WORK SHEET - 01

[SINGLE CORRECT CHOICE TYPE]

Q.1. At total equilibrium pressure P₁ atm and P₂ atm, N₂O₄ is dissociated to an extent of 33.33% and 50% respectively. Ratio of $\frac{P_1}{P_2}$ will be (A) $\frac{3}{8}$ (B) $\frac{4}{3}$ (C) $\frac{8}{3}$ (D) $\frac{3}{4}$

Q.2 For the reaction : $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2$; K = 10 M at 600 K 0.1 mol of $PCl_5(g)$ is placed in an evacuated 5L bulb. Then what would be the total pressure at equilibrium. (**Take :** R = 0.08 L-atm-mol⁻¹ K⁻¹] (A) 9.6 atm (B) 0.96 atm (C) 4.8 atm (D) 1.92 atm

- Q.3 The dissociation equilibrium of a gas AB_2 can be represented as - $2AB_2(g) \rightleftharpoons 2AB(g) + B_2(g)$ The degree of dissociation is 'x' and is small compared to 1. The expression relating the degree of dissociation (x) with equilibrium constant K_p and total pressure P is -(A) $(2K_p/P)^{1/2}$ (B) K_p/P (C) $2K_p/P$ (D) $(2K_p/P)^{1/3}$
- Q.4 At a given temperature the following reaction is allowed to reach equilibrium in a vessel of volume V_1 litre. The degree of dissociation is α_1 . If at same temperature the volume of the reaction vessel is doubled (assuming the degrees of dissociation to be small) the new degree of dissociation shall be –

(A)
$$2\alpha_1$$
 (B) $\sqrt{\frac{\alpha_1}{2}}$ (C) $\sqrt{2\alpha_1}$ (D) $\sqrt{2}\alpha_1$

Q.5 For the reversible system,

 $X(g) \rightleftharpoons Y(g) + Z(g)$

a certain quantity of X was heated at pressure P at a certain temperature. The equilibrium partial pressure

of X was found to be $\frac{P}{7}$. What is the value of K_P at given temperature

(A) $\frac{6P}{7}$ (B) $\frac{9P}{7}$ (C) $\frac{36P}{7}$ (D) 6P

Q.6 The vapour density of N_2O_4 at a certain temperature is 30. What is the % dissociation of N_2O_4 at this temperature? (A) 53.3% (B) 106.6% (C) 26.7% (D) None

Q.7 For the reaction : A $.3H_2O(s) = A$. $H_2O(s) + 2H_2O(g)$; $K_p = 9 \text{ atm}^2$ A 24.63 litre flask contains 1 mole of A. $H_2O(s)$ at 300 K. How many moles of $H_2O(g)$ should be added to the flask at the given temperature to drive the backward reaction for completion. (A) 3 moles (B) 5 moles (C) 8 moles (D) 2 moles Q.8 Ammonia at a pressure of 5 atm and H_2S gas at a pressure of 10 atm are introduced into an evacuated vessel.

 $K_{p} = 62.5 \text{ atm}^{2}$

 $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$ The total pressure of gases after long time is :

(A) 15 atm (B) more than 15 atm (C) less than 15 atm (D) unpredicted

Q.9 The progress of reaction : $A(g) \rightleftharpoons xB(g) + yC(g)$ with time is presented in figure. What is the value of K_C° at 300 K.



- $\begin{array}{ll} Q.10 & \mbox{Consider following reactions in equilibrium with equilibrium concentration 0.01 M of every species} \\ (I) PCl_5 (g) \rightleftharpoons PCl_3 (g) + Cl_2 (g) & (II) 2HI(g) \rightleftharpoons H_2 (g) + I_2 (g) \\ (III) N_2 (g) + 3H_2 (g) \rightleftharpoons 2NH_3 (g) \\ \mbox{Extent of the reactions taking place is:} \\ (A) I > II > III & (B) I < II < III & (C) II < III < I & (D) III < I < II \\ \end{array}$
- Q.11A definite amount of solid NH_4HS is placed in a flask already containing ammonia gas at a certain
temperature and 0.50 atm pressure. NH_4HS decomposes to give NH_3 and H_2S and at equilibrium total
pressure in flask is 0.84 atm. The equilibrium constant for the reaction is :
(A) 0.30(B) 0.18(C) 0.17(D) 0.11
- Q.12 At certain temperature (T) for the gas phase reaction $2H_2O(g) + 2Cl_2(g) \rightleftharpoons 4HCl(g) + O_2(g)$ $K_p = 12 \times 10^8$ atm If Cl_2 , HCl & O_2 are mixed in such a manner that the partial pressure of each is 2 atm and the mixture is brough into contact with excess of liquid water. What would be approximate partial pressure of Cl_2 when equilibrium is attained at temperature (T)? **[Given : Vapour pressure of water is 380 mm Hg at temperature (T)]** (A) 3.6×10^{-5} atm (B) 10^{-4} atm (C) 3.6×10^{-3} atm (D) 0.01 atm

Q.14 For the following Equilibria:

 $H_2O(l) \rightleftharpoons H_2O(g)$ $K_P = P_{H_2O}$

where $P_{H_2O} \longrightarrow$ Vapour pressure of $H_2O(g)$

By which of the following ways P_{H_2O} can be changed

(A) By adding more $H_2O(l)$	(B) By adding more $H_2O(g)$
(C) By changing temperature	(D) All of the above

Q.15 For the reaction : $A(s) \Longrightarrow B(g) + C(g)$. What will be the value of natural logarithm of ratio of total

pressure at 400K to that at 300K $\left[= \ln \frac{P_{400}}{P_{300}} \right]$ if $\Delta H = 16.628$ kJ. (**Given :** R = 8.314J/K-mole) (A) 5/3 (B) 5/6 (C) 3/5 (D) 6/5

Q.16At a equilibrium pressure of $3.3 \text{ atm } N_2O_4$ undergoes 10% decomposition to NO_2 . At same temperature
what will be equilibrium pressure required for 20% dissociation.
(A) 3.3 atm (B) 6.6 atm (C) 4 atm (D) 0.8 atm

[PARAGRAPH TYPE]

Paragraph for question nos. 17 to 19

Following reaction is at equilibrium in basic medium at 300 K.

 $I_2(s) \rightleftharpoons I^-(aq.) + IO_3^-(aq.)$ Equilibrium concentration at 300 K are, $[I^-] = 0.1 \text{ M}, [IO_3^-] = 0.1 \text{ M}$ Given: ΔG_{f}° (I⁻, aq) = -50 kJ/mol ΔG_{f}° (IO₃⁻, aq) = -123.5 kJ/mol ΔG_{f}° (H₂O, l) = -233 kJ/mol ΔG_{f}° (OH⁻, aq) = -150 kJ/mol $R = \frac{25}{3} \text{ J mol}^{-1} \text{ K}^{-1} \log_{10} e = 2.3$ Q.17 ΔG° of the reaction in KJ mol⁻ is (A) - 150.7(B) - 172.5(C) 172.5 (D) 150.7 Q.18 Value of equilibrium constant is (A) 10²⁵ (B) 10^{35} (C) 10^{30} (D) 10²⁷

Q.19 pH value at equilibrium is (A) 8 (B) 6 (C) 9 (D) 5

Paragraph for question no. 20 to 22

According to Le Chatelier principle when an equilibrium is subjected to any external change, the equilibria/ reaction shifts to compensate the effect of the change. This principle helps in shifting the reaction towards appropriate directions so as to increase % yield of any reaction.

Q.20 Which of the following changes can not cause an increase in extent of dissociation of CH_3COOH in its aqueous solution as per the reaction,

$CH_3COOH_{(aq)} + H_2O \rightleftharpoons CH_3COO^{-1}$	$H_{(aq)}^{+} + H_{(aq)}^{+}$
(A) Addition of water into the solution	(B) Addition of NaOH into the solution
(C)Addition of HCl into the solution	(D) Removal of CH_3COO^- from the solution.

- Q.21 A,B,C & D are in equilibrium in a 2 litre container at 400 K & their moles are respectively 4, 5, 8 & 6. If the reaction involved is $3A_{(g)} + 2B_{(g)} \rightleftharpoons C_{(g)} + 5D_{(g)}$ then calculate equilibrium concentration of C when volume is increased to 10 litre. (A) 4M (B) 0.8 M (C) 5 M (D) None of these
- Q.22 If it is given that conversion of graphite to diamond in an endothermic reaction & the conversion $C_{(graphite)} \rightleftharpoons C_{(diamond)}$ attains equilibria at 1.5×10^9 Pa at 300 K then comment at what pressure equilibria can be attained at 500 K.

(A) $P > 1.5 \times 10^9 Pa$	(B) $P < 1.5 \times 10^9 Pa$
(C) $P = 1.5 \times 10^9 Pa$	(D) At any pressure

Paragraph for question nos. 23 to 25

In a closed rigid vessel, N_2 and H_2 gases are taken in 9 : 13 mole ratio, by which the following equilibria are established :

$$N_{2}(g) + 3H_{2}(g) = 2NH_{3}(g); K_{P_{1}} = ?$$
$$N_{2}(g) + 2H_{2}(g) = N_{2}H_{4}(g); K_{P_{2}} = ?$$

At equilibrium, the total pressure is 14 atm, the partial pressure of ammonia is 2 atm and the partial pressure of hydrogen is 4 atm

Q.23 The value of
$$K_{P_1}$$
 is :

(A)
$$\frac{1}{80}$$
 atm² (B) $\frac{1}{80}$ atm⁻² (C) 80 atm² (D) $\frac{1}{40}$ atm⁻²

Q.24 The value of
$$\frac{1}{K_{P_2}}$$
 is:

(A)
$$\frac{3}{80}$$
 atm⁻² (B) $\frac{80}{3}$ atm² (C) $\frac{40}{3}$ atm² (D) $\frac{5}{3}$ atm⁻²

Q.25The equilibrium partial pressure of N_2 is:
(A) 5 atm(B) 7 atm(C) 3 atm(D) 2 atm

[ASSERTION AND REASON]

Q.26 **Statement-1:** An increase in pressure (caused by decrease in volume) at equilibrium results in increase in molar concentration of each gaseous substance involved.

Statement-2: An increase in pressure (caused by decrease in volume) at equilibrium results in increase in number of moles of each gaseous substance involved.

- (A) Statement-1 is true, statement-2 is true and statement-2 is correct explanation for statement-1.
- (B) Statement-1 is true, statement-2 is true and statement-2 is NOT the correct explanation for statement-1.
- (C) Statement-1 is true, statement-2 is false.
- (D) Statement-1 is false, statement-2 is true.

[MULTIPLE CORRECT CHOICE TYPE]

Q.27 For the reaction

 $2\operatorname{ClF}_3(g) \Longrightarrow \operatorname{Cl}_2(g) + 3\operatorname{F}_2(g)$

 $\log K_{eq} v/s \frac{1}{T}$ (where temperature is in K) curve is obtained as following



Which of the following change will increase the concentration of Cl_2 in an equilibrium mixture of Cl_2 , F_2 & ClF_3 :

- (A) Addition of inert gas at constant pressure
- (B) Increase in temperature at constant volume
- (C) Addition of catalyst at equilibrium
- (D) Removal of $F_2(g)$ at equilibrium
- Q.28 For a gaseous reaction : $A_{(g)} \rightleftharpoons 3B_{(g)} + C_{(g)}$, ΔH is positive and the reaction attains equilibrium at 1 bar total pressure and 400K. Identify the **incorrect** statements regarding the above reaction. (A) On increase of temperature, equilibrium will be shifted in forward direction.

(B) When inert gas is introduced into a rigid container containing above equilibria equilibrium shifts towards left.

(C) $\Delta G_{400}^{\circ} = 0$ for the above reaction.

(D) If volume of vessel containing the above equilibria is increased without change in temperature then partial pressure of B decreases as compared to original equilibrium partial pressure of B.

Q.29 Consider the equilibrium HgO(s) + 4I⁻(aq) + H₂O(l) \rightleftharpoons HgI₄²⁻(aq) + 2OH⁻(aq), which changes will decrease the equilibrium concentration of HgI₄²⁻ (A) Addition of 0.1 M HI (aq) (B) Addition of HgO (s) (C) Addition of H₂O(l) (D) Addition of KOH (aq)

Q.30 For the reaction $N_2O_5(g) \rightarrow 2NO_2(g) + \frac{1}{2}O_2(g)$

 $N_2O_5(g)$ decomposed at a constant volume and temperature. Initial pressure of N_2O_5 is 600 mm of Hg and total pressure at equilibrium is 960 mm of Hg. Assuming ideal behavior of gases, Select the correct option(s).

- (A) Involved reaction is intramolecular redox reaction
- (B) The mole fraction of NO_2 in the equilibrium mixture is 0.5
- (C) The equilibrium constant K_p for the above reaction is 540 mm of Hg
- (D) For the above reaction $K_C = K_P (RT)^3$

Q.31 Select correct statement(s)

- (A) K_p depends upon equilibrium pressure
- (B) Dissociation of $NH_4HS(s)$ is suppressed at high pressure $[NH_4HS(s) \implies NH_3(g) + H_2S(g)]$
- (C) Low pressure is favourable for melting of ice
- (D) During dissociation of $PCl_5(g) \longrightarrow PCl_3(g) + Cl_2(g)$, M_{avg} decreases with progress of reaction
- Q.32 Which of the following is/are correct statement(s)?
 - (A) The vapour pressure of a solid is zero at absolute zero.
 - (B) The maximum vapour pressure of a solid is its vapour pressure at the triple point.
 - (C) The minimum vapour pressure of a liquid is its vapour pressure at the triple point.
 - (D) The maximum vapour pressure of a liquid is its vapour pressure at critical temperature.
- Q.33 The equilibrium between, gaseous isomers A, B and C can be represented as

Reaction		Equilibrium constant
$A(g) \rightleftharpoons B(g)$:	$K_1 = ?$
$B(g) \rightleftharpoons C(g)$:	$K_2 = 0.4$
$C(g) \rightleftharpoons A(g)$:	$K_3 = 0.6$

If one mole of A is taken in a closed vessel of volume 1 litre, then

- (A) [A] + [B] + [C] = 1 M at any time of the reactions
- (B) Concentration of C is 4.1 M at the attainment equilibrium in all the reactions
- (C) The value of K_1 is $\frac{1}{0.24}$
- (D) Isomer [A] is least stable as per thermodynamics.

Q.34 For the endothermic reaction,

 $A_{(g)} \rightleftharpoons 2B_{(g)}$ Certain changes were caused & the behaviour of equilibria was analysed by plotting changes in concentration v/s time. Match List-I with List-II.



Q.35	Column I		Column II			
	(A) $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$	(P)	Introduction of hydrogen gas at constant volume shift equilibrium back			
	(P) PC1 (g) \rightarrow PC1 (g) + C1 (g)	(0)	g increases on increasing temperature			
	(b) $\operatorname{rcl}_5(g) \leftarrow \operatorname{rcl}_3(g) + \operatorname{cl}_2(g)$	(Q)	a increases on increasing temperature.			
	(C) 2HI (g) \rightleftharpoons H ₂ (g) + I ₂ (g)	(R)	On adding inert gas at constant volume, equilibrium state does not change			
	(D) $NH_4HS(g) \rightleftharpoons NH_3(g) + H_2S(g)$	(S)	On increasing the pressure, concentration of all reactants increases			
		(T)	α is independent of equilibrium pressure.			
	INUMERICAL INTEGE		PE QUESTIONS			

[NUMERICAL INTEGER TYPE QUESTIONS]

Q.36 5 moles each of 'A', 'B' and 'D' are added to a 1 litre container. Calculate the number of moles of 'B' at equilibrium if following reaction occurs.

 $\begin{array}{ll} A(g) + B(g) \rightleftharpoons C(s) & K_{\rm C} = 2 \times 10^{10} \ {\rm M}^{-2} \\ A(g) + D(g) \rightleftharpoons E(s) & K_{\rm C} = 10^{10} \ {\rm M}^{-2} \end{array}$ [Fill your answer by multiplying it with 150]

- Q.37 PCl₅ dissociates according to the reaction $PCl_5 \rightleftharpoons PCl_3(g) + Cl_2(g)$. At 523 K, $K_p = 1.78$ atm. Find the density of the equilibrium mixture at a total pressure of 1 atm.
- Q.38 When 1 mole of A(g) is introduced in a closed rigid 1 litre vessel maintained at constant temperature the following equilibria are established.

 $\begin{array}{rcl} A(g) \rightleftharpoons & B(g) & + & C(g) & : & K_{C_1} \\ \\ C(g) \rightleftharpoons & D(g) & + & B(g) & : & K_{C_2} \end{array}$

The pressure at equilibrium is twice the initial pressure. Calculate the value of $\frac{K_{C_2}}{K_{C_1}}$ if $\frac{[C]_{eq}}{[B]_{eq}} = \frac{1}{5}$

ANSWER KEY

Q.1	(C)	Q.2	(D)	Q.3	(D)	Q.4	(D)	Q.5	(C)
Q.6	(A)	Q.7	(B)	Q.8	(A)	Q.9	(B)	Q.10	(B)
Q.11	(D)	Q.12	(C)	Q.13	(A)	Q.14	(C)	Q.15	(B)
Q.16	(D)	Q.17	(B)	Q.18	(C)	Q.19	(A)	Q.20	(C)
Q.21	(D)	Q.22	(B)	Q.23	(B)	Q.24	(B)	Q.25	(A)
Q.26	(C)	Q.27	(BD)	Q.28	(BC)	Q.29	(CD)	Q.30	(AB)
Q.31	(BD)	Q.32	(ABCD)	Q.33	(ACD)				
Q.34	(A) R (B) Q (C) S (D) P								
Q.35	(A) P, Q, R, S	; (B) (Q, R, S ; (C) I	P, Q, R, S	S, T; (D) Q,	R, S			
Q.36	(0250)	Q.37	(2.7)	Q.38	(4)				

WORK SHEET - 01

TOPIC - CHEMICAL EQUILIBRIUM

HINTS & SOLUTIONS



$$\begin{bmatrix} & (3) \\ & 1 \\ \hline \\ & \frac{8}{9} \\ \hline \\ & \frac{9}{4} \\ & \frac{1}{3} \\ & \frac{8}{3} \\ \hline \\ & \frac{8}{3} \\ & \frac{1}{3} \\ & \frac{1}{3} \\ & \frac{8}{3} \\ & \frac{1}{3} \\$$

Q.2 (D) $Cl_5(g) \rightleftharpoons PCl_3(g) + Cl_2$ t = 0 0.1 mol 0 0 $t = t_{eq}$ (0.1-x)mol x-mol x-mol

$$\therefore K_{C} = \frac{\frac{x}{5} \times \frac{x}{5}}{\frac{(0.1 - x)}{5}} \Longrightarrow 10 = \frac{x^{2}}{5(0.1 - x)}$$
$$\Longrightarrow 50 \ (0.1 - x) = x^{2} \Longrightarrow x^{2} = 5 - 50 \ x$$
$$\Longrightarrow x^{2} + 50 \ x - 5 = 0 \qquad \therefore x = 0.0998 \approx 0.1$$
$$\therefore n_{PCl_{5}} \text{ is negligible}$$
$$(0.1 + 0.1) \times 0.08 \times 600 \text{ atm} = 1.6$$

 $\therefore P_{\text{final}} = \frac{(0.1 \pm 0.1) \times 0.08 \times 600}{5} \text{ atm} = 1.92 \text{ atm}$

$$P \rightarrow 1 - \alpha_{1} \qquad PCl_{5} \rightleftharpoons PCl_{3} + Cl_{2}$$

$$P \rightarrow 1 - \alpha_{1} \qquad \alpha_{1} \qquad \alpha_{1}$$

$$Total \text{ pressure } K_{p} = \frac{\left(\frac{\alpha_{1}}{1 + \alpha_{1}}P\right)^{2}}{\left(\frac{1 - \alpha_{1}}{1 + \alpha_{1}}O\right)^{1}} = \frac{\alpha_{1}^{2}P}{1 - \alpha_{1}^{2}}$$

$$PCl_{5} \rightleftharpoons PCl_{3} + Cl_{2}$$

$$PCl_{5} \rightleftharpoons \alpha_{2} \qquad \alpha_{2}$$

Q.4 (D)

Q.3

(D)

$$2AB_{2}(g) \implies 2AB(g) + a - ax \qquad ax$$

$$K_{p} = \frac{\left(\frac{ax}{a + \frac{ax}{2}}P\right)^{2} \left(\frac{ax/2}{a + \frac{ax}{2}}P\right)}{\left(\frac{a - ax}{a + \frac{ax}{2}}P\right)^{2}}$$

$$x = (2K_{p}/P)^{1/3}$$

$$\frac{B_2(g)}{ax}$$

$$K_{\rm P} = \frac{\alpha_2^2 P/2}{1 - \alpha_2^2}$$
$$\frac{\alpha_1^2 P}{1 - \alpha_1^2} = \frac{\alpha_2^2 P/2}{1 - \alpha_2^2}$$
$$\alpha_2^2 = 2\alpha_1^2$$
$$\alpha_2 = \sqrt{2}\alpha_1$$

Q.5 (C)





Q.6 (A)

Q.7 (B) $A . 3H_2O(s) = A . H_2O(s) + 2H_2O(g) K_p = 9 atm^2$ $x mole K_p = P_{H_2O}^2$ PV = nRT $3 at \times 24.63lt = n_{H_2O} \times 0.0821 \times 300$

 $n_{H_2O} = 3$ mole 5 mole of $H_2O(g)$ should be added.

Q.8 (A)

 $Q = P_{NH_3} \times P_{H_2S} = 50 \text{ atm}^2 \text{ as } Q < K_p$, the reaction should go in forward direction, but $NH_4HS(s)$ is not present in container \therefore there will be no change in pressure]

Q.9 (B) d[A] = 1 d[B] = 1 d[C]

 $K_P = P_{H_2O}$

Q.14 (C

- Q.13 (A)
- Q.12 (C)
- Q.11 (D)
- Q.10 (B)

$$-\frac{\mathbf{u}[\mathbf{A}]}{\mathbf{dt}} = \frac{1}{\mathbf{x}} \frac{\mathbf{u}[\mathbf{D}]}{\mathbf{dt}} = \frac{1}{\mathbf{y}} \frac{\mathbf{u}[\mathbf{C}]}{\mathbf{dt}}$$
$$-\frac{(2-3)}{\mathbf{t}} = \frac{1}{\mathbf{x}} \frac{(2-0)}{\mathbf{t}} \Rightarrow \mathbf{x} = 2$$
$$-\frac{(2-3)}{\mathbf{t}} = \frac{1}{\mathbf{y}} \frac{(1-0)}{\mathbf{t}} \Rightarrow \mathbf{y} = 1$$
$$[\mathbf{A}]_{eq} = 2, \qquad [\mathbf{B}]_{eq} = 2, [\mathbf{C}]_{eq} = 1$$
$$\therefore \mathbf{K}_{\mathbf{C}} = \frac{[\mathbf{B}]^{\mathsf{x}} [\mathbf{C}]^{\mathsf{y}}}{[\mathbf{A}]} = \frac{2^{2} \times 1^{1}}{2} = 2$$

K_p is temperature dependent only.

Q.15 (B)

$$K_{p} = P^{2}$$

 $\ln \frac{K_{P_{2}}}{K_{P_{1}}} = \frac{\Delta H}{R} \left[\frac{1}{T_{1}} - \frac{1}{T_{2}} \right]$
 $\ln \frac{P_{400}^{2}}{P_{300}^{2}} = \frac{16.628 \times 10^{3}}{8.314} \left[\frac{1}{300} - \frac{1}{400} \right]$
 $2 \ln \frac{P_{400}}{P_{300}} = 2 \times 10^{3} \left[\frac{100}{300 \times 400} \right] = \frac{10}{12} = \frac{5}{6} \text{ Ans.}$
Q.16 (D)
 $N_{2}O_{4(g)}$
Initial moles 1 α $2 \pi NO_{2(g)}$
 $At eq^{m} moles 1 - \alpha$ 2α
 $(2\alpha)^{2}P - 4\alpha^{2}P$

$$K_{p} = \frac{(2\alpha)^{-P}}{(1-\alpha^{2})} = \frac{4\alpha^{-P}}{(1-\alpha^{2})}$$
$$\frac{4 \times (0.1)^{2} \times 3.3}{1-(0.1)^{2}} = \frac{4 \times (0.2)^{2} \times P}{1-(0.2)^{2}}$$
$$\frac{3.3}{0.99} = \frac{4P}{0.96} \implies P = 0.8 \text{ atm} \text{ Ans.}$$

Q.17 (B)

Balanced Chemical Equation is

$$3I_2(s) + 6 \text{ OH}^-(aq) \rightleftharpoons 5I^-(aq) + IO_3^-(aq) + 3H_2O(l)$$

 $\Delta G^\circ = 5 \times (-50) + (-123.5) + 3 \times (-233) - 0 - 6 \times (-150) = -172 \cdot 5 \text{ kJ/ mol}$

Q.18 (C)
$$\Delta G^{\circ} = -2.3 \text{ RT } \log k = -172.5 \times 10^3 \text{ J/mol}$$

$$\Rightarrow -2.3 \times \frac{25}{3} \times 300 \log k = -172.5 \times 10^{3}$$
$$\Rightarrow \log k = 30$$

$k = 10^3$]

$$\Rightarrow \frac{[0.1]^{5}[0.1]}{[OH^{-}]^{6}} = 10^{30}$$

$$[OH^{-}] = 10^{6} \text{ M} \quad \text{pOH} = 6 \quad \therefore \text{ pH} = 8$$

$$Q.20 \quad (C) \quad CH_{3}COOH_{(aq)} + H_{2}O \rightleftharpoons CH_{3}COO^{-}_{(aq)} + H^{+}_{(aq)}$$

$$t = 0 \quad \text{a moles} \quad t_{eq} \quad a - x \quad x \quad x$$

$$\therefore Q = \frac{x^{2}}{a - x} \times \frac{1}{V}$$

On adding water, V increases so decreases. So reaction will move in forward direction. NaOH will react with H^+ . So $[H^+]$ decreases so reaction will move in forward direction. Addition of HCl will increase concentration of H^+ in solution. Reaction will shift in backward direction. Removal of CH_3COO^- will shift reaction in forward direction.

Q.21 (D)

Q.19 (A)

Sol. $k = \frac{[I^-]^5[IO_3^-]}{[OH^-]^6} = 10^3$

Q.22 (B)

 $C_{(graphite)} \rightleftharpoons C_{(diamond)}$ Endothermic reaction at 500 K reaction will shift in forward direction. $P < 1.5 \times 10^9 \text{ Pa}$ $[As C_{(diamond)} \text{ is more dense}]$

Q.23 (B)

Q.24 (B)

Q.25 (A) (i) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ t = 0 a b $t_{eq} \qquad a - x - y \qquad b - 3x - 2y \qquad 2x$ $N_2(g) + 2H_2(g) \equiv N_2H_4(g)$ t = 0 a b $t_{eq} \qquad a-y-x \qquad b-2y-2x \qquad y$ Now, $P_{NH_3} = 2 atm$ \therefore $2x = 2 \implies x = 1$ Also $P_{H_2} = 4 atm$ b - 3 - 2y = 7(i) Total pressure = 14 atm a - x - y + 4 + 2 + y = 14a - x = 8a = 9 atm(as molar ratio of a & b = 9: 13)

$$(as moral ratio of a cc or (3.15))$$

$$b = 13 atm$$

$$(i) \Rightarrow 2y = b - 7 = 6$$

$$y = 3 atm$$

$$P_{N_2} = a - x - y = 9 - 1 - 3 = 5 atm$$

$$P_{H_2} = 4 atm$$

$$P_{NH_3} = 2 atm$$

$$P_{N_2H_4} = 3 atm$$

$$K_{P_1} = \frac{2 \times 2}{4 \times 4 \times 4} = \frac{1}{80} atm^{-2}$$

$$K_{P_2} = \frac{3}{5 \times 4 \times 4} = \frac{3}{80} atm^{-2}$$

$$\therefore \frac{1}{K_{P_2}} = \frac{30}{3} atm^2$$

(iii) $P_{N_2} = 5 \text{ atm}$

Q.26 (C)

(ii)

Q.27 (B) (D) $K_{eq} = Ae^{-\Delta H/RT}$ Taking log on both the sides

$$\log K_{eq} = \log A \frac{-\Delta H}{2.303 R} \cdot \frac{1}{T}$$

$$Y = + C - m x$$
thus $\Delta H = +ve$
So the reaction is endothermic on increasing
temperature equilibrium shift in forward
direction concentration of Cl₂ increases.
On removing F₂ (g) equilibrium shift [B]
inforward direction concentration of Cl₂ increases [D]]

Q.28 (B)(C)

$$A_{(g)} \rightleftharpoons 3B_{(g)} + C_{(g)}$$

 $\Delta H = +ve \text{ at } 400K$
 $P_{total} \text{ at } eq^m = 1 \text{ bar}$



- \Rightarrow on increasing T, reaction moves in forward direction.
- \Rightarrow on introducing inert gas at const. T, total pressure increases but partial pressure remains the same so no effect at eq^m
- $\Rightarrow \quad \text{at 400K } K_{p} \neq 1 \text{ (since } P_{total} = 1 \text{ bar)} \\ \Delta G^{\circ}_{400K} = \text{ RT } \ln K_{p} \neq 0$
- \Rightarrow If V is increased, partial pressure of each species would be less than initial value.]
- Q.29 (C)(D)
- Q.30 (A)(B)
- Q.31 (B)(D)
- Q.32 (A) (B) (C) (D) For water





O is triple point and B is critical point.

- (A) At absolute zero vapour pressure of solid will be zero.
- (B,C) Beyond triple point it will get convert into other phases and liquid phase has minimum pressure at this point.
- (D) Beyond critical point phase of liquid will get changed.

Q.34 (A) R (B) Q (C) S (D) P

Q.33 (A) (C) (D)
(a) [A] + [B] + [C] = 1 mole/L since for every reaction
$$\Delta n_g = 0$$

(b) $\frac{[C]}{[B]} = 0.4 \Rightarrow [C] = 0.4 [B]$
 $\frac{[A]}{[C]} = 0.6$ [A] = 0.6 [C]
[A] + [B] + [C] = 1
 $0.6[C] + \frac{[C]}{[0.4]} + [C] = 1$
[C] $\left\{ 0.6 + \frac{1}{0.4} + 1 \right\} = 1$
[C] $= \frac{4}{16.4} = \left[\frac{1}{4.1} \right] \Rightarrow \frac{[B]}{[A]} = \left[\frac{1}{0.24} \right] = K_1$

Q.35 (A) P, Q, R, S; (B) Q, R, S; (C) P, Q, R, S, T; (D) Q, R, S

Q.36 0250 $C(s) \rightleftharpoons A + B$ $5-x \quad y \quad x$ $A + D \rightleftharpoons E(s)$ $x \quad 5$ $y \quad 5-x \quad x$ $xy = 5 \times 10^{-11}$ $y (5-x) = 10^{-10}$ $\frac{5 \times 10^{-11} (5-x)}{x} = 10^{-10}$ $2.5 - 0.5 \ x = x$ $x = \frac{5}{3}$

Q.37 2.7 g / lit

Q.38 4