DPP - Daily Practice Problems

Name :

Date :

Start Time :

End Time :

CHEMISTRY 12

SYLLABUS : Chemical Equilibrium

Max. Marks : 120

Time : 60 min.

GENERAL INSTRUCTIONS

- The Daily Practice Problem Sheet contains 30 MCQ's. For each question only one option is correct. Darken the correct circle/ bubble in the Response Grid provided on each page.
- You have to evaluate your Response Grids yourself with the help of solution booklet.
- Each correct answer will get you 4 marks and 1 mark shall be deduced for each incorrect answer. No mark will be given/ deducted if no bubble is filled. Keep a timer in front of you and stop immediately at the end of 60 min.
- The sheet follows a particular syllabus. Do not attempt the sheet before you have completed your preparation for that syllabus. Refer syllabus sheet in the starting of the book for the syllabus of all the DPP sheets.
- After completing the sheet check your answers with the solution booklet and complete the Result Grid. Finally spend time to analyse your performance and revise the areas which emerge out as weak in your evaluation.

DIRECTIONS (Q.1-Q.21) : There are 21 multiple choice questions. Each question has 4 choices (a), (b), (c) and (d), out of which ONLY ONE choice is correct.

Q.1 The volume of a closed reaction vessel in which the following equilibrium reaction occurs is halved :

$$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$$

As a result,

(a) The rates of forward and backward reactions will remain the same.

(b) The equilibrium will not shift.

(c) The equilibrium will shift to the right.

(d) The rate of forward reaction will become double that of reverse reaction and the equilibrium will shift to the right.

Q.2 $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

When 46g of I_2 and 1g of H_2 are heated at equilibrium at 450°C, the equilibrium mixture contained 1.9g of I_2. How many moles of I_2 and HI are present at equilibrium ?

(a) 0.0075 & 0.147 moles

(b) 0.0050 & 0.147 moles

(c) 0.0075 & 0.347 moles

(d) 0.0052 & 0.347 moles

Q.3 One mole of nitrogen and three moles of hydrogen are mixed in a 4 litre container. If 0.25 percent of nitrogen is converted to ammonia by the following reaction -

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

what will be the value of K for the following equilibrium?

$$\frac{1}{2} N_2(g) + \frac{3}{2} H_2(g) \rightleftharpoons NH_3(g).$$

(a) 1.49×10^{-5} L mol^{-1}

(b) 2.22×10^{-10} L^2 mol^{-2}

(c) 3.86×10^{-3} L mol^{-1}

(d) Question is incomplete

RESPONSE GRID 1. ⓐⓑⓒⓓ 2. ⓐⓑⓒⓓ 3. ⓐⓑⓒⓓ

Space for Rough Work

Q.4 When ethanol and acetic acid were mixed together in equimolar proportion, 66.6% get converted into ethyl acetate. Calculate K_C. Also calculate the quantity of ester produced if one mole of acetic acid is treated with 0.5 mole and 4 mole of alcohol respectively.

(a) 4, 0.93, 0.43 (b) 0.93, 4, 0.43

(c) 0.43, 0.93, 4 (d) 4, 0.43, 0.93

Q.5 One mole of ammonium carbamate dissociates as shown below at 500 K :

$$NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$$

If the pressure exerted by the released gases is 3.0 atm, then the value of K_P is :

(a) 7 atm (b) 3 atm (c) 4 atm (d) 8 atm

Q.6 Iron filling and water were placed in a 5 litre tank and sealed. The tank was heated to 1273 K. Upon analysis the tank was found to contain 1.10 gm of hydrogen and 42.5 gm of water vapour. If the reaction in the tank is represented by $3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$ the equilibrium constant will be -

(a) 2.949×10^3 (b) 6.490×10^3

(c) 4.940×10^3 (d) 3.200×10^3

Q.7 At 700 K, the equilibrium constant K_P for the reaction

$$2SO_3(g) \rightleftharpoons 2SO_2(g) + O_2(g)$$

is 1.8×10^{-3} kPa. What is the numerical value of K_C for this reaction at the same temperature ?

(a) 3.09×10^{-7} mol L^{-1} (b) 9.03×10^{-7} mol L^{-1}

(c) 5.05×10^{-9} mol L^{-1} (d) 5.05×10^{-5} mol L^{-1}

Q.8 The value of K_C for the reaction

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is 0.50 at 400° C.

What will be the value of K_P at 400°C when concentrations are expressed in mol L^{-1} and pressure in atmosphere ?

(a) 2×10^{-4} (b) 2.80×10^{-6}

(c) 2.80×10^{-4} (d) 2×10^{-6}

Q.9 The equilibrium constant for the reaction

$H_2(g) + S(s) \rightleftharpoons H_2S(g)$ is 18.5 at 935 K and 9.25 at 1000 K respectively. The change in enthalpy of the reaction will be :

(a) zero (b) + ve

(c) – ve (d) cannot be predicted

Q.10 The equilibrium constant K_C for the decomposition of PCl_5 is 0.0625 mol L^{-1} at 300°C. What will be the value of K_P?

(a) 2.936 atm (b) 1.936 atm

(c) 3.336 atm (d) 5.123 atm

Q.11 K_P for the reaction $A(g) + 2B(g) \rightleftharpoons 3C(g) + D(g)$ is 0.05 atm. What will be its K_C at 1000 K in terms of R ?

(a) $\frac{5 \times 10^{-5}}{R}$ (b) $\frac{R}{5 \times 10^{-5}}$

(c) 5×10^{-5} R (d) None

Q.12 The vapour density of N_2O_4 at a certain temperature is 30. The percentage dissociation of N_2O_4 at this temperature is-

(a) 55.5% (b) 60% (c) 70% (d) 53.3%

Q.13 If PCl_5 is 80% dissociated at 523 K, calculate the vapour density of the equilibrium mixture at 523 K :

(a) 75.9 (b) 57.9 (c) 97.5 (d) 95.7

Q.14 Ammonium carbamate when heated to 200°C gives a mixture of vapours

$$(NH_2COONH_4 \rightleftharpoons 2NH_3 + CO_2)$$

with a vapour density 13.0. What is the degree of dissociation of ammonium carbamate ?

(a) 1 (b) 2 (c) 3 (d) 4

Q.15 In the reaction, $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$. The concentrations of H_2, I_2 and HI at equilibrium are 8.0, 3.0 and 28.0 moles per litre respectively. What will be the equilibrium constant?

(a) 30.61 (b) 32.66 (c) 29.40 (d) 20.90

Q.16 For a gaseous reaction, $3H_2(g) + N_2(g) \rightleftharpoons 2NH_3(g)$, the partial pressures of H_2 and N_2 are 0.4 and 0.8 atmosphere, respectively. The total pressure of the entire system is 2.8 atmosphere. What will be the value of K_P if all the concentration are given in atmosphere ?

(a) 32 atm^{-2} (b) 20 atm^{-2}

(c) 50atm^{-2} (d) 80 atm^{-2}

Q.17 A two litre flask contains 1.4 gm dinitrogen and 1.0 gm dihydrogen. The ratio of active mass of dinitrogen and dihydrogen would be -

(a) 1 : 3 (b) 1 : 5 (c) 1.4 : 1 (d) 1 : 10

RESPONSE GRID	4. ⓐⓑⓒⓓ	5. ⓐⓑⓒⓓ	6. ⓐⓑⓒⓓ	7. ⓐⓑⓒⓓ	8. ⓐⓑⓒⓓ
	9. ⓐⓑⓒⓓ	10. ⓐⓑⓒⓓ	11. ⓐⓑⓒⓓ	12. ⓐⓑⓒⓓ	13. ⓐⓑⓒⓓ
	14. ⓐⓑⓒⓓ	15. ⓐⓑⓒⓓ	16. ⓐⓑⓒⓓ	17. ⓐⓑⓒⓓ	

Q.18 In the reaction : $A + B \rightleftharpoons C + D$

the initial concentration of A is double the initial concentration of B. At equilibrium, the concentration of B was found to be one third of the concentration of C. The value of equilibrium constant is –

(a) 1.8 (b) 1.008 (c) 0.0028 (d) 0.08

Q.19 The value of K_C for the reaction :

$A + 3B \rightleftharpoons 2C$ at 400°C is 0.5. Calculate the value of K_P

(a) 1.64×10^{-4} (b) 1.64×10^{-6}

(c) 1.64×10^{-5} (d) 1.64×10^{-3}

Q.20 Two moles of ammonia was introduced in an evacuated vessel of 1 litre capacity. At high temperature, the gas undergoes partial dissociation according to the equation :

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

At equilibrium the concentration of ammonia was found to be 1 mole. What is the value of 'K' ?

(a) $3/4 = 0.75\ mol^2\,L^{-2}$ (b) $3/2 = 1.5\ mol^2\,L^{-2}$

(c) $27/16 = 1.7\ mol^2\,L^{-2}$ (d) $27/64 = 0.42\ mol^2\,L^{-2}$

Q.21 In a 2 litre flask, the reaction takes place as :

$$COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$$

The equilibrium conc. of $COCl_2$ was found to be 0.4. If excess of $COCl_2$ is added to the system, the equilibrium restabilizes and $[COCl_2]$ becomes 1.6. What is the equilibrium conc. of [CO] ?

(a) Half of the former value

(b) Thrice of the former value

(c) Remains unaltered

(d) Twice of the former value

DIRECTIONS (Q.22-Q.24) : In the following questions, more than one of the answers given are correct. Select the correct answers and mark it according to the following codes:

Codes :

(a) 1, 2 and 3 are correct **(b)** 1 and 2 are correct

(c) 2 and 4 are correct **(d)** 1 and 3 are correct

Q.22 If two gases AB_2 and B_2C are mixed, the following equilibria are readily established

$$AB_2(g) + B_2C(g) \rightleftharpoons AB_3(g) + BC(g)$$

$$BC(g) + B_2C(g) \rightleftharpoons B_3C_2(g)$$

For the reaction, if AB_2 is mixed with B_2C only in the starting, then which of the following is necessarily true at equilibrium?

(1) $[AB_3]_{eq} = [BC]_{eq}$ (2) $[AB_3]_{eq} > [B_3C_2]_{eq}$

(3) $[AB_2]_{eq} = [B_2C]_{eq}$ (4) $[AB_3]_{eq} > [BC]_{eq}$

Q.23 Solid ammonium carbamate, $NH_4CO_2NH_2(s)$, dissociates into ammonia and carbon dioxide when it evaporates as shown by

$$NH_4CO_2NH_2(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$$

At 25°C, the total pressure of the gases in equilibrium with the solid is 0.116 atm. If 0.1 atm of CO_2 is introduced after equilibrium is reached, then :

(1) final pressure of CO_2 will be less than 0.1 atm

(2) final pressure of CO_2 will be more than 0.1 atm

(3) pressure of NH_3 will increase due to addition of CO_2

(4) pressure of NH_3 will decrease due to addition of CO_2

Q.24 $2CaSO_4(s) \rightleftharpoons 2CaO(s) + 2SO_2(g) + O_2(g),\ \Delta H > 0$

Above equilibrium is established by taking sufficient amount of $CaSO_4(s)$ in a closed container at 1600 K. Then which of the following may be correct option (Assume that solid $CaSO_4$ is present in the container in each case)

(1) Moles of CaO(s) will increase with the increase in temperature

(2) If two moles of the He gas is added at constant pressure then the moles of CaO(s) will increase.

(3) If the volume of the container is halved, partial pressure of $O_2(g)$ at new equilibrium will remain same

(4) If the volume of the container is doubled at equilibrium then partial pressure of $SO_2(g)$ will change at new equilibrium.

RESPONSE GRID	**18.** ⓐⓑⓒⓓ	**19.** ⓐⓑⓒⓓ	**20.** ⓐⓑⓒⓓ	**21.** ⓐⓑⓒⓓ	**22.** ⓐⓑⓒⓓ
	23. ⓐⓑⓒⓓ	**24.** ⓐⓑⓒⓓ			

DIRECTIONS (Q.25-Q.27) : Read the passage given below and answer the questions that follow :

$2A_2 \rightleftharpoons A_4$ ....(i) $K_{p_1} = \frac{2}{81}\text{atm}^{-1}$

$A_2 + 2C \rightleftharpoons A_2C_2$ ....(ii)

$A_2C_2 \rightleftharpoons 2AC$ ....(iii)

A_2 and C are taken in 3 : 1 mole ratio in a closed container of a certain volume at a fixed temperature and above three equilibriums are established simultaneously. The value K_{p_1} for the first reaction is 2/81 atm^{-1}. At equilibrium, partial pressure of A_4(g) and AC(g) are found to be 1/2 atm each and the total pressure at equilibrium is found to be 27/4 atm. Then–

Q.25 The partial pressure of A_2C_2 at equilibrium is –

(a) 1/2 (b) 1/4

(c) 3/4 (d) 1

Q.26 The mole ratio of gases A_2 and AC at equilibrium is –

(a) 9/2 (b) 7/2

(c) 8 (d) 9

Q.27 Equilibrium constant K_p for the reaction

$2AC \rightleftharpoons A_2C_2$ is–

(a) 3/4 (b) 1

(c) 4 (d) 1/3

DIRECTIONS (Q.28-Q.30) : Each of these questions contains two statements: Statement-1 (Assertion) and Statement-2 (Reason). Each of these questions has four alternative choices, only one of which is the correct answer. You have to select the correct choice.

(a) Statement-1 is True, Statement-2 is True; Statement-2 is a correct explanation for Statement-1.

(b) Statement-1 is True, Statement-2 is True; Statement-2 is NOT a correct explanation for Statement-1.

(c) Statement -1 is False, Statement-2 is True.

(d) Statement -1 is True, Statement-2 is False.

Q.28 **Statement-1 :** Pure liquids and solids can be ignored while writing the equilibrium constant expression.

Statement-2 : The concentration of pure liquids and solids does not remain constant.

Q.29 **Statement-1 :** The equilibrium constant is fixed and is the characteristic of any given chemical reaction at a specified temperature.

Statement-2 : The composition of the final equilibrium mixture at a particular temperature depends upon the starting amount of reactants.

Q.30 **Statement-1 :** On cooling a freezing mixture, colour of the mixture turns to pink from deep blue for a reaction.

$$Co(H_2O)_6^{2+}(aq) + 4Cl^-(aq) \rightleftharpoons CoCl_4^{2-}(aq) + 6H_2O(\ell)$$

Statement-2 : Reaction is endothermic so on cooling, the reaction moves to backward direction.

RESPONSE GRID	25.ⓐⓑⓒⓓ 26.ⓐⓑⓒⓓ 27.ⓐⓑⓒⓓ 28.ⓐⓑⓒⓓ 29. ⓐⓑⓒⓓ 30.ⓐⓑⓒⓓ

DAILY PRACTICE PROBLEM SHEET 12 - CHEMISTRY			
Total Questions	30	Total Marks	120
Attempted		Correct	
Incorrect		Net Score	
Cut-off Score	40	Qualifying Score	60
Success Gap = Net Score – Qualifying Score			
Net Score = (Correct × 4) – (Incorrect × 1)			

DAILY PRACTICE PROBLEMS

CHEMISTRY SOLUTIONS

(12)

(1) **(d)** $K_C = \dfrac{[SO_3]^2}{[SO_2]^2[O_2]}$

If volume is reduced to half, K_C will decrease to half. Thus, to maintain the equilibrium, the reaction should shift in the forward direction, i.e. towards right. Also, to attain equilibrium back, the rate of forward direction will become double the rate of backward direction.

(2) **(c)** Moles of I_2 taken $= \dfrac{46}{254} = 0.181$

$\left(\because \text{no. of moles} = \dfrac{\text{given mass}}{\text{molar mass}}\right)$

Moles of H_2 taken $= \dfrac{1}{2} = 0.5$

Moles of I_2 remaining $= \dfrac{1.9}{254} = 0.0075$

Moles of I_2 used $= 0.181 - 0.0075 = 0.1735$

Moles of H_2 used $= 0.1735$

Moles of H_2 remaining $0.5 - 0.1735 = 0.3265$

Moles of HI formed $= 0.1735 \times 2 = 0.347$

At equilibrium

Moles of $I_2 = 0.0075$ moles

Moles of HI $= 0.347$ moles

(3) **(c)** $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

At equilibrium $(1-x)$ $(3-3x)$ $2x$

$(x = 0.0025)$

Active masses $\dfrac{(1-0.0025)}{4}$ $\dfrac{(3-0.0075)}{4}$ $\dfrac{0.0050}{4}$

Applying law of mass action,

$$K_C = \frac{[NH_3]^2}{[N_2][H_2]^3} = \frac{\left(\dfrac{0.0050}{4}\right)^2}{\left(\dfrac{0.9975}{4}\right)\left(\dfrac{2.9925}{4}\right)^3}$$

$= 1.49 \times 10^{-5}\ L^2\ mol^{-2}$

K for the reaction,

$\frac{1}{2}N_2(g) + \frac{3}{2}H_2(g) \rightleftharpoons NH_3(g).$

is equal to $\sqrt{K_C}$,

i.e. $K = \sqrt{K_C} = \sqrt{1.49 \times 10^{-5}} = 3.86 \times 10^{-3}\ L\ mol^{-1}$

(4) **(d)**

$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O$

1 1 0 0

$1-0.666$ $1-0.666$ 0.666 0.666

$$K_C = \frac{[CH_3COOC_2H_5][H_2O]}{[CH_3COOH][C_2H_5OH]}$$

$$= \frac{[0.666][0.666]}{[0.333][0.333]} = 4$$

(a) Let x moles of ester is formed from 1 mole of acid and 0.5 mole of alcohol, then

$K_C = \dfrac{x^2}{(1-x)(0.5-x)} = 4$ $\left[\because K_C = 4 \text{ from 1}\right]$

$\therefore x = 0.43$

(b) Let 'x' mole of ester be formed from 1 mole of acid and 4 mole of alcohol. Thus,

$$K_C = \frac{x^2}{(1-x)(4-x)}$$

or $4 = \dfrac{x^2}{(1-x)(4-x)}$

$\therefore x = 0.93$

(5) **(c)** Applying the law of chemical equilibrium, we get

$K_p = (P_{NH_3})^2(P_{CO_2})$

Since total pressure is 3 atm, the partial pressures of $NH_3(g)$ and $CO_2(g)$ are

$[P_{NH_3}] = 3 \times \dfrac{2}{3} = 2$ atm

$[P_{CO_2}] = 3 \times \dfrac{1}{3} = 1$ atm

$K_p = [2.0]^2[1.0] = 4.0$ atm

(6) **(a)** In the reaction,

$3Fe(s) + 4H_2O(g) \rightleftharpoons Fe_3O_4(s) + 4H_2(g)$

42.5 gm 1.10 gm

42.5/18 1.10/2

= 2.36 moles = 0.55 moles

Now, $K_C = \dfrac{[H_2]^4}{[H_2O]^4} = \dfrac{[0.55/5]^4}{[2.36/5]^4}$

$K_C = \dfrac{(0.55)^4}{(2.36)^4} = 2.949 \times 10^3$

(7) **(a)** We know the relationship

$K_P = K_C(RT)^{\Delta n g}$

Here $K_P = 1.80 \times 10^{-3}$ kPa

$$K_P = \frac{1.8 \times 10^{-3}}{101.3} \text{ atm} = 1.78 \times 10^{-5} \text{ atm}$$

$R = 0.0821 \text{ L atm K}^{-1} \text{ mol}^{-1}$

$\Delta n_g = 3 - 2 = 1$

$T = 700\text{K}$

$$K_C = \frac{K_P}{(RT)^{\Delta n_g}} = \frac{1.78 \times 10^{-5}}{0.0821 \times 700}$$

$= 3.09 \times 10^{-7} \text{ mol L}^{-1}$.

(8) **(a)** Applying the relationship

$K_P = K_C(RT)^{\Delta n g}$

$K_C = 0.50$; $R = 0.082 \text{ L atm K}^{-1} \text{ mol}^{-1}$

$T = (400 + 273) = 673$; $\Delta n_g = (2 - 4) = -2$

$\therefore K_P = 0.5(0.082 \times 673)^{-2}$

$= 0.5(55.186)^{-2} = 2 \times 10^{-4}$

(9) **(c)** Since $(K_{eq})_2 < (K_{eq})_1$ while $T_2 > T_1$

$\therefore$ Reaction is exothermic

Hence, $\Delta H = -$ ve

(10) **(a)** $PCl_5 (g) \rightleftharpoons PCl_3(g) + Cl_2 (g)$

$\Delta n = 2 - 1 = 1$

$K_P = K_C(RT)^{\Delta n g}$

$= 0.0625 \times (0.082 \times 573)^1$

$= 2.936 \text{atm}$

(11) **(a)** We know that

$K_P = K_C (RT)^{\Delta n g}$

or, $K_C = \frac{K_P}{(RT)^{\Delta n}}$

Here, $\Delta n = 4 - 3 = 1$

$T = 1000 \text{ K}$, $K_P = 0.05$

$$K_C = \frac{0.05}{(R \times 1000)^1} = \frac{5 \times 10^{-5}}{R}$$

(12) **(d)** $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

Mol. mass of $N_2O_4 = (28 + 64) = 92$

Theoretical observed VD = 30

Vapour density,

$$D = \frac{92}{2} = 46 \left(\because D = \frac{\text{Mol mass}}{2}\right)$$

Let the degree of dissociation be x.

Applying the relationship,

$$x = \frac{D - d}{d} = \frac{(46 - 30)}{30} = \frac{16}{30} = 0.533$$

Degree of dissociation = 53.3%

(13) **(b)** Theoretical vapour density of $PCl_5 = \frac{\text{M.W. of } PCl_5}{2}$

$$= \frac{208.5}{2} = 104.25$$

Applying the formula, $x = \frac{D - d}{(n - 1)d}$

where : '*x*' is degree of dissociation -'*n*' is the total no. of moles of products

$$0.8 = \frac{104.25 - d}{(2 - 1)d}$$

$0.8d = 104.25 - d$

$1.8d = 104.25$

$$d = \frac{104.25}{1.8} = 57.9$$

(14) **(a)** Vapour density of ammonium carbamate before dissociation (d) $= \frac{\text{Mol.wt.}}{2} = \frac{78}{2} = 39$

Vapour density after dissociation (d) = 13.0 (given)

no. of moles of products (n) = 3

$$\text{Now, } \alpha = \frac{D - d}{(n - 1)d} = \frac{39 - 13}{(3 - 1) \times 13}$$

$$= \frac{26}{26} = 1 \qquad \text{i.e. } \alpha = 1$$

So, ammonium carbamate will be 100% dissociated.

(15) **(b)** $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

Applying law of mass action –

$$K_C = \frac{[HI]^2}{[H_2][I_2]}$$

Given $[H_2] = 8.0 \text{ mol L}^{-1}$

$[I_2] = 3.0 \text{ mol L}^{-1}$

$[HI] = 28.0 \text{ mol L}^{-1}$

$$\text{So, } K_C = \frac{(28.0)^2}{(8.0) \times (3.0)} = 32.66$$

(16) **(c)**

	$N_2(g)$ +	$3H_2(g)$	$\rightleftharpoons 2NH_3(g)$
Partial pressures (in atm)	0.8	0.4	$[2.8 - (0.8 + 0.4)] = 1.6$

$\because$ Total pressure = sum of partial pressures of all the components

$$K_P = \frac{(P_{NH_3})^2}{(P_{N_2})(P_{H_2})^3}$$

$$= \frac{1.6 \times 1.6}{0.8 \times 0.4 \times 0.4 \times 0.4}$$

$K_P = 50 \text{atm}^{-2}$

(17) **(d)** $[N_2] = \frac{1.4}{28 \times 2}$, $[H_2] = \frac{1}{2 \times 2}$

$$[N_2] : [H_2] = \frac{1}{40} : \frac{1}{4} = 1 : 10$$

(18) **(a)**

$$\begin{array}{lcccccccc} & A & + & B & \rightleftharpoons & C & + & D \\ \text{Initially} & 1 & & 0.5 & & 0 & & 0 \\ \text{At equilibrium} & 1-x & & 0.5-x & & x & & x \end{array}$$

According to question,

$$(0.5-x) = 1/3\,x \text{ or } x = 1.5 - 3x \text{ or } 4x = 1.5$$

$$x = \frac{1.5}{4} = 0.375$$

$$K_C = \frac{x \times x}{(1-x)(0.5-x)}$$

$$= \frac{0.375 \times 0.375}{(1-0.375) \times (0.5-0.375)}$$

$$= \frac{0.375 \times 0.375}{0.625 \times 0.125} = 1.8$$

(19) **(a)** $K_p = K_C\,[RT]^{\Delta n_g}$ $\quad \Delta n = 2 - 4 = -2$

$T = 673K,\ K_C = 0.5,\ R = 0.082$ litre. atm. $mol^{-1}\,K^{-1}$

$K_P = 0.5 \times (0.082 \times 673)^{-2}$

$= 1.64 \times 10^{-4}$ atm.

(20) **(c)** Let α be the degree of dissociation :

Hence, we have :

$$\begin{array}{lcll} 2NH_3(g) & \rightleftharpoons & N_2(g) & +\,3H_2(g) \\ 2 & & 0 & 0 \\ 2-2\alpha & & \alpha & 3\alpha \end{array}$$

At equilibrium : $[NH_3] = 2 - 2\alpha = 1$ or $\alpha = \frac{1}{2}$

$$[N_2] = \frac{1}{2}, [H_2] = \frac{3}{2}, [NH_3] = 1$$

$$\because K = \frac{[N_2][H_2]^3}{[NH_3]^2} = \frac{\frac{1}{2} \times \frac{3}{2} \times \frac{3}{2} \times \frac{3}{2}}{1 \times 1} = \frac{27}{16}$$

$$= 1.7\ mol^2\,L^{-2}$$

(21) **(d)** $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$

$$\therefore \frac{[CO][Cl_2]}{[COCl_2]} = K_C$$

Let $[CO] = x$, then $[Cl_2] = x$

$$\therefore \frac{x^2}{[COCl_2]} = K_C \text{ or } \frac{x^2}{0.4} = K_C$$

$$\text{Again } K_C = \frac{x^2}{0.4} = \frac{[CO][Cl_2]}{[COCl_2]}$$

$$\frac{x^2}{0.4} = \frac{[CO]^2}{1.6} \quad [\text{as } [CO] = [Cl]]$$

$\therefore x^2 \times 4 = [CO]^2$

$2x = [CO]$

(22) **(c)** Let reaction be started with 'a' mole of AB_2 and 'b' mole of B_2C.

$$\begin{array}{llll} AB_2(g) + & B_2C(g) & \rightleftharpoons AB_3(g) + & BC(g) \\ a & b & 0 & 0 \\ a-x & b-x-y & x & x-y \end{array}$$

$$\begin{array}{lll} BC(g) + & B_2C(g) & \rightleftharpoons B_3C_2(g) \\ x-y & b-x-y & y \end{array}$$

As $x > y$

Clearly, $[AB_3]_{eq} > [B_3C_2]_{eq}$ and $[AB_3]_{eq} > [BC]_{eq}$

(23) **(c)** Equilibrium constant, $K_C = \dfrac{[NH_3]^2\,[CO_2]}{[NH_4\,CO_2\,NH_2]}$

$$= \frac{P^2_{(NH_3)} \times P_{CO_2}}{[NH_4\,CO_2\,NH_2]}$$

Acc. to Le-Chatelier's principle, if a system at equilibrium is subjected to change in conc., T and P, it shifts in a direction to undo the effect of the change imposed.

If CO_2 is added at equilibrium, equilibrium is disturbed. Thus, to maintain equilibrium, reaction shifts in backward direction. So, pressure of NH_3 will decrease. The final pressure of CO_2 will be more than 0.1 atm.

(24) **(a)** This is explained on the basis of Le-Chatelier's principle as reaction is endothermic therefore it will go in the forward direction hence moles of CaO will increase.

With the increase or decrease of volume partial pressure of the gases will remain same.

Due to the addition of inert gas (He) at constant pressure reaction will proceed in the direction in which more number of gaseous moles are formed.

(25) (b), (26)(d), (27) (b).

$$\begin{array}{ll} 2A_2(g) \rightleftharpoons & A_4(g) \\ 3P-x-y & x/2 \end{array}$$

$$\begin{array}{llll} A_2 & +\ 2C & \rightleftharpoons & A_2C_2 \\ 3P-x-y & P-2y & & y-z \end{array}$$

$$\begin{array}{ll} A_2C_2 \rightleftharpoons & 2AC \\ y-z & 2z \end{array}$$

$$\frac{P_{A_4}}{P^2_{A_2}} = K_{P_1} \Rightarrow (P_{A_2})^2 = \frac{P_{A_4}}{K_{P_1}} = \frac{1/2}{2/81} = \frac{81}{4}$$

$$\Rightarrow P_{A_2} = \frac{9}{2} \text{atm}$$

$$\Rightarrow 3P - x - y = 9/2 \qquad \text{........ (i)}$$

$$\Rightarrow y = 3P - x - \frac{9}{2}$$

Also given $P_{A_4} = \dfrac{1}{2}$

$$\Rightarrow \frac{x}{2} = \frac{1}{2} \qquad \text{........ (ii)}$$

$$\Rightarrow x = 1 \text{ atm}$$

Also given $P_{AC} = \frac{1}{2} \Rightarrow 2z = 1/2$ ....(iii)

$\Rightarrow z = 1/4$ atm

$P_{total} = 3P - x - y + x/2 + P - 2y + y - z + 2z$

$= 4P - x/2 - 2y + z$

$\Rightarrow \frac{27}{4} = 4P - \frac{x}{2} - 6P + 2x + 9 + z$

On putting the values of x and z, we get P = 2 atm

Thus, $y = 6 - 1 - \frac{9}{2} = \frac{1}{2}$

Thus, $P_{A_2C_2} = y - z = \frac{1}{2} - \frac{1}{4} = \frac{1}{4}$ atm.

$$\frac{n_{A_2}}{n_{AC}} = \frac{P_{A_2}}{P_{AC}} = \frac{3P - x - y}{2z} = \frac{9/2}{1/2} = 9$$

$$K_p = \frac{P_{A_2C_2}}{P^2_{AC}} = \frac{1/4}{(1/2)^2} = 1$$

(28) **(d)** The concentrations of pure liquids and solids remain constant, and these terms are amalgamated (or merged) in the equilibrium constant. That is why, pure liquids and solids are ignored while writing the equilibrium constant expressions.

(29) **(a)** If the starting amounts are changed, the composition of the equilibrium mixture changes in such a way that K remains constant at constant temperature.

(30) **(a)** Both statement 1 and statement 2 are true and statement 2 is the correct explanation of statement 1. $Co(H_2O)_6^{2+}$ (Pink) while $CoCl_4^{2-}$ (blue). So, on cooling because of Le–Chatelier's principle the reaction tries to over come the effect of temperature.