Seat No.	

ENT-11

Total No. of Pages : 18

Entrane Examination, 2026
M.Sc. PHYSICS
Subject Code : 58718

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Day and Date : Friday, 15-05-2026 **Total Marks : 100**

Time : 01.00 p.m. to 02.30 p.m.

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Instructions

1) All questions are compulsory

2) Each question carries 1 mark.

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1. If a = 2i + 3j - k and b = i - 2j + 4k then a-b is .....

   A) -8 B) 8

   C) -4 D) 4

2. The angle between vectors i + j and i - j is.....

   A) 0° B) 45°

   C) 90° D) 180°

3. If |a| = 3, |b| = 4 and a.b = 6 angle between them is .....

   A) 30° B) 45°

   C) 60° D) 90°

4. Magnitude of axb for above is .....

   A) 6 B) 12

   C) 6 √ 3 D) 12 √3

5. If two vectors are parallel, their cross product is.....

   A) Max B) Unity

   C) Zero D) Undefined

6. Scalar triple product represents

   A) Area B) Volume

   C) Length D) Angle

7. If scalar triple product is zero, vectors are

A) Parallel B) Coplanar

C) Perpendicular D) Equal

8. Value of i (j x k)

A) 0 B) 1

C) -1 D) 2

9. i x j equals

A) k B) -k

C) 0 D) 1

10. *i x i* equals

A) 1 B)-1

C) 0 D) i

11. The triangle law of vector addition can be used to find the resultant of

A) only two vectors B) parallel vectors

C) unit vectors D) more than two vectors

12. The scalar product of a vector with itself is equal to

A) Its magnitude B) square of its magnitude

C) zero D) infinity

13. The scalar triple product of three coplanar vectors is

A) Positive B) negative

C) zero D) infinity

14. Kepler's third law of planetary motion is referred to as

A) Law of elliptical orbits B) law of equal areas

C) harmonic law D) law of equal areas

15. The weight of an object of mass 10 kg on the earth is

A) 9.8N B) 9.8kg

C) 98N D) 98kg

16. When a beam is fixed at one end and loaded at the other, the middle filament which is neither elongated nor compressed is called

A) plane of bending B) neutral axis

C) neutral surface D) neutral filament

17. S.I. Unit of strain has

A) cm^2 B) cm^3

C) gm D) no unit

18. Contact angle between the pure water and clean glass is

A) 90 B) 180

C) 0 D) <180

19. Which of the following is not the unit of surface tension?

A) dyne/cm B) $dyne/cm^2$

C) erg/cm^2 D) newton/m

20. The magnitude of resultant of two vectors i and j is

A) 0 B) 2

C) $\sqrt{2}$ D) 3

21. The principle of superposition is possible only in case of

A) nonhomogeneous equations

B) homogeneous nonlinear Equations

C) homogeneous Linear Equations

D) nonhomogeneous nonlinear Equations

22. The shape of the Lissajous figure does not depend on two constituent simple harmonic oscillations.

A) Frequency B) Amplitude

C) phase difference D) Wavelength

23. To produce beats of two sound sources frequency difference between them should be

A) Zero B) Hundred

C) 300 D) less than 10

24. $X^2 + Y^2 = a^2$ is the equation of

A) ellipse B) Parabola

C) Hyperbola D) circle with radius a

25. Ultrasonic waves are sound waves having frequency .....Hz.

A) 2000 B) 3000

C) 5000 D) Greater than 20000

26. In stretched string the point at which the amplitude is zero is called

A) Antinodes B) Nodes

C) Crest D) Trough

27. To produce stationary wave two progressive wave must travel .....direction.

A) same B) opposite

C) perpendicular D) diagonal

28. The nodes and antinodes are separated by distance

A) λ B) $\lambda / 2$

C) $\lambda / 3$ D) $\lambda / 4$

29. ..... remains constant during throttling process.

A) Entropy B) Enthalpy

C) Volume D) Pressure

30. In Joule Thomson effect at ordinary temperature .....gas shows heating effect.

A) hydrogen B) helium

C) nitrogen D) oxygen

31. For an ideal gas Joule Thomson effect is .....

A) zero B) positive

C) negative D) infinite

32. The temperature at which Joule Thomson effect changes its sign is known as

A) critical temperature B) temperature of inversion

C) neutral temperature D) transition temperature

33. Wien's displacement law is .....

A) $\lambda_m T = constant$ B) $\lambda_m T^4 = constant$

C) $\lambda_m / T = constant$ D) $\lambda_m = T \times constant$

34. The energy of the Plank's oscillator is .....

A) kT B) nhv

C) $\frac{1}{2}mv^2$ D) $\frac{1}{2}mw^2x^2$

35. According to Stefan's law energy radiated by black body is proportional to absolute temperature

A) T B) T^2

C) T^3 D) T^4

36. The rest mass of the photon is

A) infinity B) zero

C) negative D) infinitesimally small

37. In Newton's rings experiment, the diameter of the n^{th} dark ring is proportional to

A) n B) n^2

C) $\sqrt{n}$ D) $1/n$

38. The resolving power of a grating is directly proportional to

A) The wavelength of light B) The order of the spectrum

C) The slit width D) The focal length of the lens

39. In a Carnot engine, efficiency is 100% only if the sink temperature is

A) 0°C B) 0 K

C) Equal to source D) Infinity

40. The change in entropy in a reversible adiabatic process is

A) Maximum B) Minimum

C) Zero D) Infinity

41. A crystal lattice is best defined as

A) A one-dimensional arrangement of atoms.

B) A three-dimensional, periodic arrangement of atoms or ions.

C) A random distribution of molecules in space.

D) A two-dimensional pattern of points.

42. Which law governs the conditions for constructive interference in X-ray diffraction?

A) Bragg's Law B) Ohm's Law

C) Curie-Weiss Law D) London's Equation

43. How many distinct Bravais lattices are there in three-dimensional space?

A) 7 B) 10

C) 14 D) 32

44. The reciprocal lattice is a mathematical construct that represents the

A) Real-space distance between atoms.

B) Potential energy of the lattice.

C) Fourier transform of the real-space lattice.

D) Vibrational modes of the atoms.

45. In a Hexagonal Close-Packed (HCP) structure, the number of atoms in the basis of a primitive cell is

A) 1 B) 2

C) 4 D) 12

46. Fermi energy is defined as the

A) Minimum energy of an electron at absolute zero.

B) Energy of the highest occupied electronic state at absolute zero.

C) Average thermal energy of an electron at room temperature.

D) Binding energy of a Cooper pair.

47. According to band theory, a material with a completely filled valence band and a large energy gap to the conduction band is a(n)

A) Metal

B) Semiconductor

C) Insulator

D) Superconductor

48. What does a negative value of effective mass near the top of an energy band physically represent?

A) The electron has negative kinetic energy.

B) The electron moves faster than the speed of light.

C) The particle responds to forces like a positively charged hole.

D) The lattice is unstable.

49. Quantized elastic waves representing lattice vibrations are called

A) Photons B) Phonons

C) Plasmons D) Magnons

50. The Debye model of specific heat differs from the Einstein model by assuming

A) All atoms vibrate at the same frequency.

B) A continuous range of frequencies up to a cutoff (Debye frequency).

C) Electrons contribute more to specific heat than lattice vibrations.

D) Atoms do not interact with their neighbours.

51. In a linear diatomic chain, which vibrational branch involves atoms moving out of phase?

A) Acoustic branch B) Optical branch

C) Gamma branch D) Brillouin branch

52. As temperature increases, the resistivity of a metal generally

A) Increases due to increased electron-phonon scattering.

B) Decreases as more electrons are excited.

C) Remains constant.

D) Drops abruptly to zero.

53. The expulsion of a magnetic field from the interior of a superconductor is known as the

A) Hall Effect B) Zeeman Effect

C) Meissner Effect D) Stark Effect

54. Superconductivity is explained by the formation of electron pairs known as

A) Bardeen pairs B) Cooper pairs

C) London pairs D) Fermi pairs

55. Which type of superconductor exhibits a "mixed state" where magnetic flux can partially penetrate?

A) Type I B) Type II

C) High-temperature only D) Amorphous only

56. The temperature at which a material transitions from a normal state to a superconducting state is the

A) Curie temperature B) Neel temperature

C) Critical temperature (Tc) D) Debye temperature

57. The BCS theory attributes the attraction between electrons in a Cooper pair to

A) Direct gravitational pull.

B) Interaction mediated by phonons (lattice vibrations).

C) Exchange of photons.

D) Magnetic domain alignment.

58. Above which specific temperature does a ferromagnetic material become paramagnetic?

A) Neel temperature B) Curie temperature

C) Transition temperature D) Absolute zero

59. Materials with a small, negative magnetic susceptibility that independent of temperature are

A) Paramagnetic B) Ferromagnetic

C) Diamagnetic D) Antiferromagnetic

60. The natural unit for the magnetic moment of an electron is the

A) Fermi unit B) Bohr magneton

C) Debye unit D) Weiss constant

61. Magnetic domains are regions where

A) All electrons are paired.

B) Magnetic susceptibility is zero.

C) Magnetic moments are aligned in a single direction.

D) The material becomes a superconductor.

62. Which type of magnetism is characterised by neighbouring dipoles aligning anti-parallel with equal magnitude?

A) Ferromagnetism B) Ferrimagnetism

C) Antiferromagnetism D) Paramagnetism

63. What is the de Broglie wavelength formula for a particle with momentum P?

A) $\lambda = p/h$ B) $\lambda = h/p$

C) $\lambda = hp$ D) $\lambda = h^2 / p$

64. Which principle states that the position and momentum of a particle cannot both be precisely determined at the same time?

A) Fermat's Principle

B) Heisenberg Uncertainty Principle

C) Pauli Exclusion Principle

D) Bohr's Correspondence Principle

65. What is Schrödinger's equation in its time-independent form in one dimension?

A) $-\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2} + V(x)\psi(x) = E\psi(x)$

B) $\frac{\hbar^2}{2m}\frac{d^2\psi(x)}{dx^2} - V(x)\psi(x) = E\psi(x)$

C) $-\frac{\hbar}{2m}\frac{d^2\psi(x)}{dx^2} + V(x)\psi(x) = E\psi(x)$

D) $-\frac{\hbar^2}{2m}\frac{d\psi(x)}{dx} + V(x)\psi(x) = E\psi(x)$

66. Square of the modulus of the wave function, $|\psi|^2$, represents

A) Mass density

B) Probability density

C) Electric charge density

D) Energy density

67. Which of the following represents the commutation relation between the position operator and the momentum operator?

A) $[x, p] = 0$ B) $[x, p] = i\hbar$

C) $[x, p] = 1$ D) $[x, p] = -i\hbar$

68. What is the formula for the energy levels of a particle in a one-dimensional infinite potential well of width L?

A) $E_n = \frac{n^2\pi^2\hbar^2}{2mL^2}$ B) $E_n = \frac{n\pi\hbar}{2mL}$

C) $E_n = \frac{n^2\hbar^2}{2mL^2}$ D) $E_n = \frac{2mL^2}{n^2\pi^2\hbar^2}$

69. In quantum tunnelling, what does the transmission coefficient T describe?

A) Kinetic energy loss of a particle

B) Reflectance of a wave from a barrier

C) Probability of a particle passing through a barrier

D) Increase in particle momentum after reflection

70. What is the energy of the ground state (n = 0) for a quantum harmonic oscillator?

A) $\hbar\omega$ B) 0

C) $\frac{1}{2}\hbar\omega$ D) $\frac{3}{2}\hbar\omega$

71. Which is a characteristic outcome when applying the uncertainty principle?

A) Certain knowledge of both position and momentum

B) Increased certainty in momentum measurement leads to greater uncertainty in position

C) Increased certainty in position measurement leads to greater uncertainty in momentum

D) No influence on measurements

72. How does the potential energy function V(x) behave at boundaries in a quantum mechanical infinite potential well?

A) Zero inside the well and infinite at the walls

B) Infinite inside the well and zero at the walls

C) Constant everywhere

D) Zero at the center and increases linearly towards the walls

73. What are the eigenfunctions of the Hamiltonian for a harmonic oscillator expressed as in quantum mechanics?

A) Hermite polynomials multiplied by an exponential factor

B) Laguerre polynomials

C) Cosine functions

D) Sine functions

74. Which dimensionless number describes the radial distance in the scaled form for a hydrogen atom?

A) $\rho = a/r$ B) $\rho = \beta r$

C) $\rho = \beta r$ D) $\rho = r/\beta$

75. What does the raising operator do when applied to a wavefunction representing a quantum harmonic oscillator?

A) Increases the energy level

B) Lowers the energy level

C) Keeps the energy level the same

D) Doubles the energy level

76. In what form is the angular component of the hydrogen atom's wavefunction expressed?

A) Bessel functions B) Chebyshev polynomials

C) Associated Legendre polynomials D) Hermite polynomials

77. Define the quantum mechanical term used to denote the average measurement of an observable.

A) Expectation value B) Eigenvalue

C) Variance D) Measurement value

78. In a hydrogen atom, what is the principal quantum number associated with?

A) Size and energy of the electron's orbit

B) Shape of the electron's orbital

C) Orientation of the orbital

D) Spin of the electron

79. What principle explains electron configurations in atoms by filling the lowest energy levels first?

A) Hund's Rule

B) Aufbau Principle

C) Pauli Exclusion Principle

D) Heisenberg Uncertainty Principle

80. What does the Pauli Exclusion Principle state?

A) No two fermions can occupy the same quantum state simultaneously

B) Electrons fill an equal number of orbitals before one gets a pair

C) Energy levels can be degenerate

D) Particles can be in two places at once

81. In the standard model of particle physics, what are leptons?

A) Particles that mediate forces between other particles

B) A class of particles including electrons, muons, and neutrinos

C) Particles with no mass

D) The building blocks of atomic nuclei

82. Which is the uncertainty relation between time and energy?

A) $\Delta t \Delta E \geq \frac{h}{4\pi}$ B) $\Delta t \Delta E = 0$

C) $\Delta t \Delta E \leq \frac{h}{2\pi}$ D) $\Delta t \Delta E = h$

83. A point is given in cylindrical coordinates as (ρ = 2 m, ϕ = 30°, z = 3 m). What is the value of its x-coordinate?.

A) 1 B) √3

C) 2 √ 3 D) 3

84. If a scalar field is $V = x^2 + y^2 + z^2$ what is the gradient at (1,1,1)?

A) (1,1,1) B) (2,2,2)

C) (3,3,3) D) (0,0,0)

85. For vector field $A = xi + yj + zk$, what is divergence?

A) 1 B) 2

C) 3 D) 0

86. For vector field $A = xi + yj + zk$, what is curl?

A) 0 B) 1

C) 3 D) Undefined

87. If $V = x^2 + y^2$ find Laplacian of V.

A) 2 B) 4

C) 0 D) 1

88. Which represents volume element in cylindrical coordinates?

A) $dxdydz$ B) $rdrd\theta dz$

C) $r^2 sin\theta dr\theta d\Phi$ D) $drd\theta dz$

89. If a function satisfies Laplace equation, what is its nature?

A) Time dependent B) Harmonic

C) Oscillatory D) Linear

90. If boundary conditions of PDE change, what happens to solution?

A) Same B) Changes

C) Zero D) Undefined

91. If wave speed doubles (frequency constant), what happens to wavelength?

A) Doubles B) Halves

C) Same D) Zero

92. A wave has speed 10 m/s and frequency 5 Hz. Find wavelength.

A) 2 B) 5

C) 10 D) 50

93. If $\nabla \cdot A = 0$, what type of field?

A) Conservative B) Solenoidal

C) Irrotational D) Uniform

94. If $\nabla \times A = 0$, what type of field?

A) Solenoidal B) Conservative

C) Divergent D) Magnetic

95. What factor appears in spherical area element?

A) r^2 B) $\sin\theta$

C) $r^2 \sin\theta$ D) $r\sin\theta$

96. If potential satisfies Laplace equation, what is charge density?

A) Zero B) Constant

C) Infinite D) Variable

97. In separation of variables, solution is assumed as?

A) Sum B) Product

C) Difference D) Ratio

98. An electron in electric field E experiences force?

A) eE B) -eE

C) e/E D) 0

99. A charged particle moving perpendicular to B follows what path?

A) Straight B) Circular

C) Parabolic D) Spiral

100. Radius of circular motion increases when?

A) B increases B) Velocity increases

C) Charge increases D) Mass decreases

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