FINAL JEE–MAIN EXAMINATION – APRIL, 2024

(Held On Friday 05th April, 2024) **TIME : 3 : 00 PM to 6 : 00 PM**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

61. Match **List - I** with **List - II**.

List - I	List - II
(A) ICl	(I) T -Shape
(B) ICl_3	(II) Square pyramidal
(C) ClF_5	(III) Pentagonal bipyramidal
(D) IF_7	(IV) Linear

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

(1) (A)–(I), (B)–(IV), C–(III), D–(II)

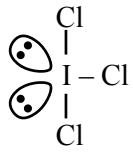
(2) (A)–(I), (B)–(III), C–(II), D–(IV)

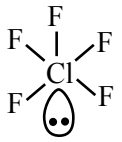
(3) (A)–(IV), (B)–(I), C–(II), D–(III)

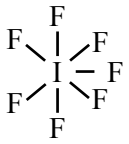
(4) (A)–(IV), (B)–(III), C–(II), D–(I)

Ans. **(3)**

Sol. A. I – Cl (iv) linear

B.  (I) T-shape

C.  (II) Square pyramidal

D.  (III) Pentagonal bipyramidal

62. While preparing crystals of Mohr's salt, dil. H_2SO_4 is added to a mixture of ferrous sulphate and ammonium sulphate, before dissolving this mixture in water, dil. H_2SO_4 is added here to:

(1) prevent the hydrolysis of ferrous sulphate

(2) prevent the hydrolysis of ammonium sulphate

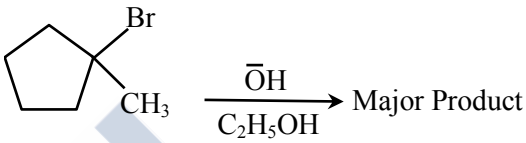
(3) make the medium strongly acidic

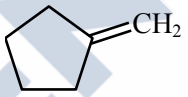
(4) increase the rate of formation of crystals

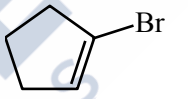
Ans. **(1)**

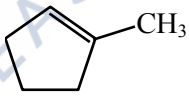
Sol. Fe^{+2} ions undergoes hydrolysis, therefore while preparing aqueous solution of ferrous sulphate and ammonium sulphate in water dilute sulphuric acid is added to prevent hydrolysis of ferrous sulphate.

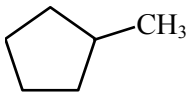
63. Identify the major product in the following reaction.



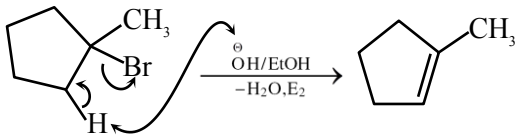
(1) 

(2) 

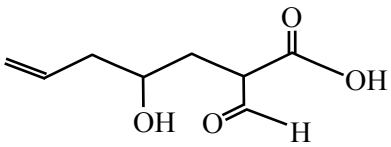
(3) 

(4) 

Ans. **(3)**

Sol. 

64. The correct nomenclature for the following compound is:



(1) 2–carboxy–4–hydroxyhept–6–enal

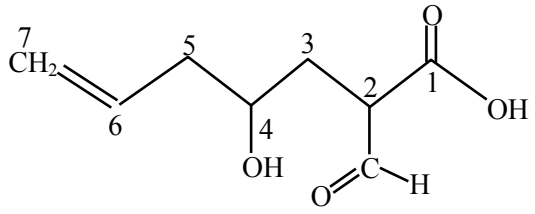
(2) 2–carboxy–4–hydroxyhept–7–enal

(3) 2–formyl–4–hydroxyhept–6–enoic acid

(4) 2–formyl–4–hydroxyhept–7–enoic acid

Ans. **(3)**

Sol.



2-formly-4-hydroxyhept-6-enoic acid

65. Given below are two statements : one is labelled as **Assertion (A)** and the other is labelled as **Reason (R)**.

Assertion (A) : NH_3 and NF_3 molecule have pyramidal shape with a lone pair of electrons on nitrogen atom. The resultant dipole moment of NH_3 is greater than that of NF_3.

Reason (R) : In NH_3, the orbital dipole due to lone pair is in the same direction as the resultant dipole moment of the N–H bonds. F is the most electronegative element.

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

(1) Both **(A)** and **(R)** are true and **(R)** is the correct explanation of **(A)**

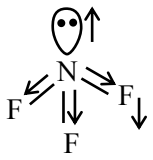
(2) **(A)** is false but **(R)** is true

(3) **(A)** is true but **(R)** is false

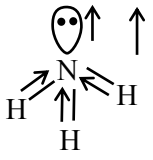
(4) Both **(A)** and **(R)** are true but **(R)** is NOT the correct explanation of **(A)**

Ans. (1)

Sol.



Resultant dipole moment = 0.80×10^{-30} Cm



Resultant dipole moment = 4.90×10^{-30} cm

66. Given below are two statements:

Statement I : On passing $HCl_{(g)}$ through a saturated solution of $BaCl_2$, at room temperature white turbidity appears.

Statement II : When HCl gas is passed through a saturated solution of NaCl, sodium chloride is precipitated due to common ion effect.

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

(1) **Statement I** is correct but **Statement II** is incorrect

(2) Both **Statement I** and **Statement II** are incorrect

(3) **Statement I** is incorrect but **Statement II** is correct

(4) Both **Statement I** and **Statement II** are correct

Ans. (1)

Sol. $BaCl_2$, NaCl are soluble but on adding HCl(g) to $BaCl_2$, NaCl solutions, Sodium or Barium chlorides may precipitate out, as a consequence of the law of mass action.

67. The metal atom present in the complex MABXL (where A, B, X and L are unidentate ligands and M is metal) involves sp^3 hybridization. The number of geometrical isomers exhibited by the complex is:

(1) 4 (2) 0

(3) 2 (4) 3

Ans. (2)

Sol. Tetrahedral complex does not show geometrical isomerism.

68. Match **List - I** with **List - II**.

	List - I (Pair of Compounds)		**List - II (Isomerism)**
(A)	n-propanol and Isopropanol	(I)	Metamerism
(B)	Methoxypropane and ethoxyethane	(II)	Chain Isomerism
(C)	Propanone and propanal	(III)	Position Isomerism
(D)	Neopentane and Isopentane	(IV)	Functional Isomerism

(1) (A)–(II), (B)–(I), (C)–(IV), (D)–(III)

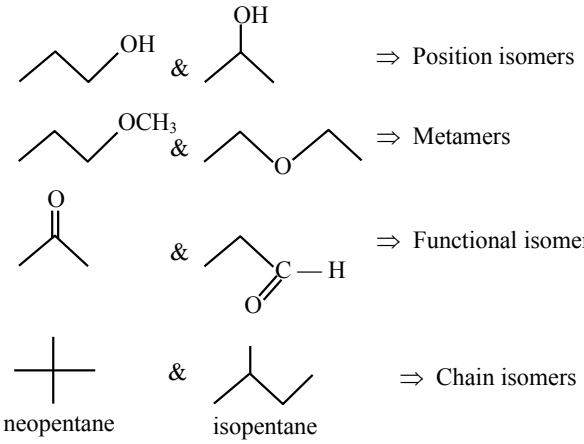
(2) (A)–(III), (B)–(I), (C)–(II), (D)–(IV)

(3) (A)–(I), (B)–(III), (C)–(IV), (D)–(II)

(4) (A)–(III), (B)–(I), (C)–(IV), (D)–(II)

Ans. (4)

Sol.



69. The quantity of silver deposited when one coulomb charge is passed through $AgNO_3$ solution:

(1) 0.1 g atom of silver

(2) 1 chemical equivalent of silver

(3) 1 g of silver

(4) 1 electrochemical equivalent of silver

Ans. (4)

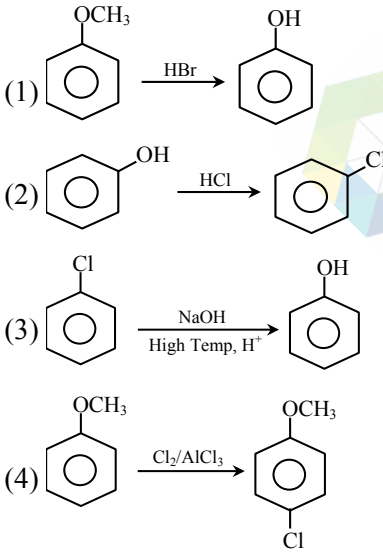
Sol. $W = ZIt$

$W = ZQ$

$Q = \frac{W}{Z}$

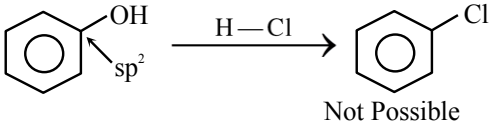
$W = ZQ$ = (electrochemical equivalent)

70. Which one of the following reactions is NOT possible?



Ans. (2)

Sol.



Not Possible

71. Given below are two statements :

Statement I : The metallic radius of Na is 1.86 A° and the ionic radius of Na^+ is lesser than 1.86 A°.

Statement II : Ions are always smaller in size than the corresponding elements.

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

(1) **Statement I** is correct but **Statement II** is false

(2) Both **Statement I** and **Statement II** are true

(3) Both **Statement I** and **Statement II** are false

(4) **Statement I** is incorrect but **Statement II** is true

Ans. (1)

Sol. $r_{Na} > r_{Na^+}$

So, Statement (I) is correct but size of anions are greater than size of neutral atoms.

So statement (II) is incorrect.

72. $CH_3CH_2–OH \xrightarrow[\text{(ii) } KMnO_4]{\text{(i) Jone's Reagent}} P$

(iii)NaOH, CaO,Δ

Consider the above reaction sequence and identify the major product P.

(1) Methane (2) Methanal

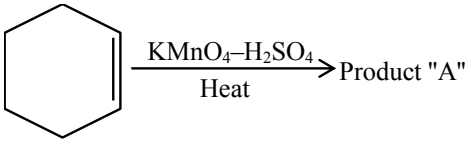
(3) Methoxymethane (4) Methanoic acid

Ans. (1)

Sol. $CH_3 — CH_2 — OH \xrightarrow[KMnO_4]{\text{Joner reagent } (CrO_3 + H^{\oplus})} CH_3 — \overset{O}{\overset{\|}{C}} — OH$

$CH_3 — \overset{O}{\overset{\|}{C}} — OH \xrightarrow[\text{lime process}]{\text{Soda}} \xrightarrow[CaI\ \Delta]{NaOH} CH_4 + Na_2CO_3$

73. Consider the given chemical reaction :



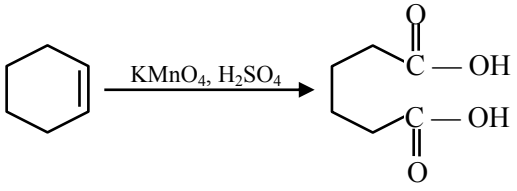
Product "A" is :

(1) picric acid (2) oxalic acid

(3) acetic acid (4) adipic acid

Ans. (4)

Sol.



74. For the electro chemical cell
$M|M^{2+}||X|X^{2-}$
If $E^0_{(M^{2+}/M)} = 0.46\,V$ and $E^0_{(X/X^{2-})} = 0.34V$.
Which of the following is **correct** ?
(1) $E_{cell} = -0.80$ V
(2) $M + X \rightarrow M^2 + X^{2-}$ is a spontaneous reaction
(3) $M^{2+} + X^{2-} \rightarrow M + X$ is a spontaneous reaction
(4) $E_{cell} = 0.80$ V

Ans. **(3)**

Sol. $M \mid M^{+2} \parallel X / X^{2-}$
$E^o_{cell} = E^o_{M/M^{+2}} + E^o_{X/X^{-2}}$
$= -0.46 + 0.34 = -0.12V$
As E^o_{cell} is negative so anode becomes cathode and cathode become anode. Spontaneous reaction will be
$M^{+2} + X^{2-} \longrightarrow M + X$

75. The number of moles of methane required to produce 11g $CO_2(g)$ after complete combustion is:
(Given molar mass of methane in g mol^{-1} : 16)
(1) 0.75 (2) 0.25
(3) 0.35 (4) 0.5

Ans. **(2)**

Sol. $C_nH_{2n+2} + \frac{3n+1}{2} O_2 \longrightarrow nCO_2 + (n+1)H_2O$
$CH_4 + 2O_2 \longrightarrow CO_2 + 2H_2O$
4gm 11gm
0.25 mole 0.25 mole
0.25 mole CH_4 gives 0.25 mole (or 11gm) CO_2

76. The number of complexes from the following with no electrons in the t_2 orbital is _____.
$TiCl_4$, $[MnO_4]^-$, $[FeO_4]^{2-}$, $[FeCl_4]^-$, $[CoCl_4]^{2-}$
(1) 3 (2) 1
(3) 4 (4) 2

Ans. **(1)**

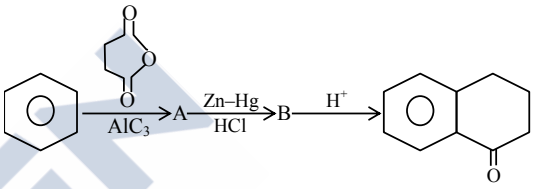
Sol. $TiCl_4 \Rightarrow Ti^{+4}$ $e^0t_2^0$
$MnO_4^- \Rightarrow Mn^{+7}$ $e^0t_2^0$
$FeO_4^{2-} \Rightarrow Fe^{+6}$ $e^2t_2^0$
$FeCl_4^{2-} \Rightarrow Fe^{+2}$ $e^3t_2^3$
$CoCl_4^{2-} \Rightarrow Co^{+2}$ $e^4t_2^3$

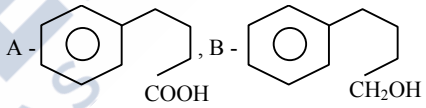
77. The number of ions from the following that have the ability to liberate hydrogen from a dilute acid is _____. Ti^{2+}, Cr^{2+} and V^{2+}
(1) 0 (2) 2
(3) 3 (4) 1

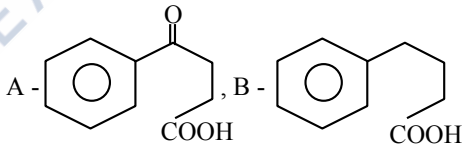
Ans. **(3)**

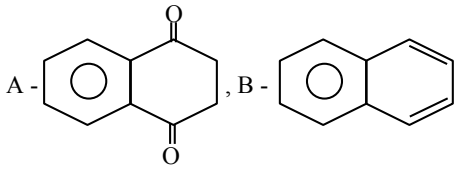
Sol. The ions Ti^{+2}, V^{+2} Cr^{+2} are strong reducing agents and will liberate hydrogen from a dilute acid, eg.
$2Cr^{+2}_{(aq.)} + 2H^+_{(aq.)} \longrightarrow 2Cr^{+3}_{(aq.)} + H_2(g)$

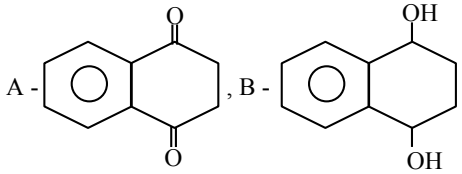
78. Identify A and B in the given chemical reaction sequence : -



(1) 

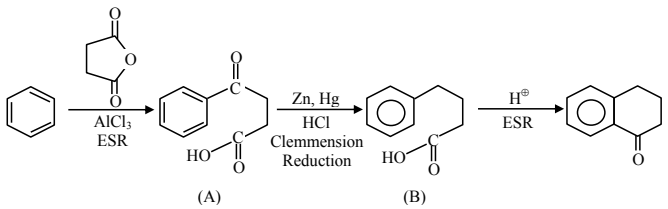
(2) 

(3) 

(4) 

Ans. **(2)**

Sol.



79. The correct statements from the following are :

(A) The decreasing order of atomic radii of group 13 elements is Tl > In > Ga > Al > B.

(B) Down the group 13 electronegativity decreases from top to bottom.

(C) Al dissolves in dil. HCl and liberate H_2 but conc. HNO_3 renders Al passive by forming a protective oxide layer on the surface.

(D) All elements of group 13 exhibits highly stable +1 oxidation state.

(E) Hybridisation of Al in $[Al(H_2O)_6]^{3+}$ ion is sp^3d^2.

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

(1) (C) and (E) only

(2) (A), (C) and (E) only

(3) (A), (B), (C) and (E) only

(4) (A) and (C) only

Ans. **(1)**

Sol. A. size order Tℓ > In > Al > Ga > B

B. Electronegativity order B > Al < Ga < In < Tℓ

D. B, Al are more stable in +3 oxidation state

So, only C, E statements are correct.

80. Coagulation of egg, on heating is because of :

(1) Denaturation of protein occurs

(2) The secondary structure of protein remains unchanged

(3) Breaking of the peptide linkage in the primary structure of protein occurs

(4) Biological property of protein remains unchanged

Ans. **(1)**

Sol. Coagulation of egg give primary structure of protein, which is known as denaturation of protein

SECTION-B

81. Combustion of 1 mole of benzene is expressed at

$$C_6H_6(1)+\frac{15}{2}O_2(g)\rightarrow CO_2(g)+3H_2O(1).$$

The standard enthalpy of combustion of 2 mol of benzene is – 'x' kJ.

x = _____.

(1) standard Enthalpy of formation of 1 mol of $C_6H_6(1)$, for the reaction
$6C(graphite)+3H_2(g)\rightarrow C_6H_6(1)$ is 48.5 kJ mol^{-1}.

(2) Standard Enthalpy of formation of 1 mol of $CO_2(g)$, for the reaction
$C(graphite)+O_{2(g)}\rightarrow CO_2(g)$ is –393.5 kJ mol^{-1}.

(3) Standard and Enthalpy of formation of 1 mol of $H_2O(1)$, for the reaction
$H_2(g)+\frac{1}{2}O_2(g)\rightarrow H_2O(1)$ is –286 kJ mol^{-1}.

Ans. **(6535)**

Sol. $6C(graphite)+3H_2(g) \rightarrow C_6H_6(\ell)$; $\Delta H = 48.5$ kJ/mol

$C(graphite)+O_2(g)\rightarrow CO_2(g)$; $\Delta H = -393.5$ kJ/mol

$H_2^{(g)}+\frac{1}{2}(g)\longrightarrow H_2O(\ell)$; $\Delta H = -286$ kJ/mol

equation $-(1)\times 1+(2)\times 6+(3)\times 3$

$-48.5-6\times 393.5-3\times 286$

$= -3267.5$ kJ for 1 mol

$= -6535$ kJ for 2 mol

Ans. 6535 kJ

82. The fusion of chromite ore with sodium carbonate in the presence of air leads to the formation of products A and B along with the evolution of CO_2. The sum of spin-only magnetic moment values of A and B is ___ B.M. (Nearest integer)

(Given atomic number : C : 6, Na : 11, O : 8, Fe : 26, Cr : 24]

Ans. **(6)**

Sol. $4FeCr_2O_4 + 8Na_2CO_3 + 7O_2 \rightarrow$

$8Na_2CrO_4 + 2Fe_2O_3 + 8CO_2$

A B

Spin only magnetic moment

For Na_2CrO_4 $\mu_B = 0$

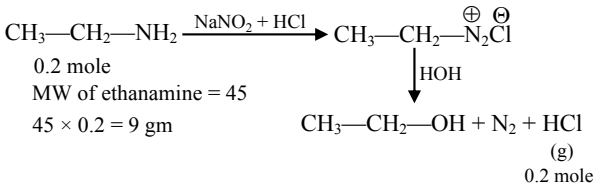
For Fe_2O_3 $\mu_B = 5.9$

sum = 5.9

83. X of enthanamine was subjected to reaction with $NaNO_2/HCl$ followed by hydrolysis to liberate N_2 and HCl. The HCl generated was completely neutralised by 0.2 moles of NaOH. X is ____ g.

Ans. **(9)**

Sol.



84. In an atom, total number of electrons having quantum numbers n = 4, $|m_l| = 1$ and $m_s = -\frac{1}{2}$ is

Ans. **(6)**

Sol. n = 4

ℓ	m_ℓ
0	0
1	–1, 0, +1
2	–2, –1, 0, +1, +2, +3

So number of orbital associated with

n = 4, $|m_\ell| = 1$ are 6

Now each orbital contain one e^- with $m_s = -\frac{1}{2}$

85. Using the given figure, the ratio of R_f values of sample A and sample C is $x \times 10^{-2}$. Value of x is _____.

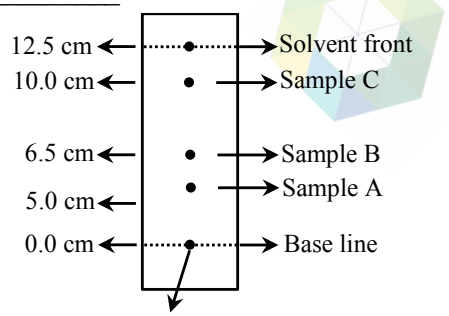


Fig : Paper chromatography of Samples

Ans. **(50)**

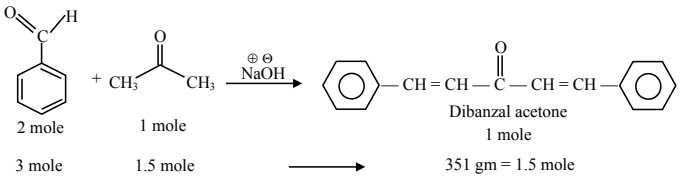
Sol. R_f of A = $\frac{5}{12.5}$ R_f of C = $\frac{10}{12.5}$

Ratio = $\frac{R_{f(A)}}{R_{f(C)}} = \frac{1}{2} = 0.5$ or 50×10^{-2}

86. In the Claisen-Schmidt reaction to prepare 351 g of dibenzalacetone using 87 g of acetone, the amount of benzaldehyde required is _____g. (Nearest integer)

Ans. **(318)**

Sol. Claisen Schmidt reaction



mw of benzaldehyde = 106

106 × 3 = 318 gm. Benzaldehyde is required to give 1.5 mole (or 351 gm) product

87. Consider the following single step reaction in gas phase at constant temperature.

$2A_{(g)} + B_{(g)} \rightarrow C_{(g)}$

The initial rate of the reaction is recorded as r_1 when the reaction starts with 1.5 atm pressure of A and 0.7 atm pressure of B. After some time, the rate r_2 is recorded when the pressure of C becomes 0.5 atm. The ratio $r_1 : r_2$ is _____ $\times 10^{-1}$. (Nearest integer)

Ans. **(315)**

Sol. $2A(g) + B(g) \longrightarrow C(g)$

r_1	1.5 atm	0.7 atm	
r_2	0.5 atm	0.2 atm	0.5 atm

$\because r = K[P_A]^2[P_B]$

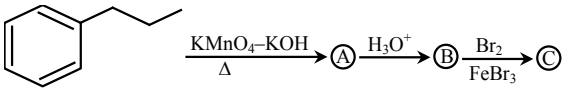
$r_1 = K[1.5]^2[0.7]$

$r_2 = K[0.5]^2[0.2]$

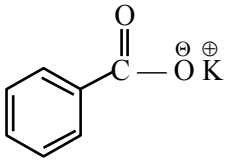
$\frac{r_1}{r_2} = 9 \times \frac{7}{2} = 31.5 = 315 \times 10^{-1}$

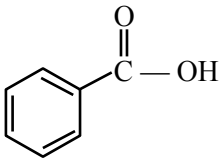
Ans. 315

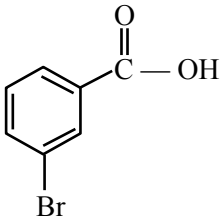
88. The product © in the following sequence of reactions has _____ π bonds.



Ans. (4)

Sol. A = 

B = 

C = 

π bonds = 4

89. Considering acetic acid dissociates in water, its dissociation constant is 6.25×10^{-5}. If 5 mL of acetic acid is dissolved in 1 litre water, the solution will freeze at $-x \times 10^{-2}$ °C, provided pure water freezes at 0 °C.

x = _____. (Nearest integer)

Given : $(K_f)_{water} = 1.86$ K kg mol^{-1}.

density of acetic acid is 1.2 g mol^{-1}

molar mass of water = 18 g mol^{-1}.

molar mass of acetic acid = 60 g mol^{-1}.

density of water = 1 g cm^{-3}

Acetic acid dissociates as

$$CH_3COOH \rightleftharpoons CH_3COO^{\ominus} + H^{\oplus}$$

Ans. (19)

Sol. Mass of CH_3COOH = V × d

= 5 ml × 1.2 g/ml

= 6 gm

$$n_{CH_3COOH} = \frac{6}{60} = 0.1 mol$$

$$m_{CH_3COOH} \approx M_{CH_3COOH} = \frac{0.1}{1} = 0.1M$$

$$CH_3COOH \rightleftharpoons CH_3COO^- + H^+$$

C

C – Cα Cα Cα

$$K_a = \frac{C\alpha^2}{1-\alpha}$$

$1 - \alpha \approx 1 \Rightarrow K_a = C\alpha^2$

$$\alpha = \sqrt{\frac{Ka}{C}} = \sqrt{\frac{6.25\times10^{-5}}{0.1}} = 25 \times 10^{-3}$$

V.f. (i) = 1 + α(n – 1) = 1 + α(2 – 1) = 1 + α

$= 1 + 25 \times 10^{-3} = 1.025$

$\Delta T_f = iK_f m$

= (1.025)(1.86)(0.1)

= 0.19

$= 19 \times 10^{-2}$

90. Number of compounds from the following with zero dipole moment is _____.

HF, H_2, H_2S, CO_2, NH_3, BF_3, CH_4, $CHCl_3$, SiF_4, H_2O, BeF_2

Ans. (6)

Sol. H_2, CO_2, BF_3, CH_4, SiF_4 , BeF_2

are symm. molecule so dipole moment is zero