VINAYAKA MISSION'S RESEARCH FOUNDATION, SALEM

(Deemed to be University under section 3 of the UGC Act 1956)

Ph.D Entrance Test – November – 2025

Faculty of Arts & Sciences / Chemistry

Instructions / Note:

1. Answer all the questions. Each question carries one mark.
2. No negative marks for wrong answers.
3. Read each question carefully and answer in the OMR sheet provided for each question with only blue/ black pen to fill the circles in the OMR Sheet.
4. Question number 1 - 35 questions belong to Research Methodology component and Question number 36-70 questions belong to the subject at PG level
5. Return the question paper along with the OMR sheet.

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36. The Jahn–Teller effect is most significant in which of the following configurations?
    A. d^5 (high spin)
    B. d^9
    C. d^3
    D. d^8

37. Substitution reactions in square planar complexes usually proceed via ____
    A. Associative mechanism
    B. Dissociative mechanism
    C. Radical mechanism
    D. Inner-sphere mechanism

38. According to the 18-electron rule, stable organometallic complexes have _____
    A. 8 valence electrons
    B. 10 valence electrons
    C. 18 valence electrons
    D. 20 valence electrons

39. Ziegler–Natta catalysts are used for_____
    A. Polymerization of alkenes
    B. Hydrogenation of alkenes
    C. Oxidation of alcohols
    D. Dehydrogenation of alkanes

40. The number of atoms per unit cell in a body-centered cubic lattice is _____
    A. 1
    B. 2
    C. 4
    D. 6

41. The band gap in semiconductors is _____
    A. Zero
    B. Very large
    C. Small (≈1 eV)
    D. Infinite

42. Inductively Coupled Plasma–Atomic Emission Spectroscopy (ICP–AES) is used for_____
    A. Qualitative organic analysis
    B. Trace metal analysis
    C. Determining molecular weights
    D. Measuring pH

43. The +I effect in organic molecules is shown most strongly by _____
    A. CH_3–
    B. C_2H_5–
    C. $(CH_3)_3C$–
    D. H–

44. Resonance energy is highest for _____
    A. Benzene
    B. Cyclohexane
    C. Naphthalene
    D. Anthracene

45. In an SN1 reaction, the rate-determining step involves _____
    A. Formation of carbocation
    B. Attack of nucleophile
    C. Loss of leaving group and nucleophile together
    D. Rearrangement

46. Curtius rearrangement proceeds via _____
    A. Carbene
    B. Carbocation
    C. Radical
    D. Nitrene intermediate

47. In the Newman projection of ethane, the most stable conformation is _____
    A. Eclipsed
    B. Staggered
    C. Half-eclipsed
    D. Gauche

48. Retrosynthesis is a method of _____
    A. Predicting reaction rate
    B. Analyzing IR data
    C. Planning synthesis backward from product
    D. Determining stereochemistry

49. In UV–Vis spectroscopy, electronic transitions occur mainly in ____
    A. $\pi \rightarrow \pi^*$ and $n \rightarrow \pi^*$
    B. $\sigma \rightarrow \sigma^*$
    C. $\pi \rightarrow \sigma^*$
    D. $n \rightarrow \sigma^*$

50. The equilibrium constant (K) and Gibbs free energy change are related by _____
    A. $\Delta G = RT \ln K$
    B. $\Delta G = -RT \ln K$
    C. $\Delta H = RT \ln K$
    D. $\Delta G = -K/RT$

51. The rate of a chemical reaction depends on _____
    A. Concentration of reactants
    B. Temperature
    C. Catalyst
    D. All of the above

52. According to the Michaelis–Menten equation, $V = V_{max}[S]/(K_m + [S])$, the rate becomes zero-order when _____
    A. $[S] \ll K_m$
    B. $[S] \gg K_m$
    C. $[S] = K_m$
    D. $[S] = 0$

53. Enzyme-catalyzed reactions follow which kinetics at low substrate concentration?
    A. Zero-order
    B. First-order
    C. Second-order
    D. Third-order

54. The square of the wave function (ψ^2) gives ____
    A. Energy of the system
    B. Momentum of particle
    C. Probability density
    D. Position of nucleus

55. The Nernst equation relates _____
    A. Potential of cell to temperature
    B. Cell potential to ion concentration
    C. Gibbs energy to enthalpy
    D. Entropy to work done

56. In heterogeneous catalysis, the catalyst functions by _____
    A. Increasing activation energy
    B. Increasing reactant concentration
    C. Absorbing products only
    D. Lowering activation energy and providing an alternative pathway

57. The stationary phase in High Performance Liquid Chromatography (HPLC) is _____
    A. Gas
    B. Solid or liquid supported on solid
    C. Polymer
    D. Metal oxide

58. In HPLC, the use of smaller particle size in stationary phase _____
    A. Decreases resolution
    B. Has no effect
    C. Reduces sensitivity
    D. Increases back pressure and improves resolution

59. In IR spectroscopy, the absorption of radiation corresponds to _____
    A. Electronic transitions
    B. Vibrational transitions
    C. Nuclear transitions
    D. Ionization

60. X-ray diffraction (XRD) is primarily used to determine _____
    A. Molecular weight
    B. Optical activity
    C. Crystal structure and lattice parameters
    D. Functional groups

61. Differential Scanning Calorimetry (DSC) measures _____
    A. Heat flow between sample and reference
    B. Weight loss
    C. Pressure change and lattice parameters
    D. Volume expansion

62. In potentiometry, the potential of an electrochemical cell is measured under _____
    A. Constant current
    B. Zero current conditions
    C. Increasing temperature
    D. Varying pressure

63. Polarography is a type of voltammetry that uses _____
    A. Stationary solid electrode
    B. Platinum electrode
    C. Dropping mercury electrode
    D. Reference glass electrode

64. The term "atom economy" refers to _____
    A. The cost of raw materials
    B. The proportion of reactant atoms incorporated into the desired product
    C. The number of atoms wasted in a reaction
    D. The energy consumed per atom

65. Catalysis is preferred in green chemistry because it _____
    A. Enhances selectivity and reduces energy use
    B. Increases waste
    C. Reduces product yield
    D. Is more expensive

66. Transmission Electron Microscopy (TEM) is used to determine _____
    A. Surface area
    B. Particle size and morphology at atomic level
    C. Chemical composition
    D. Magnetic behavior

67. A prodrug is _____
    A. A toxic drug
    B. A biologically inactive compound converted to an active drug in the body
    C. A natural metabolite
    D. A drug with no therapeutic effect

68. A copolymer contains _____
    A. Only one type of monomer
    B. Only natural monomers
    C. Two or more different monomers
    D. Cross-linked chains

69. Molecular modelling involves _____
    A. Graphical visualization and simulation of molecular structures
    B. Only experimental measurements
    C. Nuclear reaction calculations
    D. Mechanical testing

70. The electrostatic precipitator is used to control _____
    A. Noise pollution
    B. Air pollution by particulate matter
    C. Water pollution
    D. Soil pollution