PHYSICAL CHEMISTRY

DPP

DAILY PRACTICE PROBLEMS

DPP No. 39

Total Marks : 29

Max. Time : 31 min.

Topic : Chemical Equilibrium

Type of Questions		**M.M., Min.**
Single choice Objective ('–1' negative marking) Q.1 to Q.7	(3 marks, 3 min.)	[21, 21]
Subjective Questions ('–1' negative marking) Q.8 to Q.9	(4 marks, 5 min.)	[8, 10]

1. In a reaction A (g)+ 2B (g) $\rightleftharpoons$ 2C (g), 2 moles of 'A', 3 moles of 'B' and 1 mole of 'C' are placed in a 2 L flask and the equilibrium concentration of 'C' is 1 mol/L. The equilibrium constant (K_C) for the reaction is :
(A) 0.33 lit/mol (B) 1.33 lit/mol (C) 1.66lit/mol (D) 0.66 lit/mol

2 For the reaction : $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$, the equilibrium constant K_p changes with :
(A) total pressure (B) addition of catalyst
(C) the amounts of H_2 and I_2 taken initially (D) temperature

3. In a reversible chemical reaction having two reactants in equilibrium with one product, if the initial concentration of both the reactants is doubled, then the equilibrium constant will :
(A) also be doubled (B) be halved
(C) become one fourth (D) remain the same.

4. For the equilibrium $2H_2O(g) \rightleftharpoons 2H_2(g) + O_2(g)$, equilibrium constant is K_1.
For the equilibrium $2CO_2(g) \rightleftharpoons 2CO(g) + O_2(g)$, equilibrium constant is K_2.
Then, the equilibrium constant for $CO_2(g) + H_2(g) \rightleftharpoons CO(g) + H_2O(g)$ is :
(A) $K_1 K_2$ (B) $\frac{K_1}{K_2}$ (C) $\sqrt{\frac{K_1}{K_2}}$ (D) $\sqrt{\frac{K_2}{K_1}}$

5. For the reaction A(g) + B(g) $\rightleftharpoons$ C(g) at equilibrium, the partial pressure of the species are P_A = 0.15 atm, $P_C = P_B$ = 0.30 atm. If the capacity of reaction vessel is reduced, the equilibrium is re-established. In the new situation, partial pressure A and B become twice. What is the partial pressure of C :
(A) 0.3 atm (B) 0.6 atm (C) 1.2 atm (D) 1.8 atm

6. The equilibrium constant for the reaction
$A_2(g) + B_2(g) \rightleftharpoons 2AB(g)$ is 20 at 500 K.
The equilibrium constant for the reaction,
$2AB(g) \rightleftharpoons A_2(g) + B_2(g)$ at 500 K would be :
(A) 20 (B) 0.5 (C) 0.05 (D) 10

7. The value of K_p for the reaction, A(g) + 2B(g) $\rightleftharpoons$ C(g) is 25 atm^{-2} at a certain temperature. The value of K_P for the reaction, $\frac{1}{2}C(g) \rightleftharpoons \frac{1}{2}A(g) + B(g)$ at the same temperature would be :
(A) 25 atm^{-1} (B) $\frac{1}{25}$ atm^{-1} (C) $\frac{1}{5}$ atm (D) 5 atm

8. For the gaseous reaction of XO with O_2 to form XO_2, the equilibrium constant at 398 K is 1×10^{-4} lit/mole. If 1 mole of XO and 2 mole of O_2 are placed in a 1 L vessel and allowed to come to equilibrium, what will be the equilibrium concentration of each of the species ?

9. Prove that the pressure at equilibrium obtained upon 50% dissociation of PCl_5 as follows at 250ºC is numerically three times of K_p. $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

Answer Key

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1.	(B)	**2**	(D)	**3.**	(D)	**4.**	(D)	**5.**	(C)
6.	(C)	**7.**	(C)						

8. $[XO] = 0.985$ M ; $[O_2] = 1.992$ M ; $[XO_2] = 0.0141$ M **9.** $K_p = \frac{1}{3}.p$ or $p = 3K_p$.

Hints & Solutions

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8. The equilibrium reaction is

$$2XO\,(g) + O_2(g) \rightleftharpoons 2XO_2\,(g)$$

since the unit of K_c given is lit/mole.

$$2XO(g) \quad + \quad O_2\,(g) \rightleftharpoons 2XO_2\,(g)$$

	$2XO(g)$	$O_2(g)$	$2XO_2(g)$
Initial conc.	1	2	0
Conc. at equilib.	$1-2x$	$2-x$	$2x$

$$\therefore \quad K_c = \frac{[XO_2]^2}{[XO]^2\,[O_2]} = \frac{(2x)^2}{(1-2x)^2(2-x)} = \frac{4x^2}{(1-2x)^2\,(2-x)} = \frac{4x^2}{2}$$

Since, the value of equilibrium constant is very small (1×10^{-4}), so $2x$ can be ignored with respect to 1 and x can be ignored with respect to 2.

$$\therefore \quad 1 \times 10^{-4} = \frac{4x^2}{2}$$

$$x = 7.07 \times 10^{-3}$$

we can see that the value of x is very small, so the assumtion made was correct as it is within 1.4% of the actual value. Thus, the assumption made is correct and acceptable.

$\therefore$ $[XO] = 1 - 0.01414 = 0.985$ M

$[O_2] = 2 - 0.00707 = 1.992$ M

$[XO_2] = 0.0141$ M

9.

PCl_5	$\rightleftharpoons$	PCl_3	+	Cl_2	
1		0		0	Initial moles (say)
(1 – 0.5)		0.5		0.5	Moles at equilibrium

Total moles at equilibrium = 0.5 + 0.5 + 0.5 = 1.5

$$K_p = \frac{p_{PCl_3}.p_{Cl_2}}{p_{PCl_2}} = \frac{\left(\frac{0.5}{1.5}p\right)\left(\frac{0.5}{1.5}p\right)}{\left(\frac{0.5}{1.5}p\right)} \qquad (p = \text{total pressure})$$

or $\quad K_p = \frac{1}{3}.p \quad$ or $\quad p = 3K_p$.