CHEMISTRY

SECTION-A

51. 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 < N < O < F Si

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

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

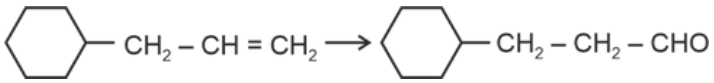
(4) < N < C < Si

Answer (1)

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

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



(1) (i) H2O/H

(ii) CrO3

(2) (i) BH3

(ii) H2O2/OH

(iii) PCC

(3) (i) BH3

(ii) H2O2/OH

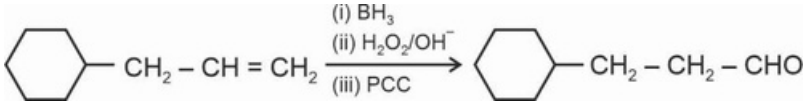
(iii) alk.KMnO4

(iv) H 3O

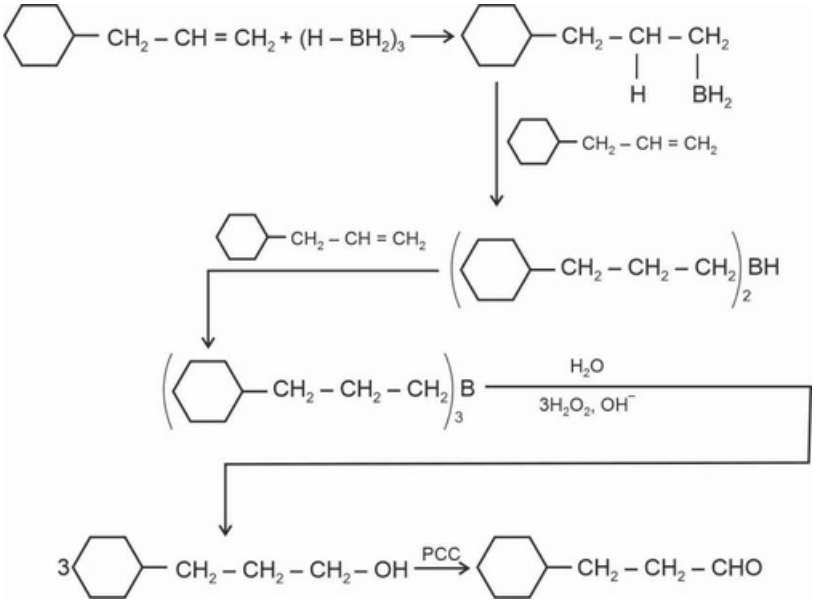
(4) (i) H 2O/H

(ii) PCC

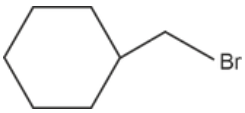
Answer (2)

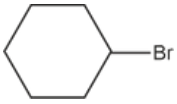
Sol. 

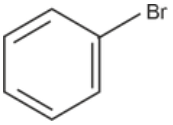
Mechanism :

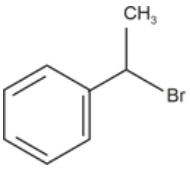


53. The compound that will undergo SN1 reaction with the fastest rate is

(1) 

(2) 

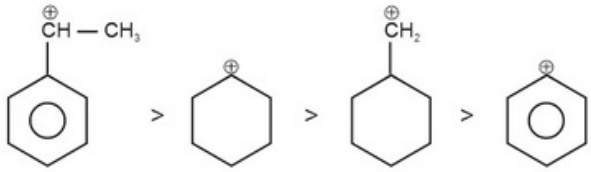
(3) 

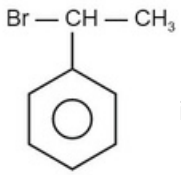
(4) 

Answer (4)

Sol. Reactivity towards SN1 depends upon stability of carbocation**.**

Order of stability is



Hence 

is most reactive

54. 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 is at equilibrium.

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

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

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

Answer (3)

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

At a given time t, QC is to be calculated and been compared with KC.

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

QC = 1

As QC > KC, so reaction has a tendency to move backward.

55. The highest number of helium atoms is in

(1) 4 mol of helium

(2) 4 u of helium

(3) 4 g of helium

(4) 2.271098 L of helium at STP

Answer (1)

Sol. (1) 4 mol of He = 4 NA He atoms

(2) 4 u of He = $\frac{4}{u}$ = 1 He atom

(3) 4 g of Helium = $\frac{4\text{ g}}{4\text{ g}}$ mole = 1 mole = NA He atom

(4) 2.2710982 of He at STP = $\frac{2.271}{22.710982}$ mole

= 0.1 mole

= 0.1 NA He atom

56. 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-III, C-II, D-

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

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

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

Answer (4)

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

(B) Isochoric process Volume is constant throughout the process

(C) Isobaric process Pressure is constant throughout the process

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

57. 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 Be3+ ion in J is

(1) –x

(2) $-\frac{x}{9}$

(3) –4x

(4) $-\frac{4}{9}x$

Answer (1)

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

For He+ (n = 1),

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

$$RH = \frac{x}{4}$$

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

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

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

58. 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:

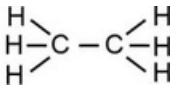
(1) A-I, B-IV, C-II, D-III

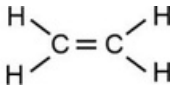
(2) A-IV, B-III, C-II, D-I

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

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

Answer (3)

Sol. (A) Ethane  one (C – C) σ bond

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

(C) C2 two (C – C) π bonds

(D) Ethyne H – C $\equiv$ C – H two (C – C) π bonds and one (C – C) σ bond

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

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

Answer (1)

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

60. 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) d5 to d4

(2) configuration d5 to

(3) d2 configuration d4

(4) to d5 configuration

Answer (3) d3 to d5 configuration

Sol. $E^\circ_{Mn^{3+}/Mn^{2+}}$ $\rightarrow$ E Cr3+/Cr2+ or EFe3+/Fe2+

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.

61. In which of the following equilibria, Kp and Kc are NOT equal?

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

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

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

(4) $2\,BrCl_{(g)} \rightleftharpoons Br_{2(g)} + Cl_{2(g)}$

Answer (1)

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

for $K_p = K_c$,

$\Delta n_g = 0$

$\Delta n_g = n_p - n_r$

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

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

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

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

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

(1) O

(2) Se

(3) Te

(4) Po

Answer (4)

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

63. '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) B and D only

(2) A and E only

(3) B and C only

(4) A and D only

Answer (1)

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 $\sqrt{n(n+2)}\,BM$

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

64. A compound with a molecular formula of C6H14 has two tertiary carbons. Its IUPAC name is :

(1) n-hexane

(2) 2-methylpentane

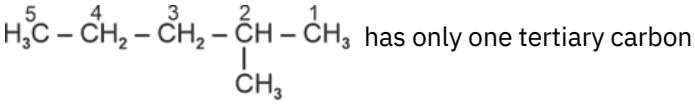
(3) 2,3-dimethylbutane

(4) 2,2-dimethylbutane

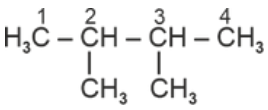
Answer (3)

Sol. CH3 – CH2 – CH2 – CH2 – CH2 – CH3 has no tertiary carbon

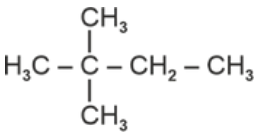
(n-Hexane)

 has only one tertiary carbon

(2-Methylpentane)

 has two tertiary carbon.

(2, 3-Dimethylbutane)

 has no tertiary carbon

(2, 2-Dimethylbutane)

65. 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 correct

(2) Both Statement I and Statement II are incorrect

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

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

Answer (1)

Sol. Both statement I and statement II are correct.

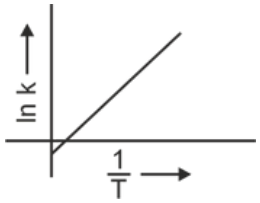
Boiling point of n-pentane = 309 K

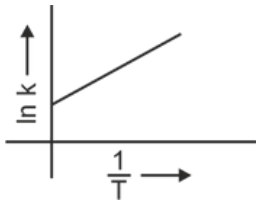
isopentane = 301 K

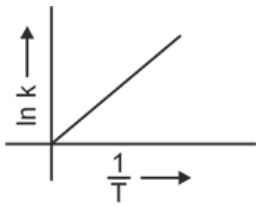
neopentane = 282.5

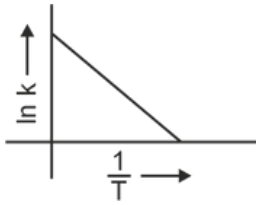
As branching increases molecules attain the shape of a sphere results in smaller area of contact thus weak intermolecular forces between spherical molecules, which are overcome at relatively lower temperature. Leading to decrease in boiling point.

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

(1) 

(2) 

(3) 

(4) 

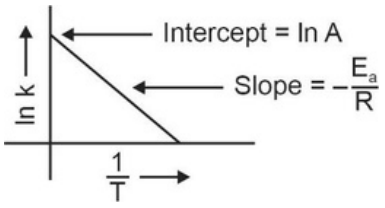
Answer (4)

Sol. TheArrhenius equation is given as

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

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

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



67. The Henry's law constant (KH) 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 > A > C (2) B > C > A

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

Answer (2)

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

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

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

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

68. Fehling's solution 'A' is

(1) aqueous copper sulphate

(2) alkaline copper sulphate

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

(4) aqueous sodium citrate

Answer (1)

Sol. Fehling solution 'A' = Aqueous copper sulphate

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

69. Given below are two statements:

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

H2O > H2Te > H2Se > H2S.

Statement II: On the basis of molecular mass, H2O is expected to have lower boiling point than the other members of the group but due to the presence of extensive H-bonding in H2O, 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 true (2) Both Statement I and Statement II are false (3) Statement I is true but Statement II is false (4) Statement I is false but Statement II is true Answer (1) Sol. Statement I

is correct, because boiling point of hydrides of group 16 follows the order

H2O > H2Te > H2Se > H2S.

Statement II due to intermolecular H-bonding H2O shows higher boiling point than respective hydrides of group 16.

(Both Statement are true)

Order from H2Te to H2S is due to decreasing molar mass.

70. 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 true

(2) Both Statement I and Statement II are false

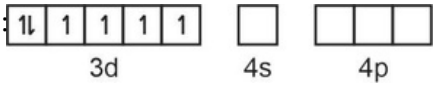
(3) Statement I is true but Statement II is false

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

Answer (1)

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.

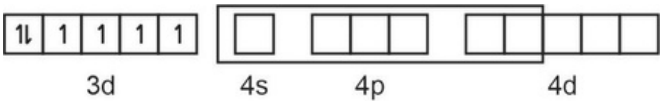
In presence of NH_3 ligand :

$\because [Co(NH_3)_6]^{3+}$ 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.

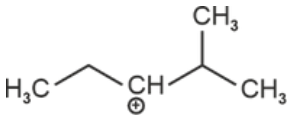
In presence of weak field F– ligand, pairing does not take place.

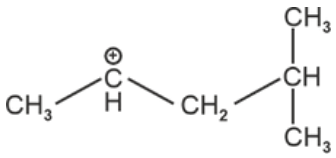
In presence of F– ligands :

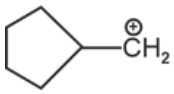


$\because$ In $[CoF_6]^{3-}$, Co is sp^3d^2 hybridised with four unpaired electrons, so it is paramagnetic in nature.

71. The most stable carbocation among the following is :

(1) 

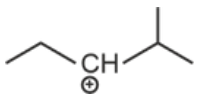
(2) 

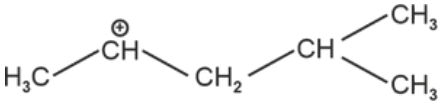
(3) 

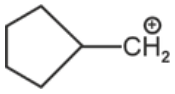
(4) 

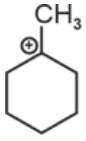
Answer (4)

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

(1)  → 3 β-H

(2)  → 5 β-H

(3)  → 1 β-H

(4)  → 7 β-H

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

72. 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) Crystallization
(2) Sublimation
(3) Distillation
(4) Chromatography

Answer (2)

Sol. (1) Crystallization : It is based on difference in the solubilities of the compound and impurities in a suitable solvent.

(2) 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.

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

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

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

Answer (1)

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

74. 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. $NaHSO_3$

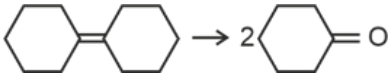
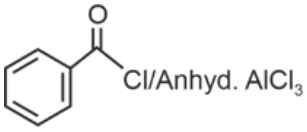
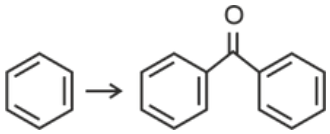
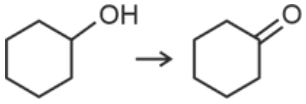
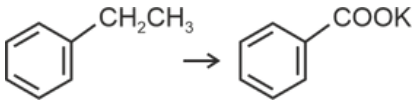
Choose the correct options from the given below:

(1) B and C
(2) A and D
(3) B and E
(4) E and D

Answer (3)

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

75. Match List I with List II.

List I (Reaction)	List II (Reagents/Condition)
A. 	I. 
B. 	II. CrO3
C. 	III. KMnO4/KOH, Δ
D. 	IV. (i) O3 (ii) Zn-H2O

Choose the correct answer from the options given below:

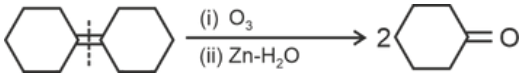
(1) A-IV, B-I, C-III, D-II

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

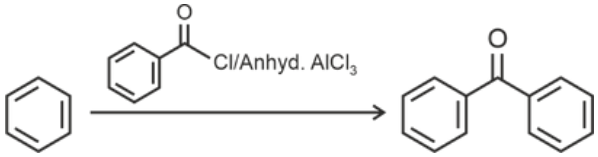
(3) A-IV, B-I, C-II, D-III

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

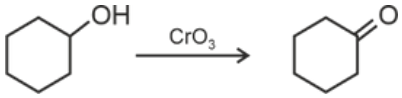
Answer (3)

Sol. (A) 

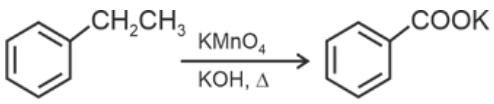
It is reductive ozonolysis

(B) 

It is Friedel-Crafts acylation reaction.

(C) 

Secondary alcohols are oxidised to ketones by CrO3

(D) 

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

(1) rate constant at standard temperature

(2) probability of collision

(3) orientation of reactant molecules during collision

(4) rate constant at two different temperatures

Answer (4)

Sol. To calculate value of Ea

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 Ea can be calculated if value of rate constant k is known at two different temperatures T1 and T2.

77. Match List I with List II.

List I (Conversion)	List II (Number of Faraday required)
A. 1 mol of H2O to O2	I. 3F
B. 1 mol of MnO_4^- to Mn2+	II. 2F
C. 1.5 mol of Ca from molten CaCl2	III. 1F
D. 1 mol of FeO to Fe2O3	IV. 5F

Choose the correct answer from the options given below:

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

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

Answer (1)

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

for 2 mole of H2O = 4F charge is required

for 1 mole of H2O = $\frac{4F}{2}$ = 2F required

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

for 1 mole MnO_4^- 5F charge is required

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

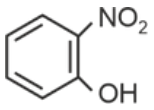
For 1 mole Ca2+ ion required = 2F

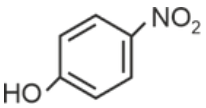
1.5 mole Ca2+ ion required = $\frac{2}{1} \times 1.5$ = 3F

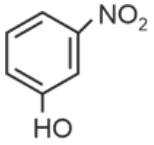
$\overset{+2}{Fe}O \rightarrow \overset{+3}{Fe}_2O_3$

for 1 mole FeO, 1F charge is required.

78. Intramolecular hydrogen bonding is present in

(1) 

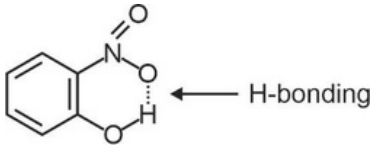
(2) 

(3) 

(4) HF

Answer (1)

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



79. 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 true

(2) Both Statement I and Statement II are false

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

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

Answer (1)

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.

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

(1) $CH3 – CH2 – CH2 – CH2OH$

(2) $CH_3 – CH_2 – \underset{\displaystyle CH_3}{\underset{|}{CH}} – OH$

(3) $CH_3 – \underset{\displaystyle CH_3}{\underset{|}{CH}} – CH_2OH$

(4) $CH_3 – \underset{\displaystyle CH_3}{\overset{\displaystyle CH_3}{\overset{|}{\underset{|}{C}}}} – OH$

Answer (4)

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 ZnCl2)

81. 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 < Be < B < C < N

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

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

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

Answer (2)

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

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

82. Which reaction is NOT a redox reaction?

(1) Zn + CuSO4 → ZnSO4 + Cu

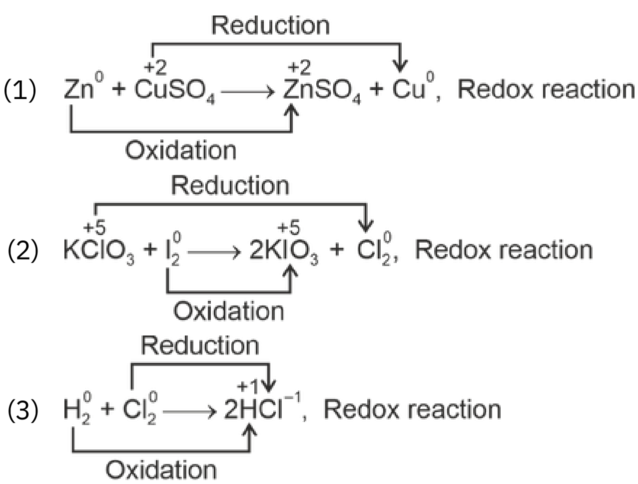
(2) 2KClO3 + I2 → 2KIO3 + Cl2

(3) H2 + Cl2 → 2HCl

(4) BaCl2 + Na2SO4 → BaSO4 + 2NaCl

Answer (4)

Sol. (1), (2), (3)



(4) BaCl−1+NaSO−2—→BaSO+2NaCl−1 (+2, +, +2, +1; 2, 2, 4, 4)

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

83. Match List I with List II

List I (Quantum Number)		List II (Information provided)	
A.	ml	I.	Shape of orbital
B.	ms	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-I, B-III, C-II, D-IV

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

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

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

Answer (2)

Sol. • Magnetic quantum number ml informs about orientation of orbital.

• Spin quantum number ms 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

84. 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 and C

(2) A, B and D

(3) A, C and D

(4) C and D

Answer (3)

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.

85. 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) 750 mg

(2) 250 mg

(3) Zero mg

(4) 200 mg

Answer (2)

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

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

= 0.684 g (Mass of HCl)

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

36.5 g HCl reacts with NaOH = 40 g

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

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

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_3

(2) $POCl_3$ and H_3PO_4

(3) H_3PO_4 and $POCl_3$

(4) H_3PO_3 and $POCl_3$

Answer (4)

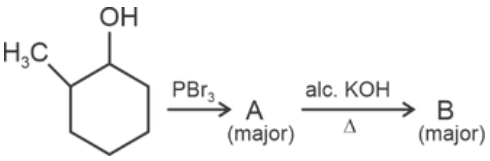
Sol. These reactions are preparation of haloalkanes from alcohols.

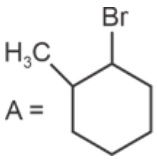
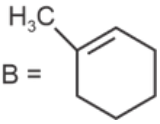
$$3ROH + PCl_3 \rightarrow \underset{(A)}{3RCl} + H_3PO_3$$

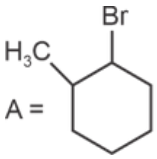
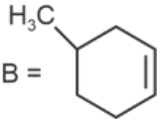
$$ROH + PCl_5 \rightarrow RCl + HCl + \underset{(B)}{POCl_3}$$

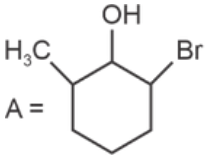
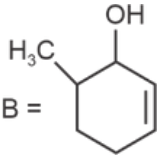
A and B are H_3PO_3 and $POCl_3$ respectively.

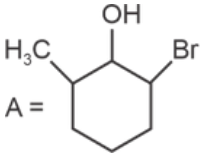
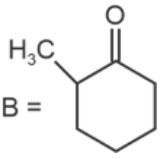
87. Major products A and B formed in the following reaction sequence, are



(1) A =  ; B = 

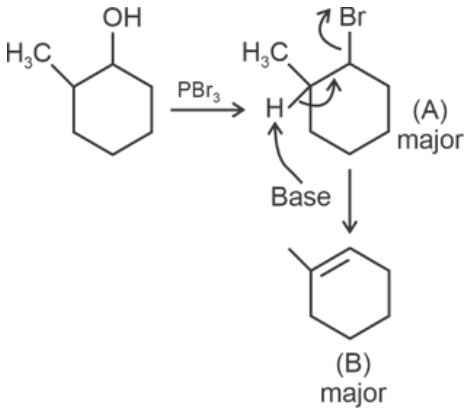
(2) A =  ; B = 

(3) A =  ; B = 

(4) A =  ; B = 

Answer (1)

Sol.



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

$CH3-CH2-CH2-I \xrightarrow{NaCN} A$

$\xrightarrow[\text{Partialhydrolysis}]{OH^-} B \xrightarrow[Br_2]{NaOH} C_{(major)}$

(1) propylamine

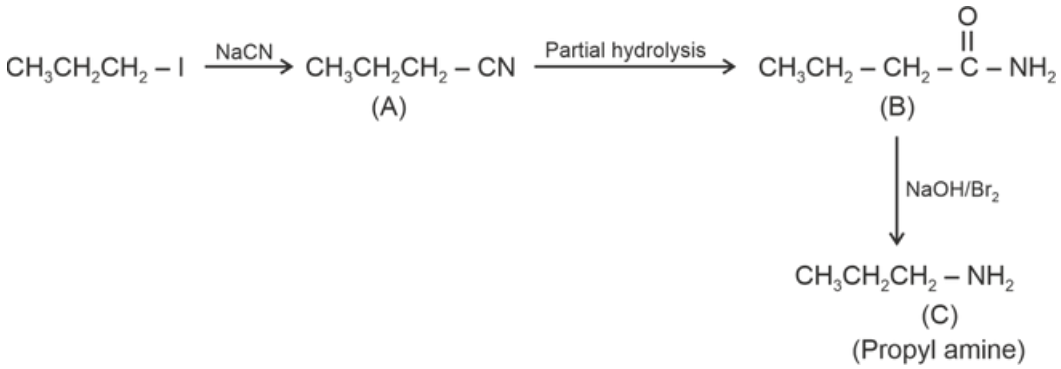
(2) butylamine

(3) butanamide

(4) □–bromobutanoic acid

Answer (1)

Sol.



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

89. During the preparation of Mohr's salt solution (Ferrous ammonium sulphate), which of the following acid is added to prevent hydrolysis of Fe2+ ion?

(1) dilute hydrochloric acid

(2) concentrated sulphuric acid

(3) dilute nitric acid

(4) dilute sulphuric acid

Answer (4)

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

90. 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 = 2.8×10^{-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) 0.00889

(2) 0.0889

(3) 0.8889

(4) 0.717

Answer (4)

Sol. $2NO(g) \rightleftharpoons N_{2(g)} + O_{2(g)}$

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

$$= \frac{3 \times 10^{-3} \times 4.2 \times 10^{-3}}{2.8 \times 10^{-3} \times 2.8 \times 10^{-3}}$$

$$= 1.607$$

$2NO(g) \rightleftharpoons N_2(g) + O_2(g)$

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

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

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

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

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

$$\frac{\alpha}{1-\alpha} = \frac{1.27 \times 0.1}{0.05}$$

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

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

$$3.54\alpha = 2.54$$

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

91. 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) 0 calorie
(2) –413.14 calories
(3) 413.14 calories
(4) 100 calories

Answer (2)

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

92. 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) 3.15 g
(2) 0.315 g
(3) 31.5 g
(4) 0.0315 g

Answer (2)

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

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

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

$= 0.315$ g

93. 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) 38.04 kJ/mol
(2) 380.4 kJ/mol
(3) 3.80 kJ/mol
(4) 3804 kJ/mol

Answer (1)

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

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

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

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

$= 38.04$ kJ/mol

94. 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) 37°C
(2) 310°C
(3) 25.73°C
(4) 12.05°C

Answer (1)

Sol. $\pi = CRT$

Slope = RT

$25.73 = 0.083 \times T$

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

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

= 37°C

95. 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, A, D, C, E (2) B, C, A, D, E

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

Answer (1)

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

96. 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 true

(2) Both Statement I and Statement II are false

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

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

Answer (1)

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^-.

97. The pair of lanthanoid ions which are diamagnetic is

(1) Ce4+ and Yb2+ (2) Ce3+ and Eu2+

(3) Gd3+ and Eu3+ (4) Pm3+ and Sm3+

Answer (1)

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

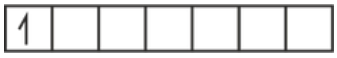
n → number of unpaired electron

Ce4+ → (Xe) $4f^0$

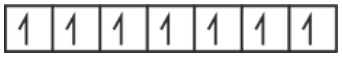
$\mu = 0$ Diamagnetic

Yb2+ → (Xe) $4f^{14}$ 

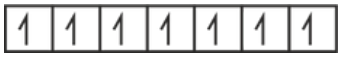
$\mu = 0$ Diamagnetic

Ce3+ → (Xe) $4f^1$ 

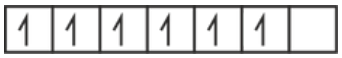
$\mu = \sqrt{3}$ Paramagnetic

Eu2+ → (Xe) $4f^7$ 

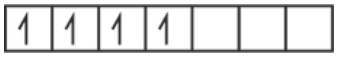
$\mu = \sqrt{63}$ Paramagnetic

Gd3+ → (Xe) $4f^7$ 

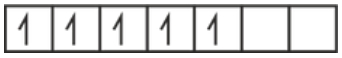
$\mu = \sqrt{63}$ Paramagnetic

Eu3+ → (Xe) $4f^6$ 

$\mu = \sqrt{48}$ Paramagnetic

Pm3+ → (Xe) $4f^4$ 

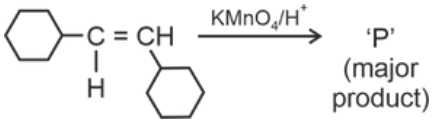
$\mu = \sqrt{24}$ Paramagnetic

Sm3+ → (Xe) $4f^5$ 

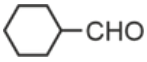
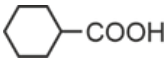
$\mu = \sqrt{35}$ Paramagnetic

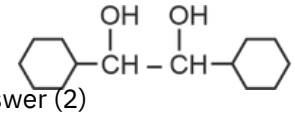
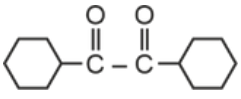
Hence Ce4+ and Yb2+ are only diamagnetic.

98. For the given reaction:

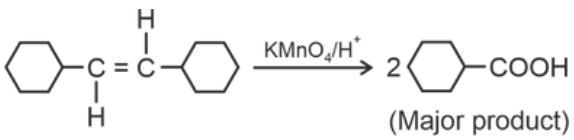


'P' is

(1)  (2) 

(3)  (4) 

Answer (2)

Sol. 

99. Identify thecorrect answer.

(1) Three resonance structures can be drawn for ozone

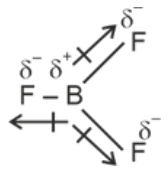
(2) BF3 has non-zero dipole moment

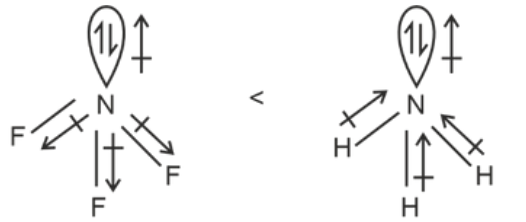
(3) Dipole moment of NF3 is greater than that of NH3

(4) Three canonical forms can be drawn for $CO2^{-}_{3}$ ion

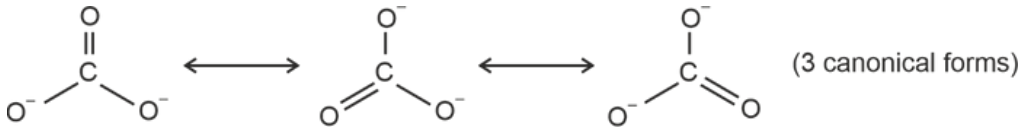
Answer (4)

Sol. (1) In ozone; there are two resonating structures.

(2) BF3 i.e.,  ; Dipole moment = 0

(3) 

$(0.80 \times 10^{-30}\ Cm)$ $(4.90 \times 10^{-30}\ Cm)$

(4) 

(3 canonical forms)

100. 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) A2BC2 (2) ABC3

(3) AB2C2 (4) ABC4

Answer (2)

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= A : B : C

1 : 1 : 3

The correct empirical formula of compound X is ABC3