CHEMISTRY

46. The lanthanide ion having four unpaired electrons is

(Given : Atomic numbers of Ce = 58, Nd = 60, Tb = 65 and Ho = 67)

(1) Tb^{3+}

(2) Ho^{3+}

(3) Nd^{3+}

(4) Ce^{3+}

Answer (2)

47. The standard electrode potential (E°) for the half-cell reaction $Fe^{3+} + e^- \rightarrow Fe^{2+}$ at 298 K is

(Given : $E°(Fe^{3+}/Fe) = -0.04$ V and $E°(Fe^{2+}/Fe) = -0.44$ V at 298 K)

(1) –0.48 V

(2) +0.92 V

(3) +0.40 V

(4) +0.76 V

Answer (4)

48. Given below are two statements :

Statement-I : Heating NaCl with concentrated H_2SO_4 and MnO_2 results in oxidation of Mn.

Statement-II : Heating NaI with concentrated H_2SO_4 and MnO_2 results in reduction of Mn.

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

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

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

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

(4) Both **Statement-I** and **Statement-II** are incorrect

Answer (2)

49. The complex which has *facial* and *meridional* isomers is

(Given : py = pyridine and en = $H_2N - CH_2 - CH_2 - NH_2$)

(1) $[Co(NH_3)_4(H_2O)_2]^{3+}$

(2) $[Ni(en)_2(H_2O)_2]^{2+}$

(3) $[Cr(py)_3(Cl)_3]$

(4) $[Cr(H_2O)_6]^{3+}$

Answer (3)

50. Among the following, the compound having conjugated double bonds is

(1) hepta-1,5-diene

(2) hepta-1,6-diene

(3) hepta-1,3-diene

(4) hepta-1,4-diene

Answer (3)

51. Match the species in **List-I** with their geometry in **List-II**.

	List-I		**List-II**
A.	PCl_5	I.	Tetrahedral
B.	BrF_5	II.	Square Planar
C.	BF_4^-	III.	Trigonal bipyramidal
D.	$[Ni(CN)_4]^{2-}$	IV.	Square pyramidal

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

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

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

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

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

Answer (4)

52. The amino acid that gives a red-blood colour on treating its sodium fusion extract with sodium nitroprusside is

(1) methionine

(2) serine

(3) leucine

(4) threonine

Answer (1)

53. A protein undergoes reversible thermal denaturation from its initial state **N** to denatured state **D** according to $\mathbf{N} \rightleftharpoons \mathbf{D}$. At 60°C, the concentrations of both **N** and **D** are equal at equilibrium, and the standard enthalpy change of denaturation is 666 kJ mol^{-1}. The standard entropy change (ΔS° in kJ K^{-1} mol^{-1}) of the protein upon denaturation at 60°C is closest to

(1) 333.0

(2) 11.1

(3) 2.0

(4) 2000.0

Answer (3)

54. $2A \xrightarrow{k} B$ is a zero-order reaction, where $k = 1.0\ mol\ L^{-1}\ min^{-1}$. If the initial concentration of A is 2 M, then the time taken to complete 75% of the reaction will be

(1) 1.0 min

(2) 2.0 min

(3) 1.5 min

(4) 0.75 min

Answer (4)

55. Given below are two statements:

Statement-I : $[Fe(ox)_3]^{3-}$ is chiral.

Statement-II : *trans* – $[Cr(H_2O)_2(ox)_2]^-$ is chiral.

(Given : oxH_2 = HOOC – COOH)

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

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

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

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

(4) Both **Statement-I** and **Statement-II** are incorrect

Answer (1)

56. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A: Generally, 3*d* transition metals have high melting points.

Reason R: Involvement of 3*d*-electrons in addition to 4*s*-electrons in the interatomic metallic bonding.

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

(1) **A** is correct but **R** is not correct.

(2) **A** is not correct but **R** is correct

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

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

Answer (3)

57. Among the species given below, the spin-only magnetic moment is highest for
(Given: Atomic number of Ti = 22, Mn = 25, Fe = 26 and Co = 27)

(1) $[Co(NH_3)_6]^{3+}$

(2) $[Ti(H_2O)_6]^{3+}$

(3) $[Mn(CN)_6]^{3-}$

(4) $[Fe(CN)_6]^{3-}$

Answer (3)

58. According to crystal field theory, the correct order of ligands with respect to their decreasing order of field strength is

(1) $Cl^- > H_2O > NH_3 > CO$

(2) $Cl^- > NH_3 > H_2O > CO$

(3) $CO > NH_3 > H_2O > Cl^-$

(4) $CO > H_2O > NH_3 > Cl^-$

Answer (3)

59. In potash alum, the ratio of K^+ and SO_4^{2-} ions is

(1) 2 : 3

(2) 3 : 2

(3) 1 : 2

(4) 2 : 1

Answer (3)

60. Given below are two statements: One is labelled as **Assertion A** and the other is labelled as **Reason R.**

Assertion A: The first ionization enthalpy of O is lower than that of N and F.

Reason R: The loss of an electron from O leads to stable half-filled *p* orbital.

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

(1) **A** is correct but **R** is not correct.

(2) **A** is not correct but **R** is correct

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

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

Answer (3)

61. Given below are two statements:

Statement-I : Oxidation of p-nitrotoluene with acidic $KMnO_4$ gives an acid that is stronger than benzoic acid.

Statement-II : Reduction of p-nitrotoluene with Sn/HCl followed by neutralization gives an amine that is more basic than aniline.

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

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

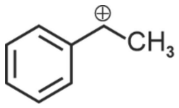
(2) **Statement-I** is incorrect but **Statement-II** is correct

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

(4) Both **Statement-I** and **Statement-II** are incorrect

Answer (3)

62. The following carbocation is stabilized by the interaction of the empty *p* orbital with



(1) empty σ^* and filled π orbitals

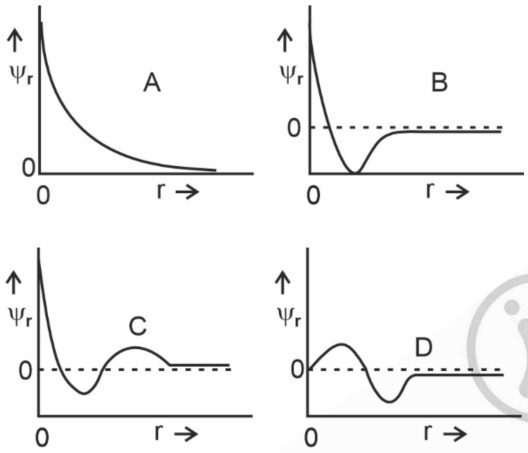
(2) empty σ^* and empty π^* orbitals

(3) filled σ and filled π orbitals

(4) empty σ and empty π^* orbitals

Answer (3)

63. Consider the following schematic plots of orbital wavefunction (ψ_r) against distance (r) from the nucleus.



The figure representing two radial nodes in the orbital is

(1) C

(2) D

(3) A

(4) B

Answer (1)

64. The correct order of solubility of the given salts in water at 298 K is

Salt	**K_{sp} at 298 K**
AgBr	5.0×10^{-13}
$Zn(OH)_2$	1.0×10^{-15}
Hg_2Cl_2	1.3×10^{-18}

(1) $Hg_2Cl_2 > AgBr > Zn(OH)_2$

(2) $Zn(OH)_2 > AgBr > Hg_2Cl_2$

(3) $Hg_2Cl_2 > Zn(OH)_2 > AgBr$

(4) $AgBr > Zn(OH)_2 > Hg_2Cl_2$

Answer (2)

65. A 1 : 3 electrolyte in an aqueous solution is

(1) $[Co(NH_3)_6]Cl_3$ (2) $[Co(NH_3)_3(NO_2)_3]$

(3) $[CoCl_2(NH_3)_4]Cl$ (4) $[CoCl(NH_3)_5]Cl_2$

Answer (1)

66. The correct statement about peptides and proteins is

(1) In β-pleated sheet structures, peptide chains are held together by intermolecular hydrogen bonds

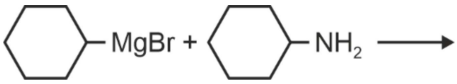
(2) In α-helices, the polypeptide chain is twisted into a left-handed screw (helix) through intramolecular hydrogen bonds

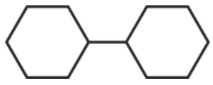
(3) Tertiary structure of proteins has two or more polypeptide subunits

(4) Only the proteins having a quaternary structure are biologically active

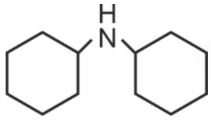
Answer (1)

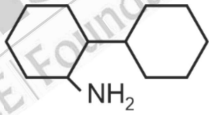
67. One of the products formed in the following reaction is



(1) 

(2) 

(3) 

(4) 

Answer (2)

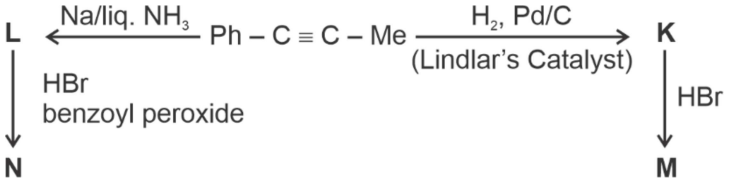
68. In an acidic medium, 10 mL of 0.25 M oxalic acid is titrated with $KMnO_4$ solution. If the volume of $KMnO_4$ solution required to reach end point is 10 mL, the strength of the $KMnO_4$ solution is

(1) 0.25 M (2) 0.15 M

(3) 0.10 M (4) 0.20 M

Answer (3)

69. Consider the following reaction sequences and choose the correct option.



(1) **M** and **N** are geometrical isomers (2) **M** and **N** are stereoisomers

(3) **K** and **L** are geometrical isomers (4) **K** and **L** are enantiomers

Answer (3)

70. Arrange the following compounds in the increasing order of polarity

A. $CH_3CH_2OCH_2CH_3$

B. CH_3CH_2OH

C. CH_3COCH_3

D. CH_3COOH

Choose the correct answer from the options given below.

(1) C < A < B < D

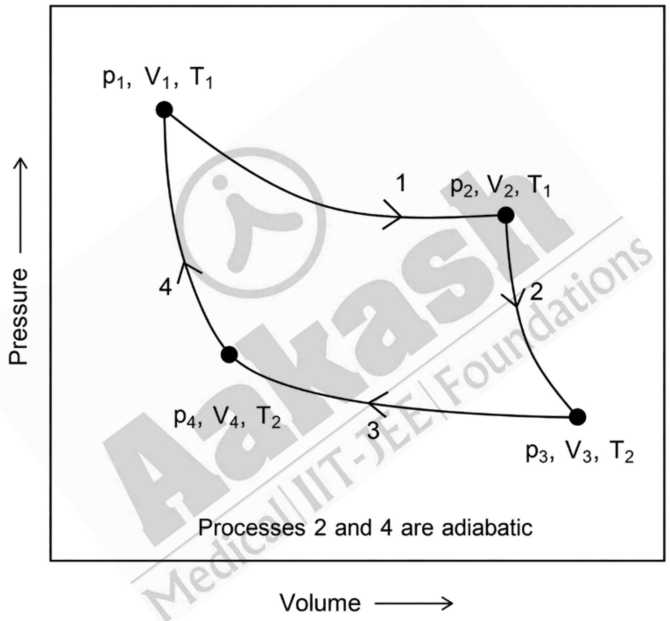
(2) A < C < B < D

(3) A < B < C < D

(4) C < A < D < B

Answer (2)

71. Consider the reversible processes for 1.0 mol of an ideal gas as shown in the figure.



w_1, w_2, w_3 and w_4 represent work done (in calories) in the processes 1, 2, 3 and 4, respectively; ΔU_2 and ΔU_4 are changes in the internal energy for the processes 2 and 4, respectively.

[use R = 2 cal K^{-1} mol^{-1}]

The correct option is

(1) $w_1 + w_2 = 2T_1 \ln \frac{V_2}{V_1}$

(2) $w_1 + w_2 + w_3 + w_4 = 0$

(3) $w_1 + w_3 = -2T_1 \ln \frac{V_2}{V_1} - 2T_2 \ln \frac{V_4}{V_3}$

(4) $w_2 + w_4 = \Delta U_2 - \Delta U_4$

Answer (3)

72. The green paramagnetic species formed by heating $KMnO_4$ at 513 K is

(1) MnO (2) KO_2

(3) K_2MnO_4 (4) Mn_3O_4

Answer (3)

73. The numbers 17.0145 and 21.0235 were rounded to three figures after the decimal point. The resulting numbers, respectively, are

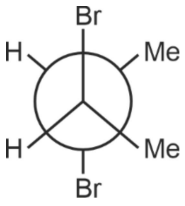
(1) 17.014 and 21.024 (2) 17.015 and 21.024

(3) 17.014 and 21.023 (4) 17.015 and 21.023

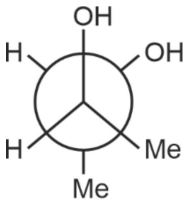
Answer (1)

74. Given below are two statements :

Statement I : *trans*-But-2-ene upon treatment with Br_2 in CCl_4 gives the following product.



Statement II : *cis*-But-2-ene upon treatment with alkaline $KMnO_4$ gives the following product.



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

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

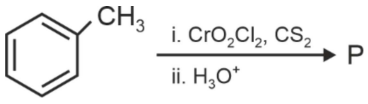
(2) **Statement I** is incorrect but **Statement II** is correct

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

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

Answer (2)

75. Consider the following reaction, and choose the correct option.



(1) On treatment with bromine water, compound **P** gives a white precipitate

(2) Compound **P** is obtained by the hydrogenation of benzoyl chloride with Pd on $BaSO_4$

(3) On treating compound **P** with saturated $NaHCO_3$ solution, brisk effervescence is observed

(4) Compound **P** can be prepared by treating benzene with anhydrous $AlCl_3$ and CH_3COCl

Answer (2)

76. Match the vitamins in **List I** with their sources in **List II**

	List I		**List II**
A.	vitamin A	I.	meat
B.	vitamin B_{12}	II.	sunflower oil
C.	vitamin E	III.	green leafy vegetables
D.	vitamin K	IV.	carrots

Choose the correct answer from the options given below.

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

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

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

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

Answer (4)

77. The amount of carbon dioxide evolved upon complete combustion of 116 g of n-butane is

(Given: atomic mass in amu H = 1, C = 12 and O = 16)

(1) 176 g

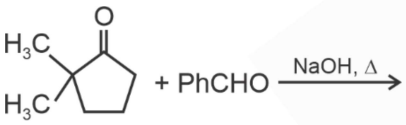
(2) 362 g

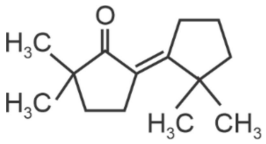
(3) 352 g

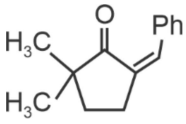
(4) 322 g

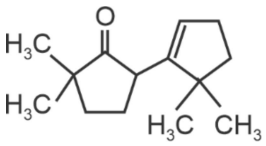
Answer (3)

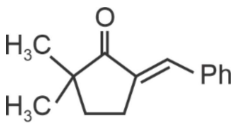
78. The compound that **CANNOT** be obtained from the aldol condensation reaction shown below, is



(1) 

(2) 

(3) 

(4) 

Answer (3)

79. The correct statement is

(1) Magnesium has a maximum covalency of four.

(2) Aluminium has five valence orbitals.

(3) Boron has a maximum covalency of four.

(4) Beryllium has three valence orbitals.

Answer (3)

80. The formula of tetraammineaquachloridocobalt(III) chloride is

(1) $[Co(NH_3)_4(H_2O)Cl]Cl$

(2) $[Co(NH_3)_4(H_2O)Cl]Cl_2$

(3) $[Co(NH_3)_4Cl_2] \times H_2O$

(4) $[Co(NH_3)_4]Cl_3 \times H_2O$

Answer (2)

81. **Assertion A:** For an ideal solution formed by mixing liquids **P** and **Q**, Δ_{mix} H = 0 and Δ_{mix} V = 0

Reason R: No interactions occur between **P** and **Q**

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

(1) **A** is correct but **R** is not correct

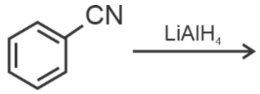
(2) **A** is not correct but **R** is correct

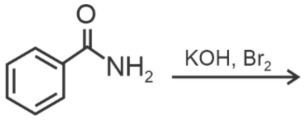
(3) Both **A** and **R** are correct and **R** is the correct explanation of **A**

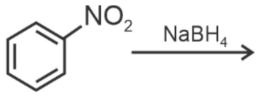
(4) Both **A** and **R** are correct but **R** is **NOT** the correct explanation of **A**

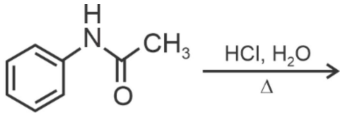
Answer (1)

82. Identify the reactions which give aniline as the major product.

A. 

B. 

C. 

D. 

Choose the correct answer from the options given below.

(1) A and C only

(2) C and D only

(3) A and B only

(4) B and D only

Answer (4)

83. The correct decreasing order of oxidation state of the underlined atom in each molecule is

(1) $\underline{Pb}O_2 > \underline{N}_2O_3 > \underline{S}O_3$

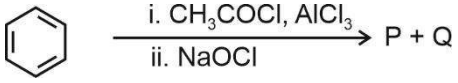
(2) $\underline{P}_4O_6 > \underline{Cl}_2O_7 > \underline{Al}H_3$

(3) $\underline{P}_4O_{10} > \underline{S}O_3 > H_2\underline{O}$

(4) $\underline{N}_2O_5 > \underline{Al}_2O_3 > H_2\underline{S}$

Answer (4)

84. For the following reaction sequence, choose the correct option



(1) If **P** gives a carboxylic acid on acidification, **Q** gives a poisonous gas on exposure to air and light

(2) Both **P** and **Q** are carbonyl compounds

(3) If **P** is the sodium salt of a carboxylic acid, **Q** is a primary alcohol

(4) **P** and **Q** are aromatic compounds

Answer (1)

85. Two moles of an ideal gas undergo free expansion from 10 L to 100 L at 300 K. The values of ΔS_{system} and $\Delta S_{surroundings}$ are

(R is universal gas constant)

(1) $\Delta S_{system} = 0$; $\Delta S_{surroundings} = 4.606$ R

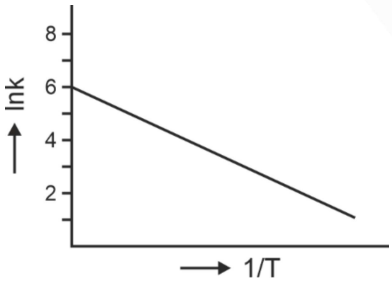
(2) $\Delta S_{system} = 4.606$ R; $\Delta S_{surroundings} = 0$

(3) $\Delta S_{system} = 0$; $\Delta S_{surroundings} = 0$

(4) $\Delta S_{system} = 4.606$ R; $\Delta S_{surroundings} = -4.606$ R

Answer (2)

86. For an elementary chemical reaction, the Arrhenius plot is given below.



If the energy of activation is 6.64 kJ mol^{-1} and R = 8.3 J K^{-1} mol^{-1}, the temperature at which the rate constant becomes e^2 min^{-1}, is

(1) 200 K

(2) 250 K

(3) 125 K

(4) 150 K

Answer (1)

87. Consider the following statements about the solutions formed by mixing two liquids.

A. An ideal solution thus formed obeys Raoult's law throughout the composition range.

B. Mixture of chloroform and acetone shows negative deviation from Raoult's law.

C. Mixture of aniline and phenol shows positive deviation from Raoult's law.

(1) A only

(2) A and C only

(3) A and B only

(4) B and C only

Answer (3)

88. The highest occupied molecular orbital for Ne_2 is

(1) π^*_{2p}

(2) σ^*_{2p}

(3) π_{2p}

(4) σ_{2p}

Answer (2)

89. For a salt **XY**, which is a strong electrolyte, the plot of Λ_m versus $\sqrt{c}$ has a slope of –90.0 S cm^2 mol$^{-3/2}$ L$^{1/2}$ at 298 K. At 0.01 M concentration of **XY**, the value of Λ_m is 145.0 S cm^2 mol^{-1}. The limiting molar conductivity of Y^- ion ($\lambda^0_{Y^-}$, in S cm^2 mol^{-1}) at 298 K will be

(Given : $\lambda^0_{X^+}$ = 74.0 S cm^2 mol^{-1})

(1) 90.0

(2) 76.0

(3) 80.0

(4) 100.0

Answer (3)

90. Among the following options, the correct trend in the electron gain enthalpy is

(1) Cl > F > Br > I

(2) I > Br > Cl > F

(3) F > Cl > Br > I

(4) Br > Cl > F > I

Answer (1)