DPP SOLUTION

- Subject – Physical Chemistry
- Chapter – Chemical Equilibrium

DPP No.- 02

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Question-

At 250°C and 1 atmospheric pressure, the vapour density of PCl_5 is 57.9 . What will be the degree of dissociation of PCl_5

$\alpha = ?$

$T = 250^{\circ}C, \; P = 1\,atm$

1. 1.00

$D_o = 57.9$

2. 0.90

$D_t = \frac{M_t}{2} = \frac{\text{Molar mass of reactant}}{2} = \frac{M_{PCl_5}}{2} = \frac{31 + 35.5 \times 5}{2} = \frac{208.5}{2}$

$D_t = 104.25$

3. 0.80

$1PCl_5(g) \rightleftharpoons 1PCl_3(g) + 1Cl_2(g)$

$n = 2$

4. 0.65

$\alpha = \frac{D_t - D_o}{D_o(n-1)} = \frac{104.25 - 57.9}{57.9(2-1)} = \frac{46.35}{57.9} = 0.80$

Ans. (3)

Question-

N_2O_4 dissociates as $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ at 273 K and 2 atm pressure. The equilibrium mixture has a density of 41 . What will be the degree of dissociation

$T = 273K$, $P = 2atm$ $\qquad \alpha = ?$ $\qquad n = 2$

1. 14.2%
2. 16.2%
3. 12.2%
4. None

$D_0 = 41$

$D_t = \frac{M_t}{2} = \frac{2\times14 + 4\times16}{2} = \frac{92}{2} = 46$

$\alpha = \frac{D_t - D_0}{D_0(n-1)}$

$\alpha = \frac{46-41}{41(2-1)} = \frac{5}{41} = 0.1219$

% age dissociation $= 0.1219 \times 100$

$= 12.19\%$

$d_{mix} = 41$

$M_{mix} = M_0$

$d_{mix} = \frac{P M_{mix}}{RT}$

Ans. (3)

Question-

An unknown compound A dissociates at 500°C to give products as follows

$$A(g) \rightleftharpoons B(g) + C(g) + D(g)$$

Vapour density of the equilibrium mixture is 50 when it dissociates to the extent to 10%. What will be the molecular weight of compound A

1. 120
2. 130
3. 134
4. 140

$D_o = 50$

%age dissociation $= 10 = \alpha \times 100 \Rightarrow \alpha = \frac{10}{100} = 0.1$

$n = 3$

$M_t = 2 \times D_t$

$\alpha = \frac{D_t - D_o}{D_o(n-1)}$

$0.1 = \frac{D_t - 50}{50(3-1)}$

$0.1 \times 100 = D_t - 50$

$D_t = 10 + 50 = 60$

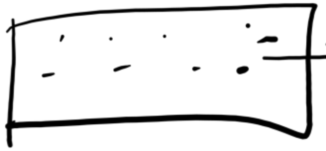
$M_t = 2 \times D_t = 2 \times 60 = 120$

Ans. (1)

Question-

The active mass of 64 gm of HI in a two litre flask would be

$M_{HI} = 1 + 127$
$= 128 g$



$\rightarrow$ 64g HI (g)

active mass $= [HI] = \dfrac{n_{HI}}{V} = \dfrac{\cancel{64}}{\underset{2}{\cancel{128}} \times 2} = \dfrac{1}{4} = 0.25$

1. 2
2. 1
3. 5
4. 0.25

Ans. (4)

Question-

15 moles of H_2 and 5.2 moles of I_2 are mixed and then allowed to attain equilibrium at 500°C. At equilibrium, the concentration of HI is found to be 10 moles. The equilibrium constant for the formation of is

1. 50
2. 15
3. 100
4. 25

$T = 500°C$

$n_{HI} = 10$

$K_c =$

$$1H_2(g) + 1I_2(g) \rightleftharpoons 2HI$$

	H_2	I_2	HI
$t=0$	15	5.2	0
$t=t$	$15-x$	$5.2-x$	$2x$
	$\frac{10}{V}$	$\frac{0.2}{V}$	$\frac{10}{V}$

$n_{HI} = 2x = 10$

$x = 5$

$$K_c = \frac{[HI]^2}{[H_2]^1[I_2]^1} = \frac{\left(\frac{10}{V}\right)^2}{\left(\frac{10}{V}\right)^1\left(\frac{0.2}{V}\right)^1} = \frac{10\cancel{0} \times 10}{1\cancel{0} \times 0.2}$$

$$K_c = \frac{100}{2} = 50$$

Ans. (1)

Question-

$NH_4COONH_2(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$

If equilibrium pressure of gaseous mixture is 3 atm then K_p will be

(1) 4

(2) 27

(3) 4/27

(4) 1/27

$$NH_4COONH_2(s) \rightleftharpoons 2NH_3(g) + 1CO_2(g)$$

$$\begin{array}{ccc} y & 0 & 0 \\ y - x & 2x & x \\ & P_{NH_3} = 2P_{CO_2} & P_{CO_2} \end{array}$$

$P_{NH_3} = x_{NH_3} \times P_T$

$P_{CO_2} = x_{CO_2} \times P_T$

Total P at eq. $= P_{NH_3} + P_{CO_2}$

$3 = 2P_{CO_2} + P_{CO_2}$

$P_{CO_2} = \frac{3}{3} = 1\,atm$

$K_p = (P_{NH_3})^2 (P_{CO_2})^1$

$= (2)^2 (1)^1$

$K_p = 4$

Ans. (1)

Question-

2 moles of N_2 is mixed with 6 moles of H_2 in a closed vessel of 1 litre capacity. If 50% N_2 is converted into NH_3 at equilibrium, the value of K_c for the reaction is

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

$K_c = ?$

	N_2	$3H_2$	$2NH_3$
$t=0$	2	6	0
$t=t$	$2-1=1$	$6-3=3$	2

$[N_2] = \frac{1}{1L}$ | $[H_2] = \frac{3}{1L}$ | $[NH_3] = \frac{2}{1L}$

$$K_c = \frac{(2)^2}{(1)^1(3)^3} = \frac{4}{27}$$

(1) 4/27

(2) 27/4

(3) 1/27

(4) 27

Ans. (1)

Question-

For the reaction A + B $\rightleftharpoons$ 2C, at the equilibrium concentration of A and B each is 0.20 mole/litre concentration C is observed as 0.6 mol/litre. Equilibrium constant (K_c) will be

1. 9
2. 18
3. 6
4. 24

$$K_C = \frac{[C]^2}{[A]^1[B]^1} = \frac{(0.6)^2}{(0.2)^1(0.2)^1} = \frac{0.\cancel{6}^{3} \times 0.\cancel{6}^{3}}{0.\cancel{2} \times 0.\cancel{2}}$$

$$K_C = 9$$

Ans. (1)

Question-

The equilibrium constant of a reaction is 20.0. At equilibrium, the rate constant of forward reaction is 10.0. The rate constant for backward reaction is

1. 0.5
2. 2
3. 10
4. 200

$K_c = 20$, $K_f = 10$, $K_b = ?$

$$K_c = \frac{K_f}{K_b}$$

$$20 = \frac{10}{K_b}$$

$$K_b = \frac{10}{20} = \frac{1}{2} = 0.5$$

Ans. (1)

Question-

Eight mole of a gas AB_3 attain equilibrium in a closed container of volume $1dm^3$ as, $2AB_3(g) \rightleftharpoons A_2(g) + 3B_2(g)$. If at equilibrium 2 mole of A_2 are present, then equilibrium constant is

$V = 1L$ $\quad K_C = ?$

1. 72 mol² L–2
2. 36 mol² L^{-2}
3. 3 mol² L^{-2}
4. 27 mol² L^{-2}

$$2AB_3(g) \rightleftharpoons 1A_2(g) + 3B_2(g)$$

$t=0 \quad 8 \quad 0 \quad 0$

$t=t \quad 8-x \quad \frac{x}{2} \quad \frac{3}{2}x$

$8-4 = \frac{4}{1} \quad \frac{2}{1} \quad \frac{3}{\cancel{2}} \times \cancel{4}^{2} = \frac{6}{1}$

$n_{A_2} = 2 = \frac{x}{2}$

$x = 4$

$2 \rightarrow 1 \quad 2 \rightarrow 3$

$x \rightarrow \frac{x}{2} \quad x \rightarrow \frac{3}{2}x$

$$K_C = \frac{[A_2]^1[B_2]^3}{[AB_3]^2} = \frac{(2)^1(6)^3}{(4)^2} = \frac{\cancel{2} \times \cancel{6}^{3} \times \cancel{6}^{3} \times \cancel{6}^{3}}{\cancel{2}\,\cancel{4} \times \cancel{4}_{\cancel{2}}} = 27$$

Ans. (4)

Question-

If one third of HI decomposes at a particular temperature, K_c for $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ is

$$2HI(g) \rightleftharpoons 1H_2(g) + 1I_2(g)$$

(1) 1/16 $t=0$ $\quad 1 \quad 0 \quad 0$

(2) 1/4 $t=t$ $\quad 1-\frac{1}{3}=\frac{2}{3\times V} \quad \frac{1}{6\times V} \quad \frac{1}{6\times V}$

(3) 1/6

(4) 1/2

$2 \rightarrow 1$

$\frac{1}{3} \rightarrow \frac{1}{2}\times\frac{1}{3} = \frac{1}{6}$

$$K_c = \frac{\left(\frac{1}{6V}\right)^2}{\left(\frac{2}{3V}\right)^2} = \frac{1\times 1\times 3\times 3}{6\times 6\times 2\times 2}$$

$$K_c = \frac{1}{16}$$

Ans. (1)

Question-

In chemical reaction A $\rightleftharpoons$ B, the system will be known in equilibrium when

1. A completely changes to B
2. 50% of A changes to B
3. The rate of change of A to B and B to A on both the sides are same
4. Only 10% of A changes to B

Ans. (3)

Question-

$A + B \rightleftharpoons C + D$. If initially the concentration of A and B are both equal but at equilibrium, concentration of D will be twice of that of A then what will be the equilibrium constant of reaction?

$[D]_{eq.} = 2[A]_{eq.}$ $\quad K_C$

1. 4/9
2. 9/4
3. 1/9
4. 4

$$
\begin{array}{lcccc}
 & A & + B & \rightleftharpoons C & + D \\
t=0 & 1 & 1 & 0 & 0 \\
t=t & 1-x & 1-x & x & x \\
 & 1-\frac{2}{3}=\frac{1}{3} & 1-\frac{2}{3}=\frac{1}{3} & \frac{2}{3} & \frac{2}{3}
\end{array}
$$

$[D]_{eq.} = 2[A]_{eq.}$

$x = 2(1-x)$

$x = 2-2x$

$3x = 2$

$x = \frac{2}{3}$

$$K_C = \frac{[C][D]}{[A][B]} = \frac{2 \times 2 \times \cancel{3} \times \cancel{3}}{\cancel{3} \times \cancel{3} \times 1 \times 1} = 4$$

Ans. (4)

Question-

2 mol of N_2 is mixed with 6 mol of H_2 in a closed vessel of one litre capacity. If 50% of N_2 is converted into NH_3 at equilibrium, the value of K_c for the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is

1. 4/27
2. 27/4
3. 1/27
4. 24

V = 1L

$$1N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$$

t = 0   2   6   0

t = t   2-1 = 1   6-3 = 3   2

$$K_c = \frac{(2)^2}{(1)^1(3)^3} = \frac{4}{27}$$

Ans. (1)

Question-

The partial pressure of $CH_3OH(g)$, $CO(g)$ and $H_2(g)$ in equilibrium mixture for the reaction, $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$ are 2.0, 1.0 and 0.1 respectively at 427°C. The value K_p of for the decomposition of CH_3OH to CO and H_2 is

1. 10^2 atm
2. 2×10^2 atm^{-1}
3. 50 atm^2
4. 5×10^{-3} atm^2

$CH_3OH(g) \rightarrow CO(g) + 2H_2(g)$

$K'_p = \frac{1}{K_p} = \frac{1}{200} = \frac{1}{2} \times \frac{10^{-2}}{\times 10} \times 10 = 5 \times 10^{-3}$

$CO(g) + 2H_2(g) \rightarrow CH_3OH(g)$

$K_p = \frac{2}{1 \times (0.1)^2} = 200$

Ans. (4)

Thank You...