Daily Tutorial Sheet-2	JEE Advanced (Archive)

16.(Less) Δng is $-ve$; $K_p = K_c(RT)^{\Delta ng}$

17.(4.54 g/L)

$$\begin{array}{llll} PCl_5(g) \rightleftharpoons & PCl_3(g) + & Cl_2(g) & \text{Total moles} \\ 1-\alpha & \alpha & \alpha & 1+\alpha \end{array}$$

Average molar mass $= \dfrac{208.5}{1.4} = 148.9$

$\rho(\text{density}) = \dfrac{pM}{RT} = \dfrac{1 \times 148.9}{0.082 \times 400} = 4.54\ g/L$

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

$1.44 \times 10^{-5} = K_c(0.082 \times 773)^{-2}$

19.(D) $\underset{1-x}{N_2O_4} \rightleftharpoons \underset{2x}{2NO_2}$ $\qquad K_p = \dfrac{4x^2P}{1-x^2}$

K_p is function of temperature only. Does not change with either P or x.

20.(D) $\underset{1-\alpha}{N_2O_4(g)} \rightleftharpoons \underset{2\alpha}{2NO_2(g)}$ $\underset{1+\alpha}{\text{Total}}$

$p_i : \dfrac{1-\alpha}{1+\alpha}p \qquad \dfrac{2\alpha}{1+\alpha}p \qquad K_p = \dfrac{4\alpha^2}{1-\alpha^2}p$

At constant temperature, changing the volume will change both p and α but K_p remains constant.

21.(0; Backward)

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$

$\Delta G^\circ = 2\Delta G_f^\circ(NO_2) - \Delta G_f^\circ(N_2O_4) = 0$

Also $\Delta G^\circ = -RT \ln K = 0, K = 1$

Let the reaction shifts in forward direction.

$$\begin{array}{lll} N_2O_4(g) \rightleftharpoons & 2NO_2(g) & \text{Total} \\ 5-x & 5+2x & 10+x \end{array}$$

$P_1 : \dfrac{5-x}{10+x} \times 20 \qquad \dfrac{5+2x}{10+x} \times 20$

$\Rightarrow \quad K = \dfrac{(5+2x)^2}{(10+x)^2} \times \dfrac{10-x}{5-x} \times 20 = 1 \quad \Rightarrow \quad 81x^2 + 405x + 450 = 0 \quad \Rightarrow \quad x = -1.66$ and -3.33

Both values of x indicates that reaction actually proceeds in backward direction.

22.(A) Add both equations $K = K_1 \times K_2$

$K = 3.5 \times 10^{-3} \times 1.7 \times 10^{-3} = 5.95 \times 10^{-6}$

23.(ABCD)

By Kirchhoff's equation,

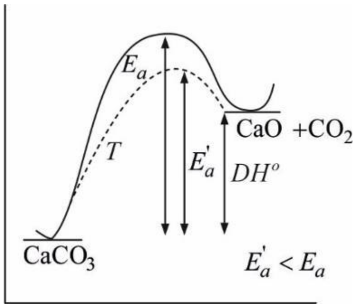
$\Delta H_2^o(\text{at } T_2) = \Delta H_1^0(\text{at } T_1) + \Delta C_p(T_2 - T_1)$

ΔH^o varies with temperature

Thus, (A) is correct.

$K = p_{co_2}$

K is dependent on pressure of CO_2 but independent of molar concentration of $CaCO_3$.



Thus, (b) and (c) are correct.

At a given temperature, addition of catalyst lowers activation energy, ΔH remaining constant.

Thus,(d) is also correct

$E_a =$ Activation energy in absence of catalyst

$E_a' =$ Activation energy in presence of catalyst

24.(B) As synthesis of ammonia is exothermic hence its yield decreases on increasing temperature, however at higher temperature equilibrium attained faster because of faster reaction rate at elevated temperatures.

25.(ABC) Le Chatelier's principle

26.(A) $X(\ell) \rightleftharpoons X(g)$

$\Delta G^\circ = \Delta G^\circ_{f_X(g)} - \Delta G^\circ_{f_X(\ell)}$; $\Delta G^\circ = -RT\,\ell n\,K_p$

In this case $K_p =$ pressure of X

27.(B)

	CO	+	Cl_2	$\rightleftharpoons$	$COCl_2$
Initial	2		3		0
at equim.	1		2		1

$[COCl_2] = \dfrac{\text{moles}}{\text{volume}} \Rightarrow K_c = \dfrac{[COCl_2]}{[CO][Cl_2]} \Rightarrow K_c = \dfrac{1\times5}{1\times2} = 2.5$

28.(8.92) $Fe^{2+}(aq) + S^{2-}(aq) \rightleftharpoons FeS(s) \quad K_C = 1.6\times10^{17}$

$0.03\text{ M} \quad 0.1\text{ M}$

$0.03 - x \quad 0.1 - x$

Since $K_C >> 1$ $\quad x \approx 0.03$

$\therefore \quad [S^{2-}] = 0.1 - 0.03 = 0.07\,M$

$\therefore \quad [Fe^{2+}][S^{2-}] = \left(\dfrac{1}{1.6\times10^{17}}\right)$

$[Fe^{2+}] = \dfrac{1}{1.6\times0.07}\times10^{-17} = 8.928\times10^{-17} = y\times10^{-17}$

$\therefore \quad y = 8.93$ (Round off)

or $\quad y = 8.92$ (After Truncation)