DATE : 05/05/2024

Test Booklet Code

R3

GRIDU

Answers & Solutions

Time : 3 hrs. 20 Min.

for

M.M. : 720

NEET (UG)-2024

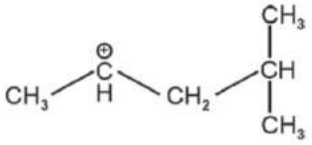
Important Instructions :

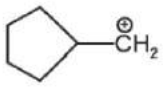
1. The test is of **3 hours 20 minutes** duration and the Test Booklet contains **200** multiple-choice questions (four options with a single correct answer) from **Physics, Chemistry and Biology (Botany and Zoology)**. 50 questions in each subject are divided into **two Sections (A and B)** as per details given below:
   (a) **Section-A** shall consist of **35 (Thirty-five)** Questions in each subject (Question Nos-1 to 35, 51 to 85, 101 to 135 and 151 to 185). All Questions are compulsory.
   (b) **Section-B** shall consist of **15 (Fifteen)** questions in each subject (Question Nos- 36 to 50, 86 to 100, 136 to 150 and 186 to 200). In **Section B**, a candidate needs to **attempt any 10 (Ten)** questions out of **15 (Fifteen)** in each subject.
   Candidates are advised to read all 15 questions in each subject of Section B before they start attempting the question paper. In the event of a candidate attempting more than ten questions, **the first ten questions answered by the candidate shall be evaluated.**
2. Each question carries **4 marks**. For each correct response, the candidate will get **4 marks**. For each incorrect response, **one mark** will be deducted from the total scores. **The maximum marks are 720.**
3. Use **Blue / Black Ball Point Pen only** for writing particulars on this page / marking responses on Answer Sheet.
4. Rough work is to be done in the space provided for this purpose in the Test Booklet only.
5. On completion of the test, the candidate must **hand over the Answer Sheet (ORIGINAL and OFFICE copy) to the Invigilator** before leaving the Room / Hall. The candidates are allowed to take away this Test Booklet with them.
6. **The CODE for this Booklet is R3. Make sure that the CODE printed on the Original Copy of the Answer Sheet is the same as that on this Test Booklet.** In case of discrepancy, the candidate should immediately report the matter to the Invigilator for replacement of both the Test Booklet and the Answer sheet.
7. The candidates should ensure that the Answer Sheet is not folded. Do not make any stray marks on the Answer Sheet. Do not write your Roll No. anywhere else except in the specified space in the Test Booklet/Answer Sheet.
8. Use of white fluid for correction is **NOT** permissible on the Answer Sheet.
9. Each candidate must show on-demand his/her Admission Card to the Invigilator.
10. No candidate, without special permission of the Centre Superintendent or Invigilator, would leave his/her seat.
11. Use of Electronic/Manual Calculator is prohibited.
12. The candidates are governed by all Rules and Regulations of the examination with regard to their conduct in the Examination Room / Hall. All cases of unfair means will be dealt with as per Rules and Regulations of this examination.
13. **No part of the Test Booklet and Answer Sheet shall be detached under any circumstances.**
14. The candidates will write the Correct Test Booklet Code as given in the Test Booklet / Answer Sheet in the Attendance Sheet.

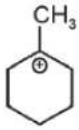
CHEMISTRY

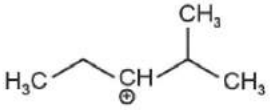
SECTION-A

51. The most stable carbocation among the following is :

(1) 

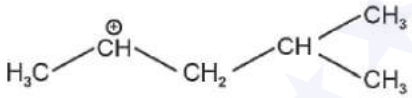
(2) 

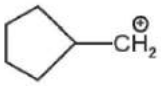
(3) 

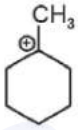
(4) 

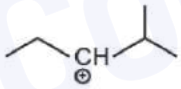
Answer (3)

Sol. The stability of carbocation can be described by the hyperconjugation. Greater the extent of hyperconjugation, more is the stability of carbocation.

(1)  → 5 α-H

(2)  → 1 α-H

(3)  → 7 α-H

(4)  → 3 α-H

Stability order of carbocations = (3) > (1) > (4) > (2)

52. For the reaction $2A \rightleftharpoons B + C$, $K_C = 4 \times 10^{-3}$. At a given time, the composition of reaction mixture is:

$[A] = [B] = [C] = 2 \times 10^{-3}$ M.

Then, which of the following is correct?

(1) Reaction has a tendency to go in forward direction.

(2) Reaction has a tendency to go in backward direction.

(3) Reaction has gone to completion in forward direction.

(4) Reaction is at equilibrium.

Answer (2)

Sol. $2A \rightleftharpoons B + C$, $K_C = 4 \times 10^{-3}$

At a given time t, Q_C is to be calculated and been compared with K_C.

$$Q_C = \frac{[B][C]}{[A]^2} = \frac{(2\times10^{-3})(2\times10^{-3})}{(2\times10^{-3})^2}$$

$Q_C = 1$

As $Q_C > K_C$, so reaction has a tendency to move backward.

53. 'Spin only' magnetic moment is same for which of the following ions?

A. Ti^{3+} B. Cr^{2+}

C. Mn^{2+} D. Fe^{2+}

E. Sc^{3+}

Choose the most appropriate answer from the options given below.

(1) A and E only (2) B and C only

(3) A and D only (4) B and D only

Answer (4)

Sol.

Ions	No. of unpaired electrons	Configuration
Ti^{3+}	1	$3d^1$
Cr^{2+}	4	$3d^4$
Mn^{2+}	5	$3d^5$
Fe^{2+}	4	$3d^6$
Sc^{3+}	0	$3d^0$

Spin only magnetic moment is given by $\sqrt{n(n+2)}$BM

$\therefore$ Cr^{2+} and Fe^{2+} will have same spin only magnetic moment.

54. The energy of an electron in the ground state (n = 1) for He^+ ion is –x J, then that for an electron in n = 2 state for Be^{3+} ion in J is

(1) $-\frac{x}{9}$ (2) –4x

(3) $-\frac{4}{9}x$ (4) –x

Answer (4)

Sol. $E_n = -R_H\left(\frac{Z^2}{n^2}\right)J$

For He^+ (n = 1),

$$E_n = -x = -R_H\left(\frac{2^2}{1^2}\right) = -4R_H$$

$$\therefore \quad R_H = \frac{x}{4}$$

For Be^{3+} (n = 2),

$$E_n = -R_H\left(\frac{Z^2}{n^2}\right) J$$

$$= -\frac{x}{4} \times \left(\frac{4 \times 4}{2 \times 2}\right) = -x\ J$$

55. Which reaction is **NOT** a redox reaction?

(1) $2KClO_3 + I_2 \rightarrow 2KIO_3 + Cl_2$

(2) $H_2 + Cl_2 \rightarrow 2HCl$

(3) $BaCl_2 + Na_2SO_4 \rightarrow BaSO_4 + 2NaCl$

(4) $Zn + CuSO_4 \rightarrow ZnSO_4 + Cu$

Answer (3)

Sol. (1) $\overset{+5}{K}\overset{+5}{Cl}O_3 + I_2^0 \longrightarrow 2\overset{+5}{K}\overset{+5}{I}O_3 + Cl_2^0$, Redox reaction

Reduction: $+5 \rightarrow 0$; Oxidation: $0 \rightarrow +5$

(2) $H_2^0 + Cl_2^0 \longrightarrow 2\overset{+1}{H}\overset{-1}{Cl}$, Redox reaction

Reduction: $0 \rightarrow -1$; Oxidation: $0 \rightarrow +1$

(3) $\overset{+2}{Ba}\overset{-1}{Cl_2} + \overset{+1}{Na_2}\overset{-2}{SO_4} \longrightarrow \overset{+2}{Ba}SO_4 + 2\overset{+1}{Na}\overset{-1}{Cl}$

This is not a redox reaction as there is no change in oxidation state.

(4) $Zn^0 + \overset{+2}{Cu}SO_4 \longrightarrow \overset{+2}{Zn}SO_4 + Cu^0$, Redox reaction

Reduction: $+2 \rightarrow 0$; Oxidation: $0 \rightarrow +2$

56. Match List I with List II.

List I (Molecule)		**List II (Number and types of bond/s between two carbon atoms)**
A.	ethane	I. one σ-bond and two π-bonds
B.	ethene	II. two π-bonds
C.	carbon molecule, C_2	III. one σ-bond
D.	ethyne	IV. one σ-bond and one π-bond

Choose the correct answer from the options given below:

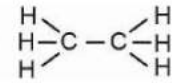
(1) A-IV, B-III, C-II, D-I

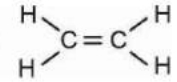
(2) A-III, B-IV, C-II, D-I

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

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

Answer (2)

Sol. (A) Ethane  one (C – C) σ bond

(B) Ethene  one (C – C) σ and one (C – C) π bond

(C) C_2 two (C – C) π bonds

(D) Ethyne H – C ≡ C – H two (C – C) π bonds and one (C – C) σ bond

57. Match List I with List II.

	List I (Complex)		**List II (Type of isomerism)**
A.	$[Co(NH_3)_5(NO_2)]Cl_2$	I.	Solvate isomerism
B.	$[Co(NH_3)_5(SO_4)]Br$	II.	Linkage isomerism
C.	$[Co(NH_3)_6][Cr(CN)_6]$	III.	Ionization isomerism
D.	$[Co(H_2O)_6]Cl_3$	IV.	Coordination isomerism

Choose the correct answer from the options given below:

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

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

Answer (4)

Sol. A. $[Co(NH_3)_5(NO_2)]Cl_2$ II. Linkage isomerism due to 'N' and 'O' linkage by NO_2

B. $[Co(NH_3)_5(SO_4)]Br$ III. Ionization isomerism

C. $[Co(NH_3)_6][Cr(CN)_6]$ IV. Coordination isomerism

D. $[Co(H_2O)_6]Cl_3$ I. Solvate isomerism

58. The E° value for the Mn^{3+}/Mn^{2+} couple is more positive than that of Cr^{3+}/Cr^{2+} or Fe^{3+}/Fe^{2+} due to change of

(1) d^5 to d^2 configuration (2) d^4 to d^5 configuration

(3) d^3 to d^5 configuration (4) d^5 to d^4 configuration

Answer (2)

Sol. $E^{\circ}_{Mn^{3+}/Mn^{2+}} > E^{\circ}_{Cr^{3+}/Cr^{2+}}$ or $E^{\circ}_{Fe^{3+}/Fe^{2+}}$

Electronic configuration of Mn^{3+} = $[Ar]3d^4$

Electronic configuration of Mn^{2+} = $[Ar]3d^5$

Electronic configuration of Cr^{3+} = $[Ar]3d^3$

Electronic configuration of Cr^{2+} = $[Ar]3d^4$

As Mn^{3+} from d^4 configuration goes to more stable d^5 configuration (Half filled), due to more exchange energy in d^5 configuration.

59. The highest number of helium atoms is in

(1) 4 u of helium

(2) 4 g of helium

(3) 2.271098 L of helium at STP

(4) 4 mol of helium

Answer (4)

Sol. (1) 4 u of He = $\frac{4\text{ u}}{4\text{ u}}$ = 1 He atom

(2) 4 g of Helium = $\frac{4\text{ g}}{4\text{ g}}$ mole = 1 mole = N_A He atom

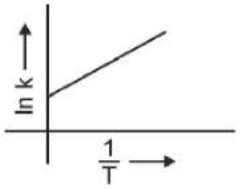
(3) 2.2710982 of He at STP = $\frac{2.271}{22.710982}$ mole

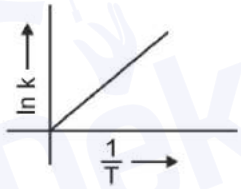
= 0.1 mole

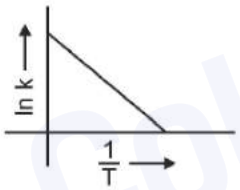
= 0.1 N_A He atom

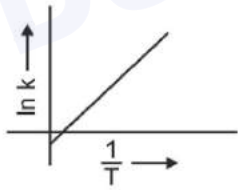
(4) 4 mol of He = 4 N_A He atoms

60. Which plot of ln k vs $\frac{1}{T}$ is consistent with Arrhenius equation?

(1) 

(2) 

(3) 

(4) 

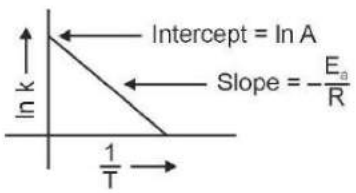
Answer (3)

Sol. The Arrhenius equation is given as

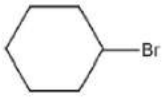
$k = Ae^{-\frac{E_a}{RT}}$

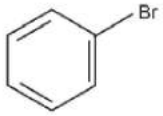
$\therefore \quad \ln k = \ln A - \frac{E_a}{RT}$

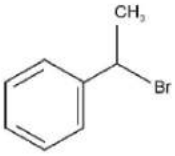
ln k v/s $\frac{1}{T}$ gives a straight line graph with slope = $-\frac{E_a}{R}$ and intercept = ln A

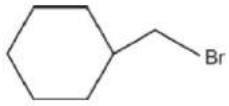


61. The compound that will undergo S_N1 reaction with the fastest rate is

(1) 

(2) 

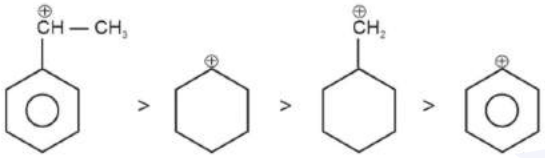
(3) 

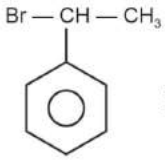
(4) 

Answer (3)

Sol. Reactivity towards S_N1 depends upon stability of carbocation.

Order of stability is



Hence 

is most reactive

62. Match List I with List II

List I (Quantum Number)		**List II (Information provided)**	
A.	m_l	I.	Shape of orbital
B.	m_s	II.	Size of orbital
C.	l	III.	Orientation of orbital
D.	n	IV.	Orientation of spin of electron

Choose the correct answer from the options given below :

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

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

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

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

Answer (1)

Sol.
- Magnetic quantum number m_l informs about orientation of orbital.
- Spin quantum number m_s informs about orientation of spin of electron.
- Azimuthal quantum number (l) informs about shape of orbital
- Principal quantum number (n) informs about size of orbital

63. The Henry's law constant (K_H) values of three gases (A, B, C) in water are 145, 2×10^{-5} and 35 kbar, respectively. The solubility of these gases in water follow the order:

(1) B > C > A (2) A > C > B

(3) A > B > C (4) B > A > C

Answer (1)

Sol. Value of Henry's law constant $\propto \frac{1}{\text{Solubility of gas}}$

Higher the value of K_H at a given pressure, lower is the solubility of the gas in the liquid.

K_H value of gases (given) : A > C > B

$\therefore$ Order of solubility of gases in water : B > C > A

64. In which of the following processes entropy increases?

A. A liquid evaporates to vapour.

B. Temperature of a crystalline solid lowered from 130 K to 0 K.

C. $2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$

D. $Cl_{2(g)} \rightarrow 2Cl_{(g)}$

Choose the correct answer from the options given below:

(1) A, B and D (2) A, C and D

(3) C and D (4) A and C

Answer (2)

Sol. When a liquid evaporates to vapour entropy increases.

$2NaHCO_{3(s)} \rightarrow Na_2CO_{3(s)} + CO_{2(g)} + H_2O_{(g)}$

Number of gaseous product molecules increases so entropy increases.

$Cl_{2(g)} \rightarrow 2Cl_{(g)}$

1 mole $Cl_{2(g)}$ form 2 mol $Cl_{(g)}$. So entropy increases.

65. Given below are two statements:

Statement I : Aniline does not undergo Friedel-Crafts alkylation reaction.

Statement II : Aniline cannot be prepared through Gabriel synthesis.

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 correct but Statement II is false

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

(4) Both statement I and Statement II are true

Answer (4)

Sol.
- Aniline does not undergo Friedel-Crafts alkylation reaction due to salt formation with aluminium chloride, the Lewis acid, which is used as a catalyst.
- Aniline (aromatic primary amine) cannot be prepared by Gabriel phthalimide synthesis because aryl halides do not undergo nucleophilic substitution with anion formed by phthalimide.

66. Fehling's solution 'A' is

(1) alkaline copper sulphate

(2) alkaline solution of sodium potassium tartrate (Rochelle's salt)

(3) aqueous sodium citrate

(4) aqueous copper sulphate

Answer (4)

Sol. Fehling solution 'A' = Aqueous copper sulphate

Fehling solution 'B' = Alkaline sodium potassium tartrate (Rochelle salt)

67. Activation energy of any chemical reaction can be calculated if one knows the value of

(1) probability of collision

(2) orientation of reactant molecules during collision

(3) rate constant at two different temperatures

(4) rate constant at standard temperature

Answer (3)

Sol. To calculate value of E_a

Equation used is

$$\log\left(\frac{k_2}{k_1}\right)=\frac{E_a}{2.303R}\left(\frac{1}{T_1}-\frac{1}{T_2}\right)$$

Hence E_a can be calculated if value of rate constant k is known at two different temperatures T_1 and T_2.

68. Arrange the following elements in increasing order of first ionization enthalpy:

Li, Be, B, C, N

Choose the correct answer from the options given below:

(1) Li < B < Be < C < N

(2) Li < Be < C < B < N

(3) Li < Be < N < B < C

(4) Li < Be < B < C < N

Answer (1)

Sol. Increasing order of first ionization enthalpy is Li < B < Be < C < N

Element	First ionization enthalpy ($\Delta_i H$/kJ mol^{-1})
Li	520
Be	899
B	801
C	1086
N	1402

69. 1 gram of sodium hydroxide was treated with 25 mL of 0.75 M HCl solution, the mass of sodium hydroxide left unreacted is equal to

(1) 250 mg (2) Zero mg

(3) 200 mg (4) 750 mg

Answer (1)

Sol. $M = \frac{W \times 1000}{M_2 \times V\ (\text{in mL})}$

$$W = \frac{M \times M_2 \times V\ (\text{in mL})}{1000} = \frac{0.75 \times 36.5 \times 25}{1000}$$

= 0.684 g (Mass of HCl)

$$\underset{36.5g}{HCl} + \underset{40\,g}{NaOH} \longrightarrow HCl + NaOH$$

36.5 g HCl reacts with NaOH = 40 g

0.684 g HCl reacts with $NaOH = \frac{40}{36.5} \times 0.684 \simeq 0.750$ g

Amount of NaOH left = 1 g – 0.750 g = 0.250 g = 250 mg

70. A compound with a molecular formula of C_6H_{14} has two tertiary carbons. Its IUPAC name is :

(1) 2-methylpentane

(2) 2,3-dimethylbutane

(3) 2,2-dimethylbutane

(4) n-hexane

Answer (2)

Sol. $CH_3 - CH_2 - CH_2 - CH_2 - CH_2 - CH_3$ has no tertiary carbon

(n-Hexane)

$H_3\overset{5}{C} - \overset{4}{C}H_2 - \overset{3}{C}H_2 - \overset{2}{C}H(\overset{|}{CH_3}) - \overset{1}{C}H_3$ has only one tertiary carbon

(2-Methylpentane)

$H_3\overset{1}{C} - \overset{2}{C}H(\overset{|}{CH_3}) - \overset{3}{C}H(\overset{|}{CH_3}) - \overset{4}{C}H_3$ has two tertiary carbon.

(2, 3-Dimethylbutane)

$H_3C - C(CH_3)(CH_3) - CH_2 - CH_3$ has no tertiary carbon

(2, 2-Dimethylbutane)

71. Given below are two statements:

Statement I : The boiling point of three isomeric pentanes follows the order

n-pentane > isopentane > neopentane

Statement II : When branching increases, the molecule attains a shape of sphere. This results in smaller surface area for contact, due to which the intermolecular forces between the spherical molecules are weak, thereby lowering the boiling point.

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 correct but Statement II is incorrect

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

(4) Both Statement I and Statement II are correct

Answer (4)

Sol. Both statement I and statement II are correct.

Boiling point of n-pentane = 309 K

isopentane = 301 K

neopentane = 282.5

As branching increases molecules attain the shape of a sphere results in smaller area of contact thus weak intermolecular forces between spherical molecules, which are overcome at relatively lower temperature. Leading to decrease in boiling point.

72. In which of the following equilibria, K_p and K_c are **NOT** equal?

(1) $H_{2(g)} + I_{2(g)} \rightleftharpoons 2HI_{(g)}$

(2) $CO_{(g)} + H_2O_{(g)} \rightleftharpoons CO_{2(g)} + H_{2(g)}$

(3) $2BrCl_{(g)} \rightleftharpoons Br_{2(g)} + Cl_{2(g)}$

(4) $PCl_{5(g)} \rightleftharpoons PCl_{3(g)} + Cl_{2(g)}$

Answer (4)

Sol. $K_p = K_c (RT)^{\Delta n_g}$

for $K_p \neq K_c$,

$\Delta n_g \neq 0$

$\Delta n_g = n_p - n_r$

(1) $\Delta n_g = 2 - 2 = 0$

(2) $\Delta n_g = 2 - 2 = 0$

(3) $\Delta n_g = 2 - 2 = 0$

(4) $\Delta n_g = 2 - 1 = 1$

73. The reagents with which glucose does **not** react to give the corresponding tests/products are

A. Tollen's reagent

B. Schiff's reagent

C. HCN

D. NH_2OH

E. $NaHSO_3$

Choose the correct options from the given below:

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

(3) E and D (4) B and C

Answer (2)

Sol. Despite having the aldehyde group glucose does not give Schiff's test and it does not form the hydrogen sulphite addition product with $NaHSO_3$.

74. Match List I with List II.

List I (Compound)		**List II (Shape/geometry)**
A.	NH_3	I. Trigonal Pyramidal
B.	BrF_5	II. Square Planar
C.	XeF_4	III. Octahedral
D.	SF_6	IV. Square Pyramidal

Choose the correct answer from the options given below:

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

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

Answer (4)

Sol. $NH_3 \Rightarrow$ sp^3 hybridised with 1 lone pair.
Structure will be Trigonal Pyramidal.

$BrF_5 \Rightarrow$ sp^3d^2 hybridised with 1 lone pair.
Structure will be Square Pyramidal.

$XeF_4 \Rightarrow$ sp^3d^2 with two lone pairs.
Structure will be Square Planar.

$SF_6 \Rightarrow$ sp^3d^2 with no lone pair.
Structure will be Octahedral.

A-I, B-IV, C-II, D-III

75. Among Group 16 elements, which one does **NOT** show –2 oxidation state?

(1) Se (2) Te

(3) Po (4) O

Answer (3)

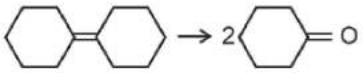
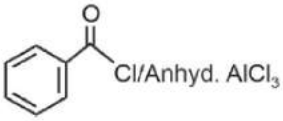
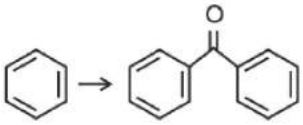
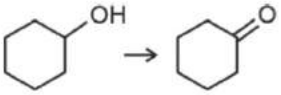
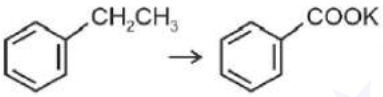
Sol. Oxygen shows –2, –1, +1 and +2 oxidation states

Selenium shows –2, +2, +4 and +6 oxidation states

Tellurium shows –2, +2, +4 and +6 oxidation states

Polonium shows +2 and +4 oxidation states

76. Match List I with List II.

List I (Reaction)		**List II (Reagents/Condition)**	
A.		I.	
B.		II.	CrO_3
C.		III.	$KMnO_4/KOH, \Delta$
D.		IV.	(i) O_3 (ii) $Zn\text{-}H_2O$

Choose the correct answer from the options given below:

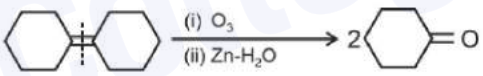
(1) A-III, B-I, C-II, D-IV

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

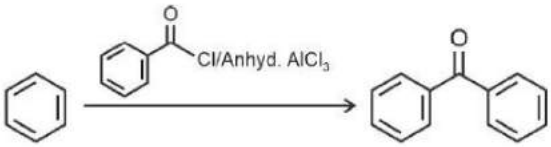
(3) A-I, B-IV, C-II, D-III

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

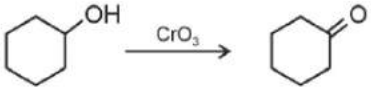
Answer (2)

Sol. (A) 

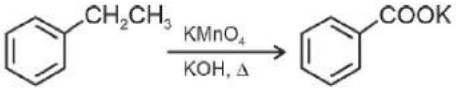
It is reductive ozonolysis

(B) 

It is Friedel-Crafts acylation reaction.

(C) 

Secondary alcohols are oxidised to ketones by CrO_3

(D) 

77. Arrange the following elements in increasing order of electronegativity:

N, O, F, C, Si

Choose the correct answer from the options given below:

(1) Si < C < O < N < F

(2) O < F < N < C < Si

(3) F < O < N < C < Si

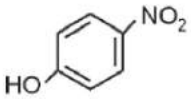
(4) Si < C < N < O < F

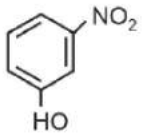
Answer (4)

Sol. Electronegativity increases across the period on moving left to right. It decreases on moving down the group.

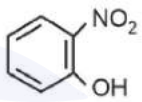
The correct option is Si < C < N < O < F

78. Intramolecular hydrogen bonding is present in

(1) 

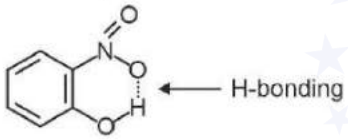
(2) 

(3) HF

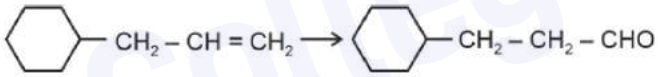
(4) 

Answer (4)

Sol. In o-nitrophenol intramolecular H-bonding is present.



79. Identify the correct reagents that would bring about the following transformation.



(1) (i) BH_3

(ii) $H_2O_2 / \overset{\ominus}{O}H$

(iii) PCC

(2) (i) BH_3

(ii) $H_2O_2 / \overset{\ominus}{O}H$

(iii) alk.$KMnO_4$

(iv) $H_3O^{\oplus}$

(3) (i) H_2O/H^+

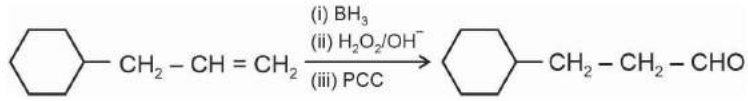
(ii) PCC

(4) (i) H_2O/H^+

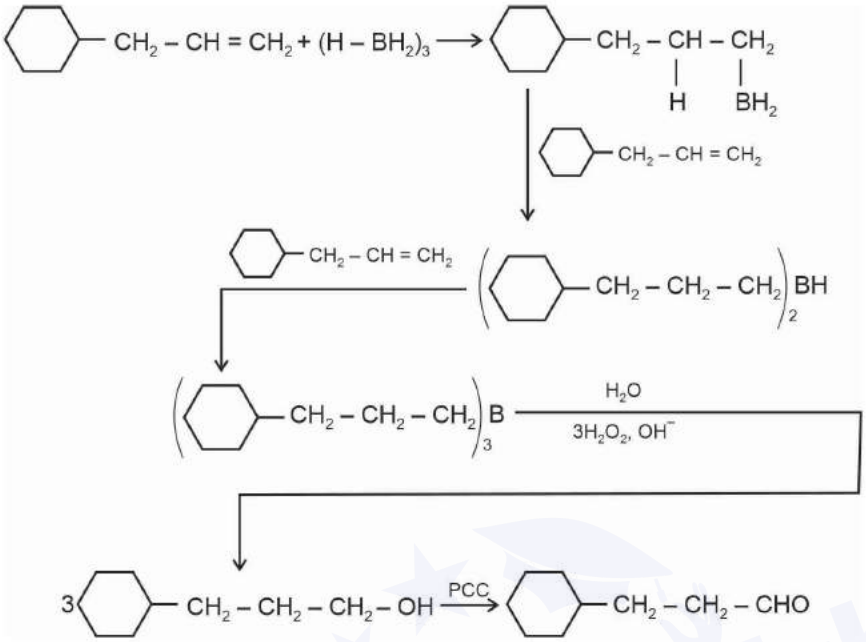
(ii) CrO_3

Answer (1)

Sol.



Mechanism :



80. Match List I with List II.

	List I (Conversion)		**List II (Number of Faraday required)**
A.	1 mol of H_2O to O_2	I.	3F
B.	1 mol of MnO_4^- to Mn^{2+}	II.	2F
C.	1.5 mol of Ca from molten $CaCl_2$	III.	1F
D.	1 mol of FeO to Fe_2O_3	IV.	5F

Choose the correct answer from the options given below:

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

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

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

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

Answer (4)

Sol. $4OH^- \rightarrow 2H_2O + O_2 + 4e^-$

for 2 mole of H_2O = 4F charge is required

for 1 mole of H_2O = $\frac{4F}{2}$ = 2F required

$\overset{+7}{Mn}O_4^- \rightarrow \overset{+2}{Mn}^{2+}$

for 1 mole MnO_4^- 5F charge is required

$Ca^{2+} \xrightarrow{+2e^-} Ca$

For 1 mole Ca^{2+} ion required = 2F

1.5 mole Ca^{2+} ion required = $\frac{2}{1} \times 1.5 = 3F$

$\overset{+2}{FeO} \rightarrow \overset{+3}{Fe_2O_3}$

for 1 mole FeO, 1F charge is required.

81. Given below are two statements:

Statement I: The boiling point of hydrides of Group 16 elements follow the order

$H_2O > H_2Te > H_2Se > H_2S$.

Statement II: On the basis of molecular mass, H_2O is expected to have lower boiling point than the other members of the group but due to the presence of extensive H-bonding in H_2O, it has higher boiling point.

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

Answer (4)

Sol. **Statement I** is correct, because boiling point of hydrides of group 16 follows the order

$H_2O > H_2Te > H_2Se > H_2S$.

Statement II due to intermolecular H-bonding H_2O shows higher boiling point than respective hydrides of group 16.

(Both Statement are true)

Order from H_2Te to H_2S is due to decreasing molar mass.

82. Given below are two statements :

Statement I: Both $[Co(NH_3)_6]^{3+}$ and $[CoF_6]^{3-}$ complexes are octahedral but differ in their magnetic behaviour.

Statement II: $[Co(NH_3)_6]^{3+}$ is diamagnetic whereas $[CoF_6]^{3-}$ is paramagnetic.

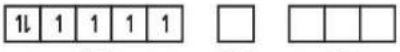
In the light of the above statements, choose the correct answer from the options given below:

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

Answer (4)

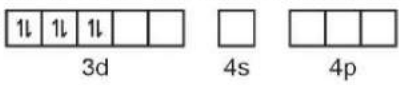
Sol. In $[Co(NH_3)_6]^{3+}$, Co^{3+} ion is having $3d^6$ configuration.

Electronic configuration of Co^{3+} :



In presence of NH_3 ligand, pairing of electrons takes place and it becomes diamagnetic complex ion.

In presence of NH_3 ligand :

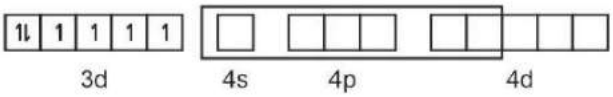


$\therefore$ $[Co(NH_3)_6]^{3+}$ is octahedral with d^2sp^3 hybridisation and it is diamagnetic in nature.

In case of $[CoF_6]^{3-}$, Co is in +3 oxidation state and it is having $3d^6$ configuration.

In presence of weak field F^- ligand, pairing does not take place.

In presence of F^- ligands :



$\therefore$ In $[CoF_6]^{3-}$, Co^{3+} is sp^3d^2 hybridised with four unpaired electrons, so it is paramagnetic in nature.

83. Which one of the following alcohols reacts instantaneously with Lucas reagent?

(1) $CH_3 - CH_2 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - OH$

(2) $CH_3 - \underset{\displaystyle CH_3}{\underset{|}{CH}} - CH_2OH$

(3) $CH_3 - \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} - OH$

(4) $CH_3 - CH_2 - CH_2 - CH_2OH$

Answer (3)

Sol. Tertiary alcohols react instantaneously with Lucas reagent and gives immediate turbidity.

In case of tertiary alcohols, they form halides easily with Lucas reagent (conc. HCl and $ZnCl_2$)

84. Match List I with List II.

	List-I (Process)		**List-II (Conditions)**
A.	Isothermal process	I.	No heat exchange
B.	Isochoric process	II.	Carried out at constant temperature
C.	Isobaric process	III.	Carried out at constant volume
D.	Adiabatic process	IV.	Carried out at constant pressure

Choose the correct answer from the options given below:

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

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

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

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

Answer (3)

Sol. (A) Isothermal process $\Rightarrow$ Temperature is constant throughout the process

(B) Isochoric process $\Rightarrow$ Volume is constant throughout the process

(C) Isobaric process $\Rightarrow$ Pressure is constant throughout the process

(D) Adiabatic process $\Rightarrow$ No exchange of heat (q) between system and surrounding

85. On heating, some solid substances change from solid to vapour state without passing through liquid state. The technique used for the purification of such solid substances based on the above principle is known as

(1) Sublimation

(2) Distillation

(3) Chromatography

(4) Crystallization

Answer (1)

Sol. (1) **Sublimation :** It is the purification technique based on principle that on heating, some solid substances change from solid to vapour state without passing through liquid state.

(2) **Distillation :** It is used to separate volatile liquids from non-volatile impurities and the liquids having sufficient difference in their boiling point.

(3) **Chromatography :** It is based on separation by using stationary and mobile phase.

(4) **Crystallization :** It is based on difference in the solubilities of the compound and impurities in a suitable solvent.

SECTION-B

86. The products A and B obtained in the following reactions, respectively, are

$3ROH + PCl_3 \rightarrow 3RCl + A$

$ROH + PCl_5 \rightarrow RCl + HCl + B$

(1) $POCl_3$ and H_3PO_4 (2) H_3PO_4 and $POCl_3$

(3) H_3PO_3 and $POCl_3$ (4) $POCl_3$ and H_3PO_3

Answer (3)

Sol. These reactions are preparation of haloalkanes from alcohols.

$$3ROH + PCl_3 \longrightarrow 3RCl + \underset{(A)}{H_3PO_3}$$

$$ROH + PCl_5 \longrightarrow RCl + HCl + \underset{(B)}{POCl_3}$$

A and B are H_3PO_3 and $POCl_3$ respectively.

87. Mass in grams of copper deposited by passing 9.6487 A current through a voltmeter containing copper sulphate solution for 100 seconds is (Given : Molar mass of Cu : 63 g mol^{-1}, 1 F = 96487 C)

(1) 0.315 g (2) 31.5 g

(3) 0.0315 g (4) 3.15 g

Answer (1)

Sol. $Cu^{2+}(aq) + 2e^- \rightarrow Cu(s)$

$$\text{Mass of Cu deposited (w)} = \frac{M \times i \times t}{nF}$$

$$= \frac{63 \times 9.6487 \times 100}{2 \times 96487}$$

$$= 0.315 \text{ g}$$

88. Consider the following reaction in a sealed vessel at equilibrium with concentrations of

$N_2 = 3.0 \times 10^{-3}$ M, $O_2 = 4.2 \times 10^{-3}$ M and $NO = 2.8 \times 10^{-3}$ M.

$2NO_{(g)} \rightleftharpoons N_{2(g)} + O_{2(g)}$

If 0.1 mol L^{-1} of $NO_{(g)}$ is taken in a closed vessel, what will be degree of dissociation (α) of $NO_{(g)}$ at equilibrium?

(1) 0.0889 (2) 0.8889

(3) 0.717 (4) 0.00889

Answer (3)

Sol. $2NO_{(g)} \rightleftharpoons N_{2(g)} + O_{2(g)}$

$$K_c = \frac{[N_2][O_2]}{[NO]^2}$$

$$= \frac{3\times10^{-3}\times4.2\times10^{-3}}{2.8\times10^{-3}\times2.8\times10^{-3}}$$

$$= 1.607$$

$$2NO_{(g)} \rightleftharpoons N_{2(g)} + O_{2(g)}$$

t = 0	0.1	0	0
	$0.1 - 0.1\alpha$	0.05α	0.05α

$$K_c = \frac{0.05\alpha\times0.05\alpha}{(0.1-0.1\alpha)^2}$$

$$K_c = \frac{0.05\alpha\times0.05\alpha}{0.01(1-\alpha)^2}$$

$$1.607 = \frac{(0.05)^2\alpha^2}{0.01(1-\alpha)^2}$$

$$\frac{\alpha^2}{(1-\alpha)^2} = \frac{1.607\times(0.1)^2}{(0.05)^2}$$

$$\frac{\alpha}{1-\alpha} = \frac{1.27\times0.1}{0.05}$$

$$\frac{\alpha}{1-\alpha} = 2.54$$

$$\alpha = 2.54 - 2.54\alpha$$

$$3.54\alpha = 2.54$$

$$\alpha = \frac{2.54}{3.54} = 0.717$$

89. Given below are two statements :

Statement I : $[Co(NH_3)_6]^{3+}$ is a homoleptic complex whereas $[Co(NH_3)_4Cl_2]^{+}$ is a heteroleptic complex.

Statement II : Complex $[Co(NH_3)_6]^{3+}$ has only one kind of ligands but $[Co(NH_3)_4Cl_2]^{+}$ has more than one kind of ligands.

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 true but Statement II is false

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

(4) Both Statement I and Statement II are true

Answer (4)

Sol. $[Co(NH_3)_6]^{3+}$ is a homoleptic complex as only one type of ligands (NH_3) is coordinated with Co^{3+} ion. While $[Co(NH_3)_4Cl_2]^+$ is a heteroleptic complex in which Co^{3+} ion is ligated with more than one type of ligands, *i.e.*, NH_3 and Cl^-.

90. Identify the major product C formed in the following reaction sequence:

$$CH_3 - CH_2 - CH_2 - I \xrightarrow{NaCN} A$$

$$\xrightarrow[\text{Partial hydrolysis}]{OH^-} B \xrightarrow[Br_2]{NaOH} \underset{\text{(major)}}{C}$$

(1) butylamine (2) butanamide

(3) α–bromobutanoic acid (4) propylamine

Answer (4)

Sol.

$$CH_3CH_2CH_2 - I \xrightarrow{NaCN} \underset{(A)}{CH_3CH_2CH_2 - CN} \xrightarrow{\text{Partial hydrolysis}} \underset{(B)}{CH_3CH_2 - CH_2 - \overset{\overset{O}{\|}}{C} - NH_2}$$

$$\downarrow NaOH/Br_2$$

$$\underset{\substack{(C)\\ \text{(Propyl amine)}}}{CH_3CH_2CH_2 - NH_2}$$

- Step-I is S_N reaction with $\overset{\ominus}{C}N$ nucleophile.
- Step-II will give amide.
- Step-III is Hoffmann bromamide degradation reaction.

91. The pair of lanthanoid ions which are diamagnetic is

(1) Ce^{3+} and Eu^{2+} (2) Gd^{3+} and Eu^{3+}

(3) Pm^{3+} and Sm^{3+} (4) Ce^{4+} and Yb^{2+}

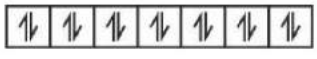
Answer (4)

Sol. Magnetic moment $\mu = \sqrt{n(n+2)}$

$n \rightarrow$ number of unpaired electron

$Ce^{4+} \Rightarrow (Xe)\ 4f^0$

$\mu = 0$ Diamagnetic

$Yb^{2+} \Rightarrow (Xe)\ 4f^{14}$ 

$\mu = 0$ Diamagnetic

$Ce^{3+} \Rightarrow (Xe)\ 4f^1$ | 1 | | | | | | |

$\mu = \sqrt{3}$ Paramagnetic

$Eu^{2+} \Rightarrow (Xe)\ 4f^7$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

$\mu = \sqrt{63}$ Paramagnetic

$Gd^{3+} \Rightarrow (Xe)\ 4f^7$ | 1 | 1 | 1 | 1 | 1 | 1 | 1 |

$\mu = \sqrt{63}$ Paramagnetic

$Eu^{3+} \Rightarrow (Xe)\ 4f^6$ | 1 | 1 | 1 | 1 | 1 | 1 | |

$\mu = \sqrt{48}$ Paramagnetic

$Pm^{3+} \Rightarrow (Xe)\ 4f^4$ | 1 | 1 | 1 | 1 | | | |

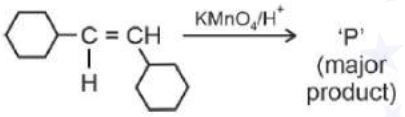
$\mu = \sqrt{24}$ Paramagnetic

$Sm^{3+} \Rightarrow (Xe)\ 4f^5$ | 1 | 1 | 1 | 1 | 1 | | |

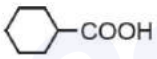
$\mu = \sqrt{35}$ Paramagnetic

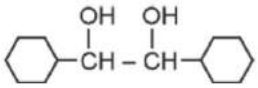
Hence Ce^{4+} and Yb^{2+} are only diamagnetic.

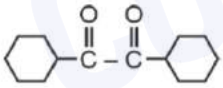
92. For the given reaction:

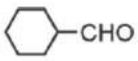


'P' is

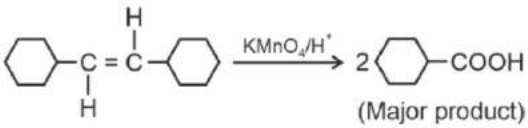
(1) 

(2) 

(3) 

(4) 

Answer (1)

Sol. 

(Major product)

93. A compound X contains 32% of A, 20% of B and remaining percentage of C. Then, the empirical formula of X is :

(Given atomic masses of A = 64; B = 40; C = 32 u)

(1) ABC_3 (2) AB_2C_2

(3) ABC_4 (4) A_2BC_2

Answer (1)

Sol.

Element	Mass percentage %	No. of moles	No. of moles/ Smallest number	Simplest whole number
A	32%	$\frac{32}{64}=\frac{1}{2}$	$\frac{1}{2}\times 2$	= 1
B	20%	$\frac{20}{40}=\frac{1}{2}$	$\frac{1}{2}\times 2$	= 1
C	48%	$\frac{48}{32}=\frac{3}{2}$	$\frac{3}{2}\times 2$	= 3

So, empirical formula of $X = \begin{matrix} A & : & B & : & C \\ 1 & : & 1 & : & 3 \end{matrix}$

$\therefore$ The correct empirical formula of compound X is ABC_3

94. Given below are certain cations. Using inorganic qualitative analysis, arrange them in increasing group number from 0 to VI.

A. Al^{3+} B. Cu^{2+}

C. Ba^{2+} D. Co^{2+}

E. Mg^{2+}

Choose the correct answer from the options given below.

(1) B, C, A, D, E (2) E, C, D, B, A

(3) E, A, B, C, D (4) B, A, D, C, E

Answer (4)

Sol.

Group	Cations
Group-II	Cu^{2+}
Group-III	Al^{3+}
Group-IV	Co^{2+}
Group-V	Ba^{2+}
Group-VI	Mg^{2+}

The correct order of group number of ions is $\underset{(B)}{Cu^{2+}} < \underset{(A)}{Al^{3+}} < \underset{(D)}{Co^{2+}} < \underset{(C)}{Ba^{2+}} < \underset{(E)}{Mg^{2+}}$

$\therefore$ The correct order is B, A, D, C, E

95. The work done during reversible isothermal expansion of one mole of hydrogen gas at 25°C from pressure of 20 atmosphere to 10 atmosphere is

(Given R = 2.0 cal K^{-1} mol^{-1})

(1) –413.14 calories

(2) 413.14 calories

(3) 100 calories

(4) 0 calorie

Answer (1)

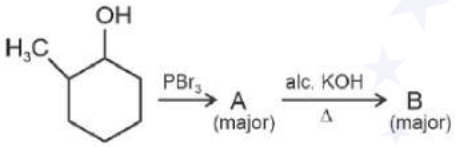
Sol. $W_{rev,\ iso} = -2.303\ nRT \log \frac{P_i}{P_f}$

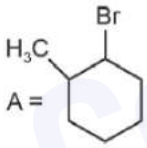
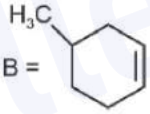
$= -2.303 \times 1 \times 2 \times 298 \times \log 2$

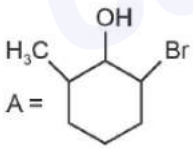
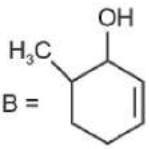
$= -2.303 \times 1 \times 2 \times 298 \times 0.3$

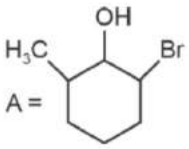
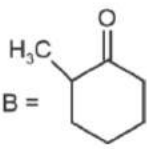
$= -413.14$ calories

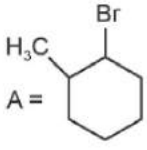
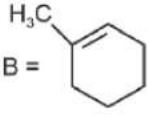
96. Major products A and B formed in the following reaction sequence, are



(1) A =  ; B = 

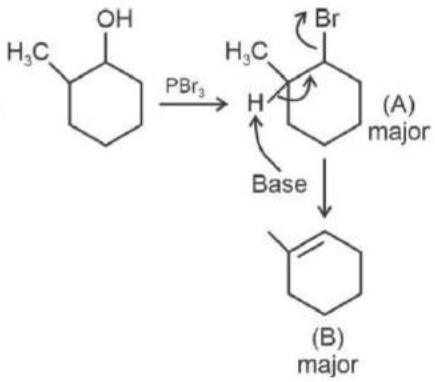
(2) A =  ; B = 

(3) A =  ; B = 

(4) A =  ; B = 

Answer (4)

Sol.



97. The rate of a reaction quadruples when temperature changes from 27°C to 57°C. Calculate the energy of activation.

Given R = 8.314 J K^{-1} mol^{-1}, log4 = 0.6021

(1) 380.4 kJ/mol

(2) 3.80 kJ/mol

(3) 3804 kJ/mol

(4) 38.04 kJ/mol

Answer (4)

Sol. $\log\left(\frac{k_2}{k_1}\right) = \frac{E_a}{2.303R}\left(\frac{1}{T_1} - \frac{1}{T_2}\right)$

$\log\left(\frac{4}{1}\right) = \frac{E_a}{2.303R}\left(\frac{1}{300} - \frac{1}{330}\right)$

$E_a = \frac{(\log(4)) \times 2.303 \times 8.314 \times 300 \times 330}{30}$

$= 3.804 \times 10^4$ J/mol

= 38.04 kJ/mol

98. During the preparation of Mohr's salt solution (Ferrous ammonium sulphate), which of the following acid is added to prevent hydrolysis of Fe^{2+} ion?

(1) concentrated sulphuric acid

(2) dilute nitric acid

(3) dilute sulphuric acid

(4) dilute hydrochloric acid

Answer (3)

Sol. During the preparation of Mohr's salt, dilute sulphuric acid is added to prevent the hydrolysis of Fe^{2+} ion.

99. The plot of osmotic pressure (Π) vs concentration (mol L^{-1}) for a solution gives a straight line with slope 25.73 L bar mol^{-1}. The temperature at which the osmotic pressure measurement is done is

(Use R = 0.083 L bar mol^{-1} K^{-1})

(1) 310°C (2) 25.73°C

(3) 12.05°C (4) 37°C

Answer (3)

Sol. $\Pi = CRT$

Slope = RT

$25.73 = 0.083 \times T$

$$T = \frac{25.73}{0.083} = 309.47 \approx 310\ K$$

$\therefore$ Temperature in °C = 310 – 273

= 37°C

100. Identify the **correct** answer.

(1) BF_3 has non-zero dipole moment

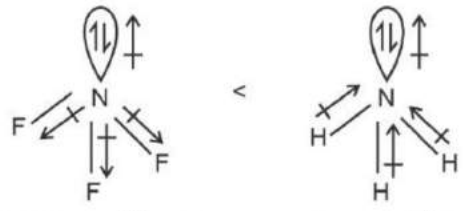
(2) Dipole moment of NF_3 is greater than that of NH_3

(3) Three canonical forms can be drawn for CO_3^{2-} ion

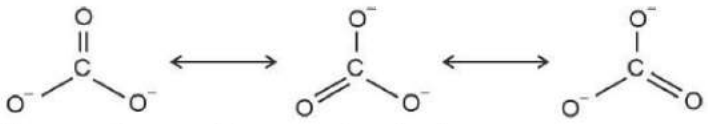
(4) Three resonance structures can be drawn for ozone

Answer (3)

Sol. (1) BF_3 i.e.,  ; Dipole moment = 0

(2) 

(0.80×10^{-30} Cm) (4.90×10^{-30} Cm)

(3)  (3 canonical forms)

(4) In ozone; there are two resonating structures.