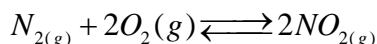


## 5. CHEMICAL EQUILIBRIUM

### PREVIOUS EAMCET BITS

1. The equilibrium constant for the given reaction is 100? (2009 E)



What is the equilibrium constant for the reaction given below  $2NO_{2(g)} \rightleftharpoons N_{2(g)} + 2O_{2(g)}$

- 1) 10                      2) 1                      3) 0.1                      4) 0.01

Ans : 3

Sol: 
$$\frac{[NO_2]^2}{[N_2][O_2]} = 100$$

$$\frac{[N_2][O_2]^2}{[NO_2]} = \frac{1}{100}$$

$$\therefore \frac{[N_2]^{1/2}[O_2]}{[NO_2]} = \sqrt{\frac{1}{100}} = \frac{1}{10} = 0.1$$

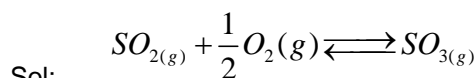
2. The equilibrium constant for the reaction  $SO_{2(g)} + \frac{1}{2}O_{2(g)} \rightleftharpoons SO_{3(g)}$  is  $5 \times 10^{-6}$

$atm^{-1}$ . The equilibrium constant of the reaction.  $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$  would be

(2009 E)

- 1) 100 atm                      2) 200 atm                      3)  $4 \times 10^4$  atm                      4)  $6.25 \times 10^4$  atm

Ans : 3



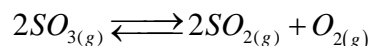
$$K_p = \frac{P_{SO_3}}{P_{SO_2} \times (P_{O_2})^{1/2}} = 5 \times 10^{-3}$$

Squaring

$$\frac{P_{SO_3}^2}{P_{SO_2}^2 \cdot P_{O_2}} = 25 \times 10^{-6}$$

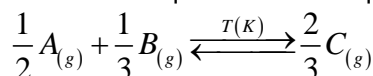
$$\frac{P_{SO_2}^2 \cdot P_{O_2}}{P_{SO_3}^2} = \frac{1}{25 \times 10^{-6}}$$

$$= 4 \times 10^4 \text{ atm}$$



$$K_p = 4 \times 10^4 \text{ atm}$$

3. What is the equation for the equilibrium constant ( $K_C$ ) for the following reaction ?



(2006 M)

1) 
$$K_C = \frac{[A]^{1/2}[B]^{1/3}}{[C]^{3/2}}$$

2) 
$$K_C = \frac{[C]^{3/2}}{[A]^2[B]^3}$$

3) 
$$K_C = \frac{[C]^{2/3}}{[A]^{1/2}[B]^{1/3}}$$

4) 
$$K_C = \frac{[C]^{2/3}}{[A]^{1/2} + [B]^{1/3}}$$

Ans : 3

$$K_c = \frac{[C]^{2/3}}{[A]^{1/2} [B]^{1/3}}$$

Sol:

4. Which of the following is not a characteristic property of chemical equilibrium?

**[2006 E]**

1. Rate of forward reaction is equal to rate of backward reaction at equilibrium
2. After reaching the chemical equilibrium, the concentrations of reactants and products remain unchanged with time
3. For  $A(g) \rightleftharpoons B(g)$  is  $10^{-2}$ . If this reaction is carried out in the presence of a catalyst, the value of  $K_c$  decreases.
4. After reaching the equilibrium, both forward and backward reactions continue to take place

Ans : 3

Sol: Addition of catalyst does not alter the equilibrium constant.

5. Observe the following reaction :  $2A + B \rightarrow C$ . The rate of formation of C is  $2.2 \times 10^{-4}$  mol. lit<sup>-1</sup>. min<sup>-1</sup>. What is

the value of  $\frac{-d[A]}{dt}$  (in mol. lit<sup>-1</sup>. min<sup>-1</sup>)

1.  $2.2 \times 10^{-3}$       2.  $1.1 \times 10^{-3}$       3.  $4.4 \times 10^{-3}$       4.  $5.5 \times 10^{-3}$

**[2005 E]**

Ans : 3

Sol:  $2A + B \rightarrow C$ 

$$\frac{-1}{2} \frac{d[A]}{dt} = \frac{-d[B]}{dt} = \frac{+d[C]}{dt}$$

$$\therefore \frac{-d[A]}{dt} = 2 \times \frac{d[C]}{dt}$$

$$= 2 \times 2.2 \times 10^{-3} \text{ mol. lit}^{-1} \cdot \text{min}^{-1}$$

$$= 4.4 \times 10^{-3} \text{ mol. lit}^{-1} \cdot \text{min}^{-1}$$

6. In Which of the following reactions, the concentration of reactant is equal to concentration of product at equilibrium (K = equilibrium constant) **(2004 E)**

- 1)  $A \rightleftharpoons B$ ;  $K = 0.01$
- 2)  $R \rightleftharpoons P$ ;  $K = 1$
- 3)  $X \rightleftharpoons Y$ ;  $K = 10$
- 4)  $L \rightleftharpoons J$ ;  $K = 0.025$

Ans : 2

Sol: If the concentration of reactant is equal to concentration of product equilibrium constant  $K = 1$ 

7. In which of the following reactions, the concentration of reactant is equal to concentration of product at equilibrium (K = equilibrium constant) **(2004 M)**

- 1)  $A \rightleftharpoons B$ ;  $K = 0.001$
- 2)  $M \rightleftharpoons N$ ;  $K = 10$
- 3)  $X \rightleftharpoons Y$ ;  $K = 0.005$
- 4)  $R \rightleftharpoons P$ ;  $K = 0.01$

Ans : 2

Sol: Highest the K value mean concentration of product is high.

8. In the reaction  $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ , the equilibrium concentration of  $PCl_5$  and  $PCl_3$  are 0.4 and 0.2 mole/litre respectively. If the value of  $K_c$  is 0.5. What is concentration of  $Cl_2$  in moles/litre ?

**(2003 M)**

- 1) 2.0      2) 1.3      3) 1.0      4) 0.5

Ans : 3

Sol: 
$$K_c = \frac{[PCl_3][Cl_2]}{[PCl_5]}$$

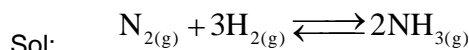
$$0.5 = \frac{0.2[Cl_2]}{0.4}$$

$$\therefore [Cl_2] = \frac{0.5 \times 0.4}{0.2} = 1$$

9. Consider the following reaction equilibrium  $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ . Initially, 1 mole of  $N_2$  and 3 moles of  $H_2$  are taken in a 2 litre flask. At equilibrium state if, the number of moles of  $N_2$  is 0.6. What is the total number moles of all gases present in the flask ? **(2003 E)**

- 1) 0.8                      2) 1.6                      3) 3.2                      4) 6.4

Ans : 3



Initial mole 1mole 3 mole 0 mole

At. eq. 0.6 3-1.2 0.8 mole  
= 1.8 mole

Total no of mole = 0.6 + 1.8 + 0.8 = 3.2 moles

10. One mole of  $A(g)$  is heated to  $200^\circ C$  in a one litre closed flask, till the following equilibrium is reached.  $A(g) \rightleftharpoons B(g)$ .

The rate of forward reaction at equilibrium is  $0.02 \text{ mol-lit}^{-1}\text{-min}^{-1}$ . What is the rate ( in mol. Lit<sup>-1</sup> min<sup>-1</sup>) of the backward reaction at equilibrium ? **(2002 E)**

- 1) 0.04                      2) 0.01                      3) 0.02                      4) 1

Ans : 3

Sol: At equilibrium rate of forward reaction is equal to rate of backward reaction.

11. Equilibrium constant for the reaction  $H_2O(g) + CO(g) \rightleftharpoons H_2(g) + CO_2(g)$  is 81. If the velocity constant of the forward reaction is  $162 \text{ lit. mol}^{-1} \text{ sec}^{-1}$ , what is the velocity constant (in lit. mole<sup>-1</sup> sec<sup>-1</sup>) for the backward reaction? **(2001 E)**

- 1) 13122                      2) 2                      3) 261                      4) 243

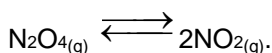
Ans : 3

Sol: Eq. constant = 
$$\frac{\text{velocity constant of forward reaction}(K_f)}{\text{velocity constant of backward reaction}(K_b)}$$

$$81 = \frac{162}{K_b}$$

$$\therefore K_b = \frac{162}{81} = 2$$

12. 9.2 gm of  $N_2O_4(g)$  is taken in a closed one litre vessel and heated till the following equilibrium is reached



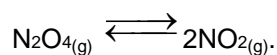
At equilibrium 50% of  $N_2O_4(g)$  is dissociated. What is the equilibrium constant (in mole lit<sup>-1</sup>) (Molecular wt. of  $N_2O_4$  is 92) **(2001 M)**

- 1) 0.1                      2) 0.2                      3) 0.4                      4) 2

Ans : 2

Sol: No of moles of  $N_2O_4$  initially taken  $\frac{9.2}{92} = 0.1$  mole  
Volume of vessel = 1lit  
At equilibrium 50% of  $N_2O_4$  is dissociated

$$= \frac{0.1 \times 50}{100} = 0.05 \text{ mole}$$



$$\text{Initial concentration} \quad \frac{0.1}{1} \text{ mole lit}^{-1}$$

$$\text{At equilibrium} \quad \frac{0.05}{1} \text{ mole lit}^{-1}$$

$$\frac{2 \times 0.05}{1} = 0.1 \text{ mole lit}^{-1}$$

$$K_c = \frac{[\text{NO}_2]^2}{[\text{N}_2\text{O}_4]} = \frac{[0.1]^2}{0.05}$$

$$= \frac{0.1 \times 0.1}{0.05}$$

$$= 0.2 \text{ mole lit}^{-1}$$

13. The equilibrium constant for the reaction  $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$  is 64, at certain temperature. The equilibrium concentrations of  $\text{H}_2$  and  $\text{HI}$  are 2 and 16 mol lit<sup>-1</sup> respectively. What is the equilibrium concentration (in mol Lit<sup>-1</sup>) of  $\text{I}_2$ ? (2000 E)

- 1) 16                      2) 4                      3) 8                      4) 2

Ans : 4



$$K_c = \frac{[\text{HI}]^2}{[\text{H}_2][\text{I}_2]}$$

$$64 = \frac{[16]^2}{2[\text{I}_2]}$$

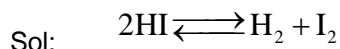
$$[\text{I}_2] = \frac{256}{64 \times 2} = 2$$

14. 4 moles of  $\text{HI}$  is taken in a lit closed vessel and heated till equilibrium is reached. At equilibrium, the concentration of  $\text{H}_2$  is one mol lit<sup>-1</sup>. What is the equilibrium constant for dissociation of  $\text{HI}$  ?

(2000M)

- 1) 4                      2) 0.5                      3) 2                      4) 0.25

Ans : 4



Initial Mole 4 0 0

At. Eq. 2                      1 1

$$K_c = \frac{[\text{H}_2][\text{I}_2]}{[\text{HI}]^2} = \frac{1 \times 1}{2^2} = \frac{1}{4} = 0.25$$

