



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

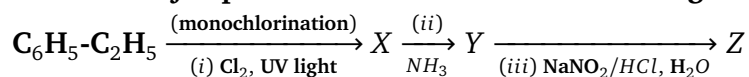
46. Match List I with List II :

List I (Reaction)	List II (Reagent/Condition)
A. Phenol → Phenol-2,4,6-trisulphonic acid	I. Oleum, Δ
B. Phenol → Benzene	II. Zn dust, Δ
C. Benzenediazonium chloride → Phenol	III. Warm water
D. Phenol → Salicylaldehyde	IV. $\text{CHCl}_3/\text{NaOH}$

Choose the correct answer from the options given below :

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

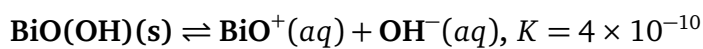
47. The major product Z formed in the following sequence of reactions is :



- (1) $\text{C}_6\text{H}_5\text{-N=N-OH}$

- (2) $\text{C}_6\text{H}_5\text{CH}(\text{OH})\text{CH}_3$
 (3) $\text{C}_6\text{H}_5\text{CH}_2\text{NO}_2$
 (4) $\text{C}_6\text{H}_5\text{CH}_2\text{NH}_2$
-

48. In a 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 : $\log 2 = 0.3010$)

- (1) 4.699
 (2) 8.714
 (3) 9.301
 (4) 5.286
-

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

- (1) 0.6 dm^3 of CO, 0.8 dm^3 of CO_2
 (2) 0.8 dm^3 of CO, 0.8 dm^3 of CO_2
 (3) 0.8 dm^3 of CO, 0.6 dm^3 of CO_2
 (4) 0.6 dm^3 of CO, 0.4 dm^3 of CO_2
-

50. Match List I with List II :

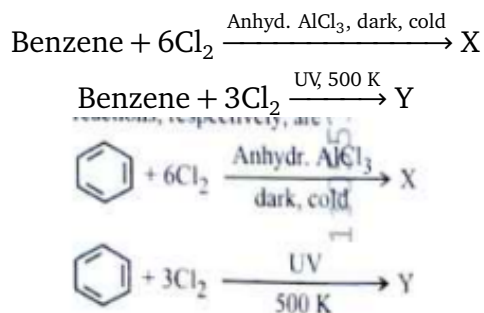
List I (Quantum Numbers)	List II (Orbital)
A. $n = 2, l = 1$	I. $3d$
B. $n = 4, l = 0$	II. $2p$
C. $n = 5, l = 3$	III. $4s$
D. $n = 3, l = 2$	IV. $5f$

Choose the correct answer from the options given below :

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

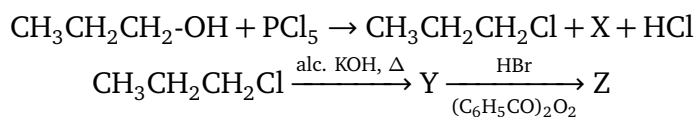
- (2) A-I, B-II, C-III, D-IV
 (3) A-IV, B-II, C-III, D-I
 (4) A-II, B-III, C-I, D-IV

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



- (1) 3 and 6
 (2) 6 and 6
 (3) 6 and 3
 (4) 3 and 3

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



- (1) X = POCl₃; Z = CH₃-CH(Br)-CH₃
 (2) X = H₃PO₃; Z = CH₃CH₂CH₂Br
 (3) X = H₃PO₃; Z = CH₃-CH(Br)-CH₃
 (4) X = POCl₃; Z = CH₃CH₂CH₂Br

53. Match List I with List II :

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

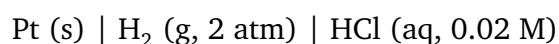
Choose the correct answer from the options given below :

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

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

- (1) It has a trigonal pyramidal geometry with two lone pairs on Cl atom.
- (2) It has T-shaped geometry with two lone pairs on Cl atom.
- (3) It has a planar trigonal geometry with two lone pairs on Cl atom.
- (4) It has T-shaped geometry with three lone pairs on Cl atom.

55. Calculate emf of the half cell given below :



$$E_{H^+/H_2}^0 = 0 \text{ V}$$

(Given : $\frac{2.303 RT}{F} = 0.059$, $\log 2 = 0.3010$)

- (1) 0.109 V
- (2) 0.035 V
- (3) -0.035 V
- (4) -0.109 V

56. 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. $\text{mol L}^{-1} \text{s}^{-1}$

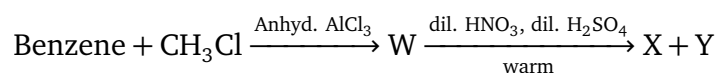
Choose the correct answer from the options given below :

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

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

- (1) 2.84 BM
 - (2) 5.92 BM
 - (3) 4.90 BM
 - (4) 3.87 BM
-

58. Two products X and Y are formed in the following reaction sequence.



The suitable method that can be used for the separation of products X and Y is :

- (1) Continuous extraction
 - (2) Differential extraction
 - (3) Fractional distillation
 - (4) Sublimation
-

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

- (1) 1.35×10^{19}
 - (2) 4.06×10^{19}
 - (3) 2.71×10^{19}
 - (4) 27.2×10^{19}
-

60. 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 :

- (1) Acetate, CH_3COO^-
 - (2) Carbonate, CO_3^{2-}
 - (3) Sulphate, SO_4^{2-}
 - (4) Sulphide, S^{2-}
-

61. 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 :

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

62. Identify the *incorrect* statement from the following :

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

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

- (1) Its nearest inert gas is Radon.
- (2) After losing one more electron, it acquires $4f^{14}$ electronic configuration.
- (3) Its atomic number is 61.
- (4) After losing one more electron, it acquires $4f^0$ electronic configuration.

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

- (1) covalent form to covalent form
- (2) ionic form to ionic form
- (3) covalent form to ionic form
- (4) ionic form to covalent form

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

(Given : Molar mass of urea : 60 g mol^{-1} , $N_A : 6.022 \times 10^{23} \text{ particles mol}^{-1}$)

- (1) 2.168×10^{23}
- (2) 2.168×10^{22}
- (3) 1.084×10^{22}
- (4) 1.084×10^{23}

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

- (1) $\text{CH}_3\text{CH}_2\text{CH}_2\text{OH}$ and $\text{CH}_3-\text{CH}(\text{OH})-\text{CH}_3$
- (2) $\text{CH}_3\text{OCH}_2\text{CH}_2\text{CH}_3$ and $\text{CH}_3\text{CH}_2\text{OCH}_2\text{CH}_3$
- (3) $\text{H}_3\text{C}-\overset{\text{O}}{\parallel}{\text{C}}-\text{CH}_3$ and $\text{H}_3\text{C}-\text{CH}_2-\overset{\text{O}}{\parallel}{\text{C}}-\text{H}$
- (4) $\text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{CH}_3$ and $(\text{CH}_3)_2\text{CHCH}_2\text{CH}_3$

67. Identify the *incorrect* statement from the following :

- (1) $P(C_2H_5)_3$ and $As(C_6H_5)_3$ form $d\pi-d\pi$ bond with transition metals.
 - (2) Nitrogen can form $d\pi-p\pi$ bond with oxygen.
 - (3) Nitrogen can form $p\pi-p\pi$ multiple bonds with itself.
 - (4) Phosphorus, arsenic and antimony show catenation property.
-

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

- (1) pinkish red to yellow
 - (2) yellow to pinkish red
 - (3) colourless to pink
 - (4) pink to colourless
-

69. Match List I with List II :

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

Choose the correct answer from the options given below :

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

70. At a certain temperature, T (K), during a process, 500 J is absorbed by the system and

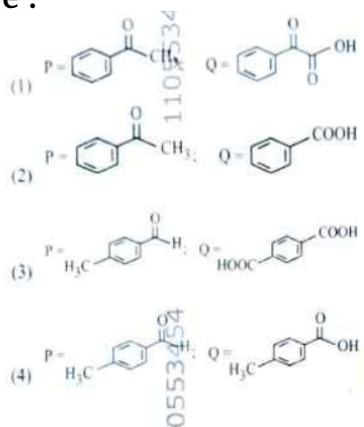
work of 200 J is done by the system. Then change in internal energy of the system is :

- (1) 700 J
- (2) 300 J
- (3) 400 J
- (4) 500 J

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

- (1) CO and H₂
- (2) CO and H₂O
- (3) CO₂ and H₂O
- (4) CO₂ and H₂

72. Compound P (C₈H₈O) gives a red orange precipitate with 2,4-DNP reagent and it does not reduce Fehling's reagent. On drastic oxidation with chromic acid, P gives an aromatic product Q that produces effervescence on treating with aq. NaHCO₃. Compounds P and Q, respectively, are :



- (1) (P: Acetophenone; Q: Benzoic acid)
- (2) (P: Propiophenone; Q: Benzoic acid)
- (3) (P: Ethylbenzaldehyde; Q: Terephthalic acid)
- (4) (P: Acetophenone; Q: Phenylacetic acid)

73. A solution of copper sulphate is electrolysed for 10 minutes with a current of 1.5 amperes.

The mass of copper deposited at cathode is :

(Given : Molar mass of Cu = 63 g mol⁻¹; 1 F = 96487 C mol⁻¹)

- (1) 2.4036 g
 - (2) 1.7018 g
 - (3) 0.5876 g
 - (4) 0.2938 g
-

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

- (1) Phenolic
 - (2) Alcohol
 - (3) Aldehyde
 - (4) Carboxylic acid
-

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

- (1) DNA possesses a single strand helix structure and contains uracil as one of the four bases.
 - (2) RNA possesses a single strand helix structure and contains thymine as one of the four bases.
 - (3) DNA possesses a double strand helix structure and contains thymine as one of the four bases.
 - (4) RNA possesses a double strand helix structure and contains uracil as one of the four bases.
-

76. Identify the correct statements :

A. The molality of 2.5 g of ethanoic acid (Molar mass : 60 g mol⁻¹) in 75 g of benzene solution is 0.556 m.

B. The molarity of a solution containing 5 g of NaOH (molar mass : 40 g mol⁻¹) in 450 mL of solution is 0.278 M at 298 K.

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 $\chi_B = \frac{n_A}{n_A + n_B}$.

Choose the correct answer from the options given below :

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

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

- (1) formation of hydrogen bonding between acetone and chloroform.
 - (2) increase in escaping tendency of molecules of each component.
 - (3) stronger intermolecular forces between chloroform molecules than those between chloroform and acetone molecules.
 - (4) repulsive forces.
-

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

- (1) 2
 - (2) 10
 - (3) 4
 - (4) 6
-

79. Identify the *incorrect* statement from the following :

- (1) The IUPAC name of the element with atomic number 107 is Unnilseptium.
 - (2) The largest and the smallest species among Mg , Mg^{2+} , Al and Al^{3+} are Al and Mg^{2+} , respectively.
 - (3) The similarity in behaviour of Li with Mg is referred to as 'diagonal relationship'.
 - (4) The oxidation state and covalency of Al in $[AlCl(H_2O)_5]^{2+}$ are 3 and 6 respectively.
-

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

- (1) $P < Si < Be < Mg < Na$

- (2) $\text{Be} < \text{Si} < \text{P} < \text{Mg} < \text{Na}$
(3) $\text{P} < \text{Si} < \text{Na} < \text{Mg} < \text{Be}$
(4) $\text{P} < \text{Mg} < \text{Be} < \text{Si} < \text{Na}$
-

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



- (1) 2,4-diethylhexane
(2) 3,5-diethylhexane
(3) 3-ethyl-5-methylheptane
(4) 3-methyl-5-ethylheptane
-

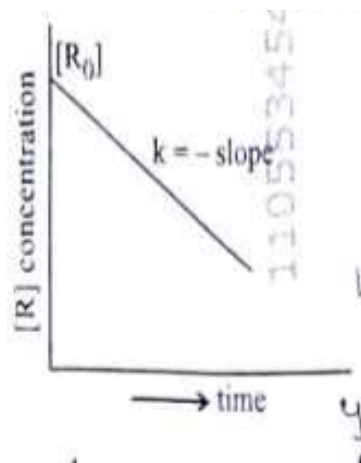
82. Match List I with List II :

List I (Complex/ion)	List II (Shape/geometry)
A. $[\text{Pt}(\text{Cl}_2)(\text{NH}_3)_2]$	I. Octahedral
B. $[\text{Co}(\text{NH}_3)_6]^{3+}$	II. Trigonal bipyramidal
C. $[\text{NiCl}_4]^{2-}$	III. Square planar
D. $[\text{Fe}(\text{CO})_5]$	IV. Tetrahedral

Choose the correct answer from the options given below :

- (1) A-I, B-III, C-IV, D-II
(2) A-III, B-I, C-IV, D-II
(3) A-IV, B-I, C-III, D-II
(4) A-III, B-I, C-IV, D-II (Note: Options 2 and 4 are identical in this version)
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83. For a certain reaction $\text{R} \rightarrow \text{Product}$, the plot of concentration $[\text{R}]$ vs time has a negative slope as shown. The order of reaction is :

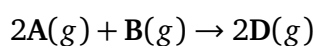


- (1) 0
- (2) 1
- (3) 2
- (4) 2.5

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

- (1) Ethylenediaminetetraacetate ion
- (2) Oxalate
- (3) Ethane-1,2-diamine
- (4) Thiocyanate

85. Consider the following reaction :



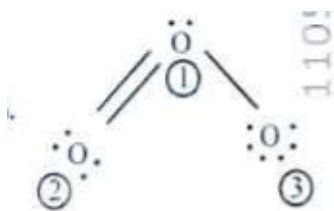
$$\Delta U^\ominus = -10 \text{ kJ mol}^{-1} \text{ and } \Delta S^\ominus = -44 \text{ J K}^{-1} \text{ at } 298 \text{ K.}$$

Identify the correct option with $\Delta G^\ominus$ for the reaction and spontaneity of the reaction at 298 K.

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

- (1) $-1.635 \text{ kJ mol}^{-1}$, spontaneous
- (2) $+0.6358 \text{ kJ mol}^{-1}$, non-spontaneous
- (3) $-0.6358 \text{ kJ mol}^{-1}$, spontaneous
- (4) $+1.635 \text{ kJ mol}^{-1}$, non-spontaneous

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



- (1) $-1, 0, +1$
 (2) $0, +1, -1$
 (3) $0, 0, 0$
 (4) $+1, 0, -1$

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

- (1) $\text{H}_2(\text{g}) + \text{I}_2(\text{g}) \rightleftharpoons 2\text{HI}(\text{g})$
 (2) $\text{N}_2(\text{g}) + \text{O}_2(\text{g}) \rightleftharpoons 2\text{NO}(\text{g})$
 (3) $\text{N}_2(\text{g}) + 3\text{H}_2(\text{g}) \rightleftharpoons 2\text{NH}_3(\text{g})$
 (4) $\text{H}_2\text{O}(\text{g}) + \text{CO}(\text{g}) \rightleftharpoons \text{H}_2(\text{g}) + \text{CO}_2(\text{g})$

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

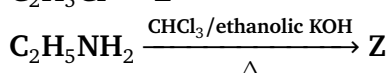
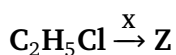
$$\ln k = 14.34 - \frac{1.25 \times 10^4}{T}$$

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

(Given : k in s^{-1} , $R = 1.987 \text{ cal mol}^{-1} \text{ K}^{-1}$)

- (1) 12.42
 (2) 14.34
 (3) 18.63
 (4) 24.84

89. The following two reactions give the same foul smelling product Z.



X and Z, respectively, are :

- (1) $X = \text{AgCN}$; $Z = \text{C}_2\text{H}_5\text{CN}$
 - (2) $X = \text{KCN}$; $Z = \text{C}_2\text{H}_5\text{CN}$
 - (3) $X = \text{KCN}$; $Z = \text{C}_2\text{H}_5\text{NC}$
 - (4) $X = \text{AgCN}$; $Z = \text{C}_2\text{H}_5\text{NC}$
-

90. 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 :

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