Daily Tutorial Sheet-1	JEE Main (Archive)

1.(D) Equilibrium constant of a given reversible reaction depends only on temperature.

2.(A) K_p for a given reversible reaction depends only on temperature.

3.(0.33) Total moles of gases at equilibrium $= \frac{pV}{RT} = \frac{2.05 \times 100}{0.082 \times 500} = 5.0$

Out of this 5 moles, 1.0 mole is for $N_2(g)$ and remaining 4 moles

For PCl_5 and its dissociation products.

$$PCl_5 \rightleftharpoons PCl_3 + Cl_2$$
$$3-x \quad x \quad x$$
$$3+x = 4 \Rightarrow x = 1$$

Degree of dissociation $= \frac{1}{3} = 0.33$

4.(D) $KNO_3(aq) + NaCl(aq) \longrightarrow KCl(aq) + NaNO_3(aq)$ is example of reversible reaction.

5.(D) $SO_2Cl_2(g) \rightleftharpoons SO_2(g) + Cl_2(g)$

Adding inert gas at constant volume will not affect partial pressure of reactant or products, hence will not affect equilibrium amount of either reactant or products.

6.(B) $N_2O_4(g) \rightleftharpoons 2NO_4(g)$

t = 0 1 mole

t = eq. 0.8 mole 0.4 mole

$$\frac{P_1}{n_1T_1} = \frac{P_2}{n_2T_2} \Rightarrow \frac{1}{1 \times 300} = \frac{P_2}{1.2 \times 600} \Rightarrow P_2 = 2.4\,\text{atm}$$

7.(D) Adding reactant will drive the reaction in forward direction in order to restore equilibrium. Therefore, addition of CO(g) will increase the equilibrium amount of CO_2.

8.(A) Both temperature and pressure will change the equilibrium amount of $X_3Y(g)$. Temperature changes the value of equilibrium constant.

9.(D) Increases as the conc. of products increases.

10.(A) Increase in volume means decrease in pressure, on decreasing pressure equilibrium shift in the direction where moles are larger.

11.(B) $x = 1 - \left(1 + \frac{1}{2}\right) = \frac{-1}{2}$

12.(B) Calculate K_{eq} by $\Delta G^{\circ} = -RT\ell n K_{eq}$

Since $Q > K_{eq} \Rightarrow$ reverse direction

13.(B) Initially at equilibrium

$$A + B \rightleftharpoons C + D \qquad K_{eq} = 100$$
$$1 \quad 1 \quad 1 \quad 1 \qquad Q = 1$$
$$(1-x) \quad (1-x) \quad 1+x \quad 1+x$$

$$K_{eq} = \frac{[C][D]}{[A][B]} = \frac{(1+x)(1+x)}{(1-x)(1-x)} = \frac{(1+x)^2}{(1-x)^2} \Rightarrow 10 = \frac{1+x}{1-x}$$

On solving $x = \frac{9}{11} \Rightarrow [D] = 1.818$

14.(A) $A_2(g) \longrightarrow 2A(g)$

$1 \qquad\qquad 0$

$0.8 \qquad\qquad 0.4 \qquad$ Total moles $= 1.2$

$p_{A_2} = \frac{0.8}{1.2} \cdot p_{total} \qquad p_A = \frac{0.4}{0.1} \cdot p_{total}$

$K_p = \frac{p_A^2}{p_{A_2}} \Rightarrow \Delta G^\circ = -RT \ln K_p$

15.(A) $A_2(g) + B_2(g) \xrightleftharpoons{K_1} 2AB(g)$ .... **(1)**

2

18.(A) $A_{(s)} \rightleftharpoons B_{(g)} + C_{(g)}, \quad K_{p_1} = x\,atm^2$

- $\quad P_1 \quad P_1 + P_2$

$D_{(s)} \rightleftharpoons C_{(g)} + E_{(g)}, \quad K_{p_2} = y\,atm^2$

- $\quad P_1 + P_2 \quad P_2$

$K_{P_1} = P_1(P_1 + P_2) = x$

$K_{P_2} = P_2(P_1 + P_2) = y$

$\therefore \quad K_{P_1} + K_{P_2} = (P_1 + P_2)^2 = x + y$

$\Rightarrow \quad P_1 + P_2 = \sqrt{x+y} \quad \Rightarrow \quad 2(P_1 + P_2) = 2\sqrt{x+y}$

$\therefore \quad P_{total} = P_B + P_C + P_E = 2(P_1 + P_2) = 2\sqrt{x+y}$

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

Initial conc., $\quad a \quad 1.5a \quad 0 \quad 0$

At equilibrium, $\quad a - x \quad 1.5a - 2x \quad 2x \quad x$

At equilibrium,

$\Rightarrow \quad a - x = 1.5a - 2x \quad \Rightarrow \quad 0.5a = x$

$\Rightarrow \quad a = 2x \quad \Rightarrow \quad K_c = \dfrac{(2x)^2 \times x}{(a-x)(1.5a-2x)^2} = \dfrac{4x^3}{x \times x^2} = 4$

20.(D) $K_p = K_c(RT)^{\Delta ng}$

$\dfrac{K_p}{K_c} = (RT)^{\Delta ng}$

For reaction $\quad N_{2(g)} + O_{2(g)} \rightleftharpoons 2NO_{(g)}$

$\Delta ng = 0$ hence $\dfrac{Kp}{Kc} = 1$

For reaction $\quad N_2O_4(g) \rightleftharpoons 2NO_2(g)$

$\Delta ng = 1$ hence $\dfrac{Kp}{Kc} = (24.62)^1\ dm^3 atm\ mol^{-1}$

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

$\Delta ng = -2$ hence $\dfrac{Kp}{Kc} = (24.62)^{-2} = 1.65 \times 10^{-3} dm^{-6} atm^{-2} mol^2$

21.(B) $2NO(g) \rightleftharpoons N_2(g) + O_2(g),\ \Delta n = 0 \qquad (K_P = K_C)$

$2C(g) + O_2(g) \rightleftharpoons 2CO(g),\ \Delta n = +1 \qquad (K_P > K_C)$

$2HI(g) \rightleftharpoons H_2(g) + I_2(g),\ \Delta n = 0 \qquad (K_P = K_C)$

$NO_2(g) + SO_2(g) \rightleftharpoons NO(g) + SO_3,\ \Delta n = 0 \qquad (K_P = K_C)$

22.(C) Given $\quad 2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

$\Delta H = -57.2$ kJ/mol

$K_c = 1.7 \times 10^{16}$

(A) From $K\downarrow = A\,e^{-\frac{\Delta H}{RT\uparrow}}$ as T increases, K decreases

(B) Equilibrium constant is not a affected by change in volume.

(C) Although K_c is large but it doesn't mean reaction go for completion.

(D) Equilibrium will shift in forward direction as pressure increases.

Hence (C) is incorrect.

23.(C) $K_{eq} = \frac{[SO_3]^2}{[SO_2]^2[O_2]}$ ...(1)

$K_1 = \frac{[SO_2]}{[O_2]} = 10^{52}$

$K_2 = \frac{[SO_3]^2}{[O_2]^3} = 10^{129}$ ...(2)

$K_1^2 = \frac{[SO_2]^2}{[O_2]^2} = 10^{104}$ ...(3)

$K_{eq} = \frac{K_2}{(K_1)^2} = \frac{10^{129}}{10^{104}} = 10^{25}$

24.(A) $K_{eq} = \frac{[P]}{[R]} = \frac{11}{6} = 1.83 \simeq 2$