



Additional Problems for Self Practice (APSP)

Marked questions are recommended for Revision.

This Section is not meant for classroom discussion. It is being given to promote self-study and self testing amongst the Resonance students.

PART - I : PRACTICE TEST-1 (IIT-JEE (MAIN Pattern))

Max. Time : 1 Hr.

Max. Marks : 120

Important Instructions

- The test is of **1 hour** duration.
- The Test Booklet consists of **30** questions. The maximum marks are **120**.
- Each question is allotted **4 (four)** marks for correct response.
- Candidates will be awarded marks as stated above in Instructions No. 3 for correct response of each question.
 $\frac{1}{4}$ (**one fourth**) marks will be deducted for indicating incorrect response of each question. No deduction from the total score will be made if no response is indicated for an item in the answer sheet.
- There is only one correct response for each question. Filling up more than one response in any question will be treated as wrong response and marks for wrong response will be deducted accordingly as per instructions 4 above.

- 1 mole of N_2 and 2 moles of H_2 are allowed to react in a 1 dm^3 vessel. At equilibrium, 0.8 mole of NH_3 is formed. The concentration of H_2 in the vessel is :
 (1) 0.6 M (2) 0.8 M (3) 0.2 M (4) 0.4 M
- For the following mechanism, $P + Q \xrightleftharpoons{K_A} PQ \xrightleftharpoons{K_D} R$ at equilibrium $\frac{[R]}{[P][Q]}$ is :
 [k represents rate constant]
 (1) $\frac{K_A \cdot K_B}{K_C \cdot K_D}$ (2) $\frac{K_A \cdot K_D}{K_B \cdot K_C}$ (3) $\frac{K_B \cdot K_D}{K_A \cdot K_C}$ (4) $\frac{K_A \cdot K_C}{K_B \cdot K_D}$
- Select the reaction for which the equilibrium constant is written as $[MX_3]^2 = K_{eq} \cdot [MX_2]^2 [X_2]$
 (1) $MX_3 \rightleftharpoons MX_2 + \frac{1}{2} X_2$ (2) $2MX_3 \rightleftharpoons 2MX_2 + X_2$
 (3) $2MX_2 + X_2 \rightleftharpoons 2MX_3$ (4) $MX_2 + \frac{1}{2} X_2 \rightleftharpoons MX_3$.
- What should be the value of K_C for the reaction $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$, if the amount are $SO_3 = 48$ g, $SO_2 = 12.8$ g and $O_2 = 9.6$ g at equilibrium and the volume of the container is one litre?
 (1) 64 (2) 0.30 (3) 42 (4) 8.5
- The equilibrium constant (K_p) for the reaction $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is 16. If the volume of the container is reduced to one half its original volume, the value of K_p for the reaction at the same temperature will be :
 (1) 32 (2) 64 (3) 16 (4) 4
- 4.5 moles each of hydrogen and iodine heated in a sealed ten litre vessel. At equilibrium 3 moles of HI were found. The equilibrium constant for $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is :
 (1) 1 (2) 10 (3) 5 (4) 0.33
- In a 20 litre vessel initially each have 1 – 1 mole CO , H_2O CO_2 is present, then for the equilibrium of $CO + H_2O \rightleftharpoons CO_2 + H_2$ following is true :
 (1) H_2 , more than 1 mole (2) CO , H_2O , H_2 less than 1 mole
 (3) CO_2 & H_2O both more than 1 mole (4) All of these

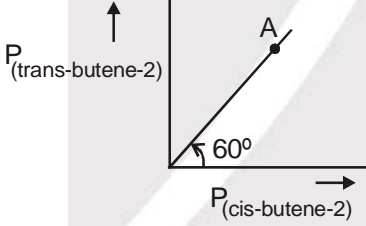


8. At 1000 K, the value of K_p for the reaction $A(g) + 2B(g) \rightleftharpoons 3C(g) + D(g)$ is 0.05 atmosphere. The value of K_c in terms of R would be :
 (1) 20000 R (2) 0.02 R (3) $5 \times 10^{-5} R$ (4) $5 \times 10^{-5} \times R^{-1}$
9. In which of the following reactions is $K_p < K_c$?
 (1) $CO(g) + Cl_2(g) \rightleftharpoons COCl_2(g)$ (2) $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$
 (3) $2BrCl(g) \rightleftharpoons Cl_2(g) + Br_2(g)$ (4) $I_2(g) \rightleftharpoons 2I(g)$
10. K for the synthesis of HI is 50. K for dissociation of HI is :
 (1) 50 (2) 5 (3) 0.2 (4) 0.02
11. The equilibrium constant of the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ is 64. If the volume of the container is reduced to one fourth of its original volume, the value of the equilibrium constant will be
 (1) 16 (2) 32 (3) 64 (4) 128
12. In equilibrium $CH_3COOH + H_2O \rightleftharpoons CH_3COO^- + H_3O^+$
 The equilibrium constant may change when
 (1) CH_3COO^- is added (2) CH_3COOH is added
 (3) Catalyst is added (4) Mixture is heated
13. In the gaseous reaction, $N_2 + O_2 \rightleftharpoons 2NO$, the moles/litre of N_2 , O_2 and NO respectively are 0.25, 0.05 and 1.0 at equilibrium. The initial concentration of N_2 and O_2 will be respectively : (Assume that initially, only N_2 and O_2 are present)
 (1) 0.75 mol/litre, 0.55 mole/litre (2) 0.50 mole/litre, 0.75 mole/litre
 (3) 0.25 mole/litre, 0.50 mole/ litre (4) 0.25 mole/litre, 1.0 mole/litre
14. In the following reaction started only with A_8 , $2A_8(g) \rightleftharpoons 2A_3(g) + 3A_2(g) + A_4(g)$ mole fraction of A_2 is found to 0.36 at a total pressure of 100 atm at equilibrium. The mole fraction of $A_8(g)$ at equilibrium is :
 (1) 0.28 (2) 0.72 (3) 0.18 (4) None of these
15. In a 0.25 litre tube dissociation of 4 moles of NO is take place. If its degree of dissociation is 10%. The value of K_p for reaction $2NO \rightleftharpoons N_2 + O_2$ is :
 (1) $\frac{1}{(18)^2}$ (2) $\frac{1}{(8)^2}$ (3) $\frac{1}{16}$ (4) $\frac{1}{32}$
16. For the given reaction at constant pressure,

$$n A(g) \rightleftharpoons A_n(g)$$
 Initial moles 1 0
 Moles at equilibrium $1 - \alpha$ α/n
 Then the correct relation between initial density (d_i) & final density (d_f) of the system is
 (1) $\left[\frac{n-1}{n} \right] \left[\frac{d_f - d_i}{d_f} \right] = \alpha$ (2) $\frac{n}{n-1} \left[\frac{d_f - d_i}{d_f} \right] = \alpha$
 (3) $\left[\frac{n-1}{n} \right] \left[\frac{d_i - d_f}{d_i} \right] = \alpha$ (4) $\frac{1}{(n-1)} \left[\frac{d_i - d_f}{d_i} \right] = \alpha$
17. On decomposition of NH_4HS , the following equilibrium is established :

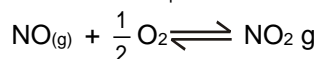
$$NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g)$$
 If the total pressure is P atm, then the equilibrium constant K_p is equal to
 (1) P atm (2) $P^2 \text{ atm}^2$ (3) $P^2 / 4 \text{ atm}^2$ (4) $2P$ atm
18. At room temperature, the equilibrium constant for the reaction $P + Q \rightleftharpoons R + S$ was calculated to be 4.32. At 425°C the equilibrium constant became 1.24×10^{-2} . This indicates that the reaction
 (1) is exothermic (2) is endothermic
 (3) is difficult to predict (4) no relation between ΔH and K



19. Calculate ΔG° for conversion of oxygen to ozone $3/2 \text{O}_2(\text{g}) \longrightarrow \text{O}_3(\text{g})$ at 298 K, if K_p for this conversion is 2.47×10^{-29}
 (1) 163 kJ mol^{-1} (2) $2.4 \times 10^2 \text{ kJ mol}^{-1}$ (3) 1.63 kJ mol^{-1} (4) $2.38 \times 10^6 \text{ kJ mol}^{-1}$
20. For the reaction, $4 \text{NH}_3(\text{g}) + 5 \text{O}_2(\text{g}) \rightleftharpoons 4 \text{NO}(\text{g}) + 6 \text{H}_2\text{O}(\ell)$, $\Delta H = \text{positive}$.
 At equilibrium which factor will not effect the concentration of NH_3 is :
 (1) change in pressure (2) change in volume (3) catalyst (4) None of these
21. The effect of adding krypton (Kr) gas on position of equilibrium, keeping the volume of the system constant is
 (1) If $\Delta n = 0$, backward reaction is favoured. (2) If, $\Delta n = +\text{ve}$, forward reaction is favoured
 (3) If $\Delta n = -\text{ve}$, forward reaction is favoured (4) No effect whatever be the value of Δn
22. Le-Chatelier's principle is applicable only to a
 (1) System in equilibrium (2) Irreversible reaction
 (3) Homogeneous reaction (4) Heterogeneous reaction
23. 'a' moles of PCl_5 , undergoes, thermal dissociation as : $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$, the mole fraction of PCl_3 at equilibrium is 0.25 and the total pressure is 2.0 atmosphere. The partial pressure of Cl_2 at equilibrium is:
 (1) 2.5 (2) 1.0 (3) 0.5 (4) None
24. The value of ΔG° for the phosphorylation of glucose in glycolysis is 15 kJ/mole . Find the value of K_c at 300 K.
 (1) e^6 (2) $10^{\frac{6}{2.303}}$ (3) $\frac{1}{e^{-6}}$ (4) $10^{\frac{2.303}{6}}$
25. Which of the following statements is correct for a reversible process in a state of equilibrium ?
 (1) $\Delta G = 2.30 \text{ RT log K}$ (2) $\Delta G^\circ = -2.30 \text{ RT log K}$
 (3) $\Delta G^\circ = 2.30 \text{ RT log K}$ (4) $\Delta G = -2.30 \text{ RT log K}$
26. For the following isomerisation reaction
 $\text{cis-butene-2} \rightleftharpoons \text{trans-butene-2}$ $K_P = 1.732$
- 
- Which of the following statement is true at point 'A' ?
 (1) $Q > K_P$ (2) $Q < K_P$ (3) $Q = K = 1$ (4) $Q = K = 1.732$
27. The following equilibrium exists in a saturated solution of NH_4Cl .
 $\text{NH}_4\text{Cl}(\text{s}) \rightleftharpoons \text{NH}_4^+(\text{aq}) + \text{Cl}^-(\text{aq})$; $\Delta H_{25^\circ\text{C}} = 3.5 \text{ kcal mol}^{-1}$
 A change that will shift the equilibrium to the right is
 (1) decrease in temperature
 (2) increase in temperature
 (3) addition of NH_4Cl crystals to the reaction mixture
 (4) addition of NH_4OH solution to the reaction mixture.
28. For the reaction : $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 The backward reaction at constant temperature is favoured by
 (1) introducing chlorine gas at constant volume
 (2) introducing an inert gas at constant pressure
 (3) increasing the volume of the container
 (4) introducing PCl_5 at constant volume



29. Find out $\ln K_{eq}$ for the formation of NO_2 from NO and O_2 at 298 K



Given :

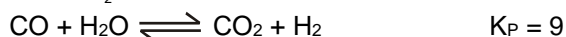
$$\Delta G_f^\circ (\text{NO}_2) = 52.0 \text{ KJ/mole}$$

$$\Delta G_f^\circ (\text{NO}) = 87.0 \text{ KJ/mole}$$

$$\Delta G_f^\circ (\text{O}_2) = 0 \text{ KJ/mole}$$

(1) $\frac{35 \times 10^3}{8.314 \times 298}$ (2) $-\frac{35 \times 10^3}{8.314 \times 298}$ (3) $\frac{35 \times 10^3}{2.303 \times 8.314 \times 298}$ (4) $\frac{35 \times 10^3}{2 \times 298}$

30. If a reaction vessel at 400°C is charged with equimolar mixture of CO and steam such that $P_{\text{CO}} = P_{\text{H}_2\text{O}} = 4 \text{ bar}$ what will be that partial pressure of H_2 at equilibrium



(1) 0.3 bar (2) 0.4 bar (3) 0.2 bar (4) 0.1 bar

Practice Test-1 (IIT-JEE (Main Pattern)) OBJECTIVE RESPONSE SHEET (ORS)

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										
Que.	21	22	23	24	25	26	27	28	29	30
Ans.										

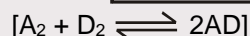
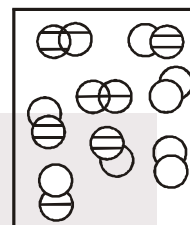
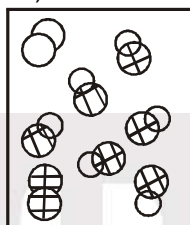
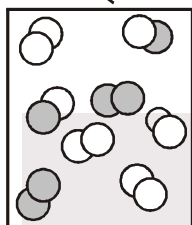
PART - II : NATIONAL STANDARD EXAMINATION IN CHEMISTRY (NSEC) STAGE-I

1. If the equilibrium constant for the reaction 0.125. [NSEC-2000]

$$\text{P}_{4(g)} + 6\text{Cl}_{2(g)} \rightleftharpoons 4\text{PCl}_{3(g)}$$
 The value of equilibrium for this reaction $4\text{PCl}_{3(g)} \rightleftharpoons \text{P}_{4(g)} + 6\text{Cl}_{2(g)}$.
 (A) 0.25 (B) 8 (C) 0.125 (D) 6
2. The free energy change for a reversible reaction at equilibrium is : [NSEC-2000]
 (A) very large positive (B) positive (C) zero (D) negative
3. Pure ammonia is placed in a vessel at a temperature where its dissociation constant is appreciable. At equilibrium : [NSEC-2001]
 (A) concentration of ammonia does not change with pressure.
 (B) its degree of dissociation, α does not change with pressure.
 (C) K_p does not change significantly with pressure.
 (D) concentration of hydrogen is less than that of nitrogen.
4. One mole of ethyl alcohol was treated with one mole of acetic acid at 25°C . Two-third of the acid changes into ester at equilibrium. The equilibrium constant for the reaction will be : [NSEC-2001]
 (A) 3 (B) 2 (C) 1 (D) 4
5. The relationship between equilibrium constants K_p and K_c for a gaseous reaction is : [NSEC-2001]
 (A) $K_p = K_c \cdot R(T)^{\Delta n}$ (B) $K_c = K_p \cdot (RT)^{\Delta n}$ (C) $K_p = K_c \cdot (RT)^{\Delta n}$ (D) $K_p = K_c / RT^{\Delta n}$
6. For the gaseous reaction, $\text{C}_2\text{H}_4 + \text{H}_2 \rightleftharpoons \text{C}_2\text{H}_6$, the equilibrium constant has the units : [NSEC-2001]
 (A) $\text{mol}^2\text{dm}^{-3}$ (B) $\text{dm}^3\text{mol}^{-1}$ (C) $\text{dm}^3\text{mol}^{-2}$ (D) $\text{mol} \cdot \text{dm}^{-3}$



7. The equilibrium constant for the reaction $\text{H}_2 + \text{Br}_2 \rightleftharpoons 2\text{HBr}$ is 67.8 at 300°K. The equilibrium constant for the dissociation of HBr is : **[NSEC-2001]**
 (A) 0.0147 (B) 67.80 (C) 33.90 (D) 8.349
8. The equilibrium constant (K) for the reaction, $\text{A} + 2\text{B} \rightleftharpoons 2\text{C} + \text{D}$ is : **[NSEC-2001]**
 (A) $\frac{[\text{C}]^2[\text{D}]}{[\text{A}][2\text{B}]}$ (B) $\frac{[2\text{C}][\text{D}]}{[\text{A}][2\text{B}]}$ (C) $\frac{[\text{C}][\text{D}]}{[\text{A}][\text{B}]}$ (D) $\frac{[\text{C}]^2[\text{D}]}{[\text{A}][\text{B}]^2}$
9. The following pictures represents the equilibrium state for three different reactions of the type **[NSEC-2002]**



Which reaction has the largest equilibrium constant ?

- (A) $\text{A}_2 + \text{B}_2 \rightleftharpoons 2\text{AB}$ (B) $\text{A}_2 + \text{C}_2 \rightleftharpoons 2\text{AC}$
 (C) $\text{A}_2 + \text{D}_2 \rightleftharpoons 2\text{AD}$ (D) none of these
10. Methanol (CH_3OH) is manufactured by reaction of carbon monoxide with hydrogen in the presence of $\text{ZnO/Cr}_2\text{O}_3$ catalyst. **[NSEC-2002]**
 $\text{CO}_{(\text{g})} + 2\text{H}_{2(\text{g})} \rightleftharpoons \text{CH}_3\text{OH}_{(\text{g})}$; $[\Delta H^\circ = -91 \text{ kJ}]$
 What happens to the amount of methanol when an equilibrium mixture of reactants and products is subjected to rise in temperature ?
 (A) Amount of methanol will increase
 (B) Amount of methanol will decrease
 (C) Amount of methanol remain the same
 (D) None of these
11. For the reversible reaction, $\text{A} + \text{B} \rightleftharpoons \text{C}$, the specific reaction rates for forward and reverse reactions are 1.25×10^{-3} and 2.75×10^{-5} respectively. The equilibrium constant for the reaction is : **[NSEC-2002]**
 (A) 45.45 (B) 0.022 (C) 2.20 (D) 0.4545
12. The equilibrium constant for the gaseous reaction $\text{H}_2 + \text{Cl}_2 \rightleftharpoons 2\text{HCl}$ is given by **[NSEC-2002]**
 (A) $K = \frac{[\text{H}_2][\text{Cl}_2]}{[\text{HCl}]^2}$ (B) $K = \frac{[\text{H}_2][\text{Cl}_2]}{2[\text{HCl}]}$ (C) $K = \frac{[\text{HCl}]^2}{[\text{H}_2][\text{Cl}_2]}$ (D) $K = \frac{2[\text{HCl}]}{[\text{H}_2][\text{Cl}_2]}$
13. For the reaction, $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$, the units of K_c and K_p respectively are : **[NSEC-2003]**
 (A) $\text{mol}^{-2} \text{L}^2$ and bar^{-2} (B) $\text{mol}^{-2} \text{L}^2$ and bar^{-1} (C) $\text{mol}^{-1} \text{L}$ and bar^{-2} (D) $\text{mol}^{-1} \text{L}^{-1}$ and bar^{-1}
14. The equilibrium constant for the reaction $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2\text{NH}_3$ is 70 at a certain temperature. Hence, equilibrium constant for the reaction $\text{NH}_3 \rightleftharpoons \frac{1}{2}\text{N}_2 + \frac{3}{2}\text{H}_2$ of the same temperature will be approximately **[NSEC-2004]**
 (A) 1.4×10^{-2} (B) 1.2×10^{-1} (C) 2.0×10^{-4} (D) 2.9×10^{-2}
15. For the reaction $4\text{NH}_3_{(\text{g})} + 7\text{O}_2_{(\text{g})} \rightleftharpoons 4\text{NO}_2_{(\text{g})} + 6\text{H}_2\text{O}_{(\text{g})}$, K_p is related to K_c by **[NSEC-2005]**
 (A) $K_p = K_c (\text{RT})$ (B) $K_p = K_c$ (C) $K_p = K_c (\text{RT})^3$ (D) $K_p = K_c (\text{RT})^{-1}$.
16. When $K_c > 1$ for a chemical reaction, **[NSEC-2005]**
 (A) the equilibrium would be achieved rapidly
 (B) the equilibrium would be achieved slowly
 (C) product concentrations would be much greater than reactant concentrations at equilibrium
 (D) reactant concentrations would be much greater than product concentrations at equilibrium.



17. Increased pressure shifts the equilibrium of the reaction : $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ so as to [NSEC-2006]
- (A) form more ammonia gas
 (B) produce more $N_2(g)$ and $H_2(g)$
 (C) keep the conversion to ammonia unaltered
 (D) produce more $H_2(g)$.
18. In which of the following reactions will an increase in volume of the reaction system favor the formation of the products ? [NSEC-2007]
- (A) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$ (B) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
 (C) $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(l)$ (D) $3O_2(g) \rightleftharpoons 2O_3(g)$
19. Which of the following changes the value of the equilibrium constant? [NSEC-2007]
- (A) change in concentration (B) change in pressure
 (C) change in volume (D) none of these
20. Consider the equilibrium reaction: [NSEC-2007]
- $$4NH_3(g) + 3O_2(g) \rightleftharpoons 2N_2(g) + 6H_2O(g) \quad (\Delta H = -1268 \text{ KJ})$$
- Which change will cause the reaction to shift to the right?
- (A) Increase the temperature
 (B) Decrease the volume of the container.
 (C) Add a catalyst to speed up the reaction.
 (D) Remove the gaseous water by allowing it to react and be absorbed by KOH.
21. At a given temperature the equilibrium constants of the gaseous reactions [NSEC-2008]
- $$NO(g) + \frac{1}{2} O_2(g) \xrightleftharpoons{K_1} NO_2(g)$$
- $$2NO_2(g) \xrightleftharpoons{K_2} 2NO(g) + O_2(g)$$
- are related as :
- (A) $K_1 = 2K_2$ (B) $K_1 = 1/K_2$ (C) $K_1 = \sqrt{K_2}$ (D) $K_1 = 1/\sqrt{K_2}$
22. For the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ [NSEC-2009]
- (A) $K_p = K_c$ (B) $K_p > K_c$ (C) $K_p < K_c$ (D) $K_c = \sqrt{K_p}$
23. If the equilibrium constants of the reactions, [NSEC-2009]
- $$2SO_3 \rightleftharpoons 2SO_2 + O_2 \quad \text{and} \quad SO_2 + \frac{1}{2} O_2 \rightleftharpoons SO_3$$
- are K_1 and K_2 respectively, the correct relation between the two equilibrium constant is,
- (A) $K_2 = (K_1)^{-1}$ (B) $K_2 = \sqrt{\frac{1}{K_1}}$ (C) $K_2 = \left(\frac{1}{K_1}\right)^2$ (D) $\sqrt{K_1}$
24. The equilibrium constant K_c for the reaction, [NSEC-2009]
- $$2NaHCO_3(s) \rightleftharpoons Na_2CO_3(s) + CO_2(g) + H_2O(l)$$
- (A) $K_c = \frac{[Na_2CO_3][CO_2][H_2O]}{[NaHCO_3]^2}$ (B) $K_c = \frac{[Na_2CO_3]}{[NaHCO_3]^2}$
 (C) $K_c = [CO_2][H_2O]$ (D) $K_c = p_{CO_2} \times p_{H_2O}$
25. For the following reaction, the value of K changes with [NSEC-2010]
- $$N_2(g) + O_2(g) \rightleftharpoons 2NO(g) \quad \Delta H = +180 \text{ kJ mol}^{-1}$$
- (A) change in pressure (B) change in concentration of oxygen
 (C) introduction of $NO(g)$ (D) change in temperature
- 26.* The formation of ammonia from nitrogen and hydrogen gases can be written by the following two equations
- (a) $\frac{1}{2} N_2(g) + \frac{3}{2} H_2(g) \rightleftharpoons NH_3(g)$ (b) $\frac{1}{3} N_2(g) + H_2(g) \rightleftharpoons \frac{2}{3} NH_3(g)$
- The two equations have equilibrium constants K_1 and K_2 , respectively. The relationship between the equilibrium constants is [NSEC-2010]
- (A) $K_1 = K_2^2$ (B) $K_1^3 = K_2^2$ (C) $K_1^{2/3} = K_2$ (D) $K_1 = K_2^{3/2}$



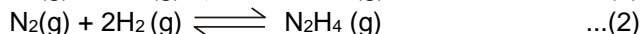
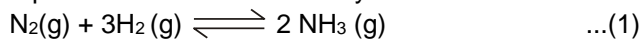
27. For the reaction $\text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g}) \rightleftharpoons \text{PCl}_5(\text{g})$, K_c is 26 at 250°C . K_p at the same temperature is ($R = 8.314 \text{ JK}^{-1}\text{mol}^{-1}$) [NSEC-2011]
 (A) 4.6×10^{-3} (B) 5.7×10^{-3} (C) 6.0×10^{-3} (D) 8.3×10^{-3}
28. At 445°C , K_c for the following reaction is 0.020.
 $2\text{HI}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{I}_2(\text{g})$
 A mixture of H_2 , I_2 and HI in a vessel at 445°C has the following concentrations : [NSEC-2011]
 $[\text{HI}] = 2.0\text{M}$, $[\text{H}_2] = 0.50\text{M}$ and $[\text{I}_2] = 0.10\text{M}$. The statement that is true concerning the reaction quotient, Q_c is:
 (A) $Q_c = K_c$; the system is at equilibrium
 (B) Q_c is less than K_c ; more H_2 and I_2 will be produced
 (C) Q_c is less than K_c ; more HI will be produced
 (D) Q_c is greater than K_c ; more H_2 and I_2 will be produced
29. The oxidation of SO_2 by O_2 is an exothermic reaction. The yield of SO_3 can be maximized if : [NSEC-2012]
 (A) temperature is increased and pressure is kept constant
 (B) temperature is decreased and pressure is increased
 (C) both temperature and pressure are increased
 (D) both temperature and pressure are decreased
30. In which of the following reaction is $K_p > K_c$ [NSEC-2012]
 (A) $\text{H}_2 + \text{I}_2 \rightleftharpoons 2 \text{HI}$ (B) $\text{N}_2 + 3\text{H}_2 \rightleftharpoons 2 \text{NH}_3$
 (C) $2\text{SO}_3 \rightleftharpoons 2\text{SO}_2 + \text{O}_2$ (D) $\text{PCl}_3 + \text{Cl}_2 \rightleftharpoons \text{PCl}_5$
31. The K_p/K_c ratio for the reaction $4\text{NH}_3(\text{g}) + 5\text{O}_2(\text{g}) \rightleftharpoons 4 \text{NO}(\text{g}) + 6 \text{H}_2\text{O}(\text{g})$, at 127°C is: [NSEC-2013]
 (A) 0.0301 (B) 0.0831 (C) 1.0001 (D) 33.26
32. K_p for the reaction given below is 1.36 at 499 K. Which of the following equations can be used to calculate K_c for this reaction ? [NSEC-2013]
 $\text{N}_2\text{O}_5(\text{g}) \rightleftharpoons \text{N}_2\text{O}_3(\text{g}) + \text{O}_2(\text{g})$
 (A) $K_c = \frac{[(0.0821) \times (499)]}{[1.36]}$ (B) $K_c = \frac{[(1.36) \times (0.0821)]}{[499]}$
 (C) $K_c = \frac{[1.36]}{[(0.0821) \times (499)]}$ (D) $K_c = \frac{[(1.36) \times (499)]}{[0.0821]}$
33. At 700 K, for the reaction $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$ the K_p is 3.2×10^4 . At the same temperature the K_p for the reaction $\text{SO}_3(\text{g}) \rightleftharpoons \text{SO}_2(\text{g}) + 0.50\text{O}_2(\text{g})$ is : [NSEC-2014]
 (A) 3.125×10^{-5} (B) 5.59×10^{-3} (C) 1.79×10^4 (D) 1.79×10^{-2}
34. For the following reaction, formation of the product is favored by [NSEC-2015]
 $\text{A}_2(\text{g}) + 4\text{B}_2(\text{g}) \rightleftharpoons 2\text{AB}_4(\text{g})$, $\Delta H < 0$
 (A) Low temperature and high pressure (B) High temperature and low pressure
 (C) Low temperature and low pressure (D) High temperature and high pressure
35. The equilibrium constant of the following isomerisation reaction at 400K and 298 K are 2.07 and 3.42 respectively.
 $\text{cis-butene} \xrightleftharpoons[k_{-1}]{k_1} \text{trans-butene}$
 Which of the following is/are correct ? [NSEC-2017]
 I. The reaction is exothermic
 II. The reaction is endothermic
 III. At 400K 50% of cis-butene and 50% of trans-butene are present of equilibrium
 IV. Both at 298K and 400K, $k_1 = k_{-1}$
 (A) I and IV (B) II and IV (C) I and III (D) I only
36. Acetic acid (CH_3COOH) is partially dimerised to $(\text{CH}_3\text{COOH})_2$ in the vapour phase. At a total pressure of 0.200 atm, acetic acid is 92.0% dimerized at 298 K.
 The value of equilibrium constant of dimerisation under these conditions is [NSEC-2017]
 (A) 57.5 (B) 9.7 (C) 97 (D) 194



PART - III : HIGH LEVEL PROBLEMS (HLP)

SUBJECTIVE QUESTIONS

1. In a vessel, two equilibrium are simultaneously established at the same temperature as follows:



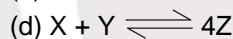
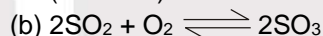
Initially the vessel contains N_2 and H_2 in the molar ratio of 9 : 13. The equilibrium pressure is $7P_0$, in which pressure due to ammonia is P_0 and due to hydrogen is $2P_0$. Find the values of equilibrium constants (K_P 's) for both the reactions

ONLY ONE OPTION CORRECT TYPE

2. For the following gases equilibrium, $\text{N}_2\text{O}_4(\text{g}) \rightleftharpoons 2\text{NO}_2(\text{g})$, K_p is found to be equal to K_c . This is attained when :

(A) 0°C (B) 273 K (C) 1 K (D) 12.19 K

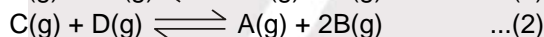
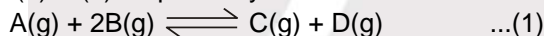
3. Consider the following reversible gaseous reactions (at 298 K) :



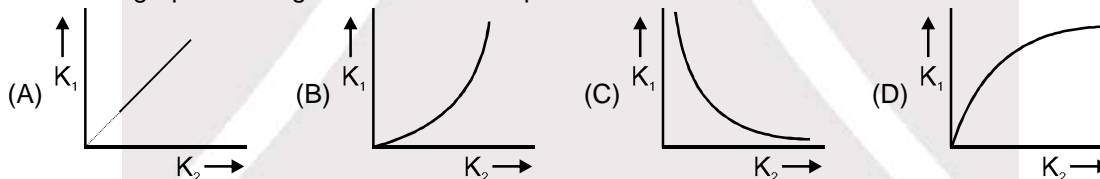
Highest and lowest value of $\frac{K_p}{K_c}$ will be shown by the equilibrium

(A) d, b (B) a, c (C) a, b (D) b, c7

4. For a container containing $\text{A}(\text{g})$, $\text{B}(\text{g})$, $\text{C}(\text{g})$ & $\text{D}(\text{g})$ with rigid walls, an experiment is carried upon. This experiment involves increase in temperature of container in steps of 1°C and system is allowed to attain equilibrium, followed by calculation of K_1 & K_2 at each step, where K_1 & K_2 are equilibrium constants for reaction (1) & (2) respectively.



Select the graph showing correct relationship –



5. If $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}(\text{s}) \rightleftharpoons \text{CuSO}_4 \cdot 3\text{H}_2\text{O}(\text{s}) + 2\text{H}_2\text{O}(\text{g})$ $K_p = 4 \times 10^{-4} \text{ atm}^2$
at 25°C . The efflorescent nature of $\text{CuSO}_4 \cdot 5\text{H}_2\text{O}$ can be noticed when vapour pressure of H_2O in atmosphere is

(A) $> 15.2 \text{ mm}$ (B) $< 15.2 \text{ mm}$ (C) $\leq 15.2 \text{ mm}$ (D) $= 15.2 \text{ mm}$

6. At a temperature T , a compound $\text{AB}_4(\text{g})$ dissociates as $2\text{AB}_4(\text{g}) \rightleftharpoons \text{A}_2(\text{g}) + 4\text{B}_2(\text{g})$ with a degree of dissociation x , which is small compared with unity. The expression of K_P in terms of x and total pressure P is :

(A) $8P^3x^5$ (B) $256P^3x^5$ (C) $4Px^2$ (D) None of these.

7. The equilibrium, $\text{SO}_2\text{Cl}_2(\text{g}) \longrightarrow \text{SO}_2(\text{g}) + \text{Cl}_2(\text{g})$ is attained at 25°C in a closed container and inert gas helium is introduced isothermally. Which of the following statement(s) is/are correct ?

I. Concentrations of SO_2 , Cl_2 and SO_2Cl_2 change

II. More chlorine is formed

III. Concentration of SO_2 is reduced

IV. More SO_2Cl_2 is formed.

(A) I, II, III (B) II, III, IV (C) III, IV (D) None





8. $C(s) + CO_2(g) \rightleftharpoons 2CO(g)$ $K_P = 1 \text{ atm}$
 $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ $K_P = 4 \times 10^{-2}$
 Solid C, CaO and $CaCO_3$ are mixed and allowed to attain equilibrium. Calculate final pressure of CO.
 (A) 0.4 atm (B) 0.2 atm (C) 8 atm (D) 0.01 atm
9. Ammonia gas at 15 atm is introduced in a rigid vessel at 300 K. At equilibrium the total pressure of the vessel is found to be 40.11 atm at 300°C. The degree of dissociation of NH_3 will be :
 (A) 0.6 (B) 0.4 (C) Unpredictable (D) None of these
10. Two solid A and B are present in two different container having same volume and same temperature following equilibrium are established :
 In container (1) $A(s) \rightleftharpoons D(g) + C(g)$ $P_T = 40 \text{ atm}$ at equilibrium
 In container (2) $B(s) \rightleftharpoons E(g) + F(g)$ $P_T = 60 \text{ atm}$ at equilibrium
 If excess of A and B are added to a third container having double the volume and at same temperature then, the total pressure of this container at equilibrium is :
 (A) 50 atm (B) 100 atm (C) 200 atm (D) 70 atm
11. For equilibrium $ZnSO_4 \cdot 7H_2O(s) \rightleftharpoons ZnSO_4 \cdot 2H_2O(s) + 5H_2O(g)$, $K_P = 56.25 \times 10^{-10} \text{ atm}^5$ and vapour pressure of water is 22.8 torr at 298 K. $ZnSO_4 \cdot 7H_2O(s)$ is efflorescent (lose water) when relative humidity is $[\sqrt[5]{56.25} = 2.23]$
 (A) more than 80.60% (B) less than 74.60%
 (C) Above than 74.60% (D) Above than 70.60%
12. Solid A and B are taken in a closed container at a certain temperature. These two solids decompose and following equilibria are established simultaneously
 $A(s) \rightleftharpoons X(g) + Y(g)$ $K_{P_1} = 250 \text{ atm}^2$
 $B(s) \rightleftharpoons Y(g) + Z(g)$ $K_{P_2} = ?$
 If the total pressure developed over the solid mixture is 50 atm. Then the value of K_P for the 2nd reaction.
 (A) 375 (B) 625 (C) 225 (D) 250
13. $X(s) \rightleftharpoons Y(g) + 2Z(g)$
 $A(s) \rightleftharpoons Y(g) + B(g)$
 Consider both these equilibrium to be established simultaneously in a closed container. At equilibrium, pressure of Z and B were found to be same and sum of pressure of Z & B is 10 atm more than that of species Y. Find ratio of standard gibb's energy of two reactions.
 (A) 20 (B) $2.303 \log_{10} 20$ (C) $\log_{10} \sqrt[3]{144}$ (D) $\frac{3 + \log 12}{2 + \log 6}$
14. In one experiment, certain amount of $NH_4I(s)$ was heated rapidly in a closed container at 375°C. The following equilibrium was established :
 $NH_4I(s) \rightleftharpoons NH_3(g) + HI(g)$
 Excess of $NH_4I(s)$ remained unreacted in the flask and equilibrium pressure was 304 mm of Hg. After some time, the pressure started increasing further owing to the dissociation of HI.
 $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ $K_C = 0.010$ calculate final pressure.
 (A) 328 mm Hg (B) 331 mm Hg
 (C) 662 mm Hg (D) 151 mm Hg
15. $A(s) \rightleftharpoons B(g) + C(g)$ $K_{P_1} = 36 \text{ atm}^2$
 $E(s) \rightleftharpoons B(g) + D(g)$ $K_{P_2} = 64 \text{ atm}^2$
 Both solids A & E were taken in a container of constant volume at a given temperature. Total pressure in the container after equilibrium is
 (A) 6 atm (B) 5 atm (C) 10 atm (D) 20 atm



16. In a closed container following equilibrium will be attained –
 $A(s) + B(g) \rightleftharpoons AB(g)$
 $B(g) + C(g) \rightleftharpoons BC(g)$
 On adding He gas (inert) to the above system at constant pressure & temperature
 (A) Amount of AB(g) will be increased surely. (B) Amount of BC(g) will be decreased surely.
 (C) Amount of C(g) will be decreased surely. (D) both (A) and (B).
17. $2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$ in a V lit container total x mol at eq.
 $N_2H_4(g) \rightleftharpoons N_2 + 2H_2(g)$ in V lit (other) container total y mol at eq.
 If both are taken in same container (V lit) then at new equation total mols will be
 (A) x + y (B) > x + y (C) < x + y (D) No prediction is possible.

SINGLE AND DOUBLE VALUE INTEGER TYPE

18. The equilibrium $SO_2(g) + \frac{1}{2} O_2(g) \rightleftharpoons SO_3(g)$ is established in a container of 4L at a particular temperature. If the number of moles of SO_2 , O_2 and SO_3 at equilibrium are 2, 1 and 4 respectively then find the value of equilibrium constant.
19. If the equilibrium constant of the reaction $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$ is 0.25, find the equilibrium constant of the reaction $\frac{1}{2} H_2(g) + \frac{1}{2} I_2(g) \rightleftharpoons HI(g)$.
20. $A_2(g)$ and $B_2(g)$ having partial pressures 60 mm of Hg & 42 mm of Hg respectively, are present in a closed vessel. At equilibrium, partial pressure of $AB(g)$ is 28 mm of Hg. If all measurements are made under similar condition, then calculate percentage of dissociation of $AB(g)$. (Round of answers to nearest integer).
21. $NH_4HS(s) \rightleftharpoons NH_3(g) + H_2S(g) \quad K_{P_1}$
 $NH_3(g) \rightleftharpoons \frac{1}{2} N_2(g) + \frac{3}{2} H_2(g) \quad K_{P_2}$
 2 mol $NH_4HS(s)$ is taken & 50% of this is dissociated till at equilibrium in 1 litre container. Find $\frac{K_{P_2}^2}{K_{P_1}^6}$ if 0.25 moles of N_2 are found finally.
22. Consider : (I) $C(s) + O_2 \rightleftharpoons CO_2(g) \quad K_{p_1} = \frac{7}{8}$
 (II) $2 C(s) + O_2 \rightleftharpoons 2 CO(g) \quad K_{p_2} = 12.5 \text{ atm}$
 As 100 L of air (80 % N_2 , 20% O_2 by volume) is passed over excess heated coke to establish these equilibrium the equilibrium mixture is found to measure 105 L at constant temperature & pressure (105 atm). Assuming no other reaction, find the sum of partial pressure of CO and CO_2 in the final equilibrium mixture.
23. Two solid compounds A and C dissociate into gaseous product at temperature T as follows :
 (i) $A(s) \rightleftharpoons B(g) + D(g) \quad K_{p_1} = 625 \text{ (atm)}^2$
 (ii) $C(s) \rightleftharpoons E(g) + D(g) \quad K_{p_2} = 975 \text{ (atm)}^2$
 Both solid are present in same container then calculate total pressure over the solid mixture.
24. If a mixture 0.4 mole H_2 and 0.2 mole Br_2 is heated at 700 K at equilibrium, the value of equilibrium constant is 0.25×10^{10} then find out the ratio of concentrations of (Br_2) and (HBr) (Report your answer as $\frac{Br_2}{HBr} \times 10^{11}$)
25. 2 mole of PCl_5 were heated in a 5 liter vessel. It dissociated. 80% at equilibrium find out the value of equilibrium constant. Report your answer as $K_c \times 50$.



26. Two solids A and D dissociates into gaseous products as follows
 $A(s) \rightleftharpoons B(g) + C(g)$; $K_{P_1} = 300$; $D(s) \rightleftharpoons E(g) + C(g)$ $K_{P_2} = 600$
 at 27°C , then find the total pressure of the solid mixture.

ONE OR MORE THAN ONE OPTIONS CORRECT TYPE

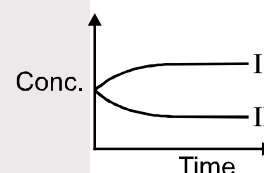
27. (i) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$, K_1
 (ii) $\left(\frac{1}{2}\right)N_2(g) + \left(\frac{1}{2}\right)O_2(g) \rightleftharpoons NO(g)$; K_2
 (iii) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$; K_3
 (iv) $NO(g) \rightleftharpoons \left(\frac{1}{2}\right)N_2(g) + \left(\frac{1}{2}\right)O_2(g)$; K_4

Correct relation between K_1 , K_2 , K_3 and K_4 is/are :

- (A) $K_1 \times K_3 = 1$ (B) $\sqrt{K_1} \times K_4 = 1$ (C) $\sqrt{K_3} \times K_2 = 1$ (D) None

28. A 2 lit vessel is filled by 1 mole of each gas A & B. If K_c for reaction
 $A(g) \rightleftharpoons B(g)$ is 1.5 at temp. T. [Atomic mass of A is 40 & B is 20].
 Which are correct option.

- (A) [A] vs time is graph I (B) [B] vs time is graph I
 (C) [A] vs time is graph II (D) [B] vs time is graph II



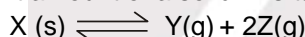
29. The equilibrium constant for some reactions are given below against each of the reaction

- (i) $2N_2 + 5O_2 \rightleftharpoons 2N_2O_5$; $K = 5 \times 10^{-27}$
 (ii) $N_2 + O_2 \rightleftharpoons 2NO$; $K = 2 \times 10^{-15}$
 (iii) $N_2 + 2O_2 \rightleftharpoons 2NO_2$; $K = 1.5 \times 10^{-29}$

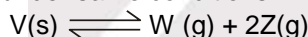
Which of the following statement is correct

- (A) The least stable oxide is NO_2
 (B) The most stable oxide is NO
 (C) The stability order is $N_2O_5 > NO_2 > NO$
 (D) The stability order is $NO_2 > NO > N_2O_5$

30. Sufficient amount of a solid X is taken in a rigid vessel at $T^\circ\text{C}$ where it attained the equilibrium :



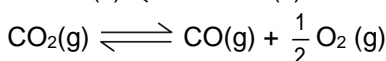
Total pressure was measured. Now the vessel is evacuated and filled with sufficient amount of another solid V under same conditions where it attained the equilibrium :



Total pressure measured now is found to be double that of previous value. Now, if both X & V solids are allowed to attain their respective equilibrium together in the same vessel at same temperature, select the correct statement(s) :

- (A) K_P for decomposition reaction of $V(s) = 8 \times K_P$ for decomposition reaction of $X(s)$.
 (B) In the 3rd case (when both solids are simultaneously establishing their equilibrium), $P_Y = \frac{1}{8} P_W$.
 (C) P_Y in 3rd case = $\frac{1}{3\sqrt[3]{3}}$ $\times P_Y$ in 1st case.
 (D) In the 3rd case, $P_W : P_Z = 4:9$

31. $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$



For above simultaneous equilibrium if CO_2 is added from out side at equilibrium then :

- (A) P_{CO_2} will increase (B) P_{CO_2} will decrease
 (C) No shift in 2nd equilibrium (D) Backward shift in 1st equilibrium



32. For the reaction $\text{SnO}_2(\text{s}) + 2\text{H}_2(\text{g}) \rightleftharpoons 2\text{H}_2\text{O}(\text{g}) + \text{Sn}(\text{s})$. If at 900 K, equilibrium mixture contains 45% H_2 by volume and at 1100 K it contains 24% H_2 by volume then which of the statements is/are correct.
 (A) Reaction is endothermic in nature
 (B) At higher temperature, the efficiency of reduction of tin oxide will increase
 (C) Reaction is exothermic in nature
 (D) At lower temperature, the efficiency of reduction of tin oxide decreases.
33. Consider equilibrium $\text{H}_2\text{O}(\ell) \rightleftharpoons \text{H}_2\text{O}(\text{g})$. Choose the correct direction of shifting of equilibrium with relative humidity.
 (A) R.H. > 1, rightward
 (B) R.H. < 1, rightward
 (C) R.H. > 1, leftward
 (D) R.H. < 1, leftward
34. An industrial fuel, 'water gas', which consists of a mixture of H_2 and CO can be made by passing steam over red-hot carbon. The reaction is

$$\text{C}(\text{s}) + \text{H}_2\text{O}(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + \text{H}_2(\text{g}), \Delta H = +131 \text{ kJ}$$
 The yield of CO and H_2 at equilibrium would be shifted to the product side by :
 (A) raising the relative pressure of the steam
 (B) adding hot carbon
 (C) raising the temperature
 (D) reducing the volume of the system

PART - IV : PRACTICE TEST-2 (IIT-JEE (ADVANCED Pattern))

Max. Time : 1 Hr.

Max. Marks : 60

Important Instructions :

A. General :

- The test is of 1 hour duration.
- The Test Booklet consists of 20 questions. The maximum marks are 60.

B. Question Paper Format

- Each part consists of five sections.
- Section-1 contains 7 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE is correct.
- Section-2 contains 4 multiple choice questions. Each question has four choices (A), (B), (C) and (D) out of which ONE OR MORE THAN ONE are correct.
- Section-3 contains 6 questions. The answer to each of the questions is a single-digit integer, ranging from 0 to 9 (both inclusive).
- Section-4 contains 1 paragraphs each describing theory, experiment and data etc. 2 questions relate to paragraph. Each question pertaining to a particular passage should have only one correct answer among the four given choices (A), (B), (C) and (D).
- Section 5 contains 1 multiple choice questions. Question has two lists (list-1 : P, Q, R and S; List-2 : 1, 2, 3 and 4). The options for the correct match are provided as (A), (B), (C) and (D) out of which ONLY ONE is correct.

C. Marking Scheme

- For each question in Section 1, 4 and 5 you will be awarded 3 marks if you darken the bubble corresponding to the correct answer and zero mark if no bubble is darkened. In all other cases, minus one (-1) mark will be awarded.
- For each question in Section 2, you will be awarded 3 marks. If you darken all the bubble(s) corresponding to the correct answer(s) and zero mark. If no bubbles are darkened. No negative marks will be answered for incorrect answer in this section.
- For each question in Section 3, you will be awarded 3 marks if you darken only the bubble corresponding to the correct answer and zero mark if no bubble is darkened. No negative marks will be awarded for incorrect answer in this section.

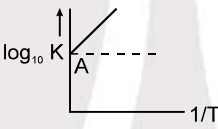
SECTION-1 : (Only One option correct Type)

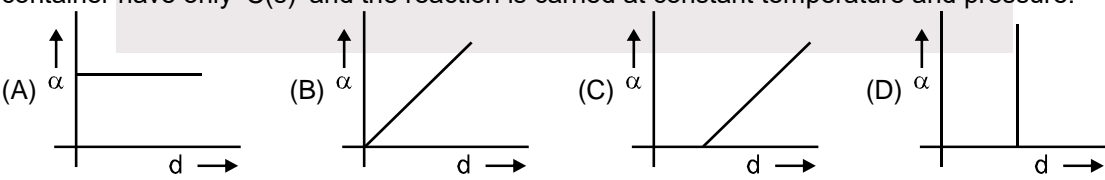
This section contains 7 multiple choice questions. Each questions has four choices (A), (B), (C) and (D) out of which Only ONE option is correct.



1. Which of the following is correct for the equilibrium of the reaction

$$\text{C(s)} + \text{H}_2\text{O(g)} \rightleftharpoons \text{CO(g)} + \text{H}_2\text{(g)}$$
 (A) $p_{\text{H}_2} \propto p_{\text{H}_2\text{O}}$ (B) $p_{\text{H}_2} \propto \sqrt{p_{\text{H}_2\text{O}}}$ (C) $p_{\text{H}_2} \propto p_{\text{H}_2\text{O}}^2$ (D) $p_{\text{H}_2} \propto \frac{p_{\text{H}_2\text{O}}^2}{p_{\text{CO}}}$
2. For the reaction $\text{PCl}_5 \rightleftharpoons \text{PCl}_3 + \text{Cl}_2$; supposing at constant temperature, if the volume is increased to 16 times the initial volume, the degree of dissociation for this reaction will become : ($\alpha \ll 1$)
 (A) 4 times (B) $\frac{1}{4}$ times (C) 2 times (D) $\frac{1}{4}$ times
3. A vessel of 10 L was filled with 6 mole of Sb_2S_3 and 6 mole of H_2 to attain the equilibrium at 440°C as :

$$\text{Sb}_2\text{S}_3\text{(s)} + 3\text{H}_2\text{(g)} \rightleftharpoons 2\text{Sb(s)} + 3\text{H}_2\text{S(g)}$$
 After equilibrium the H_2S formed was analysed by dissolving it in water and treating with excess of Pb^{2+} to give 708 g of PbS as precipitate. What is value of K_c of the reaction at 440°C ? (At. weight of $\text{Pb} = 206$).
 (A) 1 (B) 0.8 (C) 0.4 (D) 0.04
4. Variation of $\log_{10} K$ with $\frac{1}{T}$ is shown by the following graph in which straight line is at 45° , hence ΔH° is :

 (A) + 4.606 cal (B) - 4.606 cal (C) 2 cal (D) - 2 cal
5. $a\text{A} + b\text{B} \rightleftharpoons c\text{C} + d\text{D}$
 In above reaction low pressure and high temperature, conditions are shift equilibrium in back direction so correct set :
 (A) $(a + b) > (c + d)$, $\Delta H > 0$ (B) $(a + b) < (c + d)$, $\Delta H > 0$
 (C) $(a + b) < (c + d)$, $\Delta H < 0$ (D) $(a + b) > (c + d)$, $\Delta H < 0$
6. The value of k_p for the reaction at 27°C

$$\text{Br}_2(\ell) + \text{Cl}_2(\text{g}) \rightleftharpoons 2\text{BrCl}(\text{g})$$
 is '1 atm'. At equilibrium in a closed container partial pressure of BrCl gas is 0.1 atm and at this temperature the vapour pressure of $\text{Br}_2(\ell)$ is also 0.1 atm. Then what will be minimum moles of $\text{Br}_2(\ell)$ to be added to 1 mole of Cl_2 , initially, to get above equilibrium situation :
 (A) $\frac{10}{6}$ moles (B) $\frac{5}{6}$ moles (C) $\frac{15}{6}$ moles (D) 2 moles
7. $\text{C(s)} \rightleftharpoons 2\text{A(g)} + \text{B(s)}$
 If the dissociation of C(s) is ' α ' and d is the density of the gaseous mixture in the container. Initially container have only ' C(s) ' and the reaction is carried at constant temperature and pressure.


Section-2 : (One or More than one options correct Type)

This section contains 4 multiple choice questions. Each questions has four choices (A), (B), (C) and (D) out of which ONE or MORE THAN ONE are correct.

8. For which reaction at 298 K, the value of $\frac{K_p}{K_c}$ is maximum and minimum respectively :
 (A) $\text{N}_2\text{O}_4 \rightleftharpoons 2\text{NO}_2$ (B) $2\text{SO}_2 + \text{O}_2 \rightleftharpoons 2\text{SO}_3$
 (C) $\text{X} + \text{Y} \rightleftharpoons 4\text{Z}$ (D) $\text{A} + 3\text{B} \rightleftharpoons 7\text{C}$



9. For the equilibrium $2\text{SO}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{SO}_3(\text{g})$, $\Delta H = -198 \text{ kJ}$, the equilibrium concentration of SO_3 will be affected by
 (A) doubling the volume of the reaction vessel
 (B) increasing the temperature at constant volume
 (C) adding more oxygen to the reaction vessel
 (D) adding helium to the reaction vessel at constant volume
10. $\text{AB}(\text{s}) \rightleftharpoons \text{A}(\text{g}) + \text{B}(\text{g})$ $K_p = 4$, $\Delta H = +ve$
 In a container, A (g) and B (g) are filled to partial pressure of 1 atm each. Now AB (s) is added (in excess quantity). Which of the following is **CORRECT** ? (No other gas is present in container) :
 (A) At equilibrium, the total pressure in the container is 4 atm.
 (B) Equilibrium pressure decreases uniformly on increasing the volume by container.
 (C) At equilibrium, the total pressure in the container is more than 4 atm, if temperature is increased.
 (D) None of these
11. Following two equilibria are established separately in 2 different containers of unequal volume.
 $\text{PCl}_5(\text{g}) \rightleftharpoons \text{PCl}_3(\text{g}) + \text{Cl}_2(\text{g})$
 $\text{COCl}_2(\text{g}) \rightleftharpoons \text{CO}(\text{g}) + \text{Cl}_2(\text{g})$
 Now the containers are connected together by a thin tube of negligible volume. Select incorrect statement(s). (Assume T constant)
 (A) Degree of dissociation of both $\text{PCl}_5(\text{g})$ & $\text{COCl}_2(\text{g})$ will decrease
 (B) Degree of dissociation of both $\text{PCl}_5(\text{g})$ & $\text{COCl}_2(\text{g})$ will increase
 (C) Degree of dissociation of $\text{PCl}_5(\text{g})$ may increase ; decrease or remain the same irrespective of effect on degree of dissociation of $\text{COCl}_2(\text{g})$.
 (D) Degree of dissociation of $\text{PCl}_5(\text{g})$ may increase, decrease or remain the same, but the effect would be same as that on degree of dissociation of COCl_2 .

Section-3 : (One Integer Value Correct Type.)

This section contains 6 questions. Each question, when worked out will result in one integer from 0 to 9 (both inclusive)

12. If 1 mole of CH_3COOH and 1 mole of $\text{C}_2\text{H}_5\text{OH}$ are taken in 1 litre flask, 50% of CH_3COOH is converted into ester as ;

$$\text{CH}_3\text{COOH}_{(l)} + \text{C}_2\text{H}_5\text{OH}_{(l)} \rightleftharpoons \text{CH}_3\text{COOC}_2\text{H}_5_{(l)} + \text{H}_2\text{O}_{(l)}$$
 There is 33% conversion of CH_3COOH into ester, if CH_3COOH and $\text{C}_2\text{H}_5\text{OH}$ have been taken initially in molar ratio $x : 1$, find x .
13. Solid ammonium carbamate ($\text{NH}_2\text{COONH}_4$) was taken in excess in closed container of volume 5 Litre according to the following reaction $\text{NH}_2\text{COONH}_4(\text{s}) \rightleftharpoons 2\text{NH}_3(\text{g}) + \text{CO}_2(\text{g})$. If equilibrium partial pressure of ammonia is 4 atm, its equilibrium constant K_p is $x \text{ atm}^3$. If the above equilibrium mixture is transferred to another vessel of volume 10 Litre, total equilibrium pressure is $y \text{ atm}$. Calculate the value of $(x + y)$. Assuming temperature is constant during the whole experiment.
14. Find the percentage dissociation of ammonia into N_2 and H_2 if the dissociation is carried out at constant pressure and the volume at equilibrium is 20% greater than initial volume. (Initially, equal moles of NH_3 and N_2 are present with no hydrogen)
15. $\text{A}_2\text{B}(\text{g})$ is introduced in a vessel at 1000 K. If partial pressure of $\text{A}_2\text{B}(\text{g})$ is 1 atm initially and K_p for reaction $\text{A}_2\text{B}(\text{g}) \rightleftharpoons 2\text{A}(\text{g}) + \text{B}(\text{g})$ is 81×10^{-6} then calculate percentage of dissociation of A_2B .
16. Consider the following two equilibrium established together in a closed container
 $\text{A}(\text{s}) \rightleftharpoons 2\text{B}(\text{g}) + 3\text{C}(\text{g})$; K_{P_1}
 $\text{A}(\text{s}) \rightleftharpoons 3\text{D}(\text{g})$; K_{P_2}
 Starting with only A(s), molar ratio of B(g) & D(g) at equilibrium is found to be in a ratio 1 : 6. If partial pressure of B at equilibrium be 1 atm, determine $\frac{K_{P_2}}{8K_{P_1}}$.



17. 0.1 mol each of ethyl alcohol and acetic acid are allowed to react and at equilibrium the acid was exactly neutralised by 100 ml of 0.75 N NaOH. If no hydrolysis of ester is supposed to have undergone find K_c . Report your answer as $\frac{1}{K_c}$.

SECTION-4 : Comprehension Type (Only One options correct)

This section contains 1 paragraphs, each describing theory, experiments, data etc. 2 questions relate to the paragraph. Each question has only one correct answer among the four given options (A), (B), (C) and (D)

Paragraph for Question Nos. 18 to 19

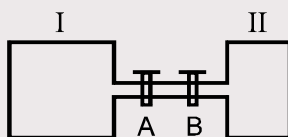
There are different types of equilibria depending on the composition of equilibrium mixture. Homogenous equilibrium contains all the species in same phase and heterogeneous equilibrium contains different phases. If heterogeneous equilibrium involves pure solid or liquid, then their concentration or pressure term is not included in K_c or K_p respectively.

18. 0.5 mole of $\text{NH}_4\text{HS}(s)$ are taken in a container having N_2 . On warming the closed container to 50°C the pressure attained a constant value of 1.5 atm, with some $\text{NH}_4\text{HS}(s)$ remaining unreacted and partial pressure of N_2 being 1 atm. The K_p of reaction $\text{NH}_4\text{HS}(s) \rightleftharpoons \text{NH}_3(g) + \text{H}_2\text{S}(g)$ at 50°C is :
 (A) 0.25 (B) 0.625 (C) 0.025 (D) 0.0625
19. How many moles of water are in vapour phase present inside 1 L vessel containing enough water after sufficient time? (Vapour pressure of water at $27^\circ\text{C} = 3000 \text{ Pa}$, $R = \frac{25}{3} \text{ J/mol-K}$)
 (A) 1.2×10^{-3} (B) 120 (C) 5×10^{-4} (D) None of these

SECTION-5 : Matching List Type (Only One options correct)

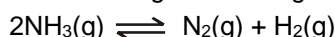
This section contains 1 questions, each having two matching lists. Choices for the correct combination of elements from List-I and List-II are given as options (A), (B), (C) and (D) out of which one is correct

20. In given setup, container I has double the volume to that of container II. Container I & II are connected by a narrow tube with two knobs.



- Knob A : Closed – No gas is allowed to pass through
 Open – All gases can pass
- Knob B : Closed – A thin filter of Pd is introduced on complete cross section of tube
 Open – All gases can pass.

Initially both knobs are closed. In container I, some amount of NH_3 gas is introduced which sets up equilibrium according to following reaction :



Match the actions in column I to corresponding value in column II and select the correct answer using the code given below the column. Assume each action from initial stage.



	Column I		Column II
P.	A & B are closed, $p_{H_2} / p_{N_2} = ?$	1.	1/3
Q.	A is open & B is closed, $n_{H_2}^I / n_{N_2}^I = ?$	2.	3
R.	A is open & B is open, $n_{N_2}^I / n_{H_2}^{II} = ?$	3.	2
S.	A & B are left open for long time; now B is closed & volume of container II is halved. $(n_{N_2}^I + n_{N_2}^{II}) / (n_{H_2}^I + n_{H_2}^{II}) = ?$	4.	2/3

Code :

	P	Q	R	S		P	Q	R	S
(A)	4	2	3	1	(B)	2	3	4	1
(C)	2	1	3	4	(D)	1	2	3	4

**Practice Test-2 (IIT-JEE (ADVANCED Pattern))
OBJECTIVE RESPONSE SHEET (ORS)**

Que.	1	2	3	4	5	6	7	8	9	10
Ans.										
Que.	11	12	13	14	15	16	17	18	19	20
Ans.										



APSP Answers

PART - I

1.	(2)	2.	(4)	3.	(3)	4.	(2)	5.	(3)
6.	(1)	7.	(2)	8.	(4)	9.	(1)	10.	(4)
11.	(3)	12.	(4)	13.	(1)	14.	(1)	15.	(1)
16.	(2)	17.	(3)	18.	(1)	19.	(1)	20.	(3)
21.	(4)	22.	(1)	23.	(3)	24.	(2)	25.	(2)
26.	(4)	27.	(2)	28.	(1)	29.	(1)	30.	(1)

PART - II

1.	(B)	2.	(C)	3.	(C)	4.	(D)	5.	(C)
6.	(B)	7.	(A)	8.	(D)	9.	(B)	10.	(B)
11.	(A)	12.	(C)	13.	(A)	14.	(B)	15.	(D)
16.	(C)	17.	(A)	18.	(A)	19.	(D)	20.	(D)
21.	(D)	22.	(A)	23.	(B)	24.	(A)	25.	(D)
26.	(CD)	27.	(C)	28.	(B)	29.	(B)	30.	(C)
31.	(A)	32.	(C)	33.	(B)	34.	(A)	35.	(D)
36.	(D)								

PART - III

1.	$K_{P_1} = \frac{1}{20P_0^2}, K_{P_2} = \frac{3}{20P_0^2}$	2.	(D)	3.	(A)	4.	(C)		
5.	(B)	6.	(A)	7.	(D)	8.	(B)	9.	(B)
10.	(B)	11.	(B)	12.	(A)	13.	(D)	14.	(A)
15.	(D)	16.	(D)	17.	(C)	18.	4	19.	2
20.	72 %	21.	27	22.	17	23.	60 atm	24.	80
25.	64	26.	80 atm.	27.	(ABC)	28.	(BC)	29.	(AB)
30.	(ABCD)	31.	(CD)	32.	(ABD)	33.	(BC)	34.	(AC)

PART - IV

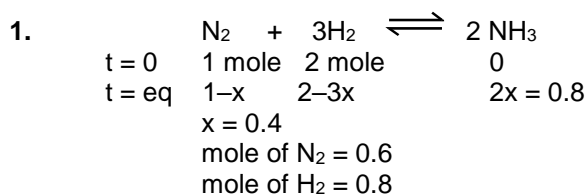
1.	(B)	2.	(A)	3.	(A)	4.	(B)	5.	(D)
6.	(C)	7.	(D)	8.	(BD)	9.	(ABC)	10.	(AC)
11.	(ABCD)	12.	2	13.	38	14.	40	15.	3
16.	8	17.	9	18.	(D)	19.	(A)	20.	(B)





APSP Solutions

PART – I

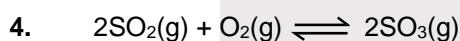


2.
$$\frac{K_A}{K_B} = \frac{[\text{PQ}]}{[\text{P}][\text{Q}]} \dots (i)$$

$$\frac{K_C}{K_D} = \frac{[\text{R}]}{[\text{PQ}]} \dots (ii)$$

On multiply equation (i) and (ii) we get

$$\frac{K_A \cdot K_C}{K_B \cdot K_D} = \frac{[\text{R}]}{[\text{P}][\text{Q}]}$$



$$K_C = \frac{[\text{SO}_3]^2}{[\text{SO}_2]^2[\text{O}_2]}$$
 Concentration in gram mole/litre, therefore

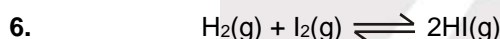
$$[\text{SO}_3] = \frac{48}{80 \times 1}$$
 (Where 80 is molecular weight of SO₃)

$$[\text{SO}_2] = \frac{128}{64 \times 1}$$
 (Where 64 is molecular weight of SO₂)

$$[\text{O}_2] = \frac{9.6}{32 \times 1}$$
 (Where 32 is molecular weight of O₂)

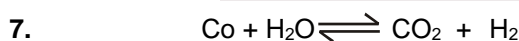
Thus, $K_C = 0.30$

5. Since, K_p is temperature dependent only.



t = 0	4.5	4.5	0
t = teq.	4.5 - x	4.5 - x	2x
put	x = 1.5		
	4.5 - 1.5	4.5 - 1.5	2 × 1.5 = 3
	↓	↓	↓
	3	3	3

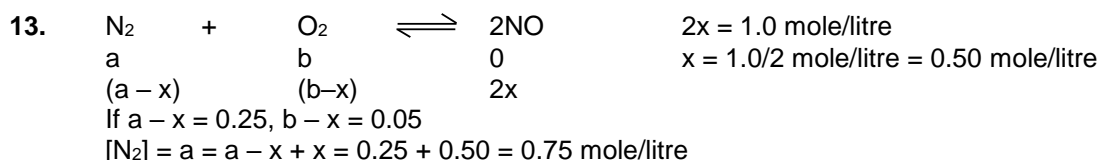
$$K_C = \frac{(3)^2}{3 \times 3} = 1$$

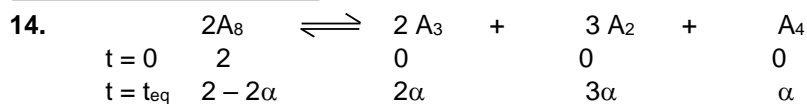


t = 0	1	1	1	0
t = teq	1 - x	1 - x	1 + x	x

at equilibrium, only CO₂ has (1 + x) moles.

8. $K_p = K_c (RT)^{\Delta n}$, $\Delta n = 4 - 3 = 1$
 $0.05 = K_c R \times 1000$
 $K_c = 5 \times 10^{-5} \times R^{-1}$



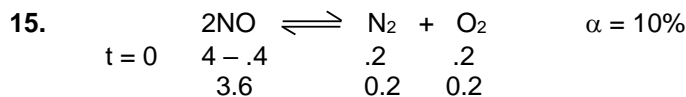


$$n_T = 2 + 4\alpha$$

given mole fraction of A_2 is = 0.36.

$$0.36 = \frac{3\alpha}{2 + 4\alpha} \Rightarrow \alpha = 0.46$$

$$\text{Mole fraction of } A_8 = \frac{2 - 2\alpha}{2 + 4\alpha} = \frac{2 - 2 \times 0.46}{2 + 4 \times 0.46} = 0.28$$

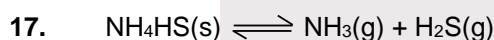


$$\Delta n = 0,$$

$$\therefore K_P = K_C, \quad K_C = \frac{(.2/V)^2}{(3.6/V)^2} = \frac{4}{36 \times 36}$$

$$16. \quad \text{Total moles at equilibrium} = 1 - \alpha + \alpha/n = 1 + \left[\frac{1}{n} - 1 \right] \alpha$$

$$\text{So using } \frac{d_i}{d_f} = 1 + \left[\frac{1}{n} - 1 \right] \alpha .$$



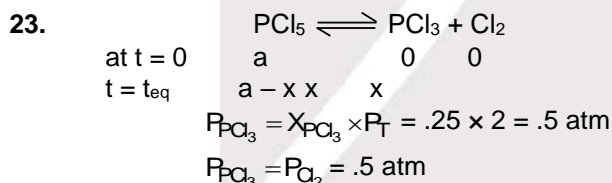
Total pressure is P

$$\text{So, } P_{NH_3} = P_{H_2S} = \frac{P}{2}$$

$$K_P = P_{NH_3} \times P_{H_2S} = \frac{P^2}{4} .$$

18. At room temperature, $K = 4.32$ and at $425^\circ C$, equilibrium constant become 1.24×10^{-4} i.e. it decreases with increase in temperature. So, it is exothermic reaction.

20. Catalyst can't disturb the state of the equilibrium.



$$24. \quad \Delta G^\circ = -RT \ln K_{eq} \quad \ln K_{eq} = -6$$

$$15000 = -\frac{25}{3} \times 300 \ln K_{eq} \quad K_{eq} = e^{-6}$$

$$\ln K_{eq} = -\frac{15000}{2500} = 6$$

$$25. \quad \Delta G^\circ = -2.303 RT \log K$$

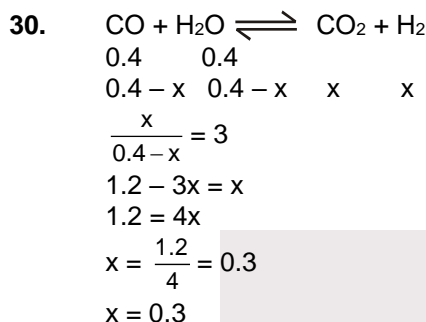
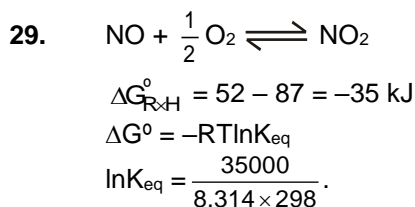
$$26. \quad \text{At point A, } Q = \tan 60^\circ C$$

$$Q = 1.732$$

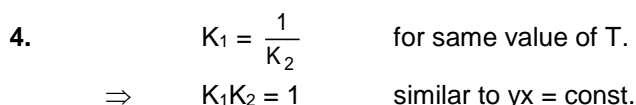
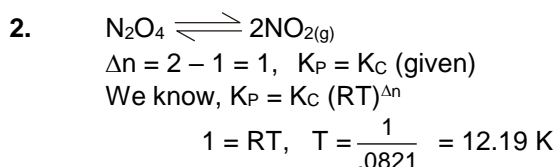
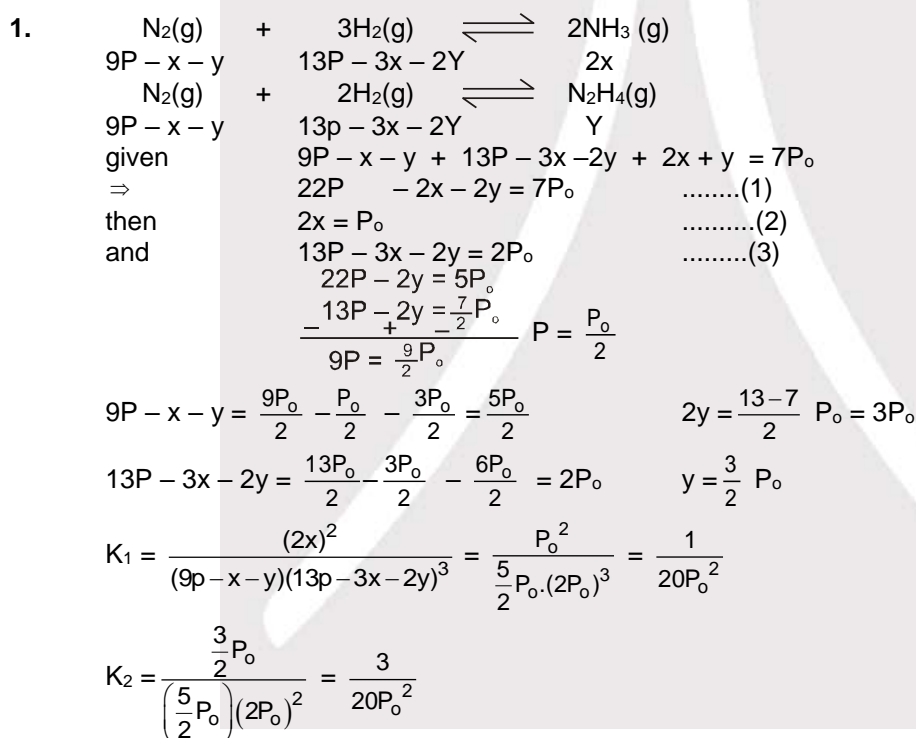
$$\therefore Q = K = 1.732$$

$$28. \quad \text{According to } K_P = \frac{P_{PCl_3}(g) \times P_{Cl_2}(g)}{P_{PCl_5}(g)} = \frac{(n_{PCl_3}(g))_{eq} \times (n_{Cl_2}(g))_{eq}}{V \times (n_{PCl_5}(g))_{eq}}$$

and on adding inert gas at constant pressure effect on equilibrium will be similar to as if volume of container has been increased.

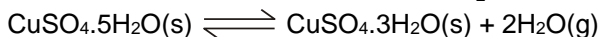


PART - III





5. An efflorescent salt is one that loses H_2O to atmosphere.



$$K_P = (P_{\text{H}_2\text{O}})^2 = 4 \times 10^{-4}$$

$$P_{\text{H}_2\text{O}} = 2 \times 10^{-2} \text{ atm} = 15.2 \text{ mm Hg}$$

If $P_{\text{H}_2\text{O}}$ at $25^\circ\text{C} < 15.2 \text{ mm}$ only then reaction will proceed in forward direction.

6. $2\text{AB}_4(g) \rightleftharpoons \text{A}_2(g) + 4\text{B}_2(g)$ $\sum n = 1 + \frac{3\alpha}{2} = 1$

$$1 - \alpha \quad \frac{\alpha}{2} \quad 2x \quad 1 - \alpha = 1$$

$$K_P = \frac{\left(\frac{\alpha}{2}P\right)\left(\frac{2\alpha}{1} \times P\right)^4}{(P)^2} = 8P^3\alpha^5$$

8. $\text{C}(s) + \text{CO}_2(g) \rightleftharpoons 2\text{CO}(g)$

$$K_P = \frac{(P_{\text{CO}})^2}{P_{\text{CO}_2}} = 1.0$$

At equilibrium, $P_{\text{CO}_2} = K_P = 4 \times 10^{-2}$ remain constant

$$\frac{(P_{\text{CO}})^2}{4 \times 10^{-2}} = 1$$

$$P_{\text{CO}} = \sqrt{4 \times 10^{-2}} = 0.2 \text{ atm}$$

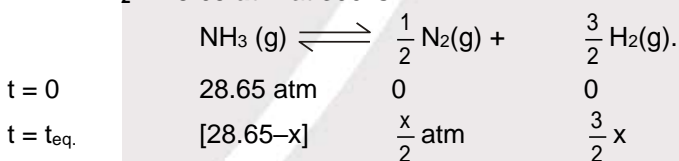
9. $P_1 = 15 \text{ atm}$; $T_1 = 300 \text{ K}$.

Equilibrium temperature is 300°C that is 573 K .

So first of all we have to calculate pressure of NH_3 at 573 K .

$$\frac{P_1}{T_1} = \frac{P_2}{T_2} = \frac{15}{300} = \frac{P_2}{573}$$

$P_2 = 28.65 \text{ atm}$ at 300°C .



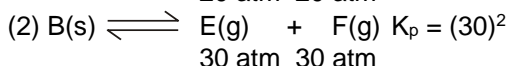
But according to question.

$$P_{\text{total}} = 28.65 - x + \frac{x}{2} + \frac{3}{2} x$$

Or $28.65 + x = 40.11$
 $x = 11.46$.

$$\text{Degree of dissociation of } \text{NH}_3 = \frac{11.46}{28.65} = 0.4.$$

10. (1) $\text{A}(s) \rightleftharpoons \text{D}(g) + \text{C}(g)$ $K_P = (20)^2$
20 atm 20 atm

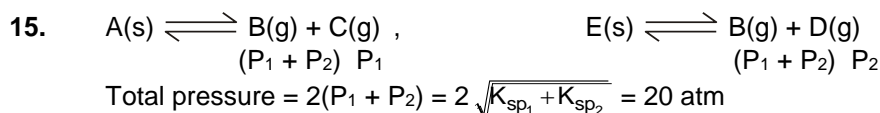
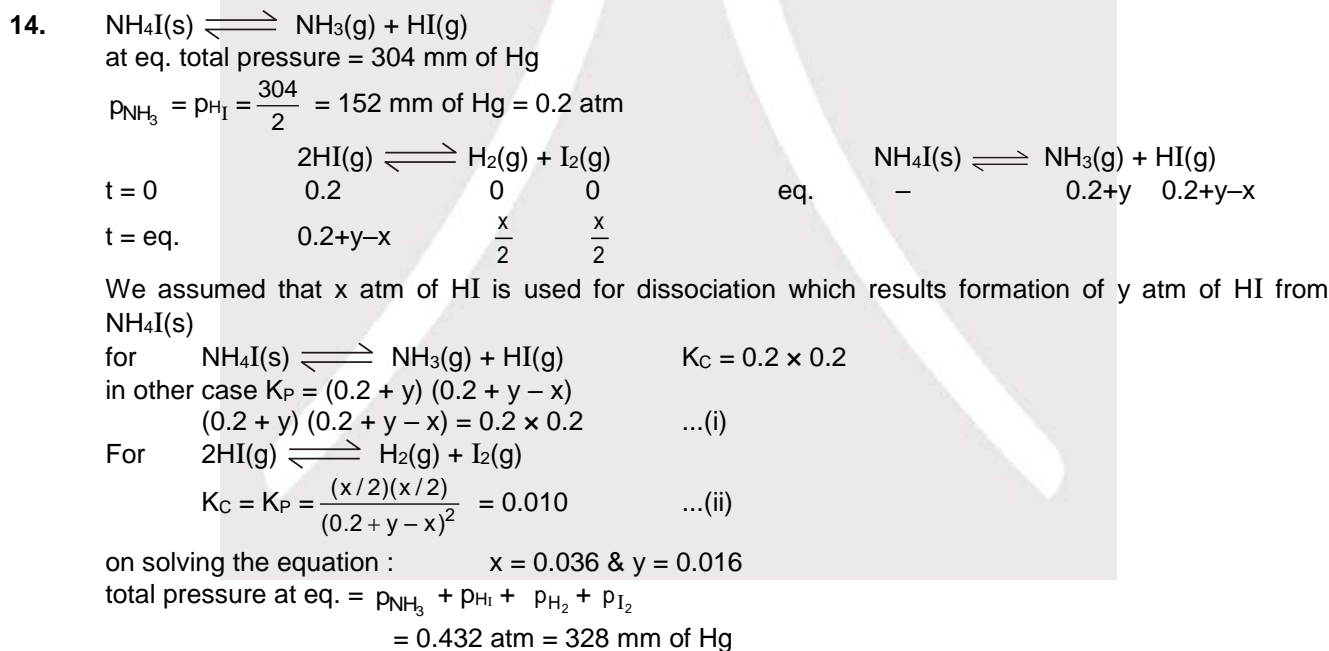
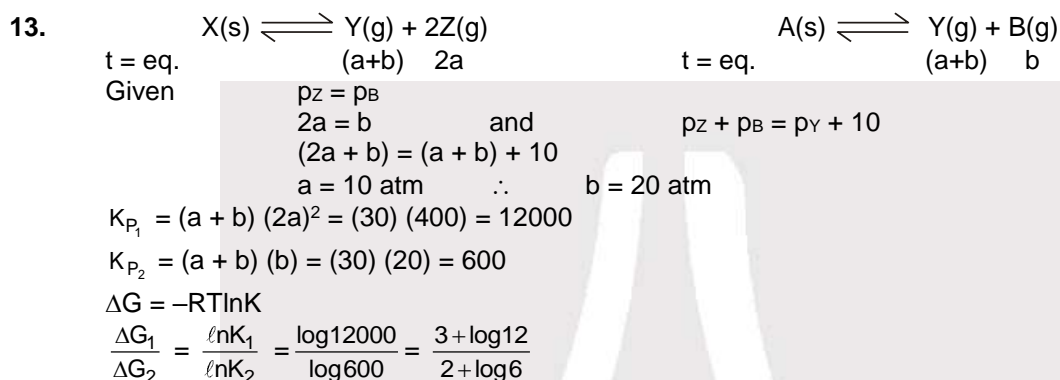
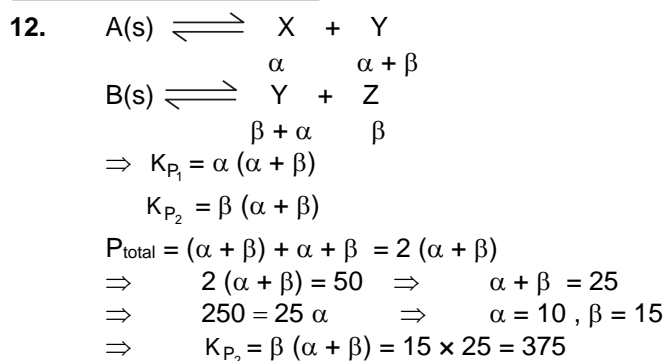


(3) container K_P is same so on doubling the volume partial pressure does not change but moles of C, D, E, F will change to maintain their partial pressure. So total pressure = $40 + 60 = 100 \text{ atm}$.

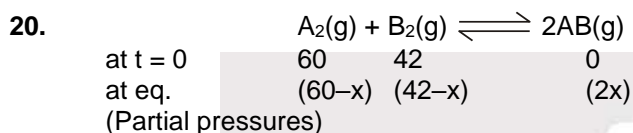
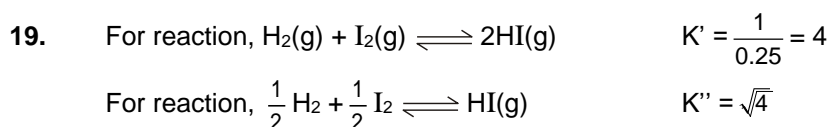
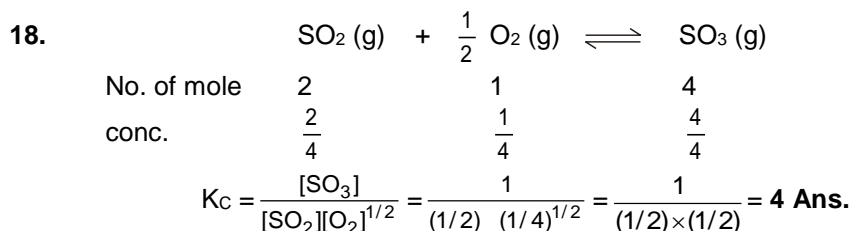
11. $K_P = (P_{\text{H}_2\text{O}})^5 = 56.25 \times 10^{-10}$

$$(P_{\text{H}_2\text{O}}) = (56.25 \times 10^{-10})^{1/5} = (56.25)^{1/5} \times 10^{-2} = 2.23 \times 10^{-2} \times 760 = 17.01 \text{ torr}$$

$$\% \text{ Relative humidity} = \frac{\text{Partial pressure}}{\text{Vapour pressure}} \times 100 = \frac{17.01}{22.8} \times 100 = 74.60\% \quad (\text{less than } 74.60\%)$$



16. On addign inert gas at content temperature & pressure 2nd reaction will be shifted in backward direction.
17. On mixing, P(N₂) & P(H₂) will add up. This will shift both the equilibrium backwards thereby decreasing the number of moles.

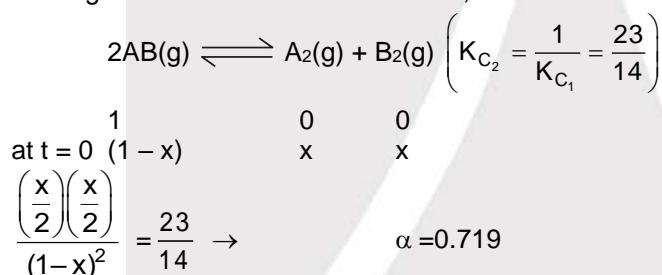


$$\Rightarrow 2x = 28 \quad \Rightarrow \quad x = 14$$

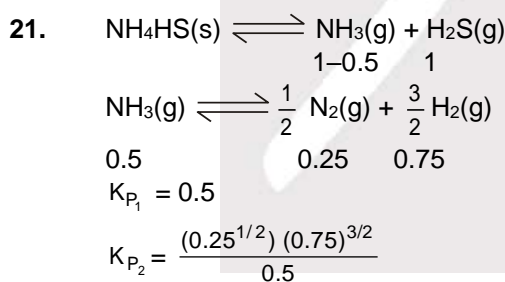
$$K_p = \frac{(P_{\text{AB}})^2}{(P_{\text{A}_2})(P_{\text{B}_2})} = \frac{(28)^2}{(46)(28)} = \frac{14}{23}$$

For $\Delta n_g = 0$; $K_p = K_{C_1} = \frac{14}{23}$

Let degree of dissociation for AB is 'x', then



Hence percentage of dissociation = $0.719 \times 100 = 72\%$



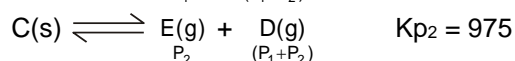
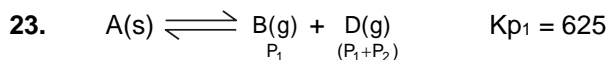
22. Since (I) causes no change in volume due to reaction, change from 100 L is due to (II) only.
 $\therefore V(\text{CO})$ finally = 10 L

$$P(\text{CO}) \text{ finally} = \left(\frac{10}{105}\right) \times 105 = 10 \text{ atm}$$

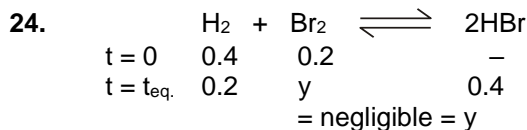
$$\therefore P(\text{O}_2) = P_{\text{CO}}^2 / K_{P_2} = \frac{10^2 \text{ atm}^2}{12.5 \text{ atm}} = 8 \text{ atm}$$

$$\text{Also, } K_{P_1} = \frac{P_{\text{CO}_2}}{P_{\text{O}_2}} = \frac{7}{8} \times 8 = 7 \text{ atm} \quad \therefore P(\text{CO}_2) = K_{P_1} \cdot P(\text{O}_2)$$

$\therefore P(\text{CO}) + P(\text{CO}_2)$ finally is $10 + 7 = 17 \text{ atm}$



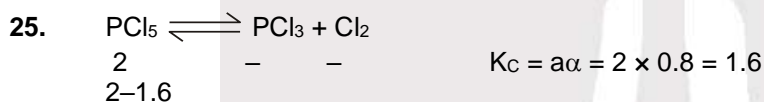
$K_{p1} + K_{p2} = (p_1^2 + p_2^2 + 2p_1p_2) = (p_1 + p_2)^2 = (625 + 975) \Rightarrow (p_1 + p_2) = 40$
 so total pressure = $2[p_1 + p_2] = 80 \text{ atm.}$



$\therefore \frac{1}{4} \times 10^{10} = \frac{0.4 \times 0.4}{0.2 \times y}$

$y = 3.2 \times 10^{-10}$

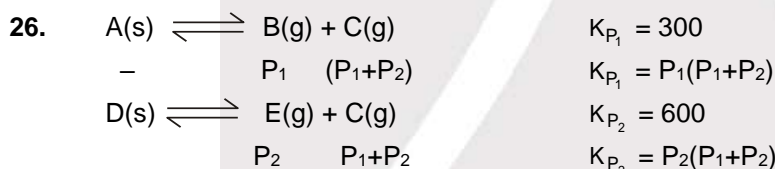
$\frac{Br_2}{HBr} \times 10^{11} = \frac{3.2}{0.4} \times 10^{-10} \times 10^{11} = 80$



= 0.4 $\frac{1.6}{5} \quad 1.6 \quad 1.6$

$\frac{0.4}{5} \quad \frac{1.6}{5} \quad \frac{1.6}{5} \quad K_C = \frac{\frac{1.6}{5} \times \frac{1.6}{5}}{\frac{0.4}{5}}$

$K_C = \frac{4 \times 1.6}{5} = \frac{64}{50}$ **Ans. is $\frac{64}{50} \times 50 = 64$**



$\left(\frac{K_{p1}}{K_{p2}}\right) = \frac{P_1(P_1+P_2)}{P_2(P_1+P_2)}$

$\frac{300}{600} = \left(\frac{P_1}{P_2}\right)$

$\frac{P_1}{P_2} = \frac{1}{2} \quad P_2 = 2P_1$

$K_{P1} = P_1(P_1+P_2) \Rightarrow K_{P1} = P_1(P_1+2P_1) \Rightarrow 300 = P_1(3P_1)$

$P_1^2 = 100 \quad (P_1 = 10)$

$P_2 = 20 \text{ atm}$

Now Total pressure

$P_B + P_E + P_C$

$(P_1+P_2) + (P_1+P_2) = (10 + 20) + (30) = 60 \text{ atm.}$

27. From given reactions.

(i) = - (iii) ; $\frac{1}{2}$ (i) = - (iv) ; $\frac{1}{2}$ (iii) = - (ii)

29. Higher is the value of equilibrium const, higher will be the stability of products.

31. Second equilibrium will not be affected by CO₂ addition only first will shift backward.



32. Since \uparrow in temperature results in shifting of equilibria in forward direction hence reaction is endothermic in nature. Endothermic reaction is driven in forward direction upon increase in temperature.
33. $R.H. > 1 \Rightarrow > V.P. \Rightarrow Q > K \Rightarrow$ leftward shift
 $R.H. < 1 \Rightarrow < V.P. \Rightarrow Q < K \Rightarrow$ Rightward shift
34. Addition of solids have no effect on equilibrium and temperature favours endothermic direction while increasing pressure will shift equilibrium in backward direction as Δn_g is +ve.

PART - IV

1.
$$K_p = \frac{P_{CO(g)} \cdot P_{H_2(g)}}{P_{H_2O(g)}} = \frac{(P_{H_2(g)})^2}{P_{H_2O(g)}} \quad (\text{as } P_{CO(g)} = P_{H_2(g)})$$

3. Mole of $PbS = 708 / 236 = 3$ mole = mole of H_2S

$$Sb_2S_3(s) + 3H_2(g) \rightleftharpoons 2Sb(s) + 3H_2S(g)$$

initial	6	6	0	0
at eq.	5	3	2	3

$$K_c = \frac{(3/10)^3}{(3/10)^3} = 1$$

4. $K = A e^{-\Delta H/RT}$

$$\log K = \log A - \frac{\Delta H}{2.303RT}$$

$$\log K = \log A - \frac{\Delta H}{2.303 R} \times \frac{1}{T}$$

$$\log K = \left[-\frac{\Delta H}{2.303 R} \right] \times \frac{1}{T} + \log A$$

$$\frac{-\Delta H}{2.303 R} = 1$$

$$\Delta H = -2.303 R = -4.606 \text{ cal.}$$

5. $aA + bB \rightleftharpoons cC + dD$
 At high temp. & low pressure equilibrium is shifting in backward direction. It means $(a + b) > (c + d)$ & heat will reaction in the formation of producers is $\Delta H < 0$.

6. $Br_2(l) + Cl_2(g) \rightleftharpoons 2BrCl(g)$

t = 0	1	0
	(1 - x)	2x

$$K_p = \frac{(P_{BrCl})^2}{P_{Cl_2}} = 1 \text{ so, } P_{Cl_2} = (P_{BrCl})^2 = 0.01 \text{ atm}$$

then at equilibrium,

$$\frac{n_{BrCl}}{n_{Cl_2}} = \frac{0.1}{0.01} = 10 = \frac{2x}{1-x}$$

So, $10 - 10x = 2x$ or $x = \frac{10}{12} = \frac{5}{6}$ moles

Moles of $Br_2(l)$ required for maintaining vapour pressure of 0.1 atm

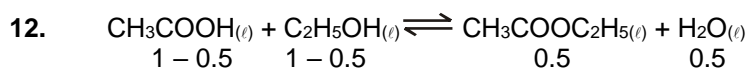
$$= 2 \times \frac{5}{6} \text{ moles} = \frac{10}{6} \text{ moles} = \text{moles of } BrCl(g).$$

Moles required for taking part in reaction = moles of Cl_2 used up = $\frac{5}{6}$ moles.

Hence total moles required = $\frac{5}{6} + \frac{10}{6} = \frac{15}{6}$ moles.



7. As in the gaseous mixture only A will be present so the molecular weight of the gaseous mixture will be 'M_A'
 $\therefore P_M = dRT$ where R, P, T are const.
 so $d \propto MA$
 and hence it does not depend on ' α '
 so 'd' will remain constant.
 Option (D) is correct.

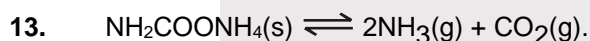


So, $K_C = \frac{0.5 \times 0.5}{0.5 \times 0.5} = 1$

Now let a moles of CH₃COOH and b moles of C₂H₅OH are taken :

$$a - \frac{a}{3} \quad b - \frac{a}{3} \quad \frac{a}{3} \quad \frac{a}{3}$$

So, $K_C = \frac{(a/3) \times (a/3)}{2a/3 \times (b - \frac{a}{3})}$ or $2\left(b - \frac{a}{3}\right) = \frac{a}{3}$ or $2b = a$ or $\frac{a}{b} = \frac{2}{1}$

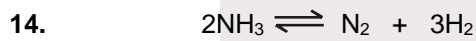


At eq. $P_{NH_3} = 4 \text{ atm}$

$P_{CO_2} = 2 \text{ atm}$

$K_p = P_{NH_3}^2 \times P_{CO_2} = 32 \text{ atm}^3$.

Therefore $x = 32$ & $y = 6 \Rightarrow x + y = 38$.



t = 0

a a 0

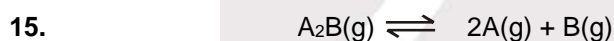
$\frac{a\alpha}{2} + a$ $\frac{3a\alpha}{2}$

t_{eq}

$a(1 - \alpha)$

$n_T = 2a + a\alpha = a(2 + \alpha) = 2a + \frac{3a\alpha}{2} \times 2a$

$2 + \alpha = 2.4 \Rightarrow \alpha = 0.4$ **Ans. 40%**



at t = 0

1 0 0

at eq.

(1-x) 2x x

(partial pressure)

Hence, $(1 - \alpha) ; 1$

$\frac{(2x)^2 \times (\alpha)}{(1)^3} = 81 \times 10^{-6}$

$\alpha = 3 \times 10^{-2}$

percentage of dissociation = $3 \times 10^{-2} \times 100 = 3\%$

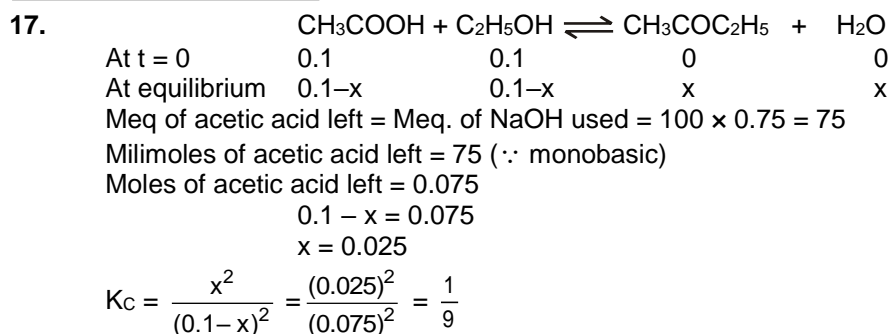
16. $P_B : P_D = 1 : 6$ Let the partial pressure of B_{eq} be P₀

$K_{P_1} = (P_0)^2 \left(\frac{3P_0}{2}\right)^3$

$K_{P_2} = (6P_0)^3$

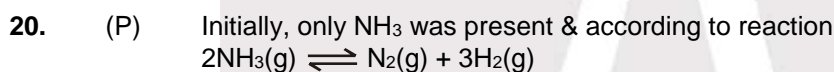
$\frac{K_{P_2}}{K_{P_1}} = \frac{6^3}{\left(\frac{3}{2}\right)^3} = 64$

$\frac{K_{P_2}}{8K_{P_1}} = \frac{64}{8} = 8$



$$\begin{aligned} & \quad \quad \quad p \quad \quad \quad p \\ 2p &= 1.5 - 1 \\ 2p &= 0.5 \\ p &= 0.25 \\ \Rightarrow K_p &= 0.25 \times 0.25 = 0.0625 \end{aligned}$$

19. $n = \frac{PV}{RT} = \frac{3000 \times 10^{-3}}{\frac{25}{3} \times 300} = 1.2 \times 10^{-3}$ moles.



$$\frac{n_{\text{N}_2}}{n_{\text{H}_2}} = \frac{1}{3}$$

Same volume for both gases $\Rightarrow \frac{p_{\text{N}_2}}{p_{\text{H}_2}} = \frac{1}{3} \Rightarrow \frac{p_{\text{H}_2}}{p_{\text{N}_2}} = 3$

(Q) When B is closed, only H_2 diffuses through filter until partial pressure of H_2 becomes equal.

$$\frac{n_{\text{H}_2\text{total}}}{n_{\text{N}_2}} = 3 \quad \dots(1)$$

$$p_{\text{H}_2}^I = p_{\text{H}_2}^{II} \quad \& \quad V_I = 2V_{II} \quad \Rightarrow \quad n_{\text{H}_2}^I = 2n_{\text{H}_2}^{II}$$

$$n_{\text{H}_2}^I + n_{\text{H}_2}^{II} = n_{\text{H}_2\text{total}} \Rightarrow n_{\text{H}_2\text{total}} / n_{\text{H}_2}^I = \frac{3}{2} \quad \dots(2)$$

from eq.(1) & (2)

$$\frac{n_{\text{H}_2}^I}{n_{\text{N}_2}} = \frac{n_{\text{H}_2}^I}{n_{\text{H}_2\text{total}}} \times \frac{n_{\text{H}_2\text{total}}}{n_{\text{N}_2}} = \frac{2}{3} \times 3 = 2$$

(R) Again same volume for N_2 & H_2

$$n_{\text{N}_2\text{total}} / n_{\text{H}_2\text{total}} = \frac{1}{3} \quad \dots(1)$$

$$p_{\text{N}_2}^I = p_{\text{N}_2}^{II} \quad \& \quad V_I = 2V_{II} \quad \Rightarrow \quad n_{\text{N}_2}^I = 2n_{\text{N}_2}^{II} \quad \& \quad n_{\text{H}_2}^I = 2n_{\text{H}_2}^{II}$$

$$n_{\text{N}_2\text{total}} = n_{\text{N}_2}^I + n_{\text{N}_2}^{II} = 3n_{\text{N}_2}^{II} = \frac{3}{2} n_{\text{N}_2}^I$$

$$n_{\text{H}_2\text{total}} = n_{\text{H}_2}^I + n_{\text{H}_2}^{II} = 3n_{\text{H}_2}^{II}$$

from eq.(1) $\frac{3}{2} n_{\text{N}_2}^I / 3n_{\text{H}_2}^{II} = \frac{1}{3} \Rightarrow \frac{n_{\text{N}_2}^I}{n_{\text{H}_2}^{II}} = \frac{2}{3}$

(S) $(n_{\text{N}_2}^I + n_{\text{N}_2}^{II}) / (n_{\text{H}_2}^I + n_{\text{H}_2}^{II}) = \frac{1}{3}$