

M.Phil./Ph.D. ADMISSION TEST, 2019 & 2020**Paper II****Subject : 107 - CHEMISTRY**

Roll No. (In figures)(In words).....

OMR Sheet Barcode No.

Signatures of Invigilators 1. 2.

Names of Invigilators 1. 2.

Time : 2 Hours

Max. Marks : 200

GENERAL INSTRUCTIONS

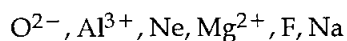
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|--|--|
| <p>1. Read the instructions given on the Question Booklet and OMR Sheet before starting the answers. All the entries should be filled by blue or black ball point pen.</p> <p>2. The Question Booklet contains 100 questions and all questions are compulsory.</p> <p>3. Each question is of 2 marks. There is no negative marking.</p> <p>4. Candidates must ensure that the Question Booklet issued to them has all the questions. Defective Question Booklet can be got changed within 10 minutes.</p> | <p>1. प्रश्नों के उत्तर लिखने से पूर्व प्रश्न-पुस्तिका और ओ.एम.आर. शीट पर दिये हुए निर्देश पढ़ें। सभी प्रविष्टियाँ नीले अथवा काले बॉल पॉइन्ट पेन से भरें।</p> <p>2. प्रश्न-पुस्तिका में 100 प्रश्न हैं और सभी प्रश्न अनिवार्य हैं।</p> <p>3. प्रत्येक प्रश्न 2 अंक का है। कोई नकारात्मक अंकन (negative marking) नहीं होगा।</p> <p>4. परीक्षार्थी सुनिश्चित कर लें कि उन्हें जो प्रश्न-पुस्तिका दी गई है उसमें सभी प्रश्न अंकित हैं। त्रुटिपूर्ण प्रश्न-पुस्तिका 10 मिनट की अवधि में बदलवाई जा सकती है।</p> |
|--|--|

SEAL

5. In case of any discrepancy between English and Hindi versions of a question, English version will be taken as correct, wherever there are both versions.
6. Select and darken the circle corresponding to the answer [(A) or (B) or (C) or (D)] in OMR sheet.
7. In case more than one circles are darkened in a question, it will not be evaluated.
8. Do not make any stray marks on OMR sheet and do not fold it.
9. Any candidate found removing pages from the Question Booklet may be disqualified and prosecuted.
10. Use of unfair means will disqualify the candidate from the examination.
11. Cell phone, calculator or any such devices are not allowed in the Examination Hall.
12. No candidate is allowed to leave the seat before handing over the original OMR sheet to the invigilator. Candidate can take Question Booklet and Carbon copy of OMR sheet.

5. किसी प्रश्न के अंग्रेजी और हिन्दी रूपान्तरणों में भिन्नता होने की स्थिति में अंग्रेजी रूपान्तरण सही माना जायेगा जहाँ प्रश्न-पत्र दोनों भाषाओं में है।
6. सही उत्तर का चयन करें तथा सम्बन्धित [(A) अथवा (B) अथवा (C) अथवा (D)] गोले को ओ.एम.आर. शीट में काला करें।
7. किसी प्रश्न में एक से अधिक गोले को काला करने पर उसे जाँचा नहीं जायेगा।
8. ओ.एम.आर. शीट पर किसी तरह का चिह्न न बनायें और न ही उसे मोड़ें।
9. प्रश्न-पुस्तिका से पृष्ठ निकालते हुए पाये जाने पर परीक्षार्थी को अयोग्य घोषित किया जा सकता है और उसके विरुद्ध विधिक कार्यवाही भी की जा सकती है।
10. अनुचित साधनों का उपयोग करने पर परीक्षार्थी को परीक्षा के लिए अयोग्य घोषित कर दिया जायेगा।
11. सेलफोन, संगणक और ऐसी किसी भी अन्य प्रविधियों को परीक्षा भवन में लाने की अनुमति नहीं है।
12. ओ.एम.आर. शीट की मूल प्रति वीक्षक को सुपुर्द किये बिना किसी भी परीक्षार्थी को अपना स्थान छोड़ने की अनुमति नहीं है। परीक्षार्थी प्रश्न-पुस्तिका एवं ओ.एम.आर. शीट की कार्बन प्रति को अपने साथ ले जा सकेगा।

1. Arrange the isoelectronic species in increasing of their size.

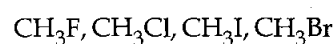


- (A) $O^{2-} > Al^{3+} > F > Mg^{2+}$
(B) $Al^{3+} > Mg^{2+} > Ne > O^{2-}$
(C) $Al^{3+} > Ne > Mg^{2+} > Na$
(D) $O^{2-} > Ne > Mg^{2+} > Al^{3+}$

2. Which hybridization is having highest stability for carbon ?

- (A) sp
(B) sp^4
(C) sp^2
(D) sp^3

3. Arrange the followings into descending order of the dipole moment.



- (A) $CH_3F > CH_3Cl > CH_3I > CH_3Br$
(B) $CH_3Cl > CH_3F > CH_3I > CH_3Br$
(C) $CH_3Cl > CH_3F > CH_3Br > CH_3I$
(D) $CH_3F > CH_3Cl > CH_3Br > CH_3I$

4. Which oxyacid has higher strength of acid ?

- (A) HClO
(B) HClO₄
(C) HClO₃
(D) HClO₂

5. Which has smallest atomic radius ?

- (A) C
(B) O
(C) F
(D) N

6. Which cation of lanthanide series is having pink color ?

- (A) Er^{3+}
(B) Tm^{3+}
(C) Pr^{3+}
(D) La^{3+}

7. _____ type of reaction can be carried out easily in Ferrocene.

- (A) Nucleophilic substitution reaction
(B) Electrophilic elimination reaction
(C) Nucleophilic addition reaction
(D) Electrophilic substitution reaction

8. Match the following :

- | | |
|-------------------------------|------------------------------------|
| (a) UV Spectroscopy | (i) DC Arc |
| (b) FTIR | (ii) Interferometer |
| (c) AES | (iii) Xenon flash lamp |
| (d) AAS | (iv) Thermal conductivity detector |
| (e) GC | (v) Hollow cathode lamp |
| (f) F and P Spectrophotometry | (vi) Deuterium discharge lamp |
- (A) (a)-(vi), (b)-(ii), (c)-(i), (d)-(v), (e)-(iv), (f)-(iii)
(B) (a)-(vi), (b)-(i), (c)-(ii), (d)-(v), (e)-(iv), (f)-(iii)
(C) (a)-(vi), (b)-(ii), (c)-(i), (d)-(v), (e)-(iii), (f)-(iv)
(D) (a)-(vi), (b)-(ii), (c)-(v), (d)-(i), (e)-(iv), (f)-(iii)

9. Which technique is known as "Zero field NMR" ?

- (A) Nuclear Quadrupole Resonance Spectroscopy
(B) Mossbauer Spectroscopy
(C) Electron Spectroscopy
(D) Carbon 13 NMR Spectroscopy

10. What is the equation of Geiger-Nattall law ?
- (A) $\log \lambda = a + b \log r$
 (B) $k = Ae^{-E/RT}$
 (C) $(K_D)_A = [A]_{org}/[A]_{aq}$
 (D) $\omega = \gamma B_0$
11. According to HMO theory, cyclobutadiene is unstable because :
- (A) Delocalization energy is 0
 (B) Delocalization energy is -1
 (C) Delocalization energy is +1
 (D) None of the above
12. How many hyperfine lines in ESR spectrum are shown by Mn^{2+} ?
- (A) 7
 (B) 2
 (C) 6
 (D) 8
13. Which statistics will apply to deuterons and α -particles ?
- (A) B-E
 (B) M-B
 (C) F-D
 (D) None of the above
14. _____ is involved in the kinetic theory of matter.
- (A) Tyndall effect
 (B) Pumice stone
 (C) Brownian motion
 (D) Dialysis
15. What is the co-ordination number Titanium in $CaTiO_3$, when it has Perovskite crystal ?
- (A) 6
 (B) 4
 (C) 12
 (D) 2
16. The current deviation method is associated with :
- (A) Correlation coefficient of variables of two qualitative characters
 (B) Qualitative measurements
 (C) Quantitative measurements
 (D) Variables of qualitative characters
17. Which of the following is not applicable to molecules that form isomers by rotation about single bonds ?
- (A) Rotational isomers
 (B) Stereoisomers
 (C) Configurations
 (D) Conformations
18. Which of the hydrocarbon has exhibited aromatic stabilization ?
- (A) Tropylium chloride
 (B) Tropylium cation
 (C) Tropylium anion
 (D) Tropylium bromide
19. Pinacol-Ponacolone rearrangement takes place by formation of _____ and migration of _____ group.
- (A) Carbocation, electron deficient
 (B) Carbocation, electron donating
 (C) Carbanion, nucleophile
 (D) Carbanion, electrophile

20. 1,4 Cyclohexadiene from Benzene will formed using _____.
- (A) $\text{Na} + \text{NH}_3 + \text{H}_2\text{O}$
 (B) $\text{Na} + \text{Ether} + \text{Ethanol}$
 (C) $\text{Na} + \text{Ethyl alcohol} + \text{NH}_3$
 (D) $\text{Na} + \text{dry Ether} + \text{NH}_3$
21. For synthesis of amide from carboxylic acid and amide _____ reagent is required.
- (A) PCC
 (B) DCC
 (C) DDQ
 (D) CAN
22. _____ is used to carry out reaction on less reactive group in presence of more reactive group.
- (A) Synthone
 (B) Resolution
 (C) Protecting group
 (D) Asymmetric induction
23. _____ is a Lindlar catalyst.
- (A) Pd/CaCO_3
 (B) Na/NH_3
 (C) CBZ
 (D) BOC
24. Claisen rearrangement is an example of _____ rearrangement.
- (A) [2, 3] sigmatropic
 (B) [3, 3] sigmatropic
 (C) [3, 2] sigmatropic
 (D) [2, 4] sigmatropic
25. Match the correct from the given columns :
- (a) D-fructose (i) Trisaccharide
 (b) D-galactose (ii) Disaccharide
 (c) Maltose (iii) Ketohexose
 (d) Raffinose (iv) Aldohexose
- (A) (a) - (iii), (b) - (iv), (c) - (ii), (d) - (i)
 (B) (a) - (iv), (b) - (iii), (c) - (ii), (d) - (i)
 (C) (a) - (iii), (b) - (iv), (c) - (i), (d) - (ii)
 (D) (a) - (ii), (b) - (iv), (c) - (iii), (d) - (i)
26. What will be the peak area for the ^1H NMR of Ethane-1-ol?
- (A) 3 : 1 : 2
 (B) 1 : 2 : 3
 (C) 2 : 3 : 1
 (D) 3 : 2 : 1
27. Carbon nanotubes having _____ hybridized bonds.
- (A) sp
 (B) sp^2
 (C) sp^3
 (D) None of the above
28. Which one is not considered as a "Green Solvent" ?
- (A) $\text{NH}_3(\text{l})$
 (B) $\text{CO}_2(\text{SC})$
 (C) H_2O
 (D) None of the above
29. Give correct instrument technique to analyze the given air pollutants.
- (a) CO (i) GC
 (b) SO_2 (ii) AAS
 (c) CH (iii) Spectrophotometric
 (d) F^- (iv) ND IR Spectrometry
 (e) Pb^{2+} (v) Potentiometric
- (A) (a) - (iv), (b) - (iii), (c) - (i), (d) - (v), (e) - (ii)
 (B) (a) - (iv), (b) - (v), (c) - (i), (d) - (iii), (e) - (ii)
 (C) (a) - (iv), (b) - (ii), (c) - (i), (d) - (v), (e) - (iii)
 (D) (a) - (i), (b) - (iii), (c) - (iv), (d) - (v), (e) - (ii)

30. Which state of Carbene is most stable ?

- (A) Singlet
- (B) Doublet
- (C) Triplet
- (D) Quartet

31. Nitrene is having _____ electrons.

- (A) 4
- (B) 6
- (C) 7
- (D) 5

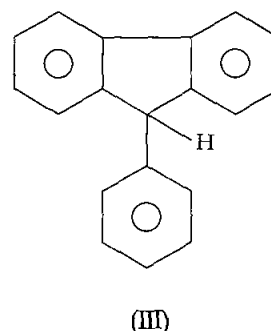
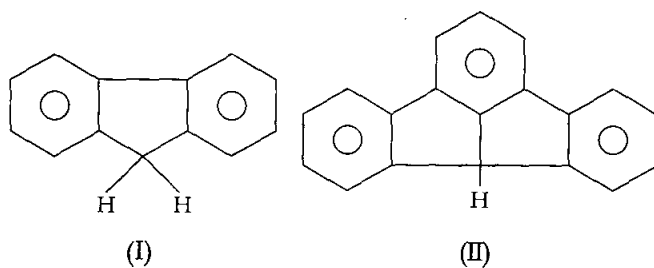
32. Which reactive intermediates having same number of electrons ?

- (A) Carbocation and Carbanion
- (B) Carbanion and Carbon free radical
- (C) Carbocation and Carbon free radical
- (D) Carbene and Carbon free radical

33. Which reactive intermediate having chirality (if different groups are attached) ?

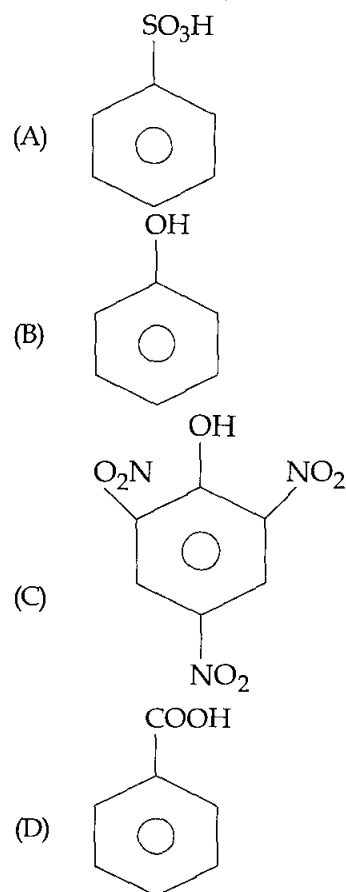
- (A) Nitrene
- (B) Carbene
- (C) Carbocation
- (D) Carbanion

34. Arrange the following molecules in the order of increasing acidic strength.



- (A) (I) < (III) < (II)
- (B) (I) < (II) < (III)
- (C) (III) < (I) < (II)
- (D) (III) < (II) < (I)

35. Identify the compound which does not give effervescence with sodium carbonate solution.



36. Meso-2,3-dibromobutane on E2 elimination gives :

- (A) trans-2-butene
- (B) cis-2-butene
- (C) mixture of cis-2-butene and trans-2-butene
- (D) 1-butene

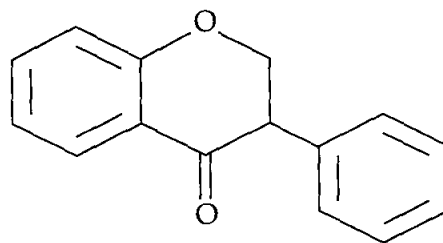
37. Which of the following molecule readily undergoes nucleophilic aromatic substitution with hydroxide ion at room temperature ?

- (A) 4-chlorotoluene
- (B) 1-chloro-4-nitrobenzene
- (C) chlorobenzene
- (D) 1-chloro-2,4,6-trinitrobenzene

38. The CMR spectrum of an unknown compound shows six absorptions and the ^1H NMR Spectrum shows five absorptions. Which of the following is the unknown compound ?

- (A)
$$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$$
- (B)
$$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{CH}_3 \end{array}$$
- (C)
$$\begin{array}{c} \text{CH}_3 \qquad \qquad \text{CH}_3 \\ | \qquad \qquad | \\ \text{CH}_3 - \text{CH} - \text{CH} - \text{CH} - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$$
- (D)
$$\begin{array}{c} \text{CH}_3 \qquad \qquad \qquad \text{CH}_3 \\ | \qquad \qquad \qquad | \\ \text{CH}_3 - \text{CH} - \text{CH}_2 - \text{CH}_2 - \text{C} - \text{CH}_3 \\ | \\ \text{CH}_3 \end{array}$$

39. The given natural product is :

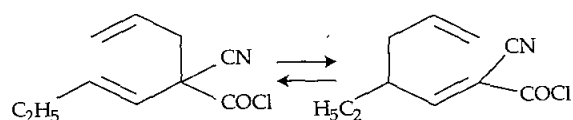


- (A) Coumarin
- (B) Flavonoid
- (C) Isoflavonoid
- (D) Oxadiazole

40. Which type of symmetry is present in LUMO of 1,3,5 hexatriene ?

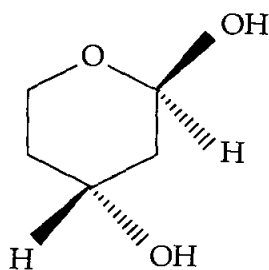
- (A) Mirror symmetry
- (B) C_2 symmetry
- (C) Both (A) and (B)
- (D) None of the above

41. The pericyclic reaction given below is an example of:



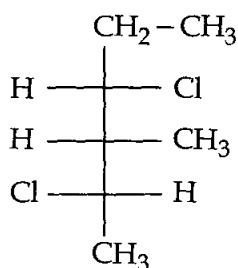
- (A) [3,3]-sigmatropic rearrangement
- (B) [1,3]-sigmatropic rearrangement
- (C) [1,5]-sigmatropic rearrangement
- (D) [1,7]-sigmatropic rearrangement

42. Assign the R and S nomenclature to the C₂ and C₄ chiral centres of the molecule given below.



- (A) 2R, 4S
 (B) 2S, 4R
 (C) 2S, 4S
 (D) 2R, 4R

43. The IUPAC name of the following compound along with the Cahn-Ingold-Prelog designation is :



- (A) (3S, 4R, 5S)-3,5-Dichloro-4-methylhexane
 (B) (2S, 3S, 4S)-2,4-Dichloro-3-methylhexane
 (C) (2S, 3R, 4R)-2,4-Dichloro-3-methylhexane
 (D) (2S, 3R, 4S)-2,4-Dichloro-3-methylhexane

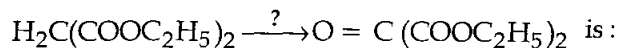
44. Name cholesterol lowering drug in the blood.

- (A) Isoniazid
 (B) Norethindrone
 (C) Atorvastatin
 (D) Tamsulosin hydrochloride

45. Name the sugar free sweetener which has chlorine atoms in its structure.

- (A) Sucralose
 (B) Aspartame
 (C) Saccharin
 (D) Neotame

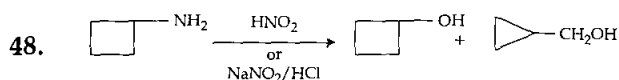
46. The reagent used for the conversion of :



- (A) Conc. HNO₃
 (B) Conc. HNO₃ + dil. H₂SO₄
 (C) K₂Cr₂O₇ + H₂SO₄
 (D) SeO₂/H₂SeO₃

47. Conversion of Quaternary salts containing an electron withdrawing group on the carbon attached to the nitrogen atom undergo rearrangement to tertiary amine on treatment with NaNH₂ is known as :

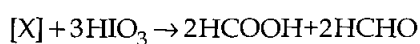
- (A) Stevens Rearrangement
 (B) Favorskii Rearrangement
 (C) Beckmann Rearrangement
 (D) Wolf Rearrangement



is known as :

- (A) Demjanov Rearrangement
 (B) Hofmann Rearrangement
 (C) Lossen Rearrangement
 (D) Neber Rearrangement

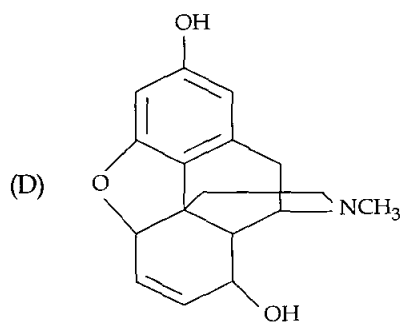
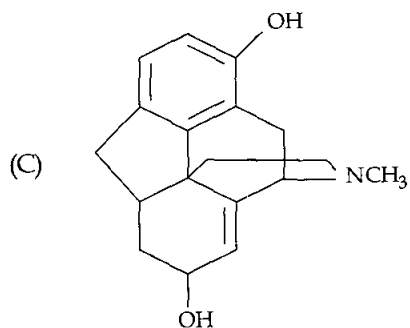
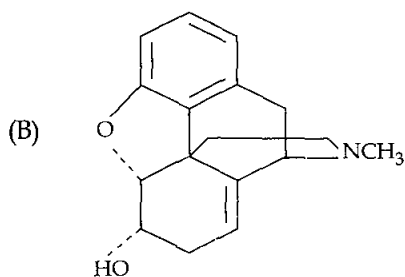
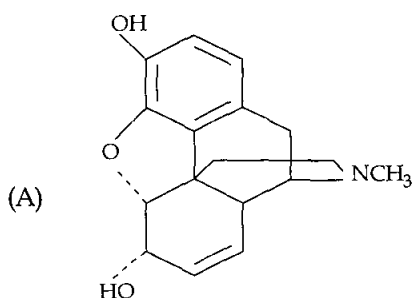
49. Assign the structure to compound [X]



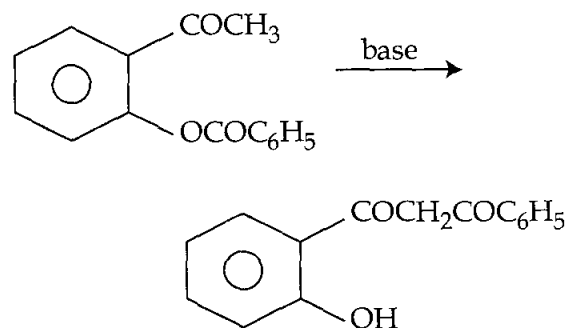
- (A) $\begin{array}{cccc} \text{CH}_2 & -\text{CH} & -\text{CH} & -\text{CH}_2\text{OH} \\ | & | & | & \\ \text{OH} & \text{OH} & \text{OH} & \end{array}$
 (B) $\begin{array}{cccc} \text{HOCH}_2 & -\text{CH} & -\text{CH}_2 & -\text{CH}_2\text{OH} \\ & | & & \\ & \text{OH} & & \end{array}$
 (C) $\begin{array}{cccc} \text{CH}_2 & -\text{CH}_2 & -\text{CH}_2 & -\text{CH}_2 \\ | & & & | \\ \text{OH} & & & \text{OH} \end{array}$
 (D) $\begin{array}{cccc} \text{HOCH}_2 & -\text{C} & -\text{CH}_2 & -\text{CH}_2 \\ & || & & | \\ & \text{O} & & \text{OH} \end{array}$

50. In alkaloid Herzig-Meyer's method is used :
- To detect and estimate the number of methyl groups attached to N atom
 - To detect and estimate the number of methyl groups attached to C atoms
 - To detect and estimate the number of methoxyl groups attached to C atoms
 - None of the above

51. Correct structure for Morphine is :



52. Base catalysed rearrangement of o-acyloxyketone to β -diketone.



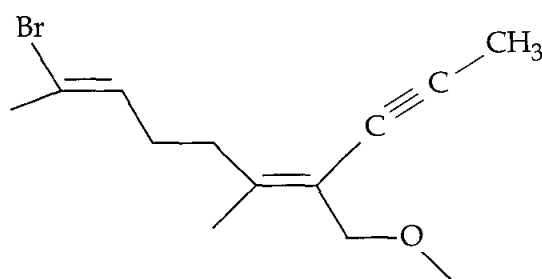
is termed as :

- Bamberger rearrangement
- Baker-Venkataraman rearrangement
- Benzilic acid rearrangement
- Beckmann rearrangement

53. Identify the Collmann's reagent.

- $\text{CrO}_3 \cdot 2\text{C}_2\text{H}_5\text{N}$
- $\text{Na}_2\text{Fe}(\text{CO})_4$
- $\text{RhCl}(\text{Ph}_3\text{P})_3$
- $\text{MeOOCN}^{\ominus}\text{SO}_2\text{N}^{\oplus}(\text{CH}_3)_3$

54. The E or Z configuration for the following molecule is :



- 4E, 8E
- 4E, 8Z
- 4Z, 8Z
- 4Z, 8E

55. In the spectrum of p-aminoanisole, the molecular ion peak appears at m/z 123 and a daughter ion is obtained on loss of a methyl radical, the position of the metastable ion peak will be at m/z :

- (A) 93.08
- (B) 140.08
- (C) 94.82
- (D) 96.59

56. The ^1H NMR data of an organic compound with molecular mass 88 is given below :

1.23 δ , t, 3H ; 1.97 δ , s, 3H ; 4.06 δ , q, 2H

The correct structure of the compound is :

- (A) $\text{CH}_3 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{OCH}_3$
- (B) $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{OCH}_2 - \text{CH}_3$
- (C) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \overset{\text{O}}{\parallel} \text{C} - \text{OH}$
- (D) $\text{CH}_3 - \overset{\text{O}}{\parallel} \text{C} - \text{CH}_2 - \text{CH}_2 - \text{OH}$

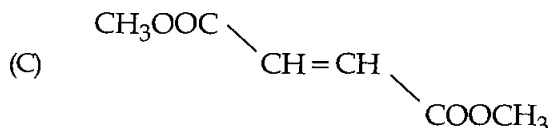
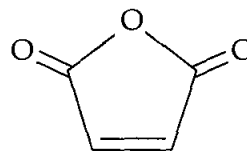
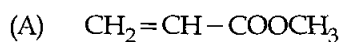
57. Methanamide shows two absorption bands between $3400\text{-}3500\text{ cm}^{-1}$, on treatment with phosphorus pentoxide, the product formed absorbs at :

- (A) 2256 cm^{-1}
- (B) 3250 cm^{-1}
- (C) 1750 cm^{-1}
- (D) 3600 cm^{-1}

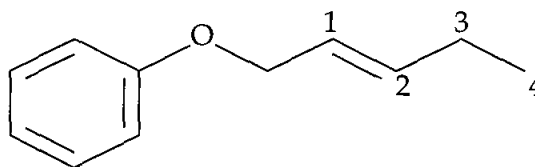
58. In α, β -unsaturated carboxyl compounds, which of the following absorption bands shifts to longer wavelength on increasing polarity of the solvent ?

- (A) $\pi \rightarrow \pi^*$
- (B) $n \rightarrow \pi^*$
- (C) $n \rightarrow \sigma^*$
- (D) $\sigma \rightarrow \sigma^*$

59. Of the following dienophiles, which one is the most reactive with 1,3-butadiene ?



60. In the following allylicphenyl ether, which side chain carbon makes a new bond to the benzene ring upon Claisen rearrangement ?



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

61. Citral and α -Terpineol are :

- (A) Bicyclic monoterpenoids
- (B) Monocyclic monoterpenoids
- (C) Acyclic sesquiterpenoids
- (D) Acyclic diterpenes

62. In the reaction between alkylhalide and hydroxide ion, increase in the polarity of solvent generally :

- (A) increases rate of SN^2 reaction
- (B) increases rate of SN^1 reaction
- (C) decreases rate of SN^1 reaction
- (D) does not alter rate of SN^1 and SN^2 reactions

63. Which of the following reactions takes place through a carbene intermediate ?
- (A) Diazonium coupling
 (B) Perkin reaction
 (C) Reimer-Tiemann reaction
 (D) Reformatsky reaction
64. In case of Hofmann bromamide degradation reaction, intermediate RNCO is formed by :
- (A) intramolecular migration
 (B) intermolecular migration
 (C) hydrolysis of RCONH₂
 (D) None of the above
65.
$$\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CH} = \text{CH}_2 \\ | \\ \text{CH}_3 \end{array} \longrightarrow \begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3 - \text{C} - \text{CH} - \text{CH}_3 \\ | \quad | \\ \text{CH}_3 \quad \text{OH} \end{array}$$

This change can be done by :

- (A) Oxymercuration - Demercuration
 (B) Acid catalysed hydration
 (C) Hydroboration oxidation
 (D) All of the above
66. $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH} = \text{CH}_2 \xrightarrow{\text{NBS}} \text{A}$
- The possible structure of product "A" is :
- (A) $\text{CH}_2 = \text{CH} - \text{CH}_2 - \underset{\text{Br}}{\text{C}} = \text{CH}_2$
 (B) $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH} = \text{CH} - \text{Br}$
 (C) $\text{CH}_2 = \text{CH} - \underset{\text{Br}}{\text{CH}} - \text{CH} = \text{CH}_2$
 (D) $\text{CH}_2 = \text{CH} - \text{CH} = \text{CH} - \text{CH}_2 - \text{Br}$
67. The diameter of an atom is how many times the diameter of the nucleus ?
- (A) 10^2 times
 (B) 10^3 times
 (C) 10^4 times
 (D) 10^6 times
68. 1 eV of energy is equivalent to a photon with wavelength about :
- (A) 30 Å
 (B) 300 Å
 (C) 1200 Å
 (D) 12000 Å
69. The most probable distance at which 1s electron of H-like atom is found will be :
- (A) $\frac{Z}{a_0}$
 (B) $\frac{Z^3}{a_0}$
 (C) $\frac{a_0}{Z}$
 (D) a_0/Z^3
70. Centre of inversion is absent in the following point group :
- (A) D_{2h}
 (B) D_{4h}
 (C) D_{6h}
 (D) T_d

71. Which of the following species possesses both C_3 and C_2 axes ?
- (A) SO_3
 (B) NH_3
 (C) PCl_3
 (D) $[H_3O]^+$
72. Which molecule or ion have D_{3h} symmetry ?
- (A) $[H_3O]^+$
 (B) $CHCl_3$
 (C) $[CO_3]^{2-}$
 (D) NF_3
73. If \hat{H} is the Hamiltonian and using the trial function for H_2^+ molecular ion, the energy of antibonding orbital is given by :
- (A) $\frac{H_{aa} + H_{ab}}{1 - S_{ab}}$
 (B) $\frac{H_{aa} + H_{ab}}{1 + S_{ab}}$
 (C) $\frac{H_{aa} - H_{bb}}{1 - S_{bb}}$
 (D) $\frac{H_{aa} - H_{ab}}{1 - S_{ab}}$
74. For ethylene molecule the coefficient of atomic orbital wave function are :
- (A) $\frac{1}{2}, \frac{-1}{2}$
 (B) $\frac{1}{\sqrt{2}}, \frac{-1}{\sqrt{2}}$
 (C) $\frac{1}{4}, \frac{-1}{4}$
 (D) $\frac{1}{2\sqrt{2}}, \frac{-1}{2\sqrt{2}}$
75. If E_0 is zero point energy of a harmonic oscillator of frequency ν and h is Planck's constant, then its energy in the $n = 2$ state will be :
- (A) $(E_0 + h\nu)$
 (B) $2E_0$
 (C) $4E_0$
 (D) $(E_0 + 2h\nu)$
76. The de-Broglie wavelength of a particle having kinetic energy E_k is given by :
- (A) $\lambda = \frac{h}{\sqrt{E_k}}$
 (B) $\lambda = \frac{h}{\sqrt{2mE_k}}$
 (C) $\lambda = \frac{h}{\sqrt{mE_k}}$
 (D) $\lambda = \frac{h}{\sqrt{3mE_k}}$
77. The compound DPPH, used for calibrating ESR spectra, shows ESR spectrum consisting of a :
- (A) 1 : 4 : 6 : 4 : 1 quintet
 (B) 1 : 3 : 3 : 1 quartet
 (C) 1 : 2 : 3 : 2 : 1 quintet
 (D) equally intense quartet
78. The increase in rotational energy shows absorption spectrum in :
- (A) I.R. region
 (B) U.V. region
 (C) Visible region
 (D) Microwave region

79. The relation between D_e and D_0 , the two dissociation energies of a SHO is :
- (A) $D_e = D_0 + \frac{h\nu}{2}$
- (B) $D_e = D_0 + 2h\nu$
- (C) $D_e = D_0 + h\nu$
- (D) $D_0 = D_e + \frac{h\nu}{2}$
80. Which of the following molecules can show a pure rotational microwave spectrum ?
- (A) N_2
- (B) CO_2
- (C) OCS
- (D) HCl
81. Zeta potential or electrokinetic potential depends on :
- (A) Viscosity
- (B) Dielectric constant
- (C) Velocity of colloidal particles when electric field is applied
- (D) All of the above
82. Aluminium hydroxide forms a positively charged sol. Which of the following ionic substances should be most effective for coagulating the sol ?
- (A) $NaCl$
- (B) $CaCl_3$
- (C) $Fe_2(SO_4)_3$
- (D) K_3PO_4
83. Colloidal solutions of gold prepared by different methods are of different colours because of :
- (A) different diameters of colloidal gold particles
- (B) variable valency of gold
- (C) different concentration of gold particles
- (D) impurities produced by different methods
84. Flocculation value of a coagulating electrolyte is expressed in :
- (A) $millimol L^{-1}$
- (B) $mol L^{-1}$
- (C) $mg K^{-1}$
- (D) $micro\ gram\ mL^{-1}$
85. Which one of the following has the largest band gap energy ?
- (A) Germanium
- (B) Silicon
- (C) Diamond
- (D) Tellurium
86. The arrangement of sulphur in Zinc blende and Wurtzite structure respectively are :
- (A) hexagonal close packing and cubic close packing
- (B) cubic close packing and hexagonal close packing
- (C) simple cubic close packing in both the structures
- (D) hexagonal close packing in both the structures

87. Sodium metal crystallizes in body centred cubic lattice with cell edge 'a'. The radius of the sodium atom is :
- (A) $\frac{a}{\sqrt{2}}$
- (B) $\frac{a\sqrt{3}}{2}$
- (C) $\frac{a\sqrt{3}}{4}$
- (D) $\frac{a}{2\sqrt{2}}$
88. The area of a Carnot cycle on a T-S diagram represents :
- (A) heat absorbed from the source
- (B) work done in a cycle
- (C) heat rejected to the sink
- (D) efficiency of the engine
89. Which of the following expresses the second law of thermodynamics? All the symbols have their usual meaning :
- (A) $\Delta S \leq 0$
- (B) $\Delta S < \frac{Q}{T}$
- (C) $\Delta F \leq W$
- (D) $\Delta V = Q + W$
90. Which of the following relation between energy E and microcanonical partition function Z is true ?
- (A) $E = -N \frac{\partial}{\partial T} \log Z$
- (B) $E = NkT^2 \left[\frac{\partial (\log Z)}{\partial T} \right]_V$
- (C) $E = -NkT \log Z$
- (D) $E = NkT \frac{\partial}{\partial V} \log Z$
91. An assembly has only two particles, which are to be arranged in three phase cells. The possible number of arrangements in B-E statistics is :
- (A) Two
- (B) Nine
- (C) Six
- (D) Three
92. Supporting electrolyte is used in polarography to suppress :
- (A) Diffusion current
- (B) Migration current
- (C) Convection current
- (D) Residual current
93. Gibbs free energy change for a cell reaction is positive. What does it indicate ?
- (A) Cell will discharge easily
- (B) Cell reaction is spontaneous
- (C) Cell reaction is non-spontaneous
- (D) Cell will work under standard conditions
94. Which of the following can be used for cathodic protection ?
- (A) Al
- (B) Cd
- (C) Cu
- (D) Any of these
95. The standard emf of a galvanic cell involving cell reaction with $n = 2$ was found to be 0.295 V at 25°C. The equilibrium constant of the reaction would be :
- (A) 2×10^{11}
- (B) 4×10^{12}
- (C) 1×10^{10}
- (D) 1×10^2

96. The rate constant is given by equation $K = P.Ze^{-E_a/RT}$. Which factor should register a decrease for the reaction to proceed more rapidly?
- (A) T
(B) Z
(C) E_a
(D) P
97. High quantum yield of photochemical reactions are due to:
- (A) lowering of activation energy
(B) high frequency of collision
(C) formation of free radicals
(D) accompanying side reactions
98. The polymer used in electrodes in rechargeable batteries is:
- (A) Conducting Polyaniline
(B) Teflon
(C) Polyacetylene
(D) Polyaniline
99. What is the effect of increasing molecular weight on melting temperature of polymer?
- (A) Increases linearly
(B) Increases non-linearly
(C) Decreases exponentially
(D) Decreases linearly
100. With the increase in absolute error the value of the relative error:
- (A) increases
(B) decreases
(C) remains same
(D) first decreases then increases

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