JEE–MAIN EXAMINATION – APRIL 2025

(HELD ON TUESDAY 08th APRIL 2025) **TIME : 3:00 PM TO 6:00 PM**

CHEMISTRY — TEST PAPER WITH SOLUTION

SECTION-A

51. In a first order decomposition reaction, the time taken for the decomposition of reactant to one fourth and one eighth of its initial concentration are t_1 and t_2 (s), respectively. The ratio t_1/t_2 will :

(1) $\frac{4}{3}$ (2) $\frac{3}{2}$

(3) $\frac{3}{4}$ (4) $\frac{2}{3}$

Ans. (4)

Sol. For Ist order reaction

When $C_t = Co/4$

$t_1 = 2t_{50\%}$.

when $C_t = Co/8$

$t_2 = 3t_{50\%}$

so $\frac{t_1}{t_2} = \frac{2}{3}$

52. Match the **LIST-I** with **LIST-II**

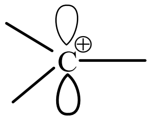
	LIST-I		LIST-II
A.	Carbocation	I.	Species that can supply a pair of electrons.
B.	C-Free radical	II.	Species that can receive a pair of electrons.
C.	Nucleophile	III.	sp^2 hybridized carbon with empty p-orbital.
D.	Electrophile	IV	sp^2/sp^3 hybridized carbon with one unpaired electron.

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

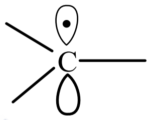
(1) A-IV, B-II, C-III, D-I
(2) A-II, B-III, C-I, D-IV
(3) A-III, B-IV, C-II, D-I
(4) A-III, B-IV, C-I, D-II

Ans. (4)

Sol. (A) Carbocation $\rightarrow sp^2$ hybridised carbon with empty P-orbital



(B) Carbon free radical $\rightarrow sp^2/sp^3$ hybridised carbon with one unpaired electron.



(C) Nuecleophile $\rightarrow$ species of that can supply a pair of electron.

(D) Electrophile $\rightarrow$ species that can receive a pair of electron.

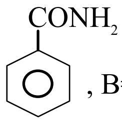
53. $A \xrightarrow[(ii)H_3O^+]{(i)NaOH} B \xrightarrow[(ii)H_2SO_4,\Delta]{(i)EtOH} C$

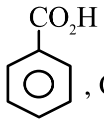
'A' shows positive Lassaign's test for N and its molar mass is 121.

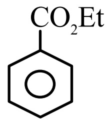
'B' gives effervescence with aq. $NaHCO_3$.

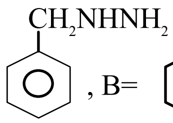
'C' gives fruity smell.

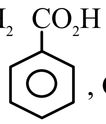
Identify A, B and C from the following.

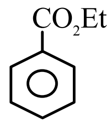
(1) A= 

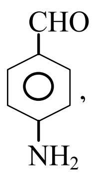
, B= 

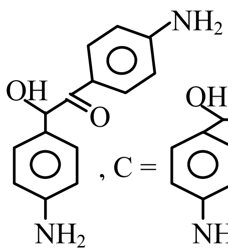
, C= 

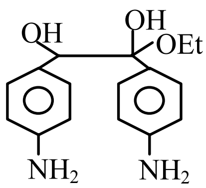
(2) A= 

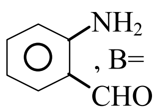
, B= 

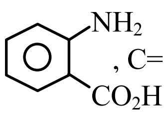
, C= 

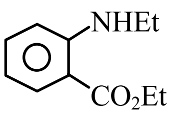
(3) A= 

, B= 

, C = 

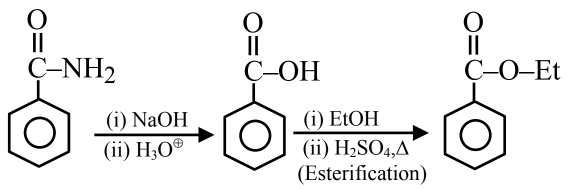
(4) A= 

, B= 

, C= 

Ans. (1)

Sol.



(A) (B) (C)

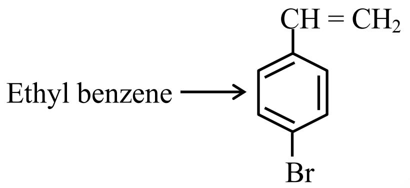
Molar mass = 121

A → Benzamide Shows positive Lassaigh's test.

B → Benzoic acid gives effervescence with aq. $NaHCO_3$.

C → Ester gives fruity smell.

54. Choose the correct set of reagents for the following conversion.



(1) Br_2/Fe ; Cl_2, Δ ; alc. KOH

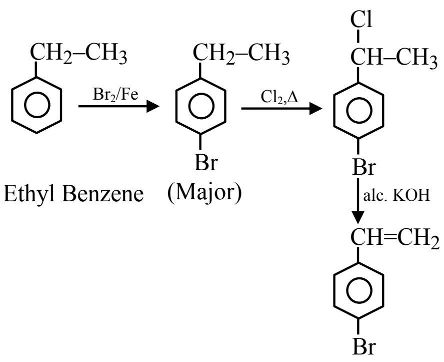
(2) Cl_2/Fe ; Br_2/anhy.$AlCl_3$; aq. KOH

(3) Br_2/anhy.$AlCl_3$; Cl_2, Δ ; aq. KOH

(4) Cl_2/anhy.$AlCl_3$; Br_2/Fe ; alc. KOH

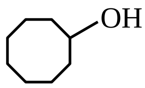
Ans. (1)

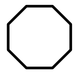
Sol.

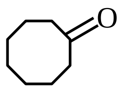


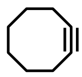
55. 1, 2-dibromocyclooctane $\xrightarrow[\text{(ii) NaNH}_2 \;\text{(iii) Hg}^{2+}/\text{H}^+ \;\text{(iv) Zn-Hg/H}^+]{\text{(i) KOH (alc.)}}$ P (Major product)

'P' is

(1) 

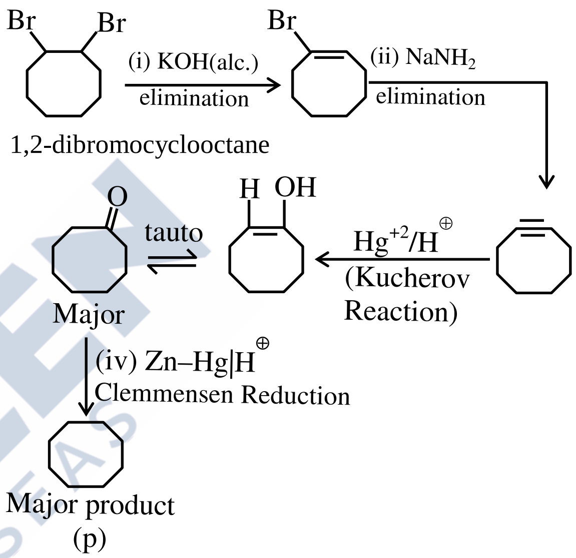
(2) 

(3) 

(4) 

Ans. (2)

Sol.



56. Given below are two statements :

Statement I : A homolepitc octahedral complex, formed using monodentate ligands, will not show stereoisomerism.

Statement II : cis– and trans– platin are heteroleptic complexes of Pd.

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

(1) Both statement I and Statement II are false.

(2) Statement I is false but Statement II is true.

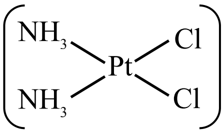
(3) Both statement I and Statement II are true.

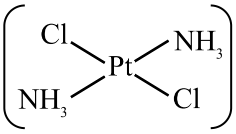
(4) Statement I is true but Statement II is false.

Ans. (4)

Sol. Homoleptic complex of type $[Ma_6]$ (Where a $\Rightarrow$ monodentate ligand) cannot show geometrical as well as optical isomerism.

Cis-platin and trans-platin has formula $[Pt(NH_3)_2Cl_2]$ which is a heteroleptic complex of platinum.


Cis-platin


Trans-platin

57. The atomic number of the element from the following with lowest 1st ionisation enthalpy is :

(1) 32 (2) 35

(3) 87 (4) 19

Ans. **(3)**

Sol. Atomic no. 32 $\Rightarrow$ Ge

Atomic no. 35 $\Rightarrow$ Br

Atomic no. 87 $\Rightarrow$ Fr

Atomic no. 19 $\Rightarrow$ K

Lowest first I.E. among the given element will be of Fr [87].

Fr – [Rn] $7s^1$

58. Which of the following binary mixture does not show the behaviour of minimum boiling azeotropes ?

(1) $H_2O + CH_3COC_2H_5$

(2) $C_6H_5OH + C_6H_5NH_2$

(3) $CS_2 + CH_3COCH_3$

(4) $CH_3OH + CHCl_3$

Ans. **(2)**

Sol. Binary mixture of C_6H_5OH and $C_6H_5NH_2$ shows negative deviation from Raoult's law

So vapour pressure of solution is less than V.P of pure C_6H_5OH & $C_6H_5NH_2$

So B.P. of solution is greater than boiling point of pure C_6H_5OH & $C_6H_5NH_2$

So shows maximum Boiling azeotrope

59. $HA(aq) \rightleftharpoons H^+(aq) + A^-(aq)$

The freezing point depression of a 0.1 m aqueous solution of a monobasic weak acid HA is 0.20°C. The dissociation constant for the acid is

Given :

$K_f(H_2O) = 1.8$ K kg mol^{-1}, molality $\equiv$ molarity

(1) 1.38×10^{-3}

(2) 1.1×10^{-2}

(3) 1.90×10^{-3}

(4) 1.89×10^{-1}

Ans. **(1)**

Sol. $\Delta T_f = ik_fm$

$0.2 = i \times 1.8 \times 0.1$

$$i = \frac{20}{18} = \frac{10}{9}$$

For $HA_{(aq)} \rightleftharpoons H^+_{(aq)} + A^-_{(aq)}$

t=0 1

t= t_{eq} $1-\alpha$ α α

$i = 1 + \alpha$

$$\frac{10}{9} = 1 + \alpha$$

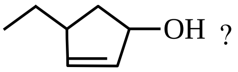
$$\alpha = \frac{1}{9}$$

$$K_{eq} = \frac{[H^+][A^-]}{[HA]} = \frac{C\alpha^2}{1-\alpha}$$

$$= \frac{0.1\left(\frac{1}{9}\right)^2}{1-\frac{1}{9}} = \frac{1}{720}$$

$K_{eq.} = 1.38 \times 10^{-3}$

60. What is the correct IUPAC name of



(1) 4-Ethyl-1-hydroxycyclopent-2-ene

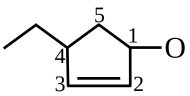
(2) 1-Ethyl-3-hydroxycyclopent-2-ene

(3) 1-Ethylcyclopent-2-en-3-ol

(4) 4-Ethylcyclopent-2-en-1-ol

Ans. (4)

Sol.



4-Ethylclopent-2-en-1-ol

61. The correct decreasing order of spin only magnetic moment values (BM) of Cu^{+}, Cu^{2+}, Cr^{2+} and Cr^{3+} ions is :

(1) $Cu^{+} > Cu^{2+} > Cr^{3+} > Cr^{2+}$

(2) $Cu^{2+} > Cu^{+} > Cr^{2+} > Cr^{3+}$

(3) $Cr^{2+} > Cr^{3+} > Cu^{2+} > Cu^{+}$

(4) $Cr^{3+} > Cr^{2+} > Cu^{+} > Cu^{2+}$

Ans. (3)

Sol. Cu^{+} : [Ar] $3d^{10}$, Spin only magnetic moment = 0 B.M.

Cu^{+2} : [Ar] $3d^{9}$, Spin only magnetic moment = $\sqrt{3}$ B.M.

Cr^{+2} : [Ar] $3d^{4}$, Spin only magnetic moment = $\sqrt{24}$ B.M.

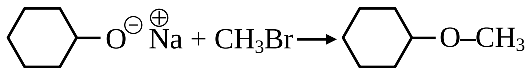
Cr^{+3} : [Ar] $3d^{3}$, Spin only magnetic moment = $\sqrt{15}$ B.M.

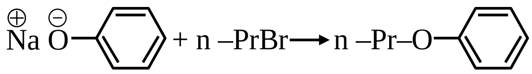
Order of μ : $Cr^{+2} > Cr^{+3} > Cu^{+2} > Cu^{+}$

62. Which one of the following reactions will not lead to the desired ether formation in major proportion?

(iso-Bu $\Rightarrow$ isobutyl, sec-Bu $\Rightarrow$ sec-butyl, nPr $\Rightarrow$ n-propyl, ^{t}Bu $\Rightarrow$ tert-butyl, Et $\Rightarrow$ ethyl)

(1) $^{t}Bu\overset{\ominus}{O}\overset{\oplus}{Na} + EtBr \longrightarrow {}^{t}Bu\text{–O–Et}$

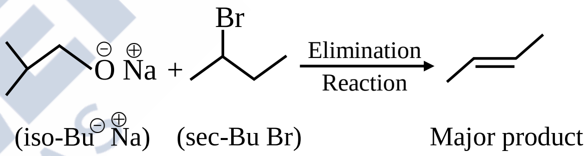
(2) 

(3) 

(4) iso-Bu$\overset{\ominus}{O}\overset{\oplus}{Na}$ + sec – BuBr $\longrightarrow$ Sec–Bu–O–iso–Bu

Ans. (4)

Sol.



63. On combustion 0.210 g of an orgainc compound containing C, H and O gave 0.127 g H_2O and 0.307 g CO_2. The percentages of hydrogen and oxygen in the given organic compound respectively are:

(1) 53.41, 39.6 (2) 6.72, 53.41

(3) 7.55, 43.85 (4) 6.72, 39.87

Ans. (2)

Sol. In the combustion of organic compound, all "C" in CO_2 and all "H" in H_2O comes from organic compound

$$\underset{0.210\,gm}{C_xH_yO_z} + O_2 \longrightarrow \underset{0.307\,gm}{CO_2} + \underset{0.127\,gm}{H_2O}$$

Weight of "C" in $CO_2 = \frac{12}{44} \times 0.307$

= 0.0837 gm

Weight of "H" in $H_2O = \frac{2}{18} \times 0.127 = 0.0141g$

% 'H' in compound = $\dfrac{0.0141}{0.21} \times 100 = 6.719\ \%$

$= 6.72\ \%$

Weight of "O" in compound

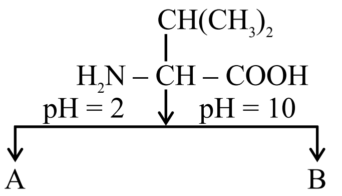
$= 0.210 - (0.0837 + 0.0141)$

$= 0.1122$

% of "O" in compound $= \dfrac{0.1122}{0.21} \times 100$

$= 53.41\ \%$

64.



Choose the correct option for structures of A and B, respectively.

(1) $H_3\overset{+}{N} - \underset{CH(CH_3)_2}{CH} - COOH$ and $H_2N - \underset{CH(CH_3)_2}{CH} - CO\bar{O}$

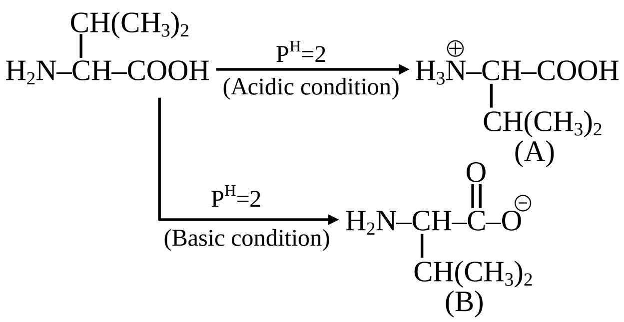
(2) $H_2N - \underset{CH(CH_3)_2}{CH} - CO\bar{O}$ and $H_3\overset{+}{N} - \underset{CH(CH_3)_2}{CH} - COOH$

(3) $H_2N - \underset{CH(CH_3)_2}{CH} - CO\overset{\ominus}{O}$ and $H_3\overset{+}{N} - \underset{CH(CH_3)_2}{CH} - CO\bar{O}$

(4) $H_3\overset{+}{N} - \underset{CH(CH_3)_2}{CH} - CO\bar{O}$ and $H_3\overset{+}{N} - \underset{CH(CH_3)_2}{CH} - COOH$

Ans. **(1)**

Sol.



65. Correct statements for an element with atomic number 9 are

A. There can be 5 electrons for which $m_s = +\frac{1}{2}$ and 4 electrons for which $m_s = -\frac{1}{2}$

B. There is only one electron in p_z orbital

C. The last electron goes to orbital with n = 2 and $l = 1$

4. The sum of angular nodes of all the atomic orbitals is 1.

Choose the correct answer from the options given below:

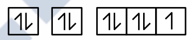
(1) C and D Only (2) A and C Only

(3) A, C and D Only (4) A and B Only

Ans. **(2)**

Sol. Element with atomic number 9 is Fluorine

$F(9) = 1s^2\ 2s^2\ 2p^5$



(A) 5 electrons can be up-spin $\left[m_s = +\frac{1}{2}\right]$ and 4 electrons can be down spin $\left[m_s = -\frac{1}{2}\right]$

(B) Unpaired electron can be in anyone of p_x, p_y or p_z orbital

(C) Last electron is in 2p subshell with n = 2, $\ell = 1$

(D) Angular node for s-orbital = 0 while of each p-orbital = 1

Sum of all angular node = 3

66. The number of species from the following that are involved in sp^3d^2 hybridization is

$[Co(NH_3)_6]^{3+}$, SF_6, $[CrF_6]^{3-}$, $[CoF_6]^{3-}$, $[Mn(CN)_6]^{3-}$ and $[MnCl_6]^{3-}$

(1) 5 (2) 6

(3) 4 (4) 3

Allen Ans. (4)

NTA Ans. (3)

Sol. In $[Co(NH_3)_6]^{3+}$, Co^{+3} : $[Ar]3d^6$, NH_3 is S.F.L

Hybridisation state of Co^{3+} is d^2sp^3

In SF_6 , Hybridisation state of sulphur is sp^3d^2

In $[CrF_6]^{3-}$, Cr^{+3} : $[Ar]3d^3$

Hybridisation state of Cr^{3+} is d^2sp^3

$[CoF_6]^{3-}$, Co^{+3} : $[Ar]3d^6$ F^- is W.F.L

Hybridisation state of Co^{3+} is sp^3d^2

$[Mn(CN)_6]^{3-}$, Mn^{+3} : $[Ar]3d^4$ CN^- is S.F.L

Hybridisation state of Mn^{3+} is d^2sp^3

$[MnCl_6]^{3-}$, Mn^{+3} : $[Ar]3d^4$ Cl^- is W.F.L

Hybridisation state of Cl^- is sp^3d^2

Total number of sp^3d^2 hybridized molecules is 3

67. Match the **LIST-I** with **LIST-II**

	LIST-I (Reagent)		LIST-II (Functional Group detected)
A.	Sodium bicarbonate solution	I.	double bond/unsaturation
B.	Neutral ferric chloride	II.	carboxylic acid
C.	ceric ammonium nitrate	III.	phenolic - OH
D.	alkaline $KMnO_4$	IV	alcoholic - OH

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

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

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

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

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

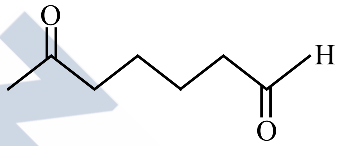
Ans. **(1)**

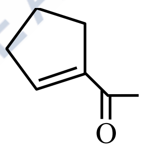
Sol. (1) Carboxylic acid gives efferve scence with sodium bicarbonate solution

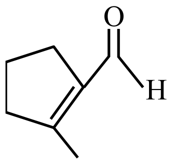
(2) Phenolic-OH gives voilet coloured complex with Neutral $FeCl_3$.

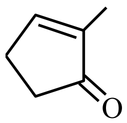
(3) Alcoholic-OH gives Red colour with cerric ammonium Nitrate.

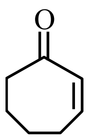
(4) When alkaline $KMnO_4$ reacts with an unsaturated compound (Alkene or alkyne) the purple colour of $KMnO_4$ solution disappears, indicating positive test for unsaturation.

68. When  undergoes intramolecular aldol condensation, the major product formed is :

(1) 

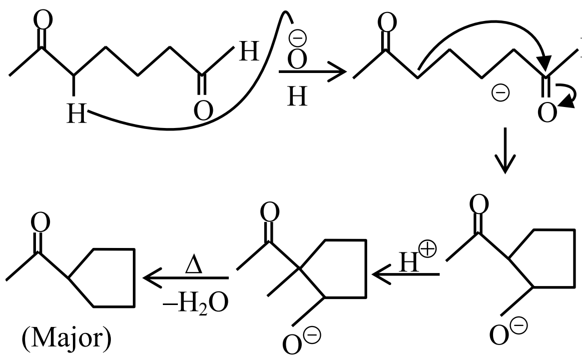
(2) 

(3) 

(4) 

Ans. (1)

Sol. Aldol condensation reaction



69. Match the **LIST-I** with **LIST-II**

LIST-I (Complex/Species)		**LIST-II (Shape & magnetic moment)**	
A.	$[Ni(CO)_4]$	I.	Tetrahedral, 2.8 BM
B.	$[Ni(CN)_4]^{2-}$	II.	Square planar, 0 BM
C.	$[NiCl_4]^{2-}$	III.	Tetrahedral, 0 BM
D.	$[MnBr_4]^{2-}$	IV	Tetrahedral, 5.9 BM

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

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

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

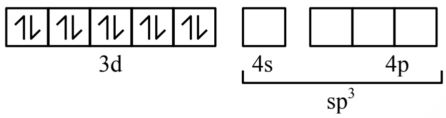
(3) A-III, B-II, C-I, D-IV

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

Ans. **(3)**

Sol. (A) $[Ni(CO)_4]$, Ni^0 : $[Ar]3d^8\,4s^2$

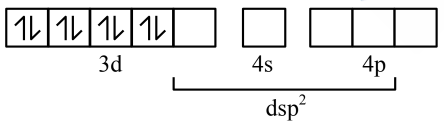
Valence orbitals of Ni^0 in pre-hybridisation state :



Tetrahedral, Diamagnetic, $\mu = 0$ B.M.

(B) $[Ni(CN)_4]^{2-}$, Ni^{+2} : $[Ar]3d^8 4s^0$

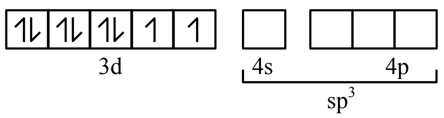
Valence orbitals of Ni^{+2} in pre-hybridisation state :



Square planar, Diamagnetic, $\mu = 0$ B.M.

(C) $[NiCl_4]^{2-}$, Ni^{+2} : $[Ar]3d^8 4s^0$

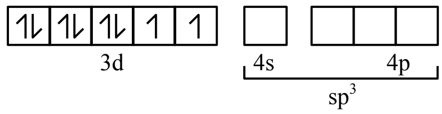
Valence orbitals of Ni^{+2} in ground state :



Tetrahedral, paramagnetic, $\mu = \sqrt{8} = 2.8$ B.M.

(D) $[MnBr_4]^{2-}$, Mn^{+2} : $[Ar]3d^5$

Valence orbitals of Mn^{+2} in ground state :



Tetrahedral, paramagnetic, $\mu = \sqrt{35} = 5.9$ B.M.

70. Given below are two statements :

Statement I : H_2Se is more acidic than H_2Te.

Statement II : H_2Se has higher bond enthalpy for dissociation than H_2Te.

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

(1) Both statement I and Statement II are false.

(2) Both statement I and Statement II are true.

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

(4) Statement I is false but Statement II is true.

Ans. **(4)**

Sol. Acidic strength : $H_2Se < H_2Te$

$\Delta_{dis}H$: H_2Se > H_2Te

[276 KJ/mol] [238 KJ/mol]

SECTION-B

71. Resonance in X_2Y can be represented as

$$\overset{\ominus}{\underset{\cdot\cdot}{\ddot{X}}} = \overset{\oplus}{X} = \underset{\cdot\cdot}{\ddot{Y}} \longleftrightarrow :X \equiv \overset{\oplus}{X} - \overset{\ominus}{\underset{\cdot\cdot}{\ddot{Y}}}:$$

The enthalpy of formation of

$$X_2Y\left(X \equiv X(g) + \frac{1}{2}Y = Y(g) \rightarrow X_2Y(g)\right) \text{ is } 80\text{ kJ mol}^{-1}.$$

The magnitude of resonance energy of X_2Y is ________ kJ mol^{-1} (nearest integer value)

Given : Bond energies of $X \equiv X$, $X = X$, $Y = Y$ and $X = Y$ are 940, 410, 500 and 602 kJ mol^{-1} respectively.

valence X : 3, Y : 2

Ans. **(98)**

Sol. $\Delta H_{R.E} = \Delta H_{f\,(exp)} - \Delta H_{f\,(Theo)}$

$\Delta H_{f\,(exp)}$ for $X_2Y_{(g)} = 80$ kJ/mole

for $\Delta H_{f\,(Theo)}$

$$X_{2(g)} + \frac{1}{2}Y_{2(g)} \rightarrow X_2Y_{(g)}\ \Delta H_f = ?$$

$$\Delta H_{f\,(Theo)} = \left(BE_{X\equiv X} + \frac{1}{2}BE_{Y=Y}\right) - \left(BE_{X=X} + BE_{X=Y}\right)$$

$$= \left(940 + \frac{1}{2}\times 500\right) - (410 + 602)$$

$= 178$ kJ/mole

$\Delta H_{R.E} = 80 - 178$

$= -98$ kJ/mol

$|\Delta H_{R.E}| = 98$

72. The energy of an electron in first Bohr orbit of H-atom is -13.6 eV. The magnitude of energy value of electron in the first excited state of Be^{3+} is ______ eV. (nearest integer value)

Ans. **(54)**

Sol. $E_T = -13.6\dfrac{z^2}{n^2}$ ev

For energy of H-atom, energy of 1st Bohr orbit $E_1 = -13.6$ eV [z = 1, n = 1]

For Be^{+3} ion, energy of Ist E.S. [z = 4, n = 2]

$$\frac{E_H}{E_{Be^{+3}}} = \frac{z_1^2}{n_1^2}\times\frac{n_2^2}{z_2^2}$$

$$\frac{E_H}{E_{Be^{+3}}} = \frac{1}{1}\times\frac{4}{16}$$

$$E_{Be^{+3}} = -13.6\times 4 = -54.4\text{eV}$$

$$|E_{Be^{+3}}| = 54.4\text{eV}$$

73. 20 mL of sodium iodide solution gave 4.74 g silver iodide when treated with excess of silver nitrate solution. The molarity of the sodium iodide solution is ______ M. (Nearest Integer value)

(Given : Na = 23, I = 127, Ag = 108, N = 14, O = 16 g mol^{-1})

Ans. **(1)**

Sol. $NaI_{(aq)} + AgNO_{3(aq)} \rightarrow AgI_{(s)} + NaNO_3(aq)$

M, 20 ml   excess   4.74g

Moles of I^- in NaI = Moles of (I^-) in AgI = $\dfrac{4.74}{235}$

Moles of NaI = $\dfrac{4.74}{235}$

Molarity [NaI] = $\dfrac{4.74}{235\times 0.02} = 1.008$

74. The equilibrium constant for decomposition of $H_2O(g)$

$$H_2O(g) \rightleftharpoons H_2(g) + \frac{1}{2}O_2(g)\ (\Delta G^\circ = 92.34\text{ kJ mol}^{-1})$$

is 8.0×10^{-3} at 2300 K and total pressure at equilibrium is 1 bar. Under this condition, the degree of dissociation (α) of water is _____ $\times 10^{-2}$ (nearest integer value).

[Assume α is negligible with respect to 1]

Ans. **(5)**

Sol. $H_2O(g) \rightleftharpoons H_{2(g)} + \frac{1}{2}O_{2(g)}$

t = 0	1 mole		
$t = t_{eq}$	$1-\alpha$	α	$\frac{\alpha}{2}$

$$n_T = 1 + \frac{\alpha}{2} \simeq 1\ (\alpha << 1)$$

$$k_P = \frac{P_{H_2}\cdot P_{O_2}^{1/2}}{P_{H_2O}} = \frac{(\alpha\cdot P)\left(\frac{\alpha}{2}P\right)^{\frac{1}{2}}}{(1-\alpha)P}$$

P = 1

$$8\times 10^{-3} = \frac{\alpha^{3/2}}{\sqrt{2}}$$

$$\alpha^{3/2} = 8\sqrt{2}\times 10^{-3}$$

$$\alpha^3 = 128 \times 10^{-6}$$

$$\alpha = \sqrt[3]{128}\times 10^{-2}$$

$= 5.03 \times 10^{-2}$

75. Consider the following half cell reaction

$$Cr_2O_7^{2-}(aq) + 6e^- + 14H^+(aq) \rightarrow 2Cr^{3+}(aq) + 7H_2O(l)$$

The reaction was conducted with the ratio of $\frac{[Cr^{3+}]^2}{[Cr_2O_7^{2-}]} = 10^{-6}$. The pH value at which the EMF of the half cell will become zero is ________ . (nearest integer value)

[Given : standard half cell reduction potential $E^o_{Cr_2O_7^{2-}, H^+/Cr^{3+}} = 1.33V, \frac{2.303RT}{F} = 0.059V$]

Ans. (10)

Sol. $Cr_2O_{7(aq)}^{-2} + 14H^+_{(aq)} + 6e^- \rightarrow 2Cr^{+3}_{(aq)} + 7H_2O_{(\ell)}$

$$E_R = E_R^0 - \frac{0.059}{6}\log\frac{[Cr^{+3}]^2}{[Cr_2O_7^{-2}][H^+]^{14}}$$

$$0 = 1.33 - \frac{0.059}{6}\log\frac{10^{-6}}{[H^+]^{14}}$$

$$\frac{1.33\times 6}{0.059} = \log\frac{10^{-6}}{[H]^{14}}$$

$135.254 = -6 - 14 \log [H^+]$

$141.254 = 14$ pH

$$pH = \frac{141.254}{14} = 10.08$$