JEE–MAIN EXAMINATION – APRIL 2025

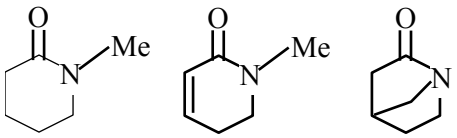
(HELD ON FRIDAY 04th APRIL 2025) **TIME : 3:00 PM TO 6:00 PM**

CHEMISTRY

TEST PAPER WITH SOLUTION

SECTION-A

51. The correct order of basicity for the following molecules is :



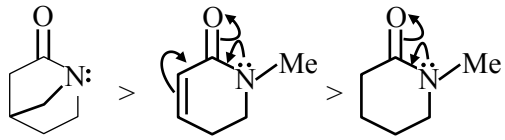
(P) (Q) (R)

(1) P > Q > R (2) R > P > Q

(3) Q > P > R (4) R > Q > P

Ans. **(4)**

Sol.



(R) > (Q) > (P)

(R) According to Bredt's rule it is localised lone pair.

(Q) cross conjugation

52. The incorrect relationship in the following pairs in relation to ionisation enthalpies is :

(1) $Mn^{+} < Cr^{+}$ (2) $Mn^{+} < Mn^{2+}$

(3) $Fe^{2+} < Fe^{3+}$ (4) $Mn^{2+} < Fe^{2+}$

Ans. **(4)**

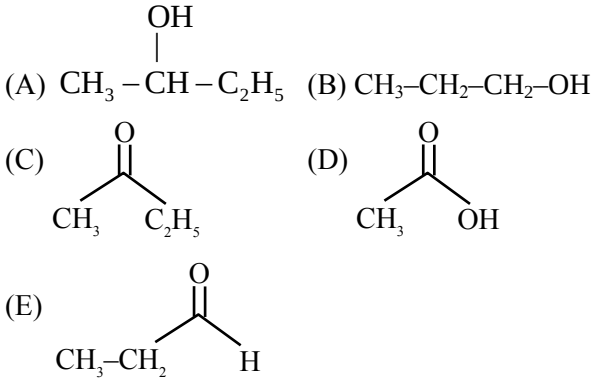
Sol. Mn^{2+} : $[Ar]3d^5$

Half filled stability

More 1E than Fe^{2+}

Fe^{2+} : $[Ar]3d^6$

53. Which among the following compounds give yellow solid when reacted with NaOI/NaOH?



(A) $CH_3-\underset{OH}{\underset{|}{CH}}-C_2H_5$ (B) $CH_3–CH_2–CH_2–OH$

(C) (D)

(E)

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

(1) (B), (C) and (E) Only

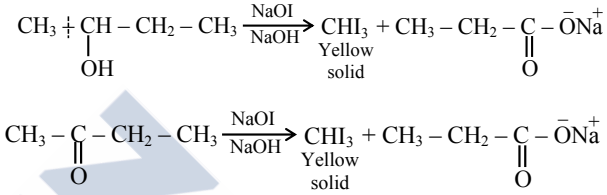
(2) (A) and (C) Only

(3) (C) and (D) Only

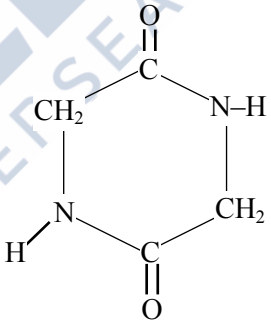
(4) (A), (C) and (D) Only

Ans. **(2)**

Sol.



54. A dipeptide, "x" on complete hydrolysis gives "y" and "z". "y" on treatment with aq. HNO_2 produces lactic acid. On the other hand "z" on heating gives the following cyclic molecule.



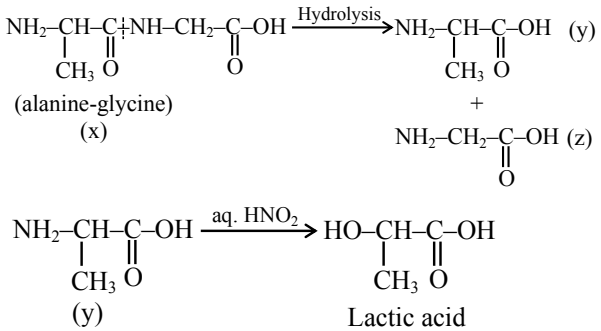
Based on the information given, the dipeptide X is:

(1) valine-glycine (2) alanine-glycine

(3) valine-leucine (4) alanine-alanine

Ans. **(2)**

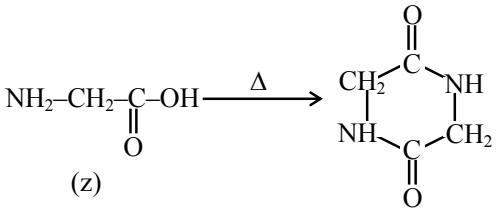
Sol.



(alanine-glycine) (x)

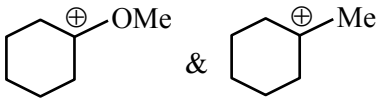
(y) + $NH_2–CH_2–\underset{O}{\underset{\|}{C}}–OH$ (z)

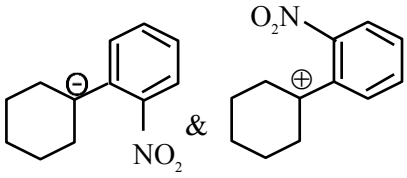
(y) Lactic acid

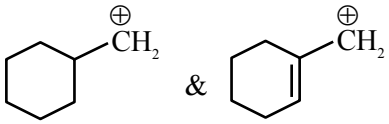


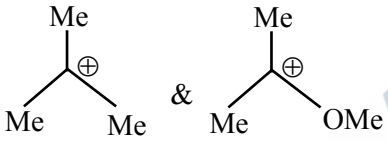
(z)

55. In which pairs, the first ion is more stable than the second ?

(A) 

(B) 

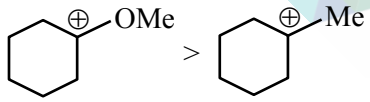
(C) 

(D) 

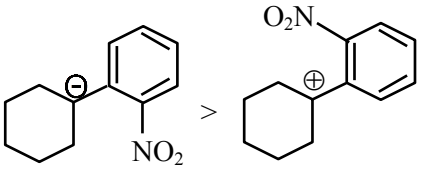
(1) (B) & (D) only (2) (A) & (B) only

(3) (B) & (C) only (4) (A) & (C) only

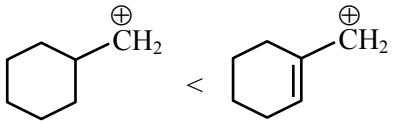
Ans. (2)

Sol. (A) 

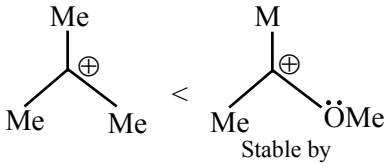
Stable by back bonding

(B) 

Stable by –M, –I effect of NO_2 group

(C) 

Stable by resonance

(D) 

Stable by back bonding

56. Given below are two statements :

Statement (I) : Alcohols are formed when alkyl chlorides are treated with aqueous potassium hydroxide by elimination reaction.

Statement (II) : In alcoholic potassium hydroxide, alkyl chlorides form alkenes by abstracting the hydrogen from the β-carbon.

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 incorrect

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

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

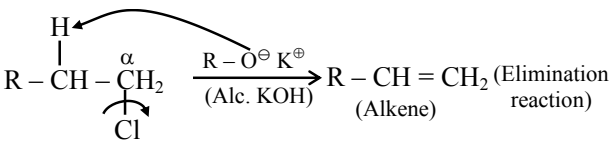
(4) Both **Statement I** and **Statement II** are correct

Ans. (2)

Sol. Statement (I) :

$$R-Cl \xrightarrow{(aq.KOH)} R-OH\,(S_N \text{ reaction})$$

Statement (II) :



57. Given below are two statements :

Statement (I) : Molal depression constant K_f is given by $\frac{M_1RT_f}{\Delta S_{fus}}$, where symbols have their usual meaning.

Statement (II) : K_f for benzene is less than the K_f for water.

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

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

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

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

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

Ans. (4)

Sol. Statement-I

Molar depression constant $k_f = \frac{M_1RT_f^2}{\Delta H_{fus}}$

$$k_f = \frac{M_1RT_f}{\left[\frac{\Delta H_{fus}}{T_f}\right]}$$

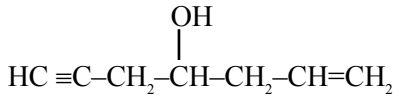
$$k_f = \frac{M_1RT_f}{\Delta S_{fus}}$$

Hence statement-I is correct

but k_f for benzene = $5.12\frac{°C}{molal}$

k_f for water = $1.86\frac{°C}{molal}$ Hence statement- II is incorrect

58. The IUPAC name of the following compound is –



(1) 4-Hydroxyhept-1-en-6-yne

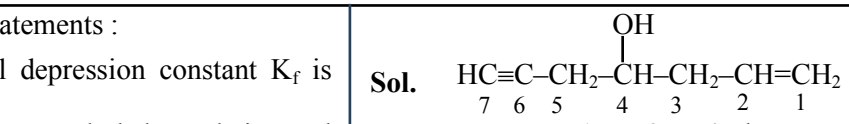
(2) 4- Hydroxyhept-6-en-1-yne

(3) Hept-6-en-1-yn-4-ol

(4) Hept-1-en-6-yn-4-ol

Ans. (4)

Sol.



Hept-1-en-6-yn-4-ol

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

	List-I (Separation of)		**List-II (Separation Technique)**
(A)	Aniline from aniline-water mixture	(I)	Simple distillation
(B)	Glycerol from spent-lye in soap industry	(II)	Fractional distillation
(C)	Different fractions of crude oil in petroleum industry	(III)	Distillation at reduced pressure
(D)	Chloroform-Aniline mixture	(IV)	Steam distillation

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

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

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

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

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

Ans. (1)

Sol. (A) Aniline – H_2O : Steam Distillation

(B) Glycerol from spent-lye in soap industry – Distillation under reduced pressure

(C) Different fraction of crude oil in petroleum industry – Fractional distillation

(D) $CHCl_3$ – Aniline – Simple distillation

60. A toxic compound "A" when reacted with NaCN in aqueous acidic medium yields an edible cooking component and food preservative 'B'. "B" is converted to "C" by diborane and can be used as an additive to petrol to reduce emission. "C" upon reaction with oleum at 140°C yields an inhalable anesthetic "D". Identify "A", "B", "C" and "D", respectively.

(1) Methanol; formaldehyde; methyl chloride; chloroform

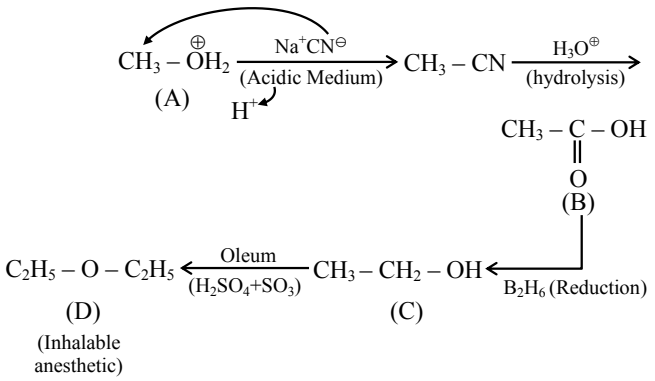
(2) Ethanol; acetonitrile; ethylamine; ethylene

(3) Methanol; acetic acid; ethanol; diethyl ether

(4) Acetaldehyde;2- hydroxypropanoic acid; propanoic acid; dipropyl ether

Ans. (3)

Sol. Methanol (A) → Acetic Acid (B) → Ethanol (C) → Diethylether (D)



61. The correct order of $[FeF_6]^{3-}$, $[CoF_6]^{3-}$, $[Ni(CO)_4]$ and $[Ni(CN)_4]^{2-}$ complex species based on the number of unpaired electrons present is :

(1) $[FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CN)_4]^{2-} > [Ni(CO)_4]$

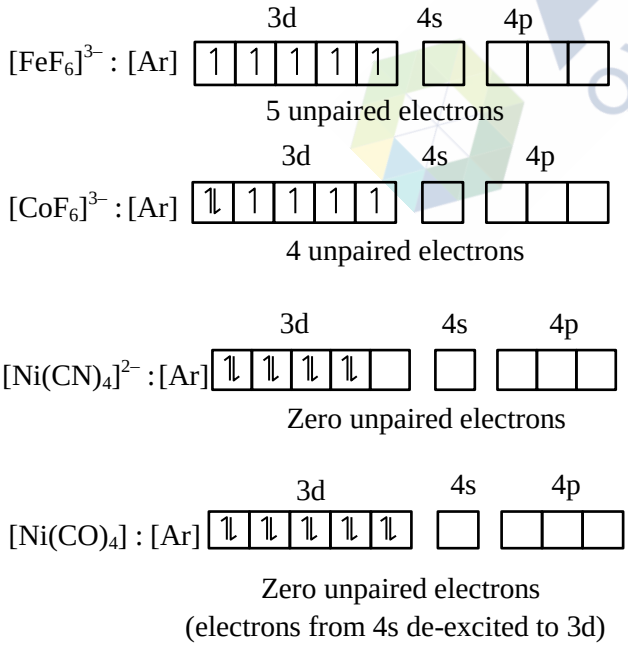
(2) $[Ni(CN)_4]^{2-} > [FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CO)_4]$

(3) $[CoF_6]^{3-} > [FeF_6]^{3-} > [Ni(CO)_4] > [Ni(CN)_4]^{2-}$

(4) $[FeF_6]^{3-} > [CoF_6]^{3-} > [Ni(CN)_4]^{2-} = [Ni(CO)_4]$

Ans. (4)

Sol.



62. Consider the given data :

(a) $HCl(g) + 10H_2O(l) \rightarrow HCl.10\,H_2O$

$\Delta H = -69.01\ kJ\ mol^{-1}$

(b) $HCl(g) + 40H_2O(l) \rightarrow HCl.40\,H_2O$

$\Delta H = -72.79\ kJ\ mol^{-1}$

Choose the **correct** statement :

(1) Dissolution of gas in water is an endothermic process

(2) The heat of solution depends on the amount of solvent.

(3) The heat of dilution for the HCl ($HCl.10H_2O$ to $HCl.40H_2O$) is 3.78 kJ mol^{-1}.

(4) The heat of formation of HCl solution is represented by both (a) and (b)

Ans. (2)

Sol. From the given information

ΔH is negative so it means dissolution of gas HCl(g) is exothermic.

$HCl(g) + 10H_2O(l) \rightarrow HCl\,.\,10H_2O$ .....(1)

$\Delta H_1 = -69.01\dfrac{kJ}{mol}$

$HCl(g) + 40H_2O(l) \rightarrow HCl\,.\,40H_2O$ .....(2)

$\Delta H_2 = -72.79\dfrac{kJ}{mol}$

Hence heat of solution depends upon amount of solvent

By equation.....(2) – equation ....(1)

$HCl.10H_2O + 30H_2O(\ell) \rightarrow HCl.40H_2O$

So Heat of dilution = –72.79 – (–69.01)

$= -3.78\dfrac{kJ}{mol}$

Hence option (3) is incorrect.

For heat of formation reactant should be in elemental form hence option (4) is incorrect

63. Consider the ground state of chromium atom (Z = 24). How many electrons are with Azimuthal quantum number $l = 1$ and $l = 2$ respectively ?

(1) 12 and 4 (2) 16 and 4

(3) 12 and 5 (4) 16 and 5

Ans. (3)

Sol. Cr : $1s^2\ 2s^2\ 2p^6\ 3s^2\ 3p^6\ 3d^5\ 4s^1$
$\ell=1 \quad \ell=1 \quad \ell=2$

electrons having $\ell = 1 \Rightarrow 12$

electrons having $\ell = 2 \Rightarrow 5$

64. Given below are two statements :

Statement (I) : The first ionisation enthalpy of group 14 elements is higher than the corresponding elements of group 13.

Statement (II) : Melting points and boiling points of group 13 elements are in general much higher than those the corresponding elements of group 14.

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

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

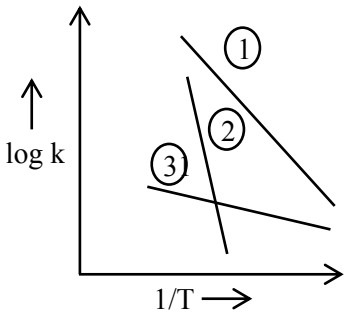
(4) Both **Statement I** and **Statement II** are correct

Ans. (1)

Sol. Statement 1 is correct since left to right 1E increases in general in periodic table.

Statement 2 is incorrect since M.P. of group 14 elements is more than group 13 elements.

65. Consider the following plots of log of rate constant k (log k) vs $\frac{1}{T}$ for three different reactions. The correct order of activation energies of these reactions is



(1) $Ea_2 > Ea_1 > Ea_3$ (2) $Ea_1 > Ea_3 > Ea_2$

(3) $Ea_1 > Ea_2 > Ea_3$ (4) $Ea_3 > Ea_2 > Ea_1$

Ans. (1)

Sol. $K = A\ e^{-Ea/RT}$

$$\log k = \log A - \frac{Ea}{2.303RT}$$

For graph between logk with $\frac{1}{T}$

$$\left|\text{Slope of curve}\right| = \frac{Ea}{2.303R}$$

From given graph

Magnitude of slope $\Rightarrow (2) > (1) > (3)$

Hence $Ea_2 > Ea_1 > Ea_3$

66. 'X' is the number of electrons in t_{2g} orbitals of the most stable complex ion among $[Fe(NH_3)_6]^{3+}$, $[Fe(Cl_6)]^{3-}$, $[Fe(C_2O_4)_3]^{3-}$ and $[Fe(H_2O)_6]^{3+}$. The nature of oxide of vanadium of the type V_2O_X is:

(1) Acidic

(2) Neutral

(3) Basic

(4) Amphoteric

Ans. (4)

Sol.

Most stable is $[Fe(C_2O_4)_3]^{3-}$ due to Chelation effect.

$[Fe(C_2O_4)_3]^{3-}$: [Ar] 3d: 1 1 1 1 1 | 4s: ☐ | 4p: ☐ ☐ ☐

5 unpaired electrons ; x = 5

V_2O_5 is amphoteric.

67. The elements of Group 13 with highest and lowest first ionisation enthalpies are respectively:

(1) B & Ga

(2) B & Tl

(3) Tl & B

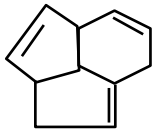
(4) B & In

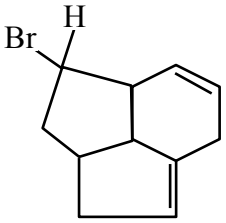
Ans. (4)

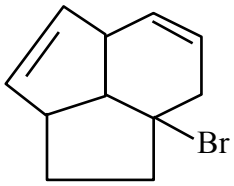
Sol. IE order

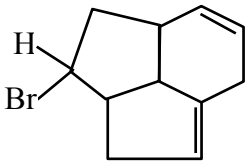
$B > T\ell > Ga > Al > In$

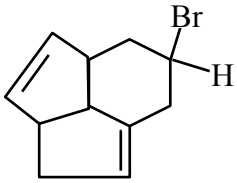
68. Consider the following molecule (X).

The structure of X is 
(X)

(1) 

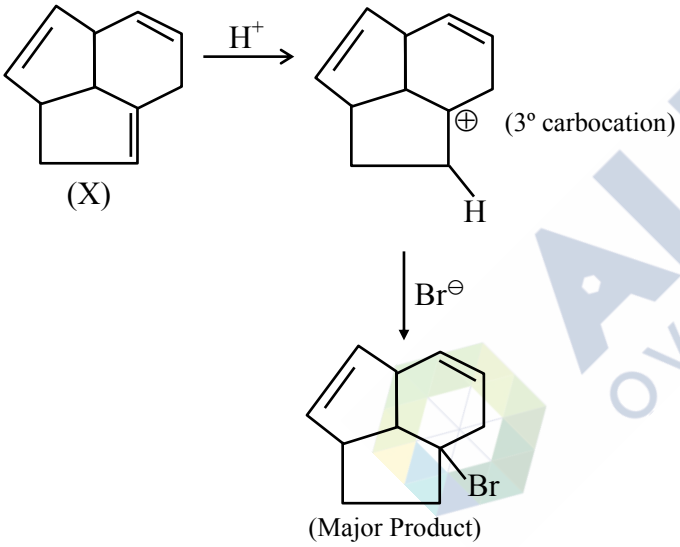
(2) 

(3) 

(4) 

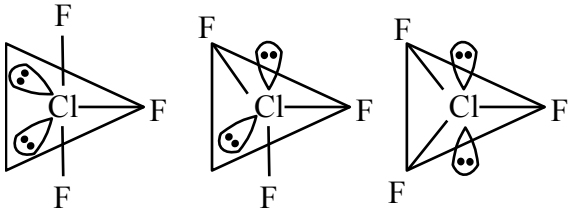
Ans. (2)

Sol.



69. Given below are two statements:

Statement (I) : for $\ddot{C}\ell F_3$, all three possible structures may be drawn as follows.



Statement (II) : Structure III is most stable, as the orbitals having the lone pairs are axial, where the $\ell p - bp$ repulsion is minimum.

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

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

(2) **Statement I** is correct but **statement II** is incorrect.

(3) Both **Statement I** and **statement II** are correct.

(4) Both **Statement I** and **statement II** are incorrect.

Ans. (2)

Sol. Statement 1 is correct.

Statement 2 is incorrect since in sp^3d hybridization; lone pair cannot occupy axial position.

70. Half life of zero order reaction A $\rightarrow$ product is 1 hour, when initial concentration of reaction is 2.0 mol L^{-1}. The time required to decrease concentration of A from 0.50 to 0.25 mol L^{-1} is:

(1) 0.5 hour (2) 4 hour

(3) 15 min (4) 60 min

Ans. (3)

Sol. For zero order reaction

$$\text{Half life} = \frac{A_o}{2k}$$

$$60\,\text{min} = \frac{2}{2k}$$

$$k = \frac{1}{60}\ M/\text{min}$$

Now

$$A_t = A_o - kt$$

$$t = \frac{A_o - A_t}{k}$$

$$= \frac{0.5 - 0.25}{1/60}$$

$$0.25 \times 60$$

$t = 15$ min

SECTION-B

71. Sea water, which can be considered as a 6 molar (6 M) solution of NaCl, has a density of 2 g mL^{-1}. The concentration of dissolved oxygen (O_2) in sea water is 5.8 ppm. Then the concentration of dissolved oxygen (O_2) in sea water, is $x \times 10^{-4}$ m.

x =_____. (Nearest integer)

Given: Molar mass of NaCl is 58.5 g mol^{-1}

Molar mass of O_2 is 32 g mol^{-1}

Ans. (2)

Sol. Sea water is 6 Molar in NaCl, So 1000 ml of sea water contains 6 mol of NaCl.

mass of solution = Volume × density

$= 1000 \times 2$

mass of solution = 2000g

$$ppm = \frac{\text{mass of } O_2}{2000} \times 10^6$$

mass of $O_2 = 5.8 \times 2 \times 10^{-3}$

$= 1.16 \times 10^{-2}$ g

$$\text{molality for } O_2 = \frac{1.16 \times 10^{-2} / 32}{(2000 - 6 \times 58.5)} \times 1000$$

$$= \frac{1.16 \times 10}{32 \times 1649}$$

$= 0.000219$

$= 2.19 \times 10^{-4}$

Correct answer $\Rightarrow$ 2

72. The amount of calcium oxide produced on heating 150 kg limestone (75% pure) is _____kg. (Nearest integer)

Given : Molar mass (in g mol^{-1}) of Ca-40, O-16, C-12

Ans. (63)

Sol. $CaCO_3 \rightarrow CaO + CO_2$

$$\text{mass of } CaCO_3 = \frac{150 \times 75}{100} = 112.5\,kg$$

$= 112500g$

$n_{CaCO_3} = 1125$

So moles of CaO = 1125

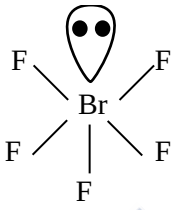
$$\text{mass of CaO} = \frac{1125 \times 56}{1000} = 63\,kg$$

Correct answer $\Rightarrow$ 63

73. A metal complex with a formula $MC\ell_4.3NH_3$ is involved in sp^3d^2 hybridisation. It upon reaction with excess of $AgNO_3$ solution gives 'x' moles of AgCl. Consider 'x' is equal to the number of lone pairs of electron present in central atom of BrF_5. Then the number of geometrical isomers exhibited by the complex is_____.

Ans. (2)

Sol.



1 lone pair hence 1 mole AgCl.

Complex is $[M(NH_3)_3Cl_3]Cl$.

It shows 2 geometrical isomers (Ma_3b_3 type)

facial (fac) & meridional (Mer)

74. The molar conductance of an infinitely dilute solution of ammonium chloride was found to be 185 S cm^2 mol^{-1} and the ionic conductance of hydroxyl and chloride ions are 170 and 70 S cm^2 mol^{-1}, respectively. If molar conductance of 0.02 M solution of ammonium hydroxide is 85.5 S cm^2 mol^{-1}, its degree of dissociation is given by $x \times 10^{-1}$. The value of x is _____. (Nearest integer)

Ans. (3)

Sol. λ_m° of $NH_4Cl = 185$

$$\left(\lambda_m^\circ\right)_{NH_4^+} + \left(\lambda_m^\circ\right)_{Cl^-} = 185$$

$$\left(\lambda_m^\circ\right)_{NH_4^+} = 185 - 70 = 115 \ \ Scm^2\ mol^{-1}$$

$$\left(\lambda_m^\circ\right)_{NH_4OH} = \left(\lambda_m^\circ\right)_{NH_4^+} + \left(\lambda_m^\circ\right)_{OH^-}$$

$= 115 + 170$

$$\left(\lambda_m^\circ\right)_{NH_4OH} = 285 \ \ Scm^2 mol^{-1}$$

$$\text{degree of dissociation} = \frac{\left(\lambda_m\right)_{NH_4OH}}{\left(\lambda_m^\circ\right)_{NH_4OH}}$$

$$= \frac{85.5}{285}$$

$= 0.3$

$= 3 \times 10^{-1}$

75. x mg of $Mg(OH)_2$ (molar mass = 58) is required to be dissolved in 1.0 L of water to produce a pH of 10.0 at 298 K. The value of x is____ mg. (Nearest integer)

(Given : $Mg(OH)_2$ is assumed to dissociate completely in H_2O)

Ans. **(3)**

Sol. pH = 10

pOH = 4

$[OH^-] = 10^{-4}$

no. of moles of $OH^- = 10^{-4}$

$$\text{no. of moles of } Mg(OH)_2 = \frac{10^{-4}}{2} = 5\times10^{-5}$$

mass of $Mg(OH)_2 = 5 \times 10^{-5} \times 58 \times 10^3$ mg

$= 2.9$