

General Instructions

- (i) The test is of 1 hours duration.
- (ii) This test paper consists of 45 questions. The maximum marks are 180.
- (iii) Each question carries +4 marks for correct answer and –1 mark for wrong answer.

Chemistry

46. Select the reagents that reduce nitriles to primary amines :

- A. (i) LiAlH_4 ; (ii) H_2O
- B. $\text{Sn} + \text{HCl}$
- C. H_2/Ni
- D. $\text{Na(Hg)}/\text{C}_2\text{H}_5\text{OH}$
- E. $\text{Br}_2/\text{aq. NaOH}$

Choose the correct answer from the options given below :

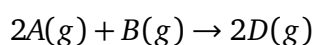
- (A) B, D and E only
- (B) A, C and D only
- (C) A, D and E only
- (D) A, B and C only

47. Match List I with List II.

	List-I (Transition metal/ Compound/complex)		List-II (Catalytic Role)
A.	V_2O_5	I.	Preparation of ammonia from N_2/H_2 mixture
B.	Fe	II.	Polymerisation of alkynes
C.	$PdCl_2$	III.	Preparation of H_2SO_4 from SO_2
D.	Ni complex	IV.	Oxidation of ethyne to ethanal

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

48. Consider the following reaction :



$$\Delta U^\circ = -10 \text{ kJ mol}^{-1}, \Delta S^\circ = -44 \text{ J K}^{-1} \text{ at } 298 \text{ K.}$$

Identify the correct option with ΔG° for the reaction and spontaneity of the reaction at 298 K.

(Given : $R = 8.31 \text{ J mol}^{-1} \text{ K}^{-1}$)

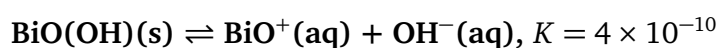
- (A) $-1.635 \text{ kJ mol}^{-1}$, spontaneous
 (B) $-0.63568 \text{ kJ mol}^{-1}$, spontaneous
 (C) $+0.63568 \text{ kJ mol}^{-1}$, non-spontaneous
 (D) $+1.635 \text{ kJ mol}^{-1}$, non-spontaneous

49. Match List I with List II.

	List-I (Quantum numbers)			List-II (Orbital)
	'n'	'l'		
(A)	2	1	(I)	3d
(B)	4	0	(II)	2p
(C)	5	3	(III)	4s
(D)	3	2	(IV)	5f

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

50. In qualitative analysis, Bi^{3+} is detected by appearance of precipitate of $\text{BiO}(\text{OH})(\text{s})$. Calculate pH when the following equilibrium exists at 298 K :



(Given : $\log 2 = 0.3010$)

- (A) 8.714
 (B) 4.699
 (C) 5.286
 (D) 9.301

51. The correct statement with regard to the secondary structure of DNA/RNA is:

- (A) RNA possesses a single strand helix structure and contains thymine as one of the four bases.
 (B) DNA possesses a double strand helix structure and contains thymine as one of the four bases.
 (C) RNA possesses a double strand helix structure and contains uracil as one of the four bases.
 (D) DNA possesses a single strand helix structure and contains uracil as one of the four bases.

52. The pair of molecules that are metamers among the following is:

- (A) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and $\text{CH}_3-\text{CH}(\text{OH})-\text{CH}_3$
(B) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_3$ and $(\text{CH}_3)_2\text{CHCH}_3$
(C) CH_3COCH_3 and $\text{CH}_3\text{CH}_2\text{CHO}$
(D) $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$
-

53. Match List I with List II.

	List I (Complex)		List II (Type of isomerism)
A.	$[\text{Pt}(\text{NH}_3)_2\text{Cl}_2]$	I.	Optical
B.	$[\text{Co}(\text{en})_3]^{3+}$	II.	Solvate
C.	$[\text{Co}(\text{NH}_3)_5\text{NO}_2]\text{Cl}_2$	III.	Geometrical
D.	$[\text{Cr}(\text{H}_2\text{O})_6]\text{Cl}_3$	IV.	Linkage

Choose the correct answer from the options given below :

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

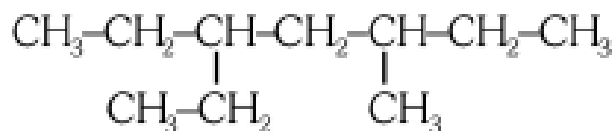
54. Match List I with List II.

	List-I Order of Reaction		List-II (Unit of rate constant)
A.	Zero order	I.	$\text{mol}^{-1} \text{L s}^{-1}$
B.	First order	II.	$\text{mol}^{-2} \text{L}^2 \text{s}^{-1}$
C.	Second order	III.	s^{-1}
D.	Third order	IV.	$\text{mol L}^{-1} \text{s}^{-1}$

Choose the correct answer from the options given below :

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

55. The correct IUPAC name of the following compound is:



- (A) 3-ethyl-5-methylheptane
(B) 2,4-diethylhexane
(C) 3-methyl-5-ethylheptane
(D) 3,5-diethylhexane
-

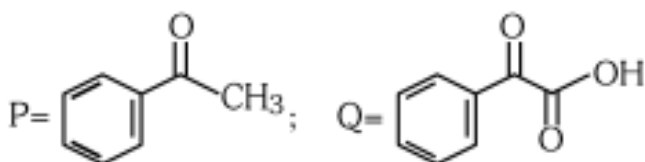
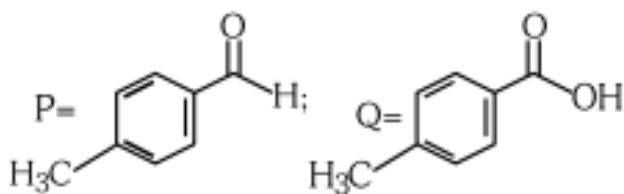
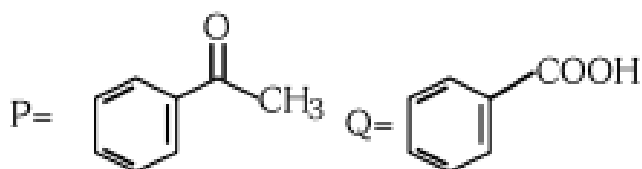
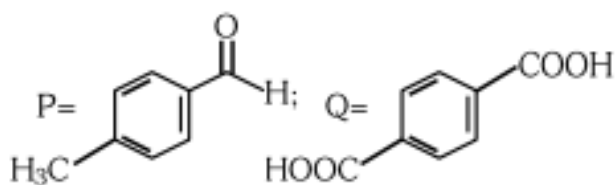
56. A bulb is rated at 150 watt, converting 8% energy into light. If energy of one photon is 4.42×10^{-19} J, how many photons are emitted by the bulb per second?

- (A) 2.71×10^{19}
(B) 4.06×10^{19}
(C) 27.2×10^{19}
(D) 1.35×10^{19}
-

57. Methane reacts with steam at 1273 K in the presence of nickel catalyst to form:

- (A) CO and H₂O
(B) CO₂ and H₂
(C) CO and H₂
(D) CO₂ and H₂O

58. Compound P, C_8H_8O , gives a red-orange precipitate with 2,4-DNP reagent and does not reduce Fehling's reagent. On drastic oxidation with chromic acid, P gives an aromatic product Q that produces effervescence on treating with aqueous $NaHCO_3$. Compounds P and Q, respectively, are:



59. Match List I with List II.

	List-I		List-II
(A)	C_2H_4	(I)	3σ bonds, 2π bonds
(B)	C_2H_2	(II)	3σ bonds one lone pair
(C)	CH_4	(III)	4σ bonds
(D)	NH_3	(IV)	5σ bonds, 1π bond

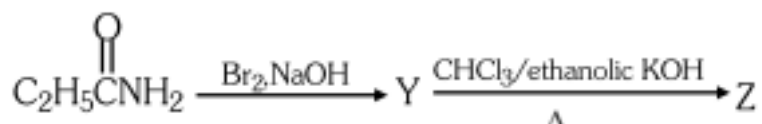
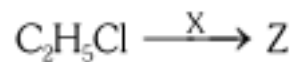
Choose the correct answer from the options given below :

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

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

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

60. The following two reactions give the same foul smelling product Z. X and Z, respectively, are:



- (A) X = AgCN, Z = C₂H₅NC
(B) X = KCN, Z = C₂H₅CN
(C) X = AgCN, Z = C₂H₅CN
(D) X = KCN, Z = C₂H₅NC
-

61. The number of hydrogen atoms present in 5.4 g of urea is:

Given: Molar mass of urea = 60 g mol⁻¹, N_A = 6.022 × 10²³ particles mol⁻¹

- (A) 1.084 × 10²³
(B) 1.084 × 10²²
(C) 2.168 × 10²²
(D) 2.168 × 10²³
-

62. Identify the incorrect statement from the following:

- (A) Nitrogen can form pπ-pπ multiple bonds with itself.
(B) P(C₂H₅)₃ and As(C₆H₅)₃ form dπ-dπ bond with transition metals.
(C) Phosphorus, arsenic and antimony show catenation property.
(D) Nitrogen can form dπ-pπ bond with oxygen.
-

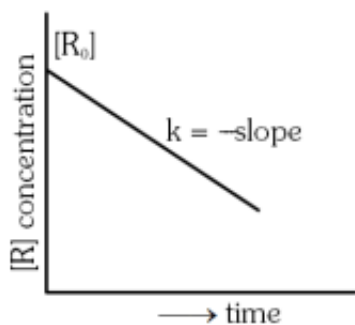
63. Which one of the following is an ambidentate ligand?

- (A) Ethane-1,2-diamine
- (B) Ethylenediaminetetraacetate ion
- (C) Thiocyanate
- (D) Oxalate

64. The correct order of increasing metallic character of Na, Be, P, Mg and Si is:

- (A) $P < Si < Be < Mg < Na$
- (B) $P < Si < Na < Mg < Be$
- (C) $P < Mg < Be < Si < Na$
- (D) $Be < Si < P < Mg < Na$

65. Match List I with List II.



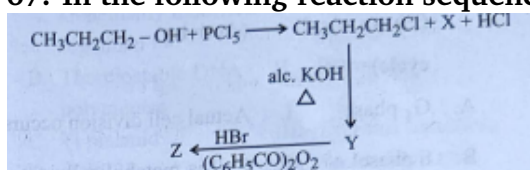
Choose the correct answer from the options given below :

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

66. Although +3 oxidation state is most common in lanthanoids, cerium still shows +4 oxidation state because:

- (A) After losing one more electron, it acquires $4f^4$ electronic configuration.
- (B) Its nearest inert gas is Radon.
- (C) Its atomic number is 61.
- (D) After losing one more electron, it acquires $4f^0$ electronic configuration.

67. In the following reaction sequence, X and Z, respectively, are:



- (A) $\text{X} = \text{POCl}_3$, $\text{Z} = \text{CH}_3\text{CH}(\text{Br})\text{CH}_3$
- (B) $\text{X} = \text{POCl}_3$, $\text{Z} = \text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$
- (C) $\text{X} = \text{H}_3\text{PO}_3$, $\text{Z} = \text{CH}_3\text{CH}(\text{Br})\text{CH}_3$
- (D) $\text{X} = \text{H}_3\text{PO}_3$, $\text{Z} = \text{CH}_3\text{CH}_2\text{CH}_2\text{Br}$

68. Match List I with List II.

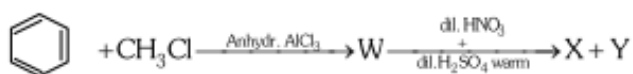
List I (Complex/ion)		List II (Shape/geometry)	
A.	$[\text{PtCl}_2(\text{NH}_3)_2]$	I.	Octahedral
B.	$[\text{Co}(\text{NH}_3)_6]\text{Cl}_3$	II.	Trigonal bipyramidal
C.	$[\text{NiCl}_4]^{2-}$	III.	Square planar
D.	$[\text{Fe}(\text{CO})_5]$	IV.	Tetrahedral

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

69. The functional group that can be identified through phthalein dye test is:

- (A) Aldehyde
 - (B) Phenolic
 - (C) Carboxylic acid
 - (D) Alcohol
-

70. Two products X and Y are formed in the following reaction sequence. The suitable method that can be used for separation of products X and Y is:



- (A) Fractional distillation
 - (B) Sublimation
 - (C) Differential extraction
 - (D) Continuous extraction
-

71. Identify the correct statements:

- A. The molality of 2.5g of ethanoic acid ($\text{Molar mass} = 60\text{g mol}^{-1}$) in 75g of benzene solution is 0.556m.
- B. The molarity of a solution containing 5g of NaOH ($\text{Molar mass} = 40\text{g mol}^{-1}$) in 450mL of solution is 0.278M at 298K.
- C. Aquatic species are more comfortable in cold water.
- D. The solubility of gas increases with decrease in pressure.
- E. For a binary mixture of A and B, the mole fraction of B will be $x_B = \frac{n_A}{n_A + n_B}$.

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

72. During Lassaigne's test, the elements present in an organic compound are converted from:

- (A) Ionic form to ionic form
 - (B) Covalent form to ionic form
 - (C) Covalent form to covalent form
 - (D) Ionic form to covalent form
-

73. A solution of copper sulphate is electrolysed for 10 minutes with a current of 1.5 ampere. The mass of copper deposited at the cathode is:

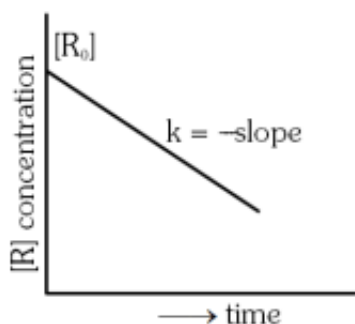
Given: Molar mass of $Cu = 63 \text{ g mol}^{-1}$, $1F = 96487 \text{ C mol}^{-1}$

- (A) 1.7018g
 - (B) 0.2938g
 - (C) 2.4036g
 - (D) 0.5876g
-

74. At a certain temperature $T(K)$, during a process, $500J$ is absorbed by the system and work of $200J$ is done by the system. Then change in internal energy of the system is:

- (A) $400J$
 - (B) $300J$
 - (C) $700J$
 - (D) $500J$
-

75. For a certain reaction $R \rightarrow \text{Product}$, the plot of concentration $[R]$ versus time has a negative slope as shown. The order of reaction is:



- (A) 0
- (B) 1
- (C) 2
- (D) 2.5

76. Identify the correct statement about ClF_3 from the following options:

- (A) It has T-shaped geometry with two lone pairs on Cl atom.
- (B) It has T-shaped geometry with three lone pairs on Cl atom.
- (C) It has trigonal pyramidal geometry with two lone pairs on Cl atom.
- (D) It has planar trigonal geometry with two lone pairs on Cl atom.

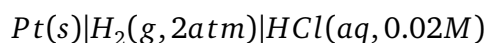
77. In a test tube containing a salt, a few drops of dilute H_2SO_4 was added, which gave colourless vapours having the smell of vinegar. The vapours turned the blue litmus paper red. Identify the correct anion from the following:

- (A) Sulphide, S^{2-}
- (B) Sulphate, SO_4^{2-}
- (C) Acetate, CH_3COO^-
- (D) Carbonate, CO_3^{2-}

78. At $298K$, a certain buffer solution contains equal concentrations of X^- and HX . If K_b for X^- is 10^{-10} , what is the pH of this buffer solution?

- (A) 2
 - (B) 6
 - (C) 4
 - (D) 10
-

79. Calculate emf of the half-cell given below:



Given: $E^\circ_{H^+/H_2} = 0V$, $\frac{2.303RT}{F} = 0.059$, $\log 2 = 0.3010$

- (A) $-0.109V$
 - (B) $-0.035V$
 - (C) $+0.035V$
 - (D) $+0.109V$
-

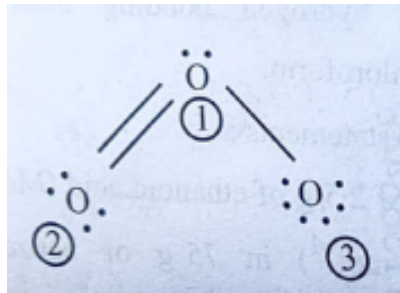
80. The calculated spin-only magnetic moment of Ti^{2+} ($3d^2$) is:

- (A) $5.92BM$
 - (B) $3.87BM$
 - (C) $2.84BM$
 - (D) $4.90BM$
-

81. Identify the incorrect statement from the following:

- (A) Carbon has the ability to form $p\pi - p\pi$ multiple bond with itself.
 - (B) ECl_3 , where $E = B$ and Al , is a monomer when $E = B$ and a dimer when $E = Al$.
 - (C) The order of catenation property of Group 14 elements is $C \gg Si > Ge = Sn$.
 - (D) Oxygen exhibits only -2 oxidation state.
-

82. The correct formal charges on oxygen atoms numbered 2, 1 and 3, respectively, are:



- (A) $-1, 0, +1$
- (B) $0, +1, -1$
- (C) $0, 0, 0$
- (D) $+1, 0, -1$

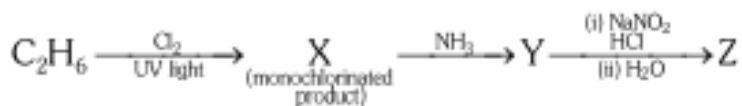
83. Phenolphthalein is used as an indicator for titration of sodium hydroxide solution against a standard solution of oxalic acid. The colour change that is observed at an alkaline pH close to equivalence point during this titration is:

- (A) Pinkish red to yellow
- (B) Yellow to pinkish red
- (C) Pink to colourless
- (D) Colourless to pink

84. When 1dm^3 of CO_2 gas is passed over hot coke, the volume of gaseous mixture after complete reaction at STP becomes 1.4dm^3 . The composition of the gaseous mixture at STP is:

- (A) 0.8dm^3 of CO , 0.6dm^3 of CO_2
- (B) 0.8dm^3 of CO , 0.6dm^3 of CO_2
- (C) 0.6dm^3 of CO , 0.8dm^3 of CO_2
- (D) 0.6dm^3 of CO , 0.4dm^3 of CO_2

85. The major product Z formed in the following sequence of reactions is:



- (A) $\text{C}_2\text{H}_5\text{NO}_2$
 (B) $\text{C}_2\text{H}_5 - \text{N} = \text{N} - \text{OH}$
 (C) $\text{C}_2\text{H}_5\text{OH}$
 (D) $\text{C}_2\text{H}_5\text{NH}_2$

86. Given below is an expression for the rate constant of a first order reaction occurring at a certain temperature, $T(K)$:

$$\ln k = 14.34 - \frac{1.25 \times 10^4}{T}$$

The energy of activation in kcal mol^{-1} for the reaction is:

Given: $R = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$

- (A) 24.84
 (B) 14.34
 (C) 18.63
 (D) 12.42

87. Given below are certain reactions. Identify the reaction for which $K_p \neq K_c$:

- (A) $\text{H}_2\text{O}(g) + \text{CO}(g) \rightleftharpoons \text{H}_2(g) + \text{CO}_2(g)$
 (B) $\text{N}_2(g) + 3\text{H}_2(g) \rightleftharpoons 2\text{NH}_3(g)$
 (C) $\text{H}_2(g) + \text{I}_2(g) \rightleftharpoons 2\text{HI}(g)$
 (D) $\text{N}_2(g) + \text{O}_2(g) \rightleftharpoons 2\text{NO}(g)$

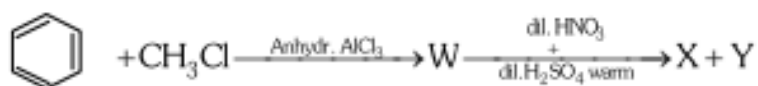
88. Identify the incorrect statement from the following:

- (A) The largest and the smallest species among Mg , Mg^{2+} , Al and Al^{3+} are Al and Mg^{2+} , respectively.
- (B) The IUPAC name of the element with atomic number 107 is Unnilseptium.
- (C) The similarity in behaviour of Li with Mg is referred to as diagonal relationship.
- (D) The oxidation state and covalency of Al in $[Al(H_2O)_6]^{3+}$ are 3 and 6, respectively.
-

89. Mixture of chloroform and acetone forms a solution with negative deviation from Raoult's law due to:

- (A) Increase in escaping tendency of molecules of each component.
- (B) Formation of hydrogen bonding between acetone and chloroform.
- (C) Stronger intermolecular forces between chloroform molecules than those between chloroform and acetone molecules.
- (D) Repulsive forces.
-

90. The number of chlorine atoms present in the organic products X and Y of the following reactions, respectively, are:



- (A) 3 and 3
- (B) 6 and 3
- (C) 6 and 6
- (D) 3 and 6
-