

DEPARTMENT OF CHEMISTRY
UNIVERSITY OF CALICUT
M Phil/Ph.D (CHEMISTRY) ENTRANCE EXAMINATION
MODEL QUESTION PAPER

Time: 2 Hours (10 -12)

Max: 100 Marks

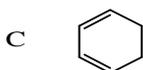
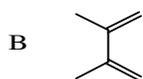
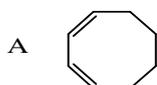
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Answer **all** Questions

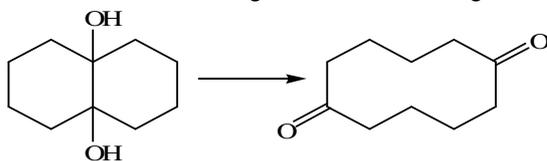
SECTION A

(Each Question carries **1** mark; **Circle** the **correct** answer; **no negative mark** for **wrong** answers)

1. Which of the following dienes undergo Diels-Alder reaction very easily



2. The most suitable reagent for the following conversion



(a) O_3

(b) $Pb(OAc)_4$

(c) CrO_3

(d) HgO

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

(a) CH_3-COOH

(b) CH_3-COCl

(c) CH_3-CH_2-COOH

(d) $HOOC-CH_2-CH_2-COOH$

4. What signals do you expect to see in the 1H NMR spectrum of 1,1-dichloroethane (CH_3CHCl_2) ?

(a) A singlet and a doublet

(b) A doublet and a triplet

(c) A doublet and a quartet

(d) A singlet and a quartet

5. The geometry of ethyl carbanion is

(a) Tetrahedral

(b) Linear

(c) Planar

(d) Pyramidal

6. The relative rate of S_N1 solvolysis of *t*-butyl chloride is highest in

- (a) Acetic acid (b) Methanol (c) Water (d) Formic acid
7. In which of the rearrangement, reaction intermediate is a carbene?
 (a) Pinacol-Pinacolone (b) Stevens
 (c) Wolff (d) Wagner-Meerwein
8. Which one of the following compounds undergoes thermal elimination reaction?
 (a) Acetates (b) Chlorides (c) Bromide (d) Alcohols
9. How many peaks are observed in the proton decoupled ^{13}C NMR spectrum of para-xylene.
 (a) 3 (b) 4 (c) 6 (d) 8
10. Aldol condensation is mainly given by
 (a) Aldehyde (b) Esters
 (c) α -haloesters (d) ketones having no α -hydrogen
11. M-SEAL available in the market is
 (a) A polyamide product (b) An epoxy resin product
 (c) A polyester product (d) A tetrafluoroethylene product
- 12 Which of the following functions is not an eigen function of d/dx operator?
 (a) e^{ikx} (b) $\tan x$ (c) $(\sin ky) e^{ikx}$ (d) None of the above
13. Which one among the following is an extensive property?
 (a) Chemical potential (b) Molar volume
 (c) Heat capacity (d) Refractive index
14. Quantum yield of $\text{H}_2\text{-Cl}_2$ photochemical reaction is
 (a) Unity (b) >1 (c) < 1 (d) zero
15. The word 'stationary state' in thermodynamics is used for explaining
 (a) Open systems (b) Reversible process
 (c) Irreversible process (d) Isolated systems
16. Activity coefficients depend on
 (a) T and P (b) Independent of T and P
 (c) Pressure only (d) None of these
17. Communal entropy exists in
 (a) Gases only (b) Solids only
 (c) Solids and liquids (d) Gases and liquids
18. BCl_3 molecule belongs to the point group
 (a) C_{3v} (b) D_{3h} (c) D_{3d} (d) C_3
19. Meissner effect is
 (a) Ideal Paramagnetism (b) Ideal ferromagnetism
 (c) Ideal diamagnetism (d) Ideal conductivity
20. How many significant figures are there in 0.0002008?
 (a) 7 (b) 4 (c) 2 (d) 8
21. Which one of the following is a boson?
 (a) ${}^7\text{N}^{14}$ atom (b) ${}^7\text{N}^{14}$ nucleus (c) ${}^2\text{He}^3$ (d) ${}^7\text{N}^{15}$ nucleus

22. Which one of the following is fermion?
 (a) ${}_8\text{O}^{16}$ atom (b) ${}_8\text{O}^{16}$ nucleus (c) ${}_2\text{He}^4$ (d) ${}_8\text{O}^{17}$ atom
23. Number of classes in C_{2v} is
 (a) 2 (b) 3 (c) 4 (d) None of the above
24. Any molecule with inversion centre also has
 (a) C_2 (b) S_2 (c) σ_d (d) None of the above
25. Fe_3O_4 is
 (a) Paramagnetic (b) Anti-ferromagnetic
 (c) Ferromagnetic (d) None of the above
26. Which of the following molecules show pure rotational spectrum?
 (a) H_2 (b) CH_4 (c) SF_6 (d) HCl
27. Which of the following molecules show pure rotational Raman spectrum?
 (a) H_2 (b) CH_4 (c) SF_6 (d) CF_4
28. The second most abundant trace element present in biological system is
 (a) Copper (b) Iron (c) Nickel (d) None of these
29. The most ductile metal present in the periodic table is
 (a) Copper (b) Gold (c) Silver (d) Platinum
30. A typical neutron-initiated fission of ${}^{235}\text{U}$ yields ${}_{42}^{97}\text{Mo}$, two neutrons and an isotope
- (a) ${}_{50}^{137}\text{Sn}$ (b) ${}_{54}^{139}\text{Xe}$
 (c) ${}_{56}^{140}\text{Ba}$ (d) ${}_{57}^{140}\text{La}$
31. Separation of lanthanides by ion-exchange method is based on
 (a) Size of the hydrated ions (b) Size of unhydrated ions
 (c) Basicity of the hydroxides (d) The solubility of their nitrates
32. The oxidation state of Iron in sodium nitroprusside is
 (a) 1 (b) 2 (c) 3 (d) 4
33. Which of the following is an Arachno carboranes
 (a) $\text{C}_2\text{B}_7\text{H}_{13}$ (b) B_5H_{11} (c) $\text{C}_2\text{B}_4\text{H}_8$ (d) $\text{C}_2\text{B}_{10}\text{H}_{12}$
34. The intense colour of $[\text{Co}(\text{en})_2\text{Cl}_2]$ is due to
 (a) Cl^- to Co^{3+} charge-transfer transition (b) Co^{3+} to Cl^- charge-transfer transition
 (c) d-d transition (d) Octahedral geometry of the complex
35. The ground state term symbol of Mn^{2+} is
 (a) ${}^3\text{F}$ (b) ${}^2\text{D}$ (c) ${}^2\text{S}$ (d) ${}^6\text{S}$
36. Which of the following product is obtained on heating B_2H_6 and NH_3 in the ratio 1:2 at higher temperature
 a) $\text{B}_3\text{N}_3\text{H}_3$ b) $\text{B}_3\text{N}_3\text{H}_6$ c) $\text{B}_2\text{H}_6 \cdot 2\text{NH}_3$ d) Boron nitride
37. The compound $[\text{Ti}(\text{C}_5\text{H}_5)_2(\text{C}_5\text{H}_5)_2]$ obeys the 18-electron rule. Then the hapticities of C_5H_5 ligands are
 (a) 1 and 5 (b) 5 (c) 2 and 3 (d) 3

38. Which of the following compounds possess residual entropy?
 (a) NO (b) O₂ (c) HCl (d) N₂
39. Calomel electrode is reversible with respect to
 (a) Hg²⁺ ions (b) Hg⁺ ions (c) Both Hg²⁺ and Cl⁻ ions (d) Cl⁻ ions
40. The point group of Hydrogen peroxide is
 (a) C_{2v} (b) C_{2h} (c) C₂ (d) D_{2h}
41. Write down the Schoenflies notation corresponding to the Hermann-Mauguin notation 4/mmm
 (a) C_{4v} (b) C_{4h} (c) D_{4h} (d) D_{4d}
42. Write down the Hermann-Mauguin notation corresponding to the Schoenflies notation C_{2v}
 (a) 2/m (b) m m (c) m m m (d) 2 2 2
43. The energy of a particle in a box is proportional to
 (a) Square of the mass of the particle (b) Square of the length of the box
 (c) Square of the quantum number (d) Square of the velocity of the particle
44. Name the scientist who won the Nobel Prize twice in Chemistry.
 (a) Marie Curie (b) Albert Einstein
 (c) Linus Carl Pauling (d) Frederick Sanger
45. Name the youngest person who received the Nobel Prize in Science?
 (a) S. Chandrasekhar (b) Albert Einstein
 (c) W.H. Bragg (d) None of the above
46. Who got the Shanti Swarup Bhatnagar Awards for Chemical Sciences in 2014?
 (a) K.R. Prasad (b) A. Ajayaghosh (c) Y. Krishnan (d) S. Verma
47. Name the place at which the first atomic bomb was exploded during World War II.
 (a) Hiroshima (b) Nagasaki (c) Tokyo (d) None of the above
48. Which is the densest metal?
 (a) Osmium (b) Lead (c) Mercury (d) Iridium
49. Of the following experimental observations, which one best demonstrates the wave like character of electrons?
 (a) The photoelectric effect (b) The diffraction pattern of electrons scattered from a crystalline solid
 (c) The ionization of an atom (d) The flow of electrons in a metal wire
50. What is the primary advantage of a hollow cathode tube used in atomic absorption spectroscopy?
 (a) It has high intensity (b) It emits a complete ultraviolet spectrum
 (c) It eliminates the need for an ionization suppresser (d) It has a narrow line width

SECTION B

(Each Question carries **5** Marks; Answer in the space provided)

1. Discuss the addition polymerization with suitable examples.

2. Explain the advantages and applications of phase transfer catalyst and crown ethers

3. Write a note on polymer blends and composites.

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4. Explain what will happen to the energy of a particle confined in a one dimensional box of infinite height, when the width of the box is increased thrice.

5. Discuss the dependence of temperature on the conductivity of metals and semiconductors.

6. What is a pseudo halide? Explain with suitable examples.

7. Discuss the various applications of carbon nanotubes.

8. What is a scintillation counter? How would you detect the presence of radio activity using a scintillation counter?

9. Calculate the energy of a particle of mass m enclosed in a cubic box of side 0.01 angstrom when it is in the first excited state.

10. What are the different types of defects normally present in solids? Explain the formation of Frenkel and Schotky defects in solids.