Exercise - O

SINGLE CORRECT TYPE QUESTIONS

Definition of Equilibrium

1. In reversible chemical reaction equilibrium will establish when:
(A) Reactant is completely converted into product
(B) Rate of forward and backward reaction is equal
(C) Minimum yield of product
(D) Concentration of reactant and product is equal

CCE074

2. The equilibrium concentration of B for the reversible reaction $A \rightleftharpoons B$ can be evaluated by the expression:

(A) K_C (B) $\frac{k_f}{k_b}[A]_{eq}^{-1}$ (C) $\frac{k_f}{k_b}[A]_{eq}$ (D) $k_f k_b [A]_{eq}^{-1}$

CCE075

3. A chemical reaction is at equilibrium when
(A) Measurable properties become constant
(B) The rates of forward and backward reactions are equal
(C) Net rate of reaction is zero
(D) All are correct

CCE076

4. In a chemical equilibrium the equilibrium constant is found to be 2.5. If the rate constant of backward reaction is 10, the rate constant of forward reaction is –
(A) 2.5 (B) 0.25 (C) 25 (D) None

CCE077

5. In which of the following reaction equilibrium cannot be established ?
(A) $NaCl + AgNO_3 \longrightarrow AgCl + NaNO_3$ (B) $HCl + NaOH \longrightarrow NaCl + H_2O$
(C) $H_2SO_4 \longrightarrow 2H^{\oplus} + SO_4^{2\ominus}$ (D) All of these

CCE078

6. 64 g of HI are present in a 2 litre vessel. The active mass of HI is :
(A) 0.5 (B) 0.25 (C) 1.0 (D) None of these

CCE079

7. The equilibrium constant in a reversible reaction at a given temperature:
(A) Depends on the initial concentration of the reactants
(B) Depends on the concentration of the products at equilibrium
(C) Does not depend on the initial concentrations
(D) It is not characteristic of the reaction

CCE080

8. When 4 moles of A are mixed with 4 moles of B, then 2 moles of C are formed at equilibrium, according to the reaction, $A + B \rightleftharpoons C + D$. The equilibrium constant is:-
(A) 4 (B) 1 (C) $\sqrt{2}$ (D) $\sqrt{4}$

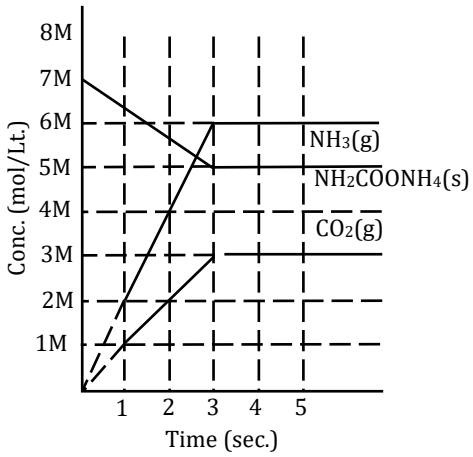
CCE081

9. Solid ammonium carbamate dissociates to give ammonia and carbon dioxide as follows

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

which of the following graph correctly represents the equilibrium?

(A)



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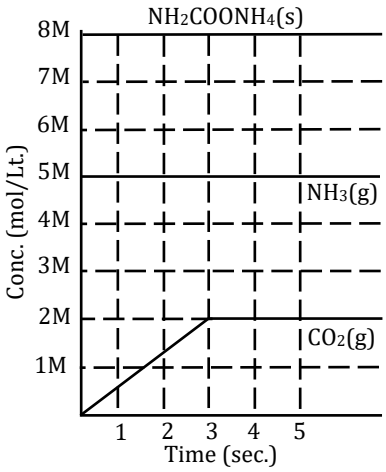

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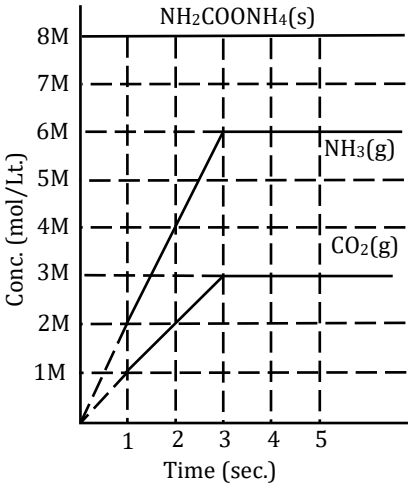
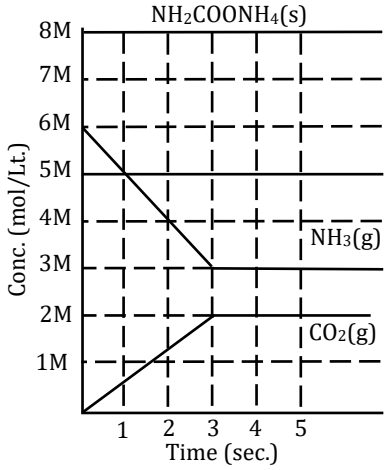


(D)



CCE082

Significance of K_p and K_c

10. If K_p for the reaction $A + 3B \rightleftharpoons 2C$ is 9 atm^{-2}, then find the value of K_p for the $\frac{A}{2} + \frac{3B}{2} \rightleftharpoons C$.

(A) 9 atm^{-1} (B) 6 atm^{-1} (C) 3 atm^{-1} (D) 2 atm^{-1}

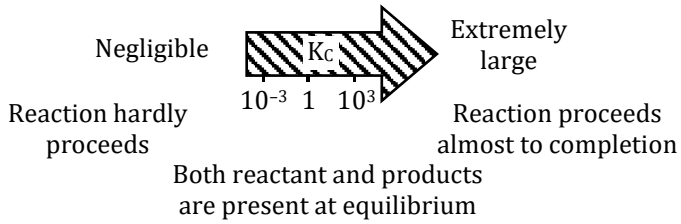
CCE087

11. For the reaction : $2HI(g) \rightleftharpoons H_2(g) + I_2(g)$, the degree of dissociation (α) of HI(g) is related to equilibrium constant K_P by the expression.

(A) $\frac{1+2\sqrt{K_P}}{2}$ (B) $\sqrt{\frac{1+2K_P}{2}}$ (C) $\sqrt{\frac{2K_P}{1+2K_P}}$ (D) $\frac{2\sqrt{K_P}}{1+2\sqrt{K_P}}$

CCE088

12. Consider the following figure which shows dependence of extent of reaction on K_C.



Point out the correct statement(s) for the above diagram.
(A) If $K_C > 10^3$, products predominate over reactants.
(B) If $K_C > 10^{-3}$ reactants predominate over products.
(C) If K_C is in the range of 10^{-3} to 10^3, appreciable concentrations of both reactants and products are present.
(D) All of the above

CCE089

13. 5.1g NH_4SH is introduced in 3.0 L evacuated flask at 327°C. 30% of the solid NH_4SH decomposed to NH_3 and H_2S as gases. The K_P of the reaction at 327°C is (R = 0.082 L atm $mol^{-1}K^{-1}$, Molar mass of S = 32 g mol^{-1}, molar mass of N = 14g mol^{-1})

(A) 1×10^{-4} atm^2 (B) 4.9×10^{-3} atm^2 (C) 0.242 atm^2 (D) 0.242×10^{-4} atm^2

CCE091

14. Two solids X and Y dissociate into gaseous products at a certain temperature as follows:
$X(s) \rightleftharpoons A(g) + C(g)$, and $Y(s) \rightleftharpoons B(g) + C(g)$. At a given temperature, pressure over excess solid X is 40 mm and pressure over excess solid Y is 60 mm when they are present in separate containers. The values of K_P for the reaction $X(s) \rightleftharpoons A(g) + C(g)$ and $Y(s) \rightleftharpoons B(g) + C(g)$ in mm^2 are

(A) 20, 300 (B) 40, 30 (C) 200, 90 (D) 400, 900

CCE100

15. 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 B(g) will be decreased surely.
(C) Amount of C(g) will be decreased surely.
(D) Amount of BC(g) will be decreased surely.

CCE101

Factors Affecting Equilibrium Constant

16. Consider the two gaseous equilibrium involving SO_2 and the corresponding equilibrium constants at 299 K

$$SO_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons SO_3(g) \; ; \; K_1$$

$$4SO_3(g) \rightleftharpoons 4SO_2(g) + 2O_2(g) \; ; \; K_2$$

The value of the equilibrium constants are related by :-

(A) $K_2 = \frac{1}{(K_1)^4}$ (B) $K_2 = \left(\frac{1}{K_1}\right)^{\frac{1}{4}}$ (C) $K_2 = \left(\frac{1}{K_1}\right)^{\frac{1}{4}}$ (D) $K_2 = \frac{1}{K_1}$

CCE083

17. The role of catalyst in a chemical reaction is :-
(A) To help attain equilibrium in a shorter time.
(B) To lower the activation energy.
(C) To shift the equilibrium in such a way as to increase the concentration of the product
(D) Both 1 & 2

CCE084

18. In a 0.25 L tube dissociation of 4 mol of NO takes place. If its degree of dissociation is 10%. The value of K_P for reaction $2NO \rightleftharpoons N_2 + O_2$ is:

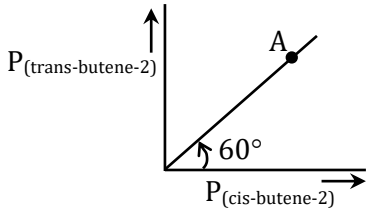
(A) $\frac{1}{(18)^2}$ (B) $\frac{1}{(8)^2}$ (C) $\frac{1}{16}$ (D) $\frac{1}{32}$

CCE085

19. Which of the following is in favour of forward reaction:
(A) $Q = K_C$ (B) $Q > K_C$ (C) $Q < K_C$ (D) None

CCE086

20. For the following isomerisation reaction
cis-butene-2 $\rightleftharpoons$ trans-butene-2; $K_P = 1.732$



Which of the following statement is true at point 'A' ?
(A) $Q > K_P$ (B) $Q < K_P$ (C) $Q = K = 1$ (D) $Q = K = 1.732$

CCE090

21. A 10 L container at 300 K contains CO_2 gas at pressure of 0.2 atm and an excess solid CaO (neglect the volume of solid CaO). The volume of container is now decreased by moving the movable piston fitted in the container. What will be the maximum volume of container when pressure of CO_2 attains its maximum value given that $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ $K_p = 0.800$ atm
(A) 5 L (B) 2.5 L
(C) 1 L (D) The information is insufficient.

CCE098

Le-Chatelier's principle & Thermodynamics of Equlibrium

22. In which of the following equilibrium reactions, the equilibrium would shift to right side, if total pressure is decreased:-
(A) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ (B) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(C) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ (D) $H_2(g) + Cl_2(g) \rightleftharpoons 2HCl(g)$

CCE092

23. For the manufacture of ammonia by the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3 + 21.9$ KCal, the favourable conditions are :-
(A) Low temperature, low pressure & catalyst
(B) Low temperature, high pressure & catalyst
(C) High temperature, low pressure & catalyst
(D) High temperature, high pressure & catalyst

CCE093

24. In the reaction $2A(g) + B(g) \rightleftharpoons C(g) + 362$ kCal. Which combination of pressure and temperature gives the highest yield of C at equilibrium:-

(A) 1000 atm and 500°C
(B) 500 atm and 500°C
(C) 1000 atm and 50°C
(D) 500 atm and 100°C

CCE094

25. Does Le chatelier principle predict a change of equilibrium concentration for the following reaction if the gas mixture is compressed $N_2O_4(g) \rightleftharpoons 2NO_2(g)$

(A) Yes, backward reaction is favoured
(B) Yes, forward reaction is favoured
(C) No change
(D) No information

CCE095

26. The reaction in which yield of production cannot be increased by the application of high pressure is :

(A) $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$
(B) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$
(C) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
(D) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

CCE096

27. In a vessel containing SO_3, SO_2 and O_2 at equilibrium, some helium gas is introduced so that the total pressure increases with temperature and volume remain constant. according to Le–chatelier principle, the dissociation of SO_3

(A) Increases
(B) Decreases
(C) Remains unaltered
(D) None of these

CCE097

MULTIPLE CORRECT TYPE QUESTIONS

Definition of Equilibrium

28. What is/are true about equilibrium state?

(A) Catalyst has no effect on equilibrium state.
(B) Equilibrium constant is independent of initial concentration of reaction.
(C) The reaction ceases at equilibrium.
(D) Equilibrium constant is independent of pressure.

CCE102

Significance of K_p and K_c

29. An amount of 1 mole of $PCl_3(g)$ and 1mole of $PCl_5(g)$ is taken in a vessel of 10L capacity maintained at 400 K. At equilibrium, the moles of Cl_2 is found to be 0.004.

(A) K_C for the reaction: $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is 0.0004 M.

(B) K_P for the reaction: $PCl_3(g) + Cl_2(g) \rightleftharpoons PCl_5(g)$ is $0.0004 \times (0.082 \times 400)$ atm.

(C) If $PCl_3(g)$ is added to the equilibrium mixture, ΔG at the new equilibrium becomes greater than the ΔG at old equilibrium.

(D) After equilibrium is achieved, the moles of PCl_3 are doubled and moles of Cl_2 are halved simultaneously, then the partial pressure of PCl_5 remains unchanged.

CCE103

30. When $NH_4HS(s)$ is vaporized in an empty vessel and maintained at 20°C, the equilibrium is established $NH_4HS(s)$ $NH_3(g) + H_2S(g)$ and the total pressure of gases at equilibrium is 0.4 atm. When $NH_4HS(s)$ is vaporized in the presence of $NH_3(g)$ in the same vessel at 20°C, the partial pressure of $NH_3(g)$ at equilibrium is 0.5 atm. Which of the following is/are correct statement(s)?

(A) At second equilibrium, the final partial pressure of $H_2S(g)$ is 0.08 atm.

(B) In second experiment, the initial pressure of $NH_3(g)$ was 0.42 atm.

(C) In the presence of $NH_3(g)$, the extent of dissociation of $NH_4HS(s)$ is decreased.

(D) At second equilibrium, the mole fraction of $H_2S(g)$ is 0.5.

CCE104

31. Which of the following reaction(s) have $K_P = K_C$?

(A) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ (B) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

(C) $2NO(g) + Cl_2(g) \rightleftharpoons 2NOCl(g)$ (D) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

CCE105

32. For dissociation of a gas N_2O_5 as $N_2O_5(g) \rightleftharpoons 2NO_2(g) + \frac{1}{2}O_2(g)$. The reaction is performed at constant temperature and volume. If D is the vapour density of equilibrium mixture, P_o is initial pressure of $N_2O_5(g)$ and M is molecular mass of N_2O_5, then the correct information(s) at the equilibrium is/are

(A) the total pressure of gases at equilibrium is $\frac{P_0 \cdot M}{2D}$

(B) the degree of dissociation of $N_2O_5(g)$ is $\frac{M-2D}{3D}$

(C) the partial pressure of $N_2O_5(g)$ at equilibrium $\frac{(5D-M)\cdot P_0}{3D}$

(D) the partial pressure of $O_2(g)$ at equilibrium is $\frac{(M-2D)\cdot P_0}{3D}$

CCE106

33. At –10°C, the solid compound $Cl_2(H_2O)_8$ is in equilibrium with gaseous chlorine, water vapour and ice. The partial pressure of the two gases in equilibrium with a mixture of $Cl_2(H_2O)_8$ and ice are 0.20 atm for Cl_2 and 0.001 atm for water vapour.

The processes may be represented as follows.

(i) $Cl_2(H_2O)_8(s) \rightleftharpoons Cl_2(g) + 8H_2O(g)$; K_{P_1}

(ii) $Cl_2(H_2O)_8(s) \rightleftharpoons Cl_2(g) + 8H_2O(s)$; K_{P_2}

Identify the correct statement among the following regarding the processes.

(A) The value of K_{P_1} is 2.0×10^{-25} atm^9.

(B) The value of K_{P_2} is 0.2 atm.

(C) The vapour pressure of ice is 0.001 atm at 263 K.

(D) Process (i) must be exothermic.

CCE107

34. In an evacuated vessel of capacity 112 L, 4 moles of Ar(g) and 5 moles of $PCl_5(g)$ were introduced and the temperature is maintained at 273°C. At equilibrium, the total pressure of the mixture was found to be 4.8 atm.

(A) The degree of dissociation of $PCl_5(g)$ into $PCl_3(g)$ and $Cl_2(g)$ is 0.6.

(B) K_P for the reaction: $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ is 2.7 atm.

(C) At equilibrium, the total moles of gases are 12.

(D) On removing Ar(g) from the equilibrium mixture at constant pressure and temperature, the extent of dissociation of PCl_5 will increase.

CCE108

35. In a vessel of 1.0 L capacity, $O_2(g)$ at 0.25 atm pressure and HCl(g) at 1.0 atm pressure are allowed to react in the presence of liquid water at 57oC.

$4HCl(g) + O_2(g) \rightleftharpoons 2Cl_2(g) + 2H_2O(g)$; $K_P = 5.0 \times 10^{12}$ atm^{-1}.

The volume occupied by liquid water is negligible, but it is sufficient at achieve equilibrium with water vapour. The vapour pressure of water at 57oC is 0.4 atm. Select the correct statement(s) regarding the equilibrium mixture.

(A) The partial pressure of water vapour at any stage of reaction is 0.4 atm.

(B) The partial pressure of $Cl_2(g)$ at equilibrium is 0.5 atm.

(C) The partial pressure of $O_2(g)$ at equilibrium is 5.0×10^{-4} atm.

(D) The partial pressure of HCl(g) at equilibrium is 2.0×10^{-3} atm.

CCE109

Le-Chatelier's principle & Thermodynamics of Equilibrium

36. Which of the following is/are correct statement(s)?

(A) The dissociation of $CaCO_3$ is suppressed at high pressure.

(B) The apparent molecular mass of PCl_5 shows lower value on dissociation.

(C) Low pressure is favourable for melting of ice.

(D) Combination of hydrogen atoms to form hydrogen molecule is favourable at high temperature.

CCE110

37. A chemical system is in equilibrium. Addition of a catalyst would result in

(A) increase in the rate of forward reaction.

(B) increase in the rate of reverse reaction.

(C) a new reaction pathway to reaction.

(D) increase the amount of heat evolved.

CCE111

38. A cylinder fitted with a movable piston contains liquid water in equilibrium with water vapour at 25°C. Which operation results in a decrease in the equilibrium vapour pressure?

(A) Moving the piston downwards a short distance.

(B) Removing a small amount of vapour.

(C) Removing a small amount of the liquid water.

(D) Dissolving salt in the water.

CCE112

39. The condition suitable for forming atomic chlorine from molecular chlorine is

(A) Low temperature (B) Low pressure

(C) High temperature (D) High pressure

CCE113

40. The position of equilibrium will shift in the given direction by the addition of inert gas at constant pressure in which of the following case(s)?

(A) $N_2(g) + 3F_2(g) \rightleftharpoons 2NF_3(g)$; forward direction

(B) $COCl_2(g) \rightleftharpoons CO(g) + Cl_2(g)$; forward direction

(C) $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$; backward direction

(D) $2C(s) + O_2(g) \rightleftharpoons 2CO(g)$; backward direction

CCE114

41. Two gases A and B, one being the dimer of the other, are at equilibrium. Decreasing of pressure at constant temperature or increasing of temperature at constant pressure favours the formation of more of B. The reaction could not be represented by

(A) $2A \rightleftharpoons B + q$ calories (B) $2A \rightleftharpoons B - q$ calories

(C) $2B \rightleftharpoons A - q$ calories (D) $2B \rightleftharpoons A + q$ calories

CCE115

42. For the gaseous reaction: $CO + H_2O \rightleftharpoons CO_2 + H_2$, the following thermodynamical data are given.

$\Delta H°_{300\ K} = -41.0$ kJ mol^{-1};
$\Delta S°_{300\ K} = -0.04$ kJ K^{-1} mol^{-1}
$\Delta H°_{1200\ K} = -33.0$ kJ mol^{-1};
$\Delta S°_{1200\ K} = -0.03$ kJ K^{-1} mol^{-1}
Assuming partial pressure of each component is 1 bar, the direction of spontaneous reaction is/are

(A) forward at 300 K. (B) forward at 1200 K.

(C) backward at 300 K. (D) backward at 1200 K.

CCE116

43. van 't Hoff equations show the effect of temperature on equilibrium constants K_C and K_P. K_P and K_C varies with temperature according to which of the following relations?

(A) $\log\frac{K_{P_2}}{K_{P_1}} = \frac{\Delta H}{2.303R}\left[\frac{T_1 - T_2}{T_1T_2}\right]$ (B) $\log\frac{K_{P_2}}{K_{P_1}} = \frac{\Delta H}{2.303R}\left[\frac{T_2 - T_1}{T_1T_2}\right]$

(C) $\log\frac{K_{C_2}}{K_{C_1}} = \frac{\Delta U}{2.303R}\left[\frac{T_2 - T_1}{T_1T_2}\right]$ (D) $\log\frac{K_{C_2}}{K_{C_1}} = \frac{\Delta U}{2.303R}\left[\frac{T_1 - T_2}{T_1T_2}\right]$

CCE117

44. For a chemical reaction at the state of equilibrium, which of the following statement(s) is/are correct?

(A) None of the variables like temperature, pressure or volume appear to change.

(B) Reaction system has maximum stability with minimum energy content.

(C) Addition of catalyst disturbs the point of equilibrium.

(D) Addition of inert gas at equilibrium for constant volume system will move the equilibrium in the direction, where more number of moles of gases is present.

CCE118

45. At chemical equilibrium, the

(A) enthalpy of system is minimum.
(B) entropy of system is maximum.
(C) free energy of system is minimum.
(D) free energy of system is zero.

CCE119

46. In the following equilibrium

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$, when 5 moles of each is taken and the temperature is kept at 298 K, the total pressure was found to be 20 bar. Given $\Delta_fG^o[N_2O_4(g)] = 100$ kJ/mol;
$\Delta_fG^o[NO_2(g)] = 50$ kJ/mol.

(A) K_P for the reaction is 1.0 bar.
(B) ΔG^o for the reaction is zero at 298 K.
(C) Under the given condition, the reaction is mainly occurring in backward direction.
(D) The mixture taken is at equilibrium.

CCE120

MATRIX MATCH TYPE QUESTION

47. Match the following:

	Column-I (Assume only reactant were present initially)		**Column-II**
(i)	For the equilibrium $NH_4I(s) \rightleftharpoons NH_3(g) + HI(g)$, if pressure is increased at equilibrium	(p)	Forward shift
(ii)	For the equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$, volume is increased at equilibrium	(q)	No shift in equilibrium
(iii)	For the equilibrium $H_2O(g) + CO(g) \rightleftharpoons H_2(g) + CO_2(g)$, inert gas is added at constant pressure at equilibrium	(r)	Backward shift
(iv)	For the equilibrium $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$, Cl_2 is removed at equilibrium.	(s)	Final pressure is more than initial pressure

(A) (i - r); (ii - r); (iii - q); (iv - p)
(B) (i - p); (ii - q); (iii - r); (iv - s)
(C) (i - p); (ii - p); (iii - q); (iv - q)
(D) (i - p); (ii - q); (iii - r); (iv - r)

CCE099

Exercise - S

Definition of Equilibrium

1. For the reaction $A(g) + 2B(g) \rightleftharpoons C(g) + D(g)$; $K_c = 10^{12}$.

If the initial moles of A,B,C and D are 0.5, 1, 0.5 and 3.5 moles respectively in a one litre vessel. What is the equilibrium concentration of B (in millimole/litre) ?

CCE131

2. The ratio of equilibrium molar concentration of PCl_3 and PCl_5 at 300 K if initially 1 mol of PCl_5 is taken in a closed container of having volume 10 litre, is x : 1.00. The value of 'x' is.

[Given : $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$; $K_C = 10^{-2}$ at 300 K, $\sqrt{41} = 6.4$]

CCE132

3. When 36.8g N_2O_4 (g) is introduced into a 1.0-litre flask at 27°C . The following equilibrium reaction occurs:

$$N_2O_4 (g) \rightleftharpoons 2NO_2 (g) ; \ K_p = 0.164 \text{ atm.}$$

(a) Calculate K_c of the equilibrium reaction. (in 10^{-3} M)

(b) What are the number of millimoles of N_2O_4 at equilibrium?

(c) What is the total pressure of gases (in atm) in the flask at equilibrium?

(d) What is the percent dissociation of N_2O_4?

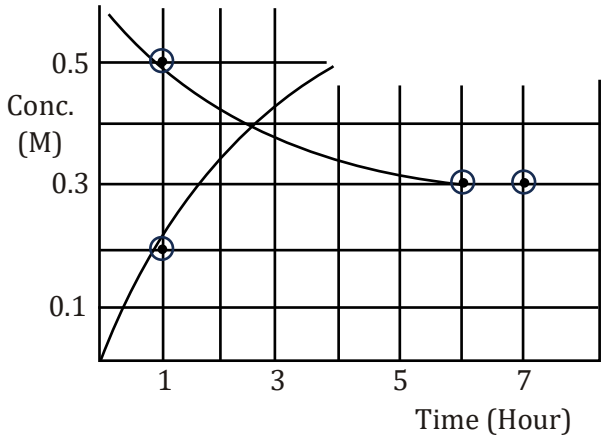
CCE133

4. The progress of the reaction

$A \rightleftharpoons nB$ with time, is presented in figure. Determine

(i) the value of n.

(ii) the equilibrium constant, K (in M^{n-1}).



CCE134

Significance of K_p and K_c

5. One mole of N_2O_4 (g) at 300 K is left in a closed container under one atm . It is heated to 600 K when 20 % by mass of N_2O_4 (g) decomposes to NO_2 (g) . Calculate resultant pressure (in atm).

CCE135

6. Solid Ammonium carbamate dissociates as: $NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$. In a closed vessel solid ammonium carbamate is in equilibrium with its dissociation products. At equilibrium, ammonia is added such that the partial pressure of NH_3 at new equilibrium now equals the original total pressure. The ratio of total pressure at new equilibrium to that of original total pressure is x : 3, the value of 'x' is.

CCE136

7. A mixture of hydrogen & iodine in the mole ratio 1.5 : 1 is maintained at 450° C. After the attainment of equilibrium $H_2(g) + I_2(g) \rightleftharpoons 2\,HI(g)$, it is found on analysis that the mole ratio of I_2 to HI is 1 : 18. Calculate the equilibrium constant, if initially, 127 grams of iodine were taken. (I = 127)

CCE137

8. At certain temperature (T) for the gas phase reaction

$$2H_2O(g) + 2Cl_2(g) \rightleftharpoons 4HCl(g) + O_2(g) \quad K_p = 12 \times 10^8 \text{ atm}$$

If Cl_2, HCl & O_2 are mixed in such a manner that the partial pressure of each is 2 atm and the mixture is brough into contact with excess of liquid water. What would be approximate partial pressure (in 10^{-3} atm) of Cl_2 when equilibrium is attained at temperature (T)?

[Given : Vapour pressure of water is 380 mm Hg at temperature (T)]

CCE138

9. Two solids X and Y disssociate into gaseous products at a certain temperature as follows:

$X(s) \rightleftharpoons A(g) + C(g)$, and $Y(s) \rightleftharpoons B(g) + C(g)$. At a given temperature, pressure over excess solid X is 40 mm and total pressure over solid Y is 60 mm. When they are preset in separate containers. Calculate

(a) the values of K_p for two reactions (in mm^2)

(b) the ratio of moles of A and B in the vapour state over a mixture of X and Y.

(c) the total pressure of gases (in mm) over a mixture of X and Y.

CCE139

10. When 1 mole of A(g) is introduced in a closed rigid 1 litre vessel maintained at constant temperature the following equilibria are established.

$$A(g) \rightleftharpoons B(g) + C(g) : K_{C_1}$$

$$C(g) \rightleftharpoons D(g) + B(g) : K_{C_2}$$

The pressure at equilibrium is twice the initial pressure. Calculate the value of $\frac{K_{C_2}}{K_{C_1}}$ if $\frac{[C]_{eq}}{[B]_{eq}} = \frac{1}{5}$

CCE140

11. In a vessel, two equilibrium are simultaneously established at same temperature as follows,

$$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \quad \text{.....(i)}$$

$$N_2(g) + 2H_2(g) \rightleftharpoons N_2H_4(g) \quad \text{.....(ii)}$$

Initially the vessel contains N_2 and H_2 in the molar ratio of 9 : 13. The equilibrium pressure is $7\,P_0$ 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.

CCE141

12. If vapour density of equilibrium mixture NO_2 and N_2O_4 is found to be 40 for the reaction,

$N_2O_4 \rightleftharpoons 2NO_2$. Find :

(a) Molar mass of equilibrium mixture (in gm/mol)

(b) Degree of dissociation

(c) Percentage of NO_2 in the mixture

CCE142

Factors Affecting Equilibrium Constant

13. A definite amount of solid NH_4HS is placed in a flask already containing ammonia gas at a certain temperature and 0.50 atm pressure. NH_4HS decomposes to give NH_3 and H_2S and at equilibrium total pressure in flask is 0.84 atm. Calculate equilibrium constant for the reaction (in atm^2):

CCE143

Miscellaneous

14. Equilibrium constants are given (in atm) for the following reactions at 0° C:

$SrCl_2 \times 6H_2O(s) \rightleftharpoons SrCl_2 \times 2H_2O(s) + 4H_2O(g)$ $K_p = 5 \times 10^{-12}$

$Na_2HPO_4 \times 12\ H_2O(s) \rightleftharpoons Na_2HPO_4 \times 7\ H_2O(s) + 5H_2O(g)$ $K_p = 2.43 \times 10^{-13}$

$Na_2SO_4 \times 10\ H_2O(s) \rightleftharpoons Na_2SO_4(s) + 10\ H_2O(g)$ $K_p = 1.024 \times 10^{-27}$

$$\left(\%\ \text{Relative humidity} = \frac{P_{H_2O}}{\text{Vapour pressure of } H_2O} \times 100\right)$$

The vapor pressure of water at 0°C is 4.56 torr.

Out of $SrCl_2 \times 2H_2O(s)$, $Na_2HPO_4 \times 7\ H_2O(s)$ and $Na_2SO_4(s)$,

Which is the most effective drying agent at 0°C?

CCE144

15. At certain temperature, $K_C = 1.0$ for reaction:

$$NO_2(g) + NO(g) \rightleftharpoons N_2O(g) + O_2(g)$$

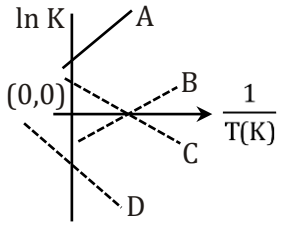
equal moles of NO and NO_2 are to be placed in 5 litre container until N_2O concentration at equilibrium is 0.5M. How many mole of ($NO + NO_2$) must be placed in the container.

CCE145

EXERCISE - JEE (Main) PYQ

1. Which of the following lines correctly show the temperature dependence of equilibrium constant, K, for an exothermic reaction?

[JEE (Main) 2018]



(1) B and C (2) C and D (3) A and D (4) A and B

CCE036

2. In which of the following reactions, an increase in the volume of the container will favour the formation of products ?

[JEE (Main) 2018]

(1) $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$ (2) $3O_2(g) \rightleftharpoons 2O_3(g)$

(3) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ (4) $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(l)$

CCE037

3. The gas phase reaction $2NO_2(g) \rightleftharpoons N_2O_4(g)$ is an exothermic reaction. The decomposition of N_2O_4, in equilibrium mixture of $NO_2(g)$ and $N_2O_4(g)$, can be increased by :-

[JEE (Main) 2018]

(1) Addition of an inert gas at constant volume.
(2) Increasing the pressure.
(3) Lowering the temperature.
(4) Addition of an inert gas at constant pressure.

CCE039

4. For the reaction,
$2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$,
$\Delta H = -57.2 kJ\ mol^{-1}$ and
$K_C = 1.7 \times 10^{16}$.
Which of the following statement is INCORRECT?

[JEE (Main) 2019]

(1) The equilibrium constant is large suggestive of reaction going to completion and so catalyst is required.
(2) The equilibrium will shift in forward direction as the pressure increase.
(3) The equilibrium constant decreases as the temperature increases.
(4) The addition of inert gas at constant volume will not affect the equilibrium constant.

CCE041

5. Two solids dissociate as follows
$A(s) \rightleftharpoons B(g) + C(g)$; $K_{P_1} = x\ atm^2$
$D(s) \rightleftharpoons C(g) + E(g)$; $K_{P_2} = y\ atm^2$
The total pressure when both the solids dissociate simultaneously is :- **[JEE (Main) 2019]**

(1) (x + y) atm (2) $x^2 + y^2$ atm (3) $2\left(\sqrt{x+y}\right)$ atm (4) $\sqrt{x+y}$ atm

CCE043

6. Consider the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$

The equilibrium constant of the above reaction is K_P. If pure ammonia is left to dissociate, the partial pressure of ammonia at equilibrium is given by (Assume that $P_{NH_3} \ll P_{total}$ at equilibrium)

[JEE (Main) 2019]

(1) $\frac{3^{\frac{3}{2}}K_P^{\frac{1}{2}}P^2}{4}$ (2) $\frac{3^{\frac{3}{2}}K_P^{\frac{1}{2}}P^2}{16}$ (3) $\frac{K_P^{\frac{1}{2}}P^2}{16}$ (4) $\frac{K_P^{\frac{1}{2}}P^2}{4}$

CCE044

7. Consider the following reaction

$N_2O_4(g) \rightleftharpoons 2NO_2(g)$; $\Delta H° = +58$ kJ

For each of the following cases (a, b), the direction in which the equilibrium shifts is:

(a) Temperature is decreased

(b) Pressure is increased by adding N_2 at constant T

[JEE (Main) 2020]

(1) (a) towards reactant, (b) no change (2) (a) towards product, (b) towards reactant

(3) (a) towards product, (b) no change (4) (a) towards reactant, (b) towards product

CCE046

8. At 1990 K and 1 atm pressure, there are equal number of Cl_2 molecules and Cl atoms in the reaction mixture. The value K_P for the reaction $Cl_{2(g)} \rightleftharpoons 2Cl_{(g)}$ under the above conditions is $x \times 10^{-1}$. The value of x is _____.

(Rounded of to the nearest integer) **[JEE (Main) 2021]**

CCE047

9. When 5.1 g of solid NH_4HS is introduced into a two litre evacuated flask at 27°C, 20% of the solid decomposes into gaseous ammonia and hydrogen sulphide. The K_p for the reaction at 27°C is $x \times 10^{-2}$. The value of x is _____. (Integer answer)

[Given R = 0.082 L atm K^{-1} mol^{-1}] **[JEE (Main) 2021]**

CCE048

10. At 298 K, the equilibrium constant is 2×10^{15} for the reaction :

$Cu(s) + 2Ag^{\oplus}(aq) \rightleftharpoons Cu^{2\oplus}(aq) + 2Ag(s)$

The equilibrium constant for the reaction

$$\frac{1}{2}Cu^{2\oplus}(aq) + Ag(s) \rightleftharpoons \frac{1}{2}Cu(s) + Ag^{\oplus}(aq)$$

is $x \times 10^{-8}$. The value of x is_____. (Nearest Integer)

[JEE (Main) 2022]

CCE049

11. At 600K, 2 mol of NO are mixed with 1 mol of O_2.

$$2NO_{(g)} + O_2(g) \rightleftharpoons 2NO_2(g)$$

The reaction occurring as above comes to equilibrium under a total pressure of 1 atm. Analysis of the system shows that 0.6 mol of oxygen are present at equilibrium. The equilibrium constant for the reaction is _____. (Nearest integer). **[JEE (Main) 2022]**

CCE050

12. For the reaction $A(g) \rightleftharpoons B(g)$ at 495 K, $\Delta_r G^\circ = -9.478$ kJ mol^{-1}.

If we start the reaction in a closed container at 495 K with 22 millimoles of A, the amount of B is the equilibrium mixture is _____ millimoles. (Round off to the Nearest Integer).

[R = 8.314 J mol^{-1} K^{-1}; ℓn 10 = 2.303]

[JEE (Main) 2022]

CCE121

13. Consider the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$. The temperature at which $K_C = 20.4$ and $K_P = 600.1$, is____K. (Round off to the Nearest Integer).

[Assume all gases are ideal and R = 0.0831 L bar K^{-1} mol^{-1}]

[JEE (Main) 2022]

CCE122

14. $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

In an equilibrium mixture, the partial pressures are

$P_{SO_3} = 43_{kPa}$; $P_{O_2} = 530$ Pa and $P_{SO_2} = 45$ kPa. The equilibrium constant KP = __× 10^{-2}. (Nearest integer)

[JEE (Main) 2022]

CCE123

15. For a reaction at equilibrium

$$A(g) \rightleftharpoons B(g) + \frac{1}{2}C(g)$$

the relation between dissociation constant (K), degree of dissociation (α) and equilibrium pressure (p) is given by : **[JEE (Main) 2022]**

(1) $K = \dfrac{\alpha^{\frac{1}{2}} p^{\frac{3}{2}}}{\left(1+\frac{3}{2}\alpha\right)^{\frac{1}{2}}(1-\alpha)}$

(2) $K = \dfrac{\alpha^{\frac{3}{2}} p^{\frac{1}{2}}}{(2+\alpha)^{\frac{1}{2}}(1-\alpha)}$

(3) $K = \dfrac{(\alpha p)^{\frac{3}{2}}}{\left(1+\frac{3}{2}\alpha\right)^{\frac{1}{2}}(1-\alpha)}$

(4) $K = \dfrac{(\alpha p)^{\frac{3}{2}}}{(1+\alpha)(1-\alpha)^{\frac{1}{2}}}$

CCE124

16. Water decomposes at 2300 K

$$H_2O(g) \rightarrow H_2(g) + \frac{1}{2}O_2(g)$$

The percent of water decomposing at 2300 K and 1 bar is _____ (Nearest integer).

Equilibrium constant for the reaction is 2 × 10^{-3} at 2300 K

[JEE (Main) 2023]

CCE125

17. At 298 K

$N_2(g)+3H_2(g) \rightleftharpoons 2NH_3(g); \quad K_1 = 4\times10^5$

$N_2(g)+O_2(g) \rightleftharpoons 2NO\ (g); \quad K_2 = 1.6\times10^{12}$

$H_2(g)+\frac{1}{2}O_2(g) \rightleftharpoons H_2O\ (g); \quad K_3 = 1.0\times10^{-13}$

Based on above equilibria, the equilibrium constant of the reaction,

$2NH_3(g)+\frac{5}{2}O_2(g) \rightleftharpoons 2NO\ (g)+3H_2O\ (g)$

is _____ × 10^{-33}. (Nearest integer)

[JEE (Main) 2023]

CCE126

18. Consider the following equation :

$2SO_2(g)+O_2(g) \rightleftharpoons 2SO_3(g), \Delta H = -190\ kJ$

The number of factors which will increase the yield of SO_3 at equilibrium from the following is _____

A. Increasing temperature
B. Increasing pressure
C. Adding more SO_2
D. Adding more O_2
E. Addition of catalyst

[JEE (Main) 2023]

CCE127

19. (i) $X(g) \rightleftharpoons Y(g) + Z(g)$; $K_{p1} = 3$

(ii) $A(g) \rightleftharpoons 2B(g)$; $K_{p2} = 1$

If the degree of dissociation and initial concentration of both the reactants X(g) and A(g) are equal, then the ratio of the total pressure at equilibrium $\left(\frac{p_1}{p_2}\right)$ is equal to x : 1. The value of x is _____ (Nearest integer)

[JEE (Main) 2023]

CCE128

20. The equilibrium composition for the reaction $PCl_3 + Cl_2 \rightleftharpoons PCl_5$ at 298 K is given below.

$[PCl_3]_{eq} = 0.2\ mol\ L^{-1}, [Cl_2]_{eq} = 0.1\ mol\ L^{-1}, [PCl_5]_{eq} = 0.40\ mol\ L^{-1}$

If 0.2 mol of Cl_2 is added at the same temperature, the equilibrium concentrations of PCl_5 is _____ × 10^{-2} mol L^{-1}.

Given : K_c for the reaction at 298 K is 20

[JEE (Main) 2023]

CCE129

EXERCISE - JEE (Advanced) PYQ

1. The thermal dissociation equilibrium of $CaCO_3(s)$ is studied under different conditions.

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

For this equilibrium, the correct statement(s) is(are)

[JEE (Advanced) 2013]

(A) ΔH is dependent on T

(B) K is independent of the initial amount of $CaCO_3$

(C) K is dependent on the pressure of CO_2 at a given T

(D) ΔH is independent of the catalyst if any

CCE072

2. For the following reaction, the equilibrium constant K_C at 298 K is 1.6×10^{17}.

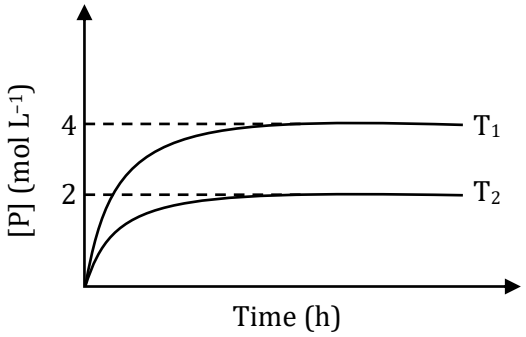
$Fe^{2\oplus}(aq) + S^{2\ominus}(aq) \rightleftharpoons FeS(s)$

When equal volumes of 0.06 M $Fe^{2\oplus}(aq)$ and 0.2 M $S^{2\ominus}(aq)$ solutions are mixed, the equilibrium concentration of $Fe^{2\oplus}(aq)$ is found to be $Y \times 10^{-17}$ M. The value of Y is (upto two decimal places.)

[JEE (Advanced) 2019]

CCE073

3. In a one-litre flask, 6 moles of A undergoes the reaction A (g) $\rightleftharpoons$ P (g). The progress of product formation at two temperatures (in Kelvin), T_1 and T_2, is shown in the figure:



If $T_1 = 2T_2$ and $(\Delta G_2^\ominus - \Delta G_1^\ominus) = RT_2 \ln x$, then the value of x is _____.

[$\Delta G_1^\ominus$ and $\Delta G_2^\ominus$ are standard Gibb's free energy change for the reaction at temperatures T_1 and T_2, respectively.]

[JEE (Advanced) 2023]

CCE130

JEE (Main) Practice Paper

This paper is for yourself practice and assessment the discussion of this paper is optional though you can see PDF solutions or video solutions or solutions in hardcopy whichever is provided.

SECTION–A

- This section contains **TWENTY** questions.
- Each question has **FOUR** options (1), (2), (3) and (4). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories :

Full Marks : +4, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : –1 in all other cases

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1. $x \rightleftharpoons y$ reaction is said to be in equilibrium, when :-

(1) Only 10% conversion of x to y takes place
(2) Complete conversion of x to y has taken place
(3) Conversion of x to y is only 50% complete
(4) The rate of change of x to y is just equal to the rate of change of y to x in the system

CCE001

2. For the following three reactions, 1, 2 and 3 equilibrium, constants are given :

(1) $CO(g) + H_2O(g) \rightleftharpoons CO_2(g) + H_2(g)$; K_1

(2) $CH_4(g) + H_2O(g) \rightleftharpoons CO(g) + 3H_2(g)$; K_2

(3) $CH_4(g) + 2H_2O(g) \rightleftharpoons CO_2(g) + 4H_2(g)$; K_3

Which of the following relations is correct ?

(1) $K_1\sqrt{K_2} = K_3$ (2) $K_2K_3 = K_1$ (3) $K_3 = K_1K_2$ (4) $K_3 = K_2^3K_1^2$

CCE002

3. In a chemical equilibrium, the rate constant for the backward reaction is 7.5×10^{-4} and the equilibrium constant is 1.5. The rate constant for the forward reaction is:-

(1) 2×10^{-3} (2) 5×10^{-4} (3) 1.125×10^{-3} (4) 9.0×10^{-4}

CCE003

4. For which reaction is $K_P = K_C$:-

(1) $2NOCl(g) \rightleftharpoons 2NO(g) + Cl_2(g)$ (2) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$
(3) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ (4) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$

CCE004

5. $\log \frac{K_p}{K_c} + \log RT = 0$ is true relationship for the following reaction:-

(1) $PCI_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ (2) $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
(3) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ (4) (2) and (3) both

CCE005

6. For the reaction, $CuSO_4.5H_2O(s) \rightleftharpoons CuSO_4.3H_2O(s) + 2H_2O(g)$
Which one is correct representation :–

(1) $K_P = (P_{H_2O})^2$ (2) $K_C = [H_2O]^2$ (3) $K_P = K_c(RT)^2$ (4) All

CCE006

7. For a reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$, the value of K_C does not depends upon :-

(A) Initial concentration of the reactants (B) Pressure
(C) Temperature (D) Catalyst
(1) Only C (2) A, B, C (3) A, B, D (4) A, B, C, D

CCE007

8. For the reaction : P ⇌ Q + R. Initially 2 moles of P were taken. Up to equilibrium 0.5 moles of P was dissociated. What would be the degree of dissociation (α) :-

(1) 0.5 (2) 1 (3) 0.25 (4) 4.2

CCE008

9. The dissociation of CO_2 can be expressed as $2CO_2(g) \rightleftharpoons 2CO(g) + O_2(g)$. If the 2 moles of CO_2 is taken initially and 40% of the CO_2 is dissociated completely. What is the total number of moles at equilibrium:

(1) 2.4 (2) 2.0 (3) 1.2 (4) 5

CCE009

10. In the reaction $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ the partial pressure of PCl_3, Cl_2 and PCl_5 are 0.3, 0.2 and 0.6 atm respectively. If partial pressure of PCl_3 and Cl_2 was increased twice, what will be the partial pressure of PCl_5 in atm :-

(1) 0.3 (2) 1.2 (3) 2.4 (4) 0.15

CCE010

11. If 0.5 mole H_2 is reacted with 0.5 mole I_2 in a ten-litre container at 444° C and at same temperature value of equilibrium constant K_c is 49, the ratio of [HI] and [I_2] will be :-

(1) 7 (2) $\frac{1}{7}$ (3) $\sqrt{\frac{1}{7}}$ (4) 49

CCE011

12. For the reaction A + 2B ⇌ 2C + D, initial concentration of A is "a" and initial concentration of B is 1.5 times that of A. Concentration of A and D are same at equilibrium. What should be the concentration of B at equilibrium?

(1) $\frac{a}{4}$ (2) $\frac{a}{2}$ (3) $\frac{3a}{4}$ (4) All of the above.

CCE012

13. A reaction in equilibrium is represented by the following equation ; 2A(s) + 3B(g) ⇌ 3C(g) + D(g) if the pressure on the system is reduced to half of its initial value:-

(1) The amounts of C and D decreases (2) The amounts of C and D increases
(3) The amount of D decreases (4) All the amounts remain constant

CCE013

14. The equilibrium constant K_P (in atm) for the reaction is 9 at 7 atm and 300 K.

$A_2(g) \rightleftharpoons B_2(g) + C_2(g)$

Calculate the average molar mass (in gm/mol) of an equilibrium mixture.

Given : Molar mass of A_2, B_2 and C_2 are 70, 49 & 21 gm/mol respectively.

(1) 50 (2) 45 (3) 40 (4) 37.5

CCE014

15. The equilibrium $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$ shifts forward if :-

(1) A catalyst is used.

(2) An adsorbent is used to remove SO_3 as soon as it is formed.

(3) Small amounts of reactants are removed.

(4) None of these

CCE015

16. In a vessel containing SO_3, SO_2 and O_2 at equilibrium, some helium gas is introduced so that the total pressure increases while temperature and volume remain constant. According to Le-Chatelier principle, the dissociation of SO_3.

(1) Increases (2) Decreases

(3) Remains unaltered (4) None of these

CCE016

17. On decreasing temperature of following system at equilibrium $CO_2(s) \rightleftharpoons CO_2(g)$, ΔH = +ve :-

(1) There is no effect on the equilibrium state (2) More CO_2 gas is formed

(3) More solid CO_2 is obtained (4) None of above

CCE017

18. Vapour density of the equilibrium mixture of the reaction

$2NH_3(g) \rightleftharpoons N_2(g) + 3H_2(g)$ is 6.0

Percent dissociation of ammonia gas is:

(1) 13.88 (2) 58.82 (3) 41.66 (4) None of these

CCE018

19. In an equilibrium reaction for which $\Delta n_g = 0$, the equilibrium on increasing the pressure

(1) will shift forward (2) does not have any effect

(3) will shift backward (4) will decrease the equilibrium constant

CCE019

20. In which of the following equilibrium reactions, the equilibrium would shift to right side, if total pressure is decreased :-

(1) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ (2) $N_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

(3) $N_2O_4(g) \rightleftharpoons 2NO(g)$ (4) $N_2(g) + O_2(g) \rightleftharpoons 2NO(g)$

CCE020

SECTION-B

- This section will have **TEN questions**. Candidate can choose to attempt any 5 questions out of these 10 questions. In case if candidate attempts more than 5 questions, first 5 attempted questions will be considered for marking.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value (Answer should be rounded off to the nearest integer).
- Answer to each question will be evaluated according to the following marking scheme:
  Full Marks : +4, if only correct answer is given.
  Zero Marks : 0, if no answer is given.
  Negative Marks : -1 for incorrect answer

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1. For the reaction $2SO_{3(g)} \rightleftharpoons 2SO_{2(g)} + O_{2(g)}$

Initially 5 moles of SO_3 is taken and at equilibrium 4 moles of SO_3 is dissociated, find out the value of K_C (in M) (Volume = 2litre)

CCE021

2. An equilibrium mixture of N_2, H_2 and NH_3 at 700 K contains 0.036 M N_2 and 0.15 M H_2. At this temperature, K_C for the reaction $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is 0.29. If concentration of NH_3 at equilibrium is 5.9×10^{-y} then calculate the value of 'y'.

CCE022

3. At 46°C, K_P for the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$ is 0.667 atm. Compute the percent dissociation of N_2O_4 at 46°C at a total pressure of 380 Torr.

CCE023

4. At some temperature and under a pressure of 4 atm, PCl_5 is 10% dissociated. Calculate the pressure (in atm) at which PCl_5 will be 20% dissociated, temperature remaining same.

CCE024

5. A vessel at 1000 K contains CO_2 with a pressure of 0.5 atm. Some of the CO_2 is converted into CO on the addition of graphite. If the total pressure at equilibrium is 0.8 atm, the value of K_P is :

CCE025

6. The vapour density of N_2O_4 at a certain temperature is 30. Calculate the percentage dissociation of N_2O_4 at this temperature. $N_2O_4(g) \rightleftharpoons 2NO_2(g)$.

CCE026

7. Solid Ammonium carbonate dissociates as : $NH_2COONH_4(s) \rightleftharpoons 2NH_3(g) + CO_2(g)$. In a closed vessel solid ammonium carbonate is in equilibrium with its dissociation products. At equilibrium, ammonia is added such that the partial pressure of NH_3 at new equilibrium now equals the original total pressure. Calculate the ratio of total pressure at new equilibrium to that of original total pressure. (Round off to the nearest integer)

CCE027

8. For the given reaction,
$A(g) + B(g) \rightleftharpoons C(g) + D(g)$

the number of moles at equilibrium was found to be 4, 4, 2 & 8 respectively in 1 L container. Find the new equilibrium concentration of C (in M) if 18 moles of D are added to above 1 L container.

CCE028

9. When 0.5 mol of N_2O_4 is placed in a 4.00 L reaction vessel and heated at 405 K, 79.3 % of the N_2O_4 decomposes to NO_2. Calculate K_P at 405 K for the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$.

CCE029

10. 20.0 grams of $CaCO_3$ (s) were placed in a closed vessel, heated & maintained at 727°C under equilibrium $CaCO_3(s) \rightleftharpoons CaO(s) + CO_2(g)$ and it is found that 75% of $CaCO_3$ was decomposed. What is the value of K_P (nearest integer)? The volume of the container was 15 litre.

CCE030

JEE (Advanced) Practice Paper

This paper is for yourself practice and assessment the discussion of this paper is optional though you can see PDF solutions or video solutions or solutions in hardcopy whichever is provided.

SECTION-I

- This section contains **FOUR** questions.
- Each question has **FOUR** options (A), (B), (C) and (D). **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +3, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : –1, in all other cases

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1. Reaction $2BaO_2(s) \rightleftharpoons 2BaO(s) + O_2(g)$; ΔH = + ve. At equilibrium condition, Pressure of O_2 is increased on:

(A) Increasing the mass of BaO_2 (B) Increasing the mass of BaO
(C) Increasing temperature at Equilibrium. (D) Increasing the mass of BaO_2 and BaO both

CCE051

2. The following equilibrium are given

$N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g) \ldots K_1$;

$N_2(g) + O_2(g) \rightleftharpoons 2NO\ (g) \ldots K_2$;

$H_2(g) + \frac{1}{2}O_2(g) \rightleftharpoons H_2O\ (g) \ldots K_3$

The equilibrium constant of the reaction $2NH_3(g) + \frac{5}{2}O_2(g) \rightleftharpoons 2NO(g) + 3H_2O(g)$, in terms of K_1, K_2 and K_3 is:

(A) $\frac{K_1K_2}{K_3}$ (B) $\frac{K_1K_3^2}{K_2}$ (C) $\frac{K_2K_3^3}{K_1}$ (D) $K_1K_2K_3$

CCE052

3. When alcohol (C_2H_5OH) and acetic acid are mixed together in equimolar ratio at 27°C, 33% is converted into ester. Then the K_C for the equilibrium :

$C_2H_5OH(\ell) + CH_3COOH(\ell) \rightleftharpoons CH_3COOC_2H_5\ (\ell) + H_2O(\ell)$

(A) 4 (B) $\frac{1}{4}$ (C) 9 (D) $\frac{1}{9}$

CCE053

4. Consider the equilibrium $HgO(s) + 4I^{\ominus}(aq) + H_2O(\ell) \rightleftharpoons HgI_4^{2\ominus}(aq) + 2OH^{\ominus}(aq)$, which change will increase the equilibrium concentration of $HgI_4^{2\ominus}$:-

(i) Adding 0.2 M HCl
(ii) Increasing $[I^{\ominus}]$
(iii) Increasing number of moles of HgO (s)

(A) (i) only (B) (iii) only (C) (i) & (ii) (D) (ii) & (iii)

CCE054

SECTION-II

- This section contains **FOUR** questions.
- Each question has **FOUR** options for correct answer(s). **ONE OR MORE THAN ONE** of these four option(s) is (are) correct option(s).
- For each question, choose the correct option(s) to answer the question.
- Answer to each question will be evaluated according to the following marking scheme:

Full Marks : +4, if only (all) the correct option(s) is (are) chosen.

Partial Marks : +3, if all the four options are correct but ONLY three options are chosen.

Partial Marks : +2, if three or more options are correct but ONLY two options are chosen, both of which are correct options.

Partial Marks : +1, if two or more options are correct but ONLY one option is chosen and it is a correct option.

Zero Marks : 0, if none of the options is chosen (i.e. the question is unanswered).

Negative Marks : –2 in all other cases.

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5. Which are true statements for the following equilibrium $H_2O(\ell) \rightleftharpoons H_2O(g)$

(A) Increase in pressure will result in the formation of more liquid water.
(B) Increase in pressure will increase boiling point
(C) Decrease in pressure will vaporize $H_2O(l)$ to a greater extent
(D) Increase in pressure will liquefy steam

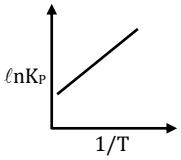
CCE055

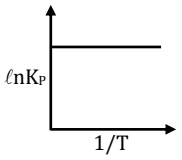
6. For which of the following reaction the product formation is not favoured by low pressure and high temperature ?

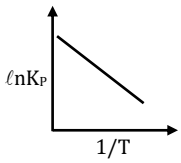
(A) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$; $\Delta H° = -9.4$ kJ
(B) $CO_2(g) + C(s) \rightleftharpoons 2CO(g)$; $\Delta H° = 172.5$ kJ
(C) $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH_{(\ell)}$; $\Delta H° = -21.7$kJ
(D) $3O_2(g) \rightleftharpoons 2O_3(g)$; $\Delta H° = 285$ kJ

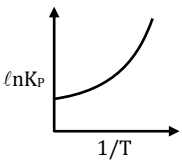
CCE056

7. An exothermic reaction is represented by the graph :

(A) 

(B) 

(C) 

(D) 

CCE057

8. The equilibrium of which of the following reactions will not be disturbed by the addition of an inert gas at constant volume?

(A) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(B) $N_2O_4(g) \rightleftharpoons 2NO_2(g)$
(C) $CO(g) + 2H_2(g) \rightleftharpoons CH_3OH(g)$
(D) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$

CCE058

SECTION–III

- This section contains **ONE** questions.
- **Each question has matching lists.** The codes for the lists have choices (A), (B), (C) and (D) out of which **ONLY ONE** is correct
- For each question, marks will be awarded in one of the following categories :

Full Marks : +3, if only the bubble corresponding to the correct option is darkened.
Zero Marks : 0, if none of the bubbles is darkened.
Negative Marks : –1, in all other cases.

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9. Match the column-I with column-II :

Column-I (Reaction)	**Column-II (If α is negligible w.r.t. 1)**
(1) $2X(g) \rightleftharpoons Y(g) + Z(g)$	(p) $\alpha = 2 \times \sqrt{K_c}$
(2) $X(g) \rightleftharpoons Y(g) + Z(g)$	(q) $\alpha = 3 \times \sqrt{K_c}$
(3) $3X(g) \rightleftharpoons Y(g) + Z(g)$	(r) $\alpha = (2K_C)^{1/3}$
(4) $2X(g) \rightleftharpoons Y(g) + 2Z(g)$	(s) $\alpha = \sqrt{K_c}$

(A) (1) → p, (2) → s, (3) → q, (4) → r
(B) (1) → q, (2) → p, (3) → r, (4) → s
(C) (1) → q, (2) → s, (3) → p, (4) → r
(D) (1) → r, (2) → q, (3) → p, (4) → s

CCE059

SECTION–IV

- This section contains **TWO** paragraphs.
- Based on 1st paragraph, there are **FOUR** questions and 2nd paragraph, there are **THREE** questions.
- Each question has **FOUR** options (A), (B), (C) and (D) **ONLY ONE** of these four options is correct.
- For each question, darken the bubble corresponding to the correct option in the ORS.
- For each question, marks will be awarded in one of the following categories:

Full Marks : +3, if only the bubble corresponding to the correct answer is darkened.
Zero Marks : 0 in all other cases.

Paragraph-(I) for Question Nos. 10 to 13

In a 7.0 L evacuated chamber, 0.50 mol H_2 and 0.50 mol I_2 react at 427°C.
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$. At the given temperature, $K_C = 49$ for the reaction.

10. What is the value of K_p ?
(A) 7 (B) 49 (C) 24.5 (D) None

CCE060

11. What is the total pressure (atm) in the chamber?
(A) 83.14 (B) 831.4 (C) 8.21 (D) None

CCE061

12. How many moles of the iodine remain unreacted at equilibrium?
(A) 0.388 (B) 0.112 (C) 0.25 (D) 0.125

CCE062

13. What is the partial pressure (atm) of HI in the equilibrium mixture?
(A) 6.385 (B) 12.77 (C) 40.768 (D) 646.58

CCE063

Paragraph-(II) for Question Nos. 14 to 16

Influence of pressure, temperature, concentration and addition of inert gas on a reversible chemical reaction in equilibrium can be explained by formulating the expression for equilibrium constant K_c or K_p for the equilibrium. On the other hand Le Chatelier principle can be theoretically used to explain the effect of P, T or concentration on the physical or chemical equilibrium both.

14. For the reaction : $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ increase of pressure shows :
(A) An increase in degree of dissociation and a decrease in K_c
(B) A decrease in degree of dissociation and a decrease in K_c
(C) An increase in degree of dissociation but K_c remains constant
(D) A decrease in degree of dissociation but K_c remains constant

CCE064

15. For the reaction : $2SO_2 + O_2 \rightleftharpoons 2SO_3$; ΔH = –ve, An increase in temperature shows :
(A) More dissociation of SO_3 and a decrease in K_c
(B) Less dissociation of SO_3 and an increase in K_c
(C) More dissociation of SO_3 and an increase in K_c
(D) Less dissociation of SO_3 and an decrease in K_c

CCE065

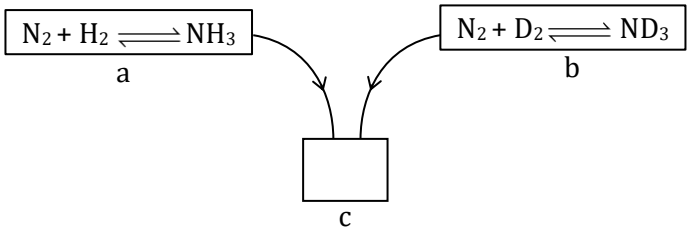
16. For the reaction : $\underset{\text{Yellow}}{Fe^{3\oplus}(aq.)} + SCN^{\ominus}(aq.) \rightleftharpoons \underset{\text{Red}}{[Fe(NCS)]^{2\oplus}}(aq.)$; in equilibrium if little more aqueous solution of $FeCl_3$ is added, than :
(A) Forward reaction becomes more and red colours is deepened
(B) Backward reaction becomes more and red colour faintness
(C) Solution becomes colourless
(D) None of these

CCE066

SECTION–V

- This section contains **FOUR** questions.
- The answer to each question is a **NUMERICAL VALUE.**
- For each question, enter the correct numerical value (in decimal notation, truncated/rounded-off to the **second decimal place**; e.g. 6.25, 7.00, –0.33, –.30, 30.27, –127.30, if answer is 11.36777..... then both 11.36 and 11.37 will be correct).
- Answer to each question will be evaluated according to the following marking scheme:
  Full Marks : +3, if ONLY the correct numerical value is entered as answer.
  Zero Marks : 0 in all other cases.

17.



Initially the reactions in the container a & b are at equilibrium when the products & reactants are put together in a container c then at the equilibrium the total number of different chemical compounds are:

CCE067

18. When 1 mole of A (g) is introduced in a closed rigid 1 litre vessel maintained at constant temperature the following equilibria are established.

$A(g) \rightleftharpoons B(g) + C(g) : K_{c_1}$

$C(g) \rightleftharpoons D(g) + B(g) : K_{c_2}$

The pressure at equilibrium is twice the initial pressure. Calculate the value of $\frac{K_{c_2}}{K_{c_1}}$, if $\frac{[C]_{eq}}{[B]_{eq}} = \frac{1}{5}$.

CCE068

19. A sample of HI (9.6×10^{-3} mol) was placed in an empty 2.00 L container at 1000 K. After equilibrium was reached, the concentration of I_2 was 8×10^{-4} M. Calculate the value of K_c at 1000 K for the reaction $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$.

CCE069

20. Consider the following two equilibrium established together in a closed container

$A(s) \rightleftharpoons 2B(g) + 3C(g);$ $\qquad K_{P_1}$

$A(s) \rightleftharpoons 3D(g);$ $\qquad K_{P_2}$

Starting with only A(s), molar ratio of B(g) & D(g) at equilibrium is found to be in a ratio 1 : 6 determine $\frac{K_{P_2}}{8K_{P_1}}$.

CCE070

ANSWER KEY

EXERCISE - O

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	B	C	D	C	D	B	C	B	C	C
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	D	D	C	D	D	A	D	A	C	D
Que.	21	22	23	24	25	26	27	28	29	30
Ans.	B	C	B	C	A	B	C	A,B,D	A,D	A,B,C
Que.	31	32	33	34	35	36	37	38	39	40
Ans.	A,B	A,B,C	A,B,C	A,C	A,B,C,D	A,B	A,B,C	D	B,C	B,C
Que.	41	42	43	44	45	46	47			
Ans.	A,B,D	A,D	B,C	A,B	A,B,C	A,B	A			

EXERCISE - S

1. 0.20 **2.** (0.36 or 0.37)

3. (a) 6.66 or 0.67, (b) 375.00, (c) 10.45 or 10.46, (d) 6.25 **4.** (i) 2, (ii) 1.20

5. 2.40 **6.** 3.44 **7.** 54.00 **8.** 3.60

9. (a) 400, 900, (b) 4 : 9, (c) 72.15 **10.** 4.00 **11.** $K_{P_1} = \frac{1}{20P_0^2}$

12. (a) 80, (b) 0.15, (c) 26.08 or 26.09 **13.** 0.11 **14.** $SrCl_2 . 2H_2O$

15. 10.00

EXERCISE - JEE (Main) PYQ

Que.	1	2	3	4	5	6	7	8	9	10
Ans.	4	1	4	1	3	2	1	5	6	2
Que.	11	12	13	14	15	16	17	18	19	20
Ans.	2	20	354	172	2	2	4	3	12	49

EXERCISE - JEE (Advanced) PYQ

Que.	1	2	3
Ans.	A,B,D	8.92 or 8.93	8

JEE (Main) Practice Paper

Section-A	**Q.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	A.	4	3	3	3	2	4	3	3	1	3
	Q.	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**	**19**	**20**
	A.	1	2	2	3	2	3	3	3	2	3
Section-B	**Q.**	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**
	A.	16	3	50	1	2	53	1	1	50	1

JEE (Advanced) Practice Paper

Section-I	**Q.**	**1**	**2**	**3**	**4**				
	A.	C	C	B	C				
Section-II	**Q.**	**5**	**6**	**7**	**8**				
	A.	A,B,C,D	A,C,D	A	A,B,C,D				
Section-III	**Q.**	**9**							
	A.	A							
Section-IV	**Q.**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	
	A.	B	C	B	A	D	A	A	
Section-V	**Q.**	**17**	**18**	**19**	**20**				
	A.	8.00	4.00	16.00	8.00				