Seat No.	

ENT - 32

Total No. of Pages : 22

P. G. Re-Entrance Examination, 2025
M. Sc. PHYSICS
Subject Code: 58718

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Day and Date : Thursday, 10-07-2024 **Total Marks : 100**

Time : 1.00 p.m. to 2.30 p.m.

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Instructions :

1) All questions are compulsory
2) Each question carries 1 mark.
3) Answers should be marked in the given OMR answer sheet by darkening the appropriate option.
4) Follow the instructions given on OMR sheet.
5) Rough work shall be done on the sheet provided at the end of question paper.

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1. The hysteresis loop for a ferromagnetic material is a plot of:

   (a) Magnetization (M) versus temperature (T)

   (b) Magnetic flux density (B) versus magnetizing field (H)

   (c) Magnetic susceptibility (X) versus applied field (H)

   (d) Resistance versus current

2. Which of the following fundamental forces is responsible for particle interactions at the nuclear level?

   (a) Gravitational force (b) Electromagnetic force

   (c) Weak nuclear force (d) Strong nuclear force

3. Which type of accelerator is typically used to achieve the highest particle energies?

   (a) Cyclotron (b) Synchrocyclotron

   (c) Synchrotron (d) Betatron

4. What is the purpose of the Wilson cloud chamber?

(a) To measure the energy of nuclear radiation

(b) To detect and visualize the tracks of charged particles

(c) To measure the intensity of gamma rays

(d) To provide high-resolution energy spectra of alpha particles

5. A unit cell containing lattice points only at its corners is known as:

(a) Face-centered cubic cell

(b) Body-centered cubic cell

(c) Primitive unit cell

(d) Non-primitive unit cell

6. Which of the following particles are the primary constituents of an atomic nucleus?

(a) Electrons and protons

(b) Protons and neutrons

(c) Neutrons and electrons

(d) Protons, neutrons, and electrons

7. The charge of an atomic nucleus is primarily due to the presence of:

(a) Neutrons (b) Electrons

(c) Protons (d) All the above

8. When analyzing a cubic crystal using the powder method, the diffraction pattern consists of:

(a) Regularly spaced spots (b) Concentric rings

(c) A continuous spectrum (d) Irregularly distributed spots

9. The smallest repeating unit that, when translated in three dimensions, generates the entire crystal structure is called:

(a) Basis (b) Lattice

(c) Unit cell (d) Miller index

10. Which of the following is NOT a magic number?

(a) 2 (b) 8

(c) 20 (d) 15

11. The principle of phase stable orbit is crucial for the operation of which accelerator?

(a) Betatron (b) Cyclotron

(c) Synchrotron (d) Linear accelerator

12. The energy gained by an electron in one revolution in a betatron is proportional to:

(a) The strength of the magnetic field

(b) The rate of change of the magnetic flux through the orbit

(c) The radius of the electron orbit

(d) The frequency of the accelerating voltage

13. Which component in a scintillation detector is responsible for converting light photons into an electrical signal?

(a) Scintillator (b) Light guide

(c) Photo-multiplier tube (PMT) (d) Preamplifier

14. Which of the following particles is a fermion?

(a) Photon (b) Gluon

(c) Electron (d) Higgs boson

15. The number of atoms per unit cell in a Body-Centered Cubic (BCC) structure is:

(a) 1 (b) 2

(c) 4 (d) 8

16. In a Hexagonal Close-Packed (HCP) structure, the coordination number is:

(a) 6 (b) 8

(c) 12 (d) 4

17. The powder photograph method is primarily used for:

(a) Determining the orientation of a single crystal

(b) Analysing the crystal structure of polycrystalline materials

(c) Measuring the intensity of individual reflections from a single crystal

(d) Studying the defects in a single crystal

18. The temperature above which a ferromagnetic material loses its ferromagnetic properties and becomes paramagnetic is called the:

(a) Curie temperature (b) Néel temperature

(c) Debye temperature (d) Fermi temperature

19. According to band theory, the velocity of an electron in a band is related to:

(a) The magnitude of its charge

(b) The slope of the energy versus wave vector (E-k) relationship

(c) The width of the energy band

(d) The density of states at that energy

20. The effective mass of an electron in a solid can be different from its free electron mass because of:

    (a) Relativistic effects

    (b) The interaction of the electron with the periodic potential of the lattice

    (c) The Pauli exclusion principle

    (d) Electron-phonon scattering

21. In spectral notation, what does the letter 'S' represent for the orbital angular momentum quantum number (l)?

    (a) l=1 (b) l = 2

    (c) l=0 (d) l=3

22. The doublet structure observed in the spectra of alkali metals like sodium arises. due to:

    (a) Nuclear spin

    (b) The presence of two isotopes

    (c) Electron spin-orbit interaction

    (d) External magnetic fields.

23. The anomalous Zeeman effect differs from the normal Zeeman effect due to the presence of:

    (a) A very strong magnetic field

    (b) Non-zero electron spin angular momentum

    (c) Only orbital angular momentum

    (d) Nuclear spin

24. What is the fundamental basis of a molecular bond?

(a) Nuclear fusion (b) Gravitational attraction

(c) Electron sharing (d) Proton exchange

25. Vibration-rotation spectra show a series of lines known as:

(a) A continuous spectrum (b) A line spectrum

(c) Bands (d) The Balmer series

26. Electronic spectra of diatomic molecules involve transitions of:

(a) The nuclei

(b) The vibrational states

(c) The rotational states

(d) The electrons

27. The power output of a solar cell is typically measured in:

(a) Watts per square meter (W/m^2)

(b) Volts (V)

(c) Amperes (A)

(d) Watts (W)

28. The expulsion of magnetic flux from the interior of a superconductor is known as the:

(a) Peltier effect (b) Seebeck effect

(c) Meissner effect (d) Hall effect

29. Which of the following is NOT an orthogonal curvilinear coordinate system?

(a) Cartesian (b) Spherical polar

(c) Cylindrical (d) Oblique

30. Which of the following equations relates the electric potential to the charge density?

(a) Laplace's equation (b) Gauss's law

(c) Poisson's equation (d) Faraday's law

31. According to classical theory, the Raman Effect arises due to the:

(a) Absorption of photons by the molecule

(b) Change in the molecule's dipole moment

(c) Change in the molecule's polarizability

(d) Excitation of electrons to higher energy levels

32. The change in electronic and optical properties of nanomaterials due to their small size is known as:

(a) Surface plasmon resonance

(b) Quantum confinement

(c) Brownian motion

(d) Van der Waals forces

33. The total solar power incident per unit area on the Earth's outer atmosphere is known as:

(a) Clarity index (b) Solar insolation

(c) Solar constant (d) Solar energy spectrum

34. Which of the following is a ID nanostructure?

(a) Quantum dot (b) Thin film

(c) Nanowire (d) Nanoparticle

35. Which of the following is a defining characteristic of a partial differential equation?

    (a) It involves only one independent variable

    (b) It involves partial derivatives with respect to multiple independent variables

    (c) The highest order derivative is always two

    (d) The solution is always a single function of one variable

36. The Davisson and Germer experiment provided experimental evidence for:

    (a) The photoelectric effect

    (b) The quantization of energy levels in atoms

    (c) The wave nature of electrons

    (d) Blackbody radiation

37. The physical significance of Poisson's and Laplace's equations lies in their ability to determine:

    (a) the magnetic force on a moving charge

    (b) the electric field due to a current-carrying wire

    (c) the electric potential distribution in space

    (d) the rate of change of magnetic flux

38. The equation $\nabla . B = 0$ signifies which of the following?

    (a) The absence of magnetic forces

    (b) Magnetic monopoles do not exist

    (c) A changing magnetic field induces an electric field

    (d) Electric field lines form closed loops

39. For a particle trapped in an infinite one-dimensional potential well, the potential energy inside the box is:

    (a) Infinite (b) Dependent on the particle's position

    (c) Zero (d) A non-zero constant

40. Raman spectroscopy is particularly useful for studying:

    (a) Elements with unpaired electrons

    (b) Molecules with strong permanent dipole moments

    (c) Molecules that are IR inactive but Raman active

    (d) Highly radioactive materials

41. A vast system of stars, gas, dust, and dark matter held together by gravity is defined as a:

    (a) Solar system (b) Nebula

    (c) Galaxy (d) Asteroid belt

42. What is the name of the galaxy that contains our solar system?

    (a) Andromeda (b) Triangulum

    (c) Milky Way (d) Magellanic Cloud

43. What is the primary origin of wind?

    (a) Solar radiation heating the Earth unevenly

    (b) Gravitational forces of the moon

    (c) Geothermal activity

    (d) Ocean currents

44. Wind power density is a measure of:

(a) The total number of wind turbines in an area

(b) The average height of wind turbines

(c) The available wind power per unit area

(d) The efficiency of a wind turbine

45. Which part of the solar energy spectrum has the shortest wavelength?

(a) Infrared (IR) (b) Visible

(c) Ultraviolet (UV) (d) All have the same wavelength.

46. What is the primary origin of biomass energy?

(a) Fossil fuels (b) Nuclear reactions

(c) Photosynthesis (d) Geothermal activity

47. The temperature below which a material becomes superconducting is called the:

(a) Curie temperature (b) Debye temperature

(c) Critical temperature (d) Neel temperature

48. The scale factors (h_1, h_2, h_3) for spherical polar coordinates (r, θ, ϕ) are:

(a) (1,1,1) (b) (1, r, rsing)

(c) (*1, r, r*) (d) (1, sinθ, 1)

49. Solutions to the two-dimensional Laplace equation are often referred to as:

(a) Wave functions

(b) Heat functions

(c) Harmonic functions

(d) Diffusion functions

50. A typical form of a three-dimensional partial differential equation in Cartesian coordinates (x, y, z) would involve partial derivatives with respect to:

(a) Only x and y (b) Only x and z

(c) Only y and z (d) x, y, and z

51. The force experienced by a charged particle moving in a uniform magnetic field is always:

(a) parallel to the magnetic field

(b) in the direction of motion

(c) perpendicular to both the velocity and the magnetic field

(d) zero

52. Ampere's Law in its original form relates magnetic fields to:

(a) Changing electric fields (b) Electric flux

(c) Conduction current (d) Displacement current

53. The concept that matter exhibits both wave-like and particle-like properties is known as:

(a) Quantum entanglement

(b) Wave-particle duality

(c) Superposition

(d) Quantum tunneling

54. The hypothesis that associates a wave with every moving particle was proposed by:

(a) Albert Einstein. (b) Max Planck

(c) Louis de Broglie (d) Werner Heisenberg

55. What is the physical interpretation of the wave function, $\psi(x,t)$?

(a) The probability of finding a particle at a specific time

(b) The energy of the particle at a specific location

(c) The probability density of finding a particle at a specific position and time

(d) The momentum of the particle at a specific time

56. Eigenvalues are:

(a) The possible values of a dynamical variable that can be obtained from a measurement

(b) The wave functions that satisfy the Schrödinger equation

(c) Operators acting on the wave function

(d) The average values of dynamical variables

57. Eigenfunctions are:

(a) The possible values of a dynamical variable

(b) The solutions to the Schrödinger equation for specific energy eigenvalues.

(c) Operators acting on the wave function

(d) The average values of dynamical variables

58. The Hamiltonian operator (*H*) in quantum mechanics represents the:

(a) Momentum of the system (b) Kinetic energy of the system

(c) Total energy of the system (d) Potential energy of the system

59. In quantum mechanics, even if a particle's energy is less than the height of a potential barrier, there is a non-zero probability of it passing through. This phenomenon is known as:

(a) Reflection (b) Diffraction

(c) Tunneling (d) Refraction

60. The Schrödinger wave equation for the Hydrogen atom is most conveniently solved using which coordinate system?

(a) Cartesian coordinates

(b) Cylindrical coordinates

(c) Spherical polar coordinates

(d) Any orthogonal coordinate system

61. A constraint that can be expressed as an equation relating the coordinates and possibly time is called:

(a) Non-holonomic constraint (b) Holonomic constraint

(c) Scleronomic constraint (d) Rheonomic constraint

62. The number of independent coordinates required to completely specify the configuration of a system is known as:

(a) Constraints (b) Degrees of freedom

(c) Generalized coordinates (d) Virtual displacement

63. The curve that solves the Brachistochrone problem is a:

(a) catenary (b) cycloid

(c) helix (d) lemniscate

64. In the absence of external torques, what is conserved for a rotating rigid body?

(a) Kinetic energy only

(b) Angular velocity only

(c) Angular momentum only

(d) Both kinetic energy and angular velocity

65. The Michelson-Morley experiment aimed to detect the existence of:

(a) Gravitational waves (b) Electromagnetic waves

(c) Luminiferous ether (d) Elementary particles

66. The output of a NOR gate is HIGH when:

(a) All inputs are HIGH (b) Any input is HIGH

(c) All inputs are LOW (d) Any input is LOW

67. Which of the following derived gates is equivalent to the complement of an XOR gate?

(a) NAND gate (b) NOR gate

(c) XNOR gate (d) OR gate

68. What is the primary purpose of the tank circuit in an oscillator?

(a) To provide DC biasing

(b) To amplify the signal

(c) To provide the frequency-determining element

(d) To provide negative feedback

69. Which type of oscillator uses the mechanical resonance of a piezoelectric crystal to determine the oscillation frequency?

(a) Phase shift oscillator (b) Colpitts oscillator

(c) Hartley oscillator (d) Crystal oscillator

70. In a central force field, which of the following is conserved?

(a) Linear momentum (b) Kinetic energy

(c) Potential energy (d) Angular momentum

71. Biot-Savart's law gives the magnetic field due to:

    (a) Changing electric field

    (b) Permanent magnet

    (c) Current-carrying conductor

    (d) Moving electric charge

72. The gradient of a scalar field $\varnothing$ is:

    (a) Scalar field (b) Vector field

    (c) Zero (d) Constant

73. In an Atwood's machine with two unequal masses, the number of generalized coordinates required to describe its motion is:

    (a) 1 (b) 2

    (c) 3 (d) 4

74. Lagrange's equation is a second-order differential equation in terms of:

    (a) Cartesian coordinates

    (b) Generalized velocities

    (c) Generalized coordinates and their time derivatives

    (d) Constraint forces

75. Lagrange's equations of motion are derived from Hamilton's principle by applying:

    (a) Newton's second law

    (b) the principle of conservation of energy

    (c) the calculus of variations

    (d) the principle of superposition

76. Euler's equations of motion describe the relationship between:

(a) External forces and linear acceleration

(b) External torques and the rate of change of angular momentum in a body-fixed frame

(c) Linear momentum and angular momentum

(d) Kinetic energy and potential energy

77. The Galilean transformation equations are valid for:

(a) Objects moving at speeds close to the speed of light

(b) Objects moving at relativistic speeds

(c) Objects moving at speeds much smaller than the speed of light

(d) All moving objects

78. Which of the following logic gates is known as a universal gate?

(a) AND gate (b) OR gate

(c) NOT gate (d) NAND gate

79. A counter is a sequential circuit used for:

(a) Multiplexing data

(b) Demultiplexing data

(c) Counting pulses

(d) Amplifying signals

80. The Barkhausen criterion for sustained oscillations states that the loop gain (AB) must be equal to:

(a) 0 (b) less than 1

(c) 1 (d) greater than 1

81. An oscillator essentially converts:

(a) AC power to DC power

(b) DC power to AC power

(c) Low-frequency signals to high-frequency signals

(d) Small signals to large signals

82. The IC 741 is an example of a:

(a) Discrete component op-amp (b) Ideal op-amp

(c) Practical op-amp (d) Power op-amp.

83. Which of the following is a key functional block within the IC555 timer?

(a) Operational Amplifier (b) Digital-to-Analog Converter

(c) Voltage Comparator (d) Phase-Locked Loop

84. The scalar product of two vectors is a:

(a) Vector quantity (b) Scalar quantity

(c) Tensor quantity (d) Undefined quantity

85. The work-energy theorem states that the net work done on a particle is equal to the change in its:

(a) Potential energy (b) Kinetic energy

(c) Total energy (d) Momentum

86. Poiseuille's formula describes the rate of flow of which of the following liquid through a capillary tube?

(a) turbulent (b) ideal

(c) viscous (d) non-viscous

87. The reciprocal of impedance is known as:

(a) Reactance (b) Susceptance

(c) Admittance (d) Conductance

88. In an adiabatic process, which of the following is true?

(a) Temperature remains constant

(b) Pressure remains constant

(c) No heat is exchanged with the surroundings

(d) Volume remains constant

89. In a dielectric medium, the polarization vector P represents:

(a) The net electric field within the dielectric

(b) The total charge density in the dielectric

(c) The dipole moment per unit volume of the dielectric material

(d) The energy stored per unit volume in the dielectric

90. In torsional oscillation, the restoring torque is proportional to:

(a) Angular velocity (b) Angular acceleration

(c) Angular displacement (d) Moment of inertia

91. The angle of contact for a liquid that wets the surface is typically:

(a) Greater than 90 degrees (b) Equal to 90 degrees

(c) Less than 90 degrees (d) Equal to 180 degrees.

92. Owen's bridge is used to measure:

(a) Frequency (b) Capacitance

(c) Inductance (d) Resistance

93. A system is said to be in thermodynamic equilibrium when it exhibits:

(a) Mechanical equilibrium only

(b) Thermal equilibrium only

(c) Chemical equilibrium only

(d) Mechanical, thermal, and chemical equilibrium

94. Viscosity in a gas arises due to the transport of:

(a) Mass (b) Energy

(c) Momentum (d) Temperature

95. The resolving power of an optical instrument is its ability to:

(a) Magnify the image

(b) Form a real image

(c) Distinguish between two closely spaced objects

(d) Polarize light

96. A platinum resistance thermometer works on the principle that the resistance of platinum changes with:

(a) Pressure (b) Volume

(c) Temperature (d) Density

97. Ultrasonic waves are sound waves with frequencies:

(a) below the audible range

(b) within the audible range

(c) above the audible range

(d) equal to the speed of light

98. A perfect blackbody is characterized by:

(a) Reflecting all incident radiation

(b) Transmitting all incident radiation

(c) Absorbing all incident radiation

(d) Emitting radiation at only one specific wavelength

99. A macrostate in statistical mechanics is defined by:

(a) The specific microstate of the system

(b) The total energy, number of particles, and volume of the system

(c) The individual positions and momenta of all particles

(d) The most probable distribution of particles among energy levels

100. The ratio of the image height to the object height defines:

(a) Axial magnification (b) Angular magnification

(c) Lateral magnification (d) Resolving power

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