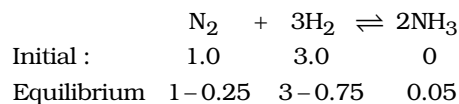


Daily Tutorial Sheet-1

JEE Advanced (Archive)

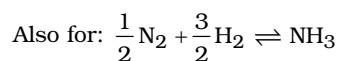
1.(F) $R \times n$ is reversed and multiplied by $\frac{1}{2}$. So $(K_{eq})_{new} = \sqrt{\frac{1}{K}}$

2.(K_c = 0.68)



$$[N_2] = \frac{0.75}{4}, [H_2] = \frac{2.25}{4}, [NH_3] = \frac{0.50}{4}$$

$$K_c = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{(0.50)^2}{(0.75)(2.25)^3} \times 16 = 0.468 \text{ L}^2 \text{ mol}^{-2}$$



$$K'_c = \sqrt{K_c} = 0.68$$

3.(F) Evaporation is an endothermic process.

4.(ABCD) $C_2H_4 + H_2 \rightleftharpoons C_2H_6, \Delta H = -32.7 \text{ kcal}$

The above reaction is exothermic, increasing temperature will favour backward reaction, will increase the amount of C_2H_4 . Decrease in pressure will favour reaction in direction containing more molecules (reactant side in the present case). Therefore, decreasing pressure will increase amount of C_2H_4 .

Removing H_2 , which is a reactant, will favour reaction in backwards direction, more C_2H_4 will be formed. Adding C_2H_6 will favour backward reaction and some of the C_2H_6 will be dehydrogenated to C_2H_4 .

5.(1.86) $A_2(g) + B_2(g) \rightleftharpoons 2AB(g) \quad \Delta n = 0$

$$K = \frac{[AB]^2}{[A_2][B_2]} = \frac{(n_{AB})^2}{n_{A_2} \cdot n_{B_2}} = \frac{(2x)^2}{(1-x)(2-x)}$$

$$\Rightarrow 5 - 0 = \frac{4x^2}{x^2 - 3x + 2} \Rightarrow 23x^2 - 7x + 50 = 0$$

$$\Rightarrow x = \frac{75 \pm \sqrt{75^2 - 4 \times 23 \times 50}}{46} = 0.93, 2.32$$

2.32 is not acceptable because x cannot be greater than 1,

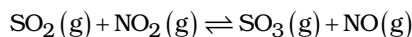
$$\text{Mole of } AB = 2x = 2 \times 0.93 = 1.86$$

6.(CD) $NaNO_3(s) \rightleftharpoons NaNO_2(s) + \frac{1}{2}O_2(g), \Delta H > 0$

$NaNO_3$ and $NaNO_2$ are in solid state, changing their amount has no effect on equilibrium. Increasing temperature favours forward reaction. Also, increasing pressure will favour backward reaction in which some $O_2(g)$ will combine with $NaNO_2(g)$ forming $NaNO_3$.

7.(T) Catalyst has no effect on thermodynamics of reaction.

8.(0.20 M)



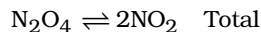
$$1-x \quad 1-x \quad x \quad x$$

$Q_c = 1 < K_c$, i. e. reaction proceed in forward direction to attain equilibrium.

$$16 = \left(\frac{x}{1-x} \right)^2 \Rightarrow x = 0.80$$

$$[\text{NO}] = 0.80\text{M}, [\text{NO}_2] = 0.20\text{M}$$

9.($K_\alpha = 0.26 \text{ atm}$; $\alpha = 0.62$)



$$1-\alpha \quad 2\alpha \quad 1+\alpha$$

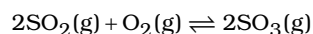
$$P_i: \frac{1-\alpha}{1+\alpha}p \quad \frac{2\alpha}{1+\alpha}p$$

$$K_p = \frac{4\alpha^2}{1-\alpha^2}p = \frac{4(0.25)^2}{1-(0.25)^2} = 0.26 \text{ atm}$$

When $p = 0.10 \text{ atm}$

$$0.26 = \frac{4\alpha^2(0.1)}{1-\alpha^2} \Rightarrow \alpha = 0.62$$

10. $\text{SO}_2 = \frac{2}{87} \text{ atm}$; $\text{O}_2 = \frac{125}{87} \text{ atm}$; $\text{SO}_3 = \frac{85}{87} \text{ atm}$



$$\text{Initial } p_i: \quad 0 \quad 2 \quad 1$$

$$\text{Equilibrium } p_i \quad 2p \quad 2+p \quad 1-2p$$

$$K_p = 900 = \frac{(1-2p)^2}{(2+p)(2p)^2} \quad [\text{Ignoring } p \text{ in comparison to } 2]$$

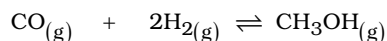
$$p = \frac{1}{87}$$

$$\text{Partial pressure of } \text{SO}_2 = 2p = \frac{2}{87} \text{ atm}$$

$$\text{Partial pressure of } \text{O}_2 = 2+p = 2 + \frac{1}{87} = \frac{125}{87} \text{ atm}$$

$$\text{Partial pressure of } \text{SO}_3 = 1-2p = 1 - 2\left(\frac{1}{87}\right) = \frac{85}{87} \text{ atm}$$

11.(277.77M⁻²)



$$\text{Mole } 0.2-0.10 \quad x-0.20 \quad 0.10 \Rightarrow \text{Total moles} = x$$

$$\Rightarrow x = \frac{4.92 \times 5}{0.082 \times 600} = 0.5 \Rightarrow \text{moles of } \text{H}_2 \text{ at equilibrium} = x - 0.2 = 0.3$$

$$\text{Partial pressures: } \text{CO} = \frac{9.1}{0.5}p, \text{H}_2 = \frac{0.3}{0.5}p,$$

$$\text{CH}_3\text{OH} = \frac{0.1}{0.5}p$$

$$K_p = \frac{\frac{p}{5}}{\left(\frac{p}{5}\right)\left(\frac{3}{5}p\right)^2} = \frac{25}{9p^2} = \frac{25}{9(4.92)^2} = 0.10 \text{ atm}^{-2}$$

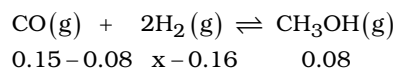
Concentrations: $[\text{CO}] = \frac{0.1}{5} \text{M}$, $[\text{H}_2] = \frac{0.3}{5} \text{M}$,

$$[\text{CH}_3\text{OH}] = \frac{0.1}{5} \text{M} \Rightarrow K_c = \frac{(0.1/5)}{(0.1/5)(0.3/5)^2} = 277.77 \text{M}^{-2}$$

12.(CD) If inert gas is introduced at constant pressure, volume of container will have to be increased and this will favour the forward reaction. Also adding $\text{PCl}_5(\text{g})$ at constant volume will favour forward reaction because $\text{PCl}_5(\text{g})$ is a reactant.

13.(T) Rate of any reaction increases on rising temperature.

14.(12.315 atm)



Total moles at equilibrium = $x - 0.01$

$$x - 0.01 = \frac{8.5 \times 2.5}{0.082 \times 750} = 0.34, \quad x = 0.35$$

(i) $K_p = 0.056$; $K_c = 213.33$

(ii) Pressure = $\frac{nRT}{V} = \frac{[0.15 + 0.35] \times 0.0821 \times 750}{2.5} = 12.315 \text{atm}$

15.(No change)

Pressure has no effect on equilibrium constant.