

JEE-MAIN EXAMINATION – APRIL 2025

(HELD ON FRIDAY 04th APRIL 2025)

TIME : 9:00 AM TO 12:00 NOON

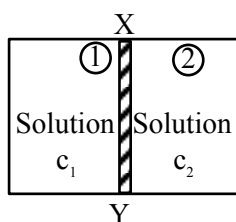
CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

51. XY is the membrane / partition between two chambers 1 and 2 containing sugar solutions of concentration c_1 and c_2 ($c_1 > c_2$) mol L⁻¹. For the reverse osmosis to take place identify the correct condition

(Here p_1 and p_2 are pressures applied on chamber 1 and 2)



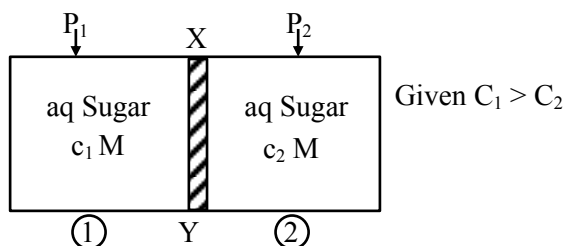
- (A) Membrane/Partition ; Cellophane, $p_1 > \pi$
- (B) Membrane/Partition ; Porous. $p_2 > \pi$
- (C) Membrane/Partition ; Parchment paper, $p_1 > \pi$
- (D) Membrane/Partition : Cellophane, $p_2 > \pi$

Choose the **correct** answer from the option given below :

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

Ans. (3)

Sol.



Normal osmosis occurs from (2) to (1)

For reverse osmosis from (1) to (2)

Pressure : $P_1 > \pi$

∴ Answer [A & C] only

52. Let us consider a reversible reaction at temperature, T.

In this reaction, both ΔH and ΔS were observed to have positive values. If the equilibrium temperature is T_e , then the reaction becomes spontaneous at :

- (1) $T = T_e$ (2) $T_e > T$
- (3) $T > T_e$ (4) $T_e = 5T$

Ans. (3)

Sol. For reaction to be spontaneous according to 2nd law:

$$\Delta G < 0$$

$$\Rightarrow \Delta H - T\Delta S < 0$$

$$\Rightarrow T > \left(\frac{\Delta H}{\Delta S} \right) = T_e$$

$$\Rightarrow T > T_e$$

53. Which of the following molecules(s) show/s paramagnetic behavior ?

- (A) O₂ (B) N₂ (C) F₂ (D) S₂ (E) Cl₂

Choose the **correct** answer from the options given below :

- (1) B only (2) A & C only
- (3) A & E only (4) A & D only

Ans. (4)

Sol.

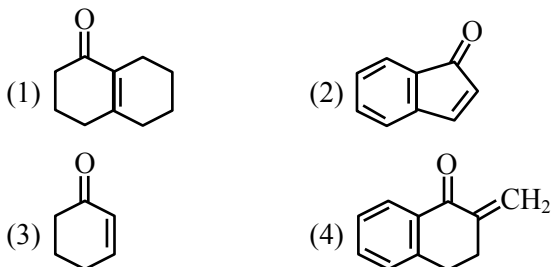
No. of unpaired e⁻

- (A) O₂ 2
- (B) N₂ 0
- (C) F₂ 0
- (D) S₂ 2
- (E) Cl₂ 0

If species contain unpaired electron than it is paramagnetic.

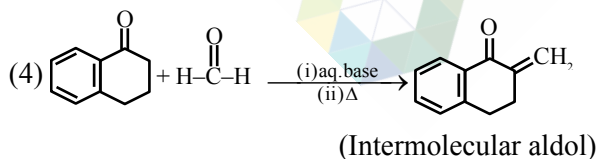
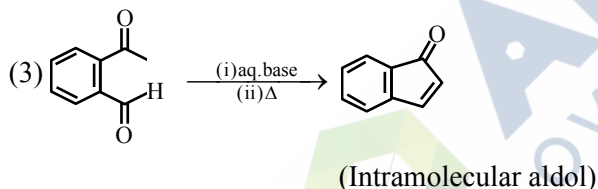
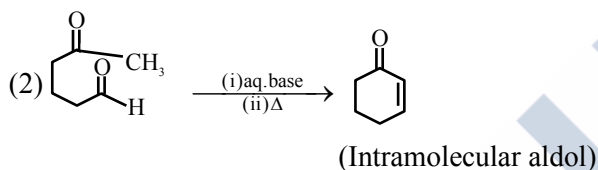
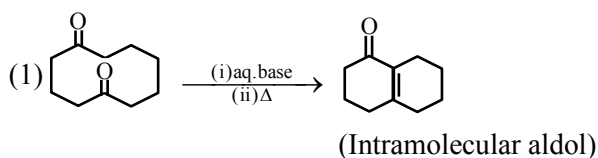
So A & D are paramagnetic.

54. Aldol condensation is a popular and classical method to prepare α,β -unsaturated carbonyl compounds. This reaction can be both intermolecular and intramolecular. Predict which one of the following is not a product of intramolecular aldol condensation ?



Ans. (4)

Sol.



55. One mole of an ideal gas expands isothermally and reversibly from 10 dm^3 to 20 dm^3 at 300 K . ΔU , q and work done in the process respectively are :

Given : $R = 8.3 \text{ JK}^{-1} \text{ mol}^{-1}$

$\ln 10 = 2.3$

$\log 2 = 0.30$

$\log 3 = 0.48$

(1) $0, 21.84 \text{ kJ}, -1.26 \text{ kJ}$ (2) $0, -17.18 \text{ kJ}, 1.718 \text{ J}$

(3) $0, 21.84 \text{ kJ}, 21.84 \text{ kJ}$ (4) $0, 178 \text{ kJ}, -1.718 \text{ kJ}$

Ans. (4)

Sol. $(10L, 300K) \xrightarrow{n=1} (20L, 300K)$

$$-q = w = -nRT \ln \frac{V_2}{V_1}$$

$$= -8.3 \times 300 \times \ln \left(\frac{20}{10} \right)$$

$$= -1.718 \text{ kJ}$$

$$\Rightarrow q = 1.718 \text{ kJ}$$

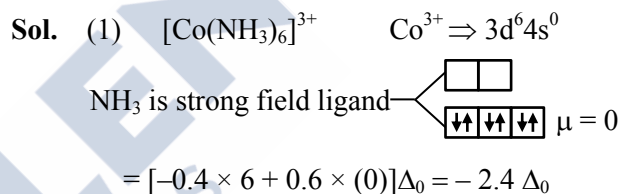
$$w = -1.718 \text{ kJ}$$

$$\Delta U = 0 (\because \Delta T = 0)$$

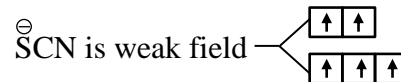
56. Which one of the following complexes will have $\Delta_0 = 0$ and $\mu = 5.96 \text{ B.M.}$?

- (1) $[\text{Fe}(\text{CN})_6]^{4-}$ (2) $[\text{Co}(\text{NH}_3)_6]^{3+}$
 (3) $[\text{FeF}_6]^{4-}$ (4) $[\text{Mn}(\text{SCN})_6]^{4-}$

Ans. (4)



- (2) $[\text{Mn}(\text{SCN})_6]^{4-}$
 $\text{Mn}^{2+} \Rightarrow 3d^5 4s^0$



$$\mu = \sqrt{35} \text{ B.M.} = 5.96 \text{ B.M.}$$

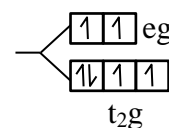
$$\text{CFSE} = (-0.4 \times 3 + 0.6 \times 2) \Delta_0$$

$$\text{So } \Delta_0 = 0$$

- (3) $[\text{Fe}(\text{CN})_6]^{4-}$ $\text{Fe}^{2+} \Rightarrow 3d^6 4s^0$
- CN^- is SFL

$$\text{CFSE} = -2.4 \Delta_0$$

- (4) $[\text{FeF}_6]^{4-}$ $\text{Fe}^{2+} \Rightarrow 3d^6 4s^0$



$$\mu = \sqrt{24} \text{ B.M.} = 4.89 \text{ B.M.}$$

$$\text{CFSE} = (-0.4 \times 4 + 0.6 \times 2) \Delta_0 = -1.2 \Delta_0$$

57. For $A_2 + B_2 \rightleftharpoons 2AB$

E_a for forward and backward reaction are 180 and 200 kJ mol^{-1} respectively

If catalyst lowers E_a for both reaction by 100 kJ mol^{-1} .

Which of the following statement is correct?

(1) Catalyst does not alter the Gibbs energy change of a reaction.

(2) Catalyst can cause non-spontaneous reactions to occur.

(3) The enthalpy change for the reaction is +20 kJ mol^{-1} .

(4) The enthalpy change for the catalysed reaction is different from that of uncatalysed reaction.

Ans. (1)

Sol. $A_2 + B_2 \rightleftharpoons 2AB$

$E_f = 180 \text{ kJ mol}^{-1}$

$E_b = 200 \text{ kJ mol}^{-1}$

$\Delta H = E_f - E_b = -20 \text{ kJ mol}^{-1}$

In presence of catalyst :

$E_f = 180 - 100 = 80 \text{ kJ mol}^{-1}$

$E_b = 200 - 100 = 100 \text{ kJ mol}^{-1}$

Catalyst does not change ΔH or ΔG of a reaction.

58. Rate law for a reaction between A and B is given by

$R = k[A]^n[B]^m$

If concentration of A is doubled and concentration of B is halved from their initial value, the ratio of new rate of reaction to the initial rate of reaction

$\left(\frac{r_2}{r_1}\right)$ is

(1) $2^{(n-m)}$

(2) $(n-m)$

(3) $(m+n)$

(4) $\frac{1}{2^{m+n}}$

Ans. (1)

Sol. $r_1 = k[A]^n[B]^m$

Now A is doubled & B is halved in concentration

$\Rightarrow r_2 = k2^n[A]^n \cdot \frac{[B]^m}{2^m}$

Now $\frac{r_2}{r_1} = 2^{(n-m)}$

59. Number of stereoisomers possible for the complexes, $[\text{CrCl}_3(\text{py})_3]$ and $[\text{CrCl}_2(\text{ox})_2]^{3-}$ are respectively

(py = pyridine, ox = oxalate)

(1) 3 & 3

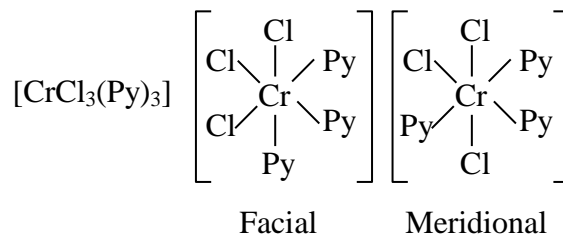
(2) 2 & 2

(3) 2 & 3

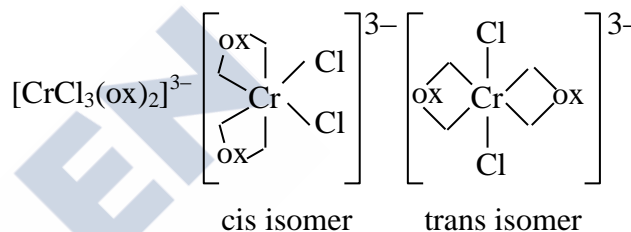
(4) 1 & 2

Ans. (3)

Sol.



So total stereo isomer = 2



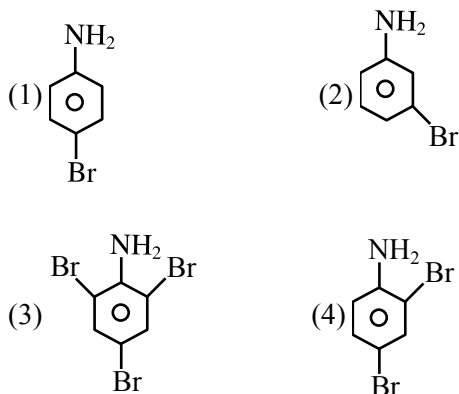
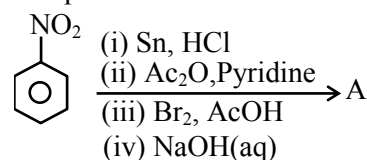
(Optically active)

Geometrical isomer = 2 (1 cis + 1 trans)

Optical isomer = 3 (2 optically active + 1 optically inactive)

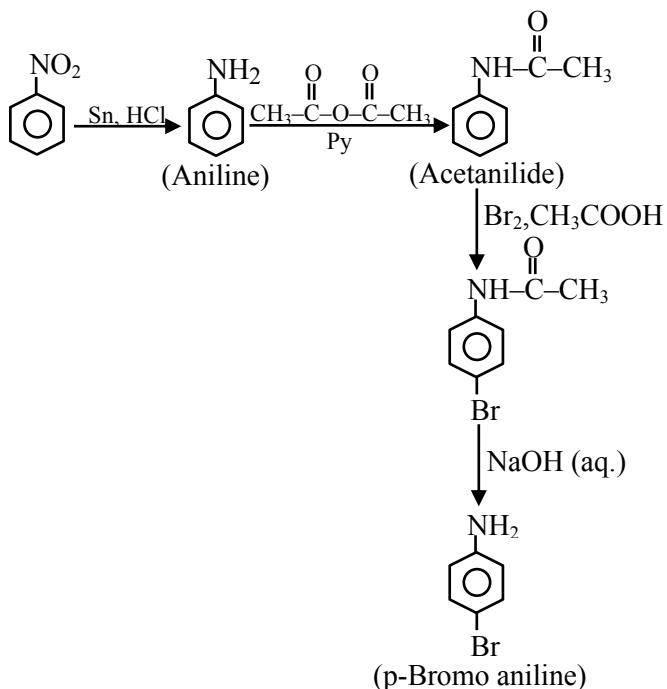
Stereoisomer = 3

60. The major product (A) formed in the following reaction sequence is



Ans. (1)

Sol.



61. On charging the lead storage battery, the oxidation state of lead changes from x_1 to y_1 at the anode and from x_2 to y_2 at the cathode. The values of x_1, y_1, x_2, y_2 are respectively :

- (1) +4,+2,0,+2 (2) +2,0,+2,+4
 (3) 0,+2,+4,+2 (4) +2,0,0,+4

Ans. (2)

Sol. For charging of lead storage battery cell reaction is $2\text{PbSO}_4(\text{s}) + 2\text{H}_2\text{O}(\text{l}) \rightarrow \text{Pb}(\text{s}) + \text{PbO}_2(\text{s}) + 2\text{H}_2\text{SO}_4(\text{aq})$
 At anode PbSO_4 reduced back to Pb and at cathode PbSO_4 oxidised back to PbO_2 .

$$\therefore x_1 = +2, y_1 = 0$$

$$x_2 = +2, y_2 = 4$$

62. Given below are two statements :

Statement I : Nitrogen forms oxides with +1 to +5 oxidation states due to the formation of $p\bar{\pi} - p\pi$ bond with oxygen .

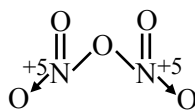
Statement II : Nitrogen does not form halides with +5 oxidation state due to the absence of d-orbital in it.

In the light of given statements, choose the **correct** answer from the options given below.

- (1) Statement I is true but Statement II is false
 (2) Both Statement I and Statement II are false
 (3) Statement I is false but Statement II is true
 (4) Both Statement I and Statement II are true

Ans. (4)

Sol. In oxide of nitrogen it can achieve +5 oxidation state because it can form $p\bar{\pi} - p\pi$ bond with oxygen e.g. N_2O_5

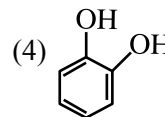
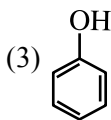
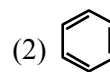
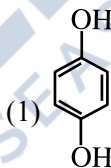


Nitrogen cannot form halide in +5 oxidation state because it does not contain d-orbital.

e.g. NX_5 does not exist

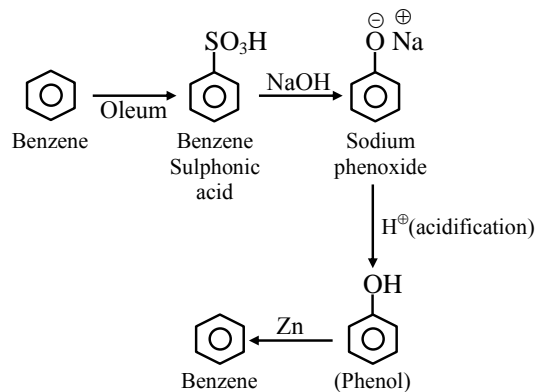
X = halide

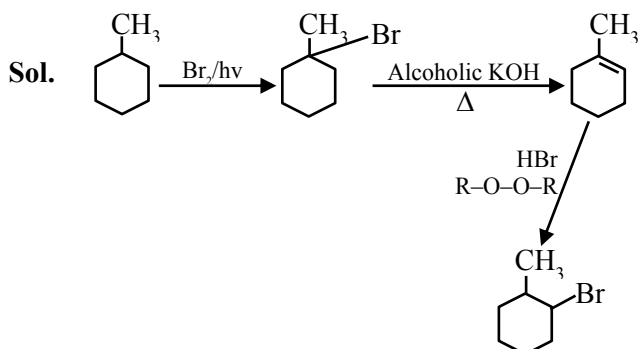
63. Benzene is treated with oleum to produce compound (X) which when further heated with molten sodium hydroxide followed by acidification produces compound (Y). The compound Y is treated with zinc metal to produce compound (Z). Identify the structure of compound (Z) from the following option.



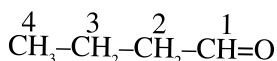
Ans. (2)

Sol.

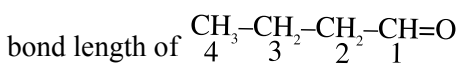




68. Given below are two statements.
Statement I : The dipole moment of $\overset{4}{\text{CH}_3}-\overset{3}{\text{CH}}=\overset{2}{\text{CH}}-\overset{1}{\text{CH}}=\text{O}$ is greater than



Statement II : C_1-C_2 bond length of $\overset{4}{\text{CH}_3}-\overset{3}{\text{CH}}=\overset{2}{\text{CH}}-\overset{1}{\text{CH}}=\text{O}$ is greater than C_1-C_2

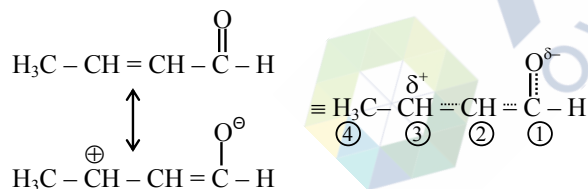


In the light of the above statements, choose the **correct** answer from the options given below:

- (1) Statement I is false but Statement II is true
- (2) Both Statement I and Statement II are false
- (3) Statement I is true but Statement II is false
- (4) Both Statement I and Statement II are true

Ans. (3)

Sol. **Statement-I** :

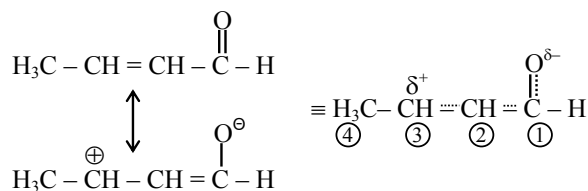


$\mu = q \times d$

More charges and more distance between charges than other compound so more dipole moment.

Statement-I is true.

Statement-II :



C_1-C_2 bond has partial double bond character that means lesser bond length than C_1-C_2 bond of other compound.

Statement-II is false.

69. Pair of transition metal ions having the same number of unpaired electrons is :

- (1) V^{2+} , Co^{2+} (2) Ti^{2+} , Co^{2+}
 (2) Fe^{3+} , Cr^{2+} (2) Ti^{3+} , Mn^{2+}

Ans. (1)

Sol.

	Configuration	No. of unpaired e^-
(1) V^{3+}	$\Rightarrow [\text{Ar}]3d^34s^0$	3
Co^{2+}	$\Rightarrow [\text{Ar}]3d^74s^0$	3
(2) Ti^{2+}	$\Rightarrow [\text{Ar}]3d^24s^0$	2
Co^{2+}	$\Rightarrow [\text{Ar}]3d^74s^0$	3
(3) Fe^{3+}	$\Rightarrow [\text{Ar}]3d^54s^0$	5
Cr^{2+}	$\Rightarrow [\text{Ar}]3d^44s^0$	4
(4) Ti^{3+}	$\Rightarrow [\text{Ar}]3d^14s^0$	1
Mn^{2+}	$\Rightarrow [\text{Ar}]3d^54s^0$	5

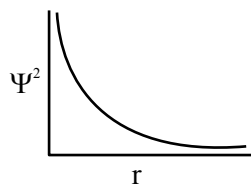
So V^{2+} & Co^{2+} same number of unpaired electron.

70. Which one of the following about an electron occupying the 1s orbital in a hydrogen atom is **incorrect**? (Bohr's radius is represented by a_0)

- (1) The probability density of finding the electron is maximum at the nucleus
- (2) The electron can be found at a distance $2a_0$ from the nucleus
- (3) The 1s orbital is spherically symmetrical
- (4) The total energy of the electron is maximum when it is at a distance a_0 from the nucleus

Ans. (4)

Sol.



1. $\Psi^2 =$ Probability density is maximum at nucleus.
2. Electron can exist upto infinity from nucleus.
3. True
4. Energy of electron is maximum at infinite distance from nucleus.

SECTION-B

71. In Dumas' method for estimation of nitrogen 1g of an organic compound gave 150 mL of nitrogen collected at 300K temperature and 900 mm Hg pressure. The percentage composition of nitrogen in the compound is _____ % (nearest integer).

(Aqueous tension at 300 K = 15mm Hg)

Ans. (20)

Sol. Partial pressure of N₂ = (900 – 15) = 885 mm Hg

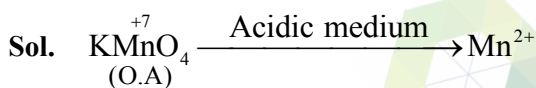
$$\text{Mole of N}_2 = \frac{\left(\frac{885}{760} \times 0.15\right)}{(0.0821 \times 300)} = 0.0071 \text{ moles}$$

% of nitrogen in organic compound

$$= \frac{(0.0071 \times 28)}{1} \times 10 = 19.85\%$$

72. KMnO₄ acts as an oxidising agent in acidic medium. 'X' is the difference between the oxidation states of Mn in reactant and product. 'Y' is the number of 'd' electrons present in the brown red precipitate formed at the end of the acetate ion test with neutral ferric chloride. The value of X + Y is _____.

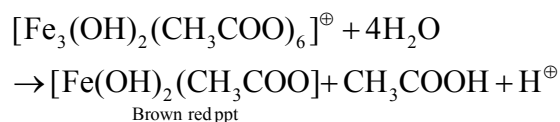
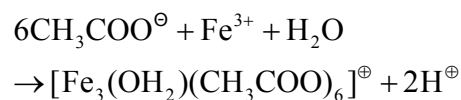
Ans. (10)



X is difference in oxidation state.

$$7 - 2 = 5$$

So X = 5



Fe³⁺ ⇒ 3d⁵ 4s⁰ contains 5 d electrons

So Y = 5

$$X + Y = 5 + 5 = 10$$

73. Fortification of food with iron is done using FeSO₄·7H₂O. The mass in grams of the FeSO₄·7H₂O required to achieve 12 ppm of iron in 150 kg of wheat is _____ (Nearest integer)

[Given : Molar mass of Fe, S and O respectively are 56, 32 and 16 g mol⁻¹]

Ans. (9)

Sol. Let mass of iron = w g

$$\Rightarrow \frac{w}{150 \times 10^3} \times 10^6 = 12$$

$$\Rightarrow w = 150 \times 12 \times 10^{-3} = 1.8 \text{ gm}$$

Let mass of FeSO₄·7H₂O = w₁ gm

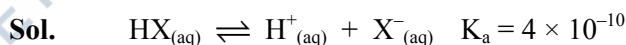
$$\Rightarrow \text{Moles of Fe} = \frac{1.8}{56} = \left(\frac{w_1}{56 + 96 + 7 \times 18}\right)$$

$$\Rightarrow w_1 = 8.935 \text{ gm}$$

74. The pH of a 0.01 M weak acid HX (K_a = 4 × 10⁻¹⁰) is found to be 5. Now the acid solution is diluted with excess of water so that the pH of the solution changes to 6. The new concentration of the diluted weak acid is given as x × 10⁻⁴ M. The value of x is _____ (nearest integer)

Allen Ans. (Bonus)

NTA Ans. (25)



0.01(1-α) 0.01α 0.01α Not justified

$$\Rightarrow 0.01\alpha = 10^{-5} \Rightarrow \alpha = 10^{-3}$$

$$K_a = 0.01\alpha^2 = 10^{-8}$$

On dilution let final concentration of HX = c M



C(1-α) Cα Cα

$$\Rightarrow C\alpha = 10^{-6} \quad \dots(1)$$

$$\frac{C\alpha^2}{1-\alpha} = K_a = 10^{-8} \quad \dots(2)$$

$$\Rightarrow \frac{10^{-6}\alpha}{1-\alpha} = 10^{-8}$$

Data given is inconsistent & contradictory. This should be bonus.

75. The total number of hydrogen bonds of a DNA-double Helix strand whose one strand has the following sequence of bases is _____.

5' – G – G – C – A – A – A – T – C – G – G – C – T – A – 3'

Ans. (33)

Sol. Two nucleic acid chains are wound about each other and held together by H bonds between pair of bases.

Adenine from two hydrogen bonds with thymine and Guanine form three hydrogen bond with cytosine.

5' G–G–C–A–A–A–T–C–G–G–C–T–A–3'

In given DNA strand total seven guanine and cytosine bases which form total 21 H-bonds and six adenine and thymine base which will form total 12 H-bonds with other DNA strand.

Total no. of H bonds = $7 \times 3 + 6 \times 2 = 33$

Ans. 33



ALLEN
OVERSEAS