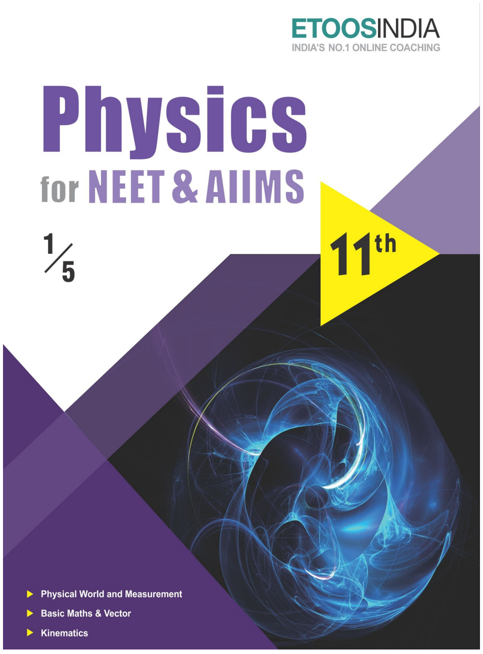
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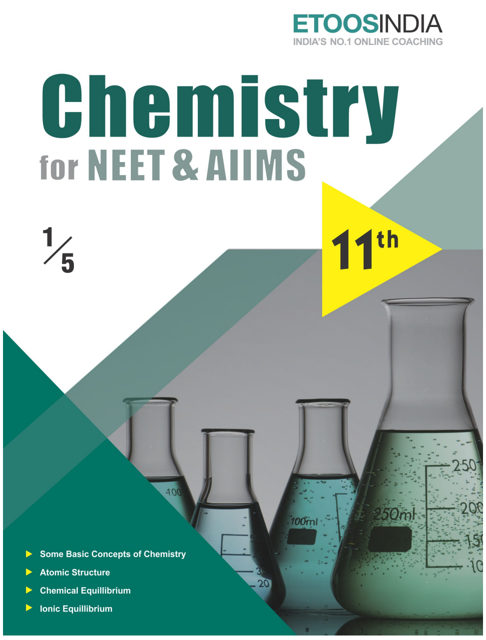
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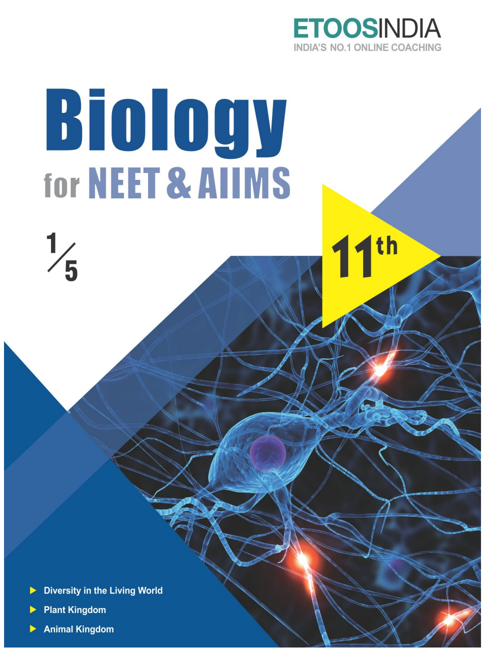
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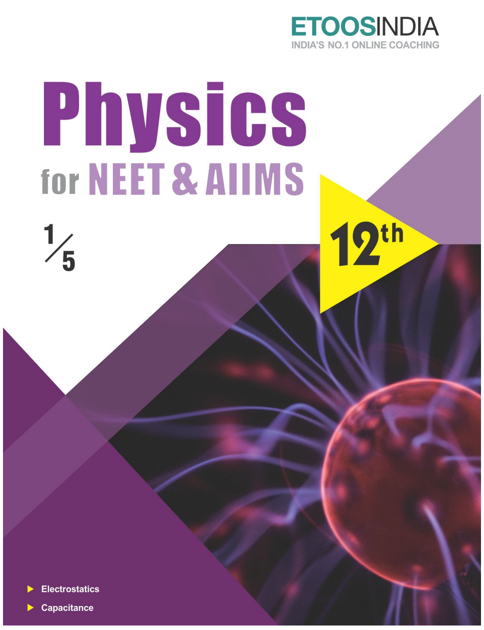
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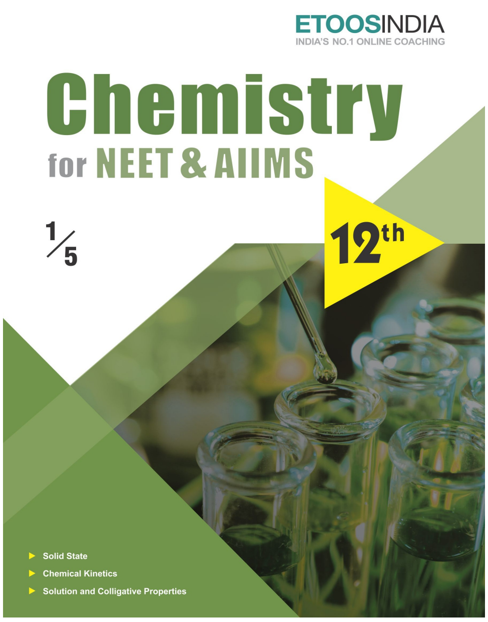
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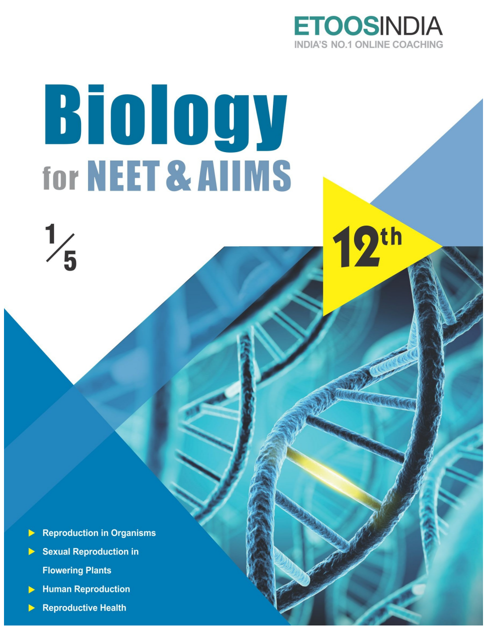
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Sexual Reproduction in Flowering Plants
Human Reproduction
Reproductive Health

CHAPTER 03

CHEMICAL EQUILIBRIUM

The proportion of ingredients is important, but the final result is also a matter of how you put them together. Equilibrium is key.

"ALAIN DUCASSE"

INTRODUCTION

Chemical equilibrium are important in numerous biological and environmental processes. For example, equilibrium involving O_2 molecules and the protein hemoglobin play a crucial role in the transport and delivery of O_2 from our lungs to our muscles. Similar equilibrium involving CO moleucles and hemoglobin account for the toxicity of CO. State of chemical equilibrium, these may be classified in three groups.

(i) The reactions that proceed nearly to completion and only negligible concentrations of the reactants are left. In some cases., it may not be even possible to detect these experimentally.

(ii) The reactions in which only small amounts of products are formed and most of the reactants remain unchanged at equilibrium state

(iii) The reactions in which the concentrations of the reactants and products are comparable. When the system is in equilibrium.

Ex. Chemical equilibrium is a condition :

(A) where all species have same concentration

(B) where all species have constant concentration with respect to time.

(C) where all species have concentration = 1

(D) all of above

Sol. (B) Chemical equilibrium defined as when all species have constant concentration with respect to time.

Ex. Example of physical equilibria, is :

(A) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$

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

(C) $H_2O(s) \rightleftharpoons H_2O(\ell)$

(D) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$

Sol. (C) Physical equilibria does not include any chemical change.

Ex. At equilibrium :

(A) the energy of system is minimum

(B) the entropy of system is maximum

(C) the energy of system is maximum

(D) the entropy of system is minimum

Sol. (A,B) It is the compromising stage of minimum energy and maximum entropy.

ETOOS KEY POINTS

(i) Whenever question doesn't ask about direction, then we take forward direction only.

(ii) In a reversible reaction if forward reaction is exothermic then the backward reaction will be endothermic and vice versa.

Law of Mass action or Law of chemical equilibrium

The law of mass action was given by **Guldberg** and **Waage** (1864). It states that the rate of a chemical reaction is directly proportional to the product of active masses of the reacting substances.

Derivation of equilibrium constant : Consider a reversible homogeneous chemical reaction which has attained equilibrium state at a particular temperature : $A + B \rightleftharpoons C + D$

Let the active masses of A, B, C and D be [A] [B] [C] and [D] respectively at equilibrium.

According to law of mass action :

Rate of forward reaction $(R_f) \propto [A][B]$

Rate of backward reaction $(R_b) \propto [C][D]$

$R_f = k_f[A][B]$ and $R_b = k_b[C][D]$

Where k_f and k_b are forward and backward rate or velocity constants respectively.

At equilibrium state :

$R_f = R_b$

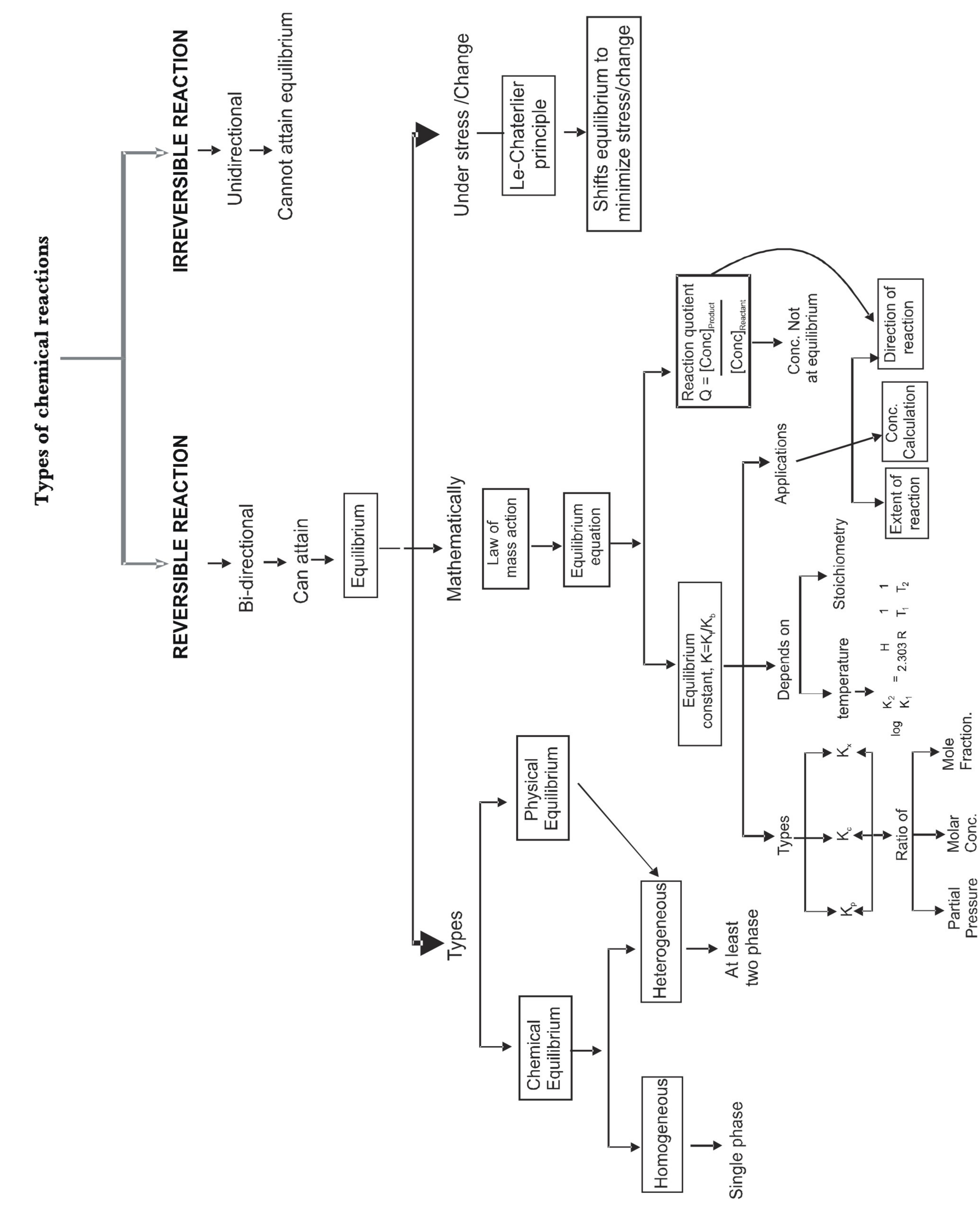
$k_f[A][B] = k_b[C][D]$

$$\frac{k_f}{k_b} = \frac{[C][D]}{[A][B]}$$

$$K_C = \frac{[C][D]}{[A][B]}; \qquad \because K_C = \frac{k_f}{k_b}$$

K_c is known as equilibrium constant. K_c has a definite value for every chemical reaction at particular temperature.

Etoos Tips & Formulas



SOLVED EXAMPLE

Ex. 1 When 1.0 mole of N_2 and 3.0 moles of H_2 was heated in a vessel at 873 K and a pressure of 3.55 atm. 30% of N_2 is converted into NH_3 at equilibrium. Find the value of K_p for the reaction.
(A) $3.1 \times 10^{-2} atm^{-2}$ (B) $4.1 \times 10^{-2} atm^{-2}$ (C) $5.1 \times 10^{-2} atm^{-2}$ (D) $6.1 \times 10^{-2} atm^{-2}$

Sol. (C)

	$N_2(g)$ +	$3H_2(g)$ $\rightleftharpoons$	$2NH_3(g)$	
	1 mole	3 moles	0	Initial moles
	1–0.3	3.0 – 0.9	0.6 moles	at equilibrium
	= 0.7 moles	= 2.1 moles		

Total no. of moles at equilibrium = 3.4

$$K_P = \frac{\left(\frac{0.6}{3.4} \times 3.55\right)^2}{\left(\frac{0.7}{3.4} \times 3.55\right)\left(\frac{2.1}{3.4} \times 3.55\right)^3} = 5.1 \times 10^{-2}\ atm^{-2}$$

Ex. 2 $2SO_2(g) + O_2(g) \rightleftharpoons 2SO_3(g)$
If the partial pressure of SO_2, O_2 and SO_3 are 0.559, 0.101 and 0.331 atm respectively. What would be the partial pressure of O_2 gas, to get equal moles of SO_2 and SO_3.
(A) 0.188 atm (B) 0.288 atm (C) 0.388 atm (D) 0.488 atm

Sol. (B)

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

$$K_P = \frac{[P_{SO_3}]^2}{[P_{SO_2}]^2[P_{O_2}]} = \frac{(0.331)^2}{(0.559)^2(0.101)} = 3.47$$

If SO_2 and SO_3 have same number of moles, their partial pressure will be equal and

$$P_{SO_3} = P_{SO_2} \ \therefore\ P_{O_2} = \frac{1}{3.47} = 0.288 atm$$

Ex. 3 K_P for the reaction $N_2 + 3H_2 \rightleftharpoons 2NH_3$ at 400°C is 3.28×10^{-4}. Calculate K_c.
(A) 0.3 $mole^{-2}$ $litre^2$ (B) 0.4 $mole^{-2}$ $litre^2$ (C) 1.0 $mole^{-2}$ $litre^2$ (D) 0.6 $mole^{-2}$ $litre^2$

Sol. (C) $N_2 + 3H_2 \rightleftharpoons 2NH_3$
$\Delta n = -2$ and $K_P = K_C (RT)^{\Delta n}$
$3.28 \times 10^{-4} = K_c (0.0821 \times 673)^{-2}$
and $K_c = 1.0$ $mole^{-2}$ $litre^2$.

Ex. 4 A mixture of H_2 and I_2 in molecular proportion of 2 : 3 was heated at 444°C till the reaction
$H_2 + I_2 \rightleftharpoons 2HI$ reached equilibrium state. Calculate the percentage of iodine converted into HI.
(K_C at 444°C is 0.02)
(A) 3.38 % (B) 4.38% (C) 5.38% (D) 6.38%

Sol. (C)

	H_2 +	I_2 $\rightleftharpoons$	2HI
Initial moles	2	3	0
Equi.conc.	$\frac{2-x}{v}$	$\frac{3-x}{v}$	$\frac{2x}{v}$

$$K_C = \frac{4x^2}{(2-x)(3-x)} = 0.02$$
$199x^2 + 5x - 6 = 0$
$x = 0.1615$
Out of 3 moles, 0.1615 moles I_2 is converted into HI.

$$\therefore \text{ Percentage of } I_2 \text{ converted to HI} = \frac{0.1615 \times 100}{3} = 5.38\%$$

Exercise # 1

SINGLE OBJECTIVE — NEET LEVEL

1. According to law of mass action rate of a chemical reaction is proportional to
(A) Concentration of reactants
(B) Molar concentration of reactants
(C) Concentration of products
(D) Molar concentration of products

2. In a reaction the rate of reaction is proportional to its active mass, this statement is known as
(A) Law of mass action
(B) Le-chatelier principle
(C) Faraday law of electrolysis
(D) Law of constant proportion

3. The active mass of 64 gm of HI in a two litre flask would be
(A) 2 (B) 1
(C) 5 (D) 0.25

4. Under a given set of experimental conditions, with increase in the concentration of the reactants, the rate of a chemical reaction
(A) Decreases
(B) Increases
(C) Remains unaltered
(D) First decreases and then increases

5. The law of mass action was enunciated by
(A) Guldberg and Waage (B) Bodenstein
(C) Birthelot (D) Graham

6. For the system $3A + 2B \rightleftharpoons C$, the expression for equilibrium constant is
(A) $\frac{[3A][2B]}{C}$ (B) $\frac{[C]}{[3A][2B]}$
(C) $\frac{[A]^3[B]^2}{[C]}$ (D) $\frac{[C]}{[A]^3[B]^2}$

7. In the reversible reaction $A + B \rightleftharpoons C + D$, the concentration of each C and D at equilibrium was 0.8 mole/litre, then the equilibrium constant K_c will be
(A) 6.4 (B) 0.64
(C) 1.6 (D) 16.0

8. 4 moles of A are mixed with 4 moles of B. At equilibrium for the reaction $A + B \rightleftharpoons C + D$, 2 moles of C and D are formed. The equilibrium constant for the reaction will be
(A) $\frac{1}{4}$ (B) $\frac{1}{2}$
(C) 1 (D) 4

9. On a given condition, the equilibrium concentration of HI, H_2 and I_2 are 0.80, 0.10 and 0.10 mole/litre. The equilibrium constant for the reaction $H_2 + I_2 \rightleftharpoons 2HI$ will be
(A) 64 (B) 12
(C) 8 (D) 0.8

10. In which of the following, the reaction proceeds towards completion
(A) $K = 10^2$ (B) $K = 10^{-2}$
(C) $K = 10$ (D) $K = 1$

11. A reversible chemical reaction having two reactants in equilibrium. If the concentrations of the reactants are doubled, then the equilibrium constant will
(A) Also be doubled (B) Be halved
(C) Become one-fourth (D) Remain the same

12. 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

13. Pure ammonia is placed in a vessel at temperature where its dissociation constant (A) is appreciable. At equilibrium
(A) K_p does not change significantly with pressure
(B) α does not change with pressure
(C) Concentration of NH_3 does not change with pressure
(D) Concentration of H_2 is less than that of N_2

14. For the system $A(g) + 2B(g) \rightleftharpoons C(g)$, the equilibrium concentrations are (A) 0.06 mole/litre (B) 0.12 mole/litre (C) 0.216 mole/litre. The K_{ep} for the reaction is
(A) 250 (B) 416
(C) $K \times 10^{-3}$ (D) 125

Exercise # 2 SINGLE OBJECTIVE AIIMS LEVEL

1. Equilibrium constant for the reactions,

$2NO + O_2 \rightleftharpoons 2NO_2$ is K_{C_1} ;

$NO_2 + SO_2 \rightleftharpoons SO_3 + NO$ is K_{C_2} and

$2SO_3 \rightleftharpoons 2SO_2 + O_2$ is K_{C_3} then correct reaction is :

(A) $K_{C_3} = K_{C_1} \times K_{C_2}$

(B) $K_{C_3} \times K_{C_1} \times K^2{}_{C_2} = 1$

(C) $K_{C_3} \times K_{C_1} \times K_{C_2} = 1$

(D) $K_{C_3} \times K^2{}_{C_1} \times K_{C_2} = 1$

2. At a certain temperature, the following reactions have the equilibrium constant as shown below :

$S(s) + O_2(g) \rightleftharpoons SO_2(g); K_c = 5 \times 10^{52}$

$2S(s) + 3O_2(g) \rightleftharpoons 2SO_3(g); K_c = 10^{29}$

What is the equilibrium constant K_c for the reaction at the same temperature ?

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

(A) 2.5×10^{76} (B) 4×10^{23}
(C) 4×10^{-77} (D) None of these

3. Sulfide ion in alkaline solution reacts with solid sulfur to form polysulfide ions having formulae S_2^{2-}, S_3^{2-}, S_4^{2-} and so on. The equilibrium constant for the formation of S_2^{2-} is $K_1 = 12$ & for the formation of S_3^{2-} is $K_2 = 132$, both from S and S^{2-}. What is the equilibrium constant for the formation of S_3^{2-} from S_2^{2-} and S?

(A) 11 (B) 12
(C) 132 (D) None of these

4. When alcohol ($C_2H_5OH(\ell)$) and acetic acid ($CH_3COOH(\ell)$) are mixed together in equimolar ratio at 27ºC , 33% of each is converted into ester. Then the K_C for the equilibrium

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

is :

(A) 4 (B) 1/4
(C) 9 (D) 1/9

5. One litre of 2M acetic acid and one litre of 3M ethyl alcohol are mixed to form ester according to the given equation :

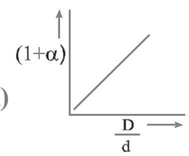
$CH_3COOH + C_2H_5OH \rightleftharpoons CH_3COOC_2H_5 + H_2O.$

If each solution is diluted by adding equal volume (1 litre) of water by how many times the initial forward rate is reduced ?

(A) 4 times (B) 2 times
(C) 0.5 times (D) 0.25 times

6. In the dissociation of N_2O_4 into NO_2, $(1 + \alpha)$ values with the vapour densities ratio $\left(\frac{D}{d}\right)$ is as given by :

[α-degree of dissociation, D-vapour density before dissociation, d-vapour density after dissociation]

(A)


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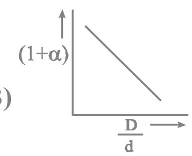

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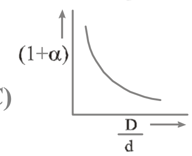

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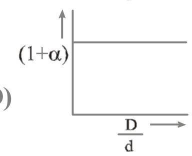
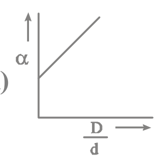


7. In the above question, α varies with $\frac{D}{d}$ according to :

(A)


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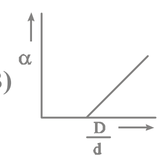
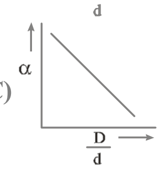
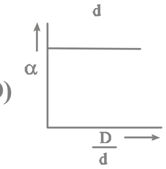


(C)


(D)


8. For the reaction $N_2O_4(g) \rightleftharpoons 2NO_2(g)$, if percentage dissociation of N_2O_4 are 20%, 45%, 65% & 80%, then the sequence of observed vapour densities will be :

(A) $d_{20} > d_{45} > d_{65} > d_{80}$
(B) $d_{80} > d_{65} > d_{45} > d_{20}$
(C) $d_{20} = d_{45} = d_{65} = d_{80}$
(D) $(d_{20} = d_{45}) > (d_{65} = d_{80})$

Exercise # 3 PART - 1 MATRIX MATCH COLUMN

1. Match the following :

Column I (Assume only reactant were present initially)	Column II
(A) For the equilibrium $NH_4I(s) \rightleftharpoons NH_3(g) + HI(g)$, if pressure is increased at equilibrium	(p) Forward shift
(B) For the equilibrium $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ volume is increased at equilibrium	(q) No shift in equilibrium
(C) 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
(D) For the equilibrium $PCl_5 \rightleftharpoons PCl_3 + Cl_2$ Cl_2 is removed at equilibrium.	(s) Final pressure is more than initial pressure

2. Match the following : (Assume only reactants were present initially).

Column I	Column II
(A) $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ (t = 300ºC)	(p) $\Delta n_g > 0$
(B) $PCl_5(g) \rightleftharpoons PCl_3(g) + Cl_2(g)$ (t = 50ºC)	(q) $K_p < K_c$
(C) $C(s) + H_2O(g) \rightleftharpoons CO(g) + H_2(g)$	(r) K_p not defined
(D) $CH_3COOH(\ell) + C_2H_5OH(\ell) \rightleftharpoons CH_3COOC_2H_5(\ell) + H_2O(\ell)$	(s) $P_{initial} > P_{eq.}$

3.

Column-I (Reactions)	Column-II (Favourable conditions)
(A) Oxidation of nitrogen $N_2(g) + O_2(g) + 180.5\text{ kJ} \rightleftharpoons 2NO(g)$	(p) Addition of inert gas at constant pressure
(B) Dissociation of $N_2O_4(g)$ $N_2O_4(g) + 57.2\text{ kJ} \rightleftharpoons 2NO_2(g)$	(q) Decrease in pressure
(C) Oxidation of $NH_3(g)$ $4NH_3(g) + 5O_2(g) \rightleftharpoons 4NO(g) + 6H_2O(g) + 905.6\text{ kJ}$	(r) Decrease in temperature
(D) Formation of $NO_2(g)$ $NO(g) + O_3(g) \rightleftharpoons NO_2(g) + O_2(g) + 200\text{ kJ}$	(s) Increase in temperature

4.

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

Exercise # 4 PART - 1 PREVIOUS YEAR (NEET/AIPMT)

1. For a reversible reaction, if the concentrations of the reactants are doubled, the equilibrium constant will be **[CBSE AIPMT 2000]**

(A) one-fourth (B) halved
(C) doubled (D) the same

2. For the equilibrium,

$MgCO_3(s) \xrightleftharpoons{\Delta} MgO(s) + CO_2(g)$

which of the following expressions is correct? **[CBSE AIPMT 2000]**

(A) $K_p = p_{CO_2}$ (B) $K_p = \frac{[MgO][CO_2]}{[MgCO_3]}$

(C) $K_p = \frac{p_{MgO} \cdot p_{CO_2}}{p_{MgCO_3}}$ (D) $K_p = \frac{p_{MgO} + p_{CO_2}}{p_{MgCO_3}}$

3. Reaction, $BaO_2(s) \rightleftharpoons BaO(s) + O_2(g)$, $\Delta H = +$ ve
In equilibrium condition, pressure of O_2 depends on **[CBSE AIPMT 2002]**

(A) increased mass of BaO_2
(B) increased mass of BaO
(C) increased temperature of equilibrium
(D) increased mass of BaO_2 and BaO both

4. The reaction quotient (Q) for the reaction, $N_2(g) + 3H_2(g) \rightleftharpoons 2NH_3(g)$ is given by $Q = \frac{[NH_3]^2}{[N_2][H_2]^3}$.
The reaction will proceed towards right side, if **[CBSE AIPMT 2003]**

(A) $Q > K_c$ (B) $Q = 0$
(C) $Q = K_c$ (D) $Q < K_c$

where, K_c is the equilibrium constant.

5. In the two gaseous reaction (i) and (ii) at 250°C

(i) $NO(g) + \frac{1}{2}O_2(g) \rightleftharpoons NO_2(g)$, K_1

(ii) $2NO_2(g) \rightleftharpoons 2NO(g) + O_2(g)$, K_2

the equilibrium constants K_1 and K_2 are related as **[CBSE AIPMT 2005, 1994]**

(A) $K_2 = \frac{1}{K_1}$ (B) $K_2 = K_1^{1/2}$

(C) $K_2 = \frac{1}{K_1^2}$ (D) $K_2 = K_1^2$

6. For the reaction,
$CH_4(g) + 2O_2(g) \rightleftharpoons CO_2(g) + 2H_2O(l)$,
$\Delta rH = -170.8$ kJ mol^{-1}
Which of the following statement is not true ? **[CBSE AIPMT 2006]**

(A) At equilibrium, the concentrations of CO_2 (g) and $H_2O(l)$ are not equal
(B) The equilibrium constant for the reaction is given by $k_p = \frac{[CO_2]}{[CH_4][O_2]}$
(C) Addition of CH4(g) or O2(g) at equilibrium will cause a shift to the right
(D) The reaction is exothermic

7. The value of equilibrium constant of the reaction,

$HI(g) \rightleftharpoons \frac{1}{2}H_2(g) + \frac{1}{2}I_2(g)$ is 8.0.

The equilibrium constant of the reaction,
$H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$ will be **[CBSE AIPMT 2008]**

(A) $\frac{1}{16}$ (B) $\frac{1}{64}$

(C) 16 (D) $\frac{1}{8}$

8. If the concentration of OH^- ions in the reaction,
$Fe(OH)_3(s) \rightleftharpoons Fe^{3+}(aq) + 3OH^-(aq)$
is decreased by 1/4 times, then equilibrium concentration of $Fe3^+$ will increase by **[CBSE AIPMT 2008]**

(A) 8 times (B) 16 times
(C) 64 times (D) 4 times

9. The dissociation constants for acetic acid and HCN at 25°C are 1.5×10^{-5} and 4.5×10^{-10}, respectively. The equilibrium constant for the equilibrium,
$CN^- + CH_3COOH \rightleftharpoons HCN + CH_3COO^-$
would be **[CBSE AIPMT 2009]**

(A) 3.0×10^5 (B) 3.0×10^{-5}
(C) 3.0×10^{-4} (D) 3.0×10^4

10. In which of the following equilibrium K_c and K_p are not equal ? **[CBSE AIPMT 2010]**

(A) $2NO(g) \rightleftharpoons N_2(g) + O_2(g)$
(B) $SO_2(g) + NO_2(g) \rightleftharpoons SO_3(g) + NO(g)$
(C) $H_2(g) + I_2(g) \rightleftharpoons 2HI(g)$
(D) $2C(s) + O_2(g) \rightleftharpoons 2CO_2(g)$

MOCK TEST

STRAIGHT OBJECTIVE TYPE

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

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

At equilibrium, ammonia is added such that partial pressures of NH_3 now equals the original totoal pressure. Calculate the ratio of the total pressure now to the original total pressure.

(A) $\frac{31}{27}$ (B) $\frac{60}{40}$ (C) $\frac{31}{9}$ (D) $\frac{62}{27}$

2. In the Haber process for the industrial manufacture of ammonia involving the reaction,

$N_2 + 3H_2 \rightleftharpoons 2NH_3$ at 200 atm pressure in the presence of a catalyst, a temperature of about 500°C is used. This is considered as optimum temperature for the process because

(A) yield is maximum at this temperature

(B) catalyst is active only at this temperature

(C) energy needed for the reaction is easily obtained at this temperature

(D) rate of the catalytic reaction is fast enough while the yield is also appreciable for this exothermic reaction at this temperature.

3. For the equilibrium of the reaction, $HgO(s) \rightleftharpoons Hg(g) + \frac{1}{2}O_2(g)$, k_p for the reaction at total pressure of P is :

(A) $K_p = \frac{2}{3^{3/2}}p^{3/2}$ (B) $K_p = \frac{2}{3^{1/2}}p^{1/2}$ (C) $K_p = \frac{1}{3^{2/3}}p^{3/2}$ (D) $K_p = \frac{1}{3^{2/3}}p$

4. The average person can see the red colour imparted by the complex $[Fe(SCN)]^{2+}$ to an aqueous solution if the concentration of the complex is 6×10^{-6} M or greater. What minimum concentration of KSCN would be required to make it possible to detect 1 ppm (part per million) of Fe(III) in a natural water sample? The instability constant for

$Fe(SCN)^{2+} \rightleftharpoons Fe^{3+} + SCN^-$ is 7.142×10^{-3}.

(A) 0.0036 M (B) 0.0037 M (C) 0.0035 M (D) None of these

5. $\frac{1}{2}N_2(g) + O_2(g) \rightleftharpoons NO_2(g)$ ...K_1

$2NO_2(g) \rightleftharpoons N_2O_4(g)$ ...K_2

Given that above reactions have equilibrium constants K_1 and K_2 respectively. What would be the expression for the equilibrium constant K for the following reaction in terms of K_1 and K_2?

(A) $K_1 K_2$ (B) $\frac{1}{K_1(K_2)^2}$ (C) $\frac{1}{K_2(K_1)^2}$ (D) $\frac{1}{K_1K_2}$

6. The value of K_p for the reaction at 27°C

$$Br_2(\ell) + Cl_2(g) \rightleftharpoons 2BrCl(g)$$

is '1 atm'. At equilibrium in a closed container partial pressure of BrCl gas ia 0.1 atm and at this temperature the vapour pressure of $Br_2(\ell)$ is also 0.1 atm. Then what will be minimum moles of $Br_2(\ell)$ to be added to 1 mole of Cl_2, to get above equilibrium situation :

(A) $\frac{10}{6}$ moles (B) $\frac{5}{6}$ moles (C) $\frac{15}{6}$ moles (D) 2 moles

7. The two equilibria, $AB(aq) \rightleftharpoons A^+(aq) + B^-(aq)$ and $AB(aq) + B^-(aq) \rightleftharpoons AB_2^-(aq)$ are simultaneously maintained in a solution with equilibrium constants, K_1 and K_2 respectively. If $[A^+]$ and $[AB_2^-]$ are y and x respectively, under equilibrium produced by adding the substance AB to the solvents, then K_1 / K_2 is equal to

(A) $\frac{y}{x}(y-x)^2$ (B) $\frac{y^2(x+y)}{x}$ (C) $\frac{y^2(x+y)}{x}$ (D) $\frac{y}{x}(x-y)$

[**Note** : Use the information of the preceding problem]

11th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Physical World & Measurements
2. Basic Maths & Vector
3. Kinematics

Module-2

1. Law of Motion & Friction
2. Work, Energy & Power

Module-3

1. Motion of system of particles & Rigid Body
2. Gravitation

Module-4

1. Mechanical Properties of Matter
2. Thermal Properties of Matter

Module-5

1. Oscillations
2. Waves

CHEMISTRY

Module-1(PC)

1. Some Basic Concepts of Chemistry
2. Atomic Structure
3. Chemical Equilibrium
4. Ionic Equilibrium

Module-2(PC)

1. Thermodynamics & Thermochemistry
2. Redox Reaction
3. States Of Matter (Gaseous & Liquid)

Module-3(IC)

1. Periodic Table
2. Chemical Bonding
3. Hydrogen & Its Compounds
4. S-Block

Module-4(OC)

1. Nomenclature of Organic Compounds
2. Isomerism
3. General Organic Chemistry

Module-5(OC)

1. Reaction Mechanism
2. Hydrocarbon
3. Aromatic Hydrocarbon
4. Environmental Chemistry & Analysis Of Organic Compounds

BIOLOGY

Module-1

1. Diversity in the Living World
2. Plant Kingdom
3. Animal Kingdom

Module-2

1. Morphology in Flowering Plants
2. Anatomy of Flowering Plants
3. Structural Organization in Animals

Module-3

1. Cell: The Unit of Life
2. Biomolecules
3. Cell Cycle & Cell Division
4. Transport in Plants
5. Mineral Nutrition

Module-4

1. Photosynthesis in Higher Plants
2. Respiration in Plants
3. Plant Growth and Development
4. Digestion & Absorption
5. Breathing & Exchange of Gases

Module-5

1. Body Fluids & Its Circulation
2. Excretory Products & Their Elimination
3. Locomotion & Its Movement
4. Neural Control & Coordination
5. Chemical Coordination and Integration

12th Class Modules Chapter Details

Physics
5
Modules

Chemistry
5
Modules

Mathematics
5
Modules

PHYSICS

Module-1

1. Electrostatics
2. Capacitance

Module-2

1. Current Electricity
2. Magnetic Effect of Current and Magnetism

Module-3

1. Electromagnetic Induction
2. Alternating Current

Module-4

1. Geometrical Optics
2. Wave Optics

Module-5

1. Modern Physics
2. Nuclear Physics
3. Solids & Semiconductor Devices
4. Electromagnetic Waves

CHEMISTRY

Module-1(PC)

1. Solid State
2. Chemical Kinetics
3. Solutions and Colligative Properties

Module-2(PC)

1. Electrochemistry
2. Surface Chemistry

Module-3(IC)

1. P-Block Elements
2. Transition Elements (d & f block)
3. Co-ordination Compound
4. Metallurgy

Module-4(OC)

1. HaloAlkanes & HaloArenes
2. Alcohol, Phenol & Ether
3. Aldehyde, Ketone & Carboxylic Acid

Module-5(OC)

1. Nitrogen & Its Derivatives
2. Biomolecules & Polymers
3. Chemistry in Everyday Life

BIOLOGY

Module-1

1. Reproduction in Organisms
2. Sexual Reproduction in Flowering Plants
3. Human Reproduction
4. Reproductive Health

Module-2

1. Principles of Inheritance and Variation
2. Molecular Basis of Inheritance
3. Evolution

Module-3

1. Human Health and Disease
2. Strategies for Enhancement in Food Production
3. Microbes in Human Welfare

Module-4

1. Biotechnology: Principles and Processes
2. Biotechnology and Its Applications
3. Organisms and Populations

Module-5

1. Ecosystem
2. Biodiversity and Conservation
3. Environmental Issues