

**Topic : Chemical Equilibrium**
**Type of Questions**

Single choice Objective ('-1' negative marking) Q.1 to Q.7

(3 marks, 3 min.)

M.M., Min.

[21, 21]

Subjective Questions ('-1' negative marking) Q.8 to Q.9

(4 marks, 5 min.)

[8, 10]

- 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
- 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
- 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.
- 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)  $\sqrt{\frac{K_2}{K_1}}$
- 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
- 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
- The value of  $K_p$  for the reaction,  $A(g) + 2B(g) \rightleftharpoons C(g)$  is  $25 \text{ atm}^{-2}$  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)  $25 \text{ atm}^{-1}$                       (B)  $\frac{1}{25} \text{ atm}^{-1}$                       (C)  $\frac{1}{5} \text{ atm}$                       (D) 5 atm
- For the gaseous reaction of XO with  $O_2$  to form  $XO_2$ , the equilibrium constant at 398 K is  $1 \times 10^{-4}$  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 ?
- Prove that the pressure at equilibrium obtained upon 50% dissociation of  $PCl_5$  as follows at  $250^\circ\text{C}$  is numerically three times of  $K_p$ .  $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$



# Answer Key

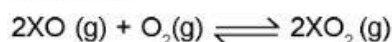
## DPP No. # 39

1. (B)                      2. (D)                      3. (D)                      4. (D)                      5. (C)  
 6. (C)                      7. (C)
8.  $[XO] = 0.985 \text{ M}$  ;  $[O_2] = 1.992 \text{ M}$  ;  $[XO_2] = 0.0141 \text{ M}$                       9.  $K_p = \frac{1}{3} \cdot p$  or  $p = 3K_p$ .

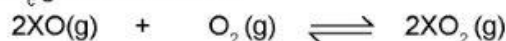
# Hints & Solutions

## DPP No. # 39

8. The equilibrium reaction is



since the unit of  $K_c$  given is lit/mole.



Initial conc.	1	2	0
Conc. at equilib.	$1 - 2x$	$2 - x$	$2x$

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

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

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

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

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

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

$$[O_2] = 2 - 0.00707 = 1.992 \text{ M}$$

$$[XO_2] = 0.0141 \text{ M}$$

- 9.
- |             |                      |                |                      |
|-------------|----------------------|----------------|----------------------|
| 1           | 0                    | 0              | Initial moles (say)  |
| $PCl_5$     | $\rightleftharpoons$ | $PCl_3 + Cl_2$ |                      |
| $(1 - 0.5)$ |                      | 0.5      0.5   | Moles at equilibrium |
- Total moles at equilibrium =  $0.5 + 0.5 + 0.5 = 1.5$

$$K_p = \frac{p_{PCl_3} \cdot p_{Cl_2}}{p_{PCl_5}} = \frac{\left(\frac{0.5}{1.5} p\right) \left(\frac{0.5}{1.5} p\right)}{\left(\frac{0.5}{1.5} p\right)} \quad (p = \text{total pressure})$$

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