SECTION - A

Q.1. The INCORRECT statement(s) about heavy water is (are)

(A) Used as moderator in nuclear reactor

(B) Obtained as a by-product in fertilizer industry

(C) used for the study of reaction mechanism

(D) has a higher dielectric constant than water

Choose the correct answer from the option given below:

(1) (B) only

(2) (B) and (D) only

(3) (C) only

(4) (D) only

Ans. (4)

Sol. D_2O = 78.06 (Dielectric constant)

H_2O = 78.39 (Dielectric constant)

Q.2. Given below are two statements:

Statement I : Potassium permanganate on heating at 573 K forms potassium manganate.

Statement II : Both potassium permanganate and potassium manganate are tetrahedral and paramagnetic in nature.

In the light of the above statements, choose the most appropriate answer from the options given below:

(1) Both statement I and statement II are true

(2)Both statement I and statement II are false

(3)statement I is true but and statement II isfalse

(4)statement I is false but statement II is true

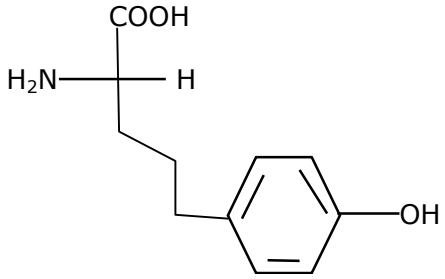
Ans. (3)

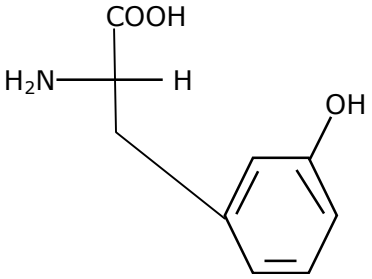
Sol. $\overset{+7}{K}\overset{+7}{Mn}O_4 \xrightarrow{573K} K_2\overset{+6}{Mn}O_4 + MnO_2 + O_2$

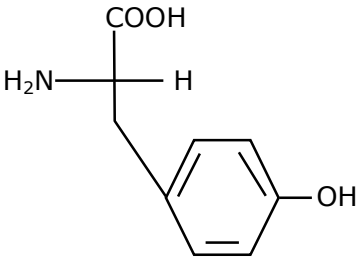
Dimagnetic — Potassium Manganate one unpaired electron (Paramagnetic)

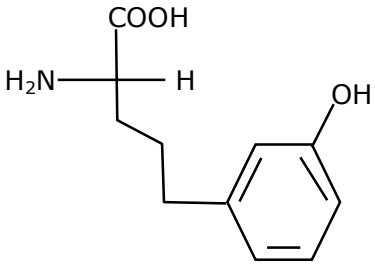
$\left.\begin{matrix} KMnO_4 \\ K_2MnO_4 \end{matrix}\right] \longrightarrow$ Both one tetrahedral

Q.3. Which of the following is correct structure of tyrosine?

(1) 

(2) 

(3) 

(4) 

Ans. (3)

Sol. Based on NCERT

Q.4. Given below are two statements:
Statement I : Retardation factor (R_f) can be measured in meter/centimeter
Statement II : R_f value of a compound remains constant in all solvents.
Choose the most appropriate answer from the options given below :
(1) Statement I is false but statement II is true
(2) Both statement I and statement II are false
(3) Both statement I and statement II are true
(4) Statement I is true but statement II is false

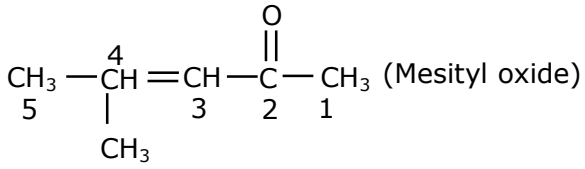
Ans. (2)

Sol. R_f (Retardation factor is dimension less)

Q.5. Mesityl oxide is a common name of :
(1) 3-Methyl cyclohexane carbaldehyde
(2) 4-Methyl pent-3-en-2-one
(3) 2,4-Dimethyl pentan-3-one
(4) 2-Methyl cyclohexanone

Ans. (2)

Sol.



4-methyl pent-3-en-2-one

Q.6. What is the spin-only magnetic moment value (BM) of a divalent metal ion with atomic number 25, in it's aqueous solution ?

(1) 5.92 (2) 5.26 (3) zero (4) 5.0

Ans. (1)

Sol. $_{25}Mn$ — $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 4s^2\ 3d^5$

$n = 5$

spin – only magnetic moment = $\sqrt{n(n+2)}$ BM

$$= \sqrt{5(5+2)} = \sqrt{35} \simeq 5.92\,\text{BM}$$

Q.7. A central atom in a molecule has two lone pairs of electrons and forms three single bonds. The shape of this molecule is :

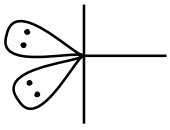
(1)trigonal pyramidal (2) T-shaped

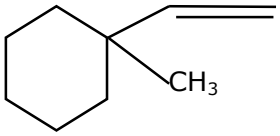
(3) see-saw (4) planar triangular

Ans. (2)

Sol. 2 L.P + 3 B.P = 5 VSEP (sp^3d)

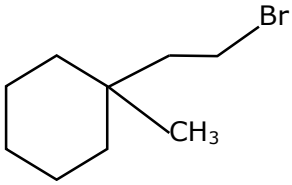
T-Shape

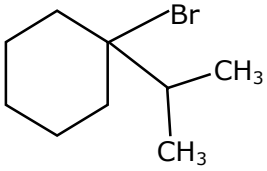


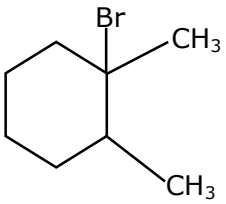
Q.8. 

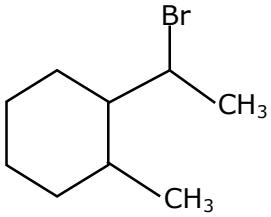
$\xrightarrow[CCl_4]{HBr}$ A (Major Product)

Product "A" in the above chemical reaction is :

(1) 

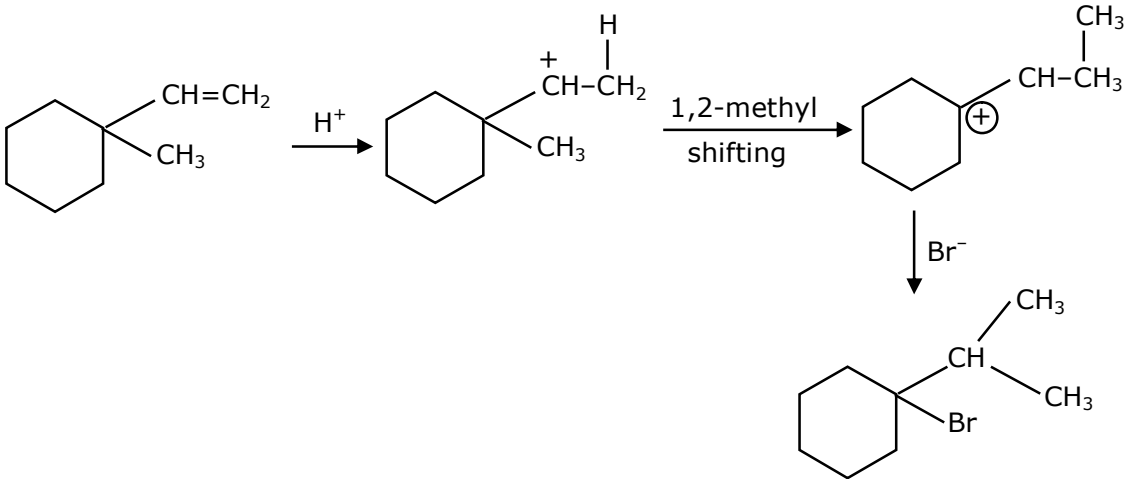
(2) 

(3) 

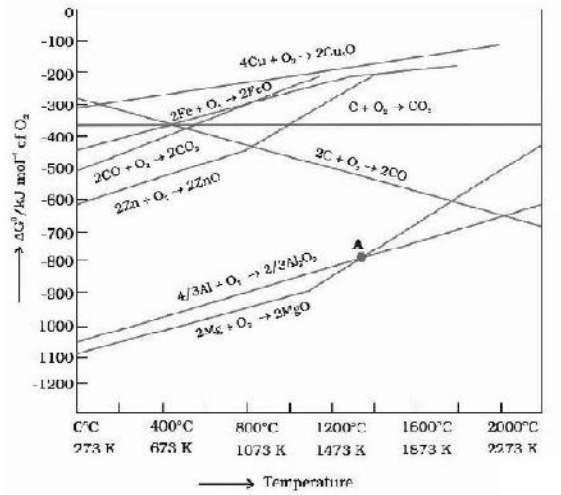
(4) 

Ans. (2)

Sol.



Q.9. The point of intersection and sudden increase in the slop, in the diagram given below respectively, indicates :



(1) $\Delta G = 0$ and melting or boiling point of the metal oxide

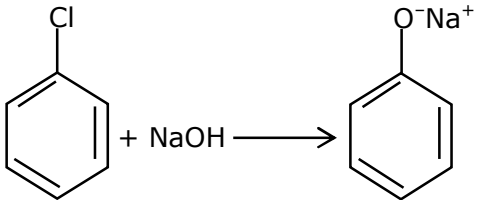
(2) $\Delta G < 0$ and decomposition of the metal oxide

(3) $\Delta G = 0$ and reduction of the metal oxide

(4) $\Delta G > 0$ and decomposition of the metal oxide

Ans. (1)

Sol. At the point of intersection $\Delta G = 0$ for involved reaction.

Q.10. 

The above reaction requires which of the following reaction conditions?

(1) 623 K, 300 atm (2) 573 K, 300 atm

(3) 573 K, Cu, 300 atm (4) 623 K, Cu 300 atm

Ans. (1)

Sol. Based on NCERT

Q.11. The correct order of conductivity of ions in water is:

(1) $Cs^+ > Rb^+ > K^+ > Na^+$ (2) $K^+ > Na^+ > Cs^+ > Rb^+$

(3) $Rb^+ > Na^+ > K^+ > Li^+$ (4) $Na^+ > K^+ > Rb^+ > Cs^+$

Ans. (1)

Sol. Cs^+_{aq} has lower hydrated radius so its electrical conductivity is higher.

Q.12. A colloidal system consisting of a gas dispersed in a solid is called a/an:

(1)aerosol (2) solidsol

(3)foam (4) gel

Ans. (2)

Sol.

Dispered phase	Dispersion medium	Type of colloid
Gas	Solid	Solid Sol

Q.13. The absolute value of the electron gain enthalpy of halogen satisfies:

(1) I > Br >Cl> F (2) F >Cl> Br > I

(3)Cl> F > Br > I (4)Cl> Br > F > I

Ans. (3)

Sol. Chlorine has higher electron gain enthalpy then flourine due to less electron density.

Q.14. Which of the following reaction is an example of ammonolysis?

(1) $C_6H_5CH_2CN \xrightarrow{[H]} C_6H_5CH_2CH_2NH_2$

(2) $C_6H_5COCl + C_6H_5NH_2 \rightarrow C_6H_5CONHC_6H_5$

(3) $C_6H_5CH_2Cl + NH_3 \rightarrow C_6H_5CH_2NH_2$

(4) $C_6H_5NH_2 \xrightarrow{HCl} C_6H_5\overset{+}{N}H_3Cl^-$

Ans. (3)

Sol. Based on NCERT

$C_6H_5CH_2Cl + NH_3 \longrightarrow C_6H_5CH_2NH_2$

Q.15. Reducing smog is a mixture of :

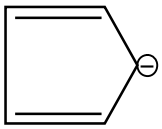
(1) Smoke, fog and N_2O_3 (2) Smoke, fog and O_3

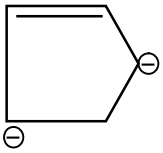
(3) Smoke, fog and SO_2 (4) Smoke, fog and CH_2=CH–CHO

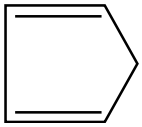
Ans. (3)

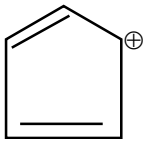
Sol. Reducing smog = smoke + fog + SO_2

Q.16. Which of the following is an aromatic compound?

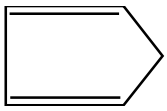
(1) 

(2) 

(3) 

(4) 

Ans. (1)
Sol.

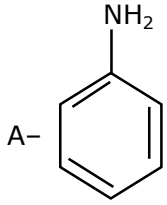
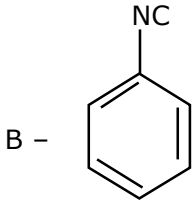


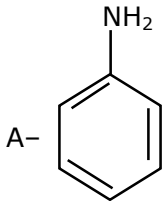
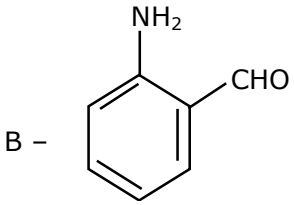
: ⊖ 6π electron

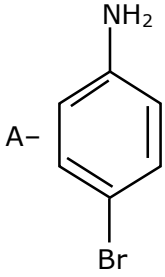
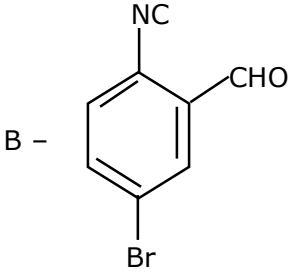
Q.17. With respect to drug-enzyme interaction, identify the wrong statement.
(1) Allosteric inhibitor competes with the enzyme's active side
(2) Competitive inhibitor binds to the enzyme's active site
(3) Non-competitive inhibitor binds to the allosteric site
(4) Allosteric inhibitor changes the enzyme's active site

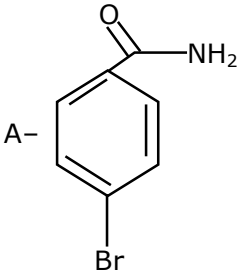
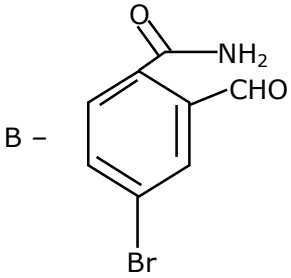
Ans. (1)
Sol. Based on NCERT

Q.18. Hoffmann bromomide degradation of benzamide gives product A, which upon heating with $CHCl_3$ and NaOH gives product B.
The structures of A and B are :

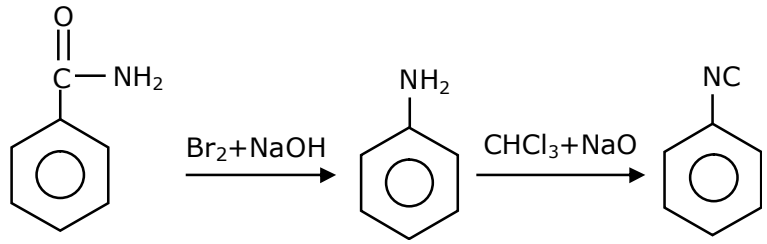
(1)  

(2)  

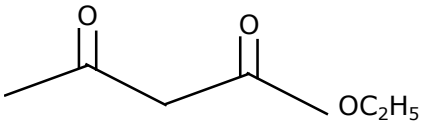
(3)  

(4)  

Ans. (1)
Sol.



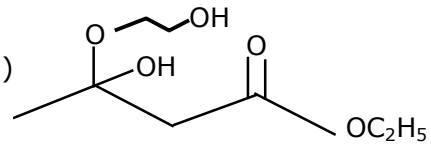
Q.19.



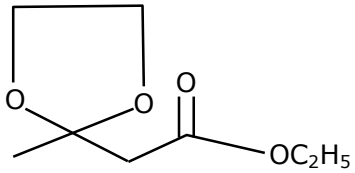
Ethylene Glycol
H^+
A
(Major Product)

The product "A" in the above reaction is :

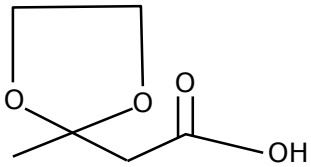
(1)



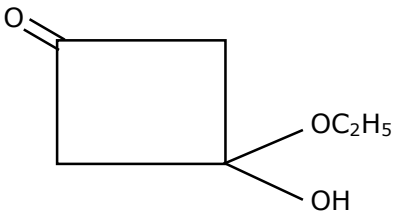
(2)



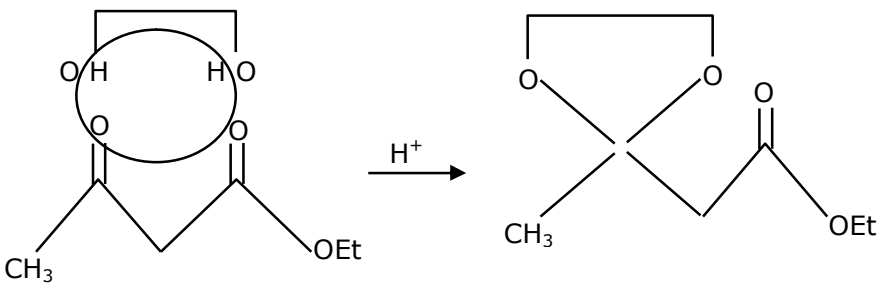
(3)



(4)



Ans. (2)
Sol.



Q.20. Which of the following compound CANNOT act as a Lewis base?

(1) ClF_3 (2) PCl_5 (3) NF_3 (4) SF_4

Ans. (2)

Sol. NF_3 has no vacant orbital neither in nitrogen nor in fluorine so it cannot accept the electron & hence cannot acts as lewis acid and but for PCl_5 P has no L.P & hence it cannot acts as base but ClF_3 (3 B.P + 2 L.P) & SF_4 (4 B.P + 1 L.P)

Section-B

Q.1. A certain orbital has n = 4 and m_L = −3. The number of radial nodes in this orbital is _____. (Round off to the Nearest Integer).

Ans. 0

Sol. Number of radial nodes = $n - \ell - 1$

$n = 4$, $m_L = -3$ so $\ell = 3$

radial nodes = $4 - 3 - 1 = 0$

Q.2. 15 mL of aqueous solution of Fe^{2+} in acidic medium completely reacted with 20 mL of 0.03 aqueous $Cr_2O_7^{2-}$. The molarity of the Fe^{2+} solution is _____× 10^{-2}M. (Round off to the Nearest Integer).

Ans. 24

Sol. By law of equivalence

Meq of Fe^{2+} = Meq of $Cr_2O_7^{2-}$

$M \times 15 \times 1 = 0.03 \times 6 \times 20$

$M = 0.24$ $M = 24 \times 10^{-2}$ M

Q.3. The reaction of white phosphorus on boiling with alkali in inert atmosphere resulted in the formation of product 'A'. The reaction of 1 mol of 'A' with excess of $AgNO_3$ in aqueous medium gives _____ mol(s) of Ag. (Round off to the Nearest Integer).

Ans. (8)

Sol. $P_4 + NaOH \xrightarrow{aq} PH_3 + NaH_2PO_2 + H_2O$

$\overset{+1}{Ag}NO_3 + \overset{-3}{P}H_3 \longrightarrow \overset{0}{Ag} + H_3\overset{+5}{P}O_4 + HNO_3$

$\begin{bmatrix} e^- + Ag^+ \longrightarrow Ag \\ P^{-3} \longrightarrow P^{+5} + 8e^- \end{bmatrix} \times 8$

$8Ag^+ + P^{3-} \longrightarrow 8Ag + P^{5+}$

So final reaction along with stiochiometric coeff. is.

$8AgNO_3 + PH_3 + 4H_2O \longrightarrow 8Ag + H_3PO_4 + 8HNO_3$

Exess 1 mol

Hence 1 mol produce 8 mol Ag

Q.4. The oxygen dissolved in water exerts a partial pressure of 20 kPa in the vapour above water. The molar solubility of oxygen in water is _____ $\times 10^{-5}$ mol dm^{-3}.
(Round off to the Nearest Integer).
[Given : Henry's law constant = $K_H = 8.0 \times 10^4$kPa for O_2.
Density of water with dissolved oxygen = 1.0 kg dm^{-3}]

Ans. **25**

Sol. $P_{(g)} = [K_H]\,\chi$

$20 \times 10^3 = [8.0 \times 10^4 \times 10^3] \times \text{Solubility}$

$\text{Solubility} = \dfrac{20 \times 10^3}{8.0 \times 10^7} = 2.5 \times 10^{-4}$

$\text{Solubility} = 25 \times 10^{-5}$

Q.5. The standard enthalpies of formation of Al_2O_3 and CaO are −1675 kJ mol^{-1} and −635 kJ mol^{-1} respectively.
For the reaction
$3CaO + 2Al \rightarrow 3Ca + Al_2O_3$ the standard reaction enthalpy $\Delta_r H^0$=_____ kJ.
(Round off to the Nearest Integer)

Ans. **230**

Sol. $\Delta H_f^0 = \Delta H_f^0\,(\text{Products}) - \Delta H_f^0\,(\text{Reactants})$

$= \Delta H_f^0(Al_2O_3) - 3 \times \Delta H_f^0(CaO)$

$= -1675 - 3\,(-635)$

$= 230$ kJ

Q.6. For a certain first order reaction 32% of the reactant is left after 570s. The rate constant of this reaction is _____ $\times 10^{-3}\ s^{-1}$.(Round off to the Nearest Integer).
[Given : $\log_{10}2 = 0.301$, $\ln 10 = 2.303$]

Ans. **2**

Sol. $k = \frac{1}{t}\ln\left[\frac{a}{a-x}\right]$

$k = \frac{2.303}{570}\log\left(\frac{100}{32}\right)$

$k = \frac{2.303}{570}\left[\log(10^2) - \log 2^5\right]$

$k = \frac{2.303}{570} \times 0.5$

$k = 2 \times 10^{-3}\ s^{-1}$

Q.7. The pressure exerted by a non-reactive gaseous mixture of 6.4 g of methane and 8.8 g of carbon dioxide in a 10 L vessel at 27°C is _____ kPa.
(Round off to the Nearest Integer).
[Assume gases are ideal, R = 8.314 J mol^{-1} K^{-1} Atomic masses : C : 12.0u, H : 1.0u, O : 16.0 u]

Ans. **150**

Sol. $V = 10\ L,\ T = 27°\ C = 300\ K$

$(m)_{methane} = 6.4\ g,\ (m)_{CO_2} = 8.8\ g$

$PV = n_{total}RT$

$P \times 10 \times 10^{-3} = \left(\frac{6.4}{16} + \frac{8.8}{44}\right) \times 8.314 \times 300$

$P \times 10^{-2} = (0.4 + 0.2) \times 8.314 \times 300$

$P = 149652\ Pa$

$P = 149.652\ KPa \approx 150\ kPa$

Q.8. The mole fraction of a solute in a 100 molal aqueous solution is _____ $\times 10^{-2}$.
(Round off to the Nearest Integer).
[Given : Atomic masses : H : 1.0 u, O : 16.0 u]

Ans. **64**

Sol. Let weight of H_2O = 1000 g

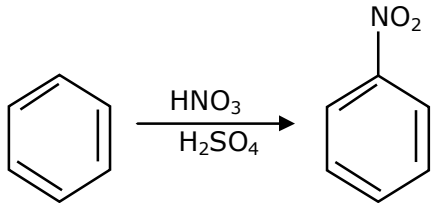
Moles of solute = 100

(mole)H_2O = $\frac{1000}{18}$

Mole fraction of solute = $\frac{\text{mole of solute}}{\text{Total moles}}$

= $\frac{100}{100+\frac{1000}{18}} = \frac{1800}{2800}$

$X_{solute} = 64 \times 10^{-2}$

Q.9. 

In the above reaction, 3.9 g of benzene on nitration gives 4.92 g of nitrobenzene. The percentage yield of nitrobenzene in the above reaction is _____%. (Round off to the Nearest Integer).

(Given atomic mass : C : 12.0 u, H : 1.0 u, O : 16.0 u, N : 14.0 u)

Ans. **80**

Sol. Moles of C_6H_6 = $\frac{3.9}{78}$ = 0.05

Moles of $C_6H_5NO_2$ = $\frac{4.92}{123}$ = 0.04

By conserving moles of carbon, mole of $C_6H_5\ NO_2$

Formed theoretically are 0.05

$\Rightarrow$ % yield = $\frac{\text{moles formed actually}}{\text{moles formed theoretically}} \times 100$

$\Rightarrow$ % yield = $\frac{0.04}{0.05} \times 100$ = 80 %

Q.10. 0.01 moles of a weak acid HA ($K_a = 2.0 \times 10^{-6}$) is dissolved in 1.0 L of 0.1 M HCl solution.
The degree of dissociation of HA is_____ $\times 10^{-5}$ (Round off to the Nearest Integer).
Assume degree of dissociation << 1

Ans. **2**

Sol.

	HA	$\rightleftharpoons$	H^+	+	A^-
C_1	0.01		0		0
C_{eq}	$0.01(1-\alpha)$		$0.01\alpha + 0.1$		0.01α
	$\simeq 0.01$		$\simeq 0.1$		

$$K_a = \frac{[H^+][A^-]}{[HA]}$$

$$2 \times 10^{-6} = \frac{(0.1)(0.01\ \alpha)}{0.01}$$

$$\alpha = 2 \times 10^{-5}$$