A

24724 **120 MINUTES**

1. The diagonal elements of which matrix must be pure imaginary numbers or zero?
   A) Symmetric B) Skew Symmetric
   C) Hermitian D) Skew Hermitian

2. If A and B are two vectors, then the value of (A-B) × (A+B) is -----
   A) $A^2 - B^2$ B) $2(A \times B)$ C) $A \times B$ D) $-(B \times A)$

3. The eigen values of the matrix $\begin{bmatrix} 1 & 0 & 0 \\ 0 & 1 & 1 \\ 0 & 1 & 1 \end{bmatrix}$ are -----

   A) 2,2,0 B) 2,2,1 C) 0,1,2 D) 1,1,2

4. The residue of Cot Z at Z = 0 is:

   A) 1 B) e^{-1} C) π D) 0

5. The number of non-vanishing terms in the Fourier series of $\cos^3\theta$ in the interval $(-\pi, \pi)$ is:
   A) One B) Two C) Three D) Infinity

6. To be a function harmonic, it will satisfy ----- equation.
   A) Hermite's B) Bessel's C) Poisson D) Laplace

7. The general solution of differential equation $\frac{d^2y}{dx^2} - y = 0$ is -----
   A) $y = Ce^x$ B) $y = Ce^{-x}$
   C) $y = C_1e^x + C_2e^{-x}$ D) None of these

8. If f (s) is the Laplace transform of f(t), the Laplace transform of f(at) is-----

   A) $f\ (s/a)$ B) $\frac{1}{a} f\ (s/a)$ C) $\bar{f}(s)$ D) $\frac{1}{a}\bar{f}(s)$

9. If $J_n(x)$ is the Bessel's function of first kind, its generating function is given by ---.
   A) $\exp\frac{x}{2}(1 - \frac{1}{t})$ B) $\exp\frac{x}{2}\left(1 - \frac{1}{t}\right)^{-1}$
   C) $\exp\frac{x}{2}(t - \frac{1}{t})$ D) $\exp\frac{x}{2}(1 - t)^{-1}$

10. For Dirac delta function, $\int_{-\infty}^{\infty} \delta(3x - 2)x^2 dx$ is -----
    A) $\frac{2}{3}$ B) $\frac{4}{9}$ C) $\frac{4}{27}$ D) $\frac{1}{3}$

11. If $P_n(x)$ is Legendre's polynomial, then -----

A) $P_n(-x) = P_n(x)$ B) $P_n(-x) = (-1)^n P_n(x)$

C) $P_n(-1) = 1$ D) $P_n(-1) = -1$

12. The path followed by a particle in sliding from one point to another in the absence of friction in the shortest distance is a -----

A) Cycloid B) Sigmoid

C) Sphere D) Catenary of revolution

13. How fast does a rocket ship have to go for its length to be contracted to 0.99% of its proper length?

A) c B) $0.98c$ C) $\sqrt{0.98}\,c$ D) None of these

14. Lagrangian for a charged particle in an electromagnetic field is -----

A) $\frac{1}{2}mv^2 + q\phi + \frac{q}{c}V \cdot A$ B) $\frac{1}{2}mv^2 + q\phi - \frac{q}{c}V \cdot A$

C) $\frac{1}{2}mv^2 - q\phi - \frac{q}{c}V \cdot A$ D) $\frac{1}{2}mv^2 - q\phi + \frac{q}{c}V \cdot A$

15. The differential equation for planetary motion is -----

A) $\frac{d^2u}{d\theta^2} = u + \frac{m}{l^2u^2}f(1/u)$ B) $\frac{d^2u}{d\theta^2} = -u - \frac{m}{l^2u^2}f(1/u)$

C) $\frac{d^2u}{d\theta^2} = u - \frac{m}{l^2u^2}f(1/u)$ D) $\frac{d^2u}{d\theta^2} = -u + \frac{m}{l^2u^2}f(\,)$

16. Hamilton's canonical equations of motion are -----

A) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = -\frac{\partial H}{\partial q_i}$ B) $q_i = \frac{\partial H}{\partial \dot{p}_i}$ and $p_i = \frac{-\partial H}{\partial \dot{q}_i}$

C) $\dot{q}_i = \frac{\partial H}{\partial p_i}$ and $\dot{p}_i = \frac{\partial H}{\partial q_i}$ D) $q_i = \frac{\partial H}{\partial \dot{P}_i}$ and $p_i = \frac{\partial H}{\partial \dot{q}_i}$

17. The number of possible longitudinal normal modes of linear symmetric triatomic molecules are:

A) One B) Two C) Three D) Four

18. The generalised velocity co-ordinate q_k of a classical system with Lagrangian ' L ' is said to be cyclic if -----

A) $\frac{\partial L}{\partial q_k} = 0$ B) $\frac{\partial L}{\partial q_{\ k}} = 0$ C) $\frac{\partial L}{\partial q_k} = \dot{q}_k$ D) $\frac{\partial L}{\partial q_k} = \frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_k}\right)$

19. The mass of an electron is double its rest mass, then the velocity of the electron is:

A) $2c$ B) $c/2$ C) $\sqrt{\frac{3}{2}}\,c$ D) $\frac{\sqrt{3}}{2}\,c$

20. The maximum and minimum velocities of a satellite are v_1, and v_2 respectively. The eccentricity of the satellite is given by:

A) $e = \frac{v_1}{v_2}$ B) $e = \frac{v_2}{v_1}$ C) $e = \frac{v_1 - v_2}{v_1 + v_2}$ D) $e = \frac{v_1 + v_2}{v_1 - v_2}$

21. The product of generalized co-ordinate and its conjugate momentum has the dimensions of -----

A) Linear momentum B) Angular momentum
C) Force D) Energy

22. The phase velocity, v_p and the group velocity, v_g of a de Broglie wave in free space are related as -----

A) $v_p v_g = c$ B) $\frac{vp}{vg} = \sqrt{2}$ C) $v_p v_g = c^2$ D) $v_p v_g = \sqrt{2}c^2$

23. The duration of radar pulse is 1μs. The uncertainty in its energy will be -----

A) 0 B) 1.05×10^{-28}J
C) 1.05×10^{-40}J D) 1.05×10^{-21}J

24. The expectation value of momentum p is -----

A) $\int \Psi(i\hbar\nabla)\Psi^* d\tau$ B) $\int \frac{\hbar}{i}\nabla(\Psi^*\Psi)\, d\tau$
C) $\int \Psi^*(\frac{\hbar}{i}\nabla)\Psi d\tau$ D) $\int \Psi^*(i\hbar\nabla)\Psi d\tau$

25. Which of the following is an eigen function of L_z?

A) Cosφ B) Sinφ C) $e^{i\varphi}$ D) $Cos^2\varphi$

26. In partial wave analysis, the expression for total cross section of scattering is -----

A) $4\pi\sum_l k^2(2l+1)\sin^2\delta_l$
B) $\frac{4\pi}{k^2}\sum_l(2l+1)sin^2\delta_l$
C) $2\pi\sum_l k^2\,(2l+1)P_l^2\,(\cos\theta)$
D) $\frac{2\pi}{k^2}\sum_l(2l+1)\,P_l^2(\cos\,\theta)$

27. Which of the following quantum mechanical operator is Hermitian?

A) $\left(\frac{d}{dx}\right)$ B) $\left(\frac{d}{dx}\right)^2$ C) $\left(\frac{d}{dx}\right)^3$ D) $i\frac{d}{dx}$

28. The value of $\frac{1}{2}(L_-L_+ + L_-L_+)$is -----

A) $L^2 - L_z^2$ B) $L^2 + L_z^2$ C) $L - L_z$ D) $L+L_z$

29. The existence of zero point energy for a linear harmonic oscillator is a consequence of -----

A) Pauli's exclusion principle B) Uncertainty principle
C) Matter waves D) Special theory of relativity

30. The expression for optical theorem is -----

A) $I_m f(0) = k\pi\sigma_T$ B) $R_e f(0) = 2\hbar i$
C) $I_m f(0) = \frac{k}{4\pi}$ D) $I_m f(0) = \frac{k}{4\pi}\sigma_T$

31. Which of the following is Fermi Golden rule?

A) $\frac{2\pi}{\hbar}\left|H_{\alpha\beta}(E)\right|^2\rho_\alpha^E(E)$ B) $\frac{2\pi}{\hbar^2}\left|H_{\alpha\beta}(E)\right|^2\rho_\alpha^E(E)$
C) $-\frac{2\pi}{\hbar}\left|H_{\alpha\beta}^2(E)\right|^2\rho_\alpha^E(E)$ D) None of these

32. Which is the following relations is true for Pauli matrices σ_x, σ_y and σ_z ?

A) $\sigma_x\sigma_y = \sigma_y\sigma_z$ B) $\sigma_x\sigma_y = \sigma_z$ C) $\sigma_x\sigma_y = i\sigma_z$ D) $\sigma_x\sigma_y = -i\sigma_x\sigma_y$

33. The root mean square speed, average speed and most probably speed for a gas are in the ratio -----

A) $\sqrt{2} : \frac{2\sqrt{2}}{\sqrt{\pi}} : \sqrt{3}$ B) $\sqrt{3} : \frac{\sqrt{2}}{\pi} : 2\sqrt{2}$
C) $\sqrt{3} : \frac{2\sqrt{2}}{\pi} : 3\sqrt{2}$ D) $\sqrt{3} : \frac{2\sqrt{2}}{\sqrt{\pi}} : \sqrt{2}$

34. In Statistical Physics, the absolute temperature T of a system is related to the total number of accessible states Ωis -----

A) $kT = \frac{\partial\Omega}{\partial E}$ B) $kT = \frac{\partial \log\Omega}{\partial E}$ C) $\frac{1}{kT} = \frac{\partial\Omega}{\partial E}$ D) $\frac{1}{kT} = \frac{\partial \log\Omega}{\partial E}$

35. In case of Bose-Einstein Condensation, number of particles -----

A) Increases in lower energy levels at low temperatures and high pressures.
B) Decreases in lower energy levels of low temperatures and high pressures.
C) Increases in lower energy levels at high temperatures and low pressure
D) Decreases in lower energy levels at high temperatures and low pressures.

36. Which of the following is not Maxwell's equation?

A) $(\frac{\partial S}{\partial V})_T = (\frac{\partial P}{\partial T})_V$ B) $(\frac{\partial T}{\partial V})_S = -(\frac{\partial P}{\partial S})_V$
C) $(\frac{\partial V}{\partial P})_S = (\frac{\partial T}{\partial S})_P$ D) $(\frac{\partial T}{\partial P})_S = (\frac{\partial V}{\partial S})_P$

37. Consider a system of two identical particles each of which can be in any one of three single particle states. The number of states of the systems possible in Bose Einstein Statistics are -----

A) 1 B) 3 C) 6 D) 9

38. In Fermi Dirac statistics, the degeneracy parameter is given by -----

A) $A = \frac{h^2}{2mkT}\left(\frac{3N}{8\pi}\right)^{2/3}$ B) $\ln A = \frac{h^2}{2mkT}\left(\frac{3N}{8\pi V}\right)^{2/3}$

C) $\ln A = \frac{h^2}{2mk}\left(\frac{3NV}{8\pi}\right)^{2/3}$ D) $\ln A = \frac{h^3}{2m}\left(\frac{3NV}{8\pi}\right)^{2/3}$

39. Fermi function $f(E) = \frac{1}{e^{(E-E_f)/kT}}$ gives the probability of occupation of electrons per energy state. Then the probability of number of electrons at absolute temperature when $E = E_f$ is -----

A) 1 B) 0 C) Infinity D) $\frac{1}{2}$

40. In the distribution of energy radiated by a black body, Planck's formula reduces to the Rayleigh Jeans Law for -----

A) Higher wavelength region B) Shorter wavelength region
C) Both A and B D) No relation between the two

41. According to Wien's displacement law, the spectral distribution of energy emitted at a given temperature has a definite -----.

A) Minimum and this minimum shifts to longer wavelengths as the temperature decreases
B) Minimum and this minimum shifts to shorter wavelengths as the temperature increases
C) Maximum and this maximum shifts to shorter wavelengths as the temperature decreases
D) Maximum and this maximum shifts to shorter wavelengths as the temperature increases

42. $\nabla^2 V = -4\pi\rho$ is -----

A) Maxwell's equation B) Poisson's equation
C) Laplace's equation D) None of these

43. Magnetic vector potential is related to electrostatic potential V through the relation:

A) $\text{div}\,\vec{A} + \mu_0\varepsilon_0\frac{\partial V}{\partial t} = 0$ B) $\text{curl}\,A + \mu_0\varepsilon_0\frac{\partial V}{\partial t} = 0$

C) $\text{div}\,\vec{A} - \mu_0\varepsilon_0\frac{\partial V}{\partial t} = 0$ D) $\text{curl}\,A - \mu_0\varepsilon_0\frac{\partial V}{\partial t} = 0$

44. An electromagnetic wave passing through vacuum is described by $E = E_0\sin(kx-\omega t)$ and $B = B_0\sin(kx-\omega t)$, then -----

A) $E_0B_0 = \omega k$ B) $E_0k = B_0\omega$ C) $E_0\omega = B_0k$ D) None of these

45. The displacement current arises due to -----

A) Positive charges only
B) Negative charges only
C) Both positive and negative charges

D) Time varying electric field

46. A solid sphere of radius R carries a uniform volume charge density ρ. The magnitude of electric field inside the sphere at a distance r from the centre is -----

A) $\frac{R\rho}{3\varepsilon_0}$ B) $\frac{r\rho}{3\varepsilon_0}$ C) $\frac{R^2\rho}{r\varepsilon_0}$ D) $\frac{R^3\rho}{3\varepsilon_0}$

47. The Curie law in case of polarisation of a polar molecule is given by -----

A) $\chi_e = \frac{nP_0{}^2}{3\varepsilon_0 kT}$ B) $\chi_e = \frac{nP_0{}^2 T}{3\varepsilon_0 k}$ C) $\chi_e = \frac{nkT}{3P_0{}^2\varepsilon_0}$ D) None of these

48. The field of magnetic vector B is always -----

A) Irrotational B) Solenoidal
C) Non-Solenoidal D) Both Irrotational and Non-Solenoidal

49. The path of a charged particle which crossed electric and magnetic fields is a -----

A) Parabolic B) Hyperbolic C) Cycloid D) Circular

50. In a loss-less transmission line, for a $\lambda/8$ long short circuit section, the input impedance will be -----

A) Inductive B) Infinite C) Capacitive D) Zero

51. The following equations are given for retarded time-varying fields:

1. $\nabla^2 V = -\frac{\rho}{\varepsilon} + \omega^2\mu\varepsilon V$ 2. $\nabla^2 V = \frac{\rho}{\varepsilon} + \omega^2\mu\varepsilon V$
3. $\nabla^2 A = J + \omega^2\mu\varepsilon A$ 4. $\nabla^2 A = -J + \omega^2\mu\varepsilon A$

Choose the correct answer from the options given below.

A) 1 & 4 only B) 1 & 3 only C) 2 & 3 only D) 2 & 4 only

52. A corona around the moon is seen when we view it on a foggy or misty night. This is due to the -----

A) Scattering of light by airborne water droplets
B) Dispersion of light by airborne water droplets
C) Diffraction patterns of airborne water droplets
D) Formation of diffused image of moon

53. The total energy of the electron in the n^{th} orbit of hydrogen atom is -----

A) $\frac{e^2}{4\pi\varepsilon_0 r_n}$ B) $\frac{e^2}{8\pi\varepsilon_0 r_n}$ C) $\frac{-e^2}{4\pi\varepsilon_0 r_n{}^2}$ D) $\frac{-e^2}{8\pi\varepsilon_0 r_n}$

54. The ratio of frequencies of the first line of the Lyman series and the first line of Balmer series is -----

A) $\frac{27}{8}$ B) $\frac{27}{5}$ C) $\frac{8}{27}$ D) $\frac{5}{27}$

55. For an atom in the state of $^2D_{5/2}$ the Lande-g factor should be -----

A) 1.33 B) 1.75 C) 1.20 D) 0.98

56. The hyperfine splitting of the spectral lines of an atom is due to -----
A) The coupling between the spins and the orbital angular momenta of electrons
B) The coupling between spins of two or more electrons
C) The effect of external electromagnetic fields
D) The coupling between the electron spin and the nuclear spin

57. Which one of the following molecules does **not** exhibit a rotational spectrum?
A) HCl B) CO C) H_2 D) HBr

58. All vibrations producing a change in the electric dipole moment of molecule yield ----- Spectra.
A) Infrared B) Ultraviolet C) Raman D) X-ray

59. In a very strong magnetic field, the splitting of a spectral line is normal. This effect is called ----- Effect.
A) Zeeman B) Raman
C) Paschen-Back D) Stark

60. The selection rule of the translational energy levels in the Raman Spectrum is ΔJ is equal to -----
A) ± 1 B) ± 2 C) $+1$ D) +2

61. Population inversion in Semiconductors laser diode is achieved by -----
A) Heavily doping p & n regions
B) Reverse biasing the junction
C) Lightly doping p & n regions
D) Introducing trap-centres on p & n regions

62. The ----experiment confirms the existence of space quantisation.
A) Double Slit B) Stern and Gerlach
C) Franck and Hertz D) Michelson and Morley

63. The dependence of Doppler broadened line width of a laser transition on temperature T is given by -----
A) $T^{1/2}$ B) $T^{-1/2}$ C) T^2 D) T

64. A thermal neutron having speed v impinches on a ^{235}U nucleus. The reaction cross section is proportional to:
A) $\sqrt{v}$ B) $v^{-1/2}$ C) v D) v^{-1}

65. Which of the following decay process is allowed?
A) $k^0 \rightarrow {}^{+} + {}^{-}$ B) ${}^{-} \rightarrow e^{-} + \gamma$
C) $n \rightarrow p + \pi^{-}$ D) $n \rightarrow \pi^{+} + \pi^{-}$

66. From meson field theory the potential energy of interaction between two nucleons is proportional to -----

A) $\frac{e^{-\mu r}}{r}$ B) $\frac{e^{-\mu r}}{r^2}$ C) $\frac{e^{-\mu r^2}}{r^2}$ D) $\frac{e^{-\mu r^2}}{r}$

67. According to the Shell model of the nucleus, which of the following is **incorrect**?
A) Magic numbers exist
B) Nucleons interact with their nearest neighbours only
C) Nucleons in a nucleus interact with a general force field
D) Large electronic quadrupole moment exists for certain nuclei

68. The nuclear reaction $4_1H^1 \rightarrow {}_2He^4 + 2_{-1}e^0 + 26$ MeV represents -----.
A) α-decay B) β-decay C) Fusion D) Fission

69. According to Fermi theory of β-decay, the number of final states of electrons corresponding to momenta between p and p+dp is -----
A) Proportional to pdp B) Proportional to p^2dp
C) Proportional to p^3dp D) Independent of p

70. In a Synchrotron, the magnetic field must change to compensate for -----
A) Relativistic mass increase
B) Heating of the coils
C) Loss of energy due to air resistance
D) Increase in the radius of the circular path

71. The quark structure of Δ^{++} is -----
A) uuu B) udu C) sss D) ddd

72. What is the mass 'm' of a particle, if its rest mass 'm_0' moves with a velocity of $c/\sqrt{2}$?
A) m_0 B) $0.5\, m_0$ C) $0.707\, m_0$ D) $1.414\, m_0$

73. The total energy of a moving meson is exactly twice its rest energy. Find the speed of the meson.
A) $v=\frac{c}{\sqrt{2}}$ B) $v=\sqrt{\frac{3}{2}}\, c$ C) $v=\frac{\sqrt{3}}{2}c$ D) $v=\frac{c}{2}$

74. Which primitive unit cell has unequal edge lengths (a≠b≠c) and all axial angles different from 90°?
A) Hexagonal B) Triclinic C) Tetragonal D) Monoclinic

75. NaCl crystals appear yellow due to -----
A) Schottky defect B) Frenkel defect
C) Interstitials D) F-centres

76. The packing fraction of fcc structure is -----
A) 0.35 B) 0.68 C) 0.32 D) 0.74

77. If the Fermi energy of a metal is 1.4 eV, the Fermi temperature of the metal is approximately -----
A) 1.6×10^{3}K B) 1.6×10^{4}K C) 1.6×10^{5}K D) 1.6×10^{6}K

78. $\frac{\varepsilon_r-1}{\varepsilon_r+2}=\frac{N\alpha}{3\varepsilon_0}$ is -----
A) Lorentz relation B) Clausius-Mossotti relation
C) Einstein relation D) None of these

79. In the AC Josephson effect, a supercurrent flows across two superconductors separated by a thin insulating layer and kept at an electrical potential difference ΔV. The angular frequency of the resultant supercurrent is given by:
A) $\frac{e\Delta V}{h}$ B) $\frac{e\Delta V}{\pi h}$ C) $\frac{2e\Delta}{h}$ D) $\frac{2e\Delta V}{\pi h}$

80. The sprinkling of water slightly reduces the temperature of a closed room because ----.
A) Specific heat of water is high
B) Water is a bad conductor of heat
C) Temperature of water is less than that of the room
D) Water has large latent heat of vaporisation

81. The effective mass of an electron in a semiconductor -----
A) Can never be positive
B) Can never be negative
C) Can be positive or negative
D) Depends on its spin

82. Temperature coefficient of resistance in a pure semiconductor is -----
A) Zero B) Positive
C) Negative D) Dependent on size of specimen

83. A transistor connected in a common base configuration has I_E = 2mA and I_B = 20 A. Find the current gain α.
A) 0.95 B) 1.98 C) 0.98 D) 0.99

84. JFET is considered as a voltage controlled device because -----
A) Gate current is controlled by drain voltage
B) Drain current is controlled by gate voltage
C) Gate current is controlled by source voltage
D) Drain current is controlled by source voltage

85. In a ----- amplifier, the collector current flows only during the positive half cycles of the input signal.
A) Class A B) Class B C) Class C D) Class AB

86. RC oscillators are usually used in ----- frequency range.
A) Audio B) Radio C) Video D) Ultrahigh

87. For a step input, the output of an integrator is:
A) A pulse B) A triangular waveform
C) A ramp D) A spike

88. The semiconductor material not used in LED is -----
A) SiC B) GaAs C) GaAsP D) Si

89. The main purpose of Accumulator register of the microprocessor 8085 is -----
A) Used as primary pointer B) Storing instructions
C) Temporary data storage D) Selection of peripheral

90. How many bits of timer is used in 8051 microcontroller?
A) 2 bits B) 4 bits C) 8 bits D) 16bits

91. If $\vec{r} = x\hat{\imath} + y\hat{\jmath} + z\hat{k}$ then divergence of $\vec{r}$ is:
A) 0 B) $\sqrt{x^2 + y^2 + z^2}$
C) $|x| + |y| + |z|$ D) 3

92. If y represents Bessel's function of first kind $x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + (x^2 - 1)y = 0$, then the solution of above equation at $x = 0$ is:
A) 1 B) 0 C) -1 D) ∞

93. The Fourier transform of a Gaussian function e^{-at^2} with $a > 0$, will be again a Gaussian function. An increase in the value of 'a' makes ---.
A) Original Gaussian function wider and Fourier transform narrower
B) Original Gaussian function narrower and Fourier transform wider
C) Both original Gaussian function and Fourier transform narrower
D) Both original Gaussian function and Fourier transform wider

94. What is the modulus of $\frac{2-i}{2+i}$?
A) $\sqrt{5}$ B) $\sqrt{\frac{1}{5}}$ C) 1 D) 5

95. If the generalized coordinate is angle, the corresponding generalized force has the dimension of :
A) Force B) Torque C) Energy D) Momentum

96. If a function F does not depends on time explicitly, and is a constant of motion, then its Poisson's bracket with Hamiltonian is ----.
A) $i\hbar$ B) $-i\hbar$ C) 0 D) $-\hbar$

97. The transformation $q = PQ^2,\ p = \frac{1}{Q}$ is canonical. Then generating function is given by:

A) $F = pq$ B) $F = P/q$ C) $F = Pq$ D) $F = p^2q$

98. The trajectory of a particle moving under an inverse square force field is hyperbolic, then its energy is:
A) zero B) Positive C) Negative D) Infinity

99. The displacement x of a particle moving along a straight line under a force is related to time t where $t = \sqrt{x} + 3$. (t and x are in second and meter).What is the displacement of the particle when its velocity is zero?
A) 18m B) 12m C) 6m D) 0m

100. The optical theorem relates the total cross section to the scattering amplitude in forward direction. Mathematical form of optical theorem is:

A) $\frac{4\pi}{k^2}\sum_{i=0}^{\infty}(2l+1)f(0)$ B) $\frac{1}{k^2}\sum_{i=0}^{\infty}(2l+1)f(0)$

C) $\frac{4\pi}{k}I_m f(0)$ D) $\frac{4\pi}{k}R_e f(0)$

101. For a particle in cubical box, the number of degenerate energy states corresponding to quantum number 1,2,3 is:
A) 3 B) 6 C) 8 D) 9

102. A second order phase transition is characterized by:
A) Latent heat
B) Change in volume
C) Discontinuous change in specific heat
D) Irreversible behavior during heating and cooling

103. The electric field intensity inside a dielectric sphere placed in a uniform electric E_0 is:
A) Equal to E_0 B) Less than E_0
C) Greater than E_0 D) zero

104. An particle is allowed to move along a uniform magnetic field such that its velocity $\vec{v}$ is antiparallel to the magnetic field $\vec{B}$. The work done by magnetic field on the α particle when it covers a distance L is:
A) $2evBL$ B) $-2evBL$ C) $4evBL$ D) zero

105. The magnetic vector potential in a region is given by $\vec{A} = z\hat{\imath} - 2x\hat{\jmath}$. The associated magnetic induction $\hat{B}$ is:
A) $\hat{\imath} - 2\hat{\jmath}$ B) $\hat{\jmath} - 2\hat{k}$ C) zero D) $-\hat{\imath} + 2\hat{\jmath}$

106. The potential energy of an electron in hydrogen atom is ---- its kinetic energy.
A) Half of B) Twice C) Equal to D) Thrice

107. The doublet observed in alkali spectra are due to
A) Screening of K electron B) Spin orbit interaction of the electron
C) Pressure of isotopes D) All the above

108. Pure rotational spectrum of a diatomic molecules consists of:
A) Two equally spaced lines B) Three equally spaced lines
C) Many equally spaced lines D) No regular pattern

109. What is the wavelength of photon emitted by hydrogen atom in a transition $2s \rightarrow 1s$ is:
A) 609 A^0 B) 1000 A^0 C) 1218 A^0 D) 2436 A^0

110. Angular momentum quantization was established by----- experiment.
A) Stern-Gerlach B) Frank Hertz
C) Photo electric D) Davison-Germer

111. Three values of rotational energies are given below in different units. $P = 10cm^{-1}$, $Q = 10^{-23}J$ and $R = 10^4MHz$. The arrangement of above energies in the increasing order of magnitude is:
A) P,Q,R B) R,P,Q C) Q,R,P D) R,Q,P

112. In a nuclear process a nucleus ruptures into two parts, which have their velocities in the ratio 1:2. What will be the ratio of their nuclear size?
A) 1:2 B) 2:1 C) $1:2^{1/3}$ D) $2^{1/3}:1$

113. Which of the following particle does **not** have a spin half?
A) proton B) neutron C) photon D) nutrino

114. The theory that explains the combination of quarks is:
A) Shell model
B) Meson theory
C) Quantum Chromodynamics
D) Standard model

115. Thermal neutron having speed *v* impinges on a U^{235} nucleus, the reaction cross-section is proportional to:
A) v B) $\frac{1}{v}$ C) v^2 D) $\sqrt{v}$

116. The density of a fcc lattice expressed in terms of atomic mass A, Avagadro number N and lattice parameter a is:
A) $\frac{A}{Na^3}$ B) $\frac{2A}{Na^3}$ C) $\frac{4A}{Na^3}$ D) $\frac{A}{Na^2}$

117. The number of Bravias lattices that can exist is:
A) 17 B) 14 C) 32 D) 23

118. The Hall coefficient of a metal is low. It means that:
A) The charge carrier density in that metal is high
B) The charge carrier density in that metal is low
C) The Hall field produced in that metal is high
D) The conductivity of that metal is zero

119. Which of the following is the suitable method for obtaining phonon spectra?
A) Neutron scattering B) Proton scattering
C) Electron scattering D) None of the above

120. For a diamond structure the packing fraction is:
A) $\frac{\pi\sqrt{3}}{8}$ B) $\frac{\pi\sqrt{3}}{4}$ C) $\frac{\pi\sqrt{3}}{2}$ D) $\frac{\pi\sqrt{3}}{16}$
