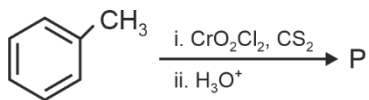


CHEMISTRY

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



- (1) Compound **P** is obtained by the hydrogenation of benzoyl chloride with Pd on BaSO₄
- (2) On treating compound **P** with saturated NaHCO₃ solution, brisk effervescence is observed
- (3) Compound **P** can be prepared by treating benzene with anhydrous AlCl₃ and CH₃COCl
- (4) On treating with bromine water, compound **P** gives a white precipitate

Answer (1)

47. The formula of tetraammineaquachloridocobalt(III) chloride is

- (1) [Co(NH₃)₄(H₂O)Cl]Cl₂
- (2) [Co(NH₃)₄Cl₂] × H₂O
- (3) [Co(NH₃)₄]Cl₃ × H₂O
- (4) [Co(NH₃)₄(H₂O)Cl]Cl

Answer (1)

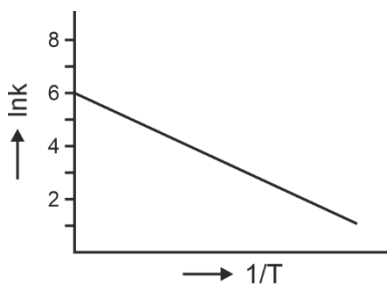
48. The lanthanide ion having four unpaired electrons is

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

- (1) Ho³⁺
- (2) Nd³⁺
- (3) Ce³⁺
- (4) Tb³⁺

Answer (1)

49. 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 e² min⁻¹, is

- (1) 250 K
- (2) 125 K
- (3) 150 K
- (4) 200 K

Answer (4)

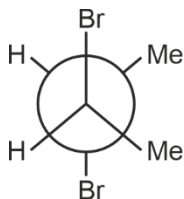
50. The green paramagnetic species formed by heating KMnO_4 at 513 K is

- (1) KO_2
- (2) K_2MnO_4
- (3) Mn_3O_4
- (4) MnO

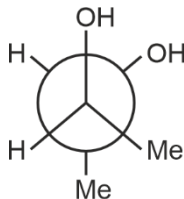
Answer (2)

51. 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.

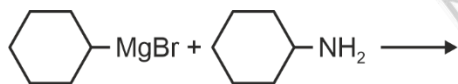


In the light of the above statements, choose the **most appropriate** answer from the options given below.

- (1) **Statement I** is incorrect but **Statement II** is correct
- (2) Both **Statement I** and **Statement II** are correct
- (3) Both **Statement I** and **Statement II** are incorrect
- (4) **Statement I** is correct but **Statement II** is incorrect

Answer (1)

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



- (1)
- (2)
- (3)
- (4)

Answer (1)

53. 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 incorrect but **Statement-II** is correct
- (2) Both **Statement-I** and **Statement-II** are correct
- (3) Both **Statement-I** and **Statement-II** are incorrect
- (4) **Statement-I** is correct but **Statement-II** is incorrect

Answer (1)

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

- (1) $\text{I} > \text{Br} > \text{Cl} > \text{F}$
- (2) $\text{F} > \text{Cl} > \text{Br} > \text{I}$
- (3) $\text{Br} > \text{Cl} > \text{F} > \text{I}$
- (4) $\text{Cl} > \text{F} > \text{Br} > \text{I}$

Answer (4)

55. Given below are two statements:

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

Statement-II : $\text{trans} - [\text{Cr}(\text{H}_2\text{O})_2(\text{ox})_2]^-$ is chiral.

(Given : $\text{oxH}_2 = \text{HOOC} - \text{COOH}$)

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

- (1) **Statement-I** is incorrect but **Statement-II** is correct
- (2) Both **Statement-I** and **Statement-II** are correct
- (3) Both **Statement-I** and **Statement-II** are incorrect
- (4) **Statement-I** is correct but **Statement-II** is incorrect

Answer (4)

56. The correct statement about peptides and proteins is

- (1) In α -helices, the polypeptide chain is twisted into a left-handed screw (helix) through intramolecular hydrogen bonds
- (2) Tertiary structure of proteins has two or more polypeptide subunits
- (3) Only the proteins having a quaternary structure are biologically active
- (4) In β -pleated sheet structures, peptide chains are held together by intermolecular hydrogen bonds

Answer (4)

57. Given below are two statements:

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

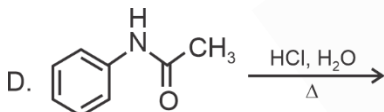
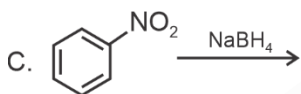
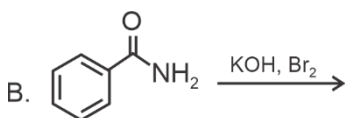
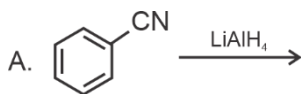
Statement-II : Reduction of p-nitrotoluene with Sn/HCl followed by neutralization gives an amine that is more basic than aniline.

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

- (1) **Statement-I** is incorrect but **Statement-II** is correct
- (2) Both **Statement-I** and **Statement-II** are correct
- (3) Both **Statement-I** and **Statement-II** are incorrect
- (4) **Statement-I** is correct but **Statement-II** is incorrect

Answer (2)

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



Choose the correct answer from the options given below.

- (1) C and D only
- (2) A and B only
- (3) B and D only
- (4) A and C only

Answer (3)

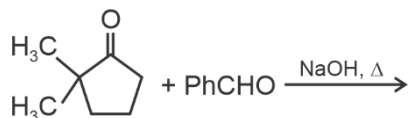
59. Two moles of an ideal gas undergo free expansion from 10 L to 100 L at 300 K. The values of ΔS_{system} and $\Delta S_{\text{surroundings}}$ are

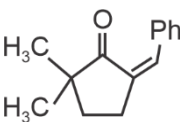
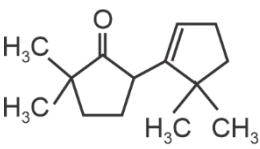
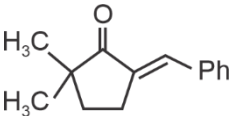
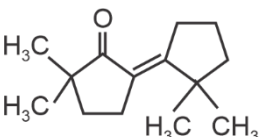
(R is universal gas constant)

- (1) $\Delta S_{\text{system}} = 4.606 R$; $\Delta S_{\text{surroundings}} = 0$
- (2) $\Delta S_{\text{system}} = 0$; $\Delta S_{\text{surroundings}} = 0$
- (3) $\Delta S_{\text{system}} = 4.606 R$; $\Delta S_{\text{surroundings}} = -4.606 R$
- (4) $\Delta S_{\text{system}} = 0$; $\Delta S_{\text{surroundings}} = 4.606 R$

Answer (1)

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



- (1) 
- (2) 
- (3) 
- (4) 

Answer (2)

61. The complex which has facial and meridional isomers is

(Given : py = pyridine and en = $\text{H}_2\text{N} - \text{CH}_2 - \text{CH}_2 - \text{NH}_2$)

- (1) $[\text{Ni}(\text{en})_2(\text{H}_2\text{O})_2]^{2+}$
- (2) $[\text{Cr}(\text{py})_3(\text{Cl})_3]$
- (3) $[\text{Cr}(\text{H}_2\text{O})_6]^{3+}$
- (4) $[\text{Co}(\text{NH}_3)_4(\text{H}_2\text{O})_2]^{3+}$

Answer (2)

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

- (1) 17.015 and 21.024
- (2) 17.014 and 21.023
- (3) 17.015 and 21.023
- (4) 17.014 and 21.024

Answer (4)

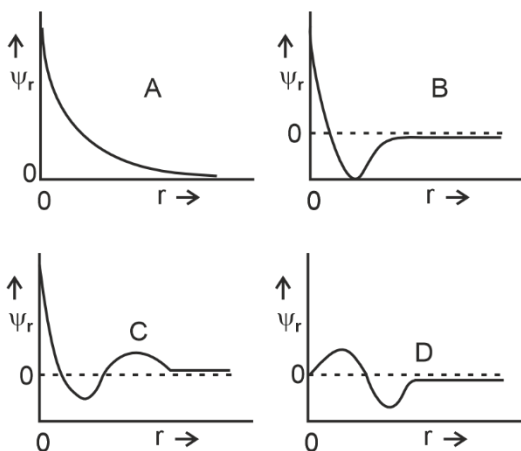
63. The amount of carbon dioxide evolved upon complete combustion of 116 g of n-butane is

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

- (1) 362 g
- (2) 352 g
- (3) 322 g
- (4) 176 g

Answer (2)

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

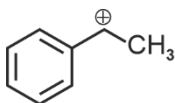


The figure representing two radial nodes in the orbital is

- (1) D
- (2) A
- (3) B
- (4) C

Answer (4)

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



- (1) empty σ^* and empty π^* orbitals
- (2) filled σ and filled π orbitals
- (3) empty σ and empty π^* orbitals
- (4) empty σ^* and filled π orbitals

Answer (2)

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

- (1) $[\text{Co}(\text{NH}_3)_3(\text{NO}_2)_3]$
- (2) $[\text{CoCl}_2(\text{NH}_3)_4]\text{Cl}$
- (3) $[\text{CoCl}(\text{NH}_3)_5]\text{Cl}_2$
- (4) $[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$

Answer (4)

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

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

- (1) +0.92 V
- (2) +0.40 V
- (3) +0.76 V
- (4) -0.48 V

Answer (3)

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

- (1) 3 : 2
- (2) 1 : 2
- (3) 2 : 1
- (4) 2 : 3

Answer (2)

69. 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 and C only
- (2) A and B only
- (3) B and C only
- (4) A only

Answer (2)

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

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

- (1) 76.0
- (2) 80.0
- (3) 100.0
- (4) 90.0

Answer (2)

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

- A. $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$
- B. $\text{CH}_3\text{CH}_2\text{OH}$
- C. CH_3COCH_3
- D. CH_3COOH

Choose the correct answer from the options given below.

- (1) $A < C < B < D$
- (2) $A < B < C < D$
- (3) $C < A < D < B$
- (4) $C < A < B < D$

Answer (1)

72. According to crystal field theory, the correct order of ligands with respect to their decreasing order of field strength is
- (1) $\text{Cl}^- > \text{NH}_3 > \text{H}_2\text{O} > \text{CO}$
 - (2) $\text{CO} > \text{NH}_3 > \text{H}_2\text{O} > \text{Cl}^-$
 - (3) $\text{CO} > \text{H}_2\text{O} > \text{NH}_3 > \text{Cl}^-$
 - (4) $\text{Cl}^- > \text{H}_2\text{O} > \text{NH}_3 > \text{CO}$

Answer (2)

73. The amino acid that gives a red-blood colour on treating its sodium fusion extract with sodium nitroprusside is
- (1) serine
 - (2) leucine
 - (3) threonine
 - (4) methionine

Answer (4)

74. 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) 0.15 M
 - (2) 0.10 M
 - (3) 0.20 M
 - (4) 0.25 M

Answer (2)

75. The correct statement is
- (1) Aluminium has five valence orbitals.
 - (2) Boron has a maximum covalency of four.
 - (3) Beryllium has three valence orbitals.
 - (4) Magnesium has a maximum covalency of four.

Answer (2)

76. Among the following, the compound having conjugated double bonds is
- (1) hepta-1,6-diene
 - (2) hepta-1,3-diene
 - (3) hepta-1,4-diene
 - (4) hepta-1,5-diene

Answer (2)

77. $2\text{A} \xrightarrow{k} \text{B}$ is a zero-order reaction, where $k = 1.0 \text{ mol L}^{-1} \text{ min}^{-1}$. If the initial concentration of A is 2 M, then the time taken to complete 75% of the reaction will be
- (1) 2.0 min
 - (2) 1.5 min
 - (3) 0.75 min
 - (4) 1.0 min

Answer (3)

78. 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) $Zn(OH)_2 > AgBr > Hg_2Cl_2$
- (2) $Hg_2Cl_2 > Zn(OH)_2 > AgBr$
- (3) $AgBr > Zn(OH)_2 > Hg_2Cl_2$
- (4) $Hg_2Cl_2 > AgBr > Zn(OH)_2$

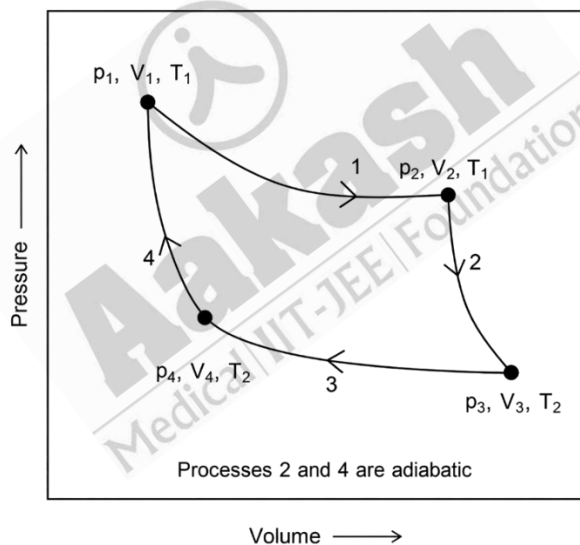
Answer (1)

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

- (1) $\underline{P}_4O_6 > \underline{Cl}_2O_7 > \underline{Al}H_3$
- (2) $\underline{P}_4O_{10} > \underline{S}O_3 > \underline{H}_2O$
- (3) $\underline{N}_2O_5 > \underline{Al}_2O_3 > \underline{H}_2S$
- (4) $\underline{Pb}O_2 > \underline{N}_2O_3 > \underline{S}O_3$

Answer (3)

80. 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 $R = 2 \text{ cal K}^{-1} \text{ mol}^{-1}$]

The correct option is

- (1) $w_1 + w_2 + w_3 + w_4 = 0$
- (2) $w_1 + w_3 = -2T_1 \ln \frac{V_2}{V_1} - 2T_2 \ln \frac{V_4}{V_3}$
- (3) $w_2 + w_4 = \Delta U_2 - \Delta U_4$
- (4) $w_1 + w_2 = 2T_1 \ln \frac{V_2}{V_1}$

Answer (2)

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

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

Answer (4)

82. 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) $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
- (2) $[\text{Mn}(\text{CN})_6]^{3-}$
- (3) $[\text{Fe}(\text{CN})_6]^{3-}$
- (4) $[\text{Co}(\text{NH}_3)_6]^{3+}$

Answer (2)

83. A protein undergoes reversible thermal denaturation from its initial state **N** to denatured state **D** according to $\text{N} \rightleftharpoons \text{D}$. 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) 11.1
- (2) 2.0
- (3) 2000.0
- (4) 333.0

Answer (2)

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

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

Reason R: Involvement of 3d-electrons in addition to 3s-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 not correct but **R** is correct
- (2) Both **A** and **R** are correct and **R** is the correct explanation of **A**
- (3) Both **A** and **R** are correct and **R** is **NOT** the correct explanation of **A**
- (4) **A** is correct but **R** is not correct.

Answer (2)

85. 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.

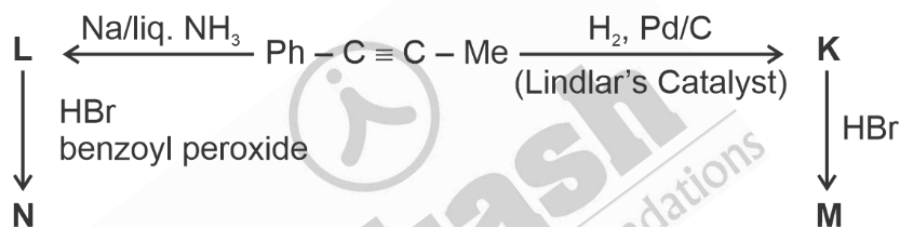
Reason R: The loss of an electron from O leads to stable half-filled *p* orbital

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

- (1) **A** is not correct but **R** is correct
- (2) Both **A** and **R** are correct and **R** is the correct explanation of **A**
- (3) Both **A** and **R** are correct and **R** is **NOT** the correct explanation of **A**
- (4) **A** is correct but **R** is not correct.

Answer (2)

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



- (1) **M** and **N** are stereoisomers
- (2) **K** and **L** are geometrical isomers
- (3) **K** and **L** are enantiomers
- (4) **M** and **N** are geometrical isomers

Answer (2)

87. The highest occupied molecular orbital for Ne_2 is

- (1) σ_{2p}^*
- (2) π_{2p}
- (3) σ_{2p}
- (4) π_{2p}^*

Answer (1)

88. 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.	$[\text{Ni}(\text{CN})_4]^{2-}$	IV.	Square pyramidal

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

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

Answer (3)

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

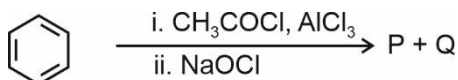
	List I		List II
A.	vitamin A	I.	meat
B.	vitamin B ₁₂	II.	sunflower oil
C.	vitamin E	III.	green leafy vegetables
D.	vitamin K	IV.	carrots

Choose the correct answer from the options given below.

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

Answer (3)

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



- (1) Both **P** and **Q** are carbonyl compounds
- (2) If **P** is the sodium salt of a carboxylic acid, **Q** is a primary alcohol
- (3) **P** and **Q** are aromatic compounds
- (4) If **P** gives a carboxylic acid on acidification, **Q** gives a poisonous gas on exposure to air and light

Answer (4)