



**INDIAN INSTITUTE OF SCIENCE
BANGALORE - 560012**

ENTRANCE TEST FOR ADMISSIONS - 2009

**Program : Research
Entrance Paper : Chemistry
Paper Code : CY**

Day & Date
SUNDAY, 26TH APRIL 2009

Time
9.00 A.M. TO 12.00 NOON

INSTRUCTIONS

CHEMISTRY

1. This question paper consists of only objective type questions for a total of 100 marks
2. Four options are provided for each question
3. Answer all questions. A correct answer gets +1 mark and a **wrong answer gets -1/3 mark.**
4. Some useful physical constants
 - (a) Universal gas constant, $R = 8.314 \text{ J K}^{-1} \text{ mol}^{-1}$
 - (b) Planck's constant, $h = 6.626 \times 10^{-34} \text{ J.s}$
 - (c) Acceleration due to gravity, $g = 9.8 \text{ m s}^{-2}$
 - (d) Speed of light in vacuum, $c = 2.988 \times 10^8 \text{ m s}^{-1}$
 - (e) Avagadro number, $N (N_0) = 6.023 \times 10^{23} \text{ mol}^{-1}$
 - (f) Boltzmann constant, $k_B = 1.38 \times 10^{-23} \text{ J K}^{-1}$
 - (g) Electronic charge, $e = 1.602 \times 10^{-19} \text{ C}$
 - (h) Electronic mass, $m = 9.109 \times 10^{-31} \text{ Kg}$
 - (i) Permittivity of vacuum, $\epsilon_0 = 8.854 \times 10^{-12} \text{ F m}^{-1}$
 - (j) Faraday constant, $F = 96500 \text{ C mol}^{-1}$
 - (k) 1 calorie = 4.184 J
 - (l) 1 atm = 760 Torr

Abbreviations used:

Me – Methyl, Ph - Phenyl

CHEMISTRY

1. Arrange the packing efficiency for the following cubic structures: Diamond (D), Simple Cube (SC), Face-Centered Cube (FCC) and Body-Centered Cube (BCC)

(A) $D > FCC > BCC > SC$
(B) $FCC > BCC > SC > D$
(C) $BCC > FCC > SC > D$
(D) $D > SC > BCC > FCC$

2. The structure of CsCl transforms to NaCl under high pressure. During this process the coordination number of Cs and Cl change from

(A) 8:8
(B) 6:6
(C) 12:12
(D) 8:6

3. TiO_2 exists as both rutile and anatase. In the rutile form the band gap is 3 eV. The approximate wavelength of light that corresponds to this energy band gap is

(A) 40 nm
(B) 3000 nm
(C) 400 nm
(D) 300 nm

4. The symmetry elements present in *p*-dichlorobenzene are

(A) $E, C_2, 2\sigma_v, \sigma_h, i$
(B) $E, C_2, \sigma_h, 2\sigma_v, i$
(C) $E, 3C_2, 2\sigma_v, \sigma_h, i$
(D) $E, 3C_2, 2\sigma_v, 2\sigma_h, i$

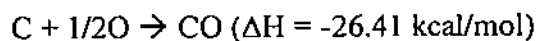
5. A certain powder diffraction pattern has the first three high peaks at $2\theta = 9.66, 12.54$ and 28.39° respectively when recorded using copper radiation of $\lambda = 1.542\text{\AA}$. If the wavelength is changed to Molybdenum with $\lambda = 0.7107\text{\AA}$ the peaks will
- (A) shift to lower angles
 - (B) shift to higher angles
 - (C) stay at the same angles
 - (D) shift such that the first two move to lower angles and the third to higher angles
6. An AX_6 molecule belongs to the O_h point group. The molecule is modified to AX_5Y . The point group changes to
- (A) D_{4h}
 - (B) D_{6h}
 - (C) C_{4h}
 - (D) C_{4v}
7. A fixed mass of an ideal gas undergoes a reversible adiabatic expansion. In this process the temperature of the gas
- (A) rises
 - (B) drops
 - (C) remains unchanged
 - (D) can increase or decrease depending on the initial pressures and volumes
8. The magnitude of the colligative property of a two-component solution depends on the
- (A) number of solute molecules
 - (B) number of solvent molecules
 - (C) number of solute molecules relative to that of solvent molecules
 - (D) total number of solvent and solute molecules

9. One ml of pH 6 solution is diluted to 1000 ml. The pH of the resulting solution is nearly equal to
- (A) 9
 - (B) 6.5
 - (C) 7
 - (D) 7.5
10. For the presumed equilibrium at 25°C, $\text{CH}_4(\text{g}) + 2\text{O}_2(\text{g}) \rightleftharpoons \text{CO}_2(\text{g}) + 2\text{H}_2\text{O}(\text{g})$
 $\Delta H = -802 \text{ kJ}$. The equilibrium constant of this process is
- (A) shifted to the right by increasing the temperature
 - (B) shifted to the left by increasing pressure
 - (C) unaffected by change in pressure
 - (D) shifted to the right by increasing pressure
11. The number of radial nodes in the 4s orbital of the H-atom in a finite distance from the nucleus is
- (A) 0
 - (B) 4
 - (C) 2
 - (D) 3
12. If a compound is formed in a FCC lattice with M atoms at the corners of the unit cell N atoms at the face centers, the formula of the compound is
- (A) MN
 - (B) MN_3
 - (C) M_3N
 - (D) M_2N_2

13. The amount of NO_2 in a smoggy atmosphere was measured to be 0.8 parts per million. The barometric pressure was 760 Torr. The partial pressure of NO_2 in atmospheres is
- (A) 80
 - (B) 8
 - (C) 0.8
 - (D) 0.08
14. The arrangement in terms of increasing order of electronegativity of the four elements Li, Mg, Zn, Pb is
- (A) Li, Mg, Zn, Pb
 - (B) Li, Zn, Mg, Pb
 - (C) Li, Mg, Pb, Zn
 - (D) Pb, Zn, Mg, Li
15. Light of wavelength $50 \mu\text{m}$ is incident on a metallic surface with a work function of 2 eV. The kinetic energy of the most energetic electrons (in eV) and stopping potential (in V) are respectively as follows:
- (A) 2 eV, 0.49 V
 - (B) 2.49 eV, 0.49 V
 - (C) 2 eV, 2.49 V
 - (D) 0.49 eV, 0.49 eV
16. Which among the following solvents, dimethyl formamide (DMF), carbon tetrachloride (CCl_4), tetrahydrofuran (THF), hydrogen fluoride (HF) is not an aprotic solvent
- (A) THF
 - (B) HF
 - (C) DMF
 - (D) CCl_4

17. The $t_{1/2}$ of a radioactive element is 231 min. The time taken for 9/10th fraction of this element to decay is approximately
- (A) 770 min
 - (B) 77 min
 - (C) 375 min
 - (D) 35 min
18. Arrange the following molecules in order of increasing bond polarity (1) H_2O , (2) NH_3 , (3) PH_3 and (4) H_2S
- (A) (1) < (2) < (3) < (4)
 - (B) (4) < (3) < (2) < (1)
 - (C) (3) < (4) < (2) < (1)
 - (D) (3) < (4) < (1) < (2)
19. 5.26 gm of a sulfur containing ore of copper releases 2.12 g of sulfur dioxide. Assuming that the ore only contains copper and sulfur, what is the empirical formula of the ore
- (A) Cu_2S
 - (B) CuS_2
 - (C) CuS
 - (D) Cu_3S
20. The elements NaCl and Kr crystallize in a cubic structure. While NaCl is a solid at room temperature, Kr is a gas? The reason for this is
- (A) NaCl has covalent bonding and Kr has metallic bonding
 - (B) NaCl has ionic bonding and Kr has covalent bonding
 - (C) NaCl has ionic bonding and Kr has van der Waals interactions
 - (D) NaCl has ionic bonding and Kr has hydrogen bonding

21. 12.0 g of carbon reacted with oxygen to form CO and CO₂ at 25 °C and constant pressure to release 75.0 kcal of energy. If no carbon is left behind, the amount of oxygen utilized during this reaction would be



(A) 0.859 moles (27.5 g)

(B) 8.59 moles (275 g)

(C) 0.0859 moles (2.75 g)

(D) 85.9 moles (275 g)

22. NO₂ gas is paramagnetic at room temperature. On cooling below 0 °C, it becomes diamagnetic. The reason behind this change of property is

(A) NO₂ becomes a liquid

(B) NO₂ becomes N₂O₄

(C) NO₂ becomes solid

(D) NO₂ becomes amorphous

23. Bulk CdS has a band gap of 2.6 eV and its optical absorption edge lies at ~475 nm. What will happen to the absorption edge when you make CdS in nanometer dimensions?

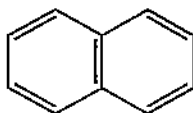
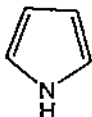
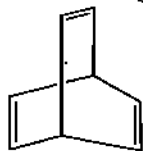
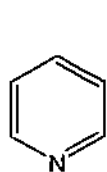
(A) The absorption edge will shift to smaller wavelengths

(B) The absorption edge will shift to longer wavelengths

(C) There will be no change in the position of the absorption edge

(D) The absorption edge will disappear

24. Which of the following compounds would be **not** be considered **aromatic** in its behavior?



A

B

C

D

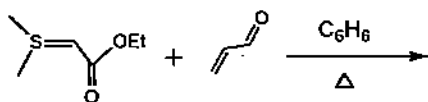
(A) A

(B) B

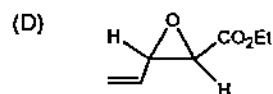
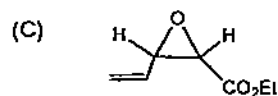
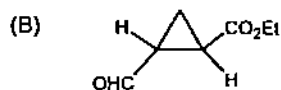
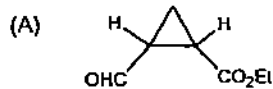
(C) C

(D) D

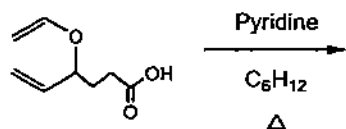
25. The major product of the following reaction



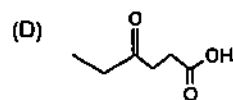
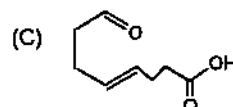
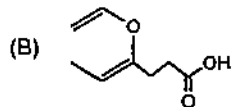
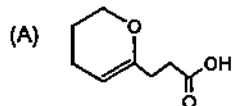
is:



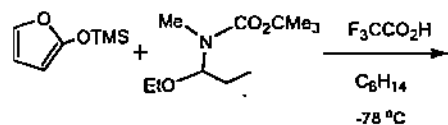
26. The product of the following reaction



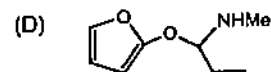
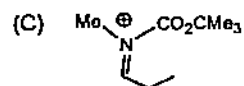
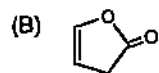
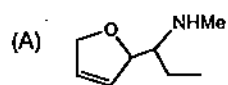
is:



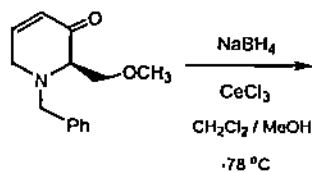
27. The product of the following reaction



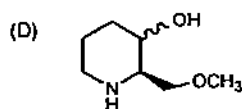
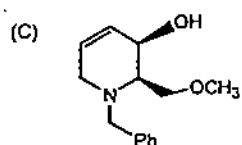
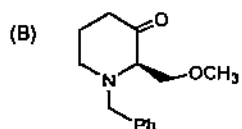
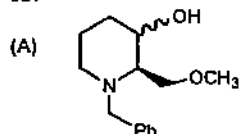
is:



28. The major product of the following reaction



is:



29. The Polymer which has amide linkage?

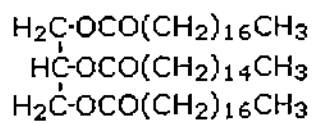
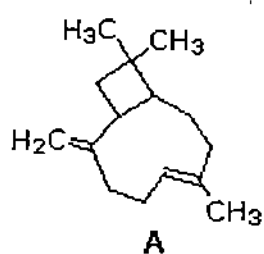
- (A) Nylon-66
- (B) Terylene
- (C) Teflon
- (D) Bakelite

30. Which of these reagents could accomplish the following reduction?

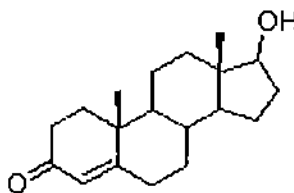


- (A) NaBH_4
- (B) LiAlH_4
- (C) 1 mole H_2 , low pressure
- (D) H_3O^+

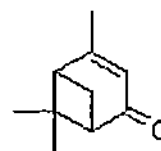
31. Which if any of the following is a triglyceride?



B



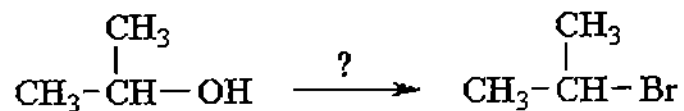
C



D

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

32. What is the best reagent to convert isopropyl alcohol to isopropyl bromide?



- (A) HBr
- (B) SOBr₂
- (C) Br₂
- (D) CH₃MgBr

33. The Hoffmann degradation of benzamide yields:

- (A) benzene
- (B) benzoic acid
- (C) aniline
- (D) phenol

34. Which one of the following Diels-Alder reactions is feasible?

- (A) maleic anhydride + ethylene
- (B) maleic anhydride + cyclopentadiene
- (C) maleic anhydride + norbornadiene
- (D) cyclopentadiene + benzene

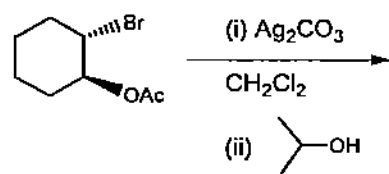
35. The product of the reaction of benzoic acid with diazomethane is

- (A) methyl benzoate
- (B) benzamide
- (C) benzene diazonium chloride
- (D) azobenzene

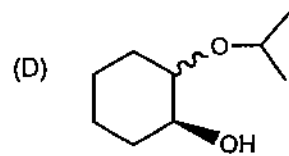
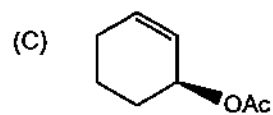
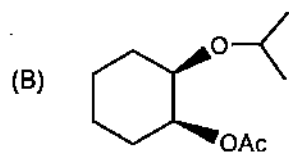
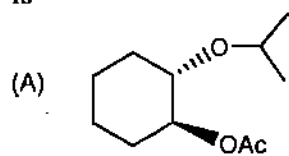
36. Which one of the following reactions leads to the formation of a Grignard reagent?

- (A) $\text{MeI} + \text{Zn}$
- (B) $\text{MeI} + \text{Mg}$
- (C) $\text{PhCl} + \text{Na}$
- (D) $\text{MeBr} + \text{K}$

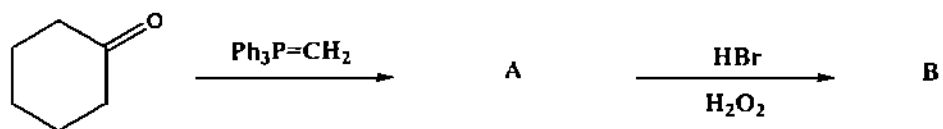
37. The major product of the following reaction



is

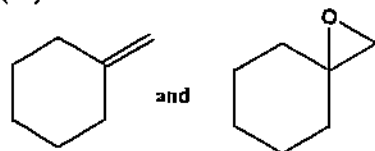


38.

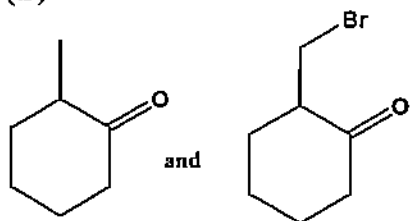


The structures of the products **A** and **B** formed in the above reaction scheme respectively are:

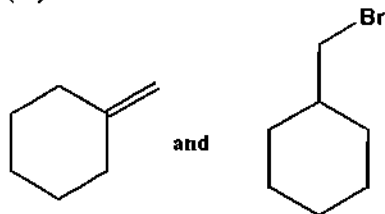
(A)



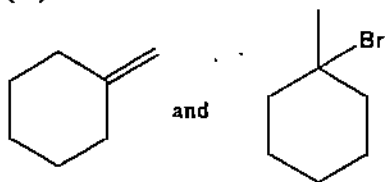
(B)



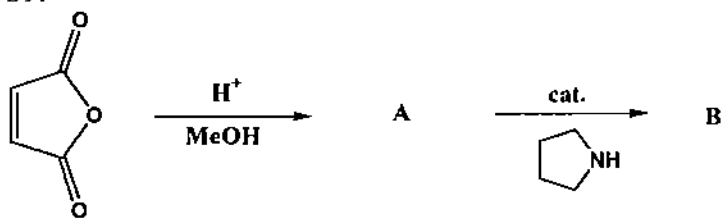
(C)



(D)

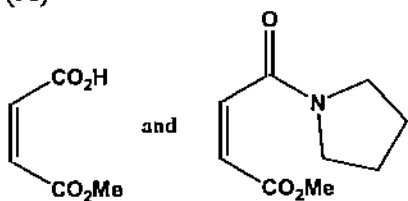


39.

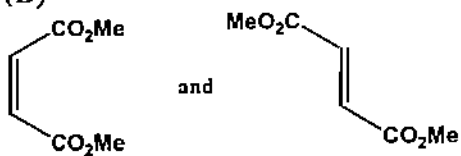


The structures of the products A and B formed in the above reaction scheme respectively are:

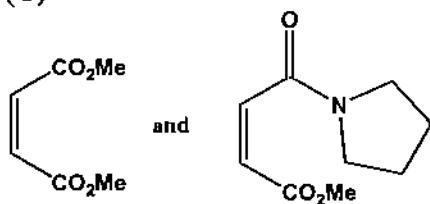
(A)



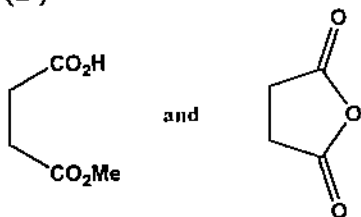
(B)



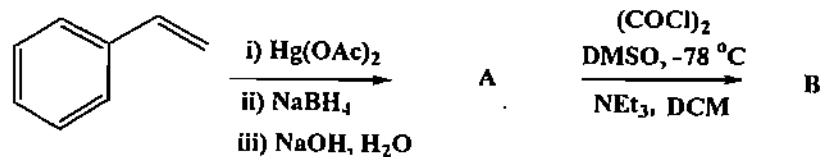
(C)



(D)

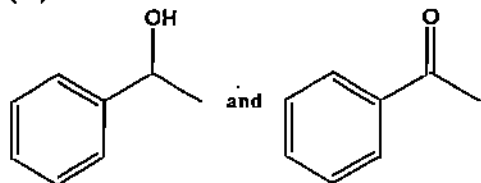


40.

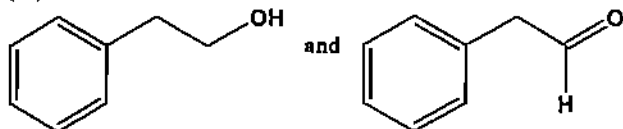


The structures of the products **A** and **B** formed in the above reaction scheme respectively are:

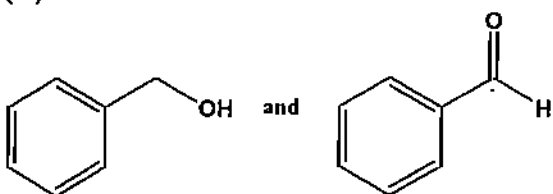
(A)



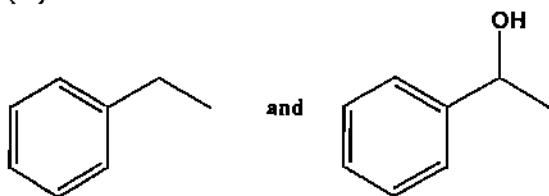
(B)



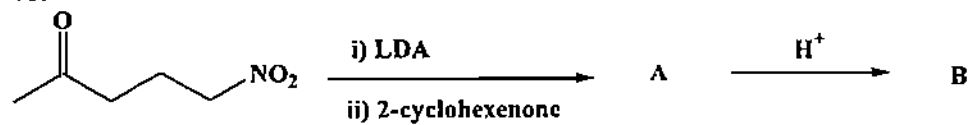
(C)



(D)

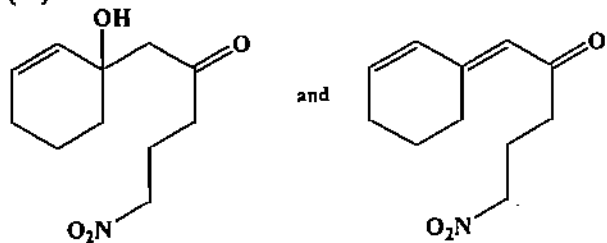


41.

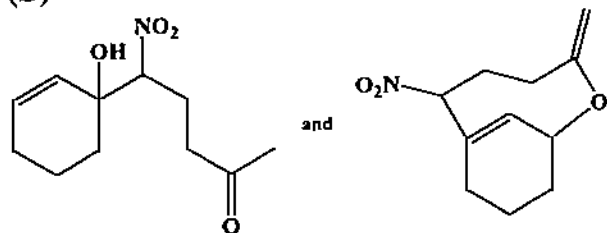


The structures of the products A and B formed in the above reaction scheme respectively are:

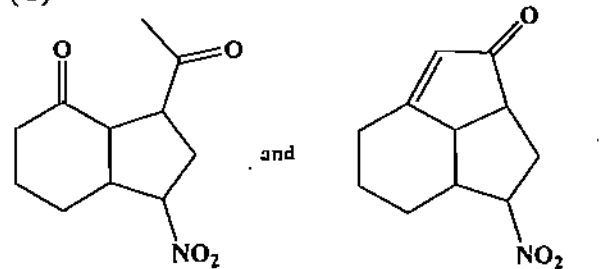
(A)



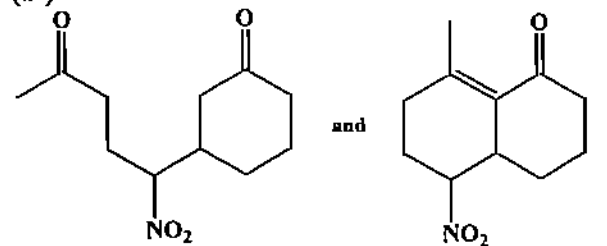
(B)



(C)



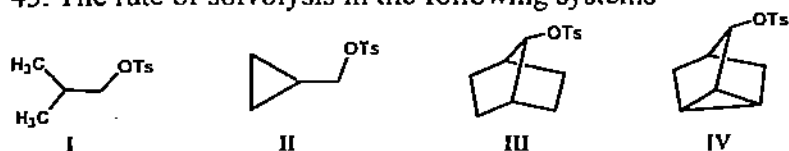
(D)



42. Which of the following is a pyrimidine base?

- (A) imidazole
- (B) guanine
- (C) cytosine
- (D) adenine

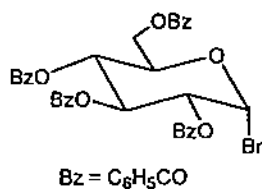
43. The rate of solvolysis in the following systems



would follow the sequence

- (A) I > II > III > IV
- (B) III > II > I > IV
- (C) IV > III > II > I
- (D) IV > III = II > I

44. The axial preference of the bromide group in the following compound



is due to:

- (A) the presence of an ester group in the adjacent carbon
- (B) the 1,3-diaxial interactions
- (C) the favorable bond angle between -O-C-Br bonds
- (D) the favorable interactions between the lone pair endo-cyclic oxygen and the C-Br bond

45. The molecular formula for glycine is $C_2H_5O_2N$. What would be the molecular formula for a linear oligomer made by linking ten glycine molecules together by condensation synthesis?

(A) $C_{20}H_{50}O_{20}N_{10}$

(B) $C_{20}H_{32}O_{11}N_{10}$

(C) $C_{20}H_{40}O_{10}N_{10}$

(D) $C_{20}H_{68}O_{29}N_{10}$

46. Which pair of amino acids absorbs the most UV light at 280 nm?

(A) Thr & His

(B) Trp & Tyr

(C) Cys & Asp

(D) Phe & Pro

47. What is the λ_{max} for the following compound? Use the provided parameters for your calculation.

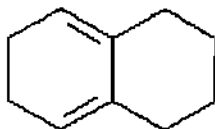
transoid base value = 214 nm

cisoid base value = 253 nm

alkyl groups on base = +5 nm

exocyclic C=C = +5 nm

extended conjugation = +30 nm



(A) 234 nm

(B) 244 nm

(C) 273 nm

(D) 283 nm

48. What is the best name for the following compound?



- (A) 1,2,6-trimethylheptane
- (B) 2-ethyl-6-methylheptane
- (C) 2,6-dimethyloctane
- (D) 3-methyl-6-(1-methylethyl)hexane

49. Heating benzene in a large excess of 80% D_2SO_4 in D_2O results in what product?

- (A) $C_6H_5SO_3D$
- (B) C_6H_5OD
- (C) C_6H_5D
- (D) C_6D_6

50. Hydration, by oxymercuration, of 3-methyl-1-butene gives 3-methyl-2-butanol. What is the observed rotation of this product, using a 20% solution in ethanol in a 1dm polarimeter cell? (Assume the specific rotation of the pure (S)-enantiomer to be $+16^\circ$)

- (A) $+3.2^\circ$
- (B) -3.2°
- (C) 180° (+ or -)
- (D) 0°

51. The correct symmetry for ClF_3 is

- (A) C_{2v}
- (B) C_{3v}
- (C) D_{3h}
- (D) C_3

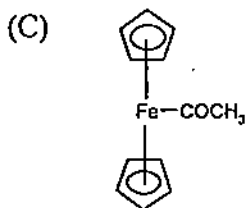
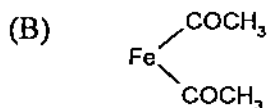
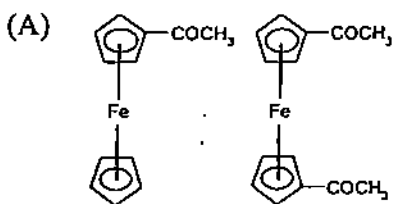
52. Which one of the following pairs is isoelectronic?
- (A) CN^- , BN
 - (B) CO_2 , NO
 - (C) O_2^- , N_2
 - (D) NO^+ , CO
53. According to VSEPR theory the structure of NF_3 is
- (A) trigonal planar
 - (B) tetrahedral
 - (C) see-saw
 - (D) trigonal bipyramidal
54. PMe_3 in a borane cluster is a:
- (A) 3-electron donor
 - (B) 2-electron donor
 - (C) 1-electron donor
 - (D) 5-electron donor
55. The carbanion character of Group 13 alkyl compounds decreases in the order:
- (A) $\text{Al}_2\text{R}_6 > \text{GaR}_3 > \text{BR}_3$
 - (B) $\text{Al}_2\text{R}_6 < \text{GaR}_3 < \text{BR}_3$
 - (C) $\text{BR}_3 > \text{Al}_2\text{R}_6 > \text{GaR}_3$
 - (D) $\text{GaR}_3 > \text{BR}_3 > \text{Al}_2\text{R}_6$
56. Which of the following metalloproteins is a redox protein?
- (A) Carbonic anhydrase
 - (B) Cytochrome c
 - (C) Ferritin
 - (D) Transferrin

57. The metal that is not prevalent in the biological system is:
- (A) Platinum
 - (B) Manganese
 - (C) Cobalt
 - (D) Nickel
58. The complex that would show paramagnetic behavior is
- (A) $[\text{MnO}_4]^-$
 - (B) $[\text{FeCl}_4]^-$
 - (C) $[\text{Cu}(1,10\text{-phenanthroline})_2]^+$
 - (D) $[\text{Fe}(\text{CN})_6]^{4-}$
59. Which of the following trivalent lanthanide ions shows maximum spin-only magnetic moment value?
- (A) La^{3+}
 - (B) Sm^{3+}
 - (C) Gd^{3+}
 - (D) Tm^{3+}
60. Red β -ketoenolate complexes of Ni(II) are diamagnetic. These red complexes turn bluish-green in presence of water or amines and become paramagnetic. Which of the following structure is formed during the reaction?
- (A) Tetrahedral
 - (B) Square-planar
 - (C) Octahedral
 - (D) Dodecahedral

61. Which one of the following electronic configurations of an octahedral metal complex will show three spin-allowed electronic transitions?
- (A) t_{2g}^1
 (B) t_{2g}^3
 (C) $t_{2g}^3 e_g^2$
 (D) $t_{2g}^6 e_g^3$
62. Reaction of $[\text{CoCl}(\text{NH}_3)_5]^{2+}$ by $\text{Cr}^{2+}(\text{aq})$ leads to the formation of $[\text{CrCl}(\text{H}_2\text{O})_5]^{2+}$. This is an example of
- (A) outer-sphere redox reaction
 (B) inner-sphere redox reaction
 (C) acid hydrolysis reaction
 (D) base hydrolysis reaction
63. The origin of the yellow color of an aqueous solution of K_2CrO_4 is due to
- (A) d-d transition
 (B) H_2O to Cr^{6+} charge transfer
 (C) O^{2-} to K^+ charge transfer
 (D) O^{2-} to Cr^{+6} charge transfer
64. The oxidation number of Fe in $\text{Na}_2[\text{Fe}(\text{CN})_5\text{NO}]$ is
- (A) +1
 (B) +2
 (C) +3
 (D) +4
65. Which one of the following is a correct representation of tetraammine nickel (II) hexacyano ferrate (III)?
- (A) $[\text{Ni}(\text{NH}_3)_4][\text{Fe}(\text{CN})_6]$
 (B) $[\text{Ni}(\text{NH}_3)_4]_3[\text{Fe}(\text{CN})_6]_4$
 (C) $[\text{Ni}(\text{NH}_3)_4][\text{Fe}(\text{CN})_6]_2$
 (D) $[\text{Ni}(\text{NH}_3)_4]_3[\text{Fe}(\text{CN})_6]_2$

66. The complex that obeys the 18 electron rule is
- (A) $[\text{Mn}(\text{CO})_5]$
 (B) $[(\eta^5\text{-C}_5\text{H}_5)_2\text{Co}]$
 (C) $[\text{Mo}(\text{CO})_3(\text{CH}_3\text{CN})_3]$
 (D) $[(\eta^5\text{-C}_5\text{H}_5)_4\text{Ti}]$
67. The order of increasing CO bond strength is
- (A) $[\text{Fe}(\text{CO})_4]^{2-} > [\text{Co}(\text{CO})_4]^- > [\text{Ni}(\text{CO})_4] > [\text{Mn}(\text{CO})_6]^+$
 (B) $[\text{Co}(\text{CO})_4]^- > [\text{Fe}(\text{CO})_4]^{2-} > [\text{Mn}(\text{CO})_6]^+ > [\text{Ni}(\text{CO})_4]$
 (C) $[\text{Ni}(\text{CO})_4] > [\text{Mn}(\text{CO})_6]^+ > [\text{Fe}(\text{CO})_4]^{2-} > [\text{Co}(\text{CO})_4]^-$
 (D) $[\text{Mn}(\text{CO})_6]^+ > [\text{Ni}(\text{CO})_4] > [\text{Co}(\text{CO})_4]^- > [\text{Fe}(\text{CO})_4]^{2-}$
68. The number of isomers that exists for $[\text{Mo}(\text{C}_5\text{H}_5\text{N})_3(\text{CO})_3]$ is
- (A) one
 (B) two
 (C) three
 (D) four
69. The reaction of $[(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{CH}_3)(\text{CO})_2]$ with PPh_3 results in
- (A) $[(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{CH}_3)(\text{CO})(\text{PPh}_3)] + \text{CO}$
 (B) $[(\eta^1\text{-C}_5\text{H}_5)\text{Fe}(\text{CH}_3)(\text{CO})_2(\text{PPh}_3)]$
 (C) $[(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{COCH}_3)(\text{CO})(\text{PPh}_3)]$
 (D) $[(\eta^5\text{-C}_5\text{H}_5)\text{Fe}(\text{COCH}_3)(\text{PPh}_3)] + \text{CO}$
70. The complex $[\text{Co}(\text{NH}_3)_5(\text{NO}_2)]^{2+}$ is capable of exhibiting
- (A) optical isomerism
 (B) geometrical isomerism
 (C) ionization isomerism
 (D) linkage isomerism

71. The reaction of acetyl chloride and AlCl_3 with ferrocene gives

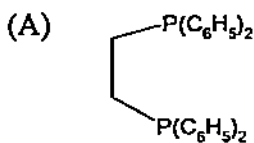


(D) FeCl_3 and $\text{Al}(\text{COCH}_3)_3$

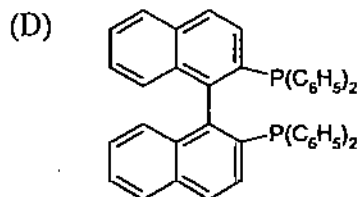
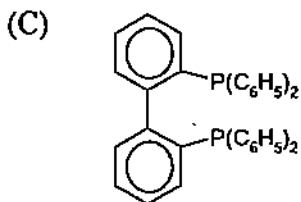
72. The reaction of H_2 with Wilkinson catalyst results in

- (A) "cis" addition of H_2 and metal oxidation state change of -2
- (B) "trans" addition of H_2 and metal oxidation state change of $+2$
- (C) "trans" addition of H_2 and an oxidation state change of -2
- (D) "cis" addition of H_2 and an oxidation state change of $+2$

73. The hydrogenation of a prochiral alkene with a metal complex containing a phosphorus ligand is likely to yield a chiral product when the ligand is



(B) PPh_3



74. Given the mass of an electron as 9.109×10^{-31} kg and the speed of light, 3×10^8 m s⁻¹, the de Broglie wavelength of an electron traveling at half the speed of light is
- (A) 4.85×10^{-12} m
 - (B) 9.7×10^{-12} m
 - (C) 4.85×10^{-24} m
 - (D) 9.7×10^{-24} m
75. The O–O bond is the strongest in
- (A) O₂
 - (B) O₂⁻
 - (C) O₂⁺
 - (D) O₂²⁻
76. The halogen with the highest polarizability is
- (A) fluorine
 - (B) chlorine
 - (C) bromine
 - (D) iodine
77. Alpha decay of ${}_{12}^{24}\text{Mg}$ results in
- (A) ${}_{10}^{22}\text{Mg}$
 - (B) ${}_{10}^{20}\text{Ne}$
 - (C) ${}_{11}^{23}\text{Na}$
 - (D) ${}_{13}^{27}\text{Al}$
78. The type of force that holds the layers of carbon atoms in graphite together is
- (A) ionic
 - (B) hydrogen-bonding
 - (C) van der Waals
 - (D) covalent

79. The point group symmetry of allene, $\text{CH}_2 = \text{C} = \text{CH}_2$ is

- (A) D_{2h}
- (B) D_{2d}
- (C) D_2
- (D) C_{2v}

80. The number of nodes that π^* orbital in $\text{CH}_2 = \text{CH}_2$ is

- (A) 1
- (B) 2
- (C) 3
- (D) 0

81. The mean free path of a gaseous molecule is 50 cm at a pressure of 1.0×10^{-4} Torr. The mean free path when the pressure is increased to 1.0×10^{-2} Torr will be

- (A) 0.5 cm
- (B) 5.0 cm
- (C) 500 cm
- (D) 5000 cm

82. 5.0 gm of a non-dissociating organic substance dissolves in water to generate an osmotic pressure of 7.15 atm at 25 °C. The molar mass of the substance is ($R = 0.08206 \text{ atm L mol}^{-1} \text{ K}^{-1}$)

- (A) 171 g mol^{-1}
- (B) 342 g mol^{-1}
- (C) 684 g mol^{-1}
- (D) 35640 g mol^{-1}

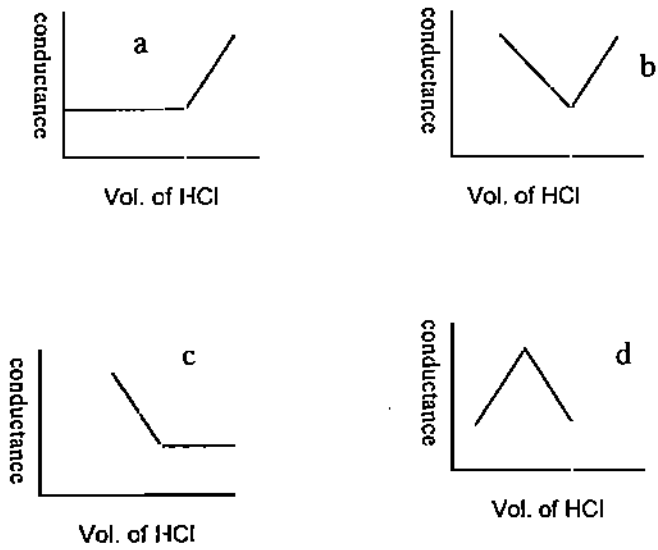
83. Sufficient heat is supplied to a monoatomic gas to double its volume and temperature while maintaining its pressure at 1.00 atm. The change in its internal energy is:

- (A) 2.26 kJ
- (B) 1.13 kJ
- (C) 3.4 kJ
- (D) 34 kJ

84. A crystal system is determined by the lengths (a, b, c) and the angles (α, β, γ) of the unit cell. For Orthorhombic system these are
- (A) $a = b = c; \quad \alpha = \beta = \gamma = 90$
 (B) $a = b \neq c; \quad \alpha = \beta = \gamma = 90$
 (C) $a \neq b \neq c; \quad \alpha = \beta = \gamma = 90$
 (D) $a \neq b \neq c; \quad \alpha \neq \beta \neq \gamma \neq 90$
85. The molecule that will not have any absorbance in the microwave or the infrared regions of the electromagnetic spectrum is:
- (A) CO_2
 (B) HF
 (C) CH_4
 (D) H_2
86. Laser induced fluorescence is a powerful technique to monitor chemical species that fluoresce. The absorption maximum for a given molecule is at 420 nm. The fluorescence maximum for this molecule could be at:
- (A) 23809 cm^{-1}
 (B) 22000 cm^{-1}
 (C) 26000 cm^{-1}
 (D) 2381 cm^{-1}
87. The EMF of the concentration cell
- $$\text{Cu(s)} \mid \text{Cu}^{2+} (0.012 \text{ M}) \parallel \text{Cu}^{2+} (1.2 \text{ M}) \mid \text{Cu(s)}$$
- is
- (A) 0.001 V
 (B) 0.025 V
 (C) 0.059V
 (D) 0.118V

88. An electrochemical cell used for electroplating operates at a current of 10 A. Coulombs that pass through in this process in an hour is
- (A) 18000
 (B) 36000
 (C) 3600
 (D) 1800

89. When NaOH (aq.) solution is titrated with HCl (aq), the variation of conductance as a function of volume of HCl (increasing volume towards the right on the x-axis) will take the shape of the curve as in



- (A) a
 (B) b
 (C) c
 (D) d

90. A solution containing one mol per liter of each $\text{Cu}(\text{NO}_3)_2$, AgNO_3 , $\text{Mg}(\text{NO}_3)_2$ and LiNO_3 is electrolyzed using Pt electrodes. Standard electrode potentials are:

Ag^+ / Ag	: 0.80 V
$\text{Cu}^{2+} / \text{Cu}$: 0.34 V
$\text{Mg}^{2+} / \text{Mg}$: -2.37 V
Li^+ / Li	: -3.10 V

With increasing voltage, the sequence of deposition of the metals on the cathode is:

- (A) Li, Mg
- (B) Mg, Li
- (C) Cu, Ag
- (D) Ag, Cu

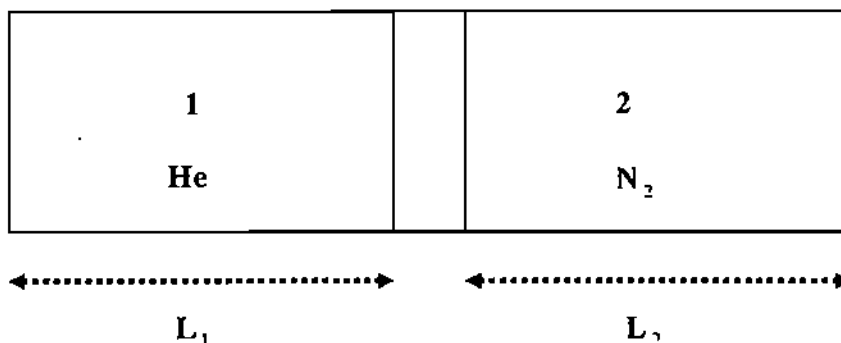
91. An element A (At. Wt. 60.22) crystallizes in the fcc close-packed lattice and has a density of 8 gm/c.c. the unit cell lattice parameter of A is

- (A) 3.65 Å
- (B) 2.65 Å
- (C) 4.35 Å
- (D) 2.35 Å

92. Benzene has a freezing point of 3 °C. The molal depression constant $K_f = 5 \text{ }^\circ\text{C} / \text{M}$. A 0.1 molal solution of a solute A in benzene has 40 % of the solute existing in the form of a dimer, A_2 . The freezing point of the solution is expected to be

- (A) 2.5 °C
- (B) 3.5 °C
- (C) 2.6 °C
- (D) 3 °C

93. The cylindrical container shown below has a total volume of one litre and has a freely moving piston separating 250 mg of He from 250 mg of Nitrogen, at 20 °C



At equilibrium, the ratio of the two lengths, L_1/L_2 is

- (A) 1
(B) 7
(C) 1/7
(C) 7/2
94. For a pure substance, the triple point in a phase diagram has
- (A) one degree of freedom
(B) two degrees of freedom
(C) three degrees of freedom
(D) zero degree of freedom
95. The amount of reversible work done to compress one mol of an ideal gas from 100 atm, 300 K to a final volume that is half the initial volume is
- (A) 2.53 kJ
(B) 1.73 kJ
(C) 5.85 kJ
(D) 4.73 kJ

96. The heat evolved in combustion of acetylene at 25 °C is 310.5 kcal/mol. If the enthalpy of formation of carbon dioxide is – 94.0 kcal/mol and that of water is – 68.3 kcal/mol, the enthalpy of formation of acetylene will be

- (A) 65.3 kcal/mol
- (B) 54.2 kcal/mol
- (C) 85.2 kcal/mol
- (D) 108.3 kcal/mol

97. In the following tetrapeptide,

H₂N-Ser-Ala-MeAla-Leu-CO₂H

the non-coded amino acid is:

- (A) H₂N-Ser
- (B) Ala
- (C) MeAla
- (D) Leu-CO₂H

98. Thermal melting experiment of a nucleic acid provides information on:

- (A) the primary sequence of the nucleic acid
- (B) the conformational stability of the nucleic acid
- (C) an estimate of the molecular weight of the nucleic acid
- (D) kinetics of the nucleic acid folding

99. The complementary sequence for the following oligonucleotide

A-T-G-T-C-A-T-G-C-C-G-A-T-G-C

is :

- (A) A-G-T-A-C-A-T-G-C-T-A-T-A-C-G
- (B) T-A-C-A-G-T-A-C-G-G-C-T-A-C-G
- (C) C-A-T-A-C-A-T-G-C-A-C-A-T-G-C
- (D) G-C-T-C-C-G-A-G-T-A-G-A-T-A-C

100. Enzymes responsible for peptide bond cleavage in proteins cleavage are

- (A) Lyases
- (B) Kinases
- (C) Proteases
- (D) Aminotransferases

END of the Question Paper