A

19224 **120 MINUTES**

1. The total energy density of an electromagnetic wave is:
   A) $\frac{\varepsilon E_0^2}{2}$ B) $\frac{B_0^2}{2\mu}$ C) $\frac{B^2}{2\epsilon}$ D) εE_0^2

2. The potential at a point due to a linear quadrupole varies with distance 'r' as:
   A) r^{-1} B) r^{-2} C) r^{-3} D) r^3

3. The Poynting Vector of a charge q moving with a uniform velocity v is
   A) $5\varepsilon_0$ B) $\frac{11}{2}\varepsilon_0$ C) $\frac{\sqrt{11}}{2}\varepsilon_0$ D) $22\varepsilon_0$

4. The angular frequency of electric field in an electromagnetic wave having wavelength 600 nm is $6.28\text{x}10^{14}$ rad/s. The velocity of the wave is:
   A) $3\text{x}10^8$ m/s B) $1.5\text{x}10^7$ m/s C) $6\text{x}10^7$ m/s D) $1.5\text{x}10^8$ m/s

5. The vector potential at the position defined by the vector $\vec{r}$ in a uniform magnetic field is:
   A) $\vec{A} = \vec{B}X\vec{r}$ B) $\vec{A} = 3(\vec{r}X\vec{B})$
   C) $\vec{A} = \frac{1}{6}(\vec{B}X\vec{r})$ D) $\vec{A} = \frac{1}{2}(\vec{B}X\vec{r})$

6. Divergence of position vector in three dimension $(\vec{\nabla}.\vec{r})$ is
   A) 0 B) 1 C) 2 D) 3

7. The ratio of amplitudes of magnetic and electric fields in an electromagnetic wave has the dimension of:
   A) Inductance B) Conductance C) Resistance D) Capacitance

8. The amplitudes of electric and magnetic fields in an electromagnetic wave propagating through vacuum is related by
   A) $E_0B_0 = \frac{\omega}{k}$ B) $E_0\omega = B_0k$ C) $E_0k = B_0\omega$ D) $\frac{B_0}{E_0} = c$

9. A charged particle moves with an acceleration 'a'. The power radiated by it is proportional to
   A) a^0 B) a C) a^2 D) a^3

10. The differential form of Faraday's law of electromagnetic induction is
    A) $\nabla X\vec{H} = \epsilon_0\frac{\partial E}{\partial t}$ B) $\text{Curl}\vec{E} = -\mu_0\frac{\partial \vec{H}}{\partial t}$
    C) $\nabla.\vec{B} = 0$ D) $\nabla.\vec{E} = \frac{\rho}{\varepsilon_0}$

11. The wavelength of light emitted by an atom which is excited to higher state by 4 eV is nearly
    A) 400 nm B) 310 nm C) 280 nm D) 460 nm

12. The binding of an electron in the ground state of an atom is 24.6 eV. The total energy required to remove both the electrons from the atom is
A) 49.2 eV B) 98.4 eV C) 79 eV D) 246 eV

13. The magnetic field required to observe normal Zeeman Effect if a spectrometer can resolve spectral lines separated by 0.45 Å at 4500 Å is
A) 3.61 T B) 4.28 T C) 1.26 T D) 2.45 T

14. The frequency at which an electron with orbital magnetic moment μ precesses in a magnetic field $\vec{B}$ is
A) $\frac{e}{2m}\vec{\mu}$ B) $\frac{2m}{e}\vec{\mu}$ C) $\vec{\mu}.\vec{B}$ D) $\frac{e}{2m}\vec{B}$

15. The minimum voltage that is to be applied to X-ray tube to produce X-ray photons of wavelength 1 Å is
A) 125 MV B) 125 kV C) 66 kV D) 25 MV

16. The surface term in the semi-empirical mass formula for the binding energy of nucleus depends on its mass number A as
A) A B) $A^{2/3}$ C) $A^{-1/3}$ D) A^{-1}

17. If the wavelength of first line of Lyman series is 1215 Å, then the series limit of Lyman series of Hydrogen spectrum is
A) 1215 Å B) 911 Å C) 1025 Å D) 3820 Å

18. Which one of- the following particles cannot be accelerated by cyclotron?
A) Electron B) Proton C) α - particle D) Deuteron

19. The co-ordination number of a face centered cubic structure is
A) 8 B) 6 C) 4 D) 12

20. If the primitive cell contains p atoms, then the number of optical branches in the phonon dispersion relation is
A) 3p-1 B) 3p-2 C) 3p-3 D) 3p

21. The specific heat capacity of a material at very low temperature varies with temperature T as:
A) $C_v \propto T^2$ B) $C_v \propto T$ C) $C_v \propto T^3$ D) $C_v \propto T^4$

22. If K and σ are the thermal and electrical conductivities of a metal at temperature T, then Lorentz number (L) can be represented as:
A) $\frac{T}{K\sigma}$ B) $\frac{K}{T\sigma}$ C) $\frac{KT}{\sigma}$ D) σKT

23. The magnetic state of a superconductor is:
A) Paramagnetic B) Diamagnetic
C) Ferromagnetic D) Antiferromagnetic

24. The critical magnetic fields of a superconductor material are $1x10^5$ A/m and $2x10^5$ A/m at 10 K and 0 K respectively. Then, the critical temperature of the material is
A) 10.31 K B) 10 K C) 14.14 K D) 7.07 K

25. Which of the following is not a set of valid quantum numbers (n, l, ml, ms)
A) 1, 1, 0, ½ B) 1, 0, 0, ½ C) 3, 1, -1, ½ D) 2, 1, 0, -½

26. The energy of an electron in the energy level (121) in a cubical potential box of side 1 Å is
A) 1.13 eV B) 2.25 eV C) 226 eV D) 11.2 eV

27. Colour of a Light Emitting Diode (LED) depends on
A) Applied biasing voltage
B) Nature of the material used
C) Recombination rate of charge carriers
D) All the above

28. The momentum of a phonon is
A) ħk B) ħω C) Zero D) hk

29. The frequency of electromagnetic wave radiated by a Josephson junction when a DC voltage of 6.63 μV is applied across the junction is
A) 1.6 MHz B) 3.2 GHz C) 6.63 GHz D) 1.6 GHz

30. The dominant mechanism for the motion of charge carriers in forward and reverse biased silicon p-n junction are
A) drift in forward bias and diffusion in reverse bias
B) diffusion in forward bias and drift in reverse bias
C) diffusion in both
D) drift in both

31. The relative permeability of a material X is slightly less than unity and that of a material Y is very much larger than unity. Then,
A) X is paramagnetic and Y is diamagnetic
B) X is ferromagnetic and Y is paramagnetic
C) X is diamagnetic and Y is ferromagnetic
D) X is diamagnetic and Y is paramagnetic

32. A magnetic needle of moment 5×10^{4} Am^2 is suspended in a horizontal magnetic field of 4×10^{-5} T. The work done to rotate it through 60^0 from the direction of the field is:
A) 2.0 J B) 1 J C) 1.2 J D) 0.2 J

33. The phase difference between electric and magnetic fields in a plane electromagnetic wave Is:
A) 180^0 B) 90^0 C) 0^0 D) 45^0

34. The earth's magnetic field at a point is 0.314×10^{-4} T. This field is to be cancelled by magnetic field at the centre of a circular loop of radius 1 cm. The required current through the loop is:
A) 0.4 A B) 0.5 A C) 0.6 A D) 0.628 A

35. Two wires of same length are shaped into a circle and square. If both of them carry same current I, then the ratio of their magnetic moments is
A) 2 : 1 B) π : 4 C) 4 : π D) π : 2

36. If E and B represent electric and magnetic fields of an electromagnetic wave respectively, then which of the following is dimensionless?

A) $\frac{E}{\epsilon_0} x \frac{\mu_0}{B}$ B) $\sqrt{\varepsilon_0 \mu_0}\left(\frac{E}{B}\right)$ C) $(\varepsilon_0 \mu_0)\left(\frac{B}{E}\right)^2$ D) $\varepsilon_0 \mu_0 \left(\frac{E}{B}\right)$

37. The dimension of ratio of magnetic flux to electric flux is

A) LT^{-1} B) $L^{-1}TA^{-1}$ C) $L^{-1}T$ D) LTA^{-2}

38. The radiation pressure exerted by an electromagnetic wave of intensity 300 mW/m^2 on a non-reflecting surface in vacuum is

A) $9x10^{10}$ N/m^2 B) $1x10^{-9}$ N/m^2 C) $9x10^{-10}$ N/m^2 D) $4x10^{9}$ N/m^2

39. If a hydrogen atom at rest emits a photon of wavelength λ, then the recoil velocity the atom of mass m is:

A) $mh\lambda$ B) mh/λ C) $h/ m\lambda$ D) $m\lambda/h$

40. If the horizontal component of earth's magnetic field at a place is B_0 and the dip angle is 45^0, then the total intensity of magnetic field at that place is

A) B_0 B) $2B_0$ C) $\sqrt{2}\,B_0$ D) $\sqrt{2}B_0^2$

41. The nuclear radius of $_{47}Ag^{207}$ is about

A) 8.1 fm B) 6.2 fm C) 3.1 fm D) 3 fm

42. The nucleus $_6C^{12}$ absorbs a neutron and emits a beta particle. The resulting nucleus is

A) $_7N^{14}$ B) $_7N^{13}$ C) $_6C^{13}$ D) $_6C^{14}$

43. The volume of an atomic nucleus is proportional to x^{th} power of total number of nucleons A. Then the value of x is

A) 1/3 B) 2/3 C) -1/3 D) 1

44. Which of the following is not a property of nuclear force?

A) Short range B) Charge independent
C) Spin independent D) Saturation property

45. Which of the following is not a magic number based on nuclear shell model?

A) 20 B) 50 C) 80 D) 82

46. The radii of nuclei of the elements ^{88}A and ^{11}B are related as, where R_A and R_B are the radii of A and B, respectively

A) $R_A = 2R_B$ B) $R_A = 8R_B$ C) $R_A = \frac{1}{2}R_B$ D) $R_A = \frac{1}{8}R_B$

47. Which of the following is not conserved during a nuclear reaction?

A) Isospin B) Parity
C) Spin D) Magnetic dipole moment

48. The energy released per fission of Uranium is about200 MeV, then the energy produced by complete fission of 1 kg of uranium in KWh is
A) 22600000 B) 5130000 C) 3600000 D) 1600000

49. Which of the following particle decay is not allowed?
A) $\Lambda^0 \to n + \gamma$ B) $\Lambda^0 \to p + \pi^-$ C) $\pi^0 \to \gamma + \gamma$ D) $\pi^+ \to e^+ + \nu_e$

50. The difference between electron and positron is in their
A) Mass B) Spin C) Charge D) All the above

51. The particles exchanged during strong interaction is
A) Photons B) Bosons C) Mesons D) Gravitons

52. The strangeness number and hypercharge of a nucleon are
A) 0 and 0 B) 1 and 0 C) -1 and 0 D) 0 and 1

53. A meson is made up of
A) Quark and antiquark B) Two quarks
C) Two antiquarks D) Two quarks and one antiquark

54. The half-life of a radioactive element X is 4 days. After 12 days, the mass of X got reduced to 4 mg. Determine the initial mass of X if its half-life is 4 days.
A) 4 mg B) 8 mg C) 16 mg D) 32 mg

55. The energy released during a proton-proton cycle in MeV is nearly
A) 2.67 B) 26.7 C) 0.267 D) 267

56. Electronic polarizability (α_e)of an atom is related to its radius (r) as
A) $\alpha_e = 4\pi\varepsilon_0 r$ B) $\alpha_e = 4\pi\varepsilon_0 r^2$ C) $\alpha_e = 4\pi\varepsilon_0 r^3$ D) $\alpha_e = 2\pi\varepsilon_0 r^3$

57. The unknown particle X in the nuclear reaction in $^{13}C_6 + X \to {}^{13}N_7 + e^-$
A) ν_e B) $\bar{\nu}_\mu$ C) e^+ D) e^-

58. When a nucleus emits beta particle
A) its charge changes by one unit B) its charge remains same
C) its mass changes by one unit D) its mass changes by four units

59. Nuclei with same mass number but proton and neutron number interchanged are called
A) isotopes B) isobars C) mirror nuclei D) isotones

60. According to the nuclear shell model, ground state spin and parity of ^{17}O nucleus is
A) $\frac{1}{2}^+$ B) $\frac{1}{2}^-$ C) $\frac{5}{2}^+$ D) $\frac{5}{2}^-$

61. Which of the following describe an n type semiconductor?
A) Neutral B) positively charged
C) negatively charged D) has many holes

62. What causes depletion layer?
A) doping B) recombination
C) barrier potential D) ions

63. In a common base amplifier the phase difference between the input signal voltage and output signal voltage is
A) 0 B) $\pi/4$ C) $\pi/2$ D) π

64. To reduce the distortion of an amplified signal we can increase the
A) collector resistance B) emitter feedback resistance
C) generator resistance D) load resistance

65. Which of the following is true related with a JFET?
A) voltage controlled device B) current controlled device
C) has low input resistance D) has very large voltage gain

66. The pinching voltage of JFET has the same magnitude as the
A) gate voltage B) drain source voltage
C) gate source voltage D) gate source cut off voltage

67. If the peak output voltage of full wave bridge rectifier is V_m,, its no-load output dc voltage is:
A) $\frac{V_m}{\pi}$ B) $\frac{2V_m}{\pi}$ C) $\frac{V_m}{2\pi}$ D) $\frac{3V_m}{\pi}$

68. An Op-Amp can amplify
A) ac signal B) dc signal
C) both ac and dc signals D) neither ac nor dc signals

69. Minimum number of NOR Gates required to construct an AND Gate is
A) 3 B) 4 C) 2 D) 6

70. Which of the following is not true about LED?
A) spontaneous emission B) incoherent light
C) low current density D) high modulation bandwidth

71. The efficiency of a photo detector is directly proportional to
A) photocurrent B) incident optical power
C) charge generated D) none of these

72. The biasing state of a solar cell is
A) unbiased B) forward biased
C) reverse biased D) either B or C

73. The number of flip-flops required to design a mode-6 counter is
A) 5 B) 6 C) 2 D) 3

74. The resolution of an ADC is 3, then the number of possible states is
A) 3 B) 2 C) 6 D) 8

75. The register that stores the address of the instructions to be executed in a microprocessor is
A) IP B) SP C) IR D) SR

76. Two resistances (60±2) Ω and (120±4) Ω are in series, then the percentage error in the combination is
A) 3.3 B) 6 C) 2 D) 8

77. Fermi level of an intrinsic semiconductor is
A) near conduction band minimum
B) near valence band maximum
C) at center of forbidden energy gap
D) none of the above

78. A common source FET amplifier has a load resistance of 500 kΩ, ac drain resistance of 100 kΩ and amplification factor 24, then its voltage gain is
A) 10 B) 20 C) 30 D) 40

79. A shift register that has both serial and parallel input and output is
A) universal shift register B) bidirectional shift register
C) shift register counter D) none of the above

80. For a transistor in CE configuration V_{cc} is 18 V, V_{bb} is 6 V, current gain is 75, I_{co} is 100 μA, R_c is 1 kΩ and V_{ce} is 9 V. Then the base current in mA is
A) 0.12 B) 12 C) 1.2 D) 120

81. If the matrix $A = \begin{pmatrix} \alpha & 1 \\ 2 & \alpha \end{pmatrix}$ and $|A^2| = 49$, then the value of α is
A) 0 B) ±1 C) ±2 D) ±3

82. The eigen values of a skew – Hermitian matrix are
A) Zero B) Imaginary
C) Real D) Both A and B

83. For Laguerre polynomials, $\int_0^\infty f(t)L_n(t)L_m(t)dt = \delta_{nm}$, where f(t)=
A) 1 B) exp(-t) C) t D) $\exp(-t^2/2)$

84. Value of $\int_0^\pi \frac{d\theta}{2-\cos\theta}$ is
A) $\frac{\pi i}{2\sqrt{5}}$ B) $\frac{\pi}{\sqrt{3}}$ C) $\frac{\pi i}{\sqrt{2}}$ D) $\frac{\pi}{\sqrt{5}}$

85. Laplace transform of $\sinh at$ for $s > 0$ is
A) $\frac{a}{s^2-a^2}$ B) $\frac{s}{s^2-a^2}$ C) $\frac{s}{s^2+a^2}$ D) $\frac{a}{s^2+a^2}$

86. Let P be a (n x n) diagonalizable matrix. Given P is idempotent with Trace (P) = n-1. Then det(P)=

A) 1 B) 0 C) n D) n^2

87. The spin and charge of Up quark is

A) $\frac{1}{2}$ and $+\frac{2}{3}e$ B) $\frac{3}{2}$ and $+\frac{1}{3}e$ C) $\frac{1}{2}$ and $-\frac{1}{2}e$ D) $\frac{3}{2}$ and $+\frac{2}{3}e$

88. As sample size increases, the sampling distribution must approaches to normal distribution is termed as

A) Limited approximation theorem
B) Secondary limit theorem
C) Primary limit theorem
D) Central limit theorem

89. A possible unit tangent vector to the plane $x^2+y^2+z^2 = 4$ at (3,2,1) is

A) $\left(-\frac{\hat{\imath}}{\sqrt{5}}+\frac{2\hat{\jmath}}{\sqrt{5}}\right)$ B) $\left(\frac{\hat{\imath}}{\sqrt{5}}+\frac{2\hat{\jmath}}{\sqrt{5}}\right)$ C) $\left(\frac{\hat{\imath}}{\sqrt{2}}-\frac{\hat{\jmath}}{\sqrt{2}}\right)$ D) $\left(-\frac{2\hat{\imath}}{\sqrt{13}}+\frac{3\hat{\jmath}}{\sqrt{13}}\right)$

90. Bessel function $J_{1/2}(x)$ varies as

A) $\frac{\sin(x)}{x}$ B) $\frac{\cos(x)}{x^2}$ C) $\frac{\sin(x)}{\sqrt{x}}$ D) $\frac{x^2}{\sin(x)}$

91. The Lagrangian of a mechanical system with two degree of freedom x and y is $L = \dot{x}^2 + \dot{y}^2$. The Hamiltonian of the system is

A) $\frac{1}{4}\left(p_x{}^2 + p_y{}^2\right)$ B) $\frac{1}{4}\left(\dot{q_x}{}^2 + \dot{q_y}{}^2\right)$

C) $\frac{1}{2}\left(p_x{}^2 + p_y{}^2\right)$ D) $\frac{1}{2}\left(\dot{q_x}{}^2 + \dot{q_y}{}^2\right)$

92. 2 bodies of masses m and 2m are connected by a massless spring of constant k. If ω is the angular frequency of oscillations, then $\omega^2 =$

A) $\frac{3k}{m}$ B) $\frac{k}{2m}$ C) $\frac{3k}{2m}$ D) $\frac{k}{3m}$

93. XRD pattern from a Body Centred Cubic (BCC) crystal does not contain the plane

A) (310) B) (111) C) (110) D) (220)

94. A particle of mass m is in a potential $V(x) = \frac{ax^2}{2} + \frac{bx^4}{4}$, where x be the displacement from the origin. The angular frequency of small oscillations will be

A) $\sqrt{\frac{a}{2m}}$ B) $\sqrt{\frac{2a}{m}}$ C) $\sqrt{\frac{b}{2m}}$ D) $\sqrt{\frac{b}{2am}}$

95. If a body moves under a potential $V(r) = -\frac{\propto}{r}$, where $\propto$ is a constant and r be the distance from origin, its path will be parabolic if total energy (E) is

A) Positive B) Negative C) Zero D) Negative but $E < -2\propto$

96. Let $q = \{q_1, q_2\}$ and $p = \{p_1, p_2\}$ be the sets of generalised coordinate and momenta. Given $A = q_1^2 + q_2^2$ and B=2p₁+p₂ , then Poisson bracket [A, B]=

A) $2(2q_1+q_2)$ B) q_1+q_2 C) $q_1p_1 + 2\,p_2q_2$ (D) $3(q_1 - 2q_2)$

97. Rutherford elastic scattering cross section varies with center of mass energy (E) as

A) $\frac{1}{E}$ B) $\frac{1}{E^2}$ C) E D) E^2

98. Choose the correct statement from the following about Moment of Inertia tensor
A) It depends on angular velocity
B) It will be symmetric only in principal axis system
C) Its components will not change with respect to change in axes system
D) In a general axis system, angular momentum will not be parallel to angular velocity

99. A satellite moves around a planet in a circular orbit at a distance R from its centre. The time period of revolution of the satellite is T. If the same satellite is taken to an orbit of radius 4R around the same planet, the time period would be

A) T/8 B) T/4 C) 8T D) 4T

100. If the kinetic energy of a relativistic particle of rest mass m is equal to half of its rest energy, then the velocity of the particle is (in terms of velocity of light in vacuum, c)

A) $\frac{\sqrt{5}}{3}c$ B) $\frac{\sqrt{2}}{3}c$ C) $\frac{3}{\sqrt{2}}c$ D) $\frac{1}{2}c$

101. A carnot engine works between two temperatures 27^0C and 127^0C . Its efficiency will be

A) 50% B) 25% C) 17% D) $\left(\frac{100}{127}\right)$ %

102. Which thermodynamic potential remains constant in Joule-Thomson process?
A) Temperature B) Volume
C) Enthalpy D) Internal Energy

103. Entropy in rolling a 6-faced dice will be (k_B is the Boltzman constant)

A) $k_B ln(10)$ B) $k_B ln(6!)$ C) $k_B\, ln(6)$ D) $k_B ln(2^6)$

104. Total energy U varies with number of particles N in fermi system as temperature $T \to 0K$

A) $N^{2/3}$ B) $N^{3/2}$ C) $N^{5/3}$ D) $N^{1/3}$

105. The frequency of a microwave radiation of wavelength 15 mm is
A) 20 GHz B) 30 GHz C) 15 GHz D) 10 GHz

106. Number of molecules of oxygen at S.T.P is N_A and number of photons in an enclosure of volume 22.4 cm^3 at 273 K is N_{ph}. Then

A) $N_{ph} > N_A$ B) $N_{ph} < N_A$ C) $N_{ph} = N_A$ D) None of these

107. Problem of Ultraviolet catastrophe is a consequence of

A) Maxwell Boltzman Law B) Rayleigh Jeans Law
C) Plank's Law D) Fermi's Golden Rule

108. According to Maxwell Boltzmann Distribution, average velocity of molecule at temperature T K is (m is the mass of one molecule)

A) $\sqrt{\frac{2k_BT}{m}}$ B) $\sqrt{\frac{k_BT}{m}}$ C) $\sqrt{\frac{3k_BT}{m}}$ D) $\sqrt{\frac{8k_BT}{\pi m}}$

109. Bose-Einstein Distribution law is obeyed by,

A) Neutral Pion B) Positive Muon
C) Tau-neutrino D) Down Quark

110. If Z is a canonical partition function and E be the energy, then

A) $\langle E^2 \rangle = \frac{1}{Z}\frac{\partial^2 Z}{\partial \beta^2}$ B) $\langle E^2 \rangle = -\frac{1}{\beta Z}\frac{\partial Z}{\partial \beta}$

C) $\langle E^2 \rangle = \frac{1}{\beta}\sqrt{\frac{1}{Z}\frac{\partial^2 Z}{\partial \beta^2}}$ D) $\langle E^2 \rangle = \frac{1}{Z^2}\frac{\partial^2 Z}{\partial \beta^2}$

111. A beam of electrons of energy 25 MeV is incident at a potential step of 16 MeV. Fraction of beam that would be reflected is

A) 9/41 B) 1/9 C) 1/81 D) 1/16

112. Intrinsic carrier concentration in a pure semiconductor is proportional to

A) $\exp\left(-\frac{E_g}{k_BT}\right)$ B) $\exp\left(-\frac{2E_g}{k_BT}\right)$

C) $\exp\left(-\frac{E_g}{2k_BT}\right)$ D) $\exp\left(-\frac{E_g}{4k_BT}\right)$

113. Hermitian conjugate of operator $\frac{\partial}{\partial x}$ will be

A) $i\frac{\partial}{\partial x}$ B) $\frac{\partial}{\partial x}$ C) $-\frac{\partial}{\partial x}$ D) $-i\frac{\partial}{\partial x}$

114. If $r = |\vec{r}|$, then $\frac{1}{r}\frac{\partial^2}{\partial r^2} r =$

A) Zero B) $\frac{1}{r^2}\frac{\partial}{\partial r}$ C) $\frac{\partial^2}{\partial r^2} + \frac{1}{r^2}\frac{\partial}{\partial r}$ D) $\frac{\partial^2}{\partial r^2} + \frac{2}{r}\frac{\partial}{\partial r}$

115. Let a, $a^\dagger$ be annihilation and creation operators in one dimensional harmonic oscillator state represented by $|n\rangle$, then , $(a + a^\dagger)^2 |3\rangle =$

A) Zero B) $\sqrt{5}\,|2\rangle$ C) $7\,|3\rangle$ D) $3\,|4\rangle$

116. First Born approximation, in case of scattering of particles by a potential, is valid for
A) Small incident energies and strong scattering potentials
B) Large incident energies and strong scattering potentials
C) Small incident energies and weak scattering potentials
D) Large incident energies and weak scattering potentials

117. 3 non - interacting electrons with spin states $|\chi_1\rangle = |\chi_2\rangle = |\chi_3\rangle$ are inside a one dimensional infinite potential well with $V(x) = 0$ for $0 < x < L$. Second excited state energy of system will be

A) $\frac{9\pi^2\hbar^2}{2mL^2}$ B) $\frac{13\pi^2\hbar^2}{mL^2}$ C) $\frac{7\pi^2\hbar^2}{mL^2}$ D) $\frac{15\pi^2\hbar^2}{2mL^2}$

118. If two spins s_1 and s_2 are coupled, then the total number of final spin states will be

A) $(2s_1 + 1)(2s_2 + 1)$ B) $(s_1 + s_2)$
C) $(s_1 - s_2)$ D) $(2(s_1 + s_2) + 1)$

119. In a low energy scattering of unpolarised electrons, singlet and triplet scattering cross sections are 2 mb and 4 mb respectively. Differential cross section is

A) 2 mb B) 6 mb C) 3.5 mb D) $\sqrt{8}$ mb

120. If $\hat{p}$ and $\hat{L}$ are the linear and angular momentum operators, $\hat{p} \times \hat{L} =$

A) $-\hat{L} \times \hat{p}$ B) Zero
C) $-\hat{L} \times \hat{p} - i\hbar\,\hat{p}$ D) $-\hat{L} \times \hat{p} + 2i\hbar\hat{p}$
