## 338 Chemical Equilibrium

## **Chemical Equilibrium**

1.	One mole of $SO_3$ was place certain temperature. The follo $2SO_3 = 2SO_2 + O_2$	ed in a litre reaction vessel at a wing equilibrium was established
	At equilibrium 0.6 moles	of $SO_2$ were formed. The
	equilibrium constant of the rea	action will be [MP PMT 1991]
	(a) 0.36	(b) 0.45
	(c) 0.54	(d) 0.675
2.	For the following homogeneo	us 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 equilib	orium
	$AA + 5B \rightarrow AV + 6V$	
	$4A + 3B \leftarrow 4A + 0I$ The equilibrium constant K	has the unit [DDMT 2000]
	The equilibrium constant $\mathbf{K}_c$	
	(a) Mole <sup>2</sup> $litre^{-2}$	(b) Litre mole <sup>-1</sup> (d) Litre <sup>2</sup> mole <sup>-2</sup>
	(c) Mole $utre^{-1}$	
4.	For the reaction $CO(g)$ -	$+2H_2(g) \rightleftharpoons CH_3OH(g)$ , true
	$\frac{1}{2} \frac{1}{2} \frac{1}$	(b) $V > V$
	(a) $\mathbf{K}_p = \mathbf{K}_c$	(b) $\mathbf{K}_p > \mathbf{K}_c$
	(c) $K_p < K_c$	(d) $K_c = 0$ but $K_p \neq 0$
5.	For the reaction $CO(g) + \frac{1}{2}O_2(g) \Rightarrow CO_2(g); \frac{K_p}{K_c}$ is	
	equivalent to	[MP PET/PMT 1998; AIEEE 2002]
	(a) 1	(b) <i>RT</i>
	(c) $\frac{1}{\sqrt{RT}}$	(d) $(RT)^{1/2}$
6.	$2N_2O_5 \rightarrow 4NO_2 + O_2 \text{ what} $	is the ratio of the rate of
	decomposition of $N_2O_5$ to rat	te 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 t	he 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

**FT** Self Evaluation Test -8

- (c) 1.00 (d) 0.3
- **9.** *HI* was heated in a closed tube at  $440^{\circ}C$  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  $CH_3COOH \Rightarrow CH_3COO^- + H^+$ . 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
  - $2SO_2(g) + O_2(g) \Rightarrow 2SO_3(g); \Delta H = -45.0 \, kcal$

## [IIT 1984; MP PET 1997]

- (a) High pressure
- (b) High temperature
- (c) Decreasing  $SO_3$  concentration
- (d) Increasing reactant concentration
- 120 gm of urea are present in 5 litre solution, the active mass of urea is [MP PMT 1994]

**13.** For the system 2A(g) + B(g) = 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<br/>becomes[AFMC 1997](a)  $\ln (K/x)$ (b) K/x(c) K+x(d) K
- Answers and Solutions

(SET -8)

1. (d) 
$$2SO_3 \Rightarrow 2SO_2 + O_2$$
  
(1-0.6)  $(0.6) = (0.3)$   
 $K_c = \frac{[SO_2]^2[O_2]}{[SO_3]} = \frac{0.6 \times 0.6 \times 0.3}{0.4 \times 0.4} = 0.675$ .

- 2. (b) *K* has the units of (conc.)<sup> $\Delta n$ </sup>, where  $\Delta n = 10 9 = +1$
- 3. (c) Unit of  $K_c = (\text{unit of concentration})^{\Delta n}$ =  $(mole \ litre^{-1})^{\Delta n}$

 $\Delta n = 10 - 9 = 1$  $\therefore K_c = mol \ Litre^{-1}.$ 

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 
$$CO + \frac{1}{2}O_2 \rightleftharpoons CO_2$$
  
 $K_p = K_c (RT)^{1-1\frac{1}{2}} = K_c (RT)^{-\frac{1}{2}}; \quad \frac{K_p}{K_c} = \sqrt{\frac{1}{RT}}$ 

 $6. \qquad \text{(b)} \quad 2N_2O_5 \to HNO_2 + O_2$ 

Rate of decomposition of  $N_2O_5$ 

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

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

 $\therefore$  Ratio = 2 : 1

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

At equilibrium 0.5 0.5 0.5  $K_{p} = \frac{Px^{2}}{(1-x^{2})} = \frac{1 \times 0.5 \times 0.5}{[1-(0.5)^{2}]} = \frac{0.5 \times 0.5}{0.75} = \frac{1}{3} = 0.3$ (c)  $2HI \Rightarrow H_{2} + I_{2}$ Initial conc. 2 moles 0 0 at equilibrium  $\frac{22}{100} \times 2$  0.22 0.22 = 2 - 0.44 = 1.56  $K = \frac{[H_{2}][I_{2}]}{[HI]^{2}} = \frac{0.22 \times 0.22}{[1.56]^{2}} = 0.0199$ . (b) When adding HCl in  $CH_{3}COOH$  solution

- 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 = 
$$\frac{moles}{litre}$$
  
=  $\frac{\text{wt.in } gm/\text{molecular } \text{wt.}}{V \text{ in } litre} = \frac{120/60}{5} = \frac{2}{5} = .4$   
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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9.

8. (d) 
$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$
  
Initial conc. 1 0 0