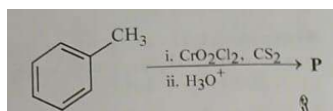


General Instructions

- (i) The test is of 3 hours and 15 minutes duration.
- (ii) This test paper consists of 180 questions. The maximum marks are 720.
- (iii) Physics and Chemistry contains 45 questions each and Biology (Botany and Zoology) contains 90 questions.
- (iv) Each question carries +4 marks for correct answer and –1 mark for wrong answer.

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



- (A) Compound P is obtained by the hydrogenation of benzoyl chloride with Pd on $BaSO_4$.
- (B) On treating compound P with saturated $NaHCO_3$ solution, brisk effervescence is observed.
- (C) Compound P can be prepared by treating benzene with anhydrous $AlCl_3$ and CH_3COCl .
- (D) On treatment with bromine water, compound P gives a white precipitate.

47. The formula of tetraammineaquachloridocobalt(III) chloride is

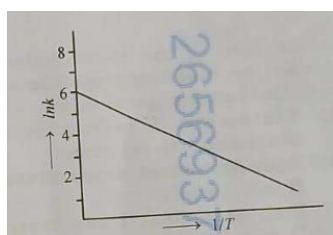
- (A) $[Co(NH_3)_4(H_2O)Cl]Cl_2$
- (B) $[Co(NH_3)_4Cl_2] \cdot H_2O$
- (C) $[Co(NH_3)_4Cl_3] \cdot H_2O$
- (D) $[Co(NH_3)_4(H_2O)Cl]Cl$

48. The lanthanide ion having four unpaired electrons is

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

- (A) Ho^{3+}
 - (B) Nd^{3+}
 - (C) Ce^{3+}
 - (D) Tb^{3+}
-

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



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

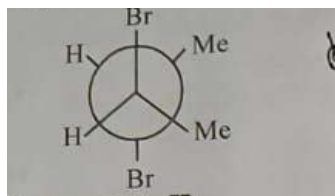
- (A) 250 K
 - (B) 125 K
 - (C) 150 K
 - (D) 200 K
-

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

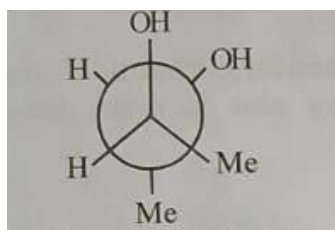
- (A) KO_2
 - (B) K_2MnO_4
 - (C) Mn_3O_4
 - (D) MnO
-

51. Given below are two statements:

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



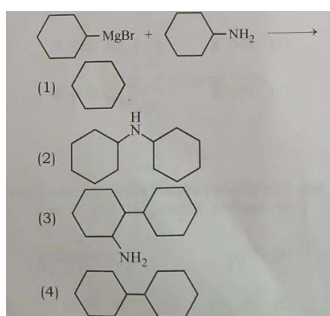
Statement II: *cis*-But-2-ene upon treatment with alkaline $KMnO_4$ gives the following product



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

- (A) Statement I is incorrect but Statement II is correct
- (B) Both Statement I and Statement II are correct
- (C) Both Statement I and Statement II are incorrect
- (D) Statement I is correct but Statement II is incorrect

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



- (A) Cyclohexane
- (B) Dicyclohexylamine
- (C) Bicyclohexyl (coupled product)
- (D) Cyclohexyl-substituted amine

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:

- (A) Statement-I is incorrect but Statement-II is correct.
 - (B) Both Statement-I and Statement-II are correct.
 - (C) Both Statement-I and Statement-II are incorrect.
 - (D) Statement-I is correct but Statement-II is incorrect.
-

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

- (A) $I > Br > Cl > F$
 - (B) $F > Cl > Br > I$
 - (C) $Br > Cl > F > I$
 - (D) $Cl > F > Br > I$
-

55. Given below are two statements:

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

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

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

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

- (A) Statement-I is incorrect but Statement-II is correct.
 - (B) Both Statement-I and Statement-II are correct.
 - (C) Both Statement-I and Statement-II are incorrect.
 - (D) Statement-I is correct but Statement-II is incorrect.
-

56. The correct statement about peptides and proteins is

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

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.

- (A) Statement-I is incorrect but Statement-II is correct.
- (B) Both Statement-I and Statement-II are correct.
- (C) Both Statement-I and Statement-II are incorrect.
- (D) Statement-I is correct but Statement-II is incorrect.
-

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

A. Benzonitrile $\xrightarrow{LiAlH_4}$

B. Benzamide $\xrightarrow{KOH, Br_2}$

C. Nitrobenzene $\xrightarrow{NaBH_4}$

D. N-Phenylacetamide $\xrightarrow{HCl, H_2O, \Delta}$

Choose the correct answer from the options given below.

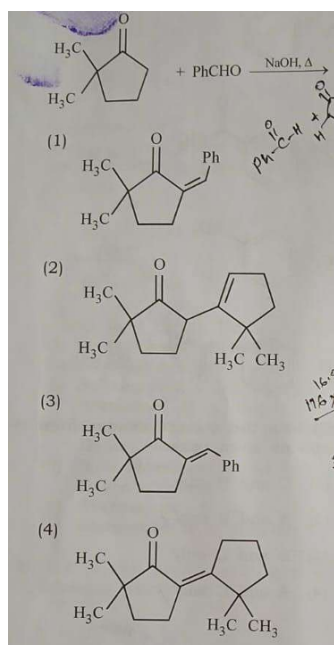
- (A) C and D only
- (B) A and B only
- (C) B and D only
- (D) A and C only
-

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)

- (A) $\Delta S_{\text{system}} = 4.606R$; $\Delta S_{\text{surroundings}} = 0$
 (B) $\Delta S_{\text{system}} = 0$; $\Delta S_{\text{surroundings}} = 0$
 (C) $\Delta S_{\text{system}} = 4.606R$; $\Delta S_{\text{surroundings}} = -4.606R$
 (D) $\Delta S_{\text{system}} = 0$; $\Delta S_{\text{surroundings}} = 4.606R$

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



61. The complex which has facial and meridional isomers is
(Given : py = pyridine and en = $\text{H}_2\text{N}-\text{CH}_2-\text{CH}_2-\text{NH}_2$)

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

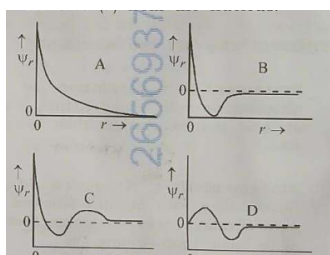
62. The numbers 17.0145 and 21.0235 were rounded to three figures after the decimal point. The resulting numbers, respectively, are

- (A) 17.015 and 21.024
 - (B) 17.014 and 21.023
 - (C) 17.015 and 21.023
 - (D) 17.014 and 21.024
-

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)

- (A) 362 g
 - (B) 352 g
 - (C) 322 g
 - (D) 176 g
-

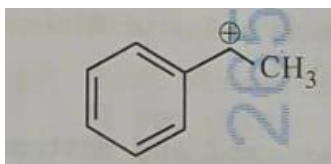
64. Consider the following schematic plots of orbital wavefunction (ψ_r) against distance (r) from the nucleus.



- (A) D
 - (B) A
 - (C) B
 - (D) C
-

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

- (A) empty σ and empty π orbitals



- (B) filled σ and filled π orbitals
(C) empty σ and empty π orbitals
(D) empty σ and filled π orbitals
-

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

- (A) $[Co(NH_3)_3(NO_2)_3]$
(B) $[CoCl_2(NH_3)_4]Cl$
(C) $[CoCl(NH_3)_5]Cl_2$
(D) $[Co(NH_3)_6]Cl_3$
-

67. The standard electrode potential (E°) for the half-cell reaction $Fe^{3+} + e^- \rightarrow Fe^{2+}$ at 298 K is
(Given: $E^\circ(Fe^{3+}/Fe) = -0.04$ V and $E^\circ(Fe^{2+}/Fe) = -0.44$ V at 298 K)

- (A) +0.92 V
(B) +0.40 V
(C) +0.76 V
(D) -0.48 V
-

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

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

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.

- (A) A and C only
(B) A and B only
(C) B and C only
(D) A only
-

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 ($\lambda_{Y^-}^\circ$, in $\text{S cm}^2 \text{ mol}^{-1}$) at 298 K will be
(Given: $\lambda_{X^+}^\circ = 74.0 \text{ S cm}^2 \text{ mol}^{-1}$)

- (A) 76.0
(B) 80.0
(C) 100.0
(D) 90.0
-

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.

- (A) $A < C < B < D$
(B) $A < B < C < D$
(C) $C < A < D < B$
(D) $C < A < B < D$
-

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

- (A) $Cl^- > NH_3 > H_2O > CO$
(B) $CO > NH_3 > H_2O > Cl^-$
(C) $CO > H_2O > NH_3 > Cl^-$
(D) $Cl^- > H_2O > NH_3 > CO$
-

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

- (A) serine
(B) leucine
(C) threonine
(D) methionine
-

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

- (A) 0.15 M
(B) 0.10 M
(C) 0.20 M
(D) 0.25 M
-

75. The correct statement is

- (A) Aluminium has five valence orbitals.
(B) Boron has a maximum covalency of four.
(C) Beryllium has three valence orbitals.
(D) Magnesium has a maximum covalency of four.
-

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

- (A) hepta-1,6-diene

- (B) hepta-1,3-diene
(C) hepta-1,4-diene
(D) hepta-1,5-diene
-

77. $2A \rightarrow B$ 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

- (A) 2.0 min
(B) 1.5 min
(C) 0.75 min
(D) 1.0 min
-

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

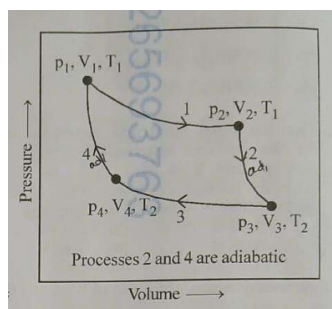
Salt	K_{sp} at 298 K
$AgBr$	5.0×10^{-13}
$Zn(OH)_2$	1.0×10^{-15}
Hg_2Cl_2	1.3×10^{-18}

- (A) $Zn(OH)_2 > AgBr > Hg_2Cl_2$
(B) $Hg_2Cl_2 > Zn(OH)_2 > AgBr$
(C) $AgBr > Zn(OH)_2 > Hg_2Cl_2$
(D) $Hg_2Cl_2 > AgBr > Zn(OH)_2$
-

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

- (A) $P_4O_6 > Cl_2O_7 > AlH_3$
(B) $P_4O_{10} > SO_3 > H_2O$
(C) $N_2O_5 > Al_2O_3 > H_2S$
(D) $PbO_2 > N_2O_3 > SO_3$
-

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

- (A) $w_1 + w_2 + w_3 + w_4 = 0$
- (B) $w_1 + w_3 = -2T_1 \ln \frac{V_2}{V_1} - 2T_2 \ln \frac{V_4}{V_3}$
- (C) $w_2 + w_4 = \Delta U_2 - \Delta U_4$
- (D) $w_1 + w_2 = 2T_1 \ln \frac{V_2}{V_1}$

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

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.

- (A) A is not correct but R is correct
- (B) Both A and R are correct and R is the correct explanation of A
- (C) Both A and R are correct but R is NOT the correct explanation of A
- (D) A is correct but R is not correct

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)

- (A) $[Ti(H_2O)_6]^{3+}$
- (B) $[Mn(CN)_6]^{3-}$

- (C) $[Fe(CN)_6]^{3-}$
(D) $[Co(NH_3)_6]^{3+}$
-

83. A protein undergoes reversible thermal denaturation from its initial state N to denatured state D according to $N \rightleftharpoons D$. 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 $\text{kJ K}^{-1} \text{mol}^{-1}$) of the protein upon denaturation at 60°C is closest to

- (A) 11.1
(B) 2.0
(C) 2000.0
(D) 333.0
-

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 $4s$ -electrons in the interatomic metallic bonding.

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

- (A) A is not correct but R is correct.
(B) Both A and R are correct and R is the correct explanation of A.
(C) Both A and R are correct and R is NOT the correct explanation of A.
(D) A is correct but R is not correct.
-

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:

- (A) A is not correct but R is correct.
 (B) Both A and R are correct and R is the correct explanation of A.
 (C) Both A and R are correct and R is NOT the correct explanation of A.
 (D) A is correct but R is not correct.

**86. Consider the following reaction sequences and choose the correct option.
 Reaction Scheme:**

Center: $Ph - C \equiv C - Me$

Left path: $\xrightarrow{Na/liq.NH_3} L \xrightarrow{HBr, benzoyl\ peroxide} N$

Right path: $\xrightarrow{H_2, Pd/C\ (Lindlar's\ Catalyst)} K \xrightarrow{HBr} M$

- (A) M and N are stereoisomers
 (B) K and L are geometrical isomers
 (C) K and L are enantiomers
 (D) M and N are geometrical isomers

87. The highest occupied molecular orbital for Ne_2 is

- (A) σ_{2p}
 (B) π_{2p}
 (C) σ_{2p}
 (D) π_{2p}

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. $[Ni(CN)_4]^{2-}$

IV. Square pyramidal

Choose the correct answer from the options given below:

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

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

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.

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

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

Reaction scheme: Benzene $\xrightarrow{i. CH_3COCl, AlCl_3} \xrightarrow{ii. NaOCl}$ P + Q

- (A) Both P and Q are carbonyl compounds.
(B) If P is the sodium salt of a carboxylic acid, Q is a primary alcohol.
(C) P and Q are aromatic compounds.
(D) If P gives a carboxylic acid on acidification, Q gives a poisonous gas on exposure to air and light.
-