Chemical Equilibrium

SET Self Evaluation Test -8

1. One mole of SO_3 was placed in a litre reaction vessel at a certain temperature. The following equilibrium was established $2SO_3 \rightleftharpoons 2SO_2 + O_2$

At equilibrium 0.6 moles of SO_2 were formed. The equilibrium constant of the reaction will be **[MP PMT 1991]**

(a) 0.36 (b) 0.45

(c) 0.54 (d) 0.675

2. For the following homogeneous gas reaction $4NH_3 + 5O_2 \rightleftharpoons 4NO + 6H_2O$, the equilibrium constant K_c has the dimension of **[CPMT 1990; MP PET/PMT 1998]**

(a) $Conc^{+10}$ (b) $Conc^{+1}$

(c) $Conc^{-1}$ (d) It is dimensionless

3. Consider the imaginary equilibrium

$4A + 5B \rightleftharpoons 4X + 6Y$

The equilibrium constant K_c has the unit **[RPMT 2000]**

(a) Mole^2 *litre*$^{-2}$ (b) *Litre* mole^{-1}

(c) Mole *litre*$^{-1}$ (d) *Litre*^{2} mole^{-2}

4. For the reaction $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$, true condition is

(a) $K_p = K_c$ (b) $K_p > K_c$

(c) $K_p < K_c$ (d) $K_c = 0$ but $K_p \neq 0$

5. For the reaction $CO(g) + \frac{1}{2}O_2(g) \rightleftharpoons CO_2(g)$; $\frac{K_p}{K_c}$ is equivalent to **[MP PET/PMT 1998; AIEEE 2002]**

(a) 1 (b) RT

(c) $\frac{1}{\sqrt{RT}}$ (d) $(RT)^{1/2}$

6. $\underset{(g)}{2N_2O_5} \rightarrow \underset{(g)}{4NO_2} + \underset{(g)}{O_2}$ what is the ratio of the rate of decomposition of N_2O_5 to rate of formation of NO_2 **[DCE 2003]**

(a) $1:2$ (b) $2:1$

(c) $1:4$ (d) $4:1$

7. The reaction quotient (Q) for the reaction

$N_{2(g)} + 3H_{2(g)} \rightleftharpoons 2NH_{3(g)}$

is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$. The reaction will proceed from right to left is **[CBSE PMT 2003]**

(a) $Q = 0$ (b) $Q = K_c$

(c) $Q < K_c$ (d) $Q > K_c$

Where K_c is the equilibrium constant

8. In the thermal dissociation of PCl_5, the partial pressure in the gaseous equilibrium mixture is 1.0 atmosphere when half of PCl_5 is found to dissociate. The equilibrium constant of the reaction (K_p) in atmosphere is **[JIPMER 2002]**

(a) 0.25 (b) 0.50

(c) 1.00 (d) 0.3

9. HI was heated in a closed tube at 440^oC till equilibrium is obtained. At this temperature 22% of HI was dissociated. The equilibrium constant for this dissociation will be

[MP PET 1988, 92; MNR 1987; UPSEAT 2000]

(a) 0.282 (b) 0.0796

(c) 0.0199 (d) 1.99

10. The following equilibrium exists in aqueous solution $CH_3COOH \rightleftharpoons CH_3COO^- + H^+$. If dilute HCl is added without a change in temperature, then the **[MNR 1987]**

(a) Concentration of CH_3COO^- will increase

(b) Concentration of CH_3COO^- will decrease

(c) Equilibrium constant will increase

(d) Equilibrium constant will decrease

11. Which of the following is not favourable for SO_3 formation

$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g); \Delta H = -45.0\,kcal$

[IIT 1984; MP PET 1997]

(a) High pressure

(b) High temperature

(c) Decreasing SO_3 concentration

(d) Increasing reactant concentration

12. $120\,gm$ of urea are present in $5\,litre$ solution, the active mass of urea is **[MP PMT 1994]**

(a) 0.2 (b) 0.06

(c) 0.4 (d) 0.08

13. For the system $2A(g) + B(g) \rightleftharpoons 3C(g)$, the expression for equilibrium constant K is **[NCERT 1973; DCE 1999]**

(a) $\frac{[2A]\times[B]}{[3C]}$ (b) $\frac{[A]^2\times[B]}{[C]^3}$

(c) $\frac{[3C]}{[2A]\times[B]}$ (d) $\frac{[C]^3}{[A]^2\times[B]}$

14. If concentration of reactants is increased by 'x', then K becomes **[AFMC 1997]**

(a) $\ln(K/x)$ (b) K/x

(c) $K+x$ (d) K

AS Answers and Solutions

(SET -8)

1. (d) $\underset{(1-0.6)}{2SO_3} \rightleftharpoons \underset{(0.6)}{2SO_2} + \underset{(0.3)}{O_2}$

$$K_c = \frac{[SO_2]^2[O_2]}{[SO_3]} = \frac{0.6\times0.6\times0.3}{0.4\times0.4} = 0.675 .$$

2. (b) K has the units of $(\text{conc.})^{\Delta n}$, where $\Delta n = 10-9 = +1$

3. (c) Unit of K_c = (unit of concentration)$^{\Delta n}$

$= (mole\ litre^{-1})^{\Delta n}$

$\Delta n = 10 - 9 = 1$

$\therefore\ K_c = mol\ Litre^{-1}$.

4. (c) When $n_r > n_p$ then $K_p < K_c$

where n_r = no. of moles of reactant

n_p = no. of moles of product.

5. (c) For $CO + \frac{1}{2}O_2 \rightleftharpoons CO_2$

$$K_p = K_c(RT)^{1-1\frac{1}{2}} = K_c(RT)^{-\frac{1}{2}};\ \frac{K_p}{K_c} = \sqrt{\frac{1}{RT}}$$

6. (b) $2N_2O_5 \rightarrow HNO_2 + O_2$

Rate of decomposition of N_2O_5

$$= -\frac{1}{2}.\frac{K[N_2O_5]}{dt}$$

Rate of formation of $NO_2 = \frac{1}{4}.\frac{d[NO_2]}{dt}$

$\therefore$ Ratio = 2 : 1

7. (d) If $Q > K_c$ reaction will proceed right to left to decrease concentration of product.

8. (d) $PCl_5 \rightleftharpoons PCl_3 + Cl_2$

Initial conc. 1 0 0

At equilibrium 0.5 0.5 0.5

$$K_p = \frac{Px^2}{(1-x^2)} = \frac{1\times0.5\times0.5}{[1-(0.5)^2]} = \frac{0.5\times0.5}{0.75} = \frac{1}{3} = 0.3$$

9. (c) $2HI \rightleftharpoons H_2 + I_2$

Initial conc. 2 *moles* 0 0

at equilibrium $\frac{22}{100}\times 2$ 0.22 0.22

$= 2 - 0.44 = 1.56$

$$K = \frac{[H_2][I_2]}{[HI]^2} = \frac{0.22\times0.22}{[1.56]^2} = 0.0199 .$$

10. (b) When adding HCl in CH_3COOH solution the concentration of H^+ is increased. So reaction is proceed in reverse direction and the concentration of CH_3COO^- is decreased.

11. (b) The reaction is exothermic so high temperature will favour backward reaction.

12. (c) Active mass $= \frac{moles}{litre}$

$$= \frac{\text{wt. in } gm/\text{molecular wt.}}{V \text{ in } litre} = \frac{120/60}{5} = \frac{2}{5} = .4$$

13. (d) $K = \frac{[C]^3}{[A]^2[B]}$.

14. (d) There is no effect of change in concentration on equilibrium constant.

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