JEE–MAIN EXAMINATION – APRIL 2025

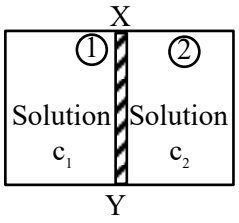
(HELD ON FRIDAY 04th APRIL 2025) **TIME : 9:00 AM TO 12:00 NOON**

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, $p_2 > \pi$

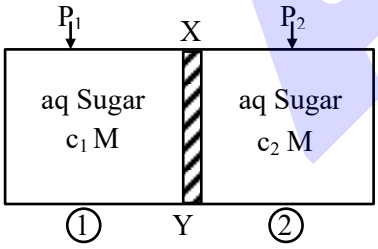
Choose the **correct** answer from the option given below :

(1) B and D only (2) A and D only

(3) A and C only (4) C only

Ans. **(3)**

Sol.



Given $C_1 > C_2$

Normal osmosis occurs from (2) to (1)

For reverse osmosis from (1) to (2)

Pressure : $P_1 > \pi$

$\therefore$ 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 Te, then the reaction becomes spontaneous at :

(1) T = Te (2) Te > T

(3) T > Te (4) Te = 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) O_2 (B) N_2 (C) F_2 (D) S_2 (E) Cl_2

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)**

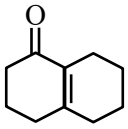
Sol.

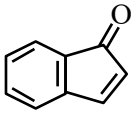
		No. of unpaired e^-
(A)	O_2	2
(B)	N_2	0
(C)	F_2	0
(D)	S_2	2
(E)	Cl_2	0

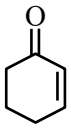
If species contain unpaired electron than it is paramagnetic.

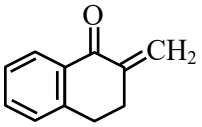
So A & D are paramagnetic.

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 ?

(1) 

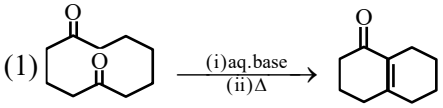
(2) 

(3) 

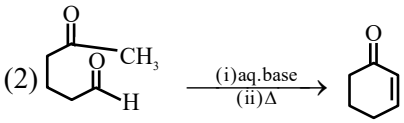
(4) 

Ans. (4)

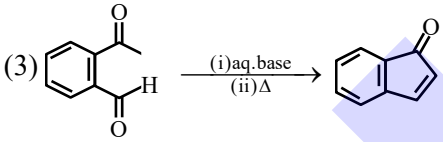
Sol.

(1) 

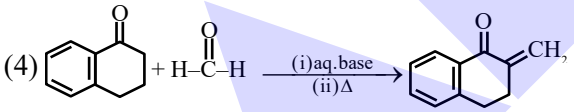
(Intramolecular aldol)

(2) 

(Intramolecular aldol)

(3) 

(Intramolecular aldol)

(4) 

(Intermolecular aldol)

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 JK^{-1} and mol^{-1}

In 10 = 2.3

log 2 = 0.30

log 3 = 0.48

(1) 0, 21.84 kJ, –1.26 kJ (2) 0, –17.18 kJ, 1.718 J

(3) 0, 21.84 kJ, 21,84 kJ (4) 0,178 kJ, – 1.718 kJ

Ans. (4)

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

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

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

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

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

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

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

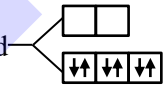
56. Which one of the following complexes will have $\Delta_0 = 0$ and $\mu = 5.96$ B.M.?

(1) $[Fe(CN)_6]^{4-}$ (2) $[CO(NH_3)_6]^{3+}$

(3) $[FeF_6]^{4-}$ (4) $[Mn(SCN)_6]^{4-}$

Ans. (4)

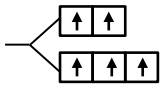
Sol. (1) $[Co(NH_3)_6]^{3+}$ $Co^{3+} \Rightarrow 3d^6 4s^0$

NH_3 is strong field ligand  $\mu = 0$

$= [-0.4 \times 6 + 0.6 \times (0)]\Delta_0 = -2.4\ \Delta_0$

(2) $[Mn(SCN)_6]^{4-}$

$Mn^{2+} \Rightarrow 3d^5\ 4s^0$

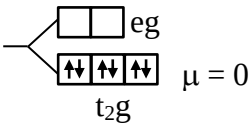
$\overset{\ominus}{S}CN$ is weak field 

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

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

So $\Delta_0 = 0$

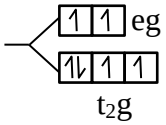
(3) $[Fe(CN)_6]^{-4}$ $Fe^{2+} \Rightarrow 3d^6 4s^0$

$\overset{\ominus}{C}N$ is SFL 

t_2g $\mu = 0$

$CFSE = -2.4\Delta_0$

(4) $[FeF_6]^{4-}$ $Fe^{2+} \Rightarrow 3d^6 4s^0$



t_2g

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

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

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. $A_2 + B_2 \rightleftharpoons 2AB$

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

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

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

In presence of catalyst :

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

$E_b = 200 - 100 = 100$ 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

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

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

59. Number of stereoisomers possible for the complexes, $[CrCl_3(py)_3]$ and $[CrCl_2(ox)_2]^{3-}$ are respectively

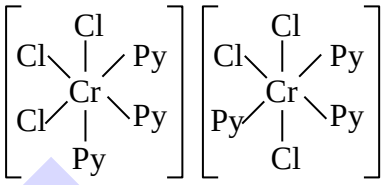
(py = pyridine, ox = oxalate)

(1) 3 & 3 (2) 2 & 2

(3) 2 &3 (4) 1 & 2

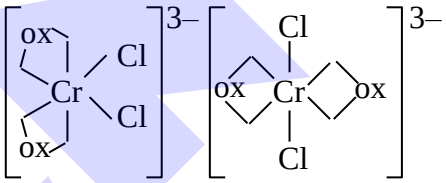
Ans. (3)

Sol.

$[CrCl_3(Py)_3]$ 

Facial Meridional

So total stereo isomer = 2

$[CrCl_3(ox)_2]^{3-}$ 

cis isomer trans isomer

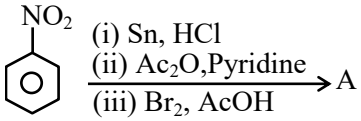
(Optically active)

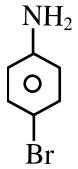
Geometrical isomer = 2 (1 cis +1 trans)

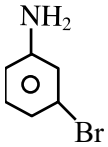
Optical isomer = 3 (2 optically active + 1 optically inactive)

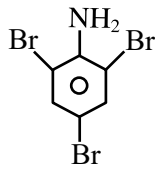
Stereoisomer = 3

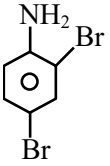
60. The major product (A) formed in the following reaction sequence is



(1) 

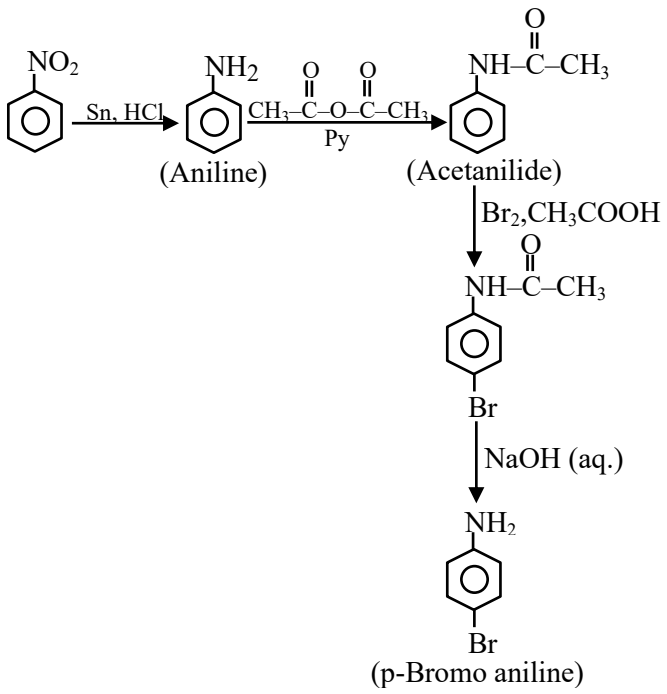
(2) 

(3) 

(4) 

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

$2PbSO_4(s)+2H_2O(l) \rightarrow Pb(s)+PbO_2(s)+2H_2SO_4(aq)$

At anode $PbSO_4$ reduced back to Pb and at cathode $PbSO_4$ oxidised back to PbO_2.

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

$x_2 = +2, y_2 = 4$

62. Given below are two statements :

Statement I : Nitrogen forms oxides with +1 to +5 oxidation states due to the formation of $p\pi - p\pi$ 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

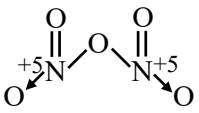
(2) Both Statement I and Statement II are false

(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 $p\pi - p\pi$ bond with oxygen e.g. N_2O_5

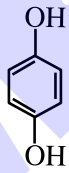


Nitrogen cannot form halide in +5 oxidation state because it does not contain d-orbital.

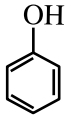
e.g. NX_5 does not exist

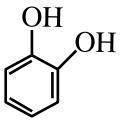
X = halide

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.

(1) 

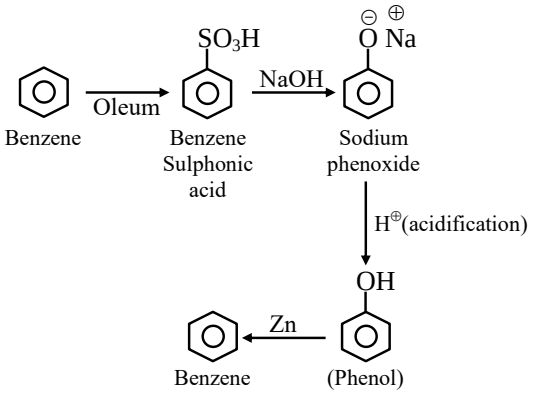
(2) 

(3) 

(4) 

Ans. (2)

Sol.



64. Identify the pair of reactants that upon reaction, with elimination of HCl will give rise to the dipeptide Gly-Ala.

(1) $NH_2–CH_2–COCl$ and $NH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–COOH$

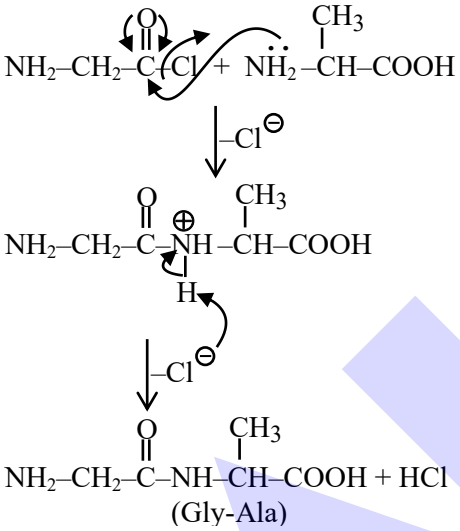
(2) $NH_2–CH_2–COCl$ and $\overset{\oplus}{N}H_3–\underset{\displaystyle CH_3}{\underset{|}{CH}}–COCl$

(3) $NH_2–CH_2–COOH$ and $NH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–COCl$

(4) $NH_2–CH_2–COOH$ and $NH_2–\underset{\displaystyle CH_3}{\underset{|}{CH}}–COOH$

Ans. **(1)**

Sol.



65. Given below are the pairs of group 13 elements showing their relation in terms of atomic radius.

(B<Al), (Al<Ga), (Ga<In) and (In<Tl)

Identify the elements present in the incorrect pair and in that pair find out the element (X) that has higher ionic radius (M^{3+}) that the other one. The atomic number of the element (X) is

(1) 31 (2) 49 (3) 13 (4) 81

Ans. **(1)**

Sol. Size order

Al > Ga

$Al^{3+} < Ga^{3+}$

Atomic number of Ga is 31

66. An organic compound (X) with molecular formula C_3H_6O is not readily oxidised. On reduction it gives (C_3H_8O(Y) which reacts with HBr to give a bromide (Z) which is converted to Grignard reagent. This Grinard reagent on reaction with (X) followed by hydrolysis give 2,3-dimethylbutan-2-ol. Compounds (X), (Y) and (Z) respectively are :

(1) CH_3COCH_3, $CH_3CH_2CH_2OH$, $CH_3CH(Br)\ CH_3$

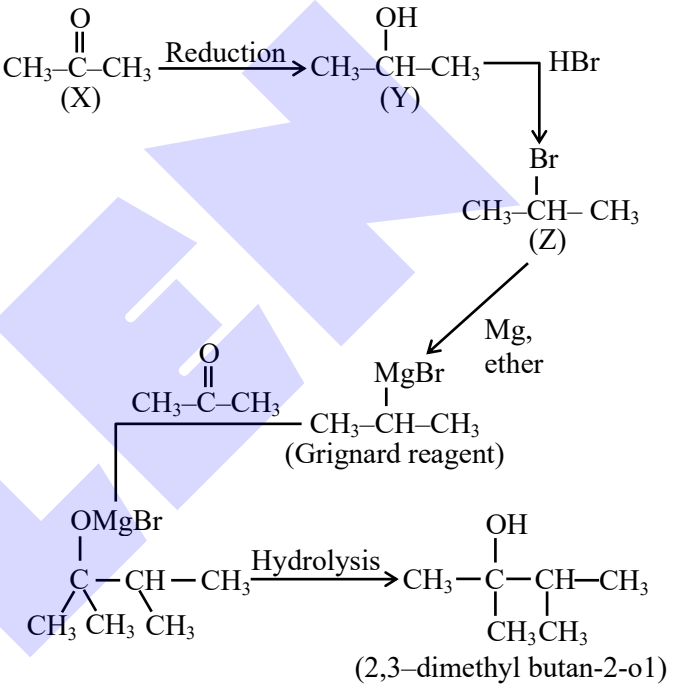
(2) CH_3COCH_3, $CH_3CH(OH)CH_3$, $CH_3CH(Br)CH_3$

(3) CH_3CH_2CHO, $CH_3CH_2CH_2OH$, $CH_3CH_2CH_2Br$

(4) CH_3CH_2CHO, $CH_3CH = CH_2$,$CH_3CH(Br)\ CH_3$

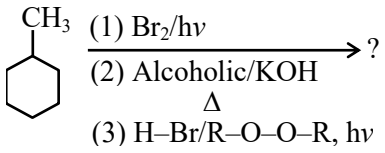
Ans. (2)

Sol.

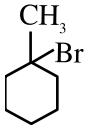


(2,3–dimethyl butan-2-o1)

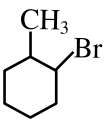
67. Predict the major product of the following reaction sequence :-



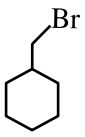
(1)



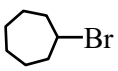
(2)



(3)

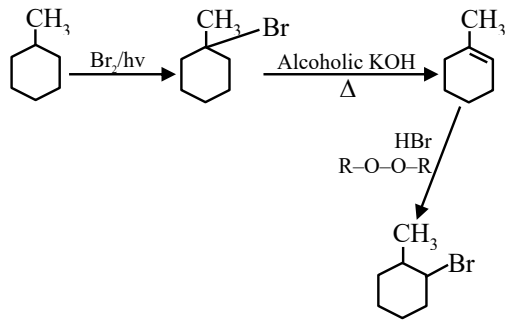


(4)



Ans. **(2)**

Sol.



68. Given below are two statements.

Statement I : The dipole moment of $\overset{4}{CH_3}\text{–}\overset{3}{CH}\text{=}\overset{2}{CH}\text{–}\overset{1}{CH}\text{=O}$ is greater than

$\overset{4}{CH_3}\text{–}\overset{3}{CH_2}\text{–}\overset{2}{CH_2}\text{–}\overset{1}{CH}\text{=O}$

Statement II : C_1–C_2 bond length of $\overset{4}{CH_3}\text{–}\overset{3}{CH}\text{=}\overset{2}{CH}\text{–}\overset{1}{CH}\text{=O}$ is greater than C_1–C_2 bond length of $\overset{4}{CH_3}\text{–}\overset{3}{CH_2}\text{–}\overset{2}{CH_2}\text{–}\overset{1}{CH}\text{=O}$

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

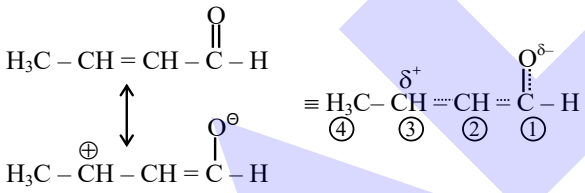
(2) Both Statement I and Statement II are false

(3) Statement I is true but Statement II is false

(4) Both Statement I and Statement II are true

Ans. (3)

Sol. Statement-I :

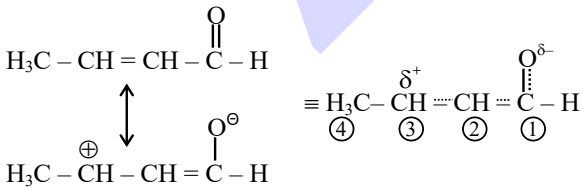


$\mu = q \times d$

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+}	⇒	$[Ar]3d^3 4s^0$	3
	Co^{2+}	⇒	$[Ar]3d^7 4s^0$	3
(2)	Ti^{2+}	⇒	$[Ar]3d^2 4s^0$	2
	Co^{2+}	⇒	$[Ar]3d^7 4s^0$	3
(3)	Fe^{3+}	⇒	$[Ar]3d^5 4s^0$	5
	Cr^{2+}	⇒	$[Ar]3d^4 4s^0$	4
(4)	Ti^{3+}	⇒	$[Ar]3d^1 4s^0$	1
	Mn^{2+}	⇒	$[Ar]3d^5 4s^0$	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

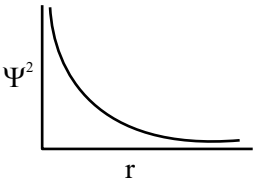
(2) The electron can be found at a distance $2a_0$ from the nucleus

(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. Ψ^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 N_2 = (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. $KMnO_4$ 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)

Sol. $\underset{(O.A)}{\overset{+7}{KMnO_4}} \xrightarrow{\text{Acidic medium}} Mn^{2+}$

X is difference in oxidation state.

7 – 2 = 5

So X = 5

$$6CH_3COO^{\ominus} + Fe^{3+} + H_2O$$
$$\rightarrow [Fe_3(OH_2)(CH_3COO)_6]^{\oplus} + 2H^{\oplus}$$
$$[Fe_3(OH)_2(CH_3COO)_6]^{\oplus} + 4H_2O$$
$$\rightarrow \underset{\text{Brown red ppt}}{[Fe(OH)_2(CH_3COO]} + CH_3COOH + H^{\oplus}$$

$Fe^{3+} \Rightarrow 3d^5\ 4s^0$ contains 5 d electrons

So Y = 5

X + Y = 5 + 5 = 10

73. Fortification of food with iron is done using $FeSO_4.7H_2O$. The mass in grams of the $FeSO_4.7H_2O$ 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 $FeSO_4\cdot 7H_2O$ = w_1 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 ($K_a = 4\times 10^{-10}$) 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 $x\times 10^{-4}$ M. The value of x is _____(nearest integer)

Allen Ans. (Bonus)

NTA Ans. (25)

Sol. $HX_{(aq)} \rightleftharpoons H^+_{(aq)} + X^-_{(aq)}$ $K_a = 4\times 10^{-10}$

$0.01(1-\alpha)$ 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

$Hx_{(aq)} \rightleftharpoons H^+_{(aq)} + X^-_{(aq)}$

$C(1-\alpha)$ $C\alpha$ $C\alpha$

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

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

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

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

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