

Roll No.

B020701T

M. Sc. (First Semester)
EXAMINATION, 2022-23
(NEP)

CHEMISTRY

(Inorganic Chemistry)

Time : Two Hours] [Maximum Marks : 75

Note : This paper consists of three Sections A, B and C. Carefully read the instructions of each Section in solving the question paper. Candidates have to write their answers in the given answer-copy only. No separate answer-copy (B Copy) will be provided.

P. T. O.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Answer the following questions as short answer type questions. Each question carries 5 marks.

1. (A) Give *one* example for each d^2sp^3 and sp^3d^2 hybridisation.
- (B) Derive a relation between stepwise and overall formation constants for complex compounds.
- (C) Discuss kinetics and mechanism of S_N^2 displacement base hydrolysis reaction of Co(III) ammine complexes.
- (D) Write a short note on the following :
Murrus-Husch's theory
Or
Trans effect
- (E) What are $d\pi-p\pi$ bonds ? Discuss its significance with proper examples.

- (F) With the help of Walsh diagram, explain triatomic molecules.
- (G) Calculate CFSE values for :
- d^1 -octahedral system
 - d^1 -tetrahedral system
- (H) $[\text{Fe}(\text{CN})_6]^{4+}$ ion is a low spin complex while $[\text{Fe}(\text{H}_2\text{O})_6]^{3+}$ ion is a high spin complex. Why?
- (I) What is Chelate effect ? Explain thermodynamically as to why chelated complexes are more stable than non-chelated complexes.

Section—B

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

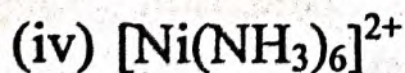
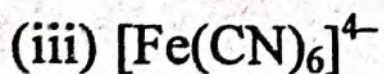
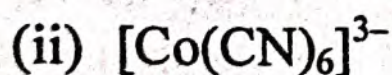
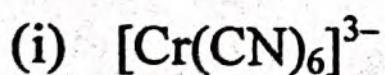
2. What are the salient features of VSEPR theory ? With the help of VSEPR theory, explain the irregular geometry of molecules and decrease in bond angles, giving suitable examples.

Or

3. What is molecular orbital theory of co-ordination compounds ? Discuss sigma and pi metal-ligand bonding in square planar complexes by constructing molecular orbital diagram for $[\text{PtCl}_4]^{2-}$.

Or

4. Based on CFT, draw the energy level diagram and write the electronic configuration of the central metal atom/ion in the following. Also determine the value of μ :



Or

5. (i) What is Bent's rule ? How does Bent's rule supplement the VSEPR interpretation of structures of non-metal compounds ?

- (ii) Explain the effect of steric repulsion of bonding and non-bonding electrons with the help of structures of Nitrogen dioxide (NO_2), Nitrite (NO_2^-) and Nitryl ion (NO_2^+).

Section—C

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

6. Discuss lability of octahedral complexes of Ni(II) on the basis of VBT and CFT. Which theory explains the reactivity of these complexes more satisfactorily and why ?

Or

7. (i) Describe pH-metric and spectrophotometric method for determining the stability constant of metal complexes in solution mentioning the merits and demerits.

(ii) What do you understand by SN_1CB mechanism ? Discuss with a suitable example.

Or

8. Discuss the hydrolysis reaction in complex compounds. Explain various factors of mechanism and kinetics of acid hydrolysis reaction of six coordinate Co(III) ammine complex.

Or

9. What is meant by stability of a complex ion ? On what factors does the stability of a complex ion depend ? Explain giving suitable examples.

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**M. Sc. (First Semester)
EXAMINATION, 2022-23**

(NEP)

CHEMISTRY

(Organic Chemistry)

Time : Two Hours] [Maximum Marks : 75

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Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Answer the following questions as short answer type questions. Each question carries 5 marks.

P. T. O.

1. (A) What is IPSO effect in electrophilic aromatic substitution ?

(B) Write a note on non-classical carbocations.

(C) Discuss the stability of triphenyl methyl radical.

(D) Write a note on Anionotropy.

(E) Describe briefly the retrochemistry of allenes.

(F) What is Chirality ? Differentiate in the meso and racemic compounds.

(G) Write a short note on cross-conjugation.

(H) Methyl bromide in presence of an alcoholic aqueous alkali usually gets hydrolysed by S_{N^2} mechanism, but in presence of formic acid and little water gives S_{N^1} mechanism. Explain why it happens.

- (I) Explain why chlorobenzene is less reactive than aniline in electrophilic substitution.

Section—B

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

2. (a) What are alternant and non-alternant hydrocarbons ?
- (b) Discuss the aromaticity of annulenes.

Or

3. Write an essay on electrophilic aromatic substitution with special references to the following :
- (a) Orientation of benzene with more than substituent.
- (b) The arenium ion mechanism.

Or

4. (a) What is stereoselective synthesis ?
- (b) Discuss the main conformations of cyclohexane. Why is the chair form more stable than boat form ?

Or

5. Write mechanism of the following :
- (a) Von-Richter rearrangement
 - (b) Sommelet-Hauser rearrangement

Section—C

(Long Answer Type Questions)

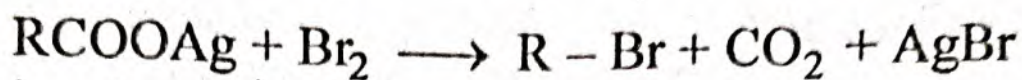
Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

6. What are carbenes ? How are they generated ? Give the structure of singlet and triplet methylene. Explain why triplet methylene is more stable than singlet methylene.

Or

7. (a) What is aromatic nucleophilic substitution reaction ? Discuss the reactions involving benzyne intermediates.

- (b) Identify the following reaction and write its mechanism :



Or

8. Discuss the stereochemistry of amines and spiranes.

Or

9. (a) Discuss optical activity of biphenyls.
(b) Explain why phenol is nitrated with dil. HNO_3 while nitrobenzene is nitrated by mixture of conc. HNO_3 and H_2SO_4 .

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M. Sc. (First Semester)

EXAMINATION, 2022-23

(NEP)

CHEMISTRY

(Physical Chemistry)

Time : Two Hours] [Maximum Marks : 75

Note : This paper consists of three Sections A, B and C. Carefully read the instructions of each Section in solving the question paper. Candidates have to write their answers in the given answer-copy only. No separate answer-copy (**B Copy**) will be provided.

P. T. O.

Section—A**(Short Answer Type Questions)**

Note : All questions are compulsory. Answer the following questions as short answer type questions. Each question carries 5 marks.

1. (A) Explain postulates of quantum mechanics.
- (B) Explain the terms normalisation and orthogonality.
- (C) Define Pauli's exclusion principle.
- (D) Give physical significance of ψ .
- (E) Define activity and activity coefficient.
- (F) Explain excess functions for non-ideal solutions.
- (G) Explain thermodynamic probability.
- (H) Define ensemble.
- (I) Explain application of irreversible process for biological systems.

Section—B**(Long Answer Type Questions)**

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

2. Discuss Schrödinger wave equation for hydrogen atom like system and solve it for calculation of energy.

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Or

3. Discuss the application of perturbation theory to helium atom.

Or

4. Explain the following terms :

- (i) Zeeman splitting
- (ii) Self-consistent field

Or

5. Discuss the Huckel's molecular orbital theory to 1, 3-butadiene.

Section—C

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

6. Explain the following :

- (i) Partial molar properties
- (ii) Gibbs-Duhem equation

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Or

7. Discuss translational and rotational partition functions.

Or

8. Explain Peltier, Kelvin and Seebeck coefficient.

Or

9. Discuss the Bose-Einstein statistics.

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M. Sc. (First Semester)
EXAMINATION, 2022-23
(NEP)
CHEMISTRY
(Spectroscopy)

Time : Two Hours] [Maximum Marks : 75

Note : This paper consists of three Sections A, B and C. Carefully read the instructions of each Section in solving the question paper. Candidates have to write their answers in the given answer-copy only. No separate answer-copy (B Copy) will be provided.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Answer the following questions as short answer type questions. Each question carries 5 marks.

1. (A) Write a definition of Spectroscopy.

- (B) Enlist different regions of electromagnetic spectrum.
- (C) Define frequency and wavelength.
- (D) Why N_2 molecule is inactive to rotational spectroscopy ? /
- (E) Write down Stark effect.
- (F) What are Rigid Rotors ?
- (G) Write a note on Franck-Codon's principle.
- (H) What is the basic principle of NMR spectroscopy ?
- (I) What is Quadruple nuclei ?

Section—B

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

2. Explain photoelectron spectroscopy. Why is high vacuum needed for its study ?

Or

3. Explain classical theory of Raman effect.

Or

4. What is the principle of ESR spectroscopy ?
Write its *two* applications.

Or

5. Explain the following molecules with respect to IR spectra :



Section—C

(Long Answer Type Questions)

Note : This section contains four questions from which *one* question is to be answered as long question. Each question carries 15 marks.

6. Explain the effect of isotopic substitution on rotational constant B.

Or

7. Define degeneracy and explain in detail energy levels $J = 1$ and $J = 2$.

Or

8. Explain basic principle of photoacoustic spectroscopy and its applications.

Or

9. Explain Born-Oppenheimer approximation.

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Question Booklet Number

273821

M. Sc. (Second Semester) (NEP)

EXAMINATION, 2022-23

CHEMISTRY

(Inorganic Chemistry-II)

Paper Code

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| B | 0 | 2 | 0 | 8 | 0 | 1 | T |
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Time : 1:30 Hours]

Questions Booklet
Series

A

[Maximum Marks : 75

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining Instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

- Electronic spectra is observed in the region :
 - IR
 - Visible and IR
 - UV and IR
 - Visible and UV
- Which one of the following pairs of electronic configuration does not show more than one electronic states ?
 - d^1 and d^9
 - d^2 and d^8
 - d^3 and d^7
 - d^4 and d^6
- Generally carbonyls are :
 - diamagnetic
 - paramagnetic
 - ferromagnetic
 - ferrimagnetic
- The structure of $C_2B_3H_7$ carborane is :
 - Trigonal pyramidal
 - Tetrahedral
 - Square planar
 - Square pyramidal
- The composition of dimolybdates is :
 - $R_2O \cdot 2MoO_3 \cdot nH_2O$
 - $R_2O \cdot 3MoO_3 \cdot nH_2O$
 - $R_2O \cdot 4MoO_3 \cdot nH_2O$
 - $R_2O \cdot 8MoO_3 \cdot nH_2O$
- The energy diagram for d^9 is inverse of :
 - d^1 configuration
 - d^2 configuration
 - d^3 configuration
 - d^5 configuration
- Carbonyls are soluble in :
 - H_2O
 - liq. NH_3
 - liq. SO_2
 - organic solvents
- The bond present in carbonyls is :
 - $M \xleftarrow{\sigma} CO$
 - $M \xrightarrow{\pi} CO$
 - $M \xleftrightarrow[\sigma]{\pi} CO$
 - None of the above

9. Orgel-energy level diagram is used for the interpretation of :
- Spin stretching
 - Rotatory stretching
 - Spin allowed transitions
 - All of the above
10. If 'S' is the absolute value of the spins of the individual electron, the spin multiplicity is given by :
- 2S
 - (2S + 1)
 - (2S + 2)
 - (2S + 3)
11. In mononuclear carbonyls a metal atom is directly linked to :
- C atom
 - O atom
 - N atom
 - H atom
12. Boranes are the compounds of :
- B and H
 - C and H
 - B and N
 - B, C and H
13. Which one of the following carbonyls does not obey EAN rule ?
- $\text{Cr}(\text{CO})_6$
 - $\text{V}(\text{CO})_6$
 - $\text{Fe}(\text{CO})_5$
 - $\text{Ni}(\text{CO})_4$
14. Nido-carboranes have the general formula :
- $\text{C}_2\text{B}_n\text{H}_{n+1}$
 - $\text{C}_2\text{B}_n\text{H}_{n+2}$
 - $\text{C}_2\text{B}_n\text{H}_{n+3}$
 - $\text{C}_2\text{B}_n\text{H}_{n+4}$
15. Which one of the following ions does not exist in solution ?
- PO_4^{3-}
 - CrO_3^{2-}
 - $\text{W}_2\text{O}_7^{2-}$
 - $\text{Mo}_7\text{O}_{24}^{6-}$
16. The spin allowed electronic transitions occur between energy levels which have :
- Different spin multiplicity
 - Different principal quantum number
 - Same spin multiplicity
 - None of the above

17. The number of electrons in the valence shell of the metal in carbonyl is :
- (A) 8
(B) 18
(C) 36
(D) 54
18. The introduction of successive CH units to the structure of smaller nido-carboranes involves the elimination of :
- (A) 1 BH₂ unit
(B) 2 BH₂ units
(C) 3 BH₂ units
(D) 4 BH₂ units
19. In isopolyacids Mo₆ octahedra do not share at :
- (A) Corners
(B) Edges
(C) Faces
(D) None of the above
20. *d-d* transition is :
- (A) ligand-ligand transition
(B) ligand-metal transition
(C) metal-ligand transition
(D) metal-metal transition
21. For a d^2 system where electron spins are parallel, its spin multiplicity is :
- (A) 1
(B) 2
(C) 3
(D) 4
22. Which one of the following is stable borane ?
- (A) B₄H₁₀
(B) B₅H₉
(C) B₅H₁₁
(D) B₆H₁₂
23. Polyacids are generally formed by the elements of the following group of the periodic table :
- (A) I A and II A
(B) I B and II B
(C) V B and VI B
(D) VIII group members
24. Which of the following carbonyl does not obey 18-electrons rule ?
- (A) Cr(CO)₆
(B) Mn(CO)₅
(C) Fe(CO)₅
(D) Ni(CO)₄

25. The geometry of $\text{Ni}(\text{CO})_4$ is :
- (A) Octahedral
 - (B) Square planar
 - (C) Square pyramidal
 - (D) Tetrahedral
26. The compounds formed by the combination of NO and metals are called :
- (A) Nitrites
 - (B) Nitrates
 - (C) Nitrides
 - (D) Nitrosyls
27. Saturated and lowest triatomic member of LNCCs is :
- (A) $\text{M}_2(\text{CO})_{12}$
 - (B) $\text{M}_3(\text{CO})_{12}$
 - (C) $\text{M}_4(\text{CO})_{12}$
 - (D) None of the above
28. Which amongst the following elements does not form isopolyanions ?
- (A) Vanadium
 - (B) Chromium
 - (C) Niobium
 - (D) Molybdenum
29. The energy state of an orbital is determined by :
- (A) Chromatography
 - (B) Polarimetry
 - (C) Spectroscopy
 - (D) Surface tension
30. In nitrosyls NO molecule is linked to the central metal atom through :
- (A) N-atom
 - (B) O-atom
 - (C) Both N and O-atoms
 - (D) None of the above
31. The ground state of an atom possesses :
- (A) Maximum number of unpaired electrons
 - (B) Few unpaired electrons
 - (C) All the paired electrons
 - (D) None of the above
32. Boranes are :
- (A) Highly electron rich compounds
 - (B) Moderately electron rich compounds
 - (C) Electron deficient compounds
 - (D) None of the above

33. The oxidation state of metal in carbonyls is :
- (A) zero
(B) four
(C) two
(D) three
34. The geometry of B_5H_9 molecule is :
- (A) Distorted octahedron
(B) Trigonal pyramidal
(C) Pentagonal
(D) Square pyramidal
35. The polyacids containing more than a single type of anhydrides are called :
- (A) Isopolyacids
(B) Heteropolyacids
(C) Peroxyacids
(D) Carboxylic acids
36. Which one of the following is unknown ?
- (A) NOI
(B) NOBr
(C) NOCl
(D) NOF
37. The geometry of $Cr(CO)_6$ is :
- (A) Tetrahedral
(B) Trigonal planar
(C) Octahedral
(D) Trigonal bipyramidal
38. For Laporte allowed transitions, which one of the following conditions is fulfilled ?
- (A) $\Delta s = \pm 1$
(B) $\Delta l = \pm 1$
(C) $\Delta m = \pm 1$
(D) $\Delta n = \pm 1$
39. Which of the following species are isoelectronic ?
- (A) $Mn(CO)_5/Re(CO)_5$
(B) $CpMo(CO)_3/CpW(CO)_3$
(C) $Co(CO)_3/Ir(CO)_3$
(D) All of the above
40. $[V_{10}O_{28}]^{6-}$ anion contains :
- (A) $6VO_6$ octahedra
(B) $8VO_6$ octahedra
(C) $10VO_6$ octahedra
(D) $12VO_6$ octahedra

41. Racah parameter is represented by :
- (A) B
 - (B) μ
 - (C) η
 - (D) S
42. Which one of the following obeys EAN rule ?
- (A) Nitrides
 - (B) Nitrites
 - (C) Nitrates
 - (D) Nitrosyls
43. High valence clusters are formed by :
- (A) Light transition metals
 - (B) Heavy transition metals
 - (C) S-block elements
 - (D) None of the above
44. The oxidation state of Mn in $[\text{Mn}(\text{NO})_3(\text{CO})]$ is :
- (A) 0
 - (B) -II
 - (C) +III
 - (D) -III
45. In carbonyls, CO molecules behave as :
- (A) Positive ligands
 - (B) Negative ligands
 - (C) Neutral ligands
 - (D) None of the above
46. Carboranes are mixed hydrides of :
- (A) Al and C
 - (B) C and N
 - (C) C and B
 - (D) C, B and N
47. The polyacids containing only one type of acid anhydride are called :
- (A) Isopolyacids
 - (B) Heteropolyacids
 - (C) Per acids
 - (D) Amino acids
48. According to spin selection rule :
- (A) $\Delta s = 0$
 - (B) $\Delta l = 0$
 - (C) $\Delta s = \pm 1$
 - (D) $\Delta l = \pm 1$

49. Infrared adsorption spectra of metallic carbonyls is used :
- To determine the geometry of metallic carbonyls
 - To determine the bond order of legated CO
 - To study reaction rate
 - All of the above
50. The oxidation state of Fe in $[\text{Fe}(\text{NO})(\text{H}_2\text{O})_5]\text{SO}_4$ is :
- zero
 - +1
 - 1
 - +2
51. The colour of sodium nitroprusside is :
- Green
 - Black
 - Yellow
 - Ruby-red
52. In complex ion $[\text{Fe}(\text{NO})(\text{CN})_5]^{2-}$, Fe^{2+} ion undergoes hybridization :
- sp^2
 - sp^3
 - d^2sp^3
 - d^3sp^3
53. Optical Rotatory Dispersion (ORD) phenomenon was first studied by :
- Frensel
 - Orgel
 - Tanabe-Sugano
 - Frank
54. Which among the following will be paramagnetic ?
- $\text{Cr}(\text{CO})_6$
 - $\text{Fe}(\text{CO})_5$
 - $\text{Ni}(\text{CO})_4$
 - None of the above
55. The first HNCC is :
- $\text{Re}_2(\text{CO})_{10}$
 - $\text{Re}_6(\text{CO})_{10}$
 - $\text{Re}_2(\text{CO})_{16}$
 - $\text{Rh}_6(\text{CO})_{16}$
56. An optically active substance absorbs two circularly polarised components to different extent. The differential absorption is known as :
- Circular dichroism
 - Optical rotation dispersion
 - Cotton effect
 - None of the above

57. The general formula for mononuclear carbonyls is :
- (A) $M_x(CO)$
 (B) $M(CO)_y$
 (C) $M_x(CO)_y$
 (D) None of the above
58. Closo-carboranes have the general formula :
- (A) $C_2B_nH_n$
 (B) $C_2B_nH_{n+1}$
 (C) $C_2B_nH_{n+2}$
 (D) $C_2B_nH_{n+4}$
59. Which one of the following is not an isopolyacid ?
- (A) $H_2CrO_3 \cdot CrO_4$
 (B) $H_2CrO_2 \cdot 2CrO_4$
 (C) $H_2CrO_4 \cdot 3CrO_4$
 (D) $3R_2O \cdot P_2O_5 \cdot 24MoO_3$
60. Which one of the following transitions is Laporte forbidden ?
- (A) $s-p$
 (B) $p-s$
 (C) $d-d$
 (D) None of the above
61. The geometry of $Fe(CO)_5$ is :
- (A) Square pyramidal
 (B) Trigonal bipyramidal
 (C) Tetrahedral
 (D) Octahedral
62. Which one of the following is liquid at ordinary temperatures ?
- (A) $Ni(CO)_4$
 (B) $Fe(CO)_5$
 (C) $Ru(CO)_5$
 (D) All of the above
63. In octahedral complexes, the relation between energies of t_{2g} and e_g sets is :
- (A) $t_{2g} > e_g$
 (B) $t_{2g} = e_g$
 (C) $t_{2g} < e_g$
 (D) None of the above
64. The resultant spin angular momentum quantum number (S) and the number of unpaired electrons (n) are related as below :
- (A) $S = \frac{n}{2}$
 (B) $S = n$
 (C) $S = 2n$
 (D) $S = 3n$

65. Among the following complex ions which do not obey EAN rule ?
- (A) $[\text{Cr}(\text{NO})(\text{CN})_5]^{3-}$
 (B) $[\text{Mn}(\text{NO})(\text{CN})_5]^{2-}$
 (C) $[\text{Fe}(\text{NO})(\text{H}_2\text{O})_5]^{2+}$
 (D) All of the above
66. Which one of the following statements is incorrect ?
- (A) dsp^2 hybrid orbital are square planar.
 (B) sp^2 hybrid orbitals are tetrahedral.
 (C) Water molecule is sp^3 hybridised.
 (D) sp^3d^2 hybrid orbitals are octahedral.
67. In tetrahedral complexes which one of the following statements is correct ?
- (A) The energy of e_g set is greater than that of t_{2g} set.
 (B) The energy of t_{2g} set is lower than that of e_g set.
 (C) The energy of e_g set is lower than that of t_{2g} set.
 (D) The energy of t_{2g} and e_g set is equal.
68. In an octahedral complex, non-bonding orbitals are :
- (A) $4s$
 (B) $4p_x, 4p_y, 4p_z$
 (C) $3d_{x^2-y^2}, 3d_{z^2}$
 (D) $3d_{xy}, 3d_{yz}, 3d_{zx}$
69. If 'n' is the number of unpaired electrons, the spin only formula is given by :
- (A) $\mu_{\text{eff.}} = \sqrt{n(n+2)}$
 (B) $\mu_{\text{eff.}} = \sqrt{n(n+1)}$
 (C) $\mu_{\text{eff.}} = \sqrt{(n+2)}$
 (D) $\mu_{\text{eff.}} = \sqrt{(n+1)}$
70. Paratungstate A in the following is :
- (A) $[\text{WO}_4]^{2-}$
 (B) $[\text{HW}_6\text{O}_{21}]^{5-}$
 (C) $[\text{H}_3\text{W}_6\text{O}_{21}]^{3-}$
 (D) $[\text{W}_{12}\text{O}_{41}]^{10-}$

71. The central atom in heteropolyacid is :
- (A) Cr
(B) Fe
(C) Pt
(D) All of the above
72. Which one of the following statements is incorrect ?
- (A) Generally metal carbonyls are crystalline solid.
(B) Most of the carbonyls are coloured.
(C) $V(CO)_6$ is diamagnetic.
(D) Carbonyls are insoluble in water.
73. The ground state term symbol for d^2 electronic configuration is :
- (A) 1S
(B) 3P
(C) 3F
(D) 1G
74. Which amongst the following isoelectronic species has the maximum CO stretching frequency ?
- (A) $[Cr(CO)_6]$
(B) $[Mn(CO)_6]^+$
(C) $[V(CO)_6]^-$
(D) $[Ti(CO)_6]^{2-}$
75. Polyacids have the general formula :
- (A) $H_{12-n}[X(MoO_4)_6]$
(B) $R_2O.3MoO_3, nH_2O$
(C) $xH_2O.P_2O_5, yMoO_3$
(D) $H_{12-n}[X(Mo_2O_7)_6]$
76. In co-ordination compounds, the ligands are :
- (A) Nucleophile
(B) Electrophile
(C) Lewis base
(D) Free radical
77. Which one of the following has highest magnetic moment ?
- (A) $t_{2g}^6 e_g^3$
(B) $t_{2g}^6 e_g^4$
(C) $t_{2g}^3 e_g^2$
(D) t_{2g}^6
78. Nido-carboranes have the following structure :
- (A) closed chain
(B) open cage
(C) closed cage
(D) trigonal planar

79. Which one of the following statements is correct ?
- (A) Metallic carbonyls are π -acid complexes.
- (B) In metallic carbonyls, CO molecule acts as a neutral ligand.
- (C) Metallic atom is in low oxidation state in metallic carbonyls.
- (D) All of the above
80. The first dinitrogen complex was discovered by :
- (A) Allen and Senoff
- (B) Wade
- (C) Corey
- (D) Beck
81. The bonds present in higher boranes are :
- (A) Terminal $(2c - 2e)$ B - H bond
- (B) Direct $(2c - 2e)$ B - B bond
- (C) Bridging $(3c - 2e)$ B - H - B bond
- (D) All of the above
82. The metal complexes of borane anions are called :
- (A) Metalloboranes
- (B) Metallocarboranes
- (C) Metal carbonyl clusters
- (D) Metallic carbide
83. Which one of the following is the strongest ligand ?
- (A) NH_3
- (B) OH^-
- (C) CN^-
- (D) F^-
84. Which of the following clusters obey the capping rule ?
- (A) $[\text{Os}_7(\text{CO})_{21}]$
- (B) $[\text{Os}_8(\text{CO})_{22}]^{2-}$
- (C) $[\text{Os}_{10}\text{C}(\text{CO})_{24}]^{2-}$
- (D) All of the above

85. The bridged carbonyl among the following is :
- (A) $\text{Mn}_2(\text{CO})_{10}$
 (B) $\text{Fe}_2(\text{CO})_9$
 (C) $\text{Fe}_3(\text{CO})_{12}$
 (D) $\text{Re}_2(\text{CO})_{10}$
86. The geometry of tetraborane anion is :
- (A) Tetrahedral
 (B) Square planar
 (C) Square pyramidal
 (D) Trigonal pyramidal
87. What is the true about heteropolyacids ?
- (A) In general, they are soluble in water and ether.
 (B) They exhibit isomorphism.
 (C) They are generally attacked by hydroxyl ions.
 (D) All of the above
88. Structure of pentaborane-9 is :
- (A) Tetrahedral
 (B) Square pyramidal
 (C) Square planar
 (D) Pentagonal pyramidal
89. Which one of the following carbonyls is not known ?
- (A) $\text{Ni}(\text{CO})_4$
 (B) $\text{Fe}(\text{CO})_5$
 (C) $\text{Mn}(\text{CO})_5$
 (D) $\text{Cr}(\text{CO})_6$
90. Dioxygen forms complexes in the form of :
- (A) Dioxygenyl cation
 (B) Peroxo group
 (C) Super oxo group
 (D) All of the above
91. In $\text{Fe}_2(\text{CO})_9$ molecule each Fe-atom is :
- (A) dsp^2 hybridised
 (B) dsp^3 hybridised
 (C) d^2sp^3 hybridised
 (D) d^3sp^3 hybridised
92. Which of the following electronic transitions has maximum energy ?
- (A) $\sigma \rightarrow \sigma^*$
 (B) $n \rightarrow \sigma^*$
 (C) $\pi \rightarrow \pi^*$
 (D) $n \rightarrow \pi^*$

93. Which of the following theories explains the structure of heteropolyacids ?
- (A) Miolati, Capaux and Rosenheim's theory
 (B) Pauling's theory
 (C) Keggin's theory
 (D) All of the above
94. Select the correct statement :
- (A) Energy of bonding MO's is higher than that of antibonding MO's.
 (B) Energy of bonding MO's is lower than that of antibonding MO's.
 (C) Energy of bonding and antibonding MO's is equal.
 (D) None of the above
95. In an endothermic reaction :
- (A) Heat is absorbed.
 (B) Heat is liberated.
 (C) Heat is neither absorbed nor liberated.
 (D) None of the above
96. Electron transfer reactions are called :
- (A) Oxidation reactions
 (B) Reduction reactions
 (C) Redox reactions
 (D) None of the above
97. A correlation of electron count and structure of HNCCs was introduced by :
- (A) Wade
 (B) Mingos
 (C) Lauher
 (D) All of the above
98. 6-polyacids are represented by the general formula :
- (A) $H_{12-n} [X(MoO_4)_6]$
 (B) $H_{12-n} [X(Mo_2O_7)_6]$
 (C) $R_2O \cdot 3 MoO_3 \cdot nH_2O$
 (D) $xH_2O, P_2O_5 \cdot yMoO_3$
99. The unit of magnetic moment is :
- (A) Poise
 (B) Curie
 (C) Rutherford
 (D) Bohr-Magneton
100. The general formula for polynuclear carbonyls is :
- (A) $M_x(CO)$
 (B) $M(CO)_y$
 (C) $M_x(CO)_y$
 (D) None of the above

Roll No.

Question Booklet Number

O. M. R. Serial No.

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277901

**M. Sc. (Second Semester) (NEP)
EXAMINATION, 2022-23**

CHEMISTRY

(Organic Chemistry-II)

Paper Code

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|---|---|---|---|---|---|---|---|
| B | 0 | 2 | 0 | 8 | 0 | 2 | T |
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Questions Booklet
Series

A

Time : 1:30 Hours]

[Maximum Marks : 75

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

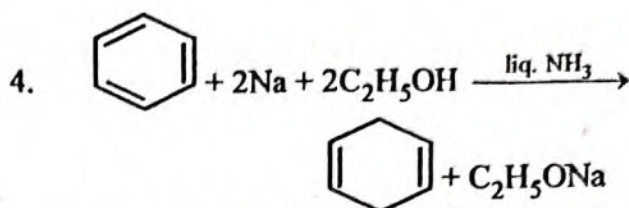
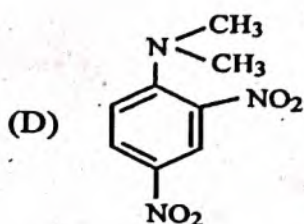
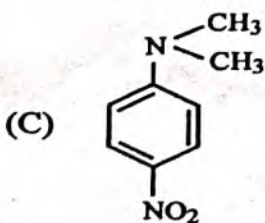
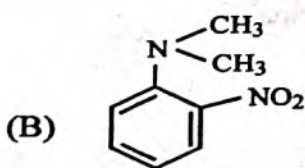
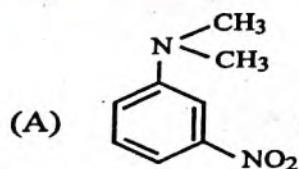
1. In nitrating mixture, the reaction between HNO_3 and H_2SO_4 results in the formation of:

- (A) $\overset{+}{\text{N}}\text{O}_2$
- (B) $\overset{-}{\text{N}}\text{O}_2$
- (C) NO_3^-
- (D) SO_3

2. In Friedel-Crafts' acylation the reactivity of acylhalide is usually:

- (A) $\text{RCOF} > \text{RCOCl} > \text{RCOBr} > \text{COI}$
- (B) $\text{RCOI} > \text{RCOBr} > \text{RCOCl} > \text{RCOF}$
- (C) $\text{RCOCl} > \text{RCOBr} > \text{RCOI} > \text{RCOF}$
- (D) $\text{RCOI} > \text{RCOF} > \text{RCOBr} > \text{RCOCl}$

3. The main product formed on nitration of N-N-dimethylaniline with conc. H_2SO_4 - HNO_3 is:



The above reaction is an example of:

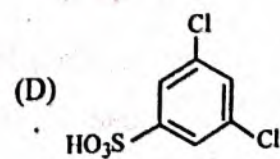
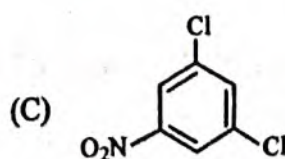
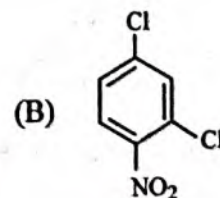
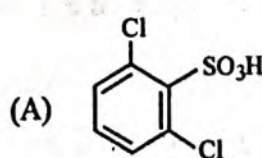
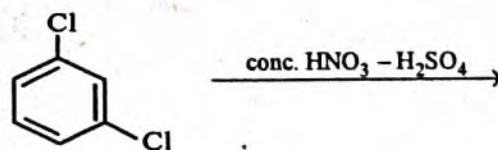
- (A) Clemmensen reduction
- (B) Rosenmund reduction
- (C) Wolf-Kishner reaction
- (D) Birch reduction

5. Carbylamine reaction involves formation of:

- (A) nitrene intermediate
- (B) carbene intermediate
- (C) benzyne intermediate
- (D) radical cation

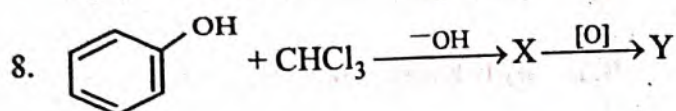
6. Predict the major product in the following

reaction:

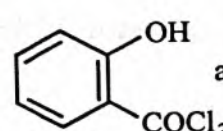
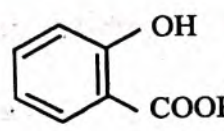
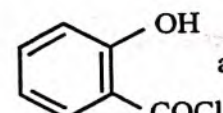
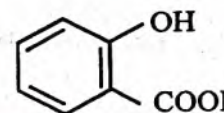
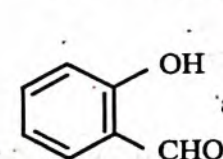
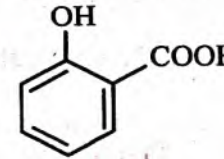
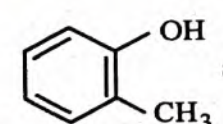
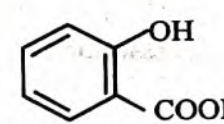


7. Which of the following groups is not meta-directing ?

- (A) $-\text{COR}$
 (B) $-\text{COOR}$
 (C) $-\text{NH}_3^+$
 (D) $-\text{O.COR}$

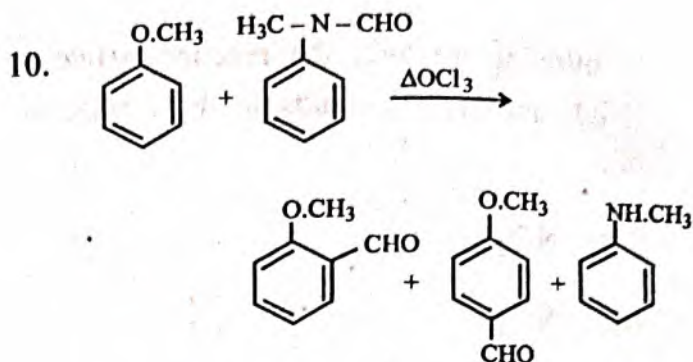


In the above reaction X and Y are :

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

9. Methyl orange indicator gives :

- (A) orange colour in neutral medium and red in alkaline medium.
 (B) orange in acidic medium and red in alkaline medium
 (C) orange in alkaline medium and red in acidic medium
 (D) None of the above



The above reaction is an example of:

- (A) Hoesch reaction
 (B) Vilsmeier-Haack reaction
 (C) Bischler-Napieralski reaction
 (D) Diazocoupling reaction

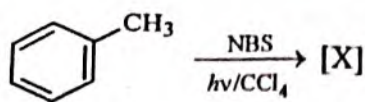
11. Which of the following substrates generally undergoes S_{N}^2 reaction mechanism ?

- (A) Benzylic alkylhalide
 (B) Tertiary alkylhalide
 (C) Secondary alkylhalide
 (D) Primary alkylhalide

12. Shortest C-Cl bond length is in :

- (A) Methyl chloride
 (B) Chlorobenzene
 (C) Benzylchloride
 (D) Chlorohexane

13. Product [X] in the following is :

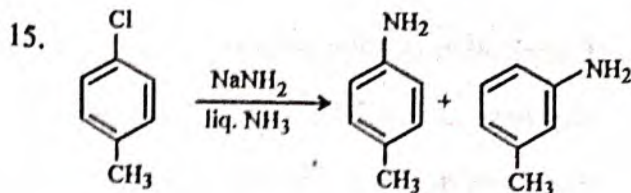


- (A)
- (B)
- (C)
- (D)

14. Which among the following will not give

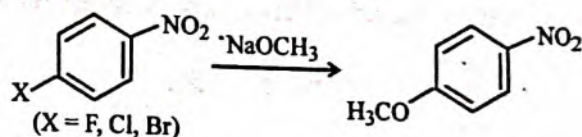
bromoform with Br_2/OH^- ?

- (A): $CH_3-CH_2-CH_2-Br$
- (B) CH_3-CH_2-Br
- (C) $Br-CH_2-CO.CH_2CH_3$
- (D)



The above reaction is an example of :

- (A) radical substitution
- (B) nucleophilic elimination-addition involving
- (C) electrophilic substitution
- (D) electrophilic substitution by addition-elimination.
16. Toluene when refluxed with Br_2 in the presence of light gives :
- (A) mixture of *o*- and *p*-bromotoluene
- (B) only *o*-bromotoluene
- (C) only *p*-bromotoluene
- (D) benzyl bromide
17. The correct order of reactivity of *p*-halo-nitrobenzene in the following reaction is :



- (A) *p*-fluoronitrobenzene >
p-chloronitrobenzene >
p-bromonitrobenzene
- (B) *p*-bromonitrobenzene >
p-chloronitrobenzene >
p-fluoronitrobenzene
- (C) *p*-chloronitrobenzene >
p-fluoronitrobenzene >
p-bromonitrobenzene
- (D) None of the above

18. Chlorination of toluene in presence of light and heat for sufficient period followed by hydrolysis results in the formation of :
- o*-cresol
 - p*-cresol
 - mixture of *o*- and *p*-cresols
 - Benzoic acid
19. Iodobenzene can be prepared easily by :
- reaction of benzene diazonium chloride and KI.
 - reaction of iodine on benzene in presence of Fe.
 - reaction of benzene with HI in presence of red P.
 - All of the above
20. Hydrolysis of different alkylhalides by S_N^1 mechanism follows the order :
- 1° alkylhalide $>$ 2° alkylhalide $>$ 3° alkylhalide.
 - 2° alkylhalide $>$ 3° alkylhalides $>$ 1° alkylhalides.
 - 3° alkylhalides $>$ 2° alkylhalides $>$ 1° alkylhalides.
 - 2° alkylhalides $>$ 1° alkylhalides $>$ 3° alkylhalides.
21. Alkylhalides react with AgCN to form :
- alkyl cyanide
 - alkyl isocyanide
 - mixture of alkyl cyanide and isocyanide
 - no reaction
22. Preparation of alkyl iodide from alkylchloride by sodium iodide in acetone is called :
- Haloform reaction.
 - Williamson's reaction.
 - Conant-Finkelstein reaction.
 - Borodine-Hunsdiecker reaction.
23. In S_N^2 reaction, product is formed withof configuration.
- inversion
 - retention
 - racemisation
 - Both (B) and (C)
24. In S_N^2 mechanism the attacking nucleophile approaches from opposite side of the C—X bond because of :
- dipole repulsion
 - steric interaction
 - Both (A) and (B)
 - None of the above

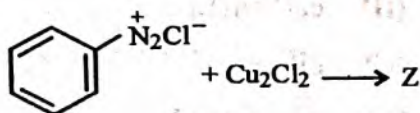
25. Which of the following will undergo free radical bromination most readily ?

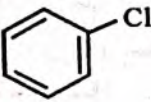
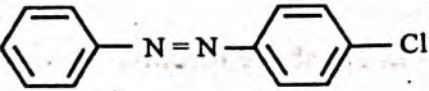
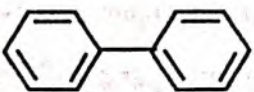
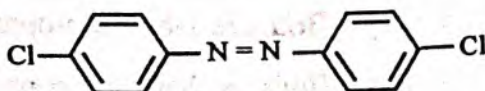
- (A) CH_3COOH
 (B) $\text{CH}_3\text{CH}_2\text{COOH}$
 (C) $\text{CH}_3\text{—COCH}_3$
 (D) $\begin{array}{c} \text{CH}_2\text{COOH} \\ | \\ \text{CH}_2\text{COOH} \end{array}$

26. Free radical bromination of *n*-butane forms :

- (A) achiral 2-bromobutane
 (B) (–)-bromobutane
 (C) (+)-bromobutane
 (D) (±)-2-bromobutane

27. Predict the product Z in the following :




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

28. Which of the following will give only one monochloro derivative on free radical chlorination ?

- (A) $(\text{CH}_3)_4\text{C}$
 (B) $\text{CH}_3\text{—CH}_2\text{—CH}_3$
 (C) $\text{CH}_3\text{—CH}_2\text{—CH}_2\text{—CH}_3$
 (D) $\begin{array}{c} \text{CH}_3 \\ | \\ \text{CH}_3\text{—CH—CH}_3 \end{array}$

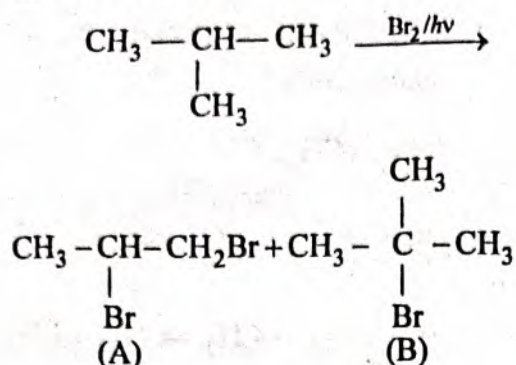
29. Which of the following free radicals is most stable ?

- (A) $\text{CH}_3\text{—CH}_2\text{—}\dot{\text{C}}\text{H—Ph}$
 (B) $\text{CH}_2\text{=CH—}\dot{\text{C}}\text{H—CH}_3$
 (C) $\text{CH}_2\text{=CH—}\dot{\text{C}}\text{H—}$ 
 (D) $\text{CH}_3\text{—CH}_2\text{—}\dot{\text{C}}(\text{CH}_3)$

30. Which of the following pairs is correctly matched ?

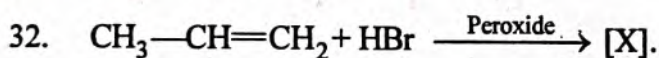
- (A) Singlet carbene – Paramagnetic
 (B) Carbocation – sp^3 hybridisation
 (C) Free radical – Paramagnetic
 (D) Carbanion – sp^2 hybridisation

31. In the reactions



The percentage of B in the product mixture is:

- (A) more than 90%
 (B) less than 10%
 (C) 50%
 (D) 30%



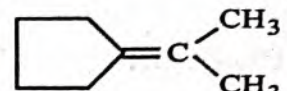
In the above reaction product [X] is:

- (A) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{Br}$
 (B) $\text{CH}_3 - \underset{\text{Br}}{\text{CH}} - \text{CH}_3$
 (C) $\text{Br} - \text{CH}_2 - \text{CH} = \text{CH}_2$
 (D) $\text{Br} - \text{CH}_2 - \text{CH}_2 - \text{CH}_2\text{Br}$

33. Presence of peroxide affects the addition of:

- (A) HI
 (B) HCl
 (C) HBr
 (D) All of the above

34. Which of the following alkenes on ozonolysis gives a mixture of ketones only?

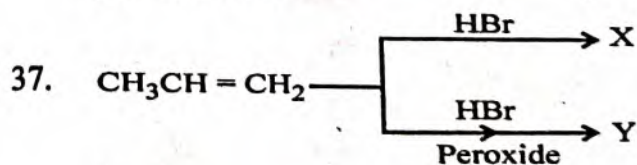
- (A) $\text{CH}_3 - \underset{\text{CH}_3}{\text{CH}} - \text{CH} = \text{CH}_2$
 (B) $\text{CH}_2 = \text{CH}_2$
 (C) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH}_3$
 (D) 

35. Oxidation of alkenes with an organic peroxy-acid is called:

- (A) carboxylation reaction
 (B) epoxidation
 (C) hydrogenation
 (D) ozonolysis

36. Halogenation of alkanes proceeds through the formation of:

- (A) carbocation
 (B) carbanion
 (C) nitrene
 (D) free radical



In the above reactions products X and Y are

- (A) 2-bromopropane and 1-bromopropane
 (B) 1-bromopropane and 2-bromopropane
 (C) Both are 1-bromopropane
 (D) Both are 2-bromopropane

38. An alkene on ozonolysis gives propanone and ethanol. Identify the alkene :

- (A) 2-methyl-2-butene
- (B) 2-pentene
- (C) 1-pentene
- (D) None of the above

39. Deviation from Markownikoff's rule occurs in the presence of :

- (A) Zn
- (B) Zn-Hg/HCl
- (C) Pd-BaSO₄
- (D) Peroxides

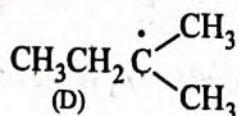
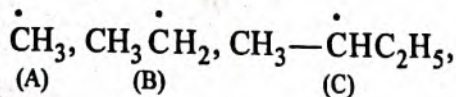
40. Alcoholic KOH solution is used for :

- (A) dehydrogenation
- (B) dehydration
- (C) dehydrohalogenation
- (D) dehalogenation

41. Free radical mechanism involves :

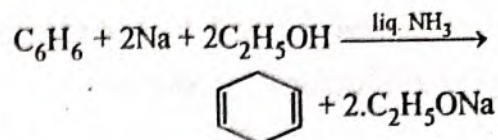
- (A) initiation
- (B) propagation
- (C) termination
- (D) All of the above

42. Arrange the following free radicals in the decreasing order of stability :



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

43. The reaction



is :

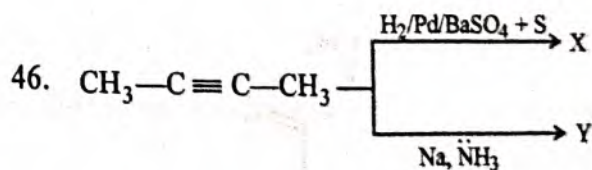
- (A) Birch reduction
- (B) Rosenmund's reduction
- (C) Clemmensen reduction
- (D) Wolff-Kishner reduction

44. Which of the following alkenes will give optically active product with Br₂/CCl₄ ?

- (A) cis-but-2-ene
- (B) trans-but-2-ene
- (C) propane
- (D) but-1-ene

45. Which one of the following pairs is not correctly matched ?

- (A) Williamson synthesis – Arenes
- (B) Skraup synthesis – Quinoline
- (C) Hantzsch synthesis – Pyridine
- (D) Haworth synthesis – Naphthalene



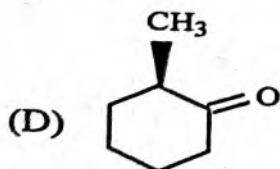
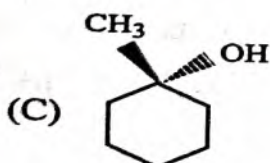
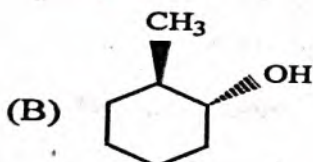
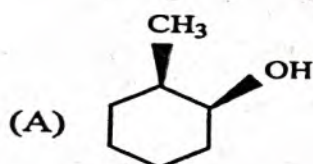
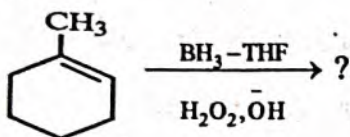
In the above reactions products X and Y are :

- (A) trans-but-2-ene and cis-but-2-ene
- (B) cis-but-2-ene and trans-but-2-ene
- (C) butene-2 and 4-butane
- (D) n-butane and butene-2

47. Which of the following reagents is commonly used as a nucleophile in the Michael addition reaction ?

- (A) LiAlH_4
- (B) Grignard reagent
- (C) Malonic ester
- (D) NaH

48. Predict the product in the following reaction :

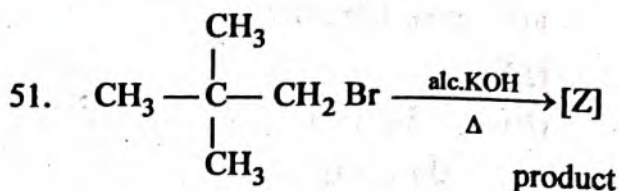


49. Cannizzaro reaction is a type of :

- (A) redox reaction
- (B) oxidation reaction
- (C) reduction reaction
- (D) displacement reaction

50. Which of the following compounds undergoes thermal elimination reaction ?

- (A) Alcohols
- (B) Bromides
- (C) Acetate
- (D) Chlorides

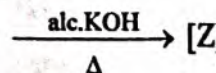
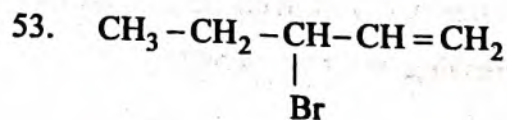


In the above reactions, the product [Z] is :

- (A) 1-butene
- (B) 2-butene
- (C) 3-methyl-1-butene
- (D) 2-methyl-2-butene

52. Reaction intermediate of E1cb reaction is :

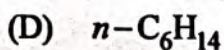
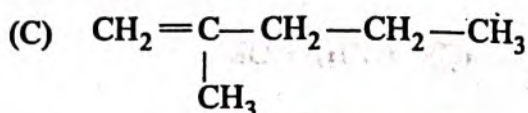
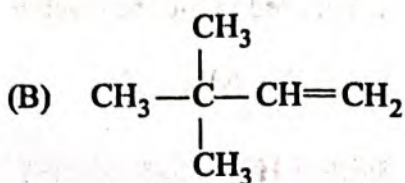
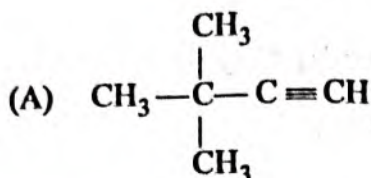
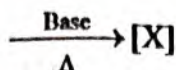
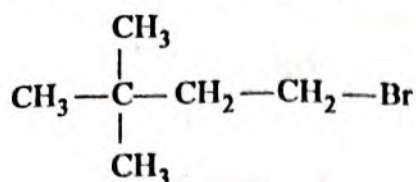
- (A) carbocation
- (B) carbanion
- (C) benzyne
- (D) six-membered cyclic transition state



In the above reaction [Z] will be :

- (A) $\text{CH}_3 - \text{CH} = \text{CH} - \text{CH} = \text{CH}_2$
- (B) $\text{CH}_3 - \text{CH}_2 - \text{CH} = \text{C} = \text{CH}_2$
- (C) $\text{CH}_2 = \text{CH} - \text{CH}_2 - \text{CH} = \text{CH}_2$
- (D) $\text{CH}_3 - \text{CH}_2 - \text{CH}_2 - \text{CH}_2 - \text{CH}_3$

54. In the following reaction, product [X] is :



55. The compound that undergoes Aldol condensation is :

(A) Benzaldehyde

(B) Chloral

(C) Trimethylacetaldehyde

(D) None of the above

56. Preparation of benzaldehyde from toluene by chromylchloride oxidation method is :

(A) Rosenmund reaction

(B) Stephen's reaction

(C) Etard reaction

(D) Claisen-Schmidt reaction

57. Reduction of >C=O by Zn-Hg/HCl is called :

(A) MPV reduction

(B) Wolf-Kishner reduction

(C) Clemmensen's reduction

(D) Rosenmund reduction

58. Which of the following does not undergo Cannizzaro's reaction ?

(A) $\text{C}_6\text{H}_5\text{CHO}$

(B) CH_3CHO

(C) HCHO

(D) Cl_3CCHO

59. Condensation reaction of carbonyl compound with α -haloester in the presence of Zn metal is called :

(A) Reformatsky reaction

(B) Wittig reaction

(C) Mannich reaction

(D) Stobbe condensation

60. Benzaldehyde reacts with Ac_2O in the presence of CH_3COONa to give :


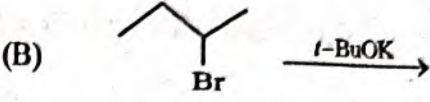
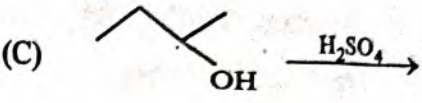
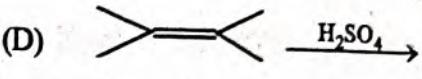
(A) Cinnamic acid

(B) Anthranilic acid

(C) Furoin

(D) Benzoin

61. Claisen-Schmidt reaction takes place between :
- Benzaldehyde and aldehyde or ketone having α -H atom(s)
 - CH_3CHO and $\text{CH}_3\text{—CO—CH}_3$
 - $\text{C}_6\text{H}_5\text{CHO}$ and KCN
 - None of the above
62. Which one of the following can be used for the formation of C—C—N bond in organic synthesis ?
- Crossed Claisen condensation
 - Claisen-ester condensation
 - Mannich reaction
 - Michael addition
63. The catalyst of the Benzoin condensation is :
- $\text{C}_2\text{H}_5\text{OH}/\text{H}_2\text{O}$
 - CN^-
 - $\text{Cu}_2\text{Cl}_2/\text{HCl}$
 - K^+
64. A Claisen condensation would most likely produce which of the following as a product ?
- β -keto acid
 - α -hydroxyester
 - secondary alcohol
 - aldehyde
65. Predict the correct reagent for the following reaction ?
- $$\text{CH}_3\text{CH}_2\text{CH}_2\text{COOH} \longrightarrow \text{CH}_3\text{CH}_2\text{CH}_2\text{CH}_2\text{OH}$$
- LiAlH_4 , ether
 - $\text{Li}/\text{liq. NH}_3$
 - NaBH_4 , CH_3OH
 - H_2/Ni
66. The reagent used in Stobbe reaction is :
- KNH_2 , liq. NH_3
 - $\text{SnCl}_2 + \text{HCl}$
 - $(\text{CH}_3)_3\text{COK}$
 - All of the above
67. The reaction of ethyl bromide with ethoxide ion is an example of :
- E_1 reaction
 - E_2 reaction
 - Pyrolytic elimination reaction
 - None of the above
68. Reaction intermediate of E_1 reaction is :
- free radical
 - carbonation
 - carbanion
 - Both carbocation and carbanion

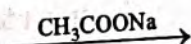
69. E2 reactions are :
- stereoselective
 - stereospecific
 - stereoselective and stereospecific
 - non-stereoselective and non-stereospecific
70. Which of the following is not a class of Organic Compounds ?
- Amides
 - Electro Compound
 - Nitro Compound
 - Carbonyl Compound
71. Which of the following is not an example of β -elimination reactions ?
- Dehydration of alcohols
 - Pyrolysis of esters
 - Dehydrohalogenation of ethyl bromide
 - Generation of dichlorocarbene from chloroform
72. With increasing basicity of the added base, the rate of E2 (bimolecular elimination) reaction :
- decreases
 - increases
 - firstly increases then decreases
 - no effect of temperature
73. Among the following reactions which gives 1-butene as a major product is :
-  (A) CCCCBr >> [t-BuOK]
 -  (B) CC(Br)CC >> [t-BuOK]
 -  (C) CCC(O)C >> [H2SO4]
 -  (D) CC(C)=CC >> [H2SO4]
74. Which of the following statements is incorrect for E1cb ?
- carbanion as reaction intermediate.
 - two step reaction.
 - as the temperature increases, the rate increases.
 - strong acid is needed to remove hydrogen as proton.
75. Which of the following statements is incorrect for E2 reaction ?
- Strong base is needed to remove hydrogen as proton
 - One step reaction
 - Carbocation as reaction intermediate
 - Most common reaction

76. Which of the following statements is incorrect for E1 reaction ?

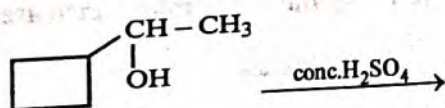
- (A) Stereospecific and Stereoselective
- (B) Follow first order
- (C) Two step reaction
- (D) Carbocation as reaction intermediate

77. Pick the incorrect match in the following :

- (A) Markownikoff's rule - addition reaction of alkenes
- (B) E1 reaction - C_2H_5Br and $C_2H_5O^\ominus$
- (C) Saytzeff's rule - dehydrohalogenation of alkyl halides
- (D) Perkin's reaction - $C_6H_5CHO + Ac_2O$

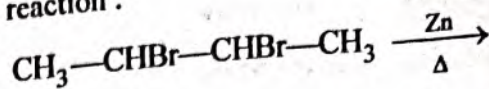


78. Predict the product in the following reaction :



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

79. Predict the product in the following reaction :

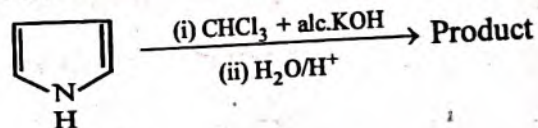


- (A) $CH_2=CH-CH=CH_2$
- (B) $CH_3-CH=CH-CH_3$
- (C) $CH_3-C \equiv C-CH_3$
- (D) $CH_2=CH_2 + CH_2=CH_2$

80. Which carbocation is the most stable ?

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

81. Predict the product in the following reaction :

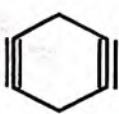
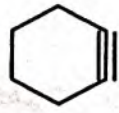
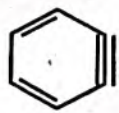
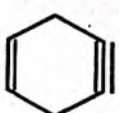


- (A)
- (B)
- (C)
- (D)

82. Which of the following pairs is not correctly matched ?

- (A) Carbylamine reaction – carbene as reaction intermediate
- (B) Wittig reaction – carbene as reaction intermediate
- (C) Reimer-Tieman reaction – carbene as reaction intermediate
- (D) Claisen-Schmidt reaction – carbene as reaction intermediate

83. Benzyne is represented as :

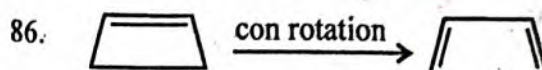
- (A) 
- (B) 
- (C) 
- (D) 

84. Which of the following reaction intermediates is formed in Reimer-Tieman reaction ?

- (A) $\overset{\ominus}{\text{C}}\text{HO}$ carbocation
- (B) dichlorocarbene
- (C) $\overset{+}{\text{C}}\text{HOH}$ carbocation
- (D) $\overset{\ominus}{\text{C}}\text{H}_2\text{—CO.CH}_3$ carbocation

85. Sigmatropic reaction is a type of :

- (A) Elimination reaction
- (B) Addition reaction
- (C) Pericyclic reaction
- (D) None of the above



The above reaction is :

- (A) Thermally allowed
- (B) Photochemically allowed
- (C) Both (A) and (B)
- (D) None of the above

87. Predict the number of node(s) in ψ_4 of 1, 3-butadiene :

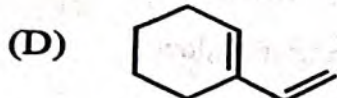
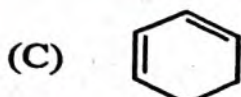
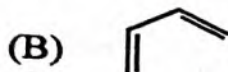
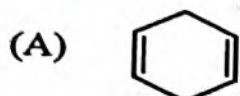
- (A) zero node
- (B) one node
- (C) two nodes
- (D) three nodes

88. Mixing the eight *p*-atomic orbitals in the tetraene given below, generates new molecular orbitals.



- (A) 16
- (B) 8
- (C) 4
- (D) 2

89. Which diene will not take part in Diels-Alder reaction ?



90. Which of the following statements is incorrect for Pericyclic reaction ?

(A) highly stereospecific

(B) brought about by heat or light

(C) not affected by presence or absence of catalyst

(D) ionic reaction, involves formation of reaction intermediates

91. Diels-Alder reaction normally yield Endo adduct as a major product. This is due to :

(A) Steric hindrance

(B) Faster rate of formation of Endo adduct

(C) secondary orbital interaction between a diene and a dienophile

(D) higher stability of the product

92. In the interaction of cyclopentadiene with acrylate ester giving Diels-Alder reaction products, the interacting Frontier orbitals are :

(A) HOMO of diene and LUMO of dienophile

(B) HOMO of dienophile and LUMO of diene

(C) HOMO of diene and HOMO of dienophile

(D) LUMO of diene and LUMO of dienophile

93. The HOMO of 1, 3, 5-hexatriene is :

(A) ψ_6

(B) ψ_5

(C) ψ_2

(D) ψ_3

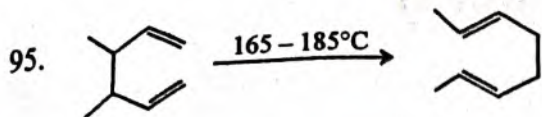
94. Orbitals which are equal in energy are referred as :

(A) HUMO

(B) Degenerate

(C) LOMO

(D) HOMO



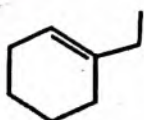
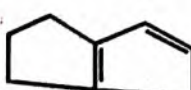
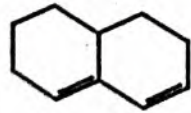
The above example of Cope rearrangement is an example of:

- (A) 2, 3-sigmatropic
- (B) 1, 5-sigmatropic
- (C) 3, 3-sigmatropic
- (D) 1, 3-sigmatropic

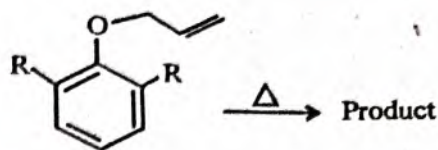
96. The conversion of vinyl cyclopropane to cyclopentene upon heating is an example of:

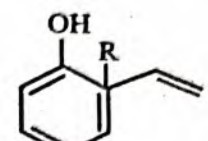
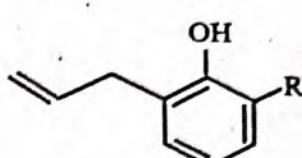
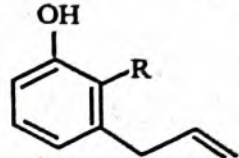
- (A) [1, 3] sigmatropic rearrangement
- (B) [3, 3] sigmatropic rearrangement
- (C) [1, 5] sigmatropic rearrangement
- (D) [1, 2] sigmatropic rearrangement

97. Which of the following will undergo Diels-Alder reaction?

- (A) 
- (B) 
- (C) 
- (D) Both (A) and (B)

98. Predict the product in the following reaction:



- (A) 
- (B) 
- (C) 
- (D) None of the above

99. Which of the following is an example of [3, 3] sigmatropic arrangement?

- (A) Cope rearrangement
- (B) Claisen rearrangement
- (C) Both (A) and (B)
- (D) None of the above

100. Symmetry properties (m & $S-2$) ψ_3 of 1, 3-butadiene are:

- (A) $m-S$ and $c-2-A$
- (B) $m-A$ and $c-2-S$
- (C) $m-S$ and $c-2-S$
- (D) $m-A$ and $c-2-A$

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**M. Sc. (Second Semester) (NEP)
EXAMINATION, 2022-23**

CHEMISTRY

(Physical Chemistry-II)

Paper Code

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|----------|----------|----------|----------|----------|----------|----------|----------|
| B | 0 | 2 | 0 | 8 | 0 | 3 | T |
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Questions Booklet
Series

C

Time : 1:30 Hours

[Maximum Marks : 75

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

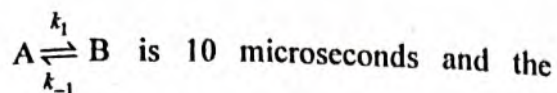
(Remaining instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

- Surface tension of lyophilic sols is :
 - lower than that of H₂O
 - more than that of H₂O
 - equal to that of H₂O
 - None of the above
- What is the equation form of Langmuir isotherm under high pressure ?
 - $\frac{x}{m} = \frac{a}{b}$
 - $\frac{x}{m} = ap$
 - $\frac{x}{m} = \frac{1}{a.p}$
 - $\frac{x}{m} = \frac{b}{a}$
- Which of the following is true in respect of adsorption ?
 - $\Delta G < 0, \Delta S > 0, \Delta H < 0$
 - $\Delta G < 0, \Delta S < 0, \Delta H < 0$
 - $\Delta G > 0, \Delta S > 0, \Delta H < 0$
 - $\Delta G > 0, \Delta S > 0, \Delta H > 0$
- Which acts as autocatalyst during titration of KMnO₄ and oxalic acid in presence of H₂SO₄ ?
 - H₂SO₄
 - KMnO₄
 - Oxalic acid
 - MnSO₄
- The correct order of adsorption of the gases studied will be :
 - NH₃ > SO₂ > CO₂ > HCl
 - CO₂ > SO₂ > NH₃ > HCl
 - SO₂ > NH₃ > HCl > CO₂
 - HCl > SO₂ > NH₃ > CO₂
- Critical micelle concentration (CMC) of soap solution lies in the range :
 - 10⁻⁶ - 10⁻⁵ M
 - 10⁻⁵ - 10⁻⁴ M
 - 10⁻³ - 10⁻² M
 - 10⁻⁴ - 10⁻³ M
- Which of the following will have maximum flocculation number (value) for arsenic sulphide sol ?
 - NaCl
 - KCl
 - BaCl₂
 - AlCl₃
- Which of the following has minimum gold number ?
 - Potato starch
 - Gum arabic
 - Gelatin
 - Albumen

9. For an endothermic reaction, where ΔH represents the enthalpy of the reaction in kJ/mol, the minimum value for the energy of activation will be :
- (A) less than ΔH
 (B) zero
 (C) more than ΔH
 (D) equal to ΔH
10. If 'I' is the intensity of absorbed light and 'C' is the concentration of AB for the photochemical process $AB + h\nu \rightarrow AB^*$ the rate of formation of AB^* is directly proportional to :
- (A) C
 (B) I
 (C) I^2
 (D) C.I.
11. A chemical reaction was carried out at 300 K and 280 K. The rate constants were found to be k_1 and k_2 respectively, then :
- (A) $k_2 = 4k_1$
 (B) $k_2 = 2k_1$
 (C) $k_2 = 0.25k_1$
 (D) $k_2 = 0.5k_1$
12. Type of molecular masses obtained from sedimentation method :
- (A) number average molecular mass
 (B) viscosity average molecular mass
 (C) weight average molecular mass
 (D) - None of the above
13. Diamond is macromolecule but not polymer because :
- (A) made by small units or molecules
 (B) made by one or more type atoms
 (C) made by larger molecules
 (D) None of the above
14. Development of green coating on copper and bronze due to :
- (A) Polarization
 (B) Overvoltage
 (C) Corrosion
 (D) Hydrolysis
15. Rust on iron is :
- (A) H_2CO_3
 (B) CH_3COONa
 (C) $Fe_2O_3 \cdot xH_2O$
 (D) xH_2O

16. The relaxation time for the fast reaction



equilibrium constant is 1.0×10^{-3} . The rate constants for the forward and the reverse reaction :

(A) 10^8 s^{-1}

(B) 10^5 s^{-1}

(C) 10^{-8} s^{-1}

(D) 10^3 s^{-1}

17. Which of the following assumptions was not made in rapid equilibrium model ?

(A) Flexible nature of enzymes

(B) $[S] \gg [E]$

(C) $[E] + [S]$

(D) None of the above

18. Which of these is referred to as K_{cat} ?

(A) Michaelis-Menten constant

(B) Catalytic efficiency

(C) Substrate concentration

(D) Turnover number

19. What does the following equation represent ?

$$1/V_0 = K_m/V_{max} (1/[S] + 1/V_{max})$$

(A) Eadie-Hofstee plot equation

(B) Lineweaver-Burk equation

(C) Michaelis-Menten equation

(D) Hanes plot equation

20. The different types of energies associated with a molecule are :

(A) Electronic energy

(B) Vibrational energy

(C) Rotational energy

(D) All of the mentioned

21. During the motion, if the centre of gravity of molecule changes the molecule possesses :

(A) Electronic energy

(B) Rotational energy

(C) Translational energy

(D) Vibrational energy

22. The correct order of different types of energies is :
- (A) $E_{el} \gg E_{vib} \gg E_{rot} \gg E_{tr}$
 (B) $E_{el} \gg E_{rot} \gg E_{vib} \gg E_{tr}$
 (C) $E_{el} \gg E_{vib} \gg E_{tr} \gg E_{rot}$
 (D) $E_{tr} \gg E_{vib} \gg E_{rot} \gg E_{el}$
23. The region of electromagnetic spectrum for NMR is :
- (A) Microwave
 (B) Radio frequency
 (C) Infrared
 (D) UV-rays
24. Which of the following is an application of molecular spectroscopy ?
- (A) Structural investigation
 (B) Basis of understanding of colors
 (C) Study of energetically excited reaction products
 (D) All of the mentioned
25. The results obtained by spectroscopic method are less reliable, less reproducible and incorrect than classical methods.
- (A) True
 (B) False
 (C) None of the above
 (D) Both of the above
26. The transition zone for Raman spectra is :
- (A) between vibrational and rotational levels
 (B) between electronic levels
 (C) between magnetic levels of nuclei
 (D) between magnetic levels of unpaired electrons
27. Metal A displaces metal B from its salt solution but not able to displace C from its salt solution. Metal B displace metal D from its salt solution which is second most reactive metal ?
- (A) A
 (B) B
 (C) C
 (D) D
28. The decreasing order of electrical conductivity of the following aqueous solution is :
- 0.1 M Formic acid (A)
 0.1 M Acetic acid (B)
 0.1 M Benzoic acid (C)
- (A) $A > C > B$
 (B) $C > B > A$
 (C) $A > B > C$
 (D) $C > A > B$

29. Which of the metals listed in the options is the least reactive ?
- (A) Gold
(B) Iron
(C) Copper
(D) Magnesium
30. e_1 is the electrochemical equivalent of an element of chemical equivalence E_1 . The electrochemical equivalent of an element of chemical equivalence E_2 is :
- (A) $E_2 E_1 / e_1$
(B) $E_1 / e_1 E_2$
(C) $e_1 E_1 / E_2$
(D) $e_1 E_2 / E_1$
31. A fuel cell is a type of electrochemical cell.
- (A) True
(B) False
(C) None of the above
(D) Both of the above
32. Which of the following is used as an electrolyte in an $H_2 - O_2$ fuel cell ?
- (A) KOH
(B) NH_4OH
(C) $Fe(OH)_2$
(D) $Cu(OH)_2$
33. Which of the following can be used as fuel in a fuel cell ?
- (A) Nitrogen
(B) Argon
(C) Hydrogen
(D) Helium
34. The activity of a pure substance can be regarded as :
- (A) 2
(B) 3
(C) 1
(D) 4
35. The system permits the measurements of surface tension of the metal in contact with the solution as a function of the electrical potential differences across the interface is :
- (A) Electrocapillary measurements
(B) Surface tension
(C) Viscosity
(D) None of the above
36. Gouy-Chapman model of the double layer gives :
- (A) fixes the solution charges on to a sheet parallel to the metal
(B) liberates the ions from a sheet parallel to the electrode
(C) Both of the above
(D) None of the above

37. The current-voltage curve obtained from solution contains a single electroactive species is known as :
- spectra
 - polarogram
 - IR
 - UV
38. Volcano is a phenomenon related to :
- Electrocatalysis
 - Polarography
 - Electrolysis
 - Kinetics
39. If the molecules or ions undergo reduction at dropping mercury electrode the polarographic waves are called :
- anodic waves
 - cathodic waves
 - oxygen waves
 - None of the above
40. The current at which the rapid increase of potential takes place is known as :
- limiting current density
 - diffuse layer
 - resistance
 - None of the above
41. In polarographic technique we use :
- dropping mercury electrode only
 - calomel electrode only
 - Both of the above
 - None of the above
42. The Hodgkin-Huxley (H-H) theory of the nervous system is an example of :
- Photochemistry
 - Bioclectrochemistry
 - Catalysis
 - None of the above
43. Flash photolysis method is used in study of :
- Fast reaction
 - Slow reaction
 - Both of the above
 - None of the above
44. The energy that remains in the same quantum state during the course of the reaction is called :
- active energy
 - inactive energy
 - balance energy
 - None of the above
45. The reactions take place in two or more steps one after the other are called :
- unimolecular reactions
 - consecutive reactions
 - zero molecular reactions
 - None of the above
46. Pyrolysis (high temperature decomposition) of hydrocarbons is :
- chain reactions
 - unimolecular reactions
 - bimolecular reactions
 - None of the above

47. The rate law expression for the reaction $\text{H}_2\text{Br}_2 \longrightarrow 2\text{HBr}$ is :
- (A) $\frac{d[\text{HBr}]}{dt} = k[\text{H}_2][\text{Br}_2]$
 (B) $\frac{d[\text{HBr}]}{dt} = k[\text{H}_2][\text{Br}_2]^{1/2}$
 (C) $\frac{d[\text{HBr}]}{dt} = k[\text{H}_2]^{1/2}[\text{Br}_2]$
 (D) None of the above
48. When a beam of light is passed through a colloidal solution, it suffers scattering which is called :
- (A) side effect
 (B) Tyndall effect
 (C) reflection
 (D) refraction
49. PMMA is obtained by the polymerization of :
- (A) vinyl chloride monomer
 (B) styrene monomer
 (C) methyl methacrylate
 (D) ethylene monomer
50. Polymers in which all the asymmetric carbon atoms have the same (*d*- or *l*-) configuration are called :
- (A) atactic polymers
 (B) isotactic polymers
 (C) syndiotactic polymers
 (D) None of the above
51. Animal charcoal is used as a decoloriser in the manufacture of can sugar is the :
- (A) Absorption
 (B) Adsorption
 (C) Chemical kinetics
 (D) Thermodynamics
52. What is the concentration of the reactant in a first order reaction when the rate of reaction is 0.6 s^{-1} and the rate constant is 0.035 ?
- (A) 26.667 M
 (B) 17.143 M
 (C) 26.183 M
 (D) 17.667 M
53. What is the rate law for the reaction $\text{C}_2\text{H}_4 + \text{I}_2 \longrightarrow \text{C}_2\text{H}_4\text{I}_2$?
- (A) $R = [\text{C}_2\text{H}_4][\text{I}_2]^{3/2}$
 (B) $R = [\text{C}_2\text{H}_4][\text{I}_2]^3$
 (C) $R = [\text{C}_2\text{H}_4][\text{I}_2]^2$
 (D) $R = [\text{C}_2\text{H}_4][\text{I}_2]$
54. According to Arrhenius equation rate constant k is proportional to :
- (A) Activation energy (E)
 (B) e^E
 (C) $e^{1/E}$
 (D) e^{-E}
55. Temperature dependence of reaction rates can be studied by plotting a graph between :
- (A) concentration of reactant and temperature
 (B) concentration of products and temperature
 (C) rate constant and temperature
 (D) rate of catalysis and temperature

56. For a Lindemann-Hinshelwood mechanism, what will be the order of reaction if the rate of deactivation by collisions is much greater than the rate of unimolecular decay ?
- (A) First order
(B) Second order
(C) Third order
(D) Zero order
57. Conversion of cyclopropane into propylene is a :
- (A) unimolecular reaction
(B) bimolecular reaction
(C) pseudomolecular reaction
(D) None of the above
58. Which of the following is a drawback of collision theory ?
- (A) Proper orientation
(B) High activation energy
(C) Hard sphere
(D) Have energy equal to or greater than the threshold energy
59. Which of the following statements is true with respect to the types of adsorption ?
- (A) Chemisorptions is stronger than physisorption.
(B) Physisorption is stronger than chemisorptions.
(C) Both are equal.
(D) They cannot be compared.
60. Who put forward the collision theory of chemical reaction ?
- (A) Trautz and Lewis
(B) Luigi Galvani
(C) Henry Cavendish
(D) Alessandro Volta
61. Which of the following statements is incorrect with respect to physisorption ?
- (A) It is reversible.
(B) It is spontaneous.
(C) $\Delta H < 0$
(D) $\Delta S > 0$
62. Which of the following is used as a catalyst for the following reactions ?
- (A) Chlorine
(B) Hydrochloric acid
(C) Sulphuric acid
(D) Nitrous acid
63. Which of the following is an example of sorption ?
- (A) Sponge in water
(B) Cotton dipped in ink
(C) Water on silica gel
(D) Oxygen on metal surface

64. Which of the following is present at the time of cracking of hydrocarbons ?
- (A) Copper
(B) Zeolite
(C) Nickel
(D) Molybdenum
65. 70%-90% reduction in thermal energy requirements can be achieved by which are of the following drying methods ?
- (A) Drum drying
(B) Airless drying
(C) Steam drying
(D) Salt drying
66. If given the surface tension of water as $73 \times 10^{-3} \text{ N/m}$ and diameter of capillary as 1 mm, calculate the ratio of capillary-vapour pressure of water in this solid to the saturation V. P. at 25°C :
- (A) 99.8%
(B) 90%
(C) 98%
(D) 97%
67. Total surface area covered by all the molecules of the adsorbed gas is given by :
- (A) $S = n\beta/N_A$
(B) $S = \beta N_A/n$
(C) $S = n\beta N_A$
(D) $S = N_A/n\beta$
68. is the movement of charged surfaces with corresponding ions and H_2O in the stationary liquid induced by an external field.
- (A) Colloidal suspension
(B) Emulsion
(C) Sedimentation potential
(D) Electrophoresis
69. Select the incorrect statement from the following options :
- (A) In the micelle formation, the water soluble heads are directed towards the centre.
(B) In the micelle formation, the water insoluble tails are directed towards the centre.
(C) In the micelle formation, the water soluble heads are on the surface in contact with the water.
(D) None of the above

70. The conductivity of micelles is :
- higher than a colloidal solution
 - lower than a colloidal solution
 - equals to the colloidal solution
 - None of the above
71. The of surfactants depends the most crucial factor that is strong water-water interaction, the hydrophobic effect.
- CMC
 - Micelle
 - Polarity
 - Non-polarity
72. What is the molecular formula of stearate ion ?
- $C_{17}H_{35}COO^-$
 - $C_{35}H_{17}COO^+$
 - $C_{35}H_{17}COO^-$
 - $C_{17}H_{35}COO^+$
73. What is the concentration of N_2 in a fresh water stream in equilibrium with air at 298 K and 1 atmosphere ? Given the value of K_H for $N_2 = 0.00060$ mole/kg bar.
- 0.0474 g/kg
 - 0.0005 g/kg
 - 1316.7 g/kg
 - 13.3 g/kg
74. What is the solubility product expression for silver chromate dissolving in water ?
- $[2Ag^+][2CrO_4^{2-}]$
 - $[Ag^+]^2 [Cr_2O_7^{2-}]^2$
 - $[Ag^+]^2 [Cr_2O_4^{2-}]^2$
 - $[Ag^+]^2 [CrO_4^{2-}]^2$
75. What is the molar solubility product for $V_3(PO_4)_5$ in terms of K_{SP} ?
- $S = (K_{SP}/84375)^{1/8}$
 - $S = K_{SP}^{1/8}$
 - $S = (K_{SP}/15)^{1/8}$
 - $S = (K_{SP}/108)^{1/8}$
76. are the compound that lowers the surface tension between two liquids or between a liquid and a solid.
- Reverse micelles
 - Surface active agent
 - Counter ion
 - Catalyst
77. In the formation of a macromolecule, what type of bond would join two amino acid subunits ?
- Ionic bond
 - Phosphodiester bond
 - Hydrogen bond
 - Peptide bond

78. How many molecules of hydrochloric acid are released when n -monomers of diacid chloride and n -monomers of di-alcohol are reacted to form a polymer ?
- (A) $2n$
 (B) $n-1$
 (C) $2n-1$
 (D) n
79. What is the role of growth of chains in condensation polymerization ?
- (A) 10^{-2} to 10^2 seconds
 (B) 10 minutes
 (C) Hours or days
 (D) Weeks
80. 12.044×10^{23} atoms of oxygen contains :
- (A) 1 mole of oxygen
 (B) 2 mole of oxygen
 (C) 3 mole of oxygen
 (D) 4 mole of oxygen
81. Boiling point of chloroform is 61°C . After addition of 5.0 gm of a non-volatile solute to 20 g chloroform boils at 64.63°C . If $k_b = 3.63 \text{ K kg mol}^{-1}$. What is the molecular weight of the solute ?
- (A) 320 g/mol
 (B) 100 g/mol
 (C) 400 g/mol
 (D) 250 g/mol
82. Which of the following does not increase with dilution ?
- (A) Conductance
 (B) Specific conductance
 (C) Equivalent conductance
 (D) Molar conductance
83. The product formed when an aqueous solution of NaBr is electrolysed in a cell having inert electrodes are :
- (A) Na and Br_2
 (B) Na and O_2
 (C) H_2 , Br_2 and NaOH
 (D) H_2 and O_2
84. The Laplace-Young equation relates :
- (A) Pressure across a surface and the curvature of the surface
 (B) Volume across a surface and the curvature of the surface
 (C) Both (A) and (B)
 (D) None of the above
85. The Laplace-Young equation is :
- (A) $P_\alpha - P_\beta = \gamma \left[\frac{\partial V_\alpha}{\partial \sigma} \right]_T$
 (B) $P_\alpha - P_\beta = \gamma \left[\frac{\partial \sigma}{\partial V_\alpha} \right]_T$
 (C) $P_\alpha - P_\beta = \left[\frac{\partial \sigma}{\partial V_\alpha} \right]_T$
 (D) None of the above

86. In an adsorption isostere :
- (A) Temperature is kept constant.
 - (B) Pressure is kept constant.
 - (C) Amount adsorbed is kept constant.
 - (D) None of the above is kept constant.
87. Adsorption is an :
- (A) endothermic process
 - (B) exothermic process
 - (C) Both (A) and (B)
 - (D) None of the above
88. Nylon is condensation polymer containing functional and group :
- (A) $-COOH$ only
 - (B) $-NH_2$ only
 - (C) Both $-COOH$ and $-NH_2$
 - (D) None of the above
89. Polyvinylidene nitrile is a polymer of the example of :
- (A) addition polymerization
 - (B) condensation polymerization
 - (C) Both (A) and (B)
 - (D) None of the above
90. HDPE is high density polyethylene due to :
- (A) Unbranched structure
 - (B) Branched structure
 - (C) Both (A) and (B)
 - (D) None of the above
91. Overvoltage or overpotential is :
- (A) difference between the potential
 - (B) difference between distance of cells
 - (C) difference between pressure
 - (D) difference between volume
92. If temperature will increase, then overvoltage will :
- (A) Increase
 - (B) Decrease
 - (C) Not sure
 - (D) None of the above
93. Zeta potential is due to the presence of :
- (A) same type of charge on fixed and diffuse layer
 - (B) opposite signs charges
 - (C) None of the above
 - (D) Both of the above

94. Units of third order rate constant :
- (A) $\text{mol L}^{-1} \text{time}^{-1}$
 (B) time^{-1}
 (C) $\text{mol}^{-1} \text{L time}^{-1}$
 (D) $\text{mol}^{-2} \text{L}^2 \text{time}^{-1}$
95. Time in which two-third of the reaction is completed ?
- (A) $t_{3/4} = \frac{2.303}{k} \times 0.4771$
 (B) $t_{3/4} = \frac{0.693}{k}$
 (C) $t_{3/4} = \frac{1}{k} \frac{x}{a(a-x)}$
 (D) None of the above
96. Arrhenius equation $k = A \exp(-E/RT)$ represents :
- (A) smaller the activation energy E , smaller the value of k rate constant
 (B) larger E activation energy, k will be smaller
 (C) larger E , larger will be k
 (D) None of the above
97. An Arrhenius plot, intercept is equal to :
- (A) $-E_a/R$
 (B) $\ln A$
 (C) $\ln k$
 (D) $\log_{10} a$
98. DDT on exposure to water decomposes. Half life = 10 years. How much time will it take for its 90% decomposition ?
- (A) 50 years
 (B) 70 years
 (C) 500 years
 (D) 700 years
99. Gelatin is mostly used in making ice-creams in orders to :
- (A) prevent forming the colloidal sol
 (B) enrich the fragrance
 (C) prevent crystallisation and stabilise the mix
 (D) modify the taste
100. Alums purify muddy water by :
- (A) Dialysis
 (B) Adsorption
 (C) Coagulation
 (D) Forming a true solution

Roll No.

Question Booklet Number

O. M. R. Serial No.

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283684

**M. Sc. (Second Semester) (NEP)
EXAMINATION, 2022-23
CHEMISTRY
(Environmental Chemistry) (Elective)**

Paper Code

| | | | | | | | |
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Questions Booklet
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D

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1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
3. प्रश्नों के उत्तर अंकित करने से पूर्व प्रश्न-पुस्तिका तथा OMR आन्सर-शीट को सावधानीपूर्वक देख लें। दोषपूर्ण प्रश्न-पुस्तिका जिसमें कुछ भाग छपने से छूट गए हों या प्रश्न एक से अधिक बार छप गए हों या उसमें किसी अन्य प्रकार की कमी हो, तो उसे तुरन्त बदल लें।

(Remaining instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

1. In water treatment which factor has major control over reaction selectivity and product distribution ?
 - (A) pH
 - (B) Temperature
 - (C) Pressure
 - (D) Ionic concentration
2. Sterilization of water can be done by using
 - (A) H_2O_2
 - (B) O_2
 - (C) Cl_2
 - (D) NaOH
3. The purest form of natural water is :
 - (A) River water
 - (B) Sea water
 - (C) Underground water
 - (D) Rain water
4. The cation-exchange resins possess :
 - (A) Acidic groups
 - (B) Basic groups
 - (C) Amphoteric groups
 - (D) None of the above
5. The blow-down operation causes the removal of :
 - (A) Scales
 - (B) Sludges
 - (C) Acidity
 - (D) Basicity
6. Liquid chlorine is most effective :
 - (A) Disinfectant
 - (B) Coagulant
 - (C) Flocculant
 - (D) None of the above
7. In reverse osmosis (RO) the flow of solvent is due to
 - (A) Potential gradient
 - (B) Vapour pressure gradient
 - (C) Concentration gradient
 - (D) None of the above
8. The acid responsible for the disinfection of germs and bacteria is :
 - (A) HCl
 - (B) HNO_3
 - (C) HOCl
 - (D) H_2CO_3

9. Excess nitrate in drinking water causes :
- Anaemia
 - Blue body syndrome
 - Irritation to eyes
 - Mouth blisters
10. Dissolved oxygen in water is determined by
- Mohr's method
 - Gravimetric method
 - Winkler's method
 - EDTA method
11. The organic impurities from sewage are removed by
- Preliminary treatment
 - Primary treatment
 - Secondary treatment
 - Tertiary treatment
12. When did the Government of India pass the Environment (Protection) Act ?
- 1990
 - 1986
 - 1996
 - 2006
13. Which industries release particulate air pollutants along with harmful gases such as N_2 , O_2 , etc. ?
- Oil industries
 - In-vitro fertilization clinics
 - Plant tissue colour labs
 - Thermal power plants and smelters
14. Which is the most widely used technique for removing particulate matter ?
- Growing trees
 - Electrostatic precipitator
 - Magnets
 - All of the above
15. The maximum permissible limit of fluoride in drinking water is
- 1.5 ppm
 - 5 ppm
 - 3 ppm
 - 8 ppm
16. What does CPCB stand for ?
- Central Particulate Control Board
 - Central Panama Channel Board
 - Central Pollution Control Board
 - None of the above

17. Where are the catalytic converters fitted ?
- (A) Plants
 - (B) Automobiles
 - (C) Cycles
 - (D) None of the above
18. What is an undesired high level of sound called ?
- (A) Air
 - (B) Music
 - (C) Noise
 - (D) Whispers
19. The gas that is mainly produced due to the incomplete burning of wood is :
- (A) CO
 - (B) NO₂
 - (C) NO₃
 - (D) SO₂
20. The burning of fossil fuels leads to :
- (A) Melting of polar ice caps
 - (B) Global warming
 - (C) Both (A) and (B)
 - (D) None of the above
21. Name the major photochemical smog :
- (A) PAN
 - (B) H₂O₂
 - (C) CFC
 - (D) All of the above
22. The PM in the air can lead to :
- (A) Rise in BP
 - (B) Tightness in the chest
 - (C) Impaired blood formation
 - (D) COPD
23. The solid or liquid particles that are dispersed in the air are known as :
- (A) Acids
 - (B) Aerosols
 - (C) Hydrocarbons
 - (D) Particulate matter
24. The CO₂ present in the atmosphere is decreased by :
- (A) Rain
 - (B) Vegetation
 - (C) Forests
 - (D) All of the above
25. The major sources of air pollution in the environment are :
- (A) Automobile exhausts
 - (B) Power plants
 - (C) Industries
 - (D) All of the above

26. Which of the following is an adsorbent for removal of NO_x from air ?
- (A) Active carbon
 - (B) Silical gel
 - (C) Bog Iron
 - (D) Pulverized limestone
27. Ringelmann chart is used for the evaluation of pollution.
- (A) Air
 - (B) Water
 - (C) Radioactive
 - (D) Noise
28. Global warming may result in
- (A) Flood
 - (B) Cyclone
 - (C) Both (A) and (B)
 - (D) None of the above
29. What is the major constituent of polluted wastewater discharged from textile, pulp and paper, tanning and distillery industries ?
- (A) Radioactive substance
 - (B) Natural organic products
 - (C) Inorganic pollution
 - (D) None of the above
30. A toxic substance produced by biological system is especially referred to as
- (A) toxicant
 - (B) toxin
 - (C) xenobiotic
 - (D) poison
31. Death in house fire is mostly attributed to
- (A) carbon dioxide poisoning
 - (B) Burns
 - (C) Carbon monoxide poisoning
 - (D) Traumatic asphyxia
32. Which of the following toxicity can occur due to single exposure ?
- (A) Acute toxicity
 - (B) Sub-acute toxicity
 - (C) Sub-chronic toxicity
 - (D) Chronic toxicity
33. Smoke is :
- (A) Smoke
 - (B) Other name for dust storm
 - (C) Moistened air gases
 - (D) Smoke and fog

34. Which of the following are the largest contributors to global pollution ?
- Soil pollution
 - Industrial pollution
 - Radioactive pollution
 - Water pollution
35. Which of the following industries produces sulphur dioxide and fly ash as the pollutants ?
- Textile Industries
 - Thermal Industries
 - Cottage Industries
 - Coal Industries
36. Which one of the following is the prime factor towards soil pollution ?
- Soil erosion
 - Floods
 - Dumping off industrial wastes
 - Using land for irrigation
37. Which one of the following is the main cause of air pollution ?
- Decrease in the factories
 - Increase in the factories
 - Increase in the sea water level
 - Increase in the modern technologies
38. Who coined the term 'Smog' ?
- Nikola Tesla
 - Stephen Hawking
 - Dr. Henry Antoine
 - Nicolas Copernicus
39. Which of the following is called as the secondary air pollutant ?
- PANs
 - Ozone
 - CO
 - NO₂
40. DDT is an example of
- Primary pollutants
 - Secondary pollutants
 - Biodegradable pollutants
 - Non-biodegradable pollutants
41. Which one of the following is the cause of industrial pollution ?
- Modern technologies
 - Efficient waste disposal
 - Efficient government policies
 - Unplanned industrial growth

42. Which one of the following is not normally a pollutant ?
- (A) CO₂
 (B) CO
 (C) SO₂
 (D) HCHO
43. Which of the following particles is called the particulate pollutants ?
- (A) Ozone
 (B) Radon
 (C) Fly Ash
 (D) Ethylene
44. Which of the oxide of nitrogen is not a common pollutant ?
- (A) N₂O₅
 (B) N₂O
 (C) NO
 (D) NO₂
45. The sink for CO is
- (A) Hemoglobin
 (B) Oceans
 (C) Valleys
 (D) Microorganisms present in the soil
46. Which of the technique(s) is/are used for controlling water pollution ?
- (A) Reverse osmosis
 (B) Ion exchange process
 (C) Adsorption process
 (D) All of the above
47. Which of the following pollutants cannot be degraded by natural process ?
- (A) Heavy metals
 (B) DDT
 (C) Nuclear waste
 (D) All of the above
48. Which of the following metals will pollute water ?
- (A) Cd
 (B) Na
 (C) K
 (D) None of the above
49. will not cause pollution.
- (A) Automobiles
 (B) Thermal power plant
 (C) Hydroelectric plant
 (D) Nuclear power plant

50. The main constituents of atmosphere are
- (A) N_2 and O_2
 - (B) CO_2 and N_2
 - (C) CO and CO_2
 - (D) O_3 and SO_2
51. BOD values are always less than :
- (A) DO value
 - (B) MPN value
 - (C) SPC value
 - (D) COD value
52. What is 'particulate matter' ?
- (A) Air pollutant
 - (B) Water pollutant
 - (C) Soil pollutant
 - (D) None of the above
53. Which pollution causes Itai-Itai disease in human beings ?
- (A) Mercury pollution
 - (B) Cadmium pollution
 - (C) Arsenic pollution
 - (D) All of the above
54. Which one of the following is NOT a greenhouse gas found naturally in the atmosphere ?
- (A) Nitrogen oxide
 - (B) Carbon dioxide
 - (C) Methane
 - (D) Ozone
55. The clean water should have BOD value :
- (A) Less than 5 mg/L
 - (B) 10 mg/L
 - (C) 20 mg/L
 - (D) 40 mg/L
56. When huge amount of sewage is dumped in a river, the BOD will be :
- (A) Decreased
 - (B) Increased
 - (C) Remain unchanged
 - (D) None of the above
57. Which of the following is not an environmental problem ?
- (A) Afforestation
 - (B) Genetic modification of food
 - (C) Acid rain
 - (D) Loss of biodiversity

58. Noise pollution is created if sound is in excess to
- (A) 70 – 75 dB
(B) 50 – 60 dB
(C) 80 – 99 dB
(D) 40 – 50 dB
59. Which of the following is non-bio-degradable ?
- (A) Wool
(B) Animal bones
(C) Nylon
(D) Tea leaves
60. 'Acid Rain' is mainly a mixture of
- (A) H_2SO_4 and HNO_3
(B) HCl and HNO_3
(C) C_6H_6 and CH_4
(D) C_2H_2 and CH_4
61. The optimum DO in natural water is :
- (A) 3 – 5 ppm
(B) 4 – 6 ppm
(C) 5 – 7 ppm
(D) 6 – 8 ppm
62. Which is an example of aerosol ?
- (A) NO_2^-
(B) CO_2
(C) Fog
(D) None of the above
63. Biogeochemical cycles are also known as
- (A) Material cycling
(B) Gaseous cycling
(C) Sedimentary cycling
(D) None of the above
64. If the depletion of oxygen is found to be 2 mg/L after incubating 3 mL of sewage diluted to 30 mL at 20°C for 5 days, then the BOD of the sewage would be :
- (A) 100 mg/L
(B) 200 mg/L
(C) 300 mg/L
(D) None of the above

65. Very low BOD level of a water body indicates that the water is :
- Less polluted
 - Highly polluted
 - Contain more organic matter
 - Rich in heavy metals
66. Which one is sedimentary cycle ?
- Oxygen cycle
 - Phosphorus cycle
 - Hydrogen cycle
 - Nitrogen cycle
67. factor contributes to the carbon cycle.
- Fossil fuel combustion
 - Respiration
 - Photosynthesis
 - All of the above
68. While testing for COD of sewage, organic matter is oxidized by $K_2Cr_2O_7$ in presence of
- HCl
 - H_2SO_4
 - HNO_3
 - All of the above
69. Which is the most common available form of S to plants ?
- S
 - SO_2
 - H_2S
 - SO_4^{2-}
70. The phosphorus cycle lacks component.
- Mineral
 - Aquatic
 - Organic
 - Atmospheric
71. As per the CPCB of India, BOD of treated sewage should be
- Less than 35 mg/L
 - Less than 25 mg/L
 - Less than 20 mg/L
 - Less than 10 mg/L
72. helps in fixation of nitrogen.
- Symbiotic bacteria
 - Leguminous nodules
 - Nitrogenase enzymes
 - All of the above

73. The source of carbon to plant in the carbon cycle is :
- (A) Fossil fuels
 - (B) Carbonate fuels
 - (C) Atmospheric CO₂
 - (D) All of the above
74. The global hydrologic cycle supports a net flow of atmospheric water vapour from :
- (A) Land to the oceans
 - (B) Oceans to the land
 - (C) Polar to tropical regions
 - (D) Tropical to polar regions
75. The full form of BOD is _____.
- (A) Biochemical Oxygen Demand
 - (B) Biodegradable Oxygen Demand
 - (C) Biological Oxygen Demand
 - (D) Bandwidth On Demand
76. Which of the following atoms most often limits the primary productivity of an ecosystem ?
- (A) Sulphur
 - (B) Phosphorus
 - (C) Nitrogen
 - (D) Carbon
77. The role of bacteria in the carbon cycle is :
- (A) Chemosynthesis
 - (B) Breakdown of organic compounds
 - (C) Photosynthesis
 - (D) Assimilation of nitrogen compounds
78. Which of the following is not a gaseous type cycle ?
- (A) Carbon cycle
 - (B) Nitrogen cycle
 - (C) Phosphorus cycle
 - (D) Oxygen cycle
79. The BOD is computed by _____.
- (A) Dissolved oxygen / Dilution factor
 - (B) Dissolved oxygen – Dilution factor
 - (C) Dissolved oxygen + Dilution factor
 - (D) Dissolved oxygen * Dilution factor
80. Nitrogen is critical elements of the ecosystem, because it is :
- (A) Labile
 - (B) Fixed by microbes
 - (C) Abundant in atmosphere
 - (D) Essential element

81. Phosphorus cycle absorbs phosphates in the form of _____.
- (A) HPO_3^-
 - (B) P_2
 - (C) PO_4^{3-}
 - (D) AlPO_4
82. In the phosphorus cycle, phosphorus becomes available by weathering of rock first to _____.
- (A) Consumers
 - (B) Decomposers
 - (C) Producers
 - (D) All of the above
83. What is the amount of nutrients present in the soil at any given time called ?
- (A) Standing state
 - (B) Sitting state
 - (C) Moving state
 - (D) Total state
84. On what aspect is precipitation calculated ?
- (A) Hydrological aspect
 - (B) Climatic conditions
 - (C) Vegetation of the area
 - (D) Weather forecast
85. The main nitrogen reservoir in the biosphere is the :
- (A) Ocean
 - (B) Rocks
 - (C) Atmosphere
 - (D) Organism
86. Respiration and photosynthesis are central to this process :
- (A) Nitrogen cycle
 - (B) Phosphorus cycle
 - (C) Sulphur cycle
 - (D) Carbon cycle
87. In the carbon cycle, the human body returns carbon to the atmosphere through this way :
- (A) Formation of glucose
 - (B) Waste products
 - (C) Photosynthesis
 - (D) Cellular respiration

88. This is known as rare and radioactive isotope of carbon _____.

- (A) Carbon-11
- (B) Carbon-12
- (C) Carbon-13
- (D) Carbon-14

89. What varies in different kinds of ecosystems and also on a seasonal basis ?

- (A) Moving state
- (B) Standing state
- (C) Sitting state
- (D) Total state

90. Which of the following indicates mixing of human faeces in analysis of river ?

- (A) Low DO
- (B) Higher count of total coliform bacteria
- (C) Higher pH value
- (D) Higher BOD

91. Which of the following is a non-renewable source of energy ?

- (A) Coal
- (B) Solar
- (C) Biomass
- (D) Wind

92. What happens to the soil after prolonged application of fertilisers and pesticides ?

- (A) The soil retains its fertility
- (B) The soil becomes acidic
- (C) The soil becomes alkaline
- (D) The soil becomes barren of life forms

93. Which one of the following is the major constituent of biogas ?

- (A) CO₂
- (B) NO
- (C) CH₄
- (D) O₂

94. What happens to the nutrients which are never lost from the ecosystems ?
- (A) Deplete
(B) Newly formed
(C) Recycle
(D) Exhaust
95. The world's available freshwater supply is about _____ percent of the total water supply.
- (A) 10
(B) 4
(C) 3
(D) 7
96. $2\text{NH}_3 + 3\text{O}_2 \rightarrow 2\text{NO}_2^- + \dots + \text{H}_2\text{O}$.
- (A) O_2
(B) 2H^+
(C) H^+
(D) 2O_2
97. SCWO stands for _____.
- (A) Supercritical water oxidation
(B) Solid and condensed water operation
(C) Storm and condensed wastewater operation
(D) None of the above
98. _____ tend to resist conventional methods of wastewater treatment.
- (A) Refractory organics
(B) Nutrients
(C) Priority pollutants
(D) Suspended solids
99. $\text{Organic matter} + \text{Nutrients} + \text{O}_2 \rightarrow \text{CO}_2 + \text{H}_2\text{O} + \dots$
- (A) O_2
(B) Biomass
(C) Nutrients
(D) Organic matter
100. Coagulants help in setting of _____.
- (A) Suspended impurities only
(B) Finely suspended impurities only
(C) Colloidal particles only
(D) Both the suspended and colloidal particles

Roll No.

Question Booklet Number

O. M. R. Serial No.

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285086

**M. Sc. (Second Semester) (NEP)
EXAMINATION, 2022-23**

CHEMISTRY

(Symmetry and Group Theory) (Elective)

Paper Code

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| B | 0 | 2 | 0 | 8 | 0 | 5 | T |
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Questions Booklet
Series

B

Time : 1:30 Hours]

[Maximum Marks : 75

Instructions to the Examinee :

1. Do not open the booklet unless you are asked to do so.
2. The booklet contains 100 questions. Examinee is required to answer 75 questions in the OMR Answer-Sheet provided and not in the question booklet. All questions carry equal marks.
3. Examine the Booklet and the OMR Answer-Sheet very carefully before you proceed. Faulty question booklet due to missing or duplicate pages/questions or having any other discrepancy should be got immediately replaced.

परीक्षार्थियों के लिए निर्देश :

1. प्रश्न-पुस्तिका को तब तक न खोलें जब तक आपसे कहा न जाए।
2. प्रश्न-पुस्तिका में 100 प्रश्न हैं। परीक्षार्थी को 75 प्रश्नों को केवल दी गई OMR आन्सर-शीट पर ही हल करना है, प्रश्न-पुस्तिका पर नहीं। सभी प्रश्नों के अंक समान हैं।
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(Remaining instructions on the last page)

(शेष निर्देश अन्तिम पृष्ठ पर)

1. The molecular point groups are represented by :
- (A) Hermann-Mauguin Symbols
 - (B) Schoenflies Symbols
 - (C) Centre of Inversion
 - (D) Rotation
2. In great Orthogonality theorem δ denotes :
- (A) Kronecker delta
 - (B) Matrix elements
 - (C) Generic element
 - (D) Reflection axis
3. In which region of the electromagnetic spectrum does an absorption at 600 nm comes ?
- (A) Infrared
 - (B) Visible
 - (C) Ultraviolet
 - (D) Vacuum UV
4. X rays were discovered by :
- (A) Thomson
 - (B) Rutherford
 - (C) Roentgen
 - (D) Chadwick
5. For a nuclear with nuclear spin quantum number $I = \frac{1}{2}$, which are the values of M_I ?
- (A) $0, +\frac{1}{2}$
 - (B) $0, +1$
 - (C) $+1, +\frac{1}{2}$
 - (D) $+\frac{1}{2}, -\frac{1}{2}$
6. The point group for crystals are denoted by :
- (A) Hermann Mauguin Symbol
 - (B) Stoneflies symbol
 - (C) Both (A) and (B)
 - (D) None of the above
7. In ^1H NMR spectrum of chlorethane, we observe :
- (A) Two doublets
 - (B) A doublet and a triplet
 - (C) A doublet and a quartet
 - (D) A triplet and a quartet

8. Mathematical study of symmetry is called :
- (A) Point
 - (B) Group theory
 - (C) Spectroscopy
 - (D) Rotation
9. All cyclic groups are :
- (A) Abelian
 - (B) Non-abelian
 - (C) Both (A) and (B)
 - (D) None of the above
10. Wavelength of cosmic rays is :
- (A) Zero — 0.001 Å
 - (B) 0.001 — 0.1 Å
 - (C) 0.1 — 150 Å
 - (D) 150 — 3800 Å
11. Symbol g_e used in spectroscopy is for :
- (A) Bohr Magnetron
 - (B) Nuclear Magnetron
 - (C) G-factor for free electron
 - (D) Wave number
12. Which of the following does not contain C_3 axis ?
- (A) ClF_3
 - (B) H_3O^+
 - (C) NH_4^+
 - (D) $POCl_3$
13. Which of the following contains C_3 and C_2 axes ?
- (A) NH_3
 - (B) PCl_3
 - (C) H_3O^+
 - (D) SO_3
14. Which has a C_4 principle axis ?
- (A) XeF_4
 - (B) CF_4
 - (C) SF_4
 - (D) $[PF_4]^+$
15. CO_2 has :
- (A) 3-vibrational modes
 - (B) 4-vibrational modes and 2 of which are degenerate
 - (C) stretching modes only
 - (D) an IR active symmetric stretch
16. Number of degrees of vibration freedom possessed by CH_4 is :
- (A) 4
 - (B) 6
 - (C) 9
 - (D) 10

17. Electromagnetic radiation travels through vacuum at the speed of :
- (A) 186 m/s
 - (B) 150 m/s
 - (C) 10,000 m/s
 - (D) 3×10^8 m/s
18. The energy of a photon of light is proportional to its frequency and proportional to its wavelength.
- (A) directly, directly
 - (B) inversely, directly
 - (C) inversely, inversely
 - (D) directly, inversely
19. Which colour of visible light has longest wavelength ?
- (A) Blue
 - (B) Violet
 - (C) Red
 - (D) Yellow
20. Spectrum containing only specific wavelengths is called spectrum.
- (A) Continuous
 - (B) Visible
 - (C) Line
 - (D) Rydberg
21. Electromagnetic waves are :
- (A) longitudinal
 - (B) transverse
 - (C) Both (A) and (B)
 - (D) None of the above
22. In which region of the electromagnetic spectrum does an absorption at 177 nm come ?
- (A) Visible
 - (B) Near UV
 - (C) Infrared
 - (D) Vacuum-UV
23. What is red shift ?
- (A) Shifting of absorption to shorter wavelength
 - (B) Shifting of absorption to lower energy
 - (C) Shifting of absorption to higher energy
 - (D) Shifting of absorption towards the blue end of spectrum

24. Which is the principal chromophore in azo-dye ?
- (A) $C=N$
 (B) $N=N$
 (C) $C \equiv N$
 (D) $N \equiv N$
25. Lycopene is present in tomatoes. What colour of light does lycopene absorb ?
- (A) Orange
 (B) Blue
 (C) Green
 (D) Red
26. Which atom has largest diameter?
- (A) F
 (B) Cl
 (C) Br
 (D) I
27. ESR imaging on animal is done to study :
- (A) brain
 (B) heart
 (C) liver
 (D) All of the above
28. Which of the following compounds one or more protons that could undergo exchange with protons in water ?
- (A) $(CH_3)_3N$
 (B) CH_3Br
 (C) $(CH_3)_2O$
 (D) CH_3OH
29. Which of the following arrangement of carbon-carbon double bonds along the backbone of a polyene does not correspond to a conjugated system ?
- (A) $-C=C-C=C-C=C-$
 (B) $-C=C-C=C-C=C-C=C-$
 (C) $-C=C-C-C=C-$
 (D) $-C=C-C=C$
30. Which list below gives only spin active nuclei ?
- (A) $^1H, ^2H, ^{12}C$
 (B) $^1H, ^{13}C, ^{19}F$
 (C) $^2H, ^{12}C, ^{19}F$
 (D) $^1H, ^{12}C, ^{19}F$

31. Which has higher electron affinity ?
(A) Cl
(B) Br
(C) N
(D) Ne
32. Which absorption maxima is not in the visible range of the electronic spectrum ?
(A) $\lambda_{\max} = 750 \text{ nm}$
(B) $\lambda_{\max} = 480 \text{ nm}$
(C) $\lambda_{\max} = 250 \text{ nm}$
(D) $\lambda_{\max} = 550 \text{ nm}$
33. How many signals are found in the ^1H NMR spectrum of $\text{CH}_3\text{OCH}_2\text{CH}_2\text{OCH}_3$?
(A) 1
(B) 2
(C) 3
(D) 4
34. Vicinal coupling is between :
(A) ^1H nuclei attached to adjacent C - atoms
(B) ^1H nuclei in an alkane
(C) ^1H nuclei in an alkene
(D) ^1H nuclei attached to the same C atom
35. What splitting pattern is observed for the proton at C_1 of 2, 3 dimethyl-2-phenyl butane ?
(A) Singlet
(B) Doublet
(C) Quartet
(D) Octet
36. Electron Spin Resonance :
(A) is called paramagnetic resonance
(B) is a technique in absorption spectroscopy
(C) are similar principles with NMR spectroscopy
(D) All of the above
37. X rays are produced the following photoelectric process while continuous X-rays are produced as a result of :
(A) Bremsstrahlung process
(B) Diffraction
(C) Interference
(D) None of the above

38. $\{I, i, -i, -1\}$ is
- (A) Semigroup
 (B) Subgroup
 (C) Cyclic group
 (D) Abelian group
39. The symmetry elements present in *p*-dichlorobenzene are :
- (A) $E, C_2, 2\sigma_v, \sigma_h, i$
 (B) $E, C_2, \sigma_h, \sigma_v, i$
 (C) $E, 3C_2, 2\sigma_v, \sigma_n, i$
 (D) $E, 3C_2, 2\sigma_v, 2\sigma_h, i$
40. The point group symmetry of $[\text{PtCl}_4]^{2-}$ is :
- (A) C_{2v}
 (B) D_{4h}
 (C) D_{2h}
 (D) C_{4v}
41. The point group of Boric acid (H_3BO_3) is :
- (A) C_{3v}
 (B) C_{3h}
 (C) D_{2d}
 (D) D_{3h}
42. 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}
43. How many σ_d are present in T_d point group ?
- (A) 1
 (B) 3
 (C) 5
 (D) 6
44. What is the number of symmetry classes in character table C_{2v} ?
- (A) 2
 (B) 3
 (C) 4
 (D) 5

45. The number of symmetry classes is equal to the number of in character table.
- (A) No. of symmetry irreducible represents
- (B) No. of symmetry atoms
- (C) No. of symmetry operations
- (D) None of the above
46. How many vibrations in linear molecular can have ?
- (A) $3N - 6$
- (B) $3N - 5$
- (C) $3N - 4$
- (D) $3N - 3$
47. How many fundamental vibrations are in H_2O molecule ?
- (A) $3N - 6$
- (B) $3N - 5$
- (C) $3N - 4$
- (D) $3N - 3$
48. Which is the special group of symmetry ?
- (A) Octahedral
- (B) Tetrahedral
- (C) Tetrahedral and octahedral
- (D) C_1
49. What is the symmetry of CCLFBI ?
- (A) O_h
- (B) T_d
- (C) C_{4v}
- (D) No symmetry
50. In which matrix number of row and column are equal ($m = n$) ?
- (A) Column matrix
- (B) Row matrix
- (C) Square matrix
- (D) Unit matrix
51. Which Mathematical concept is used to analyse the symmetry properties of molecules in spectroscopy ?
- (A) Linear algebre
- (B) Group theory
- (C) Differential equations
- (D) Calculus
52. Which of the following is NOT a point group symmetry operation ?
- (A) Rotation
- (B) Translation
- (C) Reflection
- (D) Inversion

53. The point group of formaldehyde molecule is :
- (A) C_{2v}
 (B) D_{2d}
 (C) C_2
 (D) C_s
54. Which quantum mechanical property of an atom or molecules determines the transitions observed in electronic spectroscopy ?
- (A) Spin
 (B) Orbital angular momentum
 (C) Nuclear spin
 (D) Electronic energy levels
55. The Klystron tube source produces radiation at a constant frequency of about :
- (A) 5000 MHz
 (B) 2000 MHz
 (C) 9500 MHz
 (D) 1000 MHz
56. The orbital $\psi |S_{HA} - |S_{HB}$ of water belongs to the irreducible representation :
- (A) A_1
 (B) B_1
 (C) A_2
 (D) B_2
57. Which spectroscopic technique is commonly used to study the rotational transitions of molecules ?
- (A) Mass spectrometry
 (B) Infrared spectroscopy
 (C) Ultraviolet visible spectroscopy
 (D) Microwave spectroscopy
58. Mn^{2+} has a nuclear spin of :
- (A) $1/2$
 (B) $3/2$
 (C) $5/2$
 (D) 1
59. The short wavelength region of C2 kV X-ray tube is :
- (A) 0.2 nm
 (B) 0.02 nm
 (C) 0.002 nm
 (D) 0.0002 nm
60. When an imaginary plane further the molecule divides it into two parts, which are mirror image of each other, it is called
- (A) Point symmetry
 (B) Identity
 (C) Plane of symmetry
 (D) Axis of symmetry

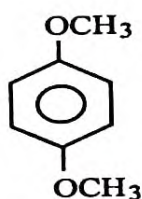
61. In group theory, the irreducible representations of a point group are labelled using :
- (A) Greek letters
 (B) Latin letters
 (C) Arabic numeral
 (D) Roman numeral
62. Which mathematical concept is used to describe the wave functions of electrons in molecular orbitals ?
- (A) Eigen values
 (B) Eigen vectors
 (C) Characteristics tables
 (D) Group representations
63. Which spectroscopic technique is commonly used to study the nuclear spin properties of atoms and molecules ?
- (A) IR spectroscopy
 (B) NMR spectroscopy
 (C) Mass spectroscopy
 (D) Raman spectroscopy
64. Which of the following point group has a chiral molecule as a representative ?
- (A) C_{2h}
 (B) D_{2h}
 (C) C_s
 (D) C_{2v}
65. The absorption of X-rays in a material is governed by :
- (A) Bragg's law
 (B) Stephan's law
 (C) Hooke's law
 (D) Lambert's Beer law
66. A cyclic group can be generated by element.
- (A) Singular
 (B) Non-singular
 (C) Inverse
 (D) Multiplication
67. Group theory is applicable to :
- (A) Atomic orbital theory
 (B) Valence Bond theory
 (C) Molecular orbital theory
 (D) All of the above
68. The matrix is a matrix representation of symmetry operation for C_{2v} point group.
- $$\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 0 & 0 & 1 \end{bmatrix}$$
- (A) E
 (B) $C_2(z)$
 (C) σ_{xz}
 (D) σ_{yz}

69. Which of the following molecules has a S_4 symmetry element ?
- (A) $POCl_3$
 - (B) $SiCl_4$
 - (C) BF_3
 - (D) SO_2Cl_2
70. In group theory what is the product of two symmetry operations called ?
- (A) Operation product
 - (B) Group product
 - (C) Character product
 - (D) Symmetry product
71. Which point group has a three-fold rotation axis and no mirror planes ?
- (A) C_{3v}
 - (B) D_{3h}
 - (C) C_s
 - (D) C_{2v}
72. The orthogonality theorem states that the inner product of two orthogonal functions is equal to :
- (A) Zero
 - (B) One
 - (C) Infinity
 - (D) A constant value
73. In which region of the electromagnetic spectrum does terahertz spectroscopy operate ?
- (A) Infrared region
 - (B) Ultraviolet region
 - (C) Microwave region
 - (D) X-ray region
74. The orthogonality theorem is a consequence of which property of orthogonal functions ?
- (A) Linearity
 - (B) Orthogonality
 - (C) Normalisation
 - (D) Completeness
75. Which spectroscopic techniques measures the change in light polarisation upon interaction with a sample to study its molecular structure ?
- (A) Fluorescence spectroscopy
 - (B) Circular dichroism spectroscopy
 - (C) Atomic force microscopy
 - (D) Laser-induced breakdown spectroscopy
76. The orthogonality theorem is important in the field of :
- (A) Quantum mechanics
 - (B) Probability theory
 - (C) Fourier analysis
 - (D) Statistical analysis

77. Point Group in cis butadiene is

- (A) C_{4v}
- (B) C_{2v}
- (C) D_{2h}
- (D) None of the above

78. How many ^1H NMR signals are expected in



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

79. Which of the following molecules have a centre of inversion ?

- (A) CO_2
- (B) C_2H_2
- (C) Both (A) and (B)
- (D) None of the above

80. Point group of Ethylene is :

- (A) Rotational Point group
- (B) S_n group
- (C) C_{nv} group
- (D) D type group

81. All octahedral complexes belong to the point group :

- (A) D group
- (B) T group
- (C) O_h group
- (D) None of the above

82. The molecule which is IR-inactive, but Raman active is :

- (A) N_2
- (B) HCl
- (C) SO_2
- (D) All of the above

83. Point group of benzene is :

- (A) D_{2h}
- (B) D_{3h}
- (C) D_{4h}
- (D) D_{6h}

84. If the IR spectrum of a ketone, $\text{R}_2\text{C}=\text{O}$, in which region the $\text{C}=\text{O}$ stretch will be obtained :

- (A) $1700-1750\text{ cm}^{-1}$
- (B) $1400-1500\text{ cm}^{-1}$
- (C) $1900-2000\text{ cm}^{-1}$
- (D) $2000-2100\text{ cm}^{-1}$

85. Point group of Trans dichloroethylene is :
- (A) D_2
 - (B) C_{2v}
 - (C) C_{2h}
 - (D) D_{2d}
86. Rotational Spectra is shown by :
- (A) H_2
 - (B) Cl_2
 - (C) CO_2
 - (D) CO
87. Object having no symmetric elements other than E is called :
- (A) Asymmetric
 - (B) Symmetric
 - (C) Disymmetric
 - (D) All of the above
88. Plane of Symmetry is designated by the symbol :
- (A) σ
 - (B) π
 - (C) α
 - (D) ϕ
89. Water belongs to :
- (A) Abelian group
 - (B) Non-abelian group
 - (C) Cyclic group
 - (D) None of the above
90. Functions that are constants for members of the same conjugacy class are called
- (A) Inverse element
 - (B) Class function
 - (C) Both (A) and (B)
 - (D) None of the above
91. NH_3 belongs to :
- (A) Abelian Group
 - (B) Non-Abelian Group
 - (C) Isomorphic Group
 - (D) All of the above
92. Order of the group is of its subgroup.
- (A) Conjugate
 - (B) Integral multiple
 - (C) Associativity
 - (D) Additive

93. Order of a group is represented by :

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

94. Raman effect is :

- (A) Elastic scattering of light
- (B) Absorption of light
- (C) Inelastic scattering of light
- (D) Adsorption of light

95. The frequency range of 9000 – 10,000 MHz lies in the region :

- (A) Visible
- (B) Microwave
- (C) Ultraviolet
- (D) Infrared

96. Point group of trigonal bipyramidal AB_3 type molecule is :

- (A) C_{2v}
- (B) C_{3v}
- (C) C_{4v}
- (D) C_{∞}

97. A subset of elements of a group forming a group of smaller order is called :

- (A) Cyclic group
- (B) Sub-group
- (C) Improper group
- (D) None of the above

98. Raman Spectra is hampered by :

- (A) Fluorescence
- (B) Infrared
- (C) Phosphorescence
- (D) None of the above

99. Electron Spin Resonance spectroscopy is applicable to :

- (A) Transition metal ions
- (B) Transition metal complexes
- (C) Free radicals and biradicals
- (D) All of the above

100. Which of the elements has greatest electro-negativity ?

- (A) Si
- (B) P
- (C) N
- (D) O

Roll No.

B020701T

M. Sc. (First Semester)
(NEP) EXAMINATION, 2023-24
CHEMISTRY
(Inorganic Chemistry—I)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

1. (A) Write a short note on 'Walsh Diagrams'.

P. T. O.

- (B) What are the limitations of 'Crystal Field Theory' ?
- (C) What is meant by stability of a complex ion ?
- (D) What is the difference between SN^1 and SN^2 Mechanism ?
- (E) Discuss the shape of H_2O molecule according to VSEPR theory.
- (F) Explain the following :
- (i) Activated Complex
 - (ii) Substrate
- (G) Write a short note on 'Chelate Effect'.
- (H) How will you determine the binary formation constant by pH-metry ?
- (I) Explain with the help of molecular orbital theory why Cl^- acts as a weak ligand whereas CN^- acts as a strong ligand in octahedral transition metal complexes.

Section—B**(Long Answer Type Questions)**

Note : Attempt any *one* question. Each question carries 15 marks.

2. What is Marcus-Hush theory ? Explain in detail.
3. What are $d\pi$ and $p\pi$ bonds ? Discuss its significance with proper examples.
4. Discuss spectrophotometry method of determining stability constant of complexes.
5. Write short notes on any *two* of the following :
 - (i) Solvent effect
 - (ii) Base hydrolysis
 - (iii) Redox reactions

Section—C**(Long Answer Type Questions)**

Note : Attempt any *one* question. Each question carries 15 marks.

6. Name the mechanism involved in one electron-transfer reactions and discuss the inner-sphere mechanism of such reactions.

7. What is molecular orbital theory of co-ordination complexes ? Discuss sigma and pi-bonding in octahedral complexes.
8. What do you understand by labile and inert complexes ? Explain on the basis of valence bond theory, the cause of lability and inertness of octahedral complexes.
9. Explain briefly the following :
 - (i) Steric effects
 - (ii) Nucleophilic reagents
 - (iii) Anation reactions
 - (iv) Oxidation-reduction reactions

Roll No.

B020702T

M. Sc. (First Semester)
(NEP) EXAMINATION, 2023-24
CHEMISTRY
(Organic Chemistry)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

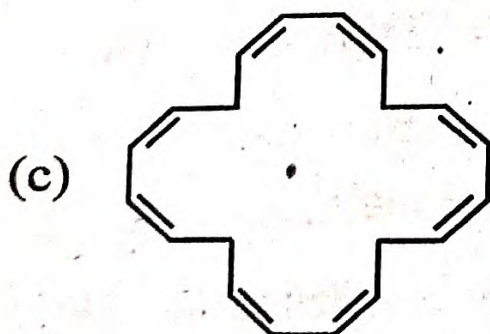
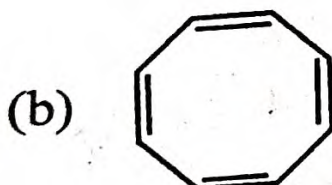
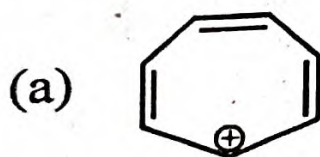
1. (A) (i) Draw the configuration and specify the R and S enantiomers of 2-chloropentane.
(ii) Arrange the isomeric butyl groups in decreasing order of priority.

P. T. O.

(B) What are antiaromatic and homoaromatic compounds ? Give examples of there.

(C) What are carbenes ? How are they generated ? Give the structure of Single and Triplet carbene.

(D) Applying Hückle's rule indicate whether the following compounds are aromatic or non-aromatic :



(E) Discuss the mechanism of Bimolecular S_E2 Reactions.

(F) Explain the following :

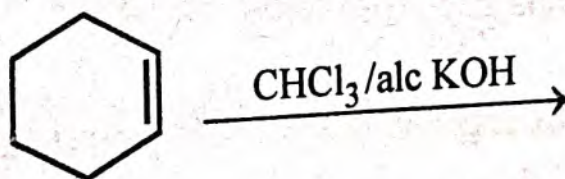
(a) Steric Inhibition of Resonance

(b) Hyperconjugation

(G) (a) Give *one* example of nucleophilic and electrophilic substrate.

(b) Give *one* reaction which occurs through Nitrene Intermediate.

(c) Give the main product of the following reaction :



(H) Explain low reactivity of vinyl and aryl halides towards nucleophilic substitution reactions.

(I) With the help of hyperconjugation explain the stability of the following alkenes :

(a) Pentene 1 and Pentene 2

(b) 2 methyl butane 1 and 2 methyl butene 2

Section—B**(Long Answer Type Questions)**

Note : Attempt any *one* question. Each question carries 15 marks.

2. (a) Discuss the aromaticity of Annulenes.
(b) What are rotaxanes ? How can they be synthesised ?
3. Discuss the following :
 - (a) Sharpless asymmetric epoxidation
 - (b) Stereochemistry of spiranes
 - (c) Optical activity of allenes
4. (a) What are non-classical carbonium ions ?
Discuss the stability of non-classical carbonium ions.
(b) Derive Hammett equation to co-relate the substituent and reaction constant.

5. Explain the following :

- (a) Ethoxy methyl chloride reacts with nucleophiles 10^6 times faster than 1-chlorobutane.
- (b) (+) - 4-Bromo-2-pentene forms a racemic product on treatment with Sodium Iodide. Why ?
- (c) Mixed S_N^1 and S_N^2 mechanism.

Section—C

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

6. Explain the following :

- (a) Which is more basic N, N dimethyl aniline or N, N dimethyl 2, 6 dinitroaniline and why ?
- (b) Fullerenes with example
- (c) Tautomerism.

7. (a) Discuss the mechanism of Nucleophilic substitution at aliphatic trigonal carbon.
- (b) What is transesterification ? Give the mechanism of acid and base catalysed transesterification.
8. Answer the following questions :
- (a) Discuss conformation of cis and trans decalins.
- (b) Discuss Absolute configuration (R, S) of Biphenyls.
- (c) What is asymmetric synthesis ? Describe with examples.
9. (a) Discuss the aromaticity of non-benzenoid aromatic compounds.
- (b) What are alternant and non-alternant hydrocarbons ? Give examples of even and odd alternant hydrocarbons.

Roll No.

B020703T

M. Sc. (First Semester)
(NEP) EXAMINATION, 2023-24
CHEMISTRY
(Physical Chemistry-I)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

1. (A) Describe postulates of quantum mechanics.

P. T. O.

- (B) Calculate the wavelength of H^+ (mass = 1.7×10^{-27} kg) moving with a speed equal to 0.1% of speed of light in vacuum.
- (C) What do you mean by Hermitian operator in quantum mechanics ? Describe its properties.
- (D) Show that $\sin 3x$ is the eigenfunction of $\frac{d^2}{dx^2}$. Write eigenvalue also.
- (E) Explain physical significance of ψ and ψ^2 .
- (F) What is Gibbs Free Energy ? Give its physical significance.
- (G) Describe graphical method for determination of fugacity.
- (H) Explain thermodynamic probability.
- (I) What do you understand by ensembles ?

Section—B**(Long Answer Type Questions)**

Note : Attempt any *one* question. Each question carries 15 marks.

2. Discuss the solution of Schrödinger wave equation for a particle of mass m confined to move in a one dimensional box of length ' a ' with infinite potential walls. Normalise the wave function.
3. Explain Perturbation Theory. Discuss the applications of this theory to He atom.
4. Give quantum mechanical definition of angular momentum. Explain its physical significance. Give the commutation relations for the orbital and spin angular momenta L and S respectively.
5. Write short notes on the following :
 - (a) The failure of classical mechanics
 - (b) Zeeman splitting
 - (c) Huckel theory of conjugated systems with special reference to butadiene

Section—C

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

6. Discuss partial molar properties and describe Gibbs-Duhem equation.
7. Define microstates. Discuss Bose-Einstein statistics.
8. Discuss Deby-Huckel theory for activity coefficient of electrolytic solution.
9. Discuss phenomenological laws and Onsager reciprocity relations.

Roll No.

B020704T

M. Sc. (First Semester)

(NEP) EXAMINATION, 2023-24

CHEMISTRY

(Spectroscopy)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

P. T. O.

1. (A) Discuss Stark effect and electron spin interaction.
- (B) Write a note on force constant.
- (C) Write a note on mutual exclusion principle.
- (D) Discuss Franck-Condon Principle.
- (E) Explain Photo-electric effect.
- (F) Why is TMS a good reference compound in NMR spectroscopy ?
- (G) Describe Mc-Connell relationship.
- (H) Explain PAS condensed system.
- (I) Define coupling constant.

Section—B

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

2. Explain classical and quantum theory of Raman effect and Raman spectroscopy.

[3]

B020704T

3. Describe vector coupling and charge-transfer spectra.
4. Explain basic principle, ionization process and Koopman's theorem.
5. Write short note on following :
 - (a) Rigid rotor model
 - (b) Non-rigid rotor
 - (c) Selection rules

Section—C

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

6. Define Chemical Shift. Discuss the factors affecting chemical shift with suitable examples.
7. Explain FT NMR. Describe advantage of FT NMR and uses of NMR in medical diagnostics.

P. T. O.

8. Explain basic principle and applications of Photoacoustic Spectroscopy (PAS).
9. Write short note on following :
 - (a) Electric field gradient
 - (b) Quadruple moments
 - (c) Theory of microwave spectroscopy

Roll No.

B020901T

**M. Sc. (Third Semester)
EXAMINATION, 2023-24**

CHEMISTRY

**(Bio-Inorganic, Bio-organic and Biophysical
Chemistry)**

Time : Two Hours]

[Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

1. (A) What is meant by essential and trace elements in biological system ?

P. T. O.

- (B) What is DNA polymerisation ?
- (C) Explain Fischer's Lock and Key hypothesis.
- (D) What is the biological function of co-enzyme A ? How is it produced in an organism ?
- (E) What do you understand by the term Bioenergetics ?
- (F) Give full form of NADP, FAD and FMN.
- (G) Give a brief account of osmosis in Biological systems.
- (H) What are heme proteins ?
- (I) Write a note on exergonic and endergonic reactions.

Section—B

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

2. Illustrate the structure of chlorophyll. Give the mechanism for the synthesis of glucose through photosynthesis in plants.

3. Discuss the mechanism of the active transport of Na^+ and K^+ across the membrane.
4. Write short notes on the following :
 - (a) Hemoglobin
 - (b) Apoenzymes
 - (c) Cytochrome
 - (d) Model system
5. Define Enzymes and discuss their catalytic power. Describe enzyme mechanism of Carboxypeptidase diagrammatically.

Section—C

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

6. What are co-factors ? Discuss the biological functions of thiamine pyrophosphate and B12.
7. Write short notes on any *three* of the following :
 - (a) Muscular contraction

(b) Membrane equilibria

(c) Helix coil transition

(d) Hydrolysis of ATP

8. Define Biological cell. Explain free energy and standard free energy change in biological reactions.

9. What do you understand by affinity labelling ? Explain some fundamentals of solution thermodynamics of Biopolymers.

Roll No.

B020902T

M. Sc. (Third Semester) (NEP)

EXAMINATION, 2023-24

CHEMISTRY

(Application of Spectroscopy)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

1. (A) Predict the number of lines in E. S. R. spectrum, when an unpaired electron interacts with three equivalent protons.

P. T. O.

(B) Explain the Zeeman effect in Mossbauer spectra.

(C) A compound with molecular formula C_3H_6O shows weak UV absorption band at 280 nm. The NMR spectrum shows one signal (a singlet). What is the structure of the compound ?

(D) Write the characteristic band of carbonyl group in the IR spectra of :

(i) CH_3CHO

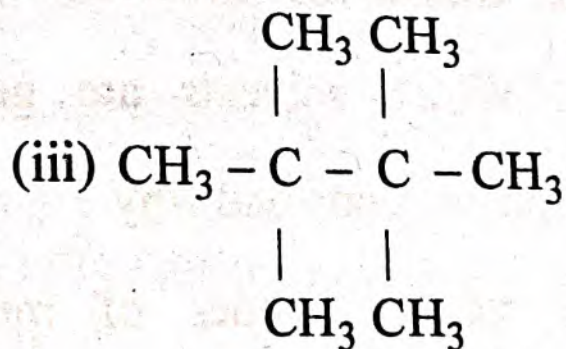
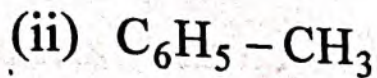
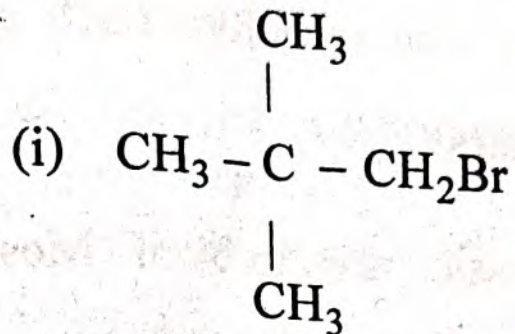
(ii) C_6H_5CHO and

(iii) CH_3COOH

(E) Explain Bathochromic effect (Red shift) and Hypsochromic effect (Blue shift).

(F) Write a short note on shielding and deshielding of protons in NMR.

(G) Predict the number of signals in the NMR spectrum of the following compounds :



(H) Acetylene protons are more shielded than ethylenic protons. Explain.

(I) Define the following term used in MS :

(i) Base peak

(ii) Nitrogen rule

Section—B**(Long Answer Type Questions)**

Note : Attempt any *one* question. Each question carries 15 marks.

2. Discuss the basic principle of Mossbauer spectroscopy. What is isomer shift ?
3. Write a detailed account on the various types of electronic transitions involved in UV-spectroscopy. Which solvents are generally used in U-V spectroscopy and why ?
4. Describe the various modes of molecular vibrations in Infrared technique. What is the fingerprint region ?
5. Explain the followings :
 - (i) Intensity of ESR lines
 - (ii) Electromagnetic spectrum
 - (iii) Fermi resonance

Section—C

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

6. What is the basic principle of NMR spectroscopy ? Write its *three* applications.
7. Write brief accounts on the following :
 - (i) ^{13}C NMR spectroscopy
 - (ii) Splitting of signals
8. Write short notes on the following :
 - (i) McLafferty rearrangement
 - (ii) Mass spectrometer
9. (a) Primary alcohol gave strong peak at $m/z = 31$. What fragment is responsible for this peak ?
(b) Acetaldehyde gave peaks at $m/z = 29, 43$ and 44 . What fragments are responsible for these peaks ?
(c) Interpret the mass spectrum of n-pentane, which shows peaks at $m/z = 15$ (8%), 27 (40%), 29 (30%), 43 (100%), 57 (15%) and 72 (20%).

Roll No.

B020903T

M. Sc. (Third Semester)
(NEP) EXAMINATION, 2023-24
CHEMISTRY

(Solid State Chemistry)
(Elective)

Time : Two Hours]

[Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

1. (A) What is F-centre ?

P. T. O.

- (B) Define Curie Law and Curie-Weiss Law.
- (C) Differentiate between Ferromagnetism and Anti-ferromagnetism.
- (D) What are Superconductors ?
- (E) Write differences between Intrinsic and Extrinsic Semiconductors.
- (F) Define Co-precipitation. Give example.
- (G) Give an account of n -type and p -type semiconductors.
- (H) What is Meissner effect ?
- (I) Define line defect. Give example.

Section—B

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

2. What do you understand by solid state reactions ? Give an account of advantages and disadvantages of such reactions.
3. Write short note on :
 - (i) Hume-Rothery rule
 - (ii) Doping
 - (iii) Dislocation defects in solids
4. Describe Point defects in Solids. Give diagrams where necessary. Differentiate between Schottky and Frenkel Defects.
5. Explain kinetics of solid-state reactions.

Section—C

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

6. What is Band theory ? Draw and explain the energy band gap structure of metals, insulators and semi-conductors.

7. Give an account of the effect of temperature on Magnetic Susceptibility. Explain Neel point and Curie point.
8. Explain Hysteresis and Hysteresis loop. Differentiate between Hard and Soft magnetic material.
9. Explain BCS theory of superconductivity. Describe the types and factors affecting superconductivity.

Roll No.

B020904T

**M. Sc. (Third Semester)
(NEP) EXAMINATION, 2023-24**

CHEMISTRY

(Photochemistry)

(Elective)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

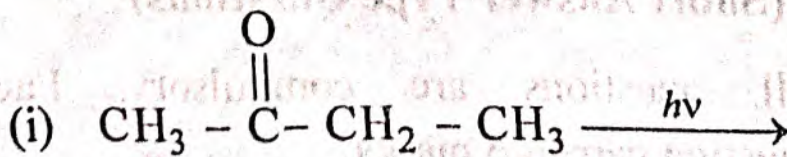
(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

1. (A) Write a note on quantum efficiency and its measurement.

P. T. O.

- (B) Photochemistry of vision.
- (C) Write a short note on dimerization of α, β unsaturated ketones.
- (D) Explain the mechanism of di- π -methane rearrangement given by 1, 4-pentadiene.
- (E) Explain photo-Fries rearrangement.
- (F) Explain the role of photosensitizer in photochemical reaction.
- (G) What is Norrish-Type-II reaction ? Explain it with example.
- (H) Discuss the difference between thermal and photochemical reaction.
- (I) Predict the product of the given reactions :



[3]

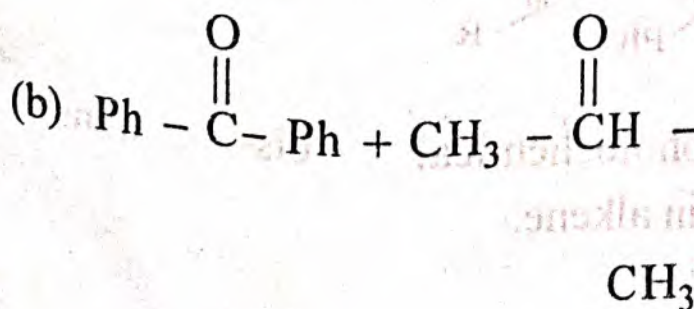
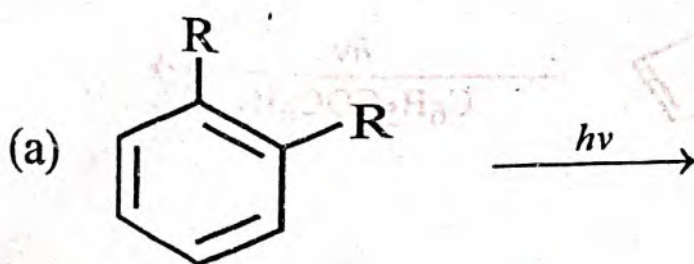
B020904T

Section—B

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

2. Explain Barton reaction and discuss the mechanism of Barton reaction.
3. Describe the fate of the excited molecule with the help of Jablonski diagram.
4. Describe photodegradation of polymers.
5. Write down the product and name of the reaction :

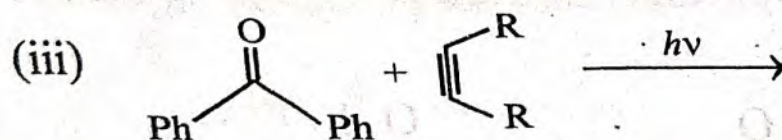
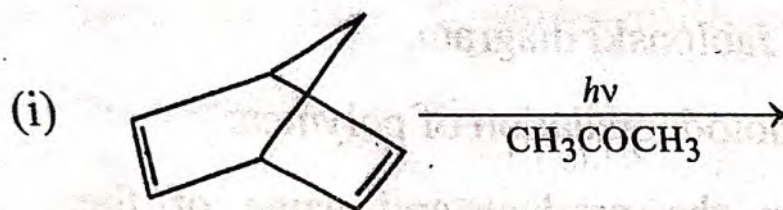


Section—C

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

6. Explain Paterno-Buchii reaction with example.
7. Discuss the photo rearrangement of cyclohexadienones.
8. Write down the mechanism and product of the following reactions :



9. Describe photochemical cis- trans isomerization in alkene.

Roll No.

B020905T

M. Sc. (Third Semester)
(NEP) EXAMINATION, 2023-24
CHEMISTRY
(Organotransition Metal Chemistry)
(Elective)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

1. (A) Explain the hydrogenolysis of transition metal alkyl.

P. T. O.

- (B) The 18-electron rule.
- (C) What is singlet and triplet carbene ? Why is triplet carbene more stable than singlet ?
- (D) Write the method of preparation and structure of Zeise's salt.
- (E) Write the product of the given $\text{CH}_2 = \text{CH}_2$, CH_2N_2 and CO molecules are inserted between metal hydride (M-H) bond.
- (F) Define the homogeneous and heterogeneous catalysis with examples.
- (G) Free propene, $\nu(\text{C} = \text{C})$ is 1652 cm^{-1} , but in the complex $\text{K}[\text{PtCl}_3(\text{CH}_3\text{CH} = \text{CH}_2)]$ it is at 1504 cm^{-1} , why ?
- (H) Write down the mechanism of polymerization of propene catalysed by Ziegler-Natta catalyst.
- (I) Write down the fluxionality in $\text{Fe}(\text{CO})_5$ molecule.

Section—B**(Long Answer Type Questions)**

Note : Attempt any *one* question. Each question carries 15 marks.

2. Write down the preparation of Lithium Organo-Cuprate (R_2CuLi) and discuss the role of organic synthesis.
3. Write down the preparation, structure and bonding of Fischer carbene complex.
4. Discuss the general method of preparation and properties of cyclobutadiene complex.
5. (a) Distinguish between $\eta^6-C_6H_6$ and $\eta^6-C_7H_8$ of metal complexes.
(b) How Tebbe's reagent is superior to Wittig reagent ?

Section—C**(Long Answer Type Questions)**

Note : Attempt any *one* question. Each question carries 15 marks.

6. Write the characterization of metal hydrogen (M-H) bond by IR and NMR spectra and discuss the preparation of metal carbonyl hydrides.

7. Explain the catalytic cycle for the preparation of acetic acid by Monasanto process.
8. (a) What is ring-whizzing ? Explain with example.
(b) Fluxionality in η^3 -allyl complex.
9. (a) Sketch the diagram of Wacker process.
(b) Give the hydrogenation of alkene by Wilkinson catalyst.

Roll No.

B020906T

M. Sc. (Third Semester)
(NEP) EXAMINATION, 2023-24
CHEMISTRY
(Analytical Chemistry)
(Elective)

Time : Two Hours] [Maximum Marks : 75

Note : Attempt questions from all Sections as directed.

Inst. : The candidates are required to answer only in serial order. If there are many parts of a question, answer them in continuation.

Section—A

(Short Answer Type Questions)

Note : All questions are compulsory. Each question carries 5 marks.

1. (A) Define Error and give the different types of error.

- (B) What is acidity and alkalinity of water ?
- (C) Explain the composition and use of Fehling's A and Fehling's B solution.
- (D) Define DO, BOD, COD.
- (E) Composition of Blood and its collection and preservation.
- (F) Flash point and octane number of fuels.
- (G) Minimata disease and Arsenicosis.
- (H) Hardness and its effects.
- (I) Determination of pH and total nitrogen of soil.

Section—B

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

- 2. (a) Classification of carbohydrates.
- (b) What is Blood Sugar ?

- (c) Determination of starch content of Flour sample.
3. Explain in detail heavy metal pollution and its relation to the environment.
 4. What is food adulteration ? List all adulterants in food.
 5. (a) Parameters for analysis of color in water.
(b) Health significance of cadmium, chromium, copper, lead, zinc, manganese, mercury, arsenic.

Section—C

(Long Answer Type Questions)

Note : Attempt any *one* question. Each question carries 15 marks.

6. (a) Determine the presence of metals in water by atomic absorption spectrophotometer.
(b) Define the proximate analysis and its disadvantages.

7. (a) What is dissolved oxygen in water ?
Describe suitable method to determine it.
- (b) Explain turbidity of water.
8. (a) What are organophosphates and their importance ?
- (b) Give the method of separation and estimation of organophosphates by gas chromatography.
9. (a) List *six* pesticides known to you.
- (b) How will you determine chlorinated pesticides in food products by thin layer chromatography (TLC) ?