 50% of the total volume when equilibrium is set up. Hence percent of dissociation of N_2O_4 is :

(A) 50% (B) 25% (C) 66.66% (D) 33.33%

6. PCl_5 is 40% dissociated according to the following reaction, when equilibrium pressure is 2 atm. It will be 80% dissociated, when equilibrium pressure is approximately : PCl_5 (g) $\rightleftharpoons$ PCl_3 (g) + Cl_2 (g)

(A) 0.2 atm (B) 0.5 atm (C) 0.3 atm (D) 0.6 atm

7. The equilibrium constant for the following reaction , H_2 (g) + Br_2 (g) $\rightleftharpoons$ 2 HBr (g) is 1.6×10^5 at 1024 K. Find the equilibrium pressure of all gases if 10 bar of HBr is introduced into a sealed container at 1024 K initially.

8. At a certain temperature, the equilibrium constant (K_c) is 9/4 for the reaction :

$CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$

If we take 10 mole of each of the four gases in a one-litre container, what would be the equilibrium mole percent of H_2 (g) ?

Answer Key

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1.	(B)	**2.**	(B)	**3.**	(C)	**4.**	(A)	**5.**	(D)
6.	(A)	**7.**	$p_{H_2} = 2.5 \times 10^{-2}$ bar ; $p_{Br_2} = 2.5 \times 10^{-2}$ bar ; $p_{HBr} \approx 10$ bar					**8.**	30%

Hints & Solutions

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3.

$$2HI \rightleftharpoons H_2 + I_2$$

Initial 2moles

At eqm. $2 - \dfrac{20}{100} \times 2$ 0.2   0.2

$= 2 - 0.4 = 1.6$

$$K = \frac{[H_2]\,[I_2]}{[HI]} = \frac{0.2 \times 0.2}{(1.6)^2} = \frac{1}{64}.$$

7.

$$H_2(g) + Br_2(g) \rightleftharpoons 2HBr(g)$$

	$H_2(g)$	$Br_2(g)$	$2HBr(g)$
Intial pressures	0	0	10.0 bar
At equilibrium	p/2	p/2	(10.0-p)

$$K_p = \frac{p^2_{HBr}}{p_{H_2} \times p_{Br_2}}$$

$$1.6 \times 10^5 = \frac{(10-p)^2}{(p/2)(p/2)}$$

Taking square root of both sides

$$4 \times 10^2 = \frac{10-p}{p/2}$$

$$200\,p = 10 - p\,;\; p = \frac{10}{201}\text{ bar}$$

$$p_{H_2} = p/2 = \frac{1}{2}\left(\frac{10}{201}\right)\text{bar} = 2.5\times10^{-2}\text{ bar}\,;\; p_{Br_2} = p/2 = 2.5\times10^{-2}\text{ bar}\,;\quad p_{HBr} = 10 - p \approx 10\text{ bar}.$$

8. We have,

10 mole	10 mole		10 mole	10 mole	Initial moles
$CO(g)$	+ $H_2O(g)$	$\rightleftharpoons$	$CO_2(g)$	+ $H_2(g)$	
$10 - x$	$10 - x$		$10 + x$	$10 + x$	Moles at eqb. or concentration at eqb.

where x is the number of moles of each reactant changed to the products at equilibrium.

$$K = \frac{(10+x)^2}{(10-x)^2} = 9/4 \text{ (given)} \qquad \text{or} \qquad \frac{10+x}{10-x} = 3/2\,;\; x = 2$$

Mole percent of H_2 (g) at equilibrium = $\frac{10+x}{40} \times 100 = 30$