

Sr. No.2038.....

ENTRANCE TEST-2024

5- Year Integrated Masters Programme in Electronics (IMSc-Electronics)

Total Questions : 100

Time Allowed : 110 Minutes

Roll No.

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1. Write your roll number in the space provided at the top of this page of question booklet and fill up the necessary information in the spaces provided on OMR Answer sheet.
2. OMR Answer sheet has an original copy and a candidate's copy glued beneath it at the top. While making entries in the original copy, candidate should ensure that the two copies are aligned properly so that the entries made in the original copy against each item are exactly copied in the candidate's copy.
3. All entries in the OMR answers sheet including answers to questions are to be recorded in the original/Carbon copy.
4. Use only blue/ black ball point pen to darken the circle of correct / most appropriate response. In no case gel/ ink pen or pencil should be used.
5. Do not darken more the one circle of option for any question. A question with more than one darkened response shall be considered wrong.
6. There will be negative marking for wrong answers. Each wrong answer will lead to the deduction of 0.25.
7. Only those candidates who would obtain positive score in entrance test examination shall be eligible for admission.
8. Do not make any stray mark on the OMR sheet.
9. Calculators and mobiles shall not be permitted inside the examination hall.
10. Rough work, if any, should be done on the blank sheets provided with the question booklet.
11. OMR answer sheet must be handled carefully and it should not be folded or mutilated in such case it will not be evaluated.
12. Ensure that your OMR Answer sheet has been signed by the invigilator and the candidate himself/herself.
13. At the end of the examination hand over the OMR answer sheet to the invigilator who will first tear off the original OMR sheet in presence of the candidate and hand over the candidate's copy to the candidate.
14. If any of the information in the response Sheet/Question Paper has been found missing or not mentioned as stated above the candidate is solely responsible for that lapse.

SEAL

1. Which of the following is NOT a fundamental unit in the SI system?
 - A. Kilogram
 - B. Meter
 - C. Newton
 - D. Second
2. If the velocity of a car is increasing uniformly with time, which graph would correctly represent its motion?
 - A. A straight line with a negative slope on a velocity-time graph
 - B. A straight line with a positive slope on a velocity-time graph
 - C. A curve on a position-time graph
 - D. A horizontal line on a velocity-time graph
3. Dimensional analysis can be used to:
 - A. Convert units
 - B. Derive relations between physical quantities
 - C. Check the correctness of equations
 - D. All of the above
4. In projectile motion, the horizontal component of velocity:
 - A. Decreases uniformly
 - B. Remains constant
 - C. Increases uniformly
 - D. Becomes zero at the peak
5. Which of the following is a correct statement of Newton's First Law of Motion?
 - A. Every object continues in its state of rest or uniform motion unless acted upon by a net external force
 - B. The force acting on an object is proportional to its mass
 - C. For every action, there is an equal and opposite reaction
 - D. The force acting on an object is equal to the rate of change of momentum
6. Which of the following is TRUE for a vehicle moving in a uniform circular motion on a level circular road?
 - A. The net force is zero
 - B. The frictional force provides the centripetal force
 - C. The velocity is directed radially outward
 - D. There is no acceleration
7. The moment of inertia of a uniform rod of mass M and length L about an axis passing through its centre and perpendicular to its length is:
 - A. $\frac{1}{3}(ML^2)$
 - B. $\frac{1}{2}(ML^2)$
 - C. $\frac{1}{12}(ML^2)$
 - D. $\frac{1}{6}(ML^2)$
8. The law of conservation of angular momentum applies when:
 - A. The net torque on a system is zero
 - B. The net force on a system is zero
 - C. The system is in uniform motion
 - D. The system is in rotational equilibrium
9. Which of the following correctly represents Kepler's third law of planetary motion?
 - A. The square of the orbital period of a planet is directly proportional to the cube of the semi-major axis.
 - B. Planets move in circular orbits around the Sun
 - C. Planets sweep equal areas in equal times
 - D. The gravitational force between two masses is inversely proportional to the square of the distance between them

10. The acceleration due to gravity at a height 'h' above the Earth's surface is:

- A. Greater than that on the surface of the Earth
- B. Independent of height
- C. Equal to that on the surface of the Earth
- D. Less than that on the surface of the Earth

11. Which of the following is TRUE for a material that obeys Hooke's Law?

- A. The stress is inversely proportional to strain
- B. The stress is directly proportional to strain
- C. The material deforms permanently under stress
- D. The material has infinite elasticity

12. Which of the following is Bernoulli's principle based on?

- A. Conservation of energy in a flowing fluid
- B. Conservation of mass in a moving fluid
- C. Conservation of momentum in an ideal fluid
- D. Conservation of mass in a static fluid

13. What is the correct definition of temperature in the context of thermal equilibrium?

- A. A measure of the total energy in a system
- B. A measure of heat transferred between objects
- C. A measure of the average kinetic energy of the particles in a system
- D. A measure of the total work done by a system

14. According to the First Law of Thermodynamics, which of the following is true?

- A. The total internal energy of an isolated system is constant
- B. Energy can be created or destroyed
- C. Heat flows from a colder to a hotter reservoir spontaneously
- D. The internal energy depends only on the heat added to the system

15. Which of the following processes involves no heat exchange with the surroundings?

- A. Isothermal process
- B. Adiabatic process
- C. Reversible process
- D. Irreversible process

16. Which of the following is an assumption of the kinetic theory of gases?

- A. Gas molecules are always at rest
- B. Gas molecules exert attractive forces on each other
- C. Gas molecules undergo perfectly elastic collisions
- D. The temperature of a gas is independent of the kinetic energy of its molecules

17. According to the law of equipartition of energy, what is the specific heat capacity of a gas related to?

- A. The internal energy of the gas
- B. The degrees of freedom of the gas molecules
- C. The total volume of the gas
- D. The external pressure on the gas

18. In Simple Harmonic Motion

(S.H.M.), what is the most appropriate relation between displacement $x(t)$ and time t ?

- A. $x(t) = A \sin(\omega t)$
- B. $x(t) = A \cos(\omega t)$
- C. $x(t) = A \sin(\omega t + \phi)$
- D. $x(t) = A \omega t$

19. Which of the following statements is true for a transverse wave?

- A. Particles of the medium move parallel to the direction of wave propagation
- B. Particles of the medium move perpendicular to the direction of wave propagation
- C. The speed of the wave depends on its frequency alone
- D. There is no displacement of particles in the medium

20. What is the principle of superposition of waves?

- A. Two waves travelling in opposite directions cancel each other completely
- B. The resultant displacement is the sum of the displacements due to individual waves
- C. Waves reflect at the boundary of two different media
- D. Waves produce beats when their frequencies differ by a large amount

21. In a standing wave, the points where no displacement occurs are called:

- A. Antinodes
- B. Nodes
- C. Harmonics
- D. Beats

22. What are beats in the context of wave motion?

- A. The phenomenon where two waves of slightly different frequencies interfere, producing a fluctuating amplitude
- B. A reflection of waves at a boundary
- C. The creation of harmonics in a standing wave
- D. The combination of longitudinal and transverse waves

23. Which of the following statements correctly describes Coulomb's Law?

- A. The force between two charges is directly proportional to the product of their magnitudes and inversely proportional to the square of the distance between them
- B. The force between two charges is inversely proportional to the product of their magnitudes
- C. The force between two charges is proportional to the square of the distance between them
- D. The force between two charges is independent of the medium between them

24. What is the electric flux through a closed surface that encloses an electric dipole, according to Gauss's Law?

- A. Zero
- B. Infinite
- C. Equal to the charge enclosed divided by the permittivity
- D. Depends on the shape of the surface

25. Which of the following factors does the capacitance of a parallel plate capacitor depend on?

- A. The separation between the plates
- B. The area of the plates
- C. The dielectric constant of material between the plates
- D. All of the above

26. Which of the following is correct according to Ohm's Law?

- A. $V=IR$
- B. $I=R^2/V$
- C. $V=RI^2$
- D. $R=VI$

27. According to Biot-Savart law, the magnetic field due to a small current element is proportional to:

- A. Current
- B. Length
- C. Sine of the angle
- D. All of the above

28. Which of the following is an application of Ampere's law?

- A. Calculating the magnetic field inside a solenoid
- B. Calculating the electric field around a point charge
- C. Determining the potential energy in a magnetic field
- D. Measuring the resistance of a wire

29. The force on a moving charge in a uniform magnetic field is maximum when the angle between the velocity of the charge and the magnetic field is:

- A. 0°
- B. 90°
- C. 45°
- D. 180°

30. Which of the following materials is ferromagnetic?

- A. Copper
- B. Iron
- C. Aluminum
- D. Zinc

31. According to Faraday's Law of Electromagnetic Induction, the induced EMF in a circuit is directly proportional to:

- A. The square of the magnetic flux
- B. The rate of change of magnetic flux through the circuit
- C. The resistance of the circuit
- D. The distance between the magnetic field source and the circuit

32. In an LCR series circuit, resonance occurs when:

- A. The inductive reactance is equal to the capacitive reactance
- B. The total impedance of the circuit is the maximum
- C. The power factor is zero
- D. The current leads the voltage by 90°

33. Which of the following describes the nature of electromagnetic waves?

- A. Longitudinal and non-polarizable
- B. Transverse and can be polarized
- C. Longitudinal and can be polarized
- D. Transverse and non-polarizable

34. Which of the following parts of the electromagnetic spectrum has the shortest wavelength?

- A. Ultraviolet rays
- B. Gamma rays
- C. Microwaves
- D. X-rays

35. Total internal reflection occurs when light passes from:
- A. A medium with a lower refractive index to a medium with higher refractive index
 - B. A medium with higher refractive index to a medium with lower refractive index at an angle greater than the critical angle
 - C. A medium with higher refractive index to a medium with lower refractive index at an angle less than the critical angle
 - D. A medium with lower refractive index to a medium with higher refractive index at any angle
36. Which of the following best describes Huygen's principle?
- A. Every point on a wavefront acts as a source of secondary wavelets that spread out in all directions
 - B. Light behaves only as a particle and does not exhibit wave properties
 - C. The laws of refraction cannot be explained by wave theory
 - D. Light cannot interfere with other light waves
37. In Young's double slit experiment, the fringe width is directly proportional to:
- A. The wavelength of light and the distance between the slits and the screen
 - B. The distance between the slits only
 - C. The intensity of the light source
 - D. The angle of incidence of the light
38. Which of the following best describes the photoelectric effect?
- A. The emission of electrons from a metal surface when light of sufficient frequency is incident on it
 - B. The reflection of light from a smooth surface
 - C. The scattering of light by a rough surface
 - D. The absorption of photons by atoms, causing them to emit radiation
39. Which of the following describes the composition of an atomic nucleus?
- A. Protons and neutrons
 - B. Protons and electrons
 - C. Electrons and neutrons
 - D. Neutrons only
40. In a p-n junction diode, what is the behaviour of the diode under forward bias?
- A. It offers high resistance
 - B. It offers low resistance
 - C. It acts as an insulator
 - D. None of the Above
41. One mole of any substance contains how many particles?
- A. 6.022×10^{23}
 - B. 3.01×10^{23}
 - C. 1.66×10^{23}
 - D. 9.31×10^{23}
42. The stoichiometric coefficients in a balanced equation indicate:
- A. The mass of reactants and product
 - B. The number of moles of each substance involved in the reaction
 - C. The total volume of gases at standard temperature and pressure
 - D. The temperature at which the reaction occurs

43. Isotopes are:

- A. Atoms with the same number of protons but different numbers of electrons
- B. Atoms with the different atomic numbers but the same mass numbers
- C. Atoms with same atomic number but different mass numbers
- D. Atoms that are chemically identical

44. Which of the following quantum numbers specifies the angular momentum of an electron in an atom?

- A. Principal quantum number (n)
- B. Azimuthal quantum number (l)
- C. Magnetic quantum number (m_l)
- D. Spin quantum number (s)

45. If the pH of a solution is 3, what is the concentration of hydrogen ions $[H^+]$ in moles per liter?

- A. 0.001 M
- B. 0.01 M
- C. 0.1 M
- D. 1 M

46. What happens to the solubility of a salt when a common ion is added?

- A. Solubility increases
- B. Solubility decreases
- C. Solubility remains unchanged
- D. Solubility becomes infinite

47. The specific rate constant k for a zero-order reaction has units of:

- A. $\text{mol L}^{-1}\text{s}^{-1}$
- B. $\text{mol}^{-1} \text{L}^{-1}\text{s}^{-1}$
- C. $\text{mol}^2 \text{L}^{-2}\text{s}^{-1}$
- D. s^{-1}

48. The Arrhenius equation relates the rate constant k to:

- A. The temperature and activation energy of the reaction
- B. The concentrations of reactants
- C. The molecularity of the reaction
- D. The order of the reaction

49. According to Raoult's law, the vapor pressure of a solution is directly proportional to:

- A. The mole fraction of the solute
- B. The mole fraction of the solvent
- C. The temperature
- D. The molecular weight of the solute

50. If 0.1 moles of a non-volatile, non-electrolyte solute are added to 1 kg of water, what is the depression in freezing point (ΔT_f)? (Assume K_f for water is $1.86^\circ\text{C kg/mol}$)

- A. 0.186°C
- B. 1.86°C
- C. 0.93°C
- D. 1.0°C

51. What is the change in internal energy (ΔU) when 100 J of heat is added to a system and 40 J of work is done by the system?

- A. -60 J
- B. 140 J
- C. 100 J
- D. 60 J

52. For a spontaneous process at constant temperature and pressure, the change in Gibbs free energy (ΔG) is:

- A. Positive
- B. Zero
- C. Negative
- D. Equal to the enthalpy change

53. In a redox reaction involving MnO_4^- reducing to Mn^{2+} , how many electrons are transferred in the half-reaction under acidic conditions?

- A. 5
- B. 7
- C. 8
- D. 6

54. According to Kohlrausch's law of independent migration of ions, the limiting molar conductivity of a weak electrolyte can be expressed as:

- A. The sum of the limiting conductivities of its ions
- B. The difference between the conductivities of its ions
- C. The product of the conductivities of its ions
- D. The average of the conductivities of its ions

55. The relationship between Gibbs free energy (ΔG) and cell emf (E) is given by which of the following equations? (n is the number of electrons involved in the reaction and F is Faraday, E is the Cell potential, R is the gas constant, T is the temperature, K is the equilibrium constant)

- A. $\Delta G = nFE$
- B. $\Delta G = -nFE$
- C. $\Delta G = RT \ln K$
- D. $\Delta G = -RT \ln K$

56. A galvanic cell is constructed with a standard reduction potential of $E_{\text{Zn}^{2+}/\text{Zn}^0} = -0.76 \text{ V}$ and $E_{\text{Cu}^{2+}/\text{Cu}^0} = +0.34 \text{ V}$. The concentrations of the solutions are: $[\text{Zn}^{2+}] = 0.05 \text{ M}$ and $[\text{Cu}^{2+}] = 0.10 \text{ M}$. Calculate the cell potential (E) at 298 K.

- A. 1.10 V
- B. 1.08 V
- C. 1.11 V
- D. 1.12 V

57. In the context of hyperconjugation, which of the following carbocations is the most stable?

- A. Methyl cation
- B. Ethyl cation
- C. Isopropyl cation
- D. tert-butyl cation

58. In Which of the following groups exhibits a negative inductive effect?

- A. $-\text{OH}$
- B. $-\text{NH}_2$
- C. $-\text{Cl}$
- D. $-\text{CH}_3$

59. Which of the following statements about resonance is FALSE?

- A. Resonance structures must have the same arrangement of atoms.
- B. The true structure of a molecule is a weighted average of its resonance forms.
- C. Resonance can increase the stability of a molecule.
- D. All resonance forms contribute equally to the resonance hybrid.

60. Which of the following statements about the electromeric effect is TRUE?

- A. It is a permanent effect that does not change with reaction conditions.
- B. It is a temporary effect that occurs only in the presence of a reagent.
- C. It involves the movement of σ electrons only.
- D. It has no impact on the reactivity of a compound

61. What is the major product of the reaction between 2-methylpropene and HBr ?

- A. 2-bromobutane
- B. 1-bromobutane
- C. 2-bromo-2-methylpropane
- D. 1-bromo-2-methylpropane

62. In the reaction of ethylene with Br_2 , which type of addition occurs?

- A. Electrophilic addition
- B. Nucleophilic addition
- C. Radical addition
- D. Addition via a concerted mechanism

63. What is the major product when toluene undergoes nitration?

- A. Nitrobenzene
- B. 2-Nitrotoluene
- C. 4-Nitrotoluene
- D. 3-Nitrotoluene

64. In mono-substituted haloarenes, which position is favored for substitution due to the directive influence of halogens?

- A. Ortho and para positions
- B. Meta position Only
- C. Ortho position
- D. Only para position

65. Which reaction would likely yield an ether from an alcohol?

- A. Nucleophilic substitution with a haloalkane
- B. Dehydration with sulfuric acid
- C. Oxidation with KMnO_4
- D. Reduction with LiAlH_4

66. What reaction occurs when a carboxylic acid reacts with an alcohol in the presence of an acid catalyst?

- A. Saponification
- B. Hydrolysis
- C. Esterification
- D. Decarboxylation

67. What is the expected product of the reaction of a primary alcohol with Lucas reagent (HCl/ZnCl_2) at room temperature?

- A. Alkyl chloride
- B. Alkene
- C. Ether
- D. No reaction

68. What type of reaction occurs when phenols react with strong acids?

- A. Oxidation
- B. Electrophilic substitution
- C. Dehydration
- D. Nucleophilic substitution

69. Which reagent is used to promote the formation of ethers from alcohols and alkyl halides in the Williamson ether synthesis?

- A. Alkyl halide
- B. Sulfuric acid
- C. Sodium metal
- D. Hydrochloric acid

70. In the nucleophilic addition of a Grignard reagent to a carbonyl compound, what is the first step of the mechanism?

- A. Proton transfer
- B. Nucleophilic attack on the carbonyl carbon
- C. Formation of a tetrahedral intermediate
- D. Elimination of water

71. Which carbonyl compound would undergo a Cannizzaro reaction?

- A. Acetaldehyde
- B. Benzaldehyde
- C. 2-Butanone
- D. Propan-2-one

72. Carboxylic acids can be prepared from which of the following reactions?
- Hydrolysis of nitrile
 - Oxidation of alcohols
 - Carbonation of Grignard reagents
 - All of the above
73. Identify pair of sulphur oxoacids having S—S and O—O linkage?
- $\text{H}_2\text{S}_2\text{O}_6$ and $\text{H}_2\text{S}_2\text{O}_8$
 - $\text{H}_2\text{S}_2\text{O}_8$ and H_2SO_5
 - $\text{H}_2\text{S}_2\text{O}_7$ and H_2SO_5
 - $\text{H}_2\text{S}_2\text{O}_7$ and $\text{H}_2\text{S}_2\text{O}_6$
74. The quadruple bond between two homonuclear metal centres consists of:
- One sigma and two pi
 - Two sigma and two pi
 - One sigma, two pi and one delta
 - Quadruple bonds do not exist
75. Paramagnetism of dioxygen molecule arises due to the presence of two unpaired electrons in:
- Bonding sigma molecular orbitals
 - Bonding Pi molecular orbitals
 - Antibonding Pi molecular orbitals
 - Non bonding orbitals
76. Identify pair of compounds with 3 lone pairs and linear shape
- CO_2, SO_2
 - $\text{XeF}_2, \text{SCl}_2$
 - $\text{HgCl}_2, \text{BeF}_2$
 - $\text{XeF}_2, \text{I}_3^-$
77. Linkage isomerism is possible in case of metal complexes with _____ ligand?
- Oxalate
 - Nitrate
 - Acetate
 - Nitrite
78. The crystal field splitting energy for octahedral (Δ_0) and tetrahedral (Δ_t) coordination complexes is related as be attributed to:
- $\Delta_t = 4/9 \Delta_0$
 - $\Delta_t = 1/2 \Delta_0$
 - $\Delta_0 = 4 \Delta_t$
 - $\Delta_0 = 4/9 \Delta_t$
79. Which of the following complexes has zero unpaired electrons?
- $[\text{Co}(\text{OH}_2)_6]^{2+}$
 - $[\text{Co}(\text{OH}_2)_6]^{3+}$
 - $[\text{Co}(\text{EDTA})]^{2-}$
 - $[\text{Co}(\text{NH}_3)_6]^{3+}$
80. The purple color of KMnO_4 is due to:
- Presence of unpaired electrons
 - d—d transitions
 - Charge transfer from metal to ligand
 - Charge transfer from O^{2-} to Mn^{+7} based molecular
81. Every resource person and every participant present at the conference _____ given a copy of proceedings.
- was
 - have been
 - are
 - were
82. By Hook or by Crook means
- By noble means
 - By any means
 - By request
 - By Permission
83. Break the Ice means
- To win some one heart
 - To win a prize
 - To do something with courage
 - To speak first after long silence

84. What is the purpose of a preposition in a sentence?

- A. Expressing strong emotions
- B. Connecting Words
- C. Showing relationship
- D. Joining Clauses

85. If $3^2 \times 3^3 = 3^n$, what is the value of n ?

- A. 2
- B. 3
- C. 5
- D. 6

86. The radius of a sphere is increased by 50%. What is the percentage increase in the surface area of the sphere?

- A. 50%
- B. 75%
- C. 100%
- D. 125%

87. Which of the following is equivalent to 5^{-2} ?

- A. $1/25$
- B. $1/5$
- C. 25
- D. 5

88. A shopkeeper sells an item for ₹850, making a profit of 25%. What was the cost price of the item?

- A. ₹600
- B. ₹680
- C. ₹700
- D. ₹750

89. The following are the salaries (in thousands) of 11 employees: 18, 25, 35, 42, 50, 60, 65, 70, 80, 85, 100. What is the median salary?

- A. 50
- B. 60
- C. 65
- D. 55

90. In a pie chart, the angle representing the number of people who like chocolate is 90° . If there are 360 people in total, how many people like chocolate?

- A. 90
- B. 120
- C. 80
- D. 100

91. In a line graph, if the x-axis represents time and the y-axis represents the number of sales, what does the slope of the graph represent?

- A. The average number of sales
- B. The rate of change of sales with respect to time
- C. The total number of sales
- D. The highest number of sales

92. A box contains 5 red balls, 7 green balls, and 8 blue balls. What is the probability of selecting a red ball at random?

- A. $5/25$
- B. $1/4$
- C. $1/2$
- D. $5/15$

93. All dogs are mammals. All mammals are animals. Which of the following conclusions is valid?

- A. All dogs are animals
- B. All animals are dogs
- C. Some animals are dogs
- D. Some dogs are mammals

94. Find the missing number in the series: 2, 5, 10, 17, ?, 37

- A. 25
- B. 26
- C. 30
- D. 35

95. John walks 5 km North, then turns East and walks 3 km. Then, he turns to the South and walks 2 km. Finally, he turns West and walks 1 km. What is the shortest distance between John's final position and the starting point?
- A. 5.2 km
 - B. 3.6 km
 - C. 2.3 km
 - D. 4.1 km
96. In a queue of 50 people, Mr. X is 15th from the front and 25th from the back. How many people are standing in the queue?
- A. 39
 - B. 40
 - C. 41
 - D. 42
97. A triangle has its vertices at points A(1, 2), B(3, 4), and C(5, 6). If the triangle is translated by moving 2 units to the right and 3 units down, what will be the new coordinates of the vertices?
- A. A(3, 5), B(5, 7), C(7, 9)
 - B. A(1, 2), B(3, 4), C(5, 6)
 - C. A(3, 1), B(5, 2), C(7, 3)
 - D. A(3, -1), B(5, 1), C(7, 3)
98. A rectangular grid of 5x5 cells is filled with alternating black and white squares. What is the total number of black squares in the grid?
- A. 12
 - B. 13
 - C. 14
 - D. 15
99. A square paper is folded in half along the diagonal, and then the resulting triangle is folded in half again. How many triangular regions will be formed after unfolding the paper?
- A. 2
 - B. 4
 - C. 6
 - D. 8
100. A square is cut into 4 smaller squares, and one of these smaller squares is rotated 45 degrees and placed next to the others. Which of the following statements is true about the resulting figure?
- A. The figure is not a square
 - B. The figure is a rectangle
 - C. The figure remains a square
 - D. The figure forms a parallelogram