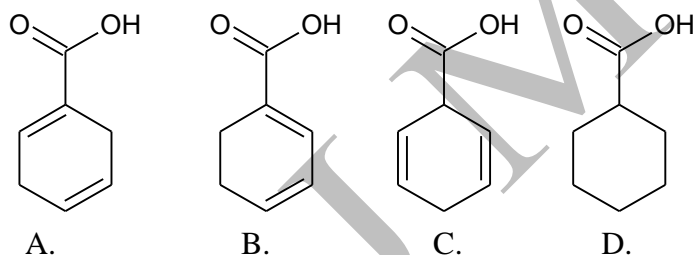
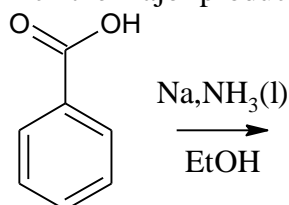


CSIR/UGC Model Question Paper

- The product formed on heating S_2Cl_2 and NH_3 over solid NH_4Cl is ¹
A. $(SN)_x$ B. $S_3N_3Cl_3$ C. S_8Cl_2 D. S_4N_4
- The No. of M-M bonds in tetranuclear osmium complexes, $Os_4(CO)_{16}$, $Os_4(CO)_{14}$ & $Os_4(CO)_{15}$ ²
A. 4,5 & 6 B. 4,6 & 5 C. 6,5 & 4 D. 6,4 & 5
- The point group symmetry of the chair conformation of cyclohexane is ³
A. C_{2v} B. D_{2d} C. D_{3d} D. D_{2h}
- The most acidic aqua ion is ⁴
A. $[Fe(H_2O)_6]^{3+}$ C. $[Ti(H_2O)_6]^{3+}$
B. $[Co(H_2O)_6]^{3+}$ D. $[Cr(H_2O)_6]^{3+}$
- The series with the correct order of decreasing ionic size is ⁵
A. $K^+ > Ca^{2+} > S^{2-} > Cl^-$ C. $K^+ > Cl^- > Ca^{2+} > S^{2-}$
B. $S^{2-} > Cl^- > K^+ > Ca^{2+}$ D. $Cl^- > K^+ > S^{2-} > Ca^{2+}$
- Pick the major product in the following reaction ⁶



- Compounds shown below are ⁷
- A.

B.

C.

D.
- Compounds shown below are ⁷
A. Enantiomers C. Homomers
B. Diastereomers D. Anomers
 - The entropy of the crystalline solid of nitric oxide at absolute zero is ⁸
A. Less than 1 B. 1 C. 0 D. greater than 1
 - If the wavelength of the first line of Balmer series of Hydrogen atom is 656.1nm, the wavelength of the second line of this series would be ⁹
A. 218.7nm B. 328.0nm C. 486.0nm D. 640.0nm
 - I_3^- ion is ¹⁰
A. Linear B. Triangular C. Bend D. tetrahedral
 - PF_3 belongs to the point group ¹¹
A. D_{3h} B. D_{2d} C. D_{2h} D. C_{3v}
 - Which of the following is a soft base? ¹²

A. CH_3COO^- B. H^- C. NO_3^- D. CO_3^{2-}

13. In the titration of acetic acid Vs sodium hydroxide, the pH of the solution at equivalence point (when temp is 25°C) is¹³

A. About 5.5 B. About 6.5 C. About 7 D. About 8

14. Match list (I) [Maxwell's relations] with list (II) [Thermodynamic relations] and select the correct answer using the codes given below¹⁴

List (I)

- a. $(\partial T/\partial P)_S = (\partial V/\partial S)_P$
 b. $(\partial S/\partial P)_T = -(\partial V/\partial T)_P$
 c. $(\partial T/\partial V)_S = -(\partial P/\partial S)_V$
 d. $(\partial S/\partial V)_T = -(\partial P/\partial T)_V$

List (II)

1. $dG = VdP - SdT$
 2. $dA = -SdT - PdV$
 3. $dH = TdS + VdP$
 4. $dE = TdS - PdV$

Codes:

- | | | | | |
|----|----|----|----|----|
| A. | a. | b. | c. | d. |
| | 1 | 3 | 4 | 2 |
| B. | a. | b. | c. | d. |
| | 3 | 1 | 4 | 2 |
| C. | a. | b. | c. | d. |
| | 3 | 1 | 2 | 4 |
| D. | a. | b. | c. | d. |
| | 1 | 3 | 2 | 4 |

15. Match list (I) [Complexes] with list (II) [LFSE values] and select the correct answer using the codes given below¹⁵

List (I)

- a. $[\text{Co}(\text{NH}_3)_6]^{3+}$
 b. $[\text{Cr}(\text{NH}_3)_6]^{3+}$
 c. $[\text{FeF}_6]^{3-}$
 d. $[\text{Fe}(\text{CN})_6]^{3-}$

List (II)

1. $20Dq - 2P$
 2. $12Dq$
 3. $24Dq - 2P$
 4. $0Dq$

Codes

- | | | | | |
|----|----|----|----|----|
| A. | a. | b. | c. | d. |
| | 3 | 2 | 4 | 1 |
| B. | a. | b. | c. | d. |
| | 2 | 3 | 1 | 4 |
| C. | a. | b. | c. | d. |
| | 4 | 1 | 2 | 3 |
| D. | a. | b. | c. | d. |
| | 3 | 4 | 2 | 1 |

16. The potential for a hydrogen electrode of pH = 10 is¹⁶

A. 0.00 V B. 0.591V C. -0.591V D. -0.0591V

17. One of the following is not a perfect differential¹⁷

A. dQ B. dH C. dT D. dG

18. The crystal field splitting energy for octahedral (Δ_o) and tetrahedral (Δ_t) complexes is related as¹⁸

A. $\Delta_t \approx 4/9\Delta_o$ B. $\Delta_t \approx 1/2\Delta_o$ C. $\Delta_o \approx 2\Delta_t$ D. $\Delta_o \approx 4/9\Delta_t$

19. All molecules would give rise to ----- spectrum¹⁹

A. Rotation B. Vibration C. Electronic D. NMR

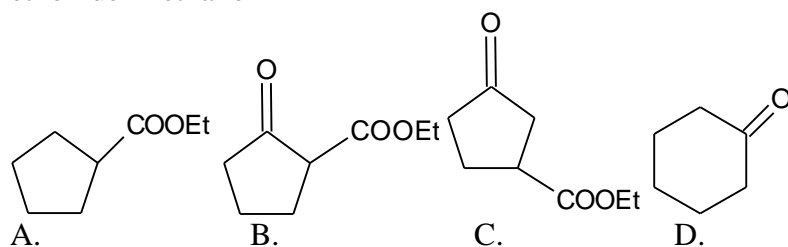
20. Chemical shift is not possible in²⁰

A. NMR B. ESR C. ESCA D. Auger

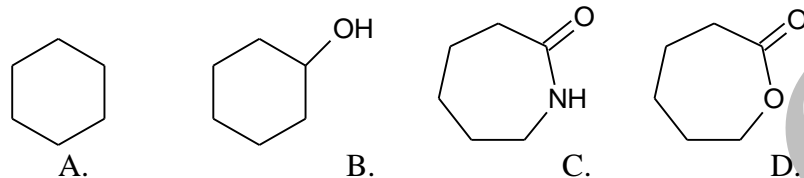
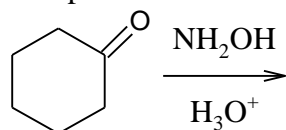
21. The Lewis acid character of BF_3 , BCl_3 and BBr_3 follows the order²¹

A. $\text{BF}_3 < \text{BBr}_3 < \text{BCl}_3$ C. $\text{BF}_3 < \text{BCl}_3 < \text{BBr}_3$
 B. $\text{BCl}_3 < \text{BBr}_3 < \text{BF}_3$ D. $\text{BBr}_3 < \text{BCl}_3 < \text{BF}_3$

22. The intermediate formed in Reimer-Tiemann reaction is²²
 A. Dichloro carbene C. Trichloro carbene
 B. Isocyanate D. Chloral
23. Which one of the following compounds will be obtained when diethyl adipate is heated with sodium ethoxide in ethanol²³



24. The product formed in the following reaction is²⁴



25. Determine the commutator of the operators d/dx and x ²⁵
 A. x B. 1 C. 0 D. x^2
26. Normalize the following wave function $\sin\left(\frac{n\pi x}{L}\right)$ in the range $0 \leq x \leq L$;²⁶

- A. $L/2$ B. $2/L$ C. $(2/L)^{1/2}$ D. $(L/2)^{1/2}$

27. Which of the following reactions will not yield a carboxylic acid²⁷

- A. $RMgX + CO_2 \rightarrow$ C. $PhCN + H_2O \rightarrow$
 B. $PhOH + CHCl_3 + NaOH \rightarrow$ D. $PhOH + NaOH + CO_2 \rightarrow$

28. Consider a particle in a cubic box, what is the degeneracy of the level that has an energy three times that of the lowest level²⁸

- A. 1 B. 2 C. 3 D. 5

29. Schrock carbenes are²⁹

- A. Triplets and nucleophilic C. Singlets and nucleophilic
 B. Triplets and electrophilic D. Singlets and electrophilic

30. A particle of mass 'm' is confined in a one dimensional box of length 'a'. Calculate the probability of finding the particle in the region $0 \leq x \leq a/4$ ³⁰

- A. $1/2$ B. $1/4$ C. $1/3$ D. $1/8$

31. A molecule would be optically active if there is³¹

- A. An improper axis S_n C. Centre of inversion i
 B. No mirror plane σ_h D. No improper axis

32. two elements A & B form an abelian group when³²

- A. $AB = BA$ C. $AB \neq BA$
 B. $A^{-1}B \neq B^{-1}A$ D. $AB^{-1} = BA^{-1}$

33. A canonical ensemble is a collection of assemblies having the same³³

- A. U, V and N C. T, N and μ
 B. T, V and μ D. T, V and N

34. What is the ground state term symbol of the p^2 ?³⁴
 A. 3P B. 1P C. 2P D. 3S
35. Which of the following are fermions?³⁵
 A. H^+ and 2D C. e^- and H^+
 B. 2D and 4He D. 4He and ^{12}C
36. In terms of molecular partition function q which of the following is true?³⁶
 A. $q_{tr} \gg q_{rot} \gg q_{vib} \gg q_{ele}$ C. $q_{ele} \gg q_{vib} \gg q_{rot} \gg q_{tr}$
 B. $q_{vib} > q_{tr} > q_{rot} > q_{ele}$ D. $q_{rot} > q_{tr} > q_{vib} > q_{ele}$
37. The mechanism involved in the following reaction is?³⁷
 $[Co(NH_3)_5Cl]^{2+} + OH^- \rightleftharpoons [Co(NH_3)_5(OH)]^{2+} + Cl^-$
 A. S_N1 B. S_N1CB C. S_N2 D. S_Ni
38. Color of Prussian Blue is due to?³⁸
 A. LMCT transition C. intervalence CT transition
 B. MLCT transition D. Laporte forbidden spin allowed d-d transition
39. Variation of chemical potential with pressure is given by?³⁹
 A. $-S_{i,m}$ B. $V_{i,m}$ C. $H_{i,m}$ D. $U_{i,m}$
40. Among the following which is an intensive property?⁴⁰
 A. Energy B. Mass C. Heat capacity D. Density
41. Vanadyl acetyl acetonate shows 8 lines in the hyperfine structure of its ESR spectrum. Calculate the spin of the V^{51} nucleus?⁴¹
 A. 1 B. 1/2 C. 3/2 D. 7/2
42. Which of the following is the one that does not exhibit NMR spectra?⁴²
 A. N^{15} B. F^{19} C. P^{31} D. S^{32}
43. What is the change in the rotational constant B when hydrogen is replaced by deuterium in the hydrogen molecule?⁴³
 A. B B. $B/2$ C. $2B$ D. $B/4$
44. The dipole moment of a molecule can be calculated from?⁴⁴
 A. Zeeman effect C. Pure rotation spectrum
 B. Stark effect D. Vibration rotation spectrum
45. 1H NMR spectrum of [18]-annulene shows?⁴⁵
 A. Only one peak at δ 7.2 (18H)
 B. Only one peak at δ 5.0 (18H)
 C. Two peaks at δ 9.0 (12H) and δ -3.0 (6H)
 D. Two peaks at δ 9.0 (6H) and δ -3.0 (12H)
46. The sensitivity of a 600MHz NMR spectrometer is more than that of a 60 MHz spectrometer because?⁴⁶
 A. Population of spin states is directly proportional to the applied magnetic field
 B. Population of spin states is inversely proportional to the applied magnetic field
 C. According to the Boltzmann distribution law, the excess population in the lower spin state increases with increasing applied magnetic field
 D. The spectral scan width is more for a 600 MHz spectrum compared to a 60 MHz spectrum
47. The intense red color of tris(bipyridyl)iron(II) is due to?⁴⁷
 A. Ligand to metal charge transfer transition
 B. Metal to ligand charge transfer transition
 C. Laporte forbidden and spin allowed d-d transition
 D. Laporte allowed and spin allowed d-d transition
48. H^- is high in spectrochemical series due to?⁴⁸
 A. It is a strong π acceptor C. it is a strong sigma acceptor
 B. It is a strong π donor D. it is a strong sigma donor

49. The time constant for the return of a spin system to equilibrium by giving up energy to the surroundings is⁴⁹
- Transverse relaxation time
 - Longitudinal relaxation time
 - Effective transverse relaxation time
 - Spin-spin relaxation time
50. The transfer of population advantage from one nucleus to another by spin relaxation processes involving internuclear dipole-dipole interaction is known as⁵⁰
- Fermi contact interaction
 - Inhomogeneous broadening
 - Free induction decay
 - Nuclear Overhauser effect
51. Vibration-rotation Raman transitions with $\Delta J = 0$ is⁵¹
- O-branch
 - P-branch
 - Q-branch
 - S-branch
52. Aldehydes and ketones react with α -bromo esters and metallic zinc to yield⁵²
- δ -keto esters
 - β -keto alcohols
 - β -hydroxy esters
 - γ -keto acids
53. How many fundamental vibrational frequencies can be observed in the IR absorption spectrum of water⁵³
- 1
 - 2
 - 3
 - 4
54. The volume of blood in a living system can be determined using the method⁵⁴
- Neutron activation analysis
 - Prompt gamma neutron activation analysis
 - Isotope dilution analysis
 - Electron multiplication analysis
55. Using the BET equation for multilayer adsorption, plot of $P/V(P_0 - P)$ and P/P_0 is made and a straight line is obtained. Then the monolayer capacity V_m can be calculated as⁵⁵
- $V_m = \text{slope} \times \text{intercept}$
 - $V_m = \text{slope} / \text{intercept}$
 - $V_m = 1/(\text{slope} + \text{intercept})$
 - $V_m = 1/(\text{slope} - \text{intercept})$
56. In BCS theory, superconductivity is due to⁵⁶
- Formation of phonons
 - Formation of Cooper pair
 - Josephson effect
 - Silsbee effect
57. A fermion should have⁵⁷
- Integral spin
 - Half integral spin
 - Wave functions symmetric with respect to exchange of particles
 - Velocity equal to that of light
58. If force of electrostatic attraction between two molecules varies inversely as the sixth power of distance, then the force is characterized as⁵⁸
- Ion dipole interaction
 - Ion induced dipole interaction
 - Induced dipole-induced dipole interaction
 - Dipole-induced dipole interaction
59. The radius of the second orbit of hydrogen atom is⁵⁹
- 1.058 \AA
 - 0.132 \AA
 - 0.265 \AA
 - 2.116 \AA
60. The complex with spin only magnetic moment of $\approx 4.9 \text{ B.M}$ is⁶⁰
- $[\text{Co}(\text{CN})_6]^{3-}$
 - $[\text{Fe}(\text{H}_2\text{O})_6]^{2+}$
 - $[\text{Ti}(\text{H}_2\text{O})_6]^{3+}$
 - $[\text{Rh}(\text{CO})_6]^{3+}$
61. The molecule of ortho hydrogen is distinguished from that of para hydrogen that⁶¹
- Spins of both electrons and protons are parallel in each of them
 - Spins of both electrons and protons are opposite in each of them
 - Spins of electrons are opposite in both, but that of protons is parallel in ortho hydrogen and opposite in para hydrogen
 - Spins of electrons are opposite in each of them, but those of protons are parallel in para hydrogen and opposite in ortho hydrogen

62. In a system, when the chemical potential of each component is the same for all the phases, the equilibrium is said to be⁶²

- A. Meta stable equilibrium C. composition equilibrium
B. Thermal equilibrium D. Mechanical equilibrium

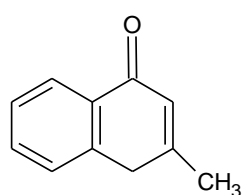
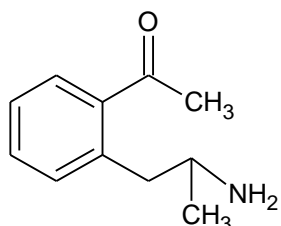
63. Buckminster fullerene, an allotrope of carbon contains⁶³

- A. 14 pentagons & 18 hexagons C. 10 pentagons & 20 hexagons
B. 12 pentagons & 20 hexagons D. 12 pentagons & 18 hexagons

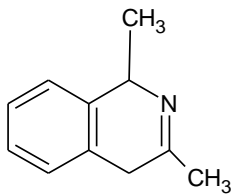
64. The ligand CO is⁶⁴

- A. σ acceptor C. σ donor & π acceptor
B. π donor D. σ acceptor & π donor

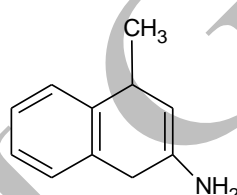
65. The amino ketone shown undergoes a spontaneous cyclization on standing. What is the product of this intra molecular reaction⁶⁵



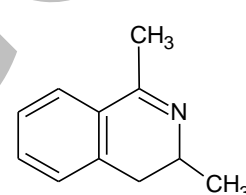
A.



B.

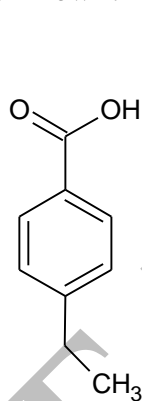


C.

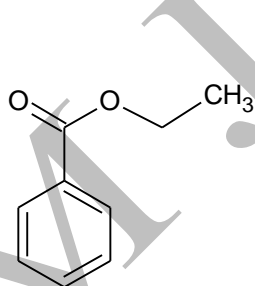


D.

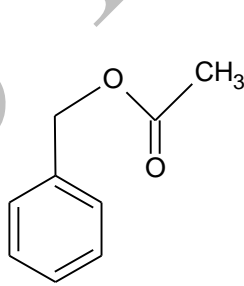
66. An unknown compound, $C_6H_{10}O_2$, did not dissolve in aqueous NaOH. The infrared spectrum exhibited strong absorption at 1730 cm^{-1} . The $^1\text{H NMR}$ spectrum had signals at δ 7.2 ppm (multiplet), 4.1 ppm (quartet), and 1.3 ppm (triplet). Which of the following is most likely the unknown?⁶⁶



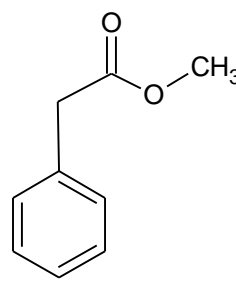
A.



B.



C.



D.

67. The interplanar spacing between the (200) planes of a cubic lattice of length 450 pm ⁶⁷

- A. 400 pm B. 159 pm C. 112.5 pm D. 225 pm

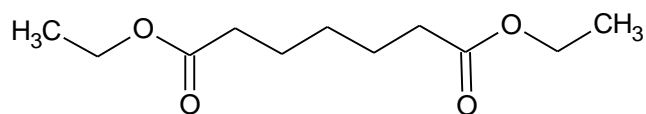
68. Molar elevation constant for a solvent is 2.16°C . When 0.15 gm of a substance was dissolved in 15 gm of the solvent, it boiled at a temperature higher by 0.216°C than that of the pure solvent. The molecular weight of the substance is⁶⁸

- A. 100 gm B. 150 gm C. 200 gm D. 225 gm

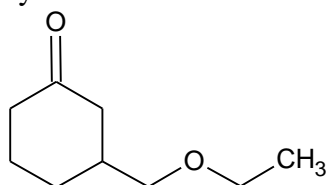
69. A solution containing 6.0 g/dm^3 of urea was found to be isotonic with a 5% solution of an organic nonvolatile solute. The molar mass of the later will be⁶⁹

- A. 500 g B. 50 g C. 250 g D. 160 g

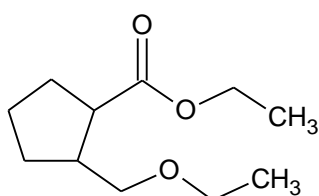
70. Dieckmann cyclization of



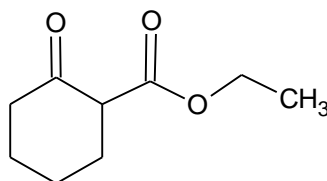
will yield ⁷⁰



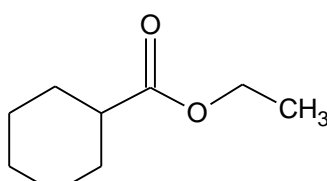
A.



B.

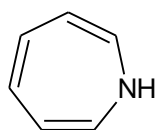


C.

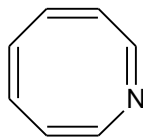


D.

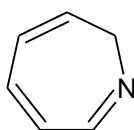
71. Which one of the following is best classified as a heterocyclic aromatic compound ⁷¹



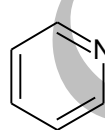
A.



B.

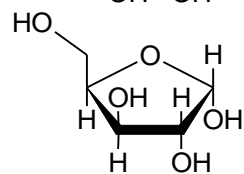
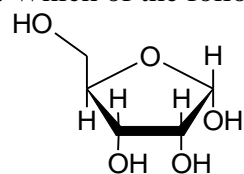


C.

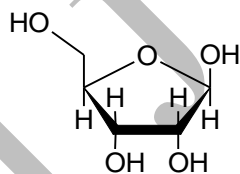


D.

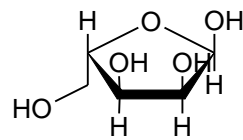
72. Which of the following represents the anomer of the compound shown ⁷²



A.



B.



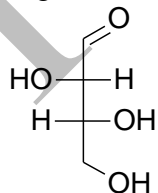
C.

D. None of these

73. The optical rotation of the α form of a pyranose is $+150.7^\circ$; that of the β form is $+52.8^\circ$. In solution an equilibrium mixture of the anomers has an optical rotation of $+80.2^\circ$. The percentage of the α form at equilibrium is ⁷³

- A. 28% B. 32% C. 68% D. 72%

74. The configurations of the stereogenic centers in D-threose (shown) are ⁷⁴



A. 2R, 3R

B. 2R, 3S

C. 2S, 3R

D. 2S, 3S

75. The quantum mechanical operator used for kinetic energy is ⁷⁵

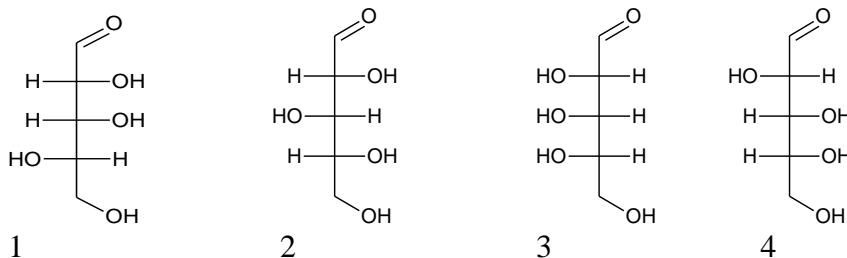
A. $\frac{\hbar}{2\pi i} \frac{\partial}{\partial x}$

B. $-\frac{\hbar^2}{8\pi^2 m} \nabla^2 + V$

C. $-\frac{\hbar^2}{2\pi^2} \frac{\partial^2}{\partial^2 x}$

D. $\frac{-\hbar^2}{8\pi^2 m} \nabla^2$

76. Which of the following aldoses yields an optically inactive substance on reaction with sodium borohydride? ⁷⁶



1 2 3 4
A. 3 only B. 1 and 4 C. 2 and 3 D. All (1,2,3& 4)

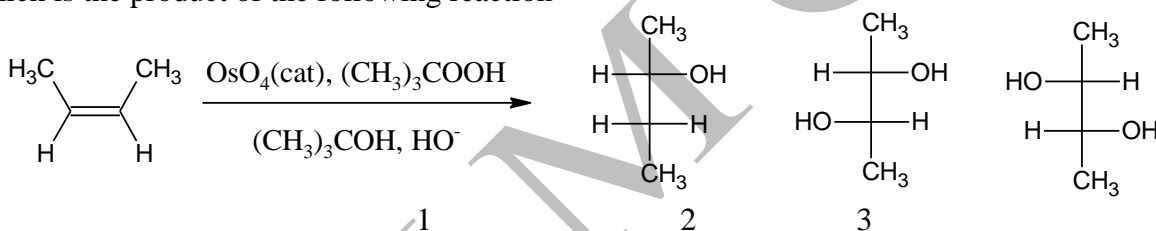
77. Which statement correctly describes the difference in the otherwise similar chemical constituents of DNA & RNA? ⁷⁷

- A. DNA contains Uracil; RNA contains Thymine
B. DNA contains Guanine but not Adenine; RNA contains both
C. DNA contains Thymine; RNA contains Uracil
D. None of these applies- the chemical constitution is the same

78. A Nucleoside is a ⁷⁸

- A. Phosphate ester of a Nucleotide
B. Unit having a sugar bonded to a purine or pyrimidine base
C. Chain whose back bone consists of sugar units connected by phosphate groups
D. Phosphate salt of purine or pyrimidine base

79. Which is the product of the following reaction ⁷⁹



1 2 3
A. Only 1 B. Only 2 C. Only 3 D. 1:1 mixture of 2 & 3

80. Complex $[V(H_2O)_6]^{3+}$ shows two peaks in the UV-visible absorption spectrum which is due to ⁸⁰

- A. d-d transition
B. Transition to cross over point of $T_{1g}(P)$ and A_{2g}
C. Laporte forbidden transition removes the frequency
D. Charge transfer spectra

81. Two protons in a nucleus are held together by sharing the particle ⁸¹

- A. π^0 meson B. π^+ meson C. π^- meson D. π^0 & π^+ simultaneously

82. The activity of 2 moles of a substance changes from 0.05 to 0.50. the change in its free energy at 27°C is ⁸²

- A. 11kJ B. 16kJ C. 24 kJ D. 34 kJ

83. When the initial concentration is changed from 0.50 to 1 moleL^{-1} , the time of half completion for a certain reaction is found to change from 50 sec to 25 sec. the order of the reaction is ⁸³

- A. 0 B. 1 C. 2 D. 2.5

84. Which of the following is not a coolant used in nuclear reactor ⁸⁴

- A. Heavy water B. Sodium C. CO_2 D. Graphite

85. The carborane which belongs to the nido series is ⁸⁵

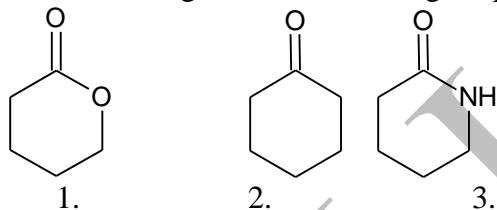
- A. $\text{B}_3\text{C}_2\text{H}_5$ B. $\text{B}_9\text{C}_2\text{H}_{13}$ C. $\text{B}_9\text{C}_2\text{H}_{11}$ D. $\text{B}_{10}\text{C}_2\text{H}_{12}$

86. Ethyl benzoate on treatment with hydroxyl amine followed by hydrolysis yield aniline, the reaction is termed ⁸⁶

- A. Curtius rearrangement C. Schmidt rearrangement
B. Hoffmann rearrangement D. Lossen rearrangement

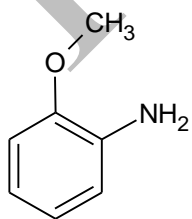
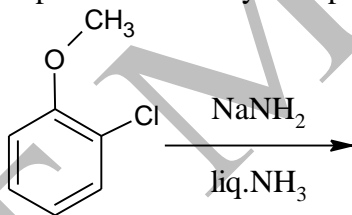
87. The C-C bond length in diamond is 154 pm. The edge length(in pm) of the unit cell is ⁸⁷
 A. 154×4 B. 154×2 C. $154 \times \sqrt{2}$ D. $154 \times 4/\sqrt{3}$
88. Activity coefficients calculated using Debye- Huckel law are always ⁸⁸
 A. less than zero C. equal to one
 B. greater than one D. less than on
89. By how much would the oxidizing power of the $\text{MnO}_4^-/\text{Mn}^{2+}$ couple change if the H^+ concentration is decreased 100 times ⁸⁹
 A. It will decrease by 0.019 V C. It will increase by 0.019 V
 B. It will decrease by 0.189 V D. It will increase by 0.189 V
90. Scalar spin-spin coupling is independent of ⁹⁰
 A. Spin-orbital effects C. Magnetic field strength
 B. Dipolar coupling D. Fermi contact coupling
91. The effect of isotopic substitution on the magnitude of J is proportional to ⁹¹
 A. Nuclear g factor (g_N) C. Spin angular momentum (I)
 B. Magnetogyric ratio (γ) D. Nuclear Magneton β_N
92. The mass spectrum, a compound with 3 bromine atoms will have ⁹²
 A. 4 molecular ions, in the ratio 1:1:1:1
 B. 3 molecular ions, in the ratio 1:1:1
 C. 3 molecular ions, in the ratio 1:2:1
 D. 4 molecular ions, in the ratio 1:3:3:1
93. Hemerythrin contains 2 Fe atoms in ⁹³
 A. Low spin Fe(II) and high spin Fe(II)
 B. 2 Fe(II) atoms are of low spin
 C. 2 Fe(II) atoms are of high spin
 D. Low spin Fe(II) and Fe(III)

94. The increasing order of stretching frequencies of the following ⁹⁴

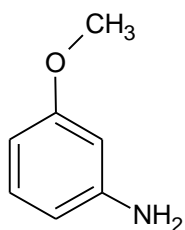


- A. $1 > 2 > 3$ B. $2 > 3 > 1$ C. $3 > 2 > 1$ D. $1 > 3 > 2$

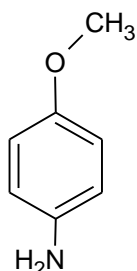
95. Which products would you expect from the following reaction ⁹⁵



A.



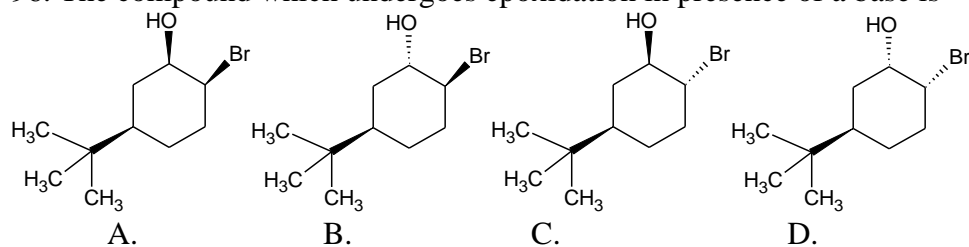
B.



C.

D. Both A & B

96. The compound which undergoes epoxidation in presence of a base is ⁹⁶



97. H_2O comes after Cl^- in the spectrochemical series due to ⁹⁷

- A. Cl^- is a weaker σ donor
 B. Cl^- is a stronger σ donor
 C. Cl^- is a weaker π donor
 D. Cl^- is a stronger π donor

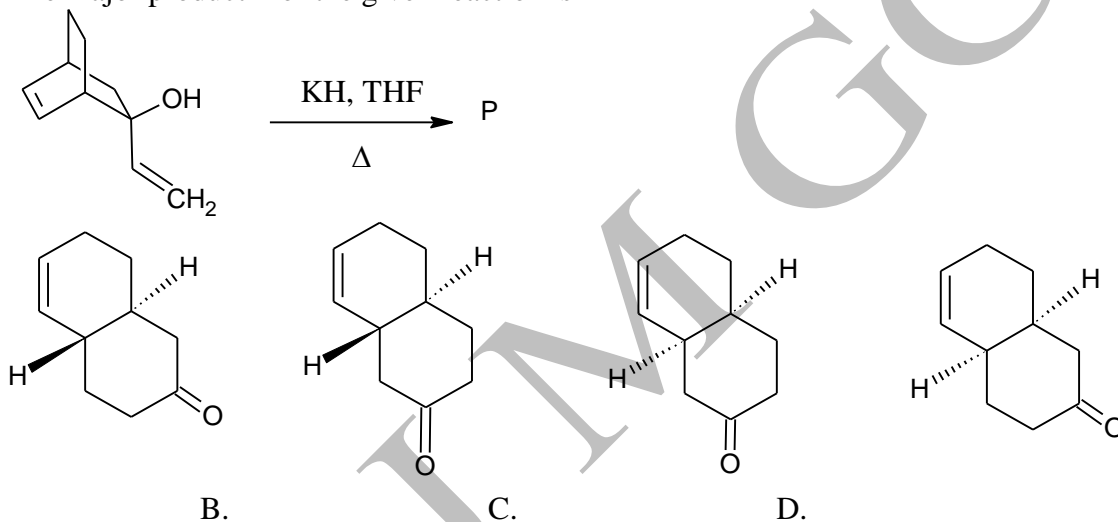
98. The number of lines that would be observed for $1s$ to $2p$ transition in one electron system is ⁹⁸

- A. 0
 B. 1
 C. 2
 D. 3

99. Given that the standard molar enthalpies of $\text{NO}(\text{g})$ and $\text{NO}_2(\text{g})$ are, respectively, 90.3 kJ mol^{-1} and 33.2 kJ mol^{-1} , the enthalpy change for the reaction $2\text{NO}(\text{g}) + \text{O}_2(\text{g}) \rightarrow 2\text{NO}_2(\text{g})$ is ⁹⁹

- A. 16.6 kJ
 B. -57.1 kJ
 C. -114.2 kJ
 D. 57.1 kJ

100. The major product P of the given reaction is ¹⁰⁰



A.

ANSWERS

- 1 D
- 2 B
- 3 C
- 4 B
- 5 B
- 6 C
- 7 B
- 8 D
- 9 C pg atomic structure 3.122
- 10 A
- 11 D
- 12 B Huheey pg 240
- 13 D pg Chemical equilibrium 7.33 FP1
- 14 B
- 15 A
- 16 C Pahari Vol I
- 17 A
- 18 A
- 19 C
- 20 B pg 231 AC1
- 21 C
- 22 A
- 23 B
- 24 C
- 25 B
- 26 C
- 27 B
- 28 C
- 29 A
- 30 B
- 31 D
- 32 A
- 33 D
- 34 A
- 35 C
- 36 A
- 37 B
- 38 C
- 39 B
- 40 D
- 41 D
- 42 D
- 43 B
- 44 B
- 45 C
- 46 A
- 47 B
- 48 D
- 49 B
- 50 D
- 51 C
- 52 C
- 53 C
- 54 C
- 55 C
- 56 B
- 57 B
- 58 B

- 59 D
60 B
61 C
62 C
63 B
64 C
65 D - OC 19 (17 B 14)
66 B
67 D
68 A
69 A
70 C (OC 19(21 B 4)
71 D[OC 19(11 B 8)
72 B [OC 19 (25 B 5)
73 A [OC 19 (25 B 4)
74 C [OC19 (25 B 10)
75 D
76 C (OC 19 (25 B 6)
77 C (OC 19 (27 B 2)
78 B (OC 19 (27 B 6)
79 A(OC 19 (15 B 10)
80 B
81 A
82 A
83 C
84 D
85 B
86 D
87 B
88 B
89 B
90 C Physical methods for chemists (Drago) pg 249
91 B Physical methods for chemists (Drago) pg 256
92 D
93 D
94 A
95 B Study guide & solution manual organic chemistry Solomons pg 472
96 B
97 D
98 C
99 C
100 D