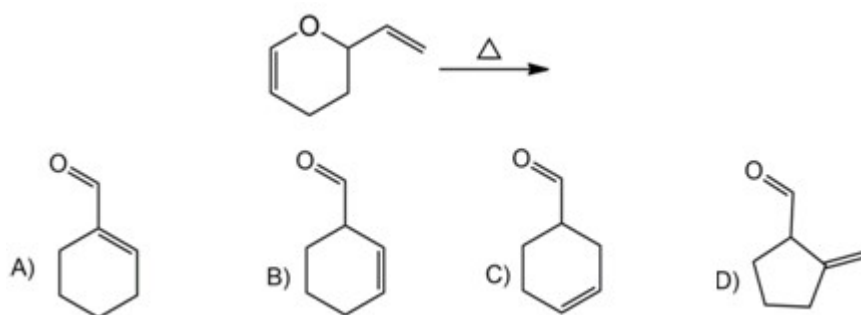
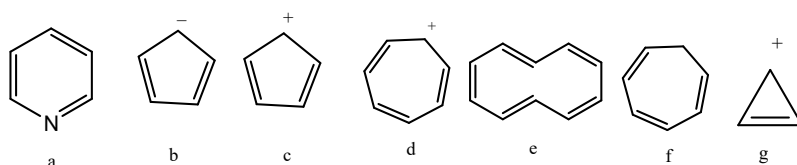


- Identify the correct order of bond dissociation enthalpy of halogens:  
 A)  $F_2 > Cl_2 > Br_2 > I_2$       B)  $Cl_2 > Br_2 > F_2 > I_2$   
 C)  $I_2 > Br_2 > Cl_2 > F_2$       D)  $Br_2 > I_2 > F_2 > Cl_2$
- Which element has atomic number 100?  
 A) Californium    B) Einsteinium    C) Fermium    D) Mendelenium
- Shapes of  $XeF_2$ ,  $XeF_4$ ,  $XeF_6$  and  $XeOF_4$  are respectively:  
 A) Linear, tetrahedral, octahedral and trigonal pyramidal  
 B) Linear, tetrahedral, octahedral and square pyramidal  
 C) Bent, t-shape, distorted octahedral and square pyramidal  
 D) Linear, square planar, distorted octahedral and square pyramidal
- Identify the major product of the reaction:

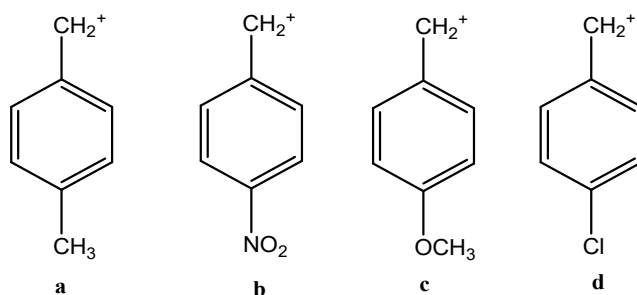


- What is the structure of  $B_5H_9$ ?  
 A) Arachno    B) Nido    C) Closo    D) hypho
- The most stable oxidation states for Th and U are:  
 A) +4 for Th and +6 for U    B) +6 for Th and +4 for U  
 C) +6 for both Th and U    D) +4 for both Th and U
- The oxidation number of Na and O in  $Na_2O_2$  is:  
 A) +1 for sodium and -1 for oxygen  
 B) -1 for sodium and +1 for oxygen  
 C) +1 for sodium and -2 for oxygen  
 D) +1 for sodium and +1 for oxygen
- The CFSE ( $\Delta$ ) for  $[CoCl_6]^{4-}$  is  $18000\text{ cm}^{-1}$ . Then CFSE ( $\Delta$ ) for  $[CoCl_4]^{2-}$  is:  
 A)  $2000\text{ cm}^{-1}$     B)  $18000\text{ cm}^{-1}$     C)  $8000\text{ cm}^{-1}$     D)  $9000\text{ cm}^{-1}$
- The number of unpaired electrons in  $[Fe(H_2O)_6]^{3+}$ :  
 A) 3    B) 4    C) 5    D) 6

10. Identify the statement which is correct about the species  $\text{CN}^-$ ,  $\text{Cl}^-$ , and  $\text{CO}$ :
- A) Both cyanide ion and  $\text{CO}$  are weak field ligands and the chloride is a strong field ligand
- B) Both cyanide ion and chloride are weak field ligands and  $\text{CO}$  is a strong field ligand
- C) All are strong field ligands
- D) Both cyanide ion and  $\text{CO}$  are strong field ligands and chlorine is a weak field ligand
11. The coordination compound  $[\text{Ni}(\text{PPh}_2\text{Et})_2\text{Br}_2]$  has zero magnetic moment. The geometry and the number of possible isomers are:
- A) Tetrahedral and zero      B) Square planar and zero
- C) Square planar and two      D) Tetrahedral and two
12. Which of the following is **not** a chelating ligand?
- A) Glycinato      B) Ethylene diamine
- C) Oxalato      D) Thiosulphato
13. Which of the following compound/s are aromatic?

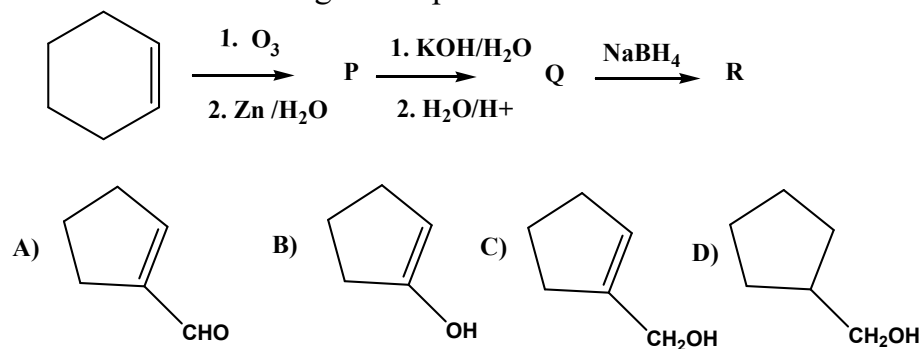


- A) a, b, c, d, e & f only      B) a, b, d & g only
- C) c, e, f & g only      D) a, b, c, d, e, f & g
14. Arrange the following in increasing order of stability of carbocation:

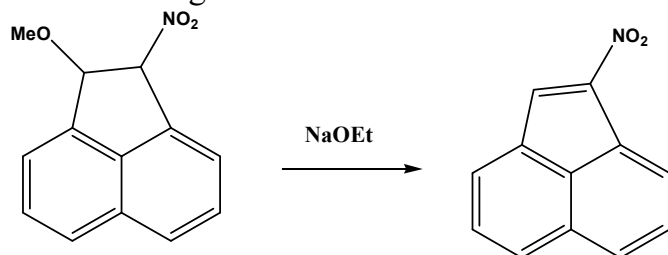


- A)  $b < d < a < c$       B)  $b < d < c < a$
- C)  $a < c < d < b$       D)  $c < a < b < d$
15. How many isomers are possible for the molecular formula  $\text{C}_4\text{H}_8$ ?
- A) 2      B) 3      C) 4      D) 5

16. Which of the following is compound **R**?

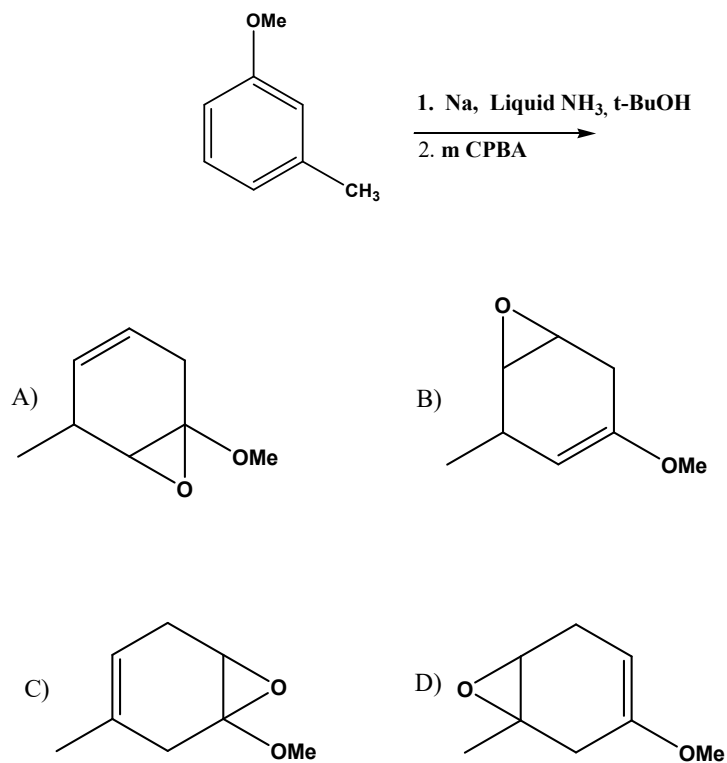


17. The reaction given below follows the mechanism:



- A)  $E_1$  mechanism                      B)  $E_2$  mechanism  
 C)  $E_1CB$  mechanism                  D) Pyrolytic syn

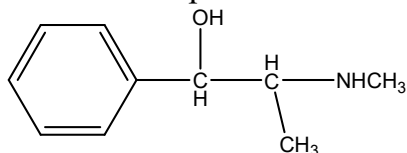
18. The major product formed in the following reaction:



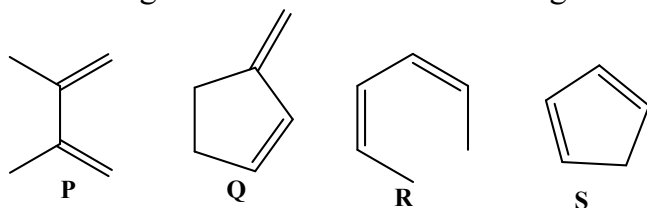
19. The configurations of two stereo centres in the compound shown below are:



- A) 1R, 4R      B) 1S, 4S      C) 1R, 4S      D) 1S, 4R
20. In the most stable conformation of Trans-3-ter-butyl cyclohexanol, the substituents at C-1 and C-3 respectively are:
- A) Axial, equatorial      B) Equatorial, axial  
C) Axial, axial      D) Equatorial, equatorial
21. Structure of the drug ephedrine is given below. How many optical isomers are possible for the compound?

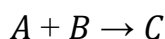


- A) 2      B) 3      C) 4      D) 6
22. List the following dienes in order of decreasing reactivity in a Diels–Alder reaction:



- A)  $P > S > R > Q$       B)  $S > P > R > Q$   
C)  $P > S > Q > R$       D)  $P > S > R > Q$
23. A chemist determines that a sample of petrified wood has a carbon-14 decay rate of 3.4 counts per minute per gram. What is the age of the piece of wood in years? The decay rate of carbon-14 in fresh wood today is 13.6 counts per minute per gram, and the half life of carbon-14 is 5730 years.
- A) 5730 years      B) 2865 years  
C) 11460 years      D) 8595 years
24. What is the concentration of the reactant in a first-order reaction when the rate of the reaction is  $0.6 \text{ mol L}^{-1}\text{S}^{-1}$  and the rate constant is  $0.030 \text{ S}^{-1}$ ?
- A)  $20 \text{ mol L}^{-1}$       B)  $2 \text{ mol L}^{-1}$       C)  $0.05 \text{ mol L}^{-1}$       D)  $0.52 \text{ mol L}^{-1}$

25. The data provided in the table were obtained from the following reaction, carried out at 273 K.



Initial concentration of [A] $\text{mol L}^{-1}$	Initial concentration of [B] $\text{mol L}^{-1}$	Initial rate of formation of [C] $\text{mol L}^{-1} \text{S}^{-1}$
0.2	0.2	0.3
0.4	0.2	0.6
0.4	0.4	2.4

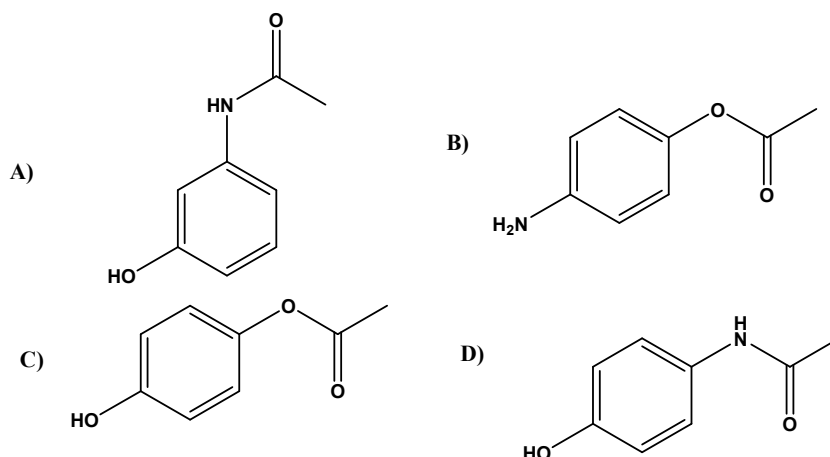
The rate equation for the reaction is:

- A)  $\text{Rate} = K[A]^2[B]$       B)  $\text{Rate} = K[A][B]^2$   
 C)  $\text{Rate} = K[A][B]$       D)  $\text{Rate} = K[A]^2$
26. In a face-centered cubic (FCC) lattice, what is the coordination number of each atom?  
 A) 4      B) 6      C) 8      D) 12
27. Which of the following affects the peak positions in an XRD pattern?  
 A) X-ray wave length      B) Crystallite size  
 C) Unit cell parameter      D) All of these
28. Which of the following statements about fuel cells is correct?  
 A) They convert chemical energy directly into electrical energy.  
 B) They require high temperatures to operate efficiently.  
 C) They produce carbon dioxide as byproduct.  
 D) They are primarily used for short energy storage.
29. The overpotential in an electrochemical reaction is defined as:  
 A) The potential difference between the anode and cathode  
 B) The extra voltage required to drive a non-spontaneous reaction  
 C) The voltage drop due to resistance in the electrolyte  
 D) The equilibrium potential of the cell
30. Which adsorption isotherm is characterized by a monolayer adsorption on a homogeneous surface?  
 A) Freundlich isotherm      B) Langmuir isotherm  
 C) BET isotherm      D) Temkin isotherm
31. The technique used to analyse the chemical composition of a surface:  
 A) Scanning Electron Microscopy (SEM)  
 B) X-ray Photoelectron Spectroscopy (XPS)  
 C) Scanning Tunnelling Microscopy (STM)  
 D) Atomic Force Microscopy (AFM)
32. Which one of the following nuclei has a magnetic moment (so that an NMR experiment can be performed)?  
 A)  $^{12}\text{C}$       B)  $^{16}\text{O}$       C)  $^{14}\text{N}$       D)  $^{32}\text{S}$

33. The Langmuir-Hinshelwood mechanism involves:  
 A) Adsorption of reactants on the catalyst surface  
 B) Formation of an intermediate complex  
 C) Desorption of products from the catalyst surface  
 D) All of the above
34. For the following four molecules: acetone, benzene, dimethyl ether, ethane (each of which contains only one type of proton), the correct order of chemical shift (in  $\delta$  units) is:  
 A) Benzene < ethane < acetone < diethyl ether  
 B) Benzene < acetone < dimethylether < ethane  
 C) Benzene > ethane > acetone > dimethyl ether  
 D) Benzene > dimethyl ether > acetone > ethane
35. In a  $^{31}\text{P}$  NMR experiment on an unknown compound, a single resonance with a septet pattern is observed. Which of the following structures would be consistent with this observation?  
 A)  $\text{PF}_3$                       B)  $\text{PH}_3$                       C)  $\text{PF}_6^-$                       D)  $\text{PMe}_3$
36. In the MO diagram of  $\text{N}_2$ , the highest occupied molecular orbital (HOMO) is:  
 A)  $\sigma_{2s}$                       B)  $\sigma_{2p_z}$                       C)  $\pi_{2p_x}$                       D)  $\pi^*_{2p_y}$
37. Identify the correct order of increasing wave number of the stretching vibrations of (1) C-H (alkane), (2) O-H (alcohol), (3) C=O (ketone), and (4) C $\equiv$ C (alkyne):  
 A)  $4 < 3 < 2 < 1$                       B)  $3 < 4 < 2 < 1$   
 C)  $3 < 4 < 1 < 2$                       D)  $4 < 3 < 1 < 2$
38. How many signals does the aldehyde  $(\text{CH}_3)_3\text{CCH}_2\text{CHO}$  have in  $^1\text{H}$  NMR and  $^{13}\text{C}$  NMR spectra?  
 A) Five  $^1\text{H}$  signals and six  $^{13}\text{C}$  signals  
 B) Three  $^1\text{H}$  signals and four  $^{13}\text{C}$  signals  
 C) Five  $^1\text{H}$  signals and four  $^{13}\text{C}$  signals  
 D) Three  $^1\text{H}$  signals and six  $^{13}\text{C}$  signals
39. Which of the following is equivalent to 1 ppm?  
 A)  $1\ \mu\text{g/L}$                       B)  $1\text{mg/L}$                       C)  $1\text{ng/L}$                       D)  $1\text{g/L}$
40. Which of the following is used as Carrier gas in gas chromatography?  
 A) Helium                      B) Nitrogen                      C) Argon                      D) All of these
41. The mobile phase solvent blend used to perform the liquid chromatography maintains the same ratio of non-polar and polar solvents throughout the chromatography is called ----- elution.  
 A) Gradient                      B) Isocratic                      C) Iso osmotic                      D) Adiabatic

42. What is the first mass loss observed in the thermogram of calcium oxalate monohydrate attributed to?
- A) Formation of  $\text{CaCO}_3$       B) Release of water  
C) Release of  $\text{CO}$       D) Release of  $\text{CO}_2$
43. At approximately what temperature range (heating rate  $10\text{K}/\text{min}$ ) does the first mass loss occur in the thermogram of calcium oxalate monohydrate?
- A)  $150\text{-}200^\circ\text{C}$     B)  $250\text{-}400^\circ\text{C}$     C)  $400\text{-}600^\circ\text{C}$     D)  $600\text{-}800^\circ\text{C}$
44. The second mass loss in the thermogram of calcium oxalate monohydrate is due to the release of which gas?
- A) Oxygen ( $\text{O}_2$ )      B) Carbon monoxide ( $\text{CO}$ )  
C) Nitrogen ( $\text{N}_2$ )      D) Hydrogen ( $\text{H}_2$ )
45. A derivative thermogram (DTG) is a plot of ----- as a function of temperature.
- A)  $(\Delta m / \Delta T)$     B)  $\Delta m$       C)  $\Delta T$       D)  $\Delta H$
46. Chemical Oxygen Demand (COD) measures the amount of:
- A) Oxygen required to oxidize organic and inorganic matter in water.  
B) Oxygen required by aquatic organisms  
C) Dissolved oxygen in water  
D) Oxygen produced by photosynthesis
47. Drugs that bind to receptors and block the effects of the natural ligand are called:
- A) Antagonist      B) Agonist  
C) Inverse agonist      D) Partial agonist
48. A drug with low  $\text{IC}_{50}$  value is:
- A) Less toxic    B) Less potent    C) More toxic    D) More potent
49. The therapeutic index of a drug is calculated as:
- A)  $\text{LD}_{50}\text{-EC}_{50}$     B)  $\text{LD}_{50}/\text{EC}_{50}$     C)  $\text{EC}_{50}\text{-LD}_{50}$     D)  $\text{EC}_{50}/\text{LD}_{50}$
50. What is the molecular basis of action of Pt(II) chemotherapy agents?
- A) A stable complex is formed between the DNA and Pt(II); the DNA is oxidized by the Pt(II) complex.  
B) A stable complex is formed between the DNA and Pt(II); the DNA is reduced by the Pt(II) complex.  
C) Pt(II) compounds have no chemotherapy action  
D) A stable complex is formed between the DNA and Pt(II); the DNA helix bends and unwinds partially
51. What is atom economy for combustion of methane if the desired product is carbon dioxide?
- A) 100%      B) 22.5%      C) 80%      D) 55%

52. Which of the following is paracetamol?



53. A “hit” in drug discovery is defined as a compound that has been :

- A) Identified as having a desired biological activity, but it may require further optimization or modification
- B) Optimized for potency and selectivity
- C) Approved for clinical trials
- D) Marketed as a drug

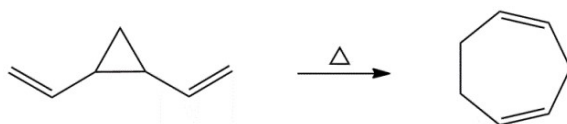
54. The chemicals which belong to the category of persistent organic pollutants (POPs):

- A) Teflon
- B) TNT
- C) Aldrin
- D) Paracetamol

55. The soil-related process which contribute to removal of carbon dioxide from the atmosphere:

- A) Microbial oxidation of soil organic matter
- B) Respiration by plants growing in a field
- C) A forest fire
- D) Rapid growth in a temperate rain forest

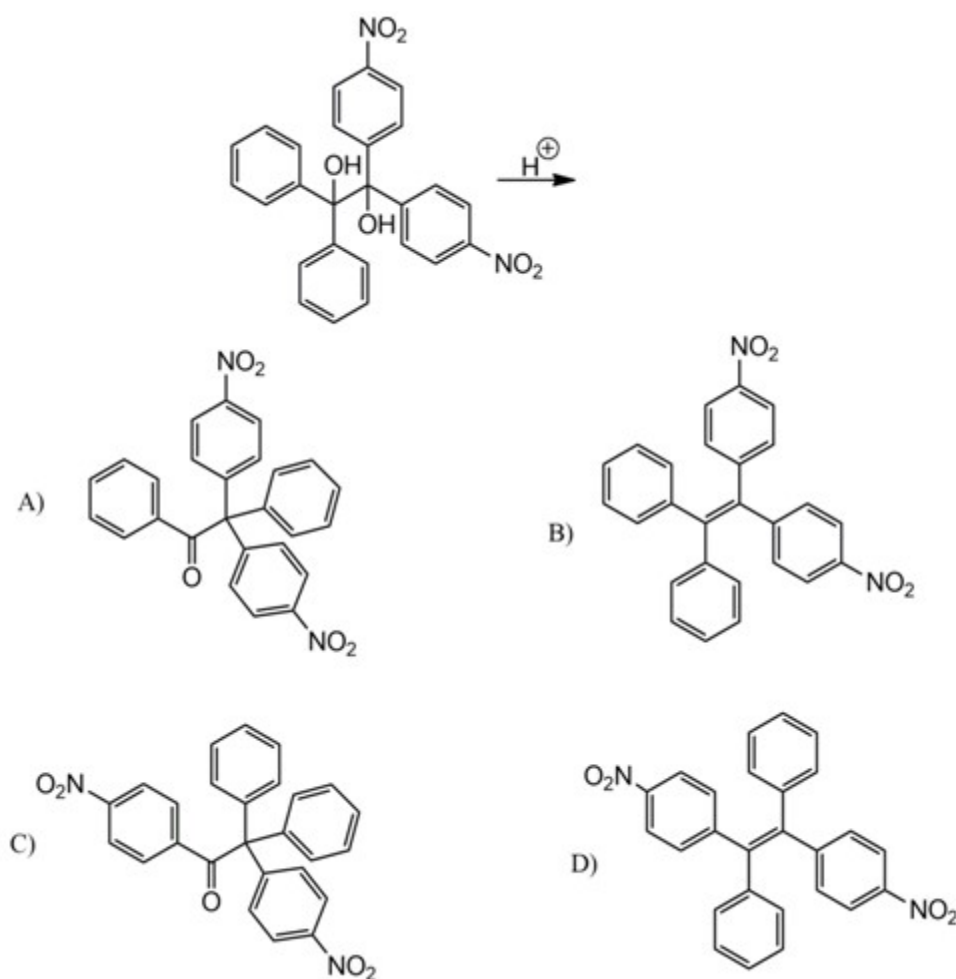
56. The following reaction is an example for:



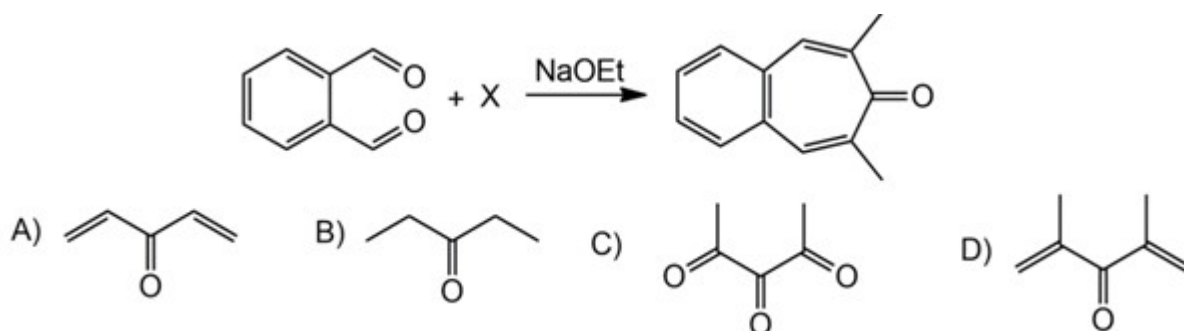
- A) [3,3] Sigmatropic rearrangement
- B) Diels-Alder reaction
- C) [2,4] Sigmatropic rearrangement
- D) 2+2 cycloaddition reaction



57. Identify the major product of the following reaction:



58. Identify X in the reaction given below:



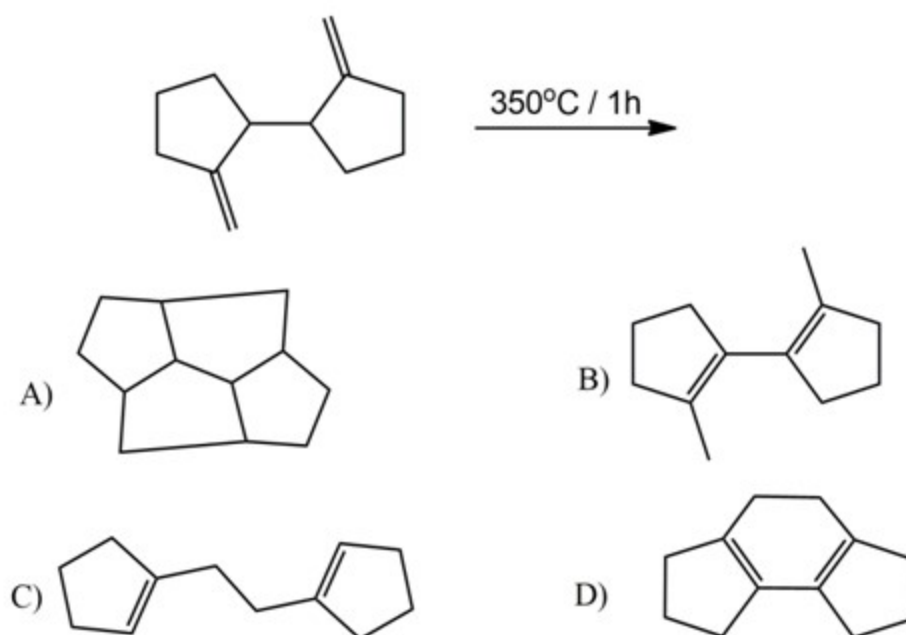
59. The reagent used for converting prop-1-ene to prop-2-en-1-ol is:

- A)  $OsO_4$       B)  $KMnO_4$       C)  $SeO_2$       D) MCPBA

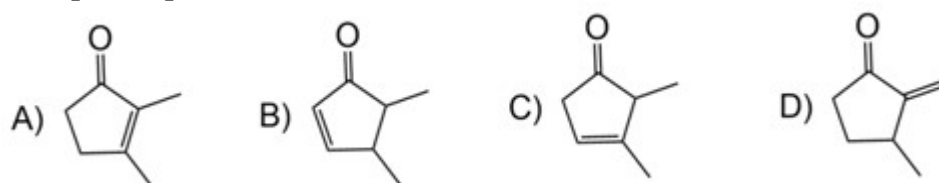
60. Identify the correct order in terms of energy for cyclohexane conformations:

- A) Chair < Twist boat < Boat < Half chair  
 B) Chair < Boat < Twist boat < Half chair  
 C) Half chair < Boat < Twist boat < Chair  
 D) Half chair < Twist boat < Boat < Chair

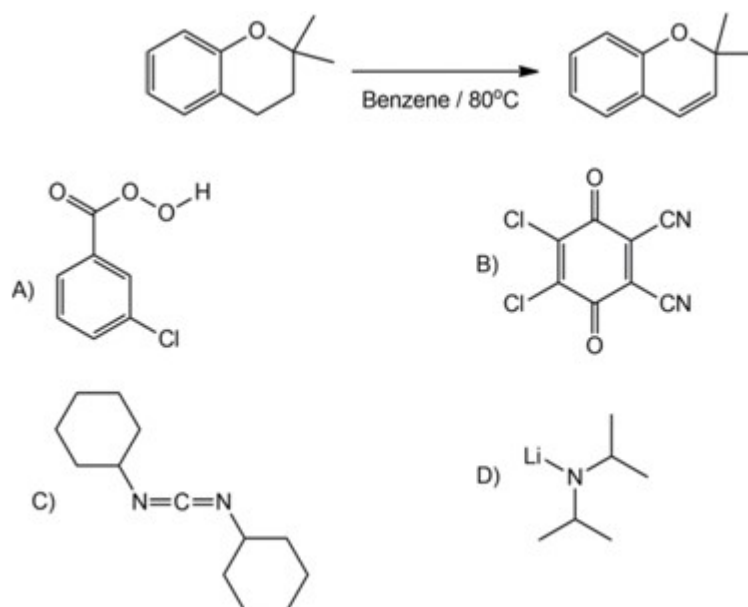
61. Identify the product of the following thermal reaction:



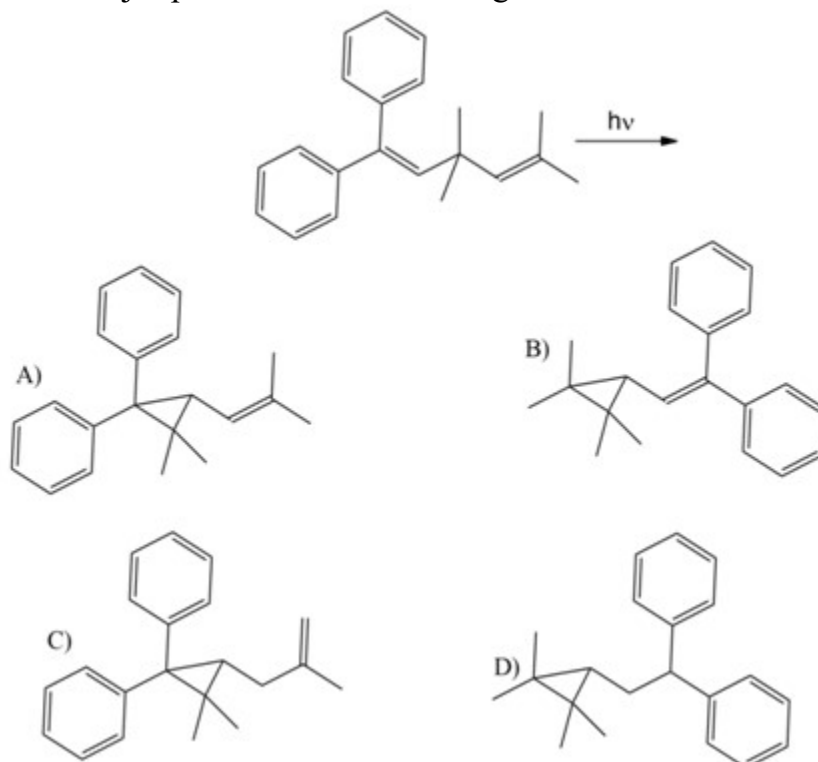
62. One among the following ketones in ethanol had  $\lambda_{\text{max}} = 224 \text{ nm}$  in its UV-Visible absorption spectrum, which was it?



63. Find the reagent used for the following conversion:



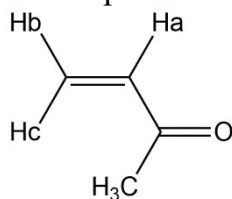
64. Find the major product of the following reaction:



65. Identify the statement which is TRUE for  $\text{Br}_2$ :

- A) IR active, microwave inactive  
 B) Microwave active, IR inactive  
 C) Neither IR nor microwave active  
 D) Both IR and microwave active

66. Predict the  $\delta$  values for the alkene protons:



- A) Ha(5.8), Hb(6.0), Hc(6.0)    B) Ha(6.0), Hb(5.8), Hc(5.8)  
 C) Ha(5.8), Hb(6.0), Hc(6.2)    D) Ha(5.8), Hb(6.2), Hc(6.0)

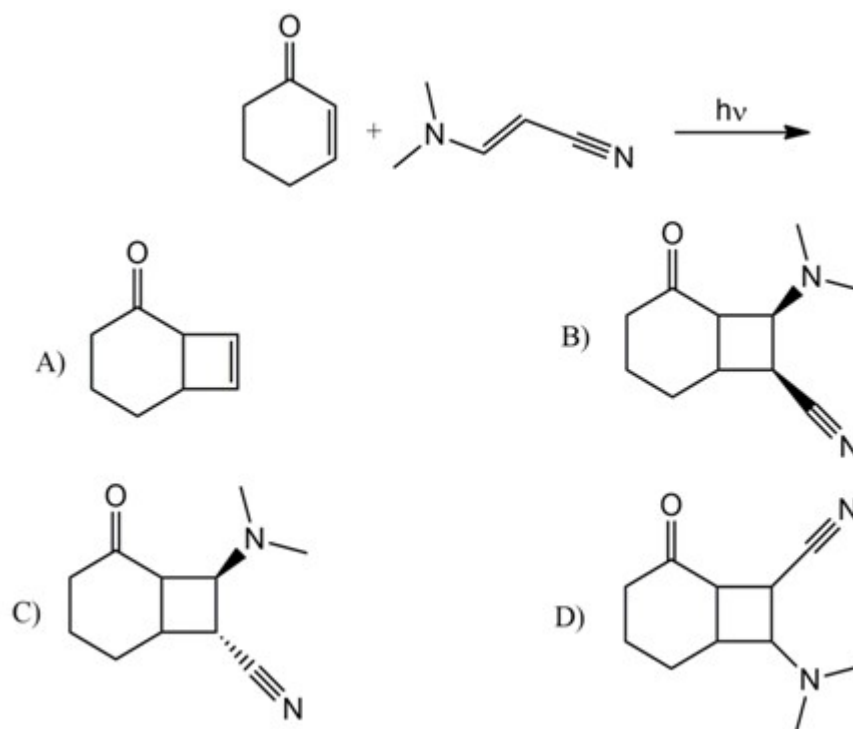
67. Calculate the  $m/z$  value for the parent ion whose normal daughter ion ( $m_2$ ) = 100 and metastable daughter ion ( $m^*$ ) = 90

- A) 117                      B) 105                      C) 111                      D) 81

68. The transmittance of  $10^{-3}$  molar aqueous solution of  $\text{KMnO}_4$  at 525 nm is 0.01 in a 1 cm cell. What is the molar absorption coefficient of  $\text{KMnO}_4$ ?

- A)  $2 \times 10^3 \text{ l mol}^{-1} \text{ m}^{-1}$     B)  $2 \times 10^5 \text{ l mol}^{-1} \text{ m}^{-1}$   
 C)  $1 \times 10^3 \text{ l mol}^{-1} \text{ m}^{-1}$     D)  $1 \times 10^5 \text{ l mol}^{-1} \text{ m}^{-1}$

69. Identify the product of the following reaction:



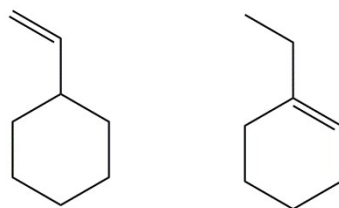
70. How many normal modes of vibrations are possible for OCS?

- A) 1                      B) 2                      C) 3                      D) 4

71. ---- technique can be used to measure the vibrational frequency of Re—Re stretch in  $(\text{CO})_5\text{Re—Re}(\text{CO})_5$ .

- A) Raman spectroscopy                      B) IR spectroscopy  
C) Mossbauer spectroscopy                      D) Microwave spectroscopy

72. The following isomers can be differentiated by looking at ---- in their mass spectra.



- A) Prominent peak at  $M - \text{C}_2\text{H}_5$   
B) Isotopic peak  
C) Metastable peak  
D) Peak due to Retro-Diels-Alder products

73.  $\text{C}_2\text{B}_4\text{H}_8$  is an example for ---- carborane.

- A) closo                      B) nido                      C) arachno                      D) conjuncto

74. Number of B—B—B bonds present in a borane having styx code 4012 is:

- A) 0                      B) 1                      C) 2                      D) 4

75. Find the product of the reaction between  $S_4N_4$  and  $Cl_2$ :  
 A)  $N_4S_4Cl_4$       B)  $S_4N_4 \cdot Cl_2$       C)  $S_4(NH)_4$       D)  $N_3S_3Cl_3$
76.  $[W_{12}O_{36}(OH)_{10}]^{10-}$  on acidification gives :  
 A)  $[H_2W_{12}O_{40}]^{6-}$       B)  $[H_3W_6O_{21}]^{3-}$   
 C)  $WO_3 \cdot 2H_2O$       D)  $[W_{12}O_{41}]^{10-}$
77. Which among the following statements regarding  $Na^+/K^+$  pump is **not** true?  
 A)  $Na/K$  pump is an example for active transport  
 B) It transport  $Na^+$  from inside of the cell to outside and  $K^+$  from outside of the cell to inside  
 C) The carrier protein involved in  $Na^+/K^+$  pump has 5 receptor sites  
 D)  $Na^+/K^+$  pump present in all parts of the body
78. During Nitrogen fixation,  $N_2$  molecule is bonded to ----in the catalytic center.  
 A) Cu      B) Mo      C) Fe      D) Zn
79. Number of  $S^{2-}$  units present in Rubredoxin and Ferredoxin are —,—.  
 A) 0,2      B) 2,2      C) 2,0      D) 0,1
80. The magnetic moment obtained for a high spin octahedral complex of  $Fe^{3+}$  is —BM.  
 A) 0      B) 5.92      C) 1.73      D) 4.89
81. Number of bridging CO group(s) present in  $Mn_2(CO)_{10}$ ,  $Fe_2(CO)_9$  and  $Fe_3(CO)_{12}$  are —, — and —.  
 A) 0, 2, 3      B) 1, 2, 3      C) 0, 3, 2      D) 1, 3, 2
82. Identify the correct expression for most probable velocity:  
 A)  $\left(\frac{2kT}{m}\right)^{1/2}$       B)  $\left(\frac{8k}{\pi m}\right)^{1/2}$       C)  $\left(\frac{3kT}{m}\right)^{1/2}$       D)  $\left(\frac{3RT}{m}\right)^{1/2}$
83. Which of the following expression does **not** express mean free path ( $l$ )?  
 A)  $l = \left(\frac{2\eta}{\frac{Mmp}{RT} \left(\frac{3RT}{M}\right)^{1/2}}\right)$       B)  $l = \left(\frac{2\eta}{\rho \bar{c}}\right)$   
 C)  $l = \left(\frac{2\eta}{\frac{Mmp}{RT} \left(\frac{8RT}{\pi M}\right)^{1/2}}\right)$       D)  $l = \left(\frac{2\eta}{mn\bar{c}}\right)$

84. Find the relation between coefficient of viscosity ( $k$ ) and specific heat capacity ( $C_v$ ):

- A)  $k = \frac{1}{3\pi\sigma^2} \left( \frac{mkT}{\pi m} \right)^{\frac{1}{2}} C_v$       B)  $k = \frac{1}{2\pi\sigma^2} \left( \frac{mkT}{\pi m} \right)^{\frac{1}{2}} C_v$   
 C)  $k = \frac{3}{2\pi\sigma^2} \left( \frac{mkT}{\pi m} \right)^{\frac{1}{2}} C_v$       D)  $k = \frac{2}{3\pi\sigma^2} \left( \frac{mkT}{\pi m} \right)^{\frac{1}{2}} C_v$

85. Schottky defect is an example for:

- A) Line defect    B) Point defect    C) Plane defect    D) None of these

86. Which one of the following suggestions of swarm theory is **not** TRUE?

- A) The ordered structure of liquid crystals does not extend over long distances  
 B) The structure exists in small agglomerates of a few molecules known as swarms, randomly arranged in space  
 C) The interactions between swarms are stronger than the interactions between molecules in each swarm.  
 D) Liquid crystals are a polycrystalline structure, with each swarm acting as an independent micro-crystal

87. It has been found that  $\text{CH}_3\text{—CHO}$  decomposes obeying 3.5 order kinetics, if its

initiation step is  $\text{CH}_3\text{—CHO} \xrightarrow{k_1} \dot{\text{C}}\text{H}_3 + \dot{\text{C}}\text{HO}$ , its chain length can be expressed as:

- A)  $k_2 \left( \frac{1}{k_1 k_4} \right) [\text{CH}_3 - \text{CHO}]^{\frac{1}{2}}$     B)  $k_2 \left( \frac{1}{k_1 k_4} \right) [\text{CH}_3 - \text{CHO}]^{\frac{3}{2}}$   
 C)  $k_2 \left( \frac{1}{k_1 k_4} \right) [\text{CH}_3 - \text{CHO}]$     D)  $k_2 \left( \frac{1}{k_1 k_4} \right) [\text{CH}_3 - \text{CHO}]^2$

88. Shock tube method and flash photolysis are examples for:

- A) Periodic perturbation method  
 B) Small perturbation method  
 C) Large perturbation method  
 D) None of the above

89. Isomerization of alkylammoniumcyanate to the corresponding substituted urea in aqueous solution is an example for ---- equilibrium reaction.

- A) 1<sup>st</sup> order opposed by 1<sup>st</sup> order  
 B) 2<sup>nd</sup> order opposed by 1<sup>st</sup> order  
 C) 1<sup>st</sup> order opposed by 2<sup>nd</sup> order  
 D) 2<sup>nd</sup> order opposed by 2<sup>nd</sup> order

90. According to Lindeman's mechanism of unimolecular reactions, the rate of unimolecular reaction  $A \rightarrow \text{Product}$ , can be expressed as:

$$-\frac{d[A]}{dt} = \frac{k_1 k_2 [A]^2}{\{k_{-1}[A] + k_2\}}$$

where,  $[A]$  is the concentration of A,  $k_1, k_{-1}$  and  $k_2$  represents the rate constants for activation, deactivation and decomposition steps respectively. Which of the following statements is TRUE?

- A) At high pressure, the chances of collisions between  $A^*$  and A are less, and hence  $-\frac{d[A]}{dt} = \frac{k_1 k_2 [A]}{k_{-1}}$
- B) At high pressure, the chances of collisions between  $A^*$  and A are greater, and hence  $-\frac{d[A]}{dt} = \frac{k_1 k_2 [A]}{k_{-1}}$
- C) At high pressure, the chances of collisions between  $A^*$  and A are less, and hence  $-\frac{d[A]}{dt} = \frac{k_1 k_2 [A]^2}{k_{-1}}$
- D) At high pressure, the chances of collisions between  $A^*$  and A are greater, and hence  $-\frac{d[A]}{dt} = \frac{k_1 k_2 [A]^2}{k_{-1}}$
91. Identify the expression which does **not** represent Sackur-Tetrode equation for translational entropy of a monoatomic gas:

- A)  $S_t = \frac{5}{2} R + R \ln \left( \frac{M^{3/2} T^{5/2}}{P} \right) + R \ln \left( \frac{2\pi}{N} \right)^{3/2} \left( \frac{k_B}{h^3} \right)^{5/2}$
- B)  $S_t = R \ln \left( \frac{M^{3/2} T^{5/2}}{P} \right) + R \ln \left( \frac{2\pi}{N} \right)^{3/2} \left( \frac{k_B}{h^3} \right)^{5/2}$
- C)  $S_t = R \ln \left( \frac{M^{3/2} T^{5/2}}{P} \right) + 25.166$
- D)  $S_t = R \ln \left( \frac{M^{3/2} T^{5/2}}{P} \right) - 2.316$

92. Identify the **wrong** statement:

- A) Maxwell-Boltzmann statistics apply to distinguishable particles, while Bose-Einstein and Fermi-Dirac statistics apply to indistinguishable particles
- B) Fermi-Dirac statistics apply to particles that obey the Pauli exclusion principle
- C) Bose-Einstein statistics apply to particles that can occupy the same quantum state, while Fermi-Dirac statistics apply to particles that cannot.
- D) At low temperatures and high chemical potentials, Bose-Einstein and Fermi-Dirac statistics approach Maxwell-Boltzmann statistics.

93. The zeta potential of a particle can be calculated using  
 A) Electrophoresis                      B) Sedimentation potential  
 C) Electro-osmosis                      D) All the above

94. Michaelis –Menton equation for enzyme catalysis is as follows:

$$V = \left( \frac{V_{max}[S]}{[S] + K} \right)$$

Where; [S] is substrate concentration, K is the rate constant

What happens when

(p) concentration of substrate is low

(q) concentration of substrate is high

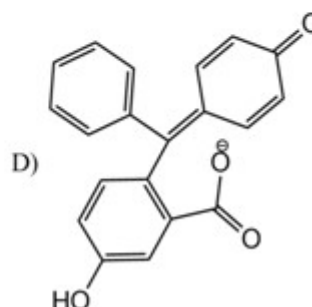
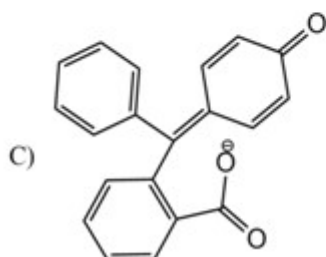
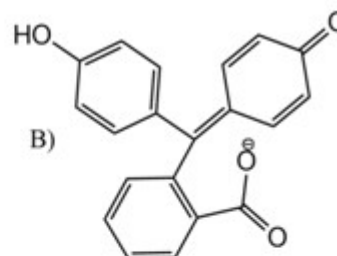
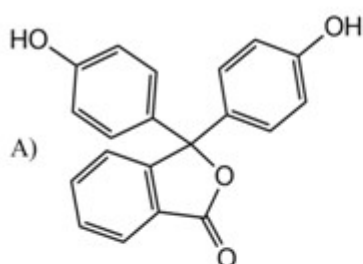
(r)  $K = [S]$

- A) (p) order =  $\infty$ , (q) order = 0, (r)  $V = \frac{1}{2} V_{max}$   
 B) (p) order = 2, (q) order = 1, (r)  $V = V_{max}$   
 C) (p) order = 1, (q) order = 0, (r)  $V = \frac{1}{2} V_{max}$   
 D) (p) order = 1, (q) order = 2, (r)  $V = \frac{1}{2} V_{max}$

95. -----calculates the ratio of the distance between an outlier and its nearest neighbour to the range of values.

- A) Q-Test                      B) T-Test                      C) F-test                      D) All of these

96. Which form of Phenolphthalein is pink in colour?

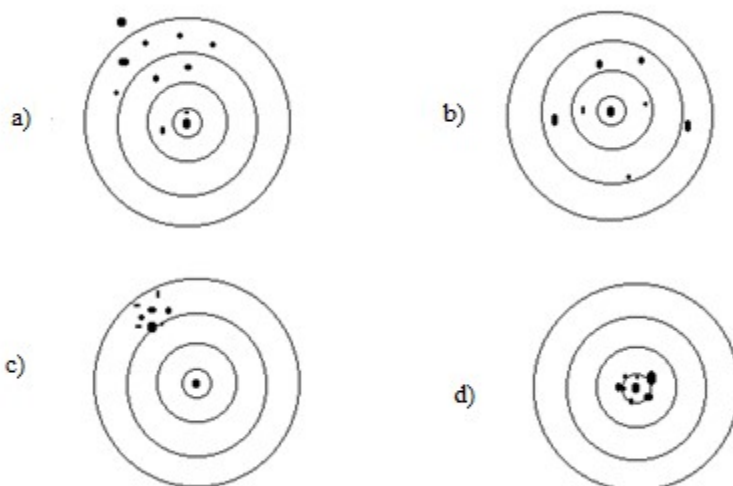


97. The method used to separate broader range of compounds using a series of solvents with increasing polarity is known as:

- A) Successive extraction                      B) Ion exchange chromatography  
 C) Solvent extraction                      D) Gas chromatography



98. Match the following List I (Figures) with List II:



List I (Figures)

List II

- |   |   |                                   |
|---|---|-----------------------------------|
| a | - | 1. High accuracy, high precession |
| b | - | 2. Low accuracy, high precession  |
| c | - | 3. High accuracy, low precession  |
| d | - | 4. Low accuracy, low precession   |

A) a-4, b-2, c-3, d-1

B) a-3, b-2, c-4, d-1

C) a-2, b-4, c-3, d-1

D) a-4, b-3, c-2, d-1

99. Gel permission chromatography is a kind of:

A) HPLC

B) Size exclusion chromatography

C) Gas chromatography

D) Liquid-liquid chromatography

100. ----- detector is commonly used in the chromatographic analysis of sugars.

A) Flame ionization

B) Fluorescence

C) Refractive index

D) Photoionization

101. ----- is a voltammetric technique in which chemical species (ions or molecules) undergo oxidation or reduction at the surface of a dropping mercury electrode at an applied potential.

A) Polarography

B) Coulometry

C) Amperometry

D) Cyclic Voltammetry

102. One of the factors which alter the difference between the sample temperature and furnace temperature and thus will affect the TG curve is:

A) Heating rate

B) Furnace atmosphere

C) Heat of reaction

D) Crucible geometry

103. Neutron activation analysis (NAA) is a technique that measures the---- emitted from a sample after it has been irradiated with neutrons.

A)  $\alpha$ -particles

B)  $\beta$ -particles

C)  $\gamma$ -rays

D) X-rays

104. The analytical technique used for finding the concentrations of  $\text{Ca}^{2+}$  and  $\text{Mg}^{2+}$  ions separately in a mixture:  
 A) Thermometric titration      B) Radiometric titration  
 C) Complexometric titration      D) All of these
105. Find the product of the reaction when acetaldehyde in an aqueous micellar medium is kept in a microwave oven and is treated with ultrasonic sound.  
 A) Acetic acid      B) But-2-enal      C) Ethanol      D) 3-hydroxybutanal
106. Which of the following is **not** a phase-transfer catalyst?  
 A) Cetyl Bromide      B) Benzyl triethyl ammonium chloride  
 C) Crown ether      D) 1,10-phenanthroline
107. Identify the statement which is **wrong** regarding quantum dots (QDs):  
 A) QDs have properties that are intermediate between those of bulk semiconductors and discrete molecules  
 B) When illuminated by UV light, QDs produce fluorescence, the color of the light depends on the size of the particle.  
 C) Size of the QDs are directly proportional to the band gap and smaller dots emit red light, while larger dots emit blue light.  
 D) QDs can be used to label different biomolecules and track them in living cells
108. The composite where matrix is an alloy or pure metal and ceramics are used as reinforcements are called:  
 A) Metal matrix composites  
 B) Polymer-matrix composites  
 C) Ceramic matrix composites  
 D) Fiber-reinforced polymer
109. Chemical oxygen demand (COD) is always greater than biological oxygen demand (BOD). Why?  
 A) BOD is calculated in domestic sewage  
 B) COD is calculated for sewage from industries  
 C) More organic compounds can be oxidised chemically than biologically  
 D) All the above
110. Photochemical smog or summer smog, is a type of smog that is produced when UV light interacts with the ----- and ----- present in the atmosphere.  
 A) Halogens, hydrocarbons      B)  $\text{NO}_2$ , hydrocarbons  
 C)  $\text{O}_3$ , halogens      D) CFCs,  $\text{O}_3$
111. Name the organic molecule formed when 4-nitrophenol is treated with  $\text{NaBH}_4$  followed by acetic anhydride:  
 A) Phenobarbital      B) Diazepam  
 C) Paracetamol      D) Benzyl penicillin

112. Identify the **wrong** statement related to polydispersity index (PDI) of a polymer:
- It is the ratio of weight average molecular weight to number average molecular weight
  - Monodisperse polymers have a PDI of 1
  - Smaller PDI values are shown by polymers formed by Step-growth polymerization reactions compared to those formed by chain-growth polymerization reactions
  - PDI of a polymer can be estimated using a diffusion experiment
113. Arrange the given high-temperature polymers in the increasing order of their thermal stability:
- Polyphenylene sulfide (PPS)
  - Liquid crystal polymer (LCP)
  - Polyetherether Ketone (PEEK)
- $2 < 1 < 3$
  - $3 < 2 < 1$
  - $1 < 2 < 3$
  - $3 < 1 < 2$
114. The biomimic which is modeled on burrs:
- Drones
  - Velcro fasteners
  - Airplane shape
  - Swimsuits
115. Given below are few molecules and their point groups. Which among them is **wrongly** matched?
- Thionyl chloride –  $C_s$
  - Carbondioxide –  $D_{\infty h}$
  - Sulphurtetrafluoride –  $C_{2v}$
  - Ethylene –  $D_{2d}$
116. Which among the following symmetry elements is **not** a part of  $D_{3h}$  point group?
- $C_3$
  - $C_2$
  - $\sigma_d$
  - $\sigma_h$
117. Identify the **false** statement from among the following:
- The binary combination of all pairs of elements is commutative
  - $C_{2v}$  point group is abelian
  - Every cyclic group is abelian
  - Every abelian group is cyclic
118. Which among the following molecules has the highest number of mirror planes?
- $NH_3$
  - $CH_4$
  - $C_6H_6$
  - $CHCl_3$
119. What group is obtained by adding the symmetry operation 'i' to  $C_3$ ?
- $S_6$
  - $S_3$
  - $C_{3h}$
  - $D_{3h}$
120. The number of irreducible representations of a point group will be equal to:
- The number of symmetry element classes
  - The order of the group
  - Half the order of the group
  - Twice the number of classes of the group
-