

## Chemical Equilibrium

**Q.1.**  $K_c$  for the reaction,  $N_2 + 3H_2 \leftrightarrow 2NH_3$  is  $0.5 \text{ mol}^{-2} \text{ litre}^2$  at 400 K. Given  $R = 0.082 \text{ litre atm degree}^{-1} \text{ mol}^{-1}$ .  $K_p$  is given by :

(A)  $4.650 \times 10^{-4} \text{ atm}^{-2}$

(B)  $4.648 \times 10^{-4} \text{ atm}^{-2}$

(C)  $4.560 \times 10^{-4} \text{ atm}^{-2}$

(D)  $4.548 \times 10^{-4} \text{ atm}^{-2}$

**Q.2.** At temperature T, a compound  $AB_2(g)$  dissociates according to the reaction :



with a degree of dissociation 'x' which is small compared to unity. The expression for 'x' in terms of the equilibrium constant  $K_p$  and the total pressure P is :

(A)  $(K_p/P)^{1/3}$

(B)  $(K_p/2P)^{1/3}$

(C)  $(2K_p/P)^{1/3}$

(D)  $(2K_p/3P)^{1/3}$

**Q.3.** The  $K_p$  value for the reaction :  $H_2 + I_2 \leftrightarrow 2HI$  at  $450^\circ \text{ C}$  is 49. If the initial pressure of  $H_2$  and  $I_2$  is 0.5 atm respectively, the partial pressure of each gas at equilibrium is :

(A) 0.111 atm; 0.111 atm; 0.111 atm

(B) 0.111 atm, 0.787 atm; 0.777 atm;

(C) 0.112 atm; 0.113 atm; 0.778 atm

(D) 0.111 atm; 0.111 atm, 0.778 atm

**Q.4.** One mole of  $H_2$ , two mole of  $I_2$  and three mole of HI are injected in one litre flask. If  $K_c$  for reaction :  $H_2 + I_2 \leftrightarrow 2HI$  is 45.9. The concentration of  $H_2$ ,  $I_2$  and HI at equilibrium at  $500^\circ \text{ C}$  is :

(A)  $0.316 \text{ mol litre}^{-1}$ ;  $0.316 \text{ mol litre}^{-1}$ ;  $0.316 \text{ mol litre}^{-1}$

(B)  $0.316 \text{ mol litre}^{-1}$ ;  $1.316 \text{ mol litre}^{-1}$ ;  $4.368 \text{ mol litre}^{-1}$

(C)  $0.316 \text{ mol litre}^{-1}$ ;  $4.368 \text{ mol litre}^{-1}$ ;  $4.368 \text{ mol litre}^{-1}$

(D)  $1.316 \text{ mol litre}^{-1}$ ;  $0.316 \text{ mol litre}^{-1}$ ;  $1.316 \text{ mol litre}^{-1}$

**Q.5.** A sample of air consisting of  $N_2$  and  $O_2$  was heated to 2500 K until the equilibrium  $N_2(g) + O_2(g) \leftrightarrow 2NO(g)$  was established with an equilibrium constant  $K_c = 2.1 \times 10^{-3}$ . The initial composition of air in mole fraction of  $N_2$  and  $O_2$  is :

- (A) 80%; 20%
- (B) 81%; 19%
- (C) 79%; 21%
- (D) 78%; 22%

**Q.6.** At 700 K, hydrogen and bromine react to form hydrogen bromide. The value of equilibrium constant for this reaction is  $5 \times 10^8$ . If a mixture of 0.6 mole of  $H_2$  and 0.2 mole of  $Br_2$  is heated to 700 K, the amount of  $H_2$ ,  $Br_2$  and  $HBr$  at equilibrium is :

- (A) 0.4 mole, 0.1 mole, 0.4 mole
- (B) 0.4 mole, 0.3 mole, 0.38 mole
- (C) 0.38 mole, 0.2 mole, 0.4 mole
- (D) 0.4 mole, 0.0 mole, 0.4 mole

**Q.7.**  $K_c$  for  $CO(g) + H_2O(g) \leftrightarrow CO_2(g) + H_2(g)$  at  $986^\circ C$  is 0.63. A mixture of 1 mole of  $H_2O(g)$  and 3 mole of  $CO(g)$  is allowed to react to come to an equilibrium at 2.0 atm. The mole of  $H_2$  formed and partial pressure of each gas at equilibrium are :

- (A) 0.682 mole; 1.16, 0.16, 0.34, 0.34 atm
- (B) 0.681 mole; 1.16, 0.16, 0.34, 0.34 atm
- (C) 0.681 mole; 2.16, 1.16, 0.34, 0.34 atm
- (D) 0.681 mole; 1.16, 2.16, 1.34, 0.34 atm

**Q.8.** The  $K_p$  for the reaction  $N_2O_4 \leftrightarrow 2NO_2$  is 640 mm at 775 K. The percentage dissociation of  $N_2O_4$  at equilibrium pressure of 160 mm and the pressure at which the dissociation will be 50% are :

- (A) 70% & 480 mm
- (B) 70% & 450 mm
- (C) 70.7% & 480 mm
- (D) 70.7% & 450 mm

**Q.9.** 0.1 mole of  $\text{N}_2\text{O}_4(\text{g})$  was sealed in a tube under atmospheric conditions at  $25^\circ\text{C}$ . The number of mole of  $\text{NO}_2(\text{g})$  present, if the equilibrium  $\text{N}_2\text{O}_4(\text{g}) \leftrightarrow 2\text{NO}_2(\text{g})$ , is reached after some time,  $K_p$  being 0.14 is :

- (A) 0.034 mole
- (B) 0.043 mole
- (C) 0.340 mole
- (D) 0.430

**Q.10.** An equilibrium mixture at 300 K contains  $\text{N}_2\text{O}_4$  and  $\text{NO}_2$  at 0.28 and 1.1 atmosphere respectively. The volume of the container is doubled, the new equilibrium pressure of two gases are :

- (A) 0.045; 0.64
- (B) 0.095; 0.55
- (C) 0.095; 0.64
- (D) 0.045; 0.09

**Q.11.** At  $25^\circ\text{C}$  and 1 atmospheric pressure, the partial pressure in equilibrium mixture of gases  $\text{N}_2\text{O}_4$  and  $\text{NO}_2$  are 0.7 and 0.3 atm respectively. The partial pressure of these gases when they are in equilibrium at  $25^\circ\text{C}$  and 10 atmospheric pressure are :

- (A) 1.07; 8.99
- (B) 1.77; 8.93
- (C) 1.77; 8.99
- (D) 1.07; 8.93

**Q.12.** At 540 K, 0.10 mole of  $\text{PCl}_5$  is heated in a 8 litre flask. The pressure of equilibrium mixture is found to be 1.0 atm.  $K_c$  and  $K_p$  for the reaction are

- (A)  $4.0 \times 10^{-1} \text{ mol litre}^{-1}$ ; 1.77 atm
- (B)  $4.0 \times 10^{-2} \text{ mol litre}^{-1}$ ; 1.77 atm
- (C)  $4.1 \times 10^{-2} \text{ mol litre}^{-1}$ ; 1.77 atm
- (D)  $4.1 \times 10^{-1} \text{ mol litre}^{-1}$ ; 1.77 atm

**Q.13.** At some temperature and under a pressure of 4 atm,  $\text{PCl}_5$  is 10% dissociated. The pressure at which  $\text{PCl}_5$  will be 20% dissociated, temperature remaining same is :

- (A) 0.96 atm
- (B) 1.96 atm
- (C) 2.96 atm
- (D) 3.96 atm

**Q.14.** The degree of dissociation is 0.4 at 400 K and 1.0 atm for the gaseous reaction:  $\text{PCl}_5 \leftrightarrow \text{PCl}_3 + \text{Cl}_2$ . Atomic mass of P and Cl being 31.0 and 35.3 respectively. Assuming ideal behavior of all the gases, the density of equilibrium mixture at 400 K and 1.0 atmosphere is :

- (A) 1.43 g/litre
- (B) 2.43 g/litre
- (C) 4.53 g/litre
- (D) 5.53 g/litre

**Q.15.**  $\text{NH}_3$  is heated at 15 atm from  $27^\circ \text{C}$  to  $347^\circ \text{C}$  assuming volume constant. The new pressure becomes 50 atm at equilibrium of the reaction :  $2\text{NH}_3 \leftrightarrow \text{N}_2 + 3\text{H}_2$  The percentage of mole of  $\text{NH}_3$  actually decomposed is :

- (A) 61.1%
- (B) 61.3%
- (C) 61.5%
- (D) 61.7%

**Q.16.** For the reaction :  $\text{CO}(\text{g}) + 2\text{H}_2(\text{g}) \leftrightarrow \text{CH}_3\text{OH}(\text{g})$   $\text{H}_2$  is introduced into a five litre flask at  $327^\circ \text{C}$ , containing 0.2 mole of  $\text{CO}(\text{g})$  and a catalyst till the pressure is 4.92 atmosphere. At this point 0.1 mole of  $\text{CH}_3\text{OH}$  is formed. The  $K_c$  and  $K_p$  are :

- (A)  $279.64 \text{ litre}^2 \text{ mol}^{-1}$ ;  $0.115 \text{ atm}^{-2}$
- (B)  $279.44 \text{ litre}^2 \text{ mol}^{-2}$ ;  $0.113 \text{ atm}^{-2}$
- (C)  $279.54 \text{ litre}^2 \text{ mol}^{-1}$ ;  $0.114 \text{ atm}^{-2}$
- (D)  $279.34 \text{ litre}^2 \text{ mol}^{-1}$ ;  $0.112 \text{ atm}^{-2}$

**Q.17.** 0.15 mole of CO taken in a 2.5 litre flask is maintained at 750 K along with a catalyst so that the following reaction can take place.



Hydrogen is introduced until the total pressure of the system is 8.5 atm at equilibrium and 0.08 mole of methanol is formed. The value of  $K_c$  and  $K_p$  are :

- (A)  $187.85 \text{ mol}^{-2} \text{ litre}^2$ ;  $0.06 \text{ atm}^{-2}$
- (B)  $187.65 \text{ mol}^{-2} \text{ litre}^2$ ;  $0.05 \text{ atm}^{-2}$
- (C)  $187.85 \text{ mol}^{-2} \text{ litre}^2$ ;  $0.05 \text{ atm}^{-2}$
- (D)  $1.87.65 \text{ mol}^{-2} \text{ litre}^2$ ;  $0.06 \text{ atm}^{-2}$

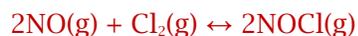
**Q.18.** 0.15 mole of CO taken in a 2.5 litre flask is maintained at 750 K along with a catalyst so that the following reaction can take place.



Hydrogen is introduced until the total pressure of the system is 8.5 atm at equilibrium and 0.08 mole of methanol is formed. The final pressure, if the same amount of CO and  $\text{H}_2$  as before are used but without catalyst so that the reaction does not take place is :

- (A) 12.538 atm
- (B) 12.835 atm
- (C) 12.358 atm
- (D) 12.438 atm

**Q.19.** The value of  $K_p$  is  $1 \times 10^{-3} \text{ atm}^{-1}$  at  $25^\circ \text{C}$  for the reaction :



A flask contains NO at 0.02 atm and at  $25^\circ \text{C}$ . The mole of  $\text{Cl}_2$  to be added, if 1% of the NO is to be converted into NOCl at equilibrium and the volume of the flask is such that 0.2 mol of gas produce 1 atm pressure at  $25^\circ \text{C}$ , ignoring the probable association of NO to  $\text{N}_2\text{O}_2$ , is :

- (A) 0.02042
- (B) 0.04204
- (C) 0.02420
- (D) 0.02204

**Q.20.** The standard enthalpy of formation of  $\text{NH}_3(\text{g})$  is  $-46 \text{ kJ}$  and standard entropies of  $\text{N}_2(\text{g})$ ,  $\text{H}_2(\text{g})$  and  $\text{NH}_3(\text{g})$  are  $191.130$  and  $192 \text{ JK}^{-1} \text{ mol}^{-1}$  respectively. Value of  $R$  is  $8.3 \text{ JK}^{-1} \text{ mol}^{-1}$ . The value of  $\log K_P$  for the reaction,

$\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \leftrightarrow 2\text{NH}_3(\text{g})$  At  $25^\circ \text{C}$  is given by :

- (A) 5.584
- (B) 5.854
- (C) 8.545
- (D) 5.845