Daily Tutorial Sheet-8	Level-2

96.(B) $CuSO_4 \cdot 5H_2O \rightleftharpoons CuSO_4 \cdot 3H_2O + 2H_2O(g)$

$p_{H_2O} = 7.8\,mm \quad \Rightarrow \; K_p = \left(p_{H_2O}\right)^2 = (7.8)^2 = 60.84$

97.(A) $CuSO_4 \cdot 5H_2O \rightleftharpoons CuSO_4 \cdot 3H_2O + 2H_2O(g)$

$K_p = 60.84$

$CuSO_4 \cdot 3H_2O \rightleftharpoons CuSO_4 \cdot H_2O + 2H_2O(g)$

$K'_p = \left(p_{H_2O}\right)^2 = (5.6)^2 = 31.56 \qquad p_{H_2O} = 5.6\,mm$

The ratio $\dfrac{K_p}{K'_p} = \dfrac{60.84}{31.36} = 1.9$

98.(B) Dehydration of $CuSO_4 \cdot 5H_2O$ is favourable at low humidity in air, high temperature and it decreases with increasing partial pressure of water vapours i.e., p_{H_2O}.

99.(B) $2A + B \rightleftharpoons C + D$

$$K_p = \frac{p_C \cdot p_D}{p_A^2 \cdot p_B} = \frac{\dfrac{n_C RT}{V} \cdot \dfrac{n_D RT}{V}}{\left(\dfrac{n_A RT}{V}\right)^2 \cdot \left(\dfrac{n_B RT}{V}\right)} = \frac{n_C\, n_D}{n_A^2\, n_B} \cdot \frac{V}{RT}$$

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

Moles	N_2	H_2	NH_3
Initial	0.2	0.6	0
At equilibrium	$0.2 - x$	$0.6 - 3x$	$2x$

Also : $0.4 = \dfrac{x}{0.2} \quad \Rightarrow \quad x = 0.08$

Ratio $= \dfrac{V_f}{V_i} = \dfrac{(n_{Total})_f}{(n_{Total})_i} = \dfrac{0.8 - 2x}{0.8} = 1 - \dfrac{x}{0.4} = 1 - \dfrac{0.08}{0.40} = \dfrac{4}{5}$

101.(C) $A + B \rightleftharpoons C$

Given : $\dfrac{dx}{dt} = \left(2 \times 10^3\right)[A][B] - \left(1 \times 10^2\right)[C]$

where x is the amount of 'A' dissociated

At equilibrium : $\dfrac{dx}{dt} = 0$ (since no change in the concentration of any reactant or product with respect to time)

$\Rightarrow \quad \dfrac{dx}{dt} = \left(2 \times 10^3\right)[A][B] - \left(1 \times 10^2\right)[C] = 0$

$\Rightarrow \quad$ Equilibrium constant $\left(K_{eq}\right) = \dfrac{[C]}{[A][B]} = \dfrac{2 \times 10^3}{1 \times 10^2} = 20$

102.(C) Consider the equation : $2Ag^{+}(aq) + Cu(s) \rightleftharpoons Cu^{2+}(aq) + 2Ag(s)$

At equilibrium : $[Cu^{2+}] = xM$; $[Ag^{+}] = yM$

$$K_{eq} = K_c = \frac{[Cu^{2+}]}{[Ag^{+}]^2} = \frac{x}{y^2}$$

103.(A)

	I_2	+	I^-	$\rightleftharpoons$	I_3^-
Moles at $t = 0$	1		0.5		0
Moles at $t = t_{eq}$	$1 - x$		$0.5 - x$		x

Excess $AgNO_3$ gives 0.25 mol of yellow ppt.

$$\left(AgNO_3 + I^- \longrightarrow \underset{\text{yellow ppt.}}{AgI} \right)$$

$\Rightarrow \quad 0.5 - x = 0.25 \quad \Rightarrow \quad x = 0.25$

$$\Rightarrow \quad K_c = \frac{[I_3^-]}{[I_2][I^-]} = \frac{x/V}{\left(\frac{1-x}{V}\right)\left(\frac{0.5-x}{V}\right)} = \frac{0.25/1}{\left(\frac{0.75}{1}\right)\left(\frac{0.25}{1}\right)} = 1.33 \quad (V = 1.0\,L)$$

104.(D) $X(g) + \text{water} \rightleftharpoons X(aq) + \text{heat}$

- Exothermic reactions are favoured at low temperature (As per Le Chatelier's Principle)
- Since there is a decrease in volume in the forward direction, it will be favoured at high pressure.

105.(D) Given : $K_c < 2$ for $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

(A) From graph, find the value of K_c.

$$K_c = \left(\frac{[PCl_3][Cl_2]}{[PCl_5]}\right)_{Eq} = \frac{4 \times 6}{2} > 2$$

(A) is incorrect

(B) Incorrect : Since the concentration of both $PCl_3(g)$ and $Cl_2(g)$ will either increase or decrease. Here it is increasing for $Cl_2(g)$ and decreasing for $PCl_3(g)$.

(C) Note that (from graph) the initial concentration of PCl_5 is zero. So the equilibrium is established as follows.

	$PCl_3(g)$	+	$Cl_2(g)$	$\rightleftharpoons$	$PCl_5(g)$
$t = 0$	a		b		0
$t = t_{eqm.}$	$a - x$		$b - x$		x

(D) Obviously this should be the correct choice
However let us check it. Find K_c.

$$K_c = \left(\frac{[PCl_3][Cl_2]}{[PCl_5]}\right)_{Eqm} = \frac{2 \times 4}{6} < 2$$