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Total No. of Pages : 14

# P. G. Re Entrance Examination, 2024

## M.Sc. (Physics)

## Subject Code : 58718

**Day and Date : Friday, 28-Jun-2024** **Total Marks : 100**

**Time : 02.30 pm to 04.00 pm**

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

   A. always zero B. always non zero C. always vector D. None of the above

2. For any scalar field $\phi$, $\nabla \times (\nabla\phi)$ is ...

   A. always non zero B. always zero C. always scalar D. None of the above

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

   A. Gauss's B. Green's C. Stoke's D. None of the above

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

   A. Gauss's B. Green's C. Stoke's D. None of the above

5. 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

6. 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

7. 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. $4\pi\epsilon_0$

8. 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 $\mu$F B. 7.11 $\mu$F C. 7.11 F D. None of the above

9. 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. $D = \epsilon_0 (E + P)$

10. 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

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

    A. vector B. scalar C. tensor D. None of the above

12. 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

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

    A. maximum B. minimum C. zero D. retard

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

A. increases B. infinity C. remain constant D. zero

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

A. increases B. decreases C. remains constant D. becomes zero

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

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

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

17. 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. $\frac{n_1}{n_2}$ D. $n_1 \times n_2$

18. The product of *Lagrangian* of a system and *time* is generally known as....of a system.

A. energy B. power

C. action D. force

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

A. greater than B. less than

C. equal to D. half of

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

A. simple pendulum B. compound pendulum C. asymmetric mode D. beat frequency

21. Microphones are ....

A. active transducers B. passive transducers C. transducers D. amplifiers

22. For a perfectly black body, the coefficient of transmission and reflection are ....

A. 0 and 1 B. 1 and 0 C. 1 and 1 D. 0 and 0

23. 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. $\lambda^4 T = \text{constant}$

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

A. $S = kW$ B. $S = WlnK$ C. $S = KlnW$ D. $S = K/W$

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

A. Position and Momentum B. Position and Energy

C. Energy and Time D. Position and Angular Momentum

26. The volume of the cell in phase space is

A. $\hbar$ B. $\hbar^2$ C. $\hbar^3$ D. $\hbar^4$

27. If the 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

28. 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

29. 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. $x = n$

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

A. 2 B. 4 C. $2\sqrt{3}$ D. None of these

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

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

32. The value of $log(i)$ is ....

A. 1 B. $\pi/2$ C. $i\pi/4$ D. $i\pi/2$

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

A. 1 B. $1+i$ C. $i$ D. $-i$

34. 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. $u=\frac{k}{\omega}$

35. 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. $\Delta x\cdot\Delta p_x\geqslant\hbar$

36. 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. $\int_a^b\psi_2^*(x)\psi_2(x)dx=0$

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

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

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

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

39. 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. $[x_i p_j] = 0$

40. 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. $n_x = 5, n_y = 5, n_z = 5$

41. 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. $E_0 = \frac{1}{2}\hbar\omega$

42. NAND gate is also called as ..... gate.

A. Unique B. Complete C. Universal D. Logic

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

A. Full adder B. Half adder C. Flip-flop D. Gates

44. 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 $mA$

45. The gain with feedback is called ..... gain

A. Closed loop B. Open loop C. Both D. None

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

A. 200 B. 180 C. 360 D. 2000

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

A. voltage B. current C. potential D. deflection sensitivity

48. 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. $1-\frac{R_f}{R_1}$

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

A. Ground B. Trigger C. Reset D. Threshold

50. 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

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

52. Hamilton's principle is given as the action integral, $I$ = ..... is minimum for true path

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

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

A. zero B. infinite C. stationary D. one

54. 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. $x' = x - vt$

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

A. related B. dependent C. independent D. different

56. 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. $\nabla^2 \cdot E = 0$

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

58. Isobars 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

59. Most stable nuclide is .....

A. ${}^{16}_{8}O$ B. ${}^{41}_{2}1Ca$ C. ${}^{206}_{82}Pb$ D. ${}^{3}_{1}H$

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

A. Cyclotron B. Synchrocyclotron C. Betatron D. Proton synchroton

61. 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

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

A. less than unity B. equal to unity C. $\sim 10^3$ D. $\sim 10^8$

63. 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

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

A. strong B. electromagnetic C. weak D. gravitational

65. ....are composite of quark (u and d) and an antiquark ($\bar{u}$ and $\bar{d}$)

A. Leptons B. Nucleons C. Pions D. Hyperons

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

A. 1 B. 2 C. 3 D. 4

67. The $\frac{c}{a}$ ratio for hcp crystal is

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

68. Reciprocal lattice to FCC lattice is

A. SC B. FCC C. BCC D. HCP

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

A. $\lambda$ is fixed while both $\Theta$ and $d$ varies B. $\lambda$ is fixed and $\Theta$ varies

C. $\Theta$ is fixed and $\lambda$ varies D. $\Theta$ and $\lambda$ both are fixed

70. The susceptibility of diamagnetic material is

A. positive and small B. positive and large C. negative and small D. zero

71. The Curie law of paramagnetism holds good for

A. $\mu B = kT$ B. $\mu B \gg kT$ C. $\mu B \ll kT$ D. $\mu B = \frac{1}{kT}$

72. The density of electron states is proportional to

A. $E$ B. $E^{-1}$ C. $\sqrt{E}$ D. $\frac{1}{\sqrt{E}}$

73. In Hall effect if the current is flowing due to motion of holes, then Hall coefficient is

A. positive B. negative C. either positive or negative D. zero

74. Selection rule for $j$ in emission transitions is

A. $\Delta j = 0$ B. $\Delta j = 1$ C. $\Delta j = -1$ D. $\Delta j = \pm 1$

75. When sodium atom is placed in weak magnetic field, $D_1$ -line corresponding to transition $^2S_{\frac{1}{2}} - {}^2P_{\frac{1}{2}}$ splits into

A. 2-components B. 4-components C. 6-components D. 8-components

76. Rotational kinetic energy of J-level of a diatomic molecule is proportional to

A. J(J+1) B. moment of inertia C. both (a) and (b) D. bond length

77. Frank-Condon principle helps in estimating the .....

A. moment of inertia of the molecule B. bond length

C. reduced mass of molecule D. intensity of bands

78. Raman shift corresponds to.... spectral region

A. X-ray B. ultraviolet C. visible D. infra-red

79. To observe Raman effect molecule must be

A. polar B. non-polar C. ionic D. any of the above

80. Birth place of all stars is

A. Milky-way galaxy B. solar system C. interstellar medium D. ylem

81. A star in the process of formation is called

A. Protostar B. Red-giant C. White dwarf D. Cephied variable

82. If $V_i$ is the incoming wind velocity for a horizontal axis type wind-turbine then maximum power output $P$ of turbine is

A. $P_{max} \propto V_i^2$ B. $P_{max} \propto V_i^3$ C. $P_{max} \propto V_i$ D. $P_{max} \propto \sqrt{V_i}$

83. The axial induction factor of wind turbine lies between

A. 1 and $\infty$ B. 0 and 1 C. 0 and $\infty$ D. 1 and -1

84. Clarity index has unit

A. $\frac{W}{m^2}$ B. $\frac{W}{m}$ C. no unit D. $\frac{J}{m^2}$

85. In solar PV panel there are $n$ solar cell in module, $m$ number of modules in a panel and $P_C$ power of single cell, then power of the PV panel is

A. $nmP_C$ B. $\frac{nm}{P_C}$ C. $\frac{P_C}{nm}$ D. $(n+m)P_C$

86. Biogas is ..... gas

A. methane B. propane C. butane D. ethane

87. 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. $T = \frac{T_c}{\sqrt{5}}$

88. 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

89. 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

90. 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

91. 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

92. 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

93. 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

94. 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)

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

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

96. $\beta(m, n+1) + \beta(m+1, n) =$

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

97. $erf(x) + erf_c(x) =$

A. 1 B. 2 C. 0 D. none of these

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

A. 2 B. 4 C. $2 + \sqrt{3}$ D. none of these

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

100. Which of the following function is not analytic?

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

## ROUGH WORK