Seat No.	

ENT - 63

Total No. of Pages : 20

M. Sc. Entrance Examination, 2024
PHYSICS
Sub. Code: 58718

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Day and Date : Monday, 29-07-2024 **Total Marks : 100**

Time : 2.30 p.m. to 4.00 p.m.

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Instructions :

1. All questions are compulsory
2. Each question carries one mark
3. Mark the correct answer in the given OMR by darkening the appropriate circle
4. Use a black pen only for marking the circle. Do not make any stray marks on the answer sheet
5. Follow the instructions given in the OMR sheet
6. Use the paper sheet provided for rough work
7. The OMR Answer Sheet and Question Paper should be handed over to the supervisor after examination
8. Only a Non-Programmable calculator is allowed

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1. Biogas is ..... gas

   A. methane B. propane

   C. butane D. ethane

2. The critical temperature of a superconductor at zero magnetic field is T_c. At which temperature, the critical field becomes half of its value at 0° K

   A. $T = \frac{T_c}{\sqrt{2}}$ B. $T = \frac{T_c}{\sqrt{3}}$

   C. $T = \frac{T_c}{\sqrt{6}}$ D. $T = \frac{T_c}{\sqrt{5}}$

3. The magnetic lines of force cannot penetrate the body of a superconductor, this phenomenon is known as

   A. isotope effect B. London's effect

   C. Meissner effect D. BCS theory

4. Which of the following is an example of top-down approach for the preparation of nanomaterials?

   A. Ball milling

   B. nucleation and growth

   C. Molecular beam epitaxy

   D. Gas phase agglomeration

5. The order and degree of the differential equation $\frac{\partial^2 z}{\partial x^2} = k\frac{\partial z}{\partial y}$ is

   A. 1, 2 B. 1, 1

   C. 2, 1 D. 2. 2

6. To solve the equation $\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} + \frac{\partial^2 u}{\partial t^2}$ by method of separation of variables, we assume the solution in the form *u (x, y,t)* =

   A. X*(x)*Y*(y)*Z*(z)* B. X*(x)*Y*(y)*

   C. X*(x)*Y*(y)*T*(t)* D. None of these

7. For the equation $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0,$ the point of regular singularity is

   A. $x = \infty$ B.*x* =1

   C. $x = 0$ D. None of these

8. Legendre's differential equation has general solution in the form

   A.y = AP*n(x)* B. y = BQ*n(x)*

   C. AP*n(x)* + BQ*n(x)* D. None of these

9. If *x = 0* is regular singularity of the differential equation, then its series solution is assumed in the form

   A. $y = \sum_{m=0}^{\infty} a_m x^m$ B. $y = \sum_{m=0}^{\infty} a_m x^{k+m}$

   C. $y = \sum_{m=0}^{\infty} a_m x^{k-m}$ D. either (A) or (C)

10. The value of $\Gamma\frac{3}{2}$ is

    A. $\sqrt{\pi}$ B. $\frac{\sqrt{\pi}}{2}$ C. $\frac{\pi}{2}$ D. $\frac{\pi}{\sqrt{2}}$

11. *ß* (m, n + 1) + *ß* (m + 1,*n*) =

    A. $\frac{m}{m+n}\beta(m,n)$ B. $\frac{n}{m+n}\beta(m,n)$ C. $\beta(m,n)$ D. 1

12. *er f (x)* + *er f (x)* =

    A. 1 B. 2

    C. 0 D. none of these

13. The modulus of complex number $2(\sqrt{3}+i)$ is

    A. 2 B. 4

    C. $2+\sqrt{3}$ D. none of these

14. Cauchy-Riemann conditions for function $f = u + iv$ to be analytic are

A. $\frac{\partial u}{\partial x} = \frac{\partial u}{\partial y}, \frac{\partial v}{\partial x} = \frac{\partial v}{\partial y}$ B. $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}, \frac{\partial u}{\partial y} = \frac{\partial v}{\partial x}$

C. $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial y}, \frac{\partial u}{\partial y} = -\frac{\partial v}{\partial x}$ D. $\frac{\partial u}{\partial x} = \frac{\partial v}{\partial x}, \frac{\partial u}{\partial y} = \frac{\partial v}{\partial y}$

15. Which of the following function is not analytic?

A. $f(z) = z$ B. $f(z) = e^z$

C. $f(z) = x^2 + 2ixy$ D. $f(z) = z^2$

16. For any vector field A, V. (x) is...

A. always zero

B. always non zero

C. always vector

D. None of the above

17. For any scalar field $\vec{A}$, $\nabla \cdot \left(\nabla \times \vec{A}\right)$ is ...

A. always non zero B. always zero

C. always scalar D. None of the above

18. ..... theorem converts the surface integral into the line integral

A. Gauss's B. Green's

C. Stoke's D. None of the above

19. .....theorem converts the volume integral into the surface integral

A. Gauss's B. Green's

C. Stoke's D. None of the above

20. if $\vec{A} = x\hat{i} + y\hat{j} + z\hat{k}$ then $\nabla \cdot \vec{A}$ is equal to .....

A. 0 B. 1

C. 2 D. 3

21. At a certain point if divergence of a vector field is zero then, the point acts as

A. source point B. sink point

C. conservative point D. non-conservative point

22. The capacitor of an isolated spherical conductor of radius R is given by.....

A. $4\pi\epsilon_0 R$ B. $\frac{4\pi\epsilon_0}{R}$ C. $\frac{R}{4\pi\epsilon_0}$ D. $4\pi\epsilon_0$

23. Assuming the earth to be a isolated spherical conductor of radius 6400 km, then its capacitor is.... Given $\left[\frac{1}{4\pi\epsilon_0} = 9 \times 10^9\right]$ SI unit

A. 711 μF B. 7.11 F

C. 7.11 F D. None of the above

24. With the usual meaning of the symbols, choose the correct equation

A. $D = E + P$ B. $D = \frac{P}{E}$ C. $D = \epsilon_0 E + P$ D. $D = \epsilon_0 (E + P)$

25. In a positively charged spherical shell, the electric field inside the shell is....

A. absent

B. present

C. present at the center

D. None of the above

26. The electric flux is a .....physical quantity.

A. vector B. scalar

C. tensor D. None of the above

27. In case of the spherical capacitor made up of two concentric, hollow metallic spheres, if the separation between them is increased, then its capacity.....

A. increases B. decreases

C. remains constant D. becomes zero

28. In LCR series circuit, at resonance the current in the circuit tends to

A. maximum B. minimum

C. zero D. retard

29. In parallel LCR circuit, at resonance the current in the circuit tends to

A. increases B. decreases

C. remains constant D. becomes zero

30. With increase in resistance R in the LCR series circuit, the sharpness

A. increases B. decreases

C. remains constant D. becomes zero

31. With increase in resistance R in the LCR series circuit, the band-width

A. increases B. decreases

C. remains constant D. becomes zero

32. The series LCR circuit9 is known as..... circuit

A. acceptor B. rejector

C. complex D. DC

33. Thevenin's theorem uses a ..... source

A. current B. voltage

C. both A and B D. None of the above

34. Norton's theorem uses a ..... source

A. current B. voltage

C. both A and B D. None of the above

35. Resistor is .....circuit element

A. active

B. passive

C. both active as well as passive

D. None of the above

36. The vector product of two parallel vectors is equal to

A. its magnitude

B. square of its magnitude

C. zero

D. None of the above

37. when two vectors $\vec{P}$ and $\vec{Q}$ of unequal magnitude are oppositely directed to each other then magnitude of its resultant is...

A. $P - Q$ B. $P + Q$

C. $P^2 - Q^2$ D. $P^2 + Q^2$

38. The equation, $\frac{dy}{dx} = sin(x)$ is ....differential equation

A. linear B. non-linear

C. homogeneous D. first order non-linear

39. when external force acting on a particle is zero, its .....is conserved.

A. linear momentum B. angular momentum

C. total energy D. None of the above

40. when external torque acting on a system is zero, its.....is conserved

A. linear momentum B. angular momentum

C. total energy D. None of the above

41. In XY-plane, a particle moves parallel to X-axis, at y = b with constant linear momentum (mv), then its angular momentum is

A. zero

B. mvb along -Z axis

C. mvb along +X axis

D. None of the above

42. The entropy of the universe is tending to.....

A. zero B. minimum

C. maximum D. remain constant

43. Efficiency of Carnot's heat engine is.....

A. zero B. one

C. greater than one D. less than one

44. All natural processes are .....

A. reversible B. irreversible

C. isothermal D. adiabatic

45. During reversible process.....remains constant

A. entropy

B. temperature

C. volume

D. density

46. Coefficient of viscosity of a gas at absolute temp T is proportional to

A. $\sqrt{T}$ B. T

C. T^2 D. T^{-2}

47. Beat frequency of two SHM's of frequencies n_1 and n_2 is given by

A. $n_1 - n_2$ B. $n_1 + n_2$

C. $n_1 \times n_2$ D. $n_1 \pm n_2$

48. In SIIM, acceleration varies.....with displacement.

A. directly B. indirectly

C. non-linearly D. indefinitely

49. In a coupled oscillator, the antisymmetric mode of oscillation has....the frequency of the symmetric mode of oscillation.

A. greater than B. less than

C. equal to D. half of

50. The symmetric mode of oscillation has the same frequency to that of

A. simple pendulum

B. compound pendulum

C. asymmetric mode

D. beat frequency

51. Microphones are....

A. active transducers B. passive transducers

C. transducers D. amplifiers

52. For a perfectly black body, the coefficient of transmission and absorption are

A. 0 and 1 B. 1 and 0

C. 1 and 1 D. 0 and 0

53. Wein's displacement law can be stated mathematically as .....

A. $\lambda_m^2 T = \text{constant}$ B. $\lambda_m^{-2} T = \text{constant}$

C. $\lambda_m T = \text{constant}$ D. $\lambda^4 T = \text{constant}$

54. The mathematical relation between entropy and probability can be stated as.....

A. $S = kW$ B. $S = WinK$

C. $S = KlnW$ D. $S = K/W$

55. The phase space is the superposition of a..... space and .....space

A. Position and Momentum

B. Position and Energy

C. Energy and Time D

D. Position and Angular Momentum

56. The volume of the cell in phase space is .....

A. h B. h^2

C. h^3 D. h^4

57. If equation $\frac{d^2y}{dx^2} + H(x)\frac{dy}{dx} + B(x)y = 0$, the function $P(x)$ and $Q(x)$ are analytic at point $x = x_0$ then the point x_0 is.....point

A. ordinary B. singular

C. both A and B D. none of these

58. For the equation, $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + y = 0$, the point of regular singularity is.....

A. $x = \infty$ B. $x = 1$

C. $x = 0$ D. None of these

59. The Bessel's equation $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - n^2)y = 0$ has regular singularity at .....point

A. $x = \infty$ B. $x = 0$

C. $x = 1$ D. $x = n$

60. The modulus of complex number $2(\sqrt{3} + i)$ is

A. 2 B. 4

C. $2\sqrt{3}$ D. None of these

61. The argument of complex number $-1 - \sqrt{3}i$ is...

A. $\pi/3$ B. $2\pi/3$ C. $4\pi/3$ D. $5\pi/6$

62. The value of *log(i)* is.....

A. 1 B. $\pi/2$ C. $i\pi/2$ D. $i\pi/2$

63. The value of $e^{(i\pi/2)}$

A. 1 B. $1 + i$

C. i D. $-i$

64. Phase velocity (u) is given by

A. $u = \frac{\Delta\omega}{\Delta k}$ B. $u = \frac{\Delta k}{\Delta\omega}$ C. $u = \frac{\omega}{k}$ D. $u = \frac{k}{\omega}$

65. Uncertainty principle is expressed as

A. $\Delta E \cdot \Delta p \geqslant \hbar$ B. $\Delta E \cdot \Delta x \geqslant \hbar$

C. $\Delta x \cdot \Delta t \geqslant \hbar$ D. $\Delta x \cdot \Delta p \geqslant \hbar$

66. The orthogonal condition for the wave functions $\psi_1(x)$ and $\psi_2(x)$ is

A. $\int_a^b \psi_1^*(x)\psi_2^*(x)dx = 0$ B. $\int_a^b \psi_1(x)\psi_2(x)dx = 0$

C. $\int_a^b \psi_1^*(x)\psi_2(x)dx = 0$ D. $\int_a^b \psi_2^*(x)\psi_2(x)dx = 0$

67. If the wave function is $\psi(x,t) = Ae^{\lambda|x|}e^{-i\omega t}$ where A, λ, ω are real and positive, then A is equal to .....

A. $A = \sqrt{\lambda}$ B. $A = \lambda$ C. $A = \lambda^2$ D. $A = \lambda^3$

68. $[L_+L_-]$ = ...

A. $\hbar L_+$ B. $2\hbar L_z$ C. $\hbar L_z$ D. $\hbar L_-$

69. Commutation relations among position and momentum operator are expressed as

A. $[x_i p_j] = i\hbar\delta_{ij}$ B. $[x_i p_j] = -i\hbar\delta_{ij}$ C. $[x_i p_j] = i\hbar$ D. $[x_i p_j] = 0$

70. The non-degenerate state of the energy possessed by a particle in three-dimensional rigid box is given by

A. $n_x = 3, n_y = 3, n_z = 3$ B. $n_x = 2, n_y = 2, n_z = 2$

C. $n_x = 4, n_y = 4, n_z = 4$ D. $n_x = 5, n_y = 5, n_z = 5$

71. The zero point energy of linear harmonic oscillator is

A. $E_0 = 0$ B. $E_0 = \hbar\omega$ C. $E_0 = 2\hbar\omega$ D. $E_0 = \frac{1}{2}\hbar\omega$

72. NAND gate is also called as ..... gate.

A. Unique B. Complete

C. Universal D. Logic

73. .....is a logic circuit that adds 2 binary digits at a time.

A. Full adder B. Half adder

C. Flip-flop D. Gates

74. In a transistor $I_c = 2mA$, $I_B = 0.5mA$ then I_E

A. 1 *mA* B. 3 *mA*

C. 0 *mA* D. 2.5 *mA*

75. The gain with feedback is called ..... gain

A. Closed loop B. Open loop

C. Both D. None

76. Power source used in CRO is about..... volts

A. 200 B. 180

C. 360 D. 2000

77. The gain control of the vertical amplifier is calibrated in terms of .....

A. voltage

B. current

C. potential

D. deflection sensitivity

78. The closed loop gain on non-inverting operational amplifier is A_{CL} = ...

A. $\frac{R_f}{R_1}$ B. $-\frac{R_f}{R_1}$ C. $1+\frac{R_f}{R_1}$ D. $1-\frac{R_f}{R_1}$

79. In IC 555 reset terminal pin 2 is..... terminal

A. Ground B. Trigger

C. Reset D. Threshold

80. For a system of N particles moving independent of each other, the number of degrees of freedom is .....

A. N B. 2N

C. 3N D. 6N

81. Langrange's equation of motion for conservative holonomic system is.....

A. $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q_j}}\right)-\frac{\partial L}{\partial q_j}=0$ B. $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q_j}}\right)+\frac{\partial L}{\partial q_j}=0$

C. $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right)-\frac{\partial L}{\partial q_j}=0$ D. $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right)+\frac{\partial L}{\partial q_j}=0$

82. Hamilton's principle is given as $\delta I = ...$ is for actual path

A. $\delta\int_{t_1}^{t_2} L dt = 0$ B. $\int_{t_1}^{t_2}\frac{1}{L}dt$ C. $\int_{t_1}^{t_2} L^2 dt$ D. $\int_{t_1}^{t_2} L^3 dt$

83. In a variational principle, the line integral of a function between two end points is.....

A. zero B. infinite

C. stationary D. one

84. In Galilean relativity the transformation equation for x coordinate from S to S' is.....

A. $x' = vt - x$ B. $x' = x - \frac{vt}{c^2}$ C. $x' = \frac{x - vt}{\sqrt{1 - \frac{v^2}{c^2}}}$ D. $x' = x - vt$

85. The Lorentz transformation equation of time shows that the space and time are not two..... entities.

A. related B. dependent

C. independent D. different.

86. The Poisson's equation is represented as.....

A. $\vec{\nabla} \cdot \vec{E} = 0$ B. $\vec{\nabla} \cdot \vec{V} = \frac{\rho}{\varepsilon_0}$ C. $\nabla^2 V = -\frac{\rho}{\varepsilon_0}$ D. $\nabla^2 \cdot E = 0$

87. Lorentz force is given by $\vec{F}$ .....

A. $q\left[\vec{v} \times \left(\vec{B} + \vec{E}\right)\right]$ B. $q\left[\vec{B} + \left(\vec{v} \times \vec{E}\right)\right]$

C. $q\left[\vec{B} + \left(\vec{E} \times \vec{v}\right)\right]$ D. $q\left[\vec{E} + \left(\vec{v} \times \vec{B}\right)\right]$

88. Isotopes are nuclides with same..... but different

A. A-values, Z-values B. A-values, N-values

C. Z-values, A-values. D. N-values, Z-values

89. Most stable nuclide is.....

A. ${}^{16}_{8}O$ B. ${}^{41}_{2}1Ca$

C. ${}^{206}_{82}Pb$ D. ${}^{3}_{1}H$

90. The first orbital resonance accelerator built was .....

A. Cyclotron B. Synchrocyclotron

C. Betatron D. Proton synchroton

91. The phase stable orbit condition in synchrocyclotron is that the instantaneous P.D. across dees is..... and

A. zero, about to become accelerating

B. zero, about to become decelerating

C. positive, very large

D. negative, very large

92. The gas amplification in GM-counter is .....

A. less than unity B. equal to unity

C. $\sim 10^3$ D. $\sim 10^8$

93. Cerenkov radiations are emitted by particle moving with a velocity ..... the phase velocity of light in same transparent medium.

A. half B. less than

C. greater than D. equal to

94. ..... interactions are very weak, but have very large range.

A. strong B. electromagnetic

C. weak D. gravitational

95. ..... are composite of quark (u and d) and an antiquark (ü and d)

A. Leptons B. Nucleons

C. Pions D. Hyperons

96. The number of atoms per unit cell of BCC crystal is .....

A. 1 B. 2

C. 3 D. 4

97. The ratio for hep crystal is .....

A. $\frac{2\sqrt{2}}{\sqrt{3}}$ B. $\frac{2\sqrt{3}}{\sqrt{2}}$ C. $\frac{\sqrt{3}}{2\sqrt{2}}$ D. $\frac{\sqrt{2}}{3}$

98. Reciprocal lattice to FCC lattice is .....

A. SC B. FCC

C. BCC D. HCP

99. In Laue's method of X-ray diffraction

A. λ is fixed while both Θ and d varies

B. λ is fixed and Θ varies

C. Θ is fixed and λ varies

D. Θ and λ both are fixed

100. The susceptibility of diamagnetic material is

A. positive and small B. positive and large

C. negative and small D. zero

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