B.H.U. – M.SC. (PHYSICS)

Q1. What is the half life of $^{238}_{92}U$ if $1\mu c_i$ of radioactivity requires approximately 7.58×10^{21} no. of ^{238}U nuclei?

(a) $4.5\times10^{6}\,1/r$ (b) $4.5\times10^{12}\,1/r$

(c) $4.5\times10^{15}\,1/r$ (d) $4.5\times10^{9}\,1/r$

Q2. The difference in coulomb energy for nuclei with $Z+1$ and Z protons is given by:

(a) $\frac{1}{4\pi\in_0}\cdot\frac{3}{5}\frac{Ze^2}{R}$ (b) $\frac{1}{4\pi\in_0}\cdot\frac{6}{5}\frac{Ze^2}{R}$

(c) $\frac{1}{4\pi\in_0}\cdot\frac{2}{5}\frac{Ze^2}{R}$ (d) $\frac{1}{4\pi\in_0}\cdot\frac{4}{5}\frac{Ze^2}{R}$

Q3. The H.O. frequency for $^{16}_{8}\mathrm{O}$ nucleus is approximately how much times of H.O. frequency for $^{125}_{56}Ba$ nucleus?

(a) 4 (b) $\frac{1}{4}$ (c) 2 (d) $\frac{1}{2}$

Q4. Interaction cross section of the neutrons with the nucleus, if the mean free path of the neutrons in nuclear matter is about 10^{4} m, is:

(a) $10^{-48}\,\mathrm{cm}^2$ (b) $10^{-48}\,\mathrm{m}^2$ (c) $10^{-34}\,\mathrm{cm}^2$ (d) $10^{-34}\,\mathrm{m}^2$

Q5. Ground state spin and parity of $^{33}_{16}S$ is:

(a) $\frac{3}{2}$;even (b) $\frac{3}{2}$;odd (c) $\frac{1}{2}$;even (d) $\frac{1}{2}$;odd

Q6. The primary source of energy released from sun is due to:

(a) nuclear fission (b) nuclear fusion

(c) chemical reactions (d) decay of radioactive atoms

Q7. Which of the following is **not** true about $\alpha-$rays?

(a) great ionizing power but low penetration power

(b) low ionizing power but high penetration power

(c) positively charged He-nuclei

(d) deflected by electric and magnetic fields

Q8. Nucleus volume is:

(a) proportional to mass number

(b) independent of mass number

(c) inversely proportional to mass number

(d) inversely proportional to square of mass number

Q9. A nuclear reactor is called sub-critical if:

(a) neutron production exceeds loss (b) neutron loss exceeds production

(c) neutron production stops (d) fissile materials is insufficient

Q10. Complete the fusion reaction: (D = deuterium) $D+{}^{3}_{2}He \rightarrow {}^{4}_{2}He + \cdots\cdots$

(a) p (b) n (c) 2p (d) 3n

Q11. Binding energy per nucleon is a measure of:

(a) size of nucleus (b) shape of nucleus

(c) angular momentum of nucleus (d) stability of nucleus

Q12. By capturing an electron, ${}^{54}_{25}M_n$ transforms into:

(a) ${}^{54}_{24}Cr$ (b) ${}^{53}_{24}Cr$ (c) ${}^{53}_{25}Cr$ (d) ${}^{55}_{25}Cr$

Q13. The surface energy term in liquid drop model is proportional to:

(a) A (b) $A^{2/3}$ (c) $A^{1/3}$ (d) $A^{3/4}$

Q14. Which of the following is **true** about nuclear forces?

(a) short range and spin dependent (b) short range and spin independent

(c) long range and spin dependent (d) long range and spin independent

Q15. Which of the following is **not** used as a moderator in a nuclear reactor?

(a) Zn (b) C (c) D_2O (d) H_2O

Q16. Binding energy of ${}^{238}_{92}U$ nucleus is approximately: $\left({}^{m}H = 1.0078 \text{ amu}, m_n = 1.0087 \text{ amu}, m_\upsilon = 238.0508 \text{ amu}, \text{amu} = 931.64 \text{ Meu}\right)$:

(a) 100 MeV (b) 300 MeV (c) 932 MeV (d) 1800 MeV

Q17. Rate of radioactive decay is proportional to:

(a) decay time (b) no. of atoms

(c) density of atoms (d) length of sample

Q18. The average life time of a nucleus is related with decay constant, λ as:

(a) $\frac{1}{\lambda}$ (b) λ (c) $\lambda \ln 2$ (d) $2 \ln \lambda$

Q19. One curie is defined as:

(a) one decay per second
(b) 10^6 decays per second
(c) 3.7×10^9 decays per second
(d) 3.7×10^{16} decays per second

Q20. Complete the following nuclear reactions involving bombardment of $\alpha-$ particles

$^{14}_{7}\mathrm{N}+\alpha=^{1}_{1}\mathrm{H}+\cdots\cdots$

(a) $^{16}_{8}\mathrm{O}$ (b) $^{17}_{8}\mathrm{O}$ (c) $^{16}_{7}\mathrm{N}$ (d) $^{15}_{7}\mathrm{N}$

Q21. $^{238}_{92}\mathrm{U}$ nucleus decay involves $8\alpha-$ decays and $6\beta-$ decays. The end product of the series have:

(a) Z = 82 A = 206
(b) Z = 84 A = 224
(c) Z = 88 A = 206
(d) Z = 84 A = 212

Q22. Which of the following is **true** about $\beta-$ decay?

(a) takes place by strong interactions
(b) is always followed by $\gamma-$ emissions
(c) a neutron in the nucleus is converted into a proton
(d) a proton in the nucleus is converted into a neutron

Q23. According to Hall effect if a conducting materials is placed in a uniform magnetic field and a current is passed, voltage is found to develop at:

(a) parallel to the current
(b) parallel to the magnetic field
(c) perpendicular to the magnetic field and current
(d) 45 degrees to the magnetic field and current

Q24. According to Mosle's law the frequency of the characteristic X-radiation is proportional to the square of:

(a) atomic weight of the element
(b) atomic number of the element
(c) number of neutrons
(d) square of atomic number

Q25. Because of which property of the crystal X-rays can be diffracted from crystals:

(a) random arrangement of atoms (b) colour of the crystals

(c) periodic array of atom (d) transparency of crystals

Q26. FCC lattice is the reciprocal lattice of the:

(a) BCC lattice (b) SC lattice

(c) HCP lattice (d) both of the BCC and SC lattice

Q27. Mobility of holes as compared to mobility of electrons in intrinsic semiconductors is:

(a) equal (b) greater

(c) less (d) cannot be defined

Q28. The electronic specific heats in metals are given by: (R is gas constant, k-boltzmann constant):

(a) $\frac{kT}{Eo}$ (b) $\frac{R}{Eo}kT$ (c) $\frac{Eo}{R}kT$ (d) $\frac{3Eo}{R}kT$

Q29. In one-dimensional periodic chain of atom with lattice parameter 'a' has first brillouin zone at:

(a) a (b) 2a (c) π/a (d) $2\pi/a$

Q30. What are example of piezo electric materials?

(a) Rochelle salt (b) lead zirconate

(c) potassium niobate (d) barium titanate

Q31. Fermi energy level for intrinsic semiconductor lies:

(a) at the middle of the band gap (b) close to the conduction band

(c) close to valence band (d) inside valence band

Q32. Flow of electron is affected by which of the following:

(a) thermal vibration only (b) impunity atom only

(c) crystal defects only (d) by all of (a), (b) and (c)

Q33. Energy band gap size of semiconductors is in the range:

(a) 1-2 eV (b) 2-3 eV

(c) 3-4 eV (d) greater than 4 eV

Q34. Electrical conductivity of insulators is in the range:

(a) $10^{-10}\,(\Omega - \text{mm})^{-1}$ (b) $10^{-10}\,(\Omega - \text{cm})^{-1}$

(c) $10^{-10}\,(\Omega - \text{m})^{-1}$ (d) $10^{-8}\,(\Omega - \text{m})^{-1}$

Q35. Characteristic X-rays are the characteristic of which of the following:

(a) Cathode materials (b) Anode materials

(c) Accelerating voltage (d) Tube current

Q36. X-ray diffraction can be applied to:

(a) liquids only

(b) solid, crystalline materials only

(c) all liquids, solids and crystalline materials

(d) gaseous or vapour materials only

Q37. The amplitude of scattering of X-rays scattered by a single atom is generally denoted as:

(a) Structure factor (b) Polarization factor

(c) Form factor (d) Fractional coordination

Q38. During X-ray emission if the voltage is increased:

(a) minimum wavelength decreases (b) minimum wavelength increases

(c) intensity increases (d) intensity decreases

Q39. For a given cubic crystal lattice parameter a is 3.18 A°. The d spacing for a (III) plane is:

(a) $2.25\ \overset{0}{\text{A}}$ (b) $1.84\ \overset{0}{\text{A}}$ (c) $3.18\ \overset{0}{\text{A}}$ (d) $3.90\ \overset{0}{\text{A}}$

Q40. In the X-ray diffraction of a set of crystal planes having d equal to 0.18 nm, first order reflection is found to be at an angle of 22°. The wavelength of X-ray is: $(\sin 22° = 0.208)$:

(a) 0.0749 nm (b) 0.0374 nm (c) 0.749 nm (d) 0.374 nm

Q41. A compound formed by elements A and B crystallizes in cubic structure, in which atoms of A are at the corners while that of B are at the face centre. The formula of the compound is:

(a) AB_3 (b) AB (c) AB_6 (d) A_2B

Q42. In X-ray diffraction studies, X-rays are scattered by:

(a) Nucleus (b) Protons only (c) Neutrons only (d) Electrons only

Q43. In diamond the coordination number of carbon is:

(a) 4 and its unit cell has 8 carbon atoms (b) 4 and its unit cell has 6 carbon atoms

(c) 6 and its unit cell has 4 carbon atoms (d) 4 and its unit cell has 4 carbon atoms

Q44. ABABA ..... represents an arrangement of layers called:

(a) hexagonal closed packing (b) cubic closed packing

(c) body centered cubic packing (d) flourite close packing

Q45. For boron (B) and fluorine (F) atoms, which of the following statements is **true**?

(a) B and F have normal doublet terms

(b) B and F have inverted doublet terms

(c) B has normal and F has inverted doublet terms

(d) B has inverted and F has normal doublet terms

Q46. In a weak magnetic field the number of lines for the transition $^1D_2 \rightarrow ^1P_1$ is:

(a) 9 (b) 6 (c) 3 (d) 1

Q47. For the three Normal Zeeman triplet lines choose correct answer:

(a) Central line is linearly polarized and other two are circularly polarized

(b) Central line is circularly polarized and other two are plane polarized

(c) All are linearly polarized

(d) All are circularly polarized

Q48. Coupling of orbital and spin motions of electron gives rise to:

(a) Zeeman effect (b) Stark effect

(c) Hyperfine splitting (d) Fine splitting

Q49. Paschen Back effect is splitting of energy levels when atom are placed in?

(a) weak magnetic field (b) weak electric field

(c) strong magnetic field (d) strong electric field

Q50. For the two transitions (i) $^2P_{3/2} \rightarrow ^2S_{1/2}$ and (ii) $^2P_{1/2} \rightarrow ^2S_{1/2}$, which statement is **true**?

(a) (i) stronger than (ii)
(b) (ii) is stronger than (i)
(c) both are equally strong
(d) nothing can be said

Q51. In alkali spectrum which of the following corresponds to sharp series?

(a) 1S – nP n = 2, 3, 4 .....
(b) 2P – nD n = 3, 4, 5 .....
(c) 2P – nS n = 3, 4, 5 .....
(d) 3D – nF n = 4, 5, 6 .....

Q52. Two equivalent p electrons give rise to spectroscopic terms:

(a) ^1S, ^1D, ^3P
(b) ^2P
(c) ^2P, ^2D, ^4S
(d) ^1S

Q53. An atomic orbital with principle quantum number n can accommodate N number of electrons, which of the following statements is **false**?

(a) $n^2 = N$
(b) $2n^2 = N$
(c) $N = \sum_{I=0}^{n-1} 2(2I+1)$
(d) $N = 2[1+3+5+\ldots..2n-1]$

Q54. Electronic configuration of an atom with atomic number 25 is:

(a) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^7$
(b) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^5\,4s^2$
(c) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^3\,4s^2\,4p^2$
(d) $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^2\,4s^2\,4p^3$

Q55. For the Rydberg constant R, which of the statement is **true**?

(a) It is a universal constant
(b) It depends on atomic weight
(c) It is independent of mass and charge of electron
(d) It is independent of Planck constant

Q56. Work function of a metal corresponds to green light. One will observe photoelectron by irradiating the metal surface by:

(a) red light
(b) microwave radiation
(c) IR radiation
(d) blue light

Q57. The Compton shift in X-ray wavelength depends on:

(a) Scattering angle only

(b) Scattering angle and wavelength of X-ray both

(c) Wavelength of X-ray only

(d) None of the (1), (2) and (3)

Q58. Ground state of C_S atom is:

(a) $^1P_1$ (b) $^3P_0$ (c) $^1S_0$ (d) $^1S_{\frac{1}{2}}$

Q59. The radius of the first Bohr orbit in H-atom is:

(a) $1.06\ \overset{0}{A}$ (b) $2.12\ \overset{0}{A}$ (c) $0.53\ \overset{0}{A}$ (d) $4.24\ \overset{0}{A}$

Q60. Which of the following series of H-atom spectrum lies in the visible region?

(a) Lyman (b) Balmer (c) Paschen (d) Bracket

Q61. A plate of thickness t behaves as a half-wave plate for a light of wavelength λ. Ignoring variation in refractive indices with λ, if a light of 2λ is used the plate will behave as a:

(a) half-wave plate (b) quarter-wave plate

(c) filter (d) normal glass plate

Q62. A natural light of wavelength λ is allowed to pass through a doubly refracting transparent sheet of calcite which splis it up into E and O rays. After emergence these two rays are combined to interfere. Which statement is **true**?

(a) There will be interference effect

(b) There will be interference effect depending on sheet thickness

(c) There will be always destructive interference

(d) There will be always constructive interference

Q63. A grating of width 2 cm is capable of resolving D_1 and D_2 lines of sodium in the 3^{rd} order. If the wavelength separation of D_1 and D_2 lines is 6 $\mathring{A}$ and average wavelength of D_1 and D_2 lines is 5893 $\mathring{A}$ the number of lines in the grating is:

(a) 164 lines/cm (b) 328 lines/cm (c) 327 lines/cm (d) 163 lines/cm

Q64. A parallel beam of light of wavelength 5460 $\mathring{A}$ is incident at an angle of 30° on a plane transmission grating with 6000 lines per centimeter. The highest order of observables spectrum is:

(a) 3 (b) 4 (c) 1 (d) 2

Q65. In a diffraction experiment (of Fraunhoffer type) with a single slit if the wavelength of the light used is equal to the slit-width. Which of the following is **true**?

(a) diffraction pattern disappears

(b) the central maximum fills the entire screen

(c) theory used becomes invalid

(d) the pattern is unaffected

Q66. In an experiment a thin wire is illuminated by a narrow slit placed parallel to the wire. The slit is illuminated by a light source of wavelength λ. On the screen fringes are seen in geometrical shadow of the wire and on either side of the shadow. Which of the following is **true**?

(a) In geometrical shadow one observes interference fringes only

(b) In geometrical shadow one observes diffraction fringes only

(c) In geometrical shadow one observes interference and diffraction fringes both

(d) On either side of the geometrical shadow one observes interference fringes only

Q67. The He-Ne laser line 6328 $\mathring{A}$ has band-width 0.1 $\mathring{A}$. The coherence length of the light beam is:

(a) 4 mm (b) 4 cm (c) 4 m (d) 40 m

Q68. In an experiment for determining refractive index of gas using Michelson interferometer a shift of 400 fringes is seen when all the gas is removed from the tube. If the light wavelength is $6000\ \overset{0}{A}$ and the tube length is 20 cm, then refractive index of the gas is:

(a) 1.0006 (b) 1.0012 (c) 0.9994 (d) 0.9988

Q69. In a Fabry-Perot etalon the reflectivity of the two mirrors is 90%. The coefficient of fineses is:

(a) 360 (b) 36 (c) $\frac{360}{19}$ (d) 6

Q70. In a Newton's ring experiment the light is reflected from the upper (ray 1) and lower (ray 2) surfaces of the planoconvex lens and the upper (ray 3) surface of the glass plate supporting the lens. The circular rings are observed due to interference between:

(a) ray 1 and ray 2 (b) ray 1 and ray 3

(c) ray 1, ray 2 and ray 3 (d) ray 2 and ray 3

Q71. In an experiment of interference of polychromatic light by extremely thin film the fringes in the reflected light are observed. The colour of the fringes:

(a) depends on the colour of source

(b) depends on the angle of incidence of light

(c) depends on the direction of reflected light

(d) is always dark (black)

Q72. In a two beam interference experiment the intensities of the beams are 2^2 and 5^2 units. The visibility of the fringe pattern is:

(a) $\frac{21}{29}$ (b) $\frac{9}{49}$ (c) $\frac{3}{7}$ (d) $\frac{20}{29}$

Q73. Which of the following statements is **incorrect**?

(a) No signal can travel with velocity greater than C

(b) Simultaneity is frame in dependent

(c) Proper time is same in all inertial frame

(d) Total energy of a particle does not depend on the choice of the inertial frame

Q74. If a clock moves with a very high velocity, the time interval in that clock will appear to a stationary observer as:

(a) shorter

(b) longer

(c) unchanged

(d) shorter or longer depends on the direction of the velocity

Q75. Which of the following does **not** remain invariant in special theory of relativity?

(a) $\frac{E^2}{c^2} - \bar{p}^2$ (b) $d^3\bar{p}$

(c) $\frac{d^3\bar{p}}{E}$ (d) $c^2t^2 - x^2 - y^2 - z^2$

Q76. Which of the following is **incorrect**?

(a) Laws of mechanics are covariant under Galilean transformation

(b) Maxwell's equations are covariant under Galilean transformation

(c) Laws of mechanics are covariant under Lorentz transformation

(d) Maxwell's equations are covariant under Lrentz transformation

Q77. Kinetic energy of a free relativistic particle is given as (m_0 is rest mass, p is the momentum of the particle):

(a) $\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} m_0 c^2$ (b) pc

(c) $\left(\frac{1}{\sqrt{1-\frac{v^2}{c^2}}} - 1 \right) m_0 c^2$ (d) mc^2

Q78. A meter scale which is moving with a speed v along its length appears to be a centimeter scale to a stationary observer. Which of the following is **correct**?

(a) $v^2 = 0.99\, c^2$ (b) $v^2 = 0.9999\, c^2$

(c) $v = 0.99c$ (d) $v^2 = 0.9\, c^2$

Q79. The speed at which the kinetic energy of an electron is equal to twice its rest energy is:

(a) $\frac{2\sqrt{2}}{3}$C (b) $\frac{\sqrt{2}}{3}$C (c) $\frac{\sqrt{3}}{2}$C (d) $\frac{C}{2}$

Q80. Which of the following remains invariant under Lorentz transformation?

(a) charge density (b) current

(c) charge (d) current density

Q81. State of a one dimensional simple harmonic oscillators is $\psi(x,t)=\frac{1}{5}\left[3\phi_0-2\sqrt{2}\phi_1+2\sqrt{2}\phi_2\right]$ where ϕ_n are the eigenfunctions of the Hamiltonian with eigenvalues $E_n=\left(n+\frac{1}{2}\right)\hbar\omega$. The expectation value of the energy in the state $\psi(x,t)$ is:

(a) 0.46 $\hbar\omega$ (b) 1.46 $\hbar\omega$ (c) 0.5 $\hbar\omega$ (d) 0

Q82. In a quantum system an observable is represented by an operator A. If $|\psi>$ is a state of the system which is not a eigen state of A, then $r\equiv<\psi/A/\psi>^2-<\psi/A^2\psi>$ must be:

(a) equal to zero (b) greater than zero

(c) less than zero (d) greater than or equal to zero

Q83. The wave function of a particle at $t=0$ is given by $|\psi|(0)>=\frac{1}{\sqrt{2}}\left[|u_1>+|u_2\right]$, where $|u_1>$ and $|u_2>$ where $14_1>$ and $14_2>$ are the normalized eigen states with eigen values E_1 and E_2, respectively, $(E_2>E_1)$ The shortest time after which $|\psi(t)>$ will become orthogonal to $|\psi(0)>$ is:

(a) $\frac{-\hbar\pi}{2(E_2-E_1)}$ (b) $\frac{\hbar\pi}{E_2-E_1}$ (c) $\frac{\sqrt{2}\hbar\pi}{E_2-E_1}$ (d) $\frac{2\hbar\pi}{E_2-E_1}$

Q84. The value of $<\frac{1}{r}>$ in the ground state of H-atom is:

(a) a_0 (b) $\frac{1}{a_0}$ (c) 0 (d) $\frac{1}{2a_0}$

Q85. A system is known to be in a state described the wave function $\psi(\theta,\phi)=\frac{1}{\sqrt{30}}\left(5y_4^0+y_6^0-2y_6^3\right)$, where $y_e^m(\theta,\phi)$ are spherical harmonics. The probability of finding the system in state with $m=0$ is:

(a) 0 (b) $\frac{1}{5}$ (c) $\frac{13}{15}$ (d) $\frac{1}{6}$

Q86. The de Broglie wave length of an electron with energy 100 eV is equal to:

(a) 12.3 $A°$ (b) 1.23 $A°$ (c) 123 $A°$ (d) 0.123 $A°$

Q87. If a system is invariant under parity, which of the following statements is incorrect?

(a) The wave functions must have definite parity

(b) $< x >$ is always zero

(c) $< px^2 >$ is always zero

(d) Half of wave functions are positive under parity

Q88. Consider a system in a state $|\psi>$ given by $|\psi>=\frac{1}{\sqrt{3}}\left[|\psi_1>+\sqrt{2}\,|\psi_2>\right]$. $|\psi>$ and $|\psi_2>$ are orthogonal and normalized eigen vectors of the system with energy eigen values E_1 and E_2, respectively. If a measurement of energy is performed on the system, what is the probability of getting a value E_2?

(a) $\sqrt{\frac{2}{3}}$ (b) $\frac{2}{3}$ (c) $\sqrt{\frac{1}{3}}$ (d) $\frac{1}{3}$

Q89. Probabilities current density is represented by the operator:

(a) $\frac{i\hbar}{2m}\left(\psi\overline{\nabla}\psi^*-\psi^*\overline{\nabla}\psi\right)$ (b) $\frac{\hbar}{2im}\left(\psi\overline{\nabla}\psi^*-\psi^*\overline{\nabla}\psi\right)$

(c) $\frac{i\hbar}{2m}\left(\psi^*\overline{\nabla}\psi-\psi\overline{\nabla}\psi^*\right)$ (d) $\frac{\hbar}{2im}\left(\psi\overline{\nabla}\psi^*-\psi\overline{\nabla}\psi^*\right)$

Q90. Degeneracy of the 10^{th} exciated state of a 2-d isotropic simple harmonic oscillator is:

(a) 10 (b) 11 (c) 45 (d) 100

Q91. The wave function for a 1-d simple harmonic oscillator has odd number of real zeros, which of the following statement is **incorrect**:

(a) The wave function is odd under parity

(b) The wave function passes through origin

(c) The wave function does not have definite parity

(d) The state for this wave function is non-degenerate

Q92. Consider one sided simple harmonic oscillator described by the potential $V(x) = \frac{1}{2} m w^2 x^2$, $0 \le x \le \infty$. The value of $< x >$ in any state will be:

(a) 0 (b) a positive number

(c) always be negative (d) can be positive or negative

Q93. The ground state energy of the system described by the Hamiltonian:

$H = \frac{bx^2}{2m} + ax^2 + bx + c$ is:

(a) $\hbar\sqrt{\frac{2a}{m}} + c - \frac{b^2}{4a}$ (b) $\hbar\sqrt{\frac{2a}{m}} - c + \frac{b^2}{4a}$

(c) $\hbar\sqrt{\frac{a}{2m}} - c + \frac{b^2}{4a}$ (d) $\hbar\sqrt{\frac{a}{2m}} + c - \frac{b^2}{4a}$

Q94. How many based states are there for the potential $V(x) = V_0 \delta(x)$, $V_0 < 0$?

(a) 0 (b) infinite

(c) 1 (d) depends on the magnitude of V_0

Q95. An electron is confined to a box of length L. If the length of the box charges to 2L, how would the uncertainty of momentum charge?

(a) uncertainly of momentum will be twice

(b) uncertainly of momentum will be half

(c) uncertainly of momentum will be one fourth

(d) uncertainly of momentum will be four times

Q96. Which of the following sets of quantum numbers is **not** possible?

(a) $n = 2,\ l = 3, m_1 = 2$ (b) $n = 3,\ l = 2, m_1 = -2$

(c) $n = 6,\ l = 2, m_1 = 0$ (d) $n = 7,\ l = 3, m_1 = -3$

Q97. An electron in hydrogen atom is described by quantum numbers $n = 8, m_e = 4$. What are the possible values of the orbital quantum number 1?

(a) 4, 5, 6, 7 (b) 5, 6, 7, 8

(c) 0, 1, 2, 3, 4, 5, 6, 7 (d) 0, 1, 2, 3, 4

Q98. Which of the following is a eigenstate of momentum operator?

(a) $cox kx + i \sin kx$ (b) $i \sin kx$

(c) $\cos kx$ (d) $A \cos kx + B \sin kx$

Q99. Which of the following statements is **incorrect** about complex conjugation operator?

(a) It is an Hermitian operator (b) It has eigen values ± 1

(c) It is not a linear operator (d) It has eigen values ± 1

Q100. Which of the following operators is **not** linear operator:

(a) Momentum (b) Parity

(c) Time reversal (d) Angular momentum

Q101. Which of the following is **not** true about the matrix

$$A = \begin{pmatrix} \cos\theta & -\sin\theta & 0 \\ \sin\theta & \cos\theta & 0 \\ 0 & 0 & 1 \end{pmatrix}$$

(a) A is orthogonal

(b) A has no inverse

(c) When acting on a vector it preserves the magnitude of the vector

(d) Using A Cartesian unit vectors can be resolved into circular cylindrical unit vectors

Q102. The generating function for Hermite polynomial is $g(t, x) = e^{-t_2+2tx}$. The zero of the Hermie polynomial $H_2(x)$ on the positive x axis is:

(a) $\frac{1}{2}$ (b) $\frac{1}{\sqrt{2}}$ (c) $\frac{1}{4}$ (d) $\frac{\sqrt{3}}{2}$

Q103. For Bessel function $J_n(x)$ given that:

$J_n^1(x) = \frac{1}{2}[J_{n-1}(x) - J_{n+1}(x)]$ (n is an integer), $\frac{d}{dx}J_0(x)$ is:

(a) $J_1(x)$ (b) $-J_1(x)$ (c) $-J_{-1}(x)$ (d) $J_0(x)$

Q104. The Legendre series expansion for the function $f(\theta) = \sin^2\left(\frac{0}{2}\right)$ can be given as:

(a) $\frac{1}{2}[P_0(\cos\theta) - P_1(\cos\theta)]$ (b) $\frac{1}{2}[P_2(\cos\theta) - P_3(\cos\theta)]$

(c) $[P_1(\cos\theta) - P_2(\cos\theta)]$ (d) $[P_0(\cos\theta) + P_1(\cos\theta)]$

Q105. A 2×2 matrix has determinant 1 and trace 2. Its eigen values are:

(a) ±1 (b) 0, 1 (c) 1, 1 (d) 0, 2

Q106. The value of $\vec{\nabla}\times\frac{\hat{r}}{r^2}$ is:

(a) $-\frac{r}{r^3}$ (b) $4\hbar\delta^3(r)$ (c) 1 (d) 0

Q107. The Lagrangian for a one dimensional harmonic oscillator is:

(a) $\frac{1}{2}m\dot{x}^2 - \frac{1}{2}kx^2$ (b) $\frac{1}{2}m\dot{x}^2 + \frac{1}{2}kx^2$

(c) $m\dot{x} + kx$ (d) $\frac{1}{2}(mx^2 + kx^2)$

Q108. The dimensions of action are:

(a) ML^2T^{-2} (b) MLT^{-2} (c) MLT^{-1} (d) M^2LT^{-1}

Q109. The Hamiltonian is equal to the total energy for:

(a) dissipative systems (b) conservative systems

(c) non-conservative systems (d) any system is general

Q110. The potential energy of a simple pendulum consisting of a bob of mass 'm' attached to a string of length 'I' displaced from the vertical by and an angle 'θ' and allowed to oscillate (assume the potential energy to be zero at the rest position) will be:

(a) $\frac{1}{2}ml^2\dot{\theta}^2 - mgl\cos\theta$ (b) $2mgl\sin^2\frac{\theta}{2}$

(c) $\frac{1}{2}ml\theta^2$ (d) $\frac{1}{2}gl\sin\theta$

Q111. The unique output for a NAND logic gate is a O:

(a) when all inputs are 0 (b) when all inputs are 1

(c) when any one input is 0 (d) when any one input is 1

Q112. In a amplifier the negative feedback is a process where a portion of output signal is fed to the input of the normal amplifier with the condition that the input signal is:

(a) in phase (b) $90°$ out of phase

(c) $180°$ out of phase (d) any arbitrary phase

Q113. In a RC coupled amplifier, the reduction in voltage gain in the high frequency range results due to:

(a) coupling capacitor (b) shunt capacitance in the circuit

(c) series capacitance in the circuit (d) bypass capacitor in the inner circuit

Q114. The function of emitter resistance R_E in CE transistor amplifier is:

(a) to have desirable value of I_{CR} (b) to provide positive feedback

(c) to provide negative feedback (d) to provide larger amplification

Q115. The input impedance of an amplifier increases by the introduction of feedback. It is due to:

(a) positive feedback (b) current series negative feedback

(c) current shunt negative feedback (d) voltage shunt negative feedback

Q116. The transistor amplifier has highest input impedance in:

(a) CB configuration (b) CE configuration

(c) CC configuration (d) both in CC and CE configuration

Q117. The relation between current gains β and α of a transistor is:

(a) $\beta = \frac{\alpha}{(1+\alpha)}$ (b) $\beta = \frac{\alpha}{(1-\alpha)}$ (c) $\beta = \frac{(1+\alpha)}{\alpha}$ (d) $\beta = \frac{(1-\alpha)}{\alpha}$

Q118. When transistor is operating in active region, collector junction is:

(a) reversed biased for npn transistor only

(b) reversed biased for pnp transistor only

(c) forward biased for both npn and pnp transistor

(d) reversed biased for both npn and pnp transistor

Q119. Transistor is a:

(a) voltage controlled device

(b) current controlled device

(c) both voltage and current controlled device

(d) neither voltage nor current controlled device

Q120. Which power supply is called a better power, if voltage regulation is:

(a) 5% (b) 20% (c) 50% (d) 100%

Q121. The rms value of full wave rectified waveform is:

(a) 0.636 times the peak value (b) 0.707 times the peak value

(c) 0.5 times the peak value (d) 0.373 times the peak value

Q122. The breakdown does not destroy a zener diode provided the zener current is less than the:

(a) breakdown voltage (b) zener test current

(c) maximum zener current rating (d) barrier potential

Q123. When operated in cut off and saturation, the transistor acts like a

(a) a linear amplifier (b) a switch

(c) a variable capacitor (d) a variable resistor

Q124. The conduction electron have more mobility than holes because they:

(a) are lighter (b) have negative charge

(c) experience collision less frequently (d) needs less energy to move them

Q125. When a reverse voltage increases from 5 V to 10 V in a semiconductor diode, the depletion layer:

(a) becomes smaller (b) becomes larger

(c) becomes unaffected (d) breaksdown

Q126. The dynamic resistance of an ideal p-n junction with forward current of 10 mA at room temperature is:

(a) 2.5 Ohm (b) 0.4 Ohm (c) 0.25 Ohm (d) 4.0 Ohm

Q127. A n type semiconductor is formed by adding impurity atoms of:

(a) phosphorous, antimony or arsenic (b) aluminium, boron or indium

(c) cobalt, aluminium or selenium (d) aluminium, boron or selenium

Q128. A coil of inductance 0.2 H and resistance 50 Ohm is connected in parallel with a capacitor of $30\,\mu F$. The value of resonant frequency is:

(a) 250 Hz (b) 52 Hz (c) 370 Hz (d) 350 Hz

Q129. The plane velocity v_p and group velocity vg of a EM wave through a dispersive medium is given by:

(a) $v_g = v_p + \lambda \frac{dv_p}{d\lambda}$ (b) $v_g = v_p - \lambda \frac{dv_p}{d\lambda}$

(c) $v_g = v_p - \frac{dv_p}{d\lambda}$ (d) $v_g = v_p - \frac{d^2 v_p}{d\lambda}$

Q130. The relative magnitude of vector H in a plane wave is 1 A/m. The magnitude of electric vector E for a plane wave in free space is:

(a) 377 V/m (b) 37.7 V/m (c) 1 V/m (d) 3.77 V/m

Q131. In Electromagnetic field $\sqrt{\mu / \in}$ has the dimension of:

(a) an inductance (b) a capacitance (c) an impedance (d) an electric field

Q132. The direction of propagation of EM wave is given by the direction of:

(a) Vector E (b) Vector H

(c) Vector $(E \times H)$ (d) Vector E and Vector H

Q133. Which one of the following Maxwell's equations implies the absence of magnetic monopole:

(a) div $D = \rho$ (b) div $B = 0$

(c) curl $E = \frac{\partial B}{\partial t}$ (d) curl $H = J + \frac{\partial D}{\partial t}$

Q134. A 300 MH_Z plane wave propagating through a non-conducting medium is having $\mu_r = 1, \in_r = 78$. The velocity of wave through medium is:

(a) 33.97×10^6 m/s (b) 3.39×10^6 m/s

(c) 3.32×10^8 m/s (d) 7.8×10^7 m/s

Q135. Curl $E = \frac{\partial B}{\partial t}$ is representing:

(a) Ampere's law (b) Gauss's law

(c) Ohm's law (d) Faraday's law

Q136. The extended Ampere's law equation can be expressed as:

(a) $\nabla \times H = J$ (b) $\nabla \times H = J + \frac{\partial D}{\partial t}$ (c) $\nabla \times E = -\frac{\partial B}{\partial t}$ (d) $\nabla \cdot E = -\frac{\partial B}{\partial t}$

Q137. The amplitude of electric field component of sinusoidal plane wave having impedance 377 Ohm in free space is 20 V/m. The power per square meter carried by the wave is:

(a) 0.53 W/m^2 (b) 2.53 W/m^2 (c) 37.7 W/m^2 (d) 3.77 W/m^2

Q138. The ratio of electric field vectors E and magnetic field vector H (i.e. E/H) has the dimension of:

(a) Resistance (b) Inductance

(c) Capacitance (d) Product of Inductance and capacitance

Q139. When a plane electromagnetic wave is propagates in a linear, isotropic, dielectric medium, the electric field E and magnetic field H vectors are:

(a) parallel to each other (b) mutually perpendicular to each other

(c) at an angle of 45° (d) at an angle of 60°

Q140. The pointing vector S of an electromagnetic wave is:

(a) $S = E \times H$ (b) $S = E \times B$ (c) $S = E / B$ (d) $S = E / H$

Q141. There are more than two systems A, B, C ..... which are almost independent of each other. Suppose that they interact with each other weakly, so that they can be regarded as a compound system $A + B + C \ldots\ldots$ If Z_A, Z_B, Z_C are the partition function of the individual system, then partition function $Z_{A+B+C\ldots\ldots}$ is given as:

(a) $Z_{A+B+C\ldots\ldots} = Z_A + Z_B + Z_C \ldots\ldots$ (b) $Z_{A+B+C\ldots\ldots} = Z_A \cdot Z_B \cdot Z_C \ldots\ldots$

(c) $Z_{A+B+C\ldots\ldots} = Z_A \cdot (Z_B + Z_C)$ (d) $Z_{A+B+C\ldots\ldots} = 1/(Z_A \cdot Z_B \cdot Z_C \ldots\ldots)$

Q142. One mole of an ideal gas at temperature T undergoes a free expansion which double its volume. The charge in entropy is given as:

(a) $\Delta S = NkT\,In2$ (b) $\Delta S = NIn2$ (c) $\Delta S = kIn2$ (d) $\Delta S = NkIn2$

Q143. In a quantity $\Omega(E)$ defined as $\Omega(E) = \frac{1}{w}\int \ldots\ldots \int_{H \angle E} d\bar{p}_1 d\bar{v}_1 \ldots\ldots d\bar{p}_N d\bar{v}_N$, the term w is given as:

(a) h^{3N} (b) N! (c) $N!h^{3N}$ (d) N!h3

Q144. Consider a gas of three particles with four available states. Find number of states available if the gas is Bose-Einstein:

(a) 64 (b) 4 (c) 16 (d) 20

Q145. If a system is in contact with a reservoir at constant imperative and pressure and if its internal parameters are fixed so that it can only do work on the pressure reservoir, then the stable equilibrium situation is characterized by the condition:

(a) G = maximum (b) F = minimum (c) G = minimum (d) H = minimum

Q146. The pressure of an ideal Bose gas at the transition point (T_c) is given as:

(a) $P(T_c) = NkT_c/V$ (b) $P(T_c) = 0.5134\,(NkT_c/V)$

(c) $P(T_c) = 1.5(NkT_c/V)$ (d) $P(T_c) = 0.5(NkT_c/V)$

Q147. The Fermi-Dirac distribution law is given in the form:

(a) $n_i = \frac{gi}{e^{(\in i + \mu)/kT} - 1}$ (b) $n_i = \frac{gi}{e^{(\in i + \mu)/kT} + 1}$

(c) $n_i = \frac{gi}{e^{(\in i - \mu)/kT} + 1}$ (d) $n_i = \frac{gi}{-e^{(\in i - \mu)/kT} + 1}$

Q148. Equation of state of a system in grand canonical ensemble is given as:

(a) $PV = kT \ln \Xi$ (b) $PV = k^2T^2 \ln \Xi$

(c) $PV = \ln \Xi$ (d) $PV = (kT)^{-1} \ln \Xi$

Q149. Mean square fluctuation in the energy E of a system in the canonical ensemble is:

(a) $k^2T^2C_v$ (b) kT^2C_v (c) kTC_v (d) $kT^2C_v^2$

Q150. Entropy probability relation is:

(a) $S = k \log W$ (b) $W = S \log k$ (c) $W = k \log S$ (d) $S = W \log k$