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**A**

**SET-X**

# PG-EE-2021

## SUBJECT : Physics

Sr. No. 10901

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words)_____

Name_____ Date of Birth_____

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SEAL

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1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
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1. Law of Conservation of total angular momentum states that :

(1) If the total applied (External) torque is zero, total angular momentum is conserved

(2) If the total applied (External) force is zero, total angular momentum is conserved

(3) If the system is in equilibrium, the total angular momentum is conserved

(4) If the system is not in equilibrium, the total angular momentum is conserved

2. Centre of mass of a system of two particles of masses $m_1$ and $m_2$ is defined as :

(1) $\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2}$

(2) $m = m_1 + m_2$

(3) $\mu = \frac{m_1 + m_2}{m_1 m_2}$

(4) The point whose radius vector $\vec{R}$ is given by $R = \frac{m_1 \vec{r_1} + m_2 \vec{r_2}}{m_1 + m_2}$ where $\vec{r_1}$ and $\vec{r_2}$ are radius vectors of particles of masses $m_1$ and $m_2$ respectively

3. Lagrange's equation of motion are :

(1) $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_j}\right) - \frac{\partial L}{\partial q_j} = 0$

(2) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right) - \frac{\partial L}{\partial q_j} = 0$

(3) $\frac{d^2}{dt^2}\left(\frac{\partial L}{\partial q_j}\right) - \frac{\partial L}{\partial q_j} = 0$

(4) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right) - \frac{\partial L}{\partial \dot{q}_j} = 0$

where $j = 1, 2, 3, \ldots\ldots$

4. According to Hamilton's principle, the motion of system from time $t_1$ to time $t_2$ is Such that :

(1) Line integral $I = \int_{t_1}^{t_2} L\,dt = \text{Extremum}$

(2) $I = \int_{t_1}^{t_2} L\,dt = 0$

(3) $\delta I = \int_{t_1}^{t_2} L\,dt = \text{Extremum}$

(4) None of these

5. Moment of inertia of solid cylinder about its axis of symmetry is equal to :

(1) $MR^2$

(2) $\frac{1}{2}MR^2$

(3) $\frac{1}{4}MR^2$

(4) $\frac{M}{l}\left[\frac{R^2}{4}\right]$

where $M$ is the total mass of cylinder, $R$ = radius and $l$ length of cylinder.

6. Out of infinite number of straight lines which may be drawn parallel to a given direction, the moment of inertia of the body about the one passing through its centre of gravity would be :

(1) least

(2) maximum

(3) can have any value

(4) None of the above

7. The acceleration of a body rolling down an inclined plane is given by :

(1) $\frac{g\sin\theta}{1+\frac{R^2}{K^2}}$

(2) $\frac{g\sin\theta}{\frac{R^2}{K^2}}$

(3) $\frac{g\sin\theta}{1+\frac{K^2}{R^2}}$

(4) None of the above

8. If $S$ is closed surface enclosing a volume V and $\hat{n}$ is the unit vector normal to the surface and $\vec{r}$ is the position vector, then the value of the integral $\iint \vec{r} . \hat{n} dS$ is :

(1) 0 (2) $V$ (3) $2V$ (4) $3V$

9. Consider the set of vectors $\frac{1}{\sqrt{2}}(1, 1, 0)$, $\frac{1}{\sqrt{2}}(0, 1, 1)$ and $\frac{1}{\sqrt{2}}(1, 0, 1)$ :

(1) the three vectors are orthogonal

(2) the three vectors are linearly independent

(3) the three vectors cannot form a basis in a 3-Dimensional real vector space

(4) $\frac{1}{\sqrt{2}}(1, 0, 0)$ is a linear combination of $\frac{1}{\sqrt{2}}(0, 1, 1)$ and $\frac{1}{\sqrt{2}}(1, 0, 1)$

10. Ferromagnetic domains consists of :

(1) Region in which all atoms have their magnetic moments aligned in a random manner

(2) Region in which alternate atoms have magnetic moments aligned in a direction

(3) Region in which all atoms have aligned their magnetic moments in one direction

(4) None of the above

11. A clock is moving with velocity $\frac{C}{3}$(C = speed of light in vacuum). In one hour the clock appears to be slow by :

(1) 3 minutes (2) 3.4 minutes (3) 3.7 second (4) Not at all

12. The relativistic mass of a particle :

(1) Increases with velocity

(2) Decreases with velocity

(3) Decreases with velocity and finally becomes zero

(4) Increases or decreases with velocity and finally becomes zero

13. Inertial frame of reference is the one in which a free particle moves :

(1) Along a straight line with a constant speed

(2) Along a straight line with a variable speed

(3) With constant speed on a curved path

(4) With variable speed on a curved path

14. Which one of the following Maxwell's equations implies the absence of magnetic monopoles ?

(1) $\nabla . \vec{E} = \frac{\pi}{\epsilon_0}$ (2) $\nabla . \vec{B} = 0$

(3) $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ (4) $\nabla \times \vec{B} = \frac{1}{C^2}\frac{\partial \vec{B}}{\partial t} + \mu_0 J$

15. According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is :

(1) Greater than the mean velocity

(2) Equal to the mean velocity

(3) Equal to the root mean square velocity

(4) Less than the root mean square velocity

16. In relation to statistical mechanics, choose ***incorrect*** statement :

(1) All particles of a given kind are treated as mutually indistinguishable

(2) The phase space for $n$ degrees of freedom will have $2n$ dimensions and its unit cell volume will be $h^n$

(3) Photons may be treated as following Fermi-Dirac statistics

(4) With a system having $N = 10^{23}$ particles, probability of two halves of a box having particle density difference of 0.001% is negligibly small

17. The quantum statistics reduces to classical statistics under the following condition :

(1) $\rho \lambda^3 = 1$ (2) $\rho \lambda^3 >> 1$

(3) $\rho \lambda^3 << 1$ (4) $\rho = 0$

18. Brownian movement is due to :

(1) Bombardment of colloidal particles by molecules of dispersion medium

(2) Bombardment of molecules by colloidal particles present in dispersion medium

(3) Collision between molecules of dispersion medium

(4) None of these

19. Which of the following is ***not*** exact differential ?

(1) dS (2) dQ (3) dU (4) dF

20. If Y, K and $\sigma$ represents Young's modulus, Bulk modulus and Poisson's ratio respectively, then following equation connects them :

(1) $K = \frac{Y}{2(1-2\sigma)}$ (2) $K = \frac{Y}{2(1-3\sigma)}$

(3) $K = \frac{Y}{3(1-2\sigma)}$ (4) None of these

21. Young's modulus is defined as :

(1) Change in volume per unit volume

(2) Ratio of tangential strain to shearing strain

(3) Ratio of stress to longitudinal strain within elastic limits

(4) None of these

22. The relation between restoring couple and bending couple, both act in opposite direction, in relation to a metallic strip bent into arc of a circle of small curvature :

(1) Restoring couple < Bending couple

(2) Restoring couple > Bending couple

(3) Restoring couple = Bending couple

(4) None of these

23. In case of heavy dopping, the concentration of impurity is 1 in $10^6$ atoms. If the total number of atoms is $10^{24}$ atoms the number of impurity atoms would be :

(1) 4 (2) $10^{18}$

(3) $4 < N < 10^{18}$ (4) None of the above

24. In case of pnp transistor, the current carried by carriers outside the transistor would be :

(1) Holes (2) Electrons

(3) Any electrons/Holes (4) None of these

25. For a common base configuration of pnp transistor $\frac{I_C}{I_E} = 0.96$. The maximum current gain in common emitter configuration will be :

(1) 12 (2) 6 (3) 5 (4) 24

26. How many free-electrons does a p-type semiconductor contains ?

(1) Many

(2) None

(3) Only those produced by thermal energy

(4) Same number as Holes

27. What happens when forward bias is applied to a junction diode ?

(1) Potential barrier is decreased

(2) Potential barrier is increased

(3) Majority charge carrier current is reduced to zero

(4) Minority charge carrier current is reduced to zero

28. Which of the following is always used in forward bias arrangement ?

(1) LED

(2) Zener diode

(3) Photodiode

(4) Varactor diode

29. The value of hybrid parameters depend upon :

(1) Position of Q-point

(2) Temperature

(3) Both of the above

(4) None of the above

30. In an RC-coupled amplifier, the dc component is blocked by :

(1) Transistor

(2) Load resistance

(3) Stray capacitances

(4) Coupling capacitor

31. Which of the following Maxwell's relation leads to Clausius-Claperyron equation ?

(1) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial V}\right)_V$

(2) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(3) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(4) $\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T$

32. Which of the following is ***not*** Maxwell's thermodynamics relation ?

(1) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(2) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$

(3) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(4) $\left(\frac{\partial P}{\partial V}\right)_T = \left(\frac{\partial S}{\partial T}\right)_V$

33. A given amount of heat cannot be completely converted into work. However it is possible to convert a given amount of work completely into heat. The statement results from the :

(1) Zeroth law of thermodynamics

(2) First law of thermodynamics

(3) Second law of thermodynamics

(4) Third law of thermodynamics

34. A physical or chemical change take place in such a way that the entropy either decreases or remains unchanged. This statement is :

(1) True universally

(2) True only for open system

(3) True only for closed system

(4) Not true

35. At absolute zero temperature for Boson gas :

(1) Entropy is zero but internal energy and pressure do not disappear

(2) Entropy and internal energy zero but pressure does not disappear

(3) Entropy, internal energy and pressure tend to zero

(4) Internal, energy, pressure zero but entropy is positive

36. FORTRAN was developed by :

(1) Google

(2) IBM

(3) Apple

(4) Black Berry

37. An identifier can not be longer than ..... characters.

(1) 30

(2) 31

(3) 25

(4) 28

38. Using Fourier series the value of $\sum_{n=1}^{\infty} \frac{1}{(2n^2-1)}$ is :

(1) $\frac{1}{2}$

(2) $\frac{\pi^2}{8}$

(3) $\frac{\pi}{8}$

(4) $\frac{\pi^2}{2}$

**39.** Fourier series which will represent $f(x) = x \sin x$ in the interval $-\pi < x < \pi$, then $\frac{1}{2}+\frac{1}{1.2}+\frac{1}{3.5}+\frac{1}{5.7}$..... will have value :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{8}$

**40.** The Laplace transform of $f(t) = \sin \pi t$ is $F(s)=\frac{\pi}{(s^2+\pi^2)}$, $s > 0$. Therefore Laplace transform of $t \sin \pi t$ is :

(1) $\frac{\pi}{s^2(s^2+\pi^2)}$ (2) $\frac{2\pi}{s^2(s^2+\pi^2)^2}$

(3) $\frac{2\pi s}{(s^2+\pi^2)^2}$ (4) $\frac{2\pi}{(s^2+\pi^2)^2}$

**41.** Fourier transform of which of the following function does not exist ?

(1) $e^{-|x|}$ (2) $xe^{-x^2}$ (3) $e^{x^2}$ (4) $e^{-x^2}$

**42.** The electromagnetic theory suggests than the electric vector in the wave suffers a sudden phase change of $\pi$ on reflection from the plane reflecting surface but magnetic vector suffers :

(1) a phase change of $\pi$ (2) a phase change of $2\pi$

(3) a phase change of $\frac{\pi}{2}$ (4) no phase change

**43.** The path difference between the rays reflected from the top and bottom of the film is :

(1) $\mu t \cos r$ (2) $\mu t \sin r$ (3) $2\mu t \cos r$ (4) $2\mu t \sin r$

**44.** Two independent sources can not be coherent because :

(1) They emit light of same frequency

(2) They emit light of almost equal amplitudes

(3) They do not emit light in phase with each other or constant phase difference between them

(4) None of the above

45. Consider Fermi-Dirac distribution function $f(E)$ at room temperature where E refers to energy. If $E_F$ is the Fermi energy which of following is true ?

(1) $f(E)$ is a step function

(2) $f(E_F)$ has a value of $\frac{1}{2}$

(3) states with $E < E_F$ are filled completely

(4) $f(E)$ is large and tends to infinity as E decreases below $E_F$

46. Condition for statistical equilibrium is :

(1) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = 0$

(2) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} \neq 0$

(3) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = 1$

(4) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = -1$

47. In case of Bose-Einstein condensation :

(1) Number of particles increases in lower energy levels at low temperatures and high pressure

(2) Number of particles decreases in lower energy levels at low temperatures and high pressure

(3) Number of particles increases in lower energy levels at high temperatures and low pressure

(4) Number of particles decreases in lower energy levels at high temperatures and low pressure

48. Choose the ***correct*** statement :

At the same temperature

(1) A Fermion gas will exert the greatest pressure

(2) A Boson gas will exert the greatest pressure

(3) A Fermion gas will exert the least pressure

(4) A Boson gas will exert the pressure more than the Fermion gas

49. Choose the ***correct*** statement :

(1) Internal energy of a Vander Waal's gas at a given temperature increases as the volume increases

(2) Internal energy of a perfect gas at a given temperature increases as the volume increases

(3) Internal energy of a Fermi gas at a given temperature increases as the volume increases

(4) Internal energy of a Fermi gas at a given temperature decreases as the volume increases

50. The specific heat of an ideal Fermi gas in 3-Dimensions at very low temperature (T) varies as :

(1) $T$ (2) $T^2$ (3) $T^3$ (4) $T^{3/2}$

51. In F-D statistics, the volume of phase cell is :

(1) $h$ (2) $h^2$ (3) $h^3$ (4) Not fixed

52. The half width of Maxwell's distribution curve is approximately :

(1) $\sqrt{\frac{2KT}{m}}$ (2) $\sqrt{\frac{3KT}{2}}$ (3) $\sqrt{\frac{KT}{2m}}$ (4) $\sqrt{\frac{2KT}{3}}$

53. A Michelson interferometer is illuminated with monochromatic light. When one of the mirrors is moved through a distance of 25.3 μm, 92 fringes pass through cross wire. Wavelength of monochromatic light is :

(1) 500 nm (2) 550 nm (3) 600 nm (4) 650 nm

54. In case of diffraction at a circular aperature, if aperature of circular opening is large, radius of the first dark ring would be :

(1) small (2) large

(3) not change (4) None of the above

55. The resultant intensity distribution in the diffraction pattern at a single slit would be represented by :

(1) $I = I_0\left(\frac{\sin\phi}{\phi}\right)^2$

(2) $I = I_0^2\frac{\sin^2\phi}{\phi^2}$

(3) $I = I_0\frac{\sin\phi}{\phi}$

(4) None of these

56. In case of phase-reversal zone plate, if the even numbered half period zones are coated with the transparent material instead of darkening then the intensity would become :

(1) $4I_0$

(2) $2I_0$

(3) $I_0$

(4) $3I_0$

57. Which one of the following experiments confirms the existence of space quantization ?

(1) Double slit experiment

(2) Stern and Gerlach experiment

(3) Frank and Hertz experiment

(4) Michelson and Morley experiment

58. A plane polarized monochromatic electromagnetic wave is incident on a plane interface at the Brewester angle give rise to a reflected wave which is :

(1) partially polarized

(2) unpolarized

(3) polarized parallel to interface

(4) polarized perpendicular to the interface

59. For explaining the interference pattern due to L Loyd's mirror :

(1) Division of wavefront is made use of

(2) Division of amplitude is made use of

(3) Any of the above

(4) None of the above

60. In case of biprism, the interference pattern would have fringe width equal to :

(1) $\frac{D}{d}\lambda$ (2) $\frac{d}{D}\lambda$ (3) $\frac{D}{d\lambda}$ (4) $\frac{d\lambda}{D}$

61. In Debye's theory of specific heat of solids, the atomic oscillators obey :

(1) MB statistics (2) FD statistics

(3) BE statistics (4) All of the above

62. Diamond is very hard because :

(1) It is covalent solid

(2) It has large cohesive energy

(3) It has very high melting point

(4) It is insoluble in all solvents

63. When molten Zinc is cooled to solid state it assumes hcp structure. Then the number of nearest neighbours of zinc atom would be :

(1) 4 (2) 6 (3) 8 (4) 12

64. A crystalline solid :

(1) Abruptly changes from solid to liquid when heated

(2) Has no definite melting point

(3) Undergoes deformation of its geometry easily

(4) Has an irregular 3-Dimensional arrangement

65. The crystal structure of diamond is :

(1) fcc with two atoms basis of (000) and $\frac{a}{4}(\hat{i}+\hat{j}+\hat{k})$

(2) Simple cubic with two atoms basis of (000) and $\frac{a}{2}(\hat{i}+\hat{j}+\hat{k})$

(3) fcc with two atoms basis of 0,00) and $\frac{a}{2}(\hat{i}+\hat{j}+\hat{k})$

(4) bcc with one atom basis

66. The translation vectors of space lattice are $\vec{a}=\frac{\hat{x}}{2}+\frac{\sqrt{3}}{2}\hat{y}$, $\vec{b}=-\frac{1}{2}\hat{x}+\frac{\sqrt{3}}{2}\hat{y}$ and $\vec{c}=\hat{z}$, the volume of the cell would be :

(1) $\frac{2}{\sqrt{3}}$

(2) $\frac{\sqrt{3}}{2}$

(3) $2\sqrt{3}$

(4) $3\sqrt{2}$

67. In a closed packed structure, the percentage of available volume occupied by hard spheres is nearly :

(1) 60%

(2) 90%

(3) 74%

(4) 82%

68. A cubic crystal can have :

(1) only primitive Bravais lattices

(2) any one of primitive, body centred and face centred Bravais lattices

(3) All of primitive, body centred and face centred Bravais lattices

(4) All of primitive, base centred and face centred Bravais lattices

**69.** The atomic specific heat of a solid is :

(1) 3R at all temperatures

(2) 3R at high temperatures and zero at low temperatures

(3) 3R at high temperatures and proportional to $T^3$ at low temperatures

(4) proportional to $T^3$ at all temperatures

**70.** The Einstein's frequency of a solid is $2.49 \times 10^{12}$ Hz. Its atomic specific heat would be 3R :

(1) at temperatures less than 120 K

(2) at temperatures higher than 120 K

(3) at 120 K

(4) Nothing can be said

**71.** Which one of the following pairs of phenomena illustrates particle aspect of wave-particle duality ?

(1) Compton effect and Braggs law

(2) Photoelectric effect and Compton effect

(3) Compton effect and Pauli's principle

(4) Bragg's law and photoelectric effect

**72.** The uncertainty in location of a particle is equal to De-Broglie wavelength then uncertainty in its velocity is :

(1) $v$ (2) $\frac{v}{2}$ (3) $2v$ (4) $\frac{3v}{2}$

**73.** The zero point energy of harmonic oscillator is :

(1) $\hbar w$ (2) $\frac{1}{2}\hbar w$ (3) $2\hbar w$ (4) $\frac{1}{4}\hbar w$

Where letters have their usual meanings.

**74.** Heisenberg uncertainty principle :

(1) Establishes the Bohr's orbital concept

(2) is not observable for macroscopic objects

(3) established the existence of electrons inside the nucleus

(4) does not agree with De-Broglie hypothesis

**75.** According to quantum mechanics, for the particle moving in a box :

(1) The energy levels are discrete and equispaced

(2) The energy levels are continuous

(3) The energy levels are descrete and not equispaced

(4) The energy is always zero

**76.** Given a wave with the dispersion relation $w = ck + m$ for $k > 0$ and $m > 0$, which one of the following is ***true*** ?

(1) The group velocity is greater than the phase velocity

(2) The group velocity is less than the phase velocity

(3) The group velocity is equal to the phase velocity

(4) There is no definite relation between group velocity and phase velocity

**77.** The degeneracy of first excited state of an isolated hydrogen atom is :

(1) 2 (2) 4 (3) 6 (4) 8

78. The ratio of electric field vector ($\vec{E}$) and magnetic field vector ($\vec{H}$) i.e. ($\vec{E}/\vec{H}$) has the dimension of :

(1) Resistance
(2) Inductance
(3) Capacitance
(4) Inductance X capacitance

79. The expression $|\psi(r,t)|^2$ represents :

(1) Position
(2) Position probability density
(3) Normalization
(4) Time probability density

80. Spin angular momentum of an electron is :

(1) always $\frac{h}{4\pi}$

(2) always $\frac{h}{2\pi}$

(3) an integral multiple of $\frac{h}{2\pi}$

(4) an half integral multiple like $\left(n+\frac{1}{2}\right)\frac{h}{2\pi}$ with '$n$' as running integer

81. Which of following is the spectroscopic ground state ${}^{2S+1}L_J$ for $M_n^{3+}$ ions of electronic configuration $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^4$ predicted by Hund's rule ?

(1) ${}^5D_0$ (2) ${}^5D_4$ (3) ${}^5D_3$ (4) ${}^5D_2$

82. Under LS coupling scheme, the possible spectral terms ${}^{2S+1}L_J$ for electronic configuration $2S$, $3S$ are :

(1) ${}^2S_{1/2}, {}^2P_{3/2}, {}^2P_{1/2}$
(2) ${}^1S_0, {}^3P_1$
(3) ${}^1S_0, {}^3S_1$
(4) ${}^3S_0, {}^3S_1$

83. According to Bohr's model, the value of ionization potential of $Li^{2+}$ ion is :

(1) 13.6 eV (2) 27.2 eV

(3) 40.8 eV (4) 122.4 eV

84. Total number of Zeeman components observed in electronic transition $^2D_{5/2} \rightarrow {}^2P_{3/2}$ of an atom in weak field is :

(1) 4 (2) 6 (3) 12 (4) 10

85. A laser beam of wavelength 600 nm with a circular cross section with a radius of 10 nm falls normally on a lens of radius 20 nm and focal length 10 cm. The radius of focused spot is approximately :

(1) 0.3 nm (2) 0.6 nm (3) 3 μm (4) 6 μm

86. The Coherence length for a laser beam of bandwidth $\Delta\nu = 3000$ Hz would be :

(1) 1 Km (2) 10 m (3) 100 Km (4) 10 Km

87. Atomic cross-section has dimension of :

(1) Length (2) Area

(3) Volume (4) None of these

88. What is 'LIDAR' ?

(1) Light Detection and Ranging

(2) Light Amplification, Detection and Ranging

(3) Light Amplification by Stimulated Emission of Radiation

(4) None of the above

89. What is stimulated emission of radiation ?

(1) Incident energy is not required for such emission

(2) Incident energy of any energy is required for such emission

(3) Incident energy equal to the difference in energies of two levels is required to trigger such emission

(4) None of these

90. In case of alkali spectra, the doublet separation :

(1) Decreases with increasing principal quantum number

(2) Increases with increasing principal quantum number

(3) Increases with increasing orbital quantum number

(4) Increases with decreasing orbital quantum number

91. Parity is ***not*** conserved in :

(1) $\alpha$-decay

(2) $\beta$-decay

(3) $\gamma$-decay

(4) None of the above

92. Mass of Neutron is :

(1) Equal to the mass of the electron

(2) Equal to mass of the proton

(3) Slightly greater than mass of proton

(4) Slightly less than the mass of proton

93. $\alpha$-particle are :

(1) Electromagnetic radiations

(2) Positively charged particles and have same properties as protons

(3) Helium Nuclei

(4) Negatively charged particles

94. Gamma rays are :

(1) Visible to eye

(2) Neutral particles with unitmass number

(3) Electromagnetic radiations of high frequency

(4) Like fast moving electrons

95. Stripping reactions are :

(1) Indirect reactions

(2) Direct reactions

(3) Compound nuclear reactions

(4) None of these

96. Whenever a charged particle passes through a medium with a velocity more than the velocity of light in that medium, the electromagnetic radiation is emitted. This radiation is called :

(1) Bremsstrahlung Radiation

(2) Compton effect

(3) Cerenkor Radiation

(4) Straggling Radiation

97. Which of the following accelerators cannot-accelerate protons ?

(1) Linear Accelerator

(2) Betatron

(3) Cyclotron

(4) Van-de Graff Generator

98. The accelerator which make use of principle of electromagnetic induction for accelerating the particles is :

(1) Van-de Graff Generator

(2) Cyclotron

(3) Synchrotron

(4) Betatron

99. A nuclear fusion process, a proton and a neutron combine to form a deuterium nucleus. If $m_p$ and $m_n$ denote the mass of a proton and neutron respectively, the mass of the deuterium nucleus is :

(1) Equal to $(m_p + m_n)$

(2) greater than $(m_p + m_n)$

(3) less than $(m_p + m_n)$

(4) Sometimes greater than and sometimes less than $(m_p + m_n)$

100. The process by which a heavy nucleus splits into two lighter nuclei is known as :

(1) Nuclear fission

(2) Nuclear fusion

(3) Chain reaction

(4) $\alpha$-decay

Total No. of Printed Pages : 21

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**SET-X**

**B**

# PG-EE-2021

## SUBJECT : Physics

Sr. No. 10902

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words)_____

Name_____ Date of Birth_____

Father's Name_____ Mother's Name_____

Date of Examination_____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

SEAL

**CANDIDATES MUST READ THE FOLLOWING INFORMATION/INSTRUCTIONS BEFORE STARTING THE QUESTION PAPER.**

1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
3. Keeping in view the transparency of the examination system, carbonless OMR Sheet is provided to the candidate so that a copy of OMR Sheet may be kept by the candidate.
4. Question Booklet along with answer key of all the A, B, C & D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University website. The complaint be sent by the students to the Controller of Examinations by hand or through email. Thereafter, no complaint in any case will be considered.
5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. A clock is moving with velocity $\frac{C}{3}$ (C = speed of light in vacuum). In one hour the clock appears to be slow by :

(1) 3 minutes (2) 3.4 minutes (3) 3.7 second (4) Not at all

2. The relativistic mass of a particle :

(1) Increases with velocity

(2) Decreases with velocity

(3) Decreases with velocity and finally becomes zero

(4) Increases or decreases with velocity and finally becomes zero

3. Inertial frame of reference is the one in which a free particle moves :

(1) Along a straight line with a constant speed

(2) Along a straight line with a variable speed

(3) With constant speed on a curved path

(4) With variable speed on a curved path

4. Which one of the following Maxwell's equations implies the absence of magnetic monopoles ?

(1) $\nabla . \vec{E} = \frac{\pi}{\epsilon_0}$ (2) $\nabla . \vec{B} = 0$

(3) $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ (4) $\nabla \times \vec{B} = \frac{1}{C^2}\frac{\partial \vec{B}}{\partial t} + \mu_0 J$

5. According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is :

(1) Greater than the mean velocity

(2) Equal to the mean velocity

(3) Equal to the root mean square velocity

(4) Less than the root mean square velocity

6. In relation to statistical mechanics, choose ***incorrect*** statement :

(1) All particles of a given kind are treated as mutually indistinguishable

(2) The phase space for $n$ degrees of freedom will have $2n$ dimensions and its unit cell volume will be $h^n$

(3) Photons may be treated as following Fermi-Dirac statistics

(4) With a system having $N = 10^{23}$ particles, probability of two halves of a box having particle density difference of 0.001% is negligibly small

7. The quantum statistics reduces to classical statistics under the following condition :

(1) $\rho \lambda^3 = 1$ (2) $\rho \lambda^3 >> 1$

(3) $\rho \lambda^3 << 1$ (4) $\rho = 0$

8. Brownian movement is due to :

(1) Bombardment of colloidal particles by molecules of dispersion medium

(2) Bombardment of molecules by colloidal particles present in dispersion medium

(3) Collision between molecules of dispersion medium

(4) None of these

9. Which of the following is ***not*** exact differential ?

(1) dS (2) dQ (3) dU (4) dF

10. If Y, K and $\sigma$ represents Young's modulus, Bulk modulus and Poisson's ratio respectively, then following equation connects them :

(1) $K = \frac{Y}{2(1-2\sigma)}$ (2) $K = \frac{Y}{2(1-3\sigma)}$

(3) $K = \frac{Y}{3(1-2\sigma)}$ (4) None of these

11. Parity is ***not*** conserved in :

(1) $\alpha$-decay (2) $\beta$-decay

(3) $\gamma$-decay (4) None of the above

12. Mass of Neutron is :

(1) Equal to the mass of the electron

(2) Equal to mass of the proton

(3) Slightly greater than mass of proton

(4) Slightly less than the mass of proton

13. $\alpha$-particle are :

(1) Electromagnetic radiations

(2) Positively charged particles and have same properties as protons

(3) Helium Nuclei

(4) Negatively charged particles

14. Gamma rays are :

(1) Visible to eye

(2) Neutral particles with unitmass number

(3) Electromagnetic radiations of high frequency

(4) Like fast moving electrons

15. Stripping reactions are :

(1) Indirect reactions (2) Direct reactions

(3) Compound nuclear reactions (4) None of these

16. Whenever a charged particle passes through a medium with a velocity more than the velocity of light in that medium, the electromagnetic radiation is emitted. This radiation is called :

(1) Bremsstrahlung Radiation (2) Compton effect

(3) Cerenkor Radiation (4) Straggling Radiation

17. Which of the following accelerators cannot-accelerate protons ?

(1) Linear Accelerator (2) Betatron

(3) Cyclotron (4) Van-de Graff Generator

18. The accelerator which make use of principle of electromagnetic induction for accelerating the particles is :

(1) Van-de Graff Generator (2) Cyclotron

(3) Synchrotron (4) Betatron

19. A nuclear fusion process, a proton and a neutron combine to form a deuterium nucleus. If $m_p$ and $m_n$ denote the mass of a proton and neutron respectively, the mass of the deuterium nucleus is :

(1) Equal to $(m_p + m_n)$

(2) greater than $(m_p + m_n)$

(3) less than $(m_p + m_n)$

(4) Sometimes greater than and sometimes less than $(m_p + m_n)$

20. The process by which a heavy nucleus splits into two lighter nuclei is known as :

(1) Nuclear fission (2) Nuclear fusion

(3) Chain reaction (4) $\alpha$-decay

21. Which one of the following pairs of phenomena illustrates particle aspect of wave-particle duality ?

(1) Compton effect and Braggs law

(2) Photoelectric effect and Compton effect

(3) Compton effect and Pauli's principle

(4) Bragg's law and photoelectric effect

22. The uncertainty in location of a particle is equal to De-Broglie wavelength then uncertainty in its velocity is :

(1) $v$ (2) $\frac{v}{2}$ (3) $2v$ (4) $\frac{3v}{2}$

23. The zero point energy of harmonic oscillator is :

(1) $\hbar w$ (2) $\frac{1}{2}\hbar w$ (3) $2\hbar w$ (4) $\frac{1}{4}\hbar w$

Where letters have their usual meanings.

24. Heisenberg uncertainty principle :

(1) Establishes the Bohr's orbital concept

(2) is not observable for macroscopic objects

(3) established the existence of electrons inside the nucleus

(4) does not agree with De-Broglie hypothesis

25. According to quantum mechanics, for the particle moving in a box :

(1) The energy levels are discrete and equispaced

(2) The energy levels are continuous

(3) The energy levels are descrete and not equispaced

(4) The energy is always zero

26. Given a wave with the dispersion relation $w = ck + m$ for $k > 0$ and $m > 0$, which one of the following is ***true*** ?

(1) The group velocity is greater than the phase velocity

(2) The group velocity is less than the phase velocity

(3) The group velocity is equal to the phase velocity

(4) There is no definite relation between group velocity and phase velocity

27. The degeneracy of first excited state of an isolated hydrogen atom is :

(1) 2 (2) 4 (3) 6 (4) 8

28. The ratio of electric field vector ($\vec{E}$) and magnetic field vector ($\vec{H}$) i.e. ($\vec{E}/\vec{H}$) has the dimension of :

(1) Resistance (2) Inductance

(3) Capacitance (4) Inductance X capacitance

29. The expression $|\psi(r,t)|^2$ represents :

(1) Position (2) Position probability density

(3) Normalization (4) Time probability density

30. Spin angular momentum of an electron is :

(1) always $\frac{h}{4\pi}$

(2) always $\frac{h}{2\pi}$

(3) an integral multiple of $\frac{h}{2\pi}$

(4) an half integral multiple like $\left(n+\frac{1}{2}\right)\frac{h}{2\pi}$ with '$n$' as running integer

31. In F-D statistics, the volume of phase cell is :

(1) $h$ (2) $h^2$ (3) $h^3$ (4) Not fixed

32. The half width of Maxwell's distribution curve is approximately :

(1) $\sqrt{\frac{2KT}{m}}$ (2) $\sqrt{\frac{3KT}{2}}$ (3) $\sqrt{\frac{KT}{2m}}$ (4) $\sqrt{\frac{2KT}{3}}$

33. A Michelson interferometer is illuminated with monochromatic light. When one of the mirrors is moved through a distance of 25.3 μm, 92 fringes pass through cross wire. Wavelength of monochromatic light is :

(1) 500 nm (2) 550 nm (3) 600 nm (4) 650 nm

34. In case of diffraction at a circular aperature, if aperature of circular opening is large, radius of the first dark ring would be :

(1) small (2) large

(3) not change (4) None of the above

35. The resultant intensity distribution in the diffraction pattern at a single slit would be represented by :

(1) $I = I_0\left(\frac{\sin\phi}{\phi}\right)^2$ (2) $I = I_0^2\frac{\sin^2\phi}{\phi^2}$

(3) $I = I_0\frac{\sin\phi}{\phi}$ (4) None of these

36. In case of phase-reversal zone plate, if the even numbered half period zones are coated with the transparent material instead of darkening then the intensity would become :

(1) $4I_0$ (2) $2I_0$

(3) $I_0$ (4) $3I_0$

37. Which one of the following experiments confirms the existence of space quantization ?

(1) Double slit experiment

(2) Stern and Gerlach experiment

(3) Frank and Hertz experiment

(4) Michelson and Morley experiment

38. A plane polarized monochromatic electromagnetic wave is incident on a plane interface at the Brewester angle give rise to a reflected wave which is :

(1) partially polarized

(2) unpolarized

(3) polarized parallel to interface

(4) polarized perpendicular to the interface

39. For explaining the interference pattern due to L Loyd's mirror :

(1) Division of wavefront is made use of

(2) Division of amplitude is made use of

(3) Any of the above

(4) None of the above

40. In case of biprism, the interference pattern would have fringe width equal to :

(1) $\frac{D}{d}\lambda$ (2) $\frac{d}{D}\lambda$ (3) $\frac{D}{d\lambda}$ (4) $\frac{d\lambda}{D}$

41. Which of the following Maxwell's relation leads to Clausius-Claperyron equation ?

(1) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial V}\right)_V$ (2) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(3) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$ (4) $\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T$

42. Which of the following is ***not*** Maxwell's thermodynamics relation ?

(1) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$ (2) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$

(3) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$ (4) $\left(\frac{\partial P}{\partial V}\right)_T = \left(\frac{\partial S}{\partial T}\right)_V$

43. A given amount of heat cannot be completely converted into work. However it is possible to convert a given amount of work completely into heat. The statement results from the :

(1) Zeroth law of thermodynamics

(2) First law of thermodynamics

(3) Second law of thermodynamics

(4) Third law of thermodynamics

44. A physical or chemical change take place in such a way that the entropy either decreases or remains unchanged. This statement is :

(1) True universally

(2) True only for open system

(3) True only for closed system

(4) Not true

45. At absolute zero temperature for Boson gas :

(1) Entropy is zero but internal energy and pressure do not disappear

(2) Entropy and internal energy zero but pressure does not disappear

(3) Entropy, internal energy and pressure tend to zero

(4) Internal, energy, pressure zero but entropy is positive

46. FORTRAN was developed by :

(1) Google

(2) IBM

(3) Apple

(4) Black Berry

47. An identifier can not be longer than ..... characters.

(1) 30 (2) 31 (3) 25 (4) 28

48. Using Fourier series the value of $\sum_{n=1}^{\infty} \frac{1}{(2n^2-1)}$ is :

(1) $\frac{1}{2}$ (2) $\frac{\pi^2}{8}$ (3) $\frac{\pi}{8}$ (4) $\frac{\pi^2}{2}$

49. Fourier series which will represent $f(x) = x \sin x$ in the interval $-\pi < x < \pi$, then $\frac{1}{2}+\frac{1}{1.2}+\frac{1}{3.5}+\frac{1}{5.7}$..... will have value :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{8}$

50. The Laplace transform of $f(t) = \sin \pi t$ is $F(s)=\frac{\pi}{(s^2+\pi^2)}$, $s > 0$. Therefore Laplace transform of $t \sin \pi t$ is :

(1) $\frac{\pi}{s^2(s^2+\pi^2)}$ (2) $\frac{2\pi}{s^2(s^2+\pi^2)^2}$

(3) $\frac{2\pi s}{(s^2+\pi^2)^2}$ (4) $\frac{2\pi}{(s^2+\pi^2)^2}$

51. Young's modulus is defined as :

(1) Change in volume per unit volume

(2) Ratio of tangential strain to shearing strain

(3) Ratio of stress to longitudinal strain within elastic limits

(4) None of these

52. The relation between restoring couple and bending couple, both act in opposite direction, in relation to a metallic strip bent into arc of a circle of small curvature :

(1) Restoring couple < Bending couple

(2) Restoring couple > Bending couple

(3) Restoring couple = Bending couple

(4) None of these

53. In case of heavy dopping, the concentration of impurity is 1 in $10^6$ atoms. If the total number of atoms is $10^{24}$ atoms the number of impurity atoms would be :

(1) 4 (2) $10^{18}$

(3) $4 < N < 10^{18}$ (4) None of the above

54. In case of pnp transistor, the current carried by carriers outside the transistor would be :

(1) Holes (2) Electrons

(3) Any electrons/Holes (4) None of these

55. For a common base configuration of pnp transistor $\frac{I_C}{I_E} = 0.96$. The maximum current gain in common emitter configuration will be :

(1) 12 (2) 6 (3) 5 (4) 24

56. How many free-electrons does a p-type semiconductor contains ?

(1) Many

(2) None

(3) Only those produced by thermal energy

(4) Same number as Holes

57. What happens when forward bias is applied to a junction diode ?

(1) Potential barrier is decreased

(2) Potential barrier is increased

(3) Majority charge carrier current is reduced to zero

(4) Minority charge carrier current is reduced to zero

58. Which of the following is always used in forward bias arrangement ?

(1) LED (2) Zener diode

(3) Photodiode (4) Varactor diode

59. The value of hybrid parameters depend upon :

(1) Position of Q-point (2) Temperature

(3) Both of the above (4) None of the above

60. In an RC-coupled amplifier, the dc component is blocked by :

(1) Transistor (2) Load resistance

(3) Stray capacitances (4) Coupling capacitor

61. Fourier transform of which of the following function does not exist ?

(1) $e^{-|x|}$ (2) $xe^{-x^2}$ (3) $e^{x^2}$ (4) $e^{-x^2}$

62. The electromagnetic theory suggests than the electric vector in the wave suffers a sudden phase change of $\pi$ on reflection from the plane reflecting surface but magnetic vector suffers :

(1) a phase change of $\pi$ (2) a phase change of $2\pi$

(3) a phase change of $\frac{\pi}{2}$ (4) no phase change

63. The path difference between the rays reflected from the top and bottom of the film is :

(1) $\mu t \cos r$ (2) $\mu t \sin r$

(3) $2\mu t \cos r$ (4) $2\mu t \sin r$

64. Two independent sources can not be coherent because :

(1) They emit light of same frequency

(2) They emit light of almost equal amplitudes

(3) They do not emit light in phase with each other or constant phase difference between them

(4) None of the above

65. Consider Fermi-Dirac distribution function $f(E)$ at room temperature where E refers to energy. If $E_F$ is the Fermi energy which of following is true ?

(1) $f(E)$ is a step function

(2) $f(E_F)$ has a value of $\frac{1}{2}$

(3) states with $E < E_F$ are filled completely

(4) $f(E)$ is large and tends to infinity as E decreases below $E_F$

66. Condition for statistical equilibrium is :

(1) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = 0$ (2) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} \neq 0$

(3) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = 1$ (4) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = -1$

67. In case of Bose-Einstein condensation :

(1) Number of particles increases in lower energy levels at low temperatures and high pressure

(2) Number of particles decreases in lower energy levels at low temperatures and high pressure

(3) Number of particles increases in lower energy levels at high temperatures and low pressure

(4) Number of particles decreases in lower energy levels at high temperatures and low pressure

68. Choose the ***correct*** statement :

At the same temperature

(1) A Fermion gas will exert the greatest pressure

(2) A Boson gas will exert the greatest pressure

(3) A Fermion gas will exert the least pressure

(4) A Boson gas will exert the pressure more than the Fermion gas

**69.** Choose the ***correct*** statement :

(1) Internal energy of a Vander Waal's gas at a given temperature increases as the volume increases

(2) Internal energy of a perfect gas at a given temperature increases as the volume increases

(3) Internal energy of a Fermi gas at a given temperature increases as the volume increases

(4) Internal energy of a Fermi gas at a given temperature decreases as the volume increases

**70.** The specific heat of an ideal Fermi gas in 3-Dimensions at very low temperature (T) varies as :

(1) $T$ (2) $T^2$ (3) $T^3$ (4) $T^{3/2}$

**71.** In Debye's theory of specific heat of solids, the atomic oscillators obey :

(1) MB statistics (2) FD statistics

(3) BE statistics (4) All of the above

**72.** Diamond is very hard because :

(1) It is covalent solid (2) It has large cohesive energy

(3) It has very high melting point (4) It is insoluble in all solvents

**73.** When molten Zinc is cooled to solid state it assumes hcp structure. Then the number of nearest neighbours of zinc atom would be :

(1) 4 (2) 6 (3) 8 (4) 12

**74.** A crystalline solid :

(1) Abruptly changes from solid to liquid when heated

(2) Has no definite melting point

(3) Undergoes deformation of its geometry easily

(4) Has an irregular 3-Dimensional arrangement

**75.** The crystal structure of diamond is :

(1) fcc with two atoms basis of (000) and $\frac{a}{4}(\hat{i}+\hat{j}+\hat{k})$

(2) Simple cubic with two atoms basis of (000) and $\frac{a}{2}(\hat{i}+\hat{j}+\hat{k})$

(3) fcc with two atoms basis of 0,00) and $\frac{a}{2}(\hat{i}+\hat{j}+\hat{k})$

(4) bcc with one atom basis

**76.** The translation vectors of space lattice are $\vec{a}=\frac{\hat{x}}{2}+\frac{\sqrt{3}}{2}\hat{y}$, $\vec{b}=-\frac{1}{2}\hat{x}+\frac{\sqrt{3}}{2}\hat{y}$ and $\vec{c}=\hat{z}$, the volume of the cell would be :

(1) $\frac{2}{\sqrt{3}}$

(2) $\frac{\sqrt{3}}{2}$

(3) $2\sqrt{3}$

(4) $3\sqrt{2}$

**77.** In a closed packed structure, the percentage of available volume occupied by hard spheres is nearly :

(1) 60%

(2) 90%

(3) 74%

(4) 82%

**78.** A cubic crystal can have :

(1) only primitive Bravais lattices

(2) any one of primitive, body centred and face centred Bravais lattices

(3) All of primitive, body centred and face centred Bravais lattices

(4) All of primitive, base centred and face centred Bravais lattices

**79.** The atomic specific heat of a solid is :

(1) 3R at all temperatures

(2) 3R at high temperatures and zero at low temperatures

(3) 3R at high temperatures and proportional to $T^3$ at low temperatures

(4) proportional to $T^3$ at all temperatures

**80.** The Einstein's frequency of a solid is $2.49 \times 10^{12}$ Hz. Its atomic specific heat would be 3R :

(1) at temperatures less than 120 K

(2) at temperatures higher than 120 K

(3) at 120 K

(4) Nothing can be said

**81.** Law of Conservation of total angular momentum states that :

(1) If the total applied (External) torque is zero, total angular momentum is conserved

(2) If the total applied (External) force is zero, total angular momentum is conserved

(3) If the system is in equilibrium, the total angular momentum is conserved

(4) If the system is not in equilibrium, the total angular momentum is conserved

**82.** Centre of mass of a system of two particles of masses $m_1$ and $m_2$ is defined as :

(1) $\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2}$

(2) $m = m_1 + m_2$

(3) $\mu = \frac{m_1 + m_2}{m_1 m_2}$

(4) The point whose radius vector $\vec{R}$ is given by $R = \frac{m_1 \vec{r_1} + m_2 \vec{r_2}}{m_1 + m_2}$ where $\vec{r_1}$ and $\vec{r_2}$ are radius vectors of particles of masses $m_1$ and $m_2$ respectively

**83.** Lagrange's equation of motion are :

(1) $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_j}\right)-\frac{\partial L}{\partial q_j}=0$

(2) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right)-\frac{\partial L}{\partial q_j}=0$

(3) $\frac{d^2}{dt^2}\left(\frac{\partial L}{\partial q_j}\right)-\frac{\partial L}{\partial q_j}=0$

(4) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right)-\frac{\partial L}{\partial \dot{q}_j}=0$

where $j = 1, 2, 3, \ldots..$

**84.** According to Hamilton's principle, the motion of system from time $t_1$ to time $t_2$ is Such that :

(1) Line integral $I=\int_{t_1}^{t_2} L\,dt$ = Extremum

(2) $I=\int_{t_1}^{t_2} L\,dt=0$

(3) $\delta I=\int_{t_1}^{t_2} L\,dt$ = Extremum

(4) None of these

**85.** Moment of inertia of solid cylinder about its axis of symmetry is equal to :

(1) $MR^2$

(2) $\frac{1}{2}MR^2$

(3) $\frac{1}{4}MR^2$

(4) $\frac{M}{l}\left[\frac{R^2}{4}\right]$

where $M$ is the total mass of cylinder, $R$ = radius and $l$ length of cylinder.

**86.** Out of infinite number of straight lines which may be drawn parallel to a given direction, the moment of inertia of the body about the one passing through its centre of gravity would be :

(1) least
(2) maximum
(3) can have any value
(4) None of the above

**87.** The acceleration of a body rolling down an inclined plane is given by :

(1) $\dfrac{g\sin\theta}{1+\dfrac{R^2}{K^2}}$ (2) $\dfrac{g\sin\theta}{\dfrac{R^2}{K^2}}$ (3) $\dfrac{g\sin\theta}{1+\dfrac{K^2}{R^2}}$ (4) None of the above

**88.** If $S$ is closed surface enclosing a volume V and $\hat{n}$ is the unit vector normal to the surface and $\vec{r}$ is the position vector, then the value of the integral $\iint \vec{r}.\hat{n}dS$ is :

(1) 0 (2) $V$ (3) $2V$ (4) $3V$

**89.** Consider the set of vectors $\frac{1}{\sqrt{2}}(1, 1, 0)$, $\frac{1}{\sqrt{2}}(0, 1, 1)$ and $\frac{1}{\sqrt{2}}(1, 0, 1)$ :

(1) the three vectors are orthogonal

(2) the three vectors are linearly independent

(3) the three vectors cannot form a basis in a 3-Dimensional real vector space

(4) $\frac{1}{\sqrt{2}}(1, 0, 0)$ is a linear combination of $\frac{1}{\sqrt{2}}(0, 1, 1)$ and $\frac{1}{\sqrt{2}}(1, 0, 1)$

**90.** Ferromagnetic domains consists of :

(1) Region in which all atoms have their magnetic moments aligned in a random manner

(2) Region in which alternate atoms have magnetic moments aligned in a direction

(3) Region in which all atoms have aligned their magnetic moments in one direction

(4) None of the above

**91.** Which of following is the spectroscopic ground state $^{2S+1}L_J$ for $M_n^{3+}$ ions of electronic configuration $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^4$ predicted by Hund's rule ?

(1) $^5D_0$ (2) $^5D_4$ (3) $^5D_3$ (4) $^5D_2$

**92.** Under LS coupling scheme, the possible spectral terms $^{2S+1}L_J$ for electronic configuration $2S$, $3S$ are :

(1) $^2S_{1/2}, ^2P_{3/2}, ^2P_{1/2}$ (2) $^1S_0, ^3P_1$

(3) $^1S_0, ^3S_1$ (4) $^3S_0, ^3S_1$

**93.** According to Bohr's model, the value of ionization potential of $Li^{2+}$ ion is :

(1) 13.6 eV (2) 27.2 eV

(3) 40.8 eV (4) 122.4 eV

**94.** Total number of Zeeman components observed in electronic transition $^2D_{5/2} \rightarrow {}^2P_{3/2}$ of an atom in weak field is :

(1) 4 (2) 6 (3) 12 (4) 10

**95.** A laser beam of wavelength 600 nm with a circular cross section with a radius of 10 nm falls normally on a lens of radius 20 nm and focal length 10 cm. The radius of focused spot is approximately :

(1) 0.3 nm (2) 0.6 nm (3) 3 μm (4) 6 μm

**96.** The Coherence length for a laser beam of bandwidth $\Delta\nu = 3000$ Hz would be :

(1) 1 Km (2) 10 m

(3) 100 Km (4) 10 Km

**97.** Atomic cross-section has dimension of :

(1) Length (2) Area

(3) Volume (4) None of these

98. What is 'LIDAR' ?

(1) Light Detection and Ranging

(2) Light Amplification, Detection and Ranging

(3) Light Amplification by Stimulated Emission of Radiation

(4) None of the above

99. What is stimulated emission of radiation ?

(1) Incident energy is not required for such emission

(2) Incident energy of any energy is required for such emission

(3) Incident energy equal to the difference in energies of two levels is required to trigger such emission

(4) None of these

100. In case of alkali spectra, the doublet separation :

(1) Decreases with increasing principal quantum number

(2) Increases with increasing principal quantum number

(3) Increases with increasing orbital quantum number

(4) Increases with decreasing orbital quantum number

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**C**

**SET-X**

# PG-EE-2021

## SUBJECT : Physics

10903

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words)_____

Name_____ Date of Birth_____

Father's Name_____ Mother's Name_____

Date of Examination_____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

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SEAL

1. ***All questions are compulsory.***
2. The candidates ***must return*** the question booklet as well as OMR Answer-Sheet to the Invigilator concerned before leaving the Examination Hall, failing which a case of use of unfair-means / mis-behaviour will be registered against him / her, in addition to lodging of an FIR with the police. Further the answer-sheet of such a candidate will not be evaluated.
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4. Question Booklet along with answer key of all the A, B, C & D code shall be got uploaded on the University Website immediately after the conduct of Entrance Examination. Candidates may raise valid objection/complaint if any, with regard to discrepancy in the question booklet/answer key within 24 hours of uploading the same on the University website. The complaint be sent by the students to the Controller of Examinations by hand or through email. Thereafter, no complaint in any case will be considered.
5. The candidate ***must not*** do any rough work or writing in the OMR Answer-Sheet. Rough work, if any, may be done in the question booklet itself. Answers ***must not*** be ticked in the question booklet.
6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
7. Use only **Black** or **Blue Ball Point Pen** of good quality in the OMR Answer-Sheet.
8. *Before answering the questions, the candidates should ensure that they have been supplied correct and complete booklet. Complaints, if any, regarding misprinting etc. will not be entertained* **30** *minutes after starting of the examination.*

1. Fourier transform of which of the following function does not exist ?

(1) $e^{-|x|}$ (2) $xe^{-x^2}$ (3) $e^{x^2}$ (4) $e^{-x^2}$

2. The electromagnetic theory suggests than the electric vector in the wave suffers a sudden phase change of $\pi$ on reflection from the plane reflecting surface but magnetic vector suffers :

(1) a phase change of $\pi$ (2) a phase change of $2\pi$

(3) a phase change of $\frac{\pi}{2}$ (4) no phase change

3. The path difference between the rays reflected from the top and bottom of the film is :

(1) $\mu t \cos r$ (2) $\mu t \sin r$ (3) $2\mu t \cos r$ (4) $2\mu t \sin r$

4. Two independent sources can not be coherent because :

(1) They emit light of same frequency

(2) They emit light of almost equal amplitudes

(3) They do not emit light in phase with each other or constant phase difference between them

(4) None of the above

5. Consider Fermi-Dirac distribution function $f(E)$ at room temperature where E refers to energy. If $E_F$ is the Fermi energy which of following is true ?

(1) $f(E)$ is a step function

(2) $f(E_F)$ has a value of $\frac{1}{2}$

(3) states with $E < E_F$ are filled completely

(4) $f(E)$ is large and tends to infinity as E decreases below $E_F$

6. Condition for statistical equilibrium is :

(1) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = 0$ (2) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} \neq 0$ (3) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = 1$ (4) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = -1$

7. In case of Bose-Einstein condensation :

(1) Number of particles increases in lower energy levels at low temperatures and high pressure

(2) Number of particles decreases in lower energy levels at low temperatures and high pressure

(3) Number of particles increases in lower energy levels at high temperatures and low pressure

(4) Number of particles decreases in lower energy levels at high temperatures and low pressure

8. Choose the ***correct*** statement :

At the same temperature

(1) A Fermion gas will exert the greatest pressure

(2) A Boson gas will exert the greatest pressure

(3) A Fermion gas will exert the least pressure

(4) A Boson gas will exert the pressure more than the Fermion gas

9. Choose the ***correct*** statement :

(1) Internal energy of a Vander Waal's gas at a given temperature increases as the volume increases

(2) Internal energy of a perfect gas at a given temperature increases as the volume increases

(3) Internal energy of a Fermi gas at a given temperature increases as the volume increases

(4) Internal energy of a Fermi gas at a given temperature decreases as the volume increases

10. The specific heat of an ideal Fermi gas in 3-Dimensions at very low temperature (T) varies as :

(1) $T$ (2) $T^2$ (3) $T^3$ (4) $T^{3/2}$

**11.** Young's modulus is defined as :

(1) Change in volume per unit volume

(2) Ratio of tangential strain to shearing strain

(3) Ratio of stress to longitudinal strain within elastic limits

(4) None of these

**12.** The relation between restoring couple and bending couple, both act in opposite direction, in relation to a metallic strip bent into arc of a circle of small curvature :

(1) Restoring couple < Bending couple

(2) Restoring couple > Bending couple

(3) Restoring couple = Bending couple

(4) None of these

**13.** In case of heavy dopping, the concentration of impurity is 1 in $10^6$ atoms. If the total number of atoms is $10^{24}$ atoms the number of impurity atoms would be :

(1) 4 (2) $10^{18}$

(3) $4 < N < 10^{18}$ (4) None of the above

**14.** In case of pnp transistor, the current carried by carriers outside the transistor would be :

(1) Holes (2) Electrons

(3) Any electrons/Holes (4) None of these

**15.** For a common base configuration of pnp transistor $\frac{I_C}{I_E} = 0.96$. The maximum current gain in common emitter configuration will be :

(1) 12 (2) 6 (3) 5 (4) 24

16. How many free-electrons does a p-type semiconductor contains ?

(1) Many

(2) None

(3) Only those produced by thermal energy

(4) Same number as Holes

17. What happens when forward bias is applied to a junction diode ?

(1) Potential barrier is decreased

(2) Potential barrier is increased

(3) Majority charge carrier current is reduced to zero

(4) Minority charge carrier current is reduced to zero

18. Which of the following is always used in forward bias arrangement ?

(1) LED (2) Zener diode

(3) Photodiode (4) Varactor diode

19. The value of hybrid parameters depend upon :

(1) Position of Q-point (2) Temperature

(3) Both of the above (4) None of the above

20. In an RC-coupled amplifier, the dc component is blocked by :

(1) Transistor (2) Load resistance

(3) Stray capacitances (4) Coupling capacitor

21. Law of Conservation of total angular momentum states that :

(1) If the total applied (External) torque is zero, total angular momentum is conserved

(2) If the total applied (External) force is zero, total angular momentum is conserved

(3) If the system is in equilibrium, the total angular momentum is conserved

(4) If the system is not in equilibrium, the total angular momentum is conserved

**22.** Centre of mass of a system of two particles of masses $m_1$ and $m_2$ is defined as :

(1) $\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2}$

(2) $m = m_1 + m_2$

(3) $\mu = \frac{m_1 + m_2}{m_1 m_2}$

(4) The point whose radius vector $\vec{R}$ is given by $R = \frac{m_1 \vec{r_1} + m_2 \vec{r_2}}{m_1 + m_2}$ where $\vec{r_1}$ and $\vec{r_2}$ are radius vectors of particles of masses $m_1$ and $m_2$ respectively

**23.** Lagrange's equation of motion are :

(1) $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_j}\right) - \frac{\partial L}{\partial q_j} = 0$

(2) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right) - \frac{\partial L}{\partial q_j} = 0$

(3) $\frac{d^2}{dt^2}\left(\frac{\partial L}{\partial q_j}\right) - \frac{\partial L}{\partial q_j} = 0$

(4) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right) - \frac{\partial L}{\partial \dot{q}_j} = 0$

where $j = 1, 2, 3, \ldots\ldots$

**24.** According to Hamilton's principle, the motion of system from time $t_1$ to time $t_2$ is Such that :

(1) Line integral $I = \int_{t_1}^{t_2} L\, dt$ = Extremum

(2) $I = \int_{t_1}^{t_2} L\, dt = 0$

(3) $\delta I = \int_{t_1}^{t_2} L\, dt$ = Extremum

(4) None of these

**25.** Moment of inertia of solid cylinder about its axis of symmetry is equal to :

(1) $MR^2$ (2) $\frac{1}{2}MR^2$

(3) $\frac{1}{4}MR^2$ (4) $\frac{M}{l}\left[\frac{R^2}{4}\right]$

where $M$ is the total mass of cylinder, $R$ = radius and $l$ length of cylinder.

**26.** Out of infinite number of straight lines which may be drawn parallel to a given direction, the moment of inertia of the body about the one passing through its centre of gravity would be :

(1) least (2) maximum

(3) can have any value (4) None of the above

**27.** The acceleration of a body rolling down an inclined plane is given by :

(1) $\frac{g\sin\theta}{1+\frac{R^2}{K^2}}$ (2) $\frac{g\sin\theta}{\frac{R^2}{K^2}}$

(3) $\frac{g\sin\theta}{1+\frac{K^2}{R^2}}$ (4) None of the above

**28.** If $S$ is closed surface enclosing a volume V and $\hat{n}$ is the unit vector normal to the surface and $\vec{r}$ is the position vector, then the value of the integral $\iint \vec{r}.\hat{n}dS$ is :

(1) 0 (2) $V$ (3) $2V$ (4) $3V$

**29.** Consider the set of vectors $\frac{1}{\sqrt{2}}(1, 1, 0)$, $\frac{1}{\sqrt{2}}(0, 1, 1)$ and $\frac{1}{\sqrt{2}}(1, 0, 1)$ :

(1) the three vectors are orthogonal

(2) the three vectors are linearly independent

(3) the three vectors cannot form a basis in a 3-Dimensional real vector space

(4) $\frac{1}{\sqrt{2}}(1, 0, 0)$ is a linear combination of $\frac{1}{\sqrt{2}}(0, 1, 1)$ and $\frac{1}{\sqrt{2}}(1, 0, 1)$

30. Ferromagnetic domains consists of :

(1) Region in which all atoms have their magnetic moments aligned in a random manner

(2) Region in which alternate atoms have magnetic moments aligned in a direction

(3) Region in which all atoms have aligned their magnetic moments in one direction

(4) None of the above

31. Parity is ***not*** conserved in :

(1) $\alpha$-decay (2) $\beta$-decay

(3) $\gamma$-decay (4) None of the above

32. Mass of Neutron is :

(1) Equal to the mass of the electron

(2) Equal to mass of the proton

(3) Slightly greater than mass of proton

(4) Slightly less than the mass of proton

33. $\alpha$-particle are :

(1) Electromagnetic radiations

(2) Positively charged particles and have same properties as protons

(3) Helium Nuclei

(4) Negatively charged particles

34. Gamma rays are :

(1) Visible to eye

(2) Neutral particles with unitmass number

(3) Electromagnetic radiations of high frequency

(4) Like fast moving electrons

35. Stripping reactions are :

(1) Indirect reactions (2) Direct reactions

(3) Compound nuclear reactions (4) None of these

36. Whenever a charged particle passes through a medium with a velocity more than the velocity of light in that medium, the electromagnetic radiation is emitted. This radiation is called :

(1) Bremsstrahlung Radiation (2) Compton effect

(3) Cerenkor Radiation (4) Straggling Radiation

37. Which of the following accelerators cannot-accelerate protons ?

(1) Linear Accelerator (2) Betatron

(3) Cyclotron (4) Van-de Graff Generator

38. The accelerator which make use of principle of electromagnetic induction for accelerating the particles is :

(1) Van-de Graff Generator (2) Cyclotron

(3) Synchrotron (4) Betatron

39. A nuclear fusion process, a proton and a neutron combine to form a deuterium nucleus. If $m_p$ and $m_n$ denote the mass of a proton and neutron respectively, the mass of the deuterium nucleus is :

(1) Equal to $(m_p + m_n)$

(2) greater than $(m_p + m_n)$

(3) less than $(m_p + m_n)$

(4) Sometimes greater than and sometimes less than $(m_p + m_n)$

40. The process by which a heavy nucleus splits into two lighter nuclei is known as :

(1) Nuclear fission (2) Nuclear fusion

(3) Chain reaction (4) $\alpha$-decay

41. In Debye's theory of specific heat of solids, the atomic oscillators obey :

(1) MB statistics

(2) FD statistics

(3) BE statistics

(4) All of the above

42. Diamond is very hard because :

(1) It is covalent solid

(2) It has large cohesive energy

(3) It has very high melting point

(4) It is insoluble in all solvents

43. When molten Zinc is cooled to solid state it assumes hcp structure. Then the number of nearest neighbours of zinc atom would be :

(1) 4 (2) 6 (3) 8 (4) 12

44. A crystalline solid :

(1) Abruptly changes from solid to liquid when heated

(2) Has no definite melting point

(3) Undergoes deformation of its geometry easily

(4) Has an irregular 3-Dimensional arrangement

45. The crystal structure of diamond is :

(1) fcc with two atoms basis of (000) and $\frac{a}{4}(\hat{i}+\hat{j}+\hat{k})$

(2) Simple cubic with two atoms basis of (000) and $\frac{a}{2}(\hat{i}+\hat{j}+\hat{k})$

(3) fcc with two atoms basis of 0,00) and $\frac{a}{2}(\hat{i}+\hat{j}+\hat{k})$

(4) bcc with one atom basis

46. The translation vectors of space lattice are $\vec{a} = \frac{\hat{x}}{2} + \frac{\sqrt{3}}{2}\hat{y}$, $\vec{b} = -\frac{1}{2}\hat{x} + \frac{\sqrt{3}}{2}\hat{y}$ and $\vec{c} = \hat{z}$, the volume of the cell would be :

(1) $\frac{2}{\sqrt{3}}$

(2) $\frac{\sqrt{3}}{2}$

(3) $2\sqrt{3}$

(4) $3\sqrt{2}$

47. In a closed packed structure, the percentage of available volume occupied by hard spheres is nearly :

(1) 60%

(2) 90%

(3) 74%

(4) 82%

48. A cubic crystal can have :

(1) only primitive Bravais lattices

(2) any one of primitive, body centred and face centred Bravais lattices

(3) All of primitive, body centred and face centred Bravais lattices

(4) All of primitive, base centred and face centred Bravais lattices

49. The atomic specific heat of a solid is :

(1) 3R at all temperatures

(2) 3R at high temperatures and zero at low temperatures

(3) 3R at high temperatures and proportional to $T^3$ at low temperatures

(4) proportional to $T^3$ at all temperatures

**50.** The Einstein's frequency of a solid is $2.49 \times 10^{12}$ Hz. Its atomic specific heat would be 3R :

(1) at temperatures less than 120 K

(2) at temperatures higher than 120 K

(3) at 120 K

(4) Nothing can be said

**51.** Which of the following Maxwell's relation leads to Clausius-Claperyron equation ?

(1) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial V}\right)_V$

(2) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(3) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(4) $\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T$

**52.** Which of the following is ***not*** Maxwell's thermodynamics relation ?

(1) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(2) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$

(3) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(4) $\left(\frac{\partial P}{\partial V}\right)_T = \left(\frac{\partial S}{\partial T}\right)_V$

**53.** A given amount of heat cannot be completely converted into work. However it is possible to convert a given amount of work completely into heat. The statement results from the :

(1) Zeroth law of thermodynamics

(2) First law of thermodynamics

(3) Second law of thermodynamics

(4) Third law of thermodynamics

54. A physical or chemical change take place in such a way that the entropy either decreases or remains unchanged. This statement is :

(1) True universally
(2) True only for open system
(3) True only for closed system
(4) Not true

55. At absolute zero temperature for Boson gas :

(1) Entropy is zero but internal energy and pressure do not disappear
(2) Entropy and internal energy zero but pressure does not disappear
(3) Entropy, internal energy and pressure tend to zero
(4) Internal, energy, pressure zero but entropy is positive

56. FORTRAN was developed by :

(1) Google
(2) IBM
(3) Apple
(4) Black Berry

57. An identifier can not be longer than ..... characters.

(1) 30 (2) 31 (3) 25 (4) 28

58. Using Fourier series the value of $\sum_{n=1}^{\infty} \frac{1}{(2n^2-1)}$ is :

(1) $\frac{1}{2}$
(2) $\frac{\pi^2}{8}$
(3) $\frac{\pi}{8}$
(4) $\frac{\pi^2}{2}$

59. Fourier series which will represent $f(x) = x \sin x$ in the interval $-\pi < x < \pi$, then $\frac{1}{2}+\frac{1}{1.2}+\frac{1}{3.5}+\frac{1}{5.7}$..... will have value :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{8}$

**60.** The Laplace transform of $f(t) = \sin \pi t$ is $F(s) = \frac{\pi}{(s^2 + \pi^2)}$, $s > 0$. Therefore Laplace transform of $t \sin \pi t$ is :

(1) $\frac{\pi}{s^2(s^2 + \pi^2)}$ (2) $\frac{2\pi}{s^2(s^2 + \pi^2)^2}$

(3) $\frac{2\pi s}{(s^2 + \pi^2)^2}$ (4) $\frac{2\pi}{(s^2 + \pi^2)^2}$

**61.** Which one of the following pairs of phenomena illustrates particle aspect of wave-particle duality ?

(1) Compton effect and Braggs law

(2) Photoelectric effect and Compton effect

(3) Compton effect and Pauli's principle

(4) Bragg's law and photoelectric effect

**62.** The uncertainty in location of a particle is equal to De-Broglie wavelength then uncertainty in its velocity is :

(1) $v$ (2) $\frac{v}{2}$ (3) $2v$ (4) $\frac{3v}{2}$

**63.** The zero point energy of harmonic oscillator is :

(1) $\hbar w$ (2) $\frac{1}{2}\hbar w$ (3) $2\hbar w$ (4) $\frac{1}{4}\hbar w$

Where letters have their usual meanings.

**64.** Heisenberg uncertainty principle :

(1) Establishes the Bohr's orbital concept

(2) is not observable for macroscopic objects

(3) established the existence of electrons inside the nucleus

(4) does not agree with De-Broglie hypothesis

65. According to quantum mechanics, for the particle moving in a box :

(1) The energy levels are discrete and equispaced

(2) The energy levels are continuous

(3) The energy levels are descrete and not equispaced

(4) The energy is always zero

66. Given a wave with the dispersion relation $w = ck + m$ for $k > 0$ and $m > 0$, which one of the following is ***true*** ?

(1) The group velocity is greater than the phase velocity

(2) The group velocity is less than the phase velocity

(3) The group velocity is equal to the phase velocity

(4) There is no definite relation between group velocity and phase velocity

67. The degeneracy of first excited state of an isolated hydrogen atom is :

(1) 2 (2) 4 (3) 6 (4) 8

68. The ratio of electric field vector $(\vec{E})$ and magnetic field vector $(\vec{H})$ i.e. $(\vec{E}/\vec{H})$ has the dimension of :

(1) Resistance (2) Inductance

(3) Capacitance (4) Inductance X capacitance

69. The expression $|\psi(r,t)|^2$ represents :

(1) Position

(2) Position probability density

(3) Normalization

(4) Time probability density

**70.** Spin angular momentum of an electron is :

(1) always $\frac{h}{4\pi}$

(2) always $\frac{h}{2\pi}$

(3) an integral multiple of $\frac{h}{2\pi}$

(4) an half integral multiple like $\left(n+\frac{1}{2}\right)\frac{h}{2\pi}$ with '$n$' as running integer

**71.** Which of following is the spectroscopic ground state $^{2S+1}L_J$ for $M_n^{3+}$ ions of electronic configuration $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^4$ predicted by Hund's rule ?

(1) $^5D_0$ (2) $^5D_4$

(3) $^5D_3$ (4) $^5D_2$

**72.** Under LS coupling scheme, the possible spectral terms $^{2S+1}L_J$ for electronic configuration $2S$, $3S$ are :

(1) $^2S_{1/2}, {}^2P_{3/2}, {}^2P_{1/2}$ (2) $^1S_0, {}^3P_1$

(3) $^1S_0, {}^3S_1$ (4) $^3S_0, {}^3S_1$

**73.** According to Bohr's model, the value of ionization potential of $Li^{2+}$ ion is :

(1) 13.6 eV (2) 27.2 eV

(3) 40.8 eV (4) 122.4 eV

**74.** Total number of Zeeman components observed in electronic transition $^2D_{5/2} \rightarrow {}^2P_{3/2}$ of an atom in weak field is :

(1) 4 (2) 6

(3) 12 (4) 10

75. A laser beam of wavelength 600 nm with a circular cross section with a radius of 10 nm falls normally on a lens of radius 20 nm and focal length 10 cm. The radius of focused spot is approximately :

(1) 0.3 nm (2) 0.6 nm (3) 3 μm (4) 6 μm

76. The Coherence length for a laser beam of bandwidth $\Delta\nu = 3000$ Hz would be :

(1) 1 Km (2) 10 m (3) 100 Km (4) 10 Km

77. Atomic cross-section has dimension of :

(1) Length (2) Area

(3) Volume (4) None of these

78. What is 'LIDAR' ?

(1) Light Detection and Ranging

(2) Light Amplification, Detection and Ranging

(3) Light Amplification by Stimulated Emission of Radiation

(4) None of the above

79. What is stimulated emission of radiation ?

(1) Incident energy is not required for such emission

(2) Incident energy of any energy is required for such emission

(3) Incident energy equal to the difference in energies of two levels is required to trigger such emission

(4) None of these

80. In case of alkali spectra, the doublet separation :

(1) Decreases with increasing principal quantum number

(2) Increases with increasing principal quantum number

(3) Increases with increasing orbital quantum number

(4) Increases with decreasing orbital quantum number

**81.** A clock is moving with velocity $\frac{C}{3}$ (C = speed of light in vacuum). In one hour the clock appears to be slow by :

(1) 3 minutes (2) 3.4 minutes (3) 3.7 second (4) Not at all

**82.** The relativistic mass of a particle :

(1) Increases with velocity

(2) Decreases with velocity

(3) Decreases with velocity and finally becomes zero

(4) Increases or decreases with velocity and finally becomes zero

**83.** Inertial frame of reference is the one in which a free particle moves :

(1) Along a straight line with a constant speed

(2) Along a straight line with a variable speed

(3) With constant speed on a curved path

(4) With variable speed on a curved path

**84.** Which one of the following Maxwell's equations implies the absence of magnetic monopoles ?

(1) $\nabla . \vec{E} = \frac{\pi}{\epsilon_0}$ (2) $\nabla . \vec{B} = 0$

(3) $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ (4) $\nabla \times \vec{B} = \frac{1}{C^2}\frac{\partial \vec{B}}{\partial t} + \mu_0 J$

**85.** According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is :

(1) Greater than the mean velocity

(2) Equal to the mean velocity

(3) Equal to the root mean square velocity

(4) Less than the root mean square velocity

**86.** In relation to statistical mechanics, choose ***incorrect*** statement :

(1) All particles of a given kind are treated as mutually indistinguishable

(2) The phase space for $n$ degrees of freedom will have $2n$ dimensions and its unit cell volume will be $h^n$

(3) Photons may be treated as following Fermi-Dirac statistics

(4) With a system having $N = 10^{23}$ particles, probability of two halves of a box having particle density difference of 0.001% is negligibly small

**87.** The quantum statistics reduces to classical statistics under the following condition :

(1) $\rho \lambda^3 = 1$ (2) $\rho \lambda^3 >> 1$

(3) $\rho \lambda^3 << 1$ (4) $\rho = 0$

**88.** Brownian movement is due to :

(1) Bombardment of colloidal particles by molecules of dispersion medium

(2) Bombardment of molecules by colloidal particles present in dispersion medium

(3) Collision between molecules of dispersion medium

(4) None of these

**89.** Which of the following is ***not*** exact differential ?

(1) dS (2) dQ (3) dU (4) dF

**90.** If Y, K and $\sigma$ represents Young's modulus, Bulk modulus and Poisson's ratio respectively, then following equation connects them :

(1) $K = \frac{Y}{2(1-2\sigma)}$ (2) $K = \frac{Y}{2(1-3\sigma)}$

(3) $K = \frac{Y}{3(1-2\sigma)}$ (4) None of these

**91.** In F-D statistics, the volume of phase cell is :

(1) $h$ (2) $h^2$ (3) $h^3$ (4) Not fixed

**92.** The half width of Maxwell's distribution curve is approximately :

(1) $\sqrt{\frac{2KT}{m}}$ (2) $\sqrt{\frac{3KT}{2}}$ (3) $\sqrt{\frac{KT}{2m}}$ (4) $\sqrt{\frac{2KT}{3}}$

**93.** A Michelson interferometer is illuminated with monochromatic light. When one of the mirrors is moved through a distance of 25.3 μm, 92 fringes pass through cross wire. Wavelength of monochromatic light is :

(1) 500 nm (2) 550 nm (3) 600 nm (4) 650 nm

**94.** In case of diffraction at a circular aperature, if aperature of circular opening is large, radius of the first dark ring would be :

(1) small (2) large

(3) not change (4) None of the above

**95.** The resultant intensity distribution in the diffraction pattern at a single slit would be represented by :

(1) $I = I_0\left(\frac{\sin\phi}{\phi}\right)^2$ (2) $I = I_0^2\frac{\sin^2\phi}{\phi^2}$

(3) $I = I_0\frac{\sin\phi}{\phi}$ (4) None of these

**96.** In case of phase-reversal zone plate, if the even numbered half period zones are coated with the transparent material instead of darkening then the intensity would become :

(1) $4I_0$ (2) $2I_0$

(3) $I_0$ (4) $3I_0$

97. Which one of the following experiments confirms the existence of space quantization ?

(1) Double slit experiment

(2) Stern and Gerlach experiment

(3) Frank and Hertz experiment

(4) Michelson and Morley experiment

98. A plane polarized monochromatic electromagnetic wave is incident on a plane interface at the Brewester angle give rise to a reflected wave which is :

(1) partially polarized

(2) unpolarized

(3) polarized parallel to interface

(4) polarized perpendicular to the interface

99. For explaining the interference pattern due to L Loyd's mirror :

(1) Division of wavefront is made use of

(2) Division of amplitude is made use of

(3) Any of the above

(4) None of the above

100. In case of biprism, the interference pattern would have fringe width equal to :

(1) $\frac{D}{d}\lambda$ (2) $\frac{d}{D}\lambda$ (3) $\frac{D}{d\lambda}$ (4) $\frac{d\lambda}{D}$

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**D**

**SET-X**

# PG-EE-2021

## SUBJECT : Physics

10900

Sr. No. .....

Time : **1¼ Hours** Max. Marks : **100** Total Questions : **100**

Roll No. (in figures)_____ (in words)_____

Name_____ Date of Birth_____

Father's Name_____ Mother's Name_____

Date of Examination_____

_____ _____

(Signature of the Candidate) (Signature of the Invigilator)

SEAL

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6. ***There will be no negative marking. Each correct answer will be awarded one full mark. Cutting, erasing, overwriting and more than one answer in OMR Answer-Sheet will be treated as incorrect answer.***
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D

1. Which one of the following pairs of phenomena illustrates particle aspect of wave-particle duality ?

(1) Compton effect and Braggs law

(2) Photoelectric effect and Compton effect

(3) Compton effect and Pauli's principle

(4) Bragg's law and photoelectric effect

2. The uncertainty in location of a particle is equal to De-Broglie wavelength then uncertainty in its velocity is :

(1) $v$ (2) $\frac{v}{2}$ (3) $2v$ (4) $\frac{3v}{2}$

3. The zero point energy of harmonic oscillator is :

(1) $\hbar w$ (2) $\frac{1}{2}\hbar w$ (3) $2\hbar w$ (4) $\frac{1}{4}\hbar w$

Where letters have their usual meanings.

4. Heisenberg uncertainty principle :

(1) Establishes the Bohr's orbital concept

(2) is not observable for macroscopic objects

(3) established the existence of electrons inside the nucleus

(4) does not agree with De-Broglie hypothesis

5. According to quantum mechanics, for the particle moving in a box :

(1) The energy levels are discrete and equispaced

(2) The energy levels are continuous

(3) The energy levels are descrete and not equispaced

(4) The energy is always zero

6. Given a wave with the dispersion relation $w = ck + m$ for $k > 0$ and $m > 0$, which one of the following is ***true*** ?

(1) The group velocity is greater than the phase velocity

(2) The group velocity is less than the phase velocity

(3) The group velocity is equal to the phase velocity

(4) There is no definite relation between group velocity and phase velocity

7. The degeneracy of first excited state of an isolated hydrogen atom is :

(1) 2 (2) 4 (3) 6 (4) 8

8. The ratio of electric field vector $(\vec{E})$ and magnetic field vector $(\vec{H})$ i.e. $(\vec{E}/\vec{H})$ has the dimension of :

(1) Resistance (2) Inductance

(3) Capacitance (4) Inductance X capacitance

9. The expression $|\psi(r,t)|^2$ represents :

(1) Position (2) Position probability density

(3) Normalization (4) Time probability density

10. Spin angular momentum of an electron is :

(1) always $\frac{h}{4\pi}$

(2) always $\frac{h}{2\pi}$

(3) an integral multiple of $\frac{h}{2\pi}$

(4) an half integral multiple like $\left(n+\frac{1}{2}\right)\frac{h}{2\pi}$ with '$n$' as running integer

**11.** In F-D statistics, the volume of phase cell is :

(1) $h$ (2) $h^2$ (3) $h^3$ (4) Not fixed

**12.** The half width of Maxwell's distribution curve is approximately :

(1) $\sqrt{\frac{2KT}{m}}$ (2) $\sqrt{\frac{3KT}{2}}$ (3) $\sqrt{\frac{KT}{2m}}$ (4) $\sqrt{\frac{2KT}{3}}$

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(1) $I = I_0\left(\frac{\sin\phi}{\phi}\right)^2$ (2) $I = I_0^2\frac{\sin^2\phi}{\phi^2}$

(3) $I = I_0\frac{\sin\phi}{\phi}$ (4) None of these

**16.** In case of phase-reversal zone plate, if the even numbered half period zones are coated with the transparent material instead of darkening then the intensity would become :

(1) $4I_0$ (2) $2I_0$

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17. Which one of the following experiments confirms the existence of space quantization ?

(1) Double slit experiment

(2) Stern and Gerlach experiment

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(4) Michelson and Morley experiment

18. A plane polarized monochromatic electromagnetic wave is incident on a plane interface at the Brewester angle give rise to a reflected wave which is :

(1) partially polarized

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(3) polarized parallel to interface

(4) polarized perpendicular to the interface

19. For explaining the interference pattern due to L Loyd's mirror :

(1) Division of wavefront is made use of

(2) Division of amplitude is made use of

(3) Any of the above

(4) None of the above

20. In case of biprism, the interference pattern would have fringe width equal to :

(1) $\frac{D}{d}\lambda$ (2) $\frac{d}{D}\lambda$ (3) $\frac{D}{d\lambda}$ (4) $\frac{d\lambda}{D}$

21. Which of the following Maxwell's relation leads to Clausius-Claperyron equation ?

(1) $\left(\frac{\partial T}{\partial V}\right)_S = -\left(\frac{\partial P}{\partial V}\right)_V$ (2) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(3) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$ (4) $\left(\frac{\partial V}{\partial T}\right)_P = -\left(\frac{\partial S}{\partial P}\right)_T$

22. Which of the following is ***not*** Maxwell's thermodynamics relation ?

(1) $\left(\frac{\partial S}{\partial V}\right)_T = \left(\frac{\partial P}{\partial T}\right)_V$

(2) $\left(\frac{\partial S}{\partial P}\right)_T = -\left(\frac{\partial V}{\partial T}\right)_P$

(3) $\left(\frac{\partial T}{\partial P}\right)_S = \left(\frac{\partial V}{\partial S}\right)_P$

(4) $\left(\frac{\partial P}{\partial V}\right)_T = \left(\frac{\partial S}{\partial T}\right)_V$

23. A given amount of heat cannot be completely converted into work. However it is possible to convert a given amount of work completely into heat. The statement results from the :

(1) Zeroth law of thermodynamics

(2) First law of thermodynamics

(3) Second law of thermodynamics

(4) Third law of thermodynamics

24. A physical or chemical change take place in such a way that the entropy either decreases or remains unchanged. This statement is :

(1) True universally

(2) True only for open system

(3) True only for closed system

(4) Not true

25. At absolute zero temperature for Boson gas :

(1) Entropy is zero but internal energy and pressure do not disappear

(2) Entropy and internal energy zero but pressure does not disappear

(3) Entropy, internal energy and pressure tend to zero

(4) Internal, energy, pressure zero but entropy is positive

26. FORTRAN was developed by :

(1) Google

(2) IBM

(3) Apple

(4) Black Berry

27. An identifier can not be longer than ..... characters.

(1) 30 (2) 31 (3) 25 (4) 28

28. Using Fourier series the value of $\sum_{n=1}^{\infty} \frac{1}{(2n^2-1)}$ is :

(1) $\frac{1}{2}$ (2) $\frac{\pi^2}{8}$ (3) $\frac{\pi}{8}$ (4) $\frac{\pi^2}{2}$

29. Fourier series which will represent $f(x) = x \sin x$ in the interval $-\pi < x < \pi$, then $\frac{1}{2}+\frac{1}{1.2}+\frac{1}{3.5}+\frac{1}{5.7}$..... will have value :

(1) $\frac{\pi}{2}$ (2) $\frac{\pi}{4}$ (3) $\frac{\pi}{6}$ (4) $\frac{\pi}{8}$

30. The Laplace transform of $f(t) = \sin \pi t$ is $F(s) = \frac{\pi}{(s^2+\pi^2)}$, $s > 0$. Therefore Laplace transform of $t \sin \pi t$ is :

(1) $\frac{\pi}{s^2(s^2+\pi^2)}$ (2) $\frac{2\pi}{s^2(s^2+\pi^2)^2}$ (3) $\frac{2\pi s}{(s^2+\pi^2)^2}$ (4) $\frac{2\pi}{(s^2+\pi^2)^2}$

31. A clock is moving with velocity $\frac{C}{3}$ (C = speed of light in vacuum). In one hour the clock appears to be slow by :

(1) 3 minutes (2) 3.4 minutes (3) 3.7 second (4) Not at all

32. The relativistic mass of a particle :

(1) Increases with velocity

(2) Decreases with velocity

(3) Decreases with velocity and finally becomes zero

(4) Increases or decreases with velocity and finally becomes zero

33. Inertial frame of reference is the one in which a free particle moves :

(1) Along a straight line with a constant speed

(2) Along a straight line with a variable speed

(3) With constant speed on a curved path

(4) With variable speed on a curved path

34. Which one of the following Maxwell's equations implies the absence of magnetic monopoles ?

(1) $\nabla . \vec{E} = \frac{\pi}{\epsilon_0}$ (2) $\nabla . \vec{B} = 0$

(3) $\nabla \times \vec{E} = -\frac{\partial \vec{B}}{\partial t}$ (4) $\nabla \times \vec{B} = \frac{1}{C^2}\frac{\partial \vec{B}}{\partial t} + \mu_0 J$

35. According to Maxwell's law of distribution of velocities of molecules, the most probable velocity is :

(1) Greater than the mean velocity

(2) Equal to the mean velocity

(3) Equal to the root mean square velocity

(4) Less than the root mean square velocity

36. In relation to statistical mechanics, choose ***incorrect*** statement :

(1) All particles of a given kind are treated as mutually indistinguishable

(2) The phase space for $n$ degrees of freedom will have $2n$ dimensions and its unit cell volume will be $h^n$

(3) Photons may be treated as following Fermi-Dirac statistics

(4) With a system having $N = 10^{23}$ particles, probability of two halves of a box having particle density difference of 0.001% is negligibly small

37. The quantum statistics reduces to classical statistics under the following condition :

(1) $\rho \lambda^3 = 1$ (2) $\rho \lambda^3 >> 1$

(3) $\rho \lambda^3 << 1$ (4) $\rho = 0$

38. Brownian movement is due to :

(1) Bombardment of colloidal particles by molecules of dispersion medium

(2) Bombardment of molecules by colloidal particles present in dispersion medium

(3) Collision between molecules of dispersion medium

(4) None of these

39. Which of the following is ***not*** exact differential ?

(1) dS (2) dQ (3) dU (4) dF

40. If Y, K and $\sigma$ represents Young's modulus, Bulk modulus and Poisson's ratio respectively, then following equation connects them :

(1) $K = \frac{Y}{2(1-2\sigma)}$ (2) $K = \frac{Y}{2(1-3\sigma)}$

(3) $K = \frac{Y}{3(1-2\sigma)}$ (4) None of these

41. Parity is ***not*** conserved in :

(1) $\alpha$-decay (2) $\beta$-decay (3) $\gamma$-decay (4) None of the above

42. Mass of Neutron is :

(1) Equal to the mass of the electron

(2) Equal to mass of the proton

(3) Slightly greater than mass of proton

(4) Slightly less than the mass of proton

43. $\alpha$-particle are :

(1) Electromagnetic radiations

(2) Positively charged particles and have same properties as protons

(3) Helium Nuclei

(4) Negatively charged particles

44. Gamma rays are :

(1) Visible to eye

(2) Neutral particles with unitmass number

(3) Electromagnetic radiations of high frequency

(4) Like fast moving electrons

45. Stripping reactions are :

(1) Indirect reactions (2) Direct reactions

(3) Compound nuclear reactions (4) None of these

46. Whenever a charged particle passes through a medium with a velocity more than the velocity of light in that medium, the electromagnetic radiation is emitted. This radiation is called :

(1) Bremsstrahlung Radiation (2) Compton effect

(3) Cerenkor Radiation (4) Straggling Radiation

47. Which of the following accelerators cannot-accelerate protons ?

(1) Linear Accelerator (2) Betatron

(3) Cyclotron (4) Van-de Graff Generator

48. The accelerator which make use of principle of electromagnetic induction for accelerating the particles is :

(1) Van-de Graff Generator (2) Cyclotron

(3) Synchrotron (4) Betatron

49. A nuclear fusion process, a proton and a neutron combine to form a deuterium nucleus. If $m_p$ and $m_n$ denote the mass of a proton and neutron respectively, the mass of the deuterium nucleus is :

(1) Equal to $(m_p + m_n)$

(2) greater than $(m_p + m_n)$

(3) less than $(m_p + m_n)$

(4) Sometimes greater than and sometimes less than $(m_p + m_n)$

50. The process by which a heavy nucleus splits into two lighter nuclei is known as :

(1) Nuclear fission (2) Nuclear fusion

(3) Chain reaction (4) $\alpha$-decay

51. In Debye's theory of specific heat of solids, the atomic oscillators obey :

(1) MB statistics (2) FD statistics

(3) BE statistics (4) All of the above

52. Diamond is very hard because :

(1) It is covalent solid

(2) It has large cohesive energy

(3) It has very high melting point

(4) It is insoluble in all solvents

53. When molten Zinc is cooled to solid state it assumes hcp structure. Then the number of nearest neighbours of zinc atom would be :

(1) 4 (2) 6 (3) 8 (4) 12

54. A crystalline solid :

(1) Abruptly changes from solid to liquid when heated

(2) Has no definite melting point

(3) Undergoes deformation of its geometry easily

(4) Has an irregular 3-Dimensional arrangement

55. The crystal structure of diamond is :

(1) fcc with two atoms basis of (000) and $\frac{a}{4}(\hat{i}+\hat{j}+\hat{k})$

(2) Simple cubic with two atoms basis of (000) and $\frac{a}{2}(\hat{i}+\hat{j}+\hat{k})$

(3) fcc with two atoms basis of 0,00) and $\frac{a}{2}(\hat{i}+\hat{j}+\hat{k})$

(4) bcc with one atom basis

56. The translation vectors of space lattice are $\vec{a}=\frac{\hat{x}}{2}+\frac{\sqrt{3}}{2}\hat{y}$, $\vec{b}=-\frac{1}{2}\hat{x}+\frac{\sqrt{3}}{2}\hat{y}$ and $\vec{c}=\hat{z}$, the volume of the cell would be :

(1) $\frac{2}{\sqrt{3}}$ (2) $\frac{\sqrt{3}}{2}$

(3) $2\sqrt{3}$ (4) $3\sqrt{2}$

57. In a closed packed structure, the percentage of available volume occupied by hard spheres is nearly :

(1) 60% (2) 90% (3) 74% (4) 82%

58. A cubic crystal can have :

(1) only primitive Bravais lattices

(2) any one of primitive, body centred and face centred Bravais lattices

(3) All of primitive, body centred and face centred Bravais lattices

(4) All of primitive, base centred and face centred Bravais lattices

59. The atomic specific heat of a solid is :

(1) 3R at all temperatures

(2) 3R at high temperatures and zero at low temperatures

(3) 3R at high temperatures and proportional to $T^3$ at low temperatures

(4) proportional to $T^3$ at all temperatures

60. The Einstein's frequency of a solid is $2.49 \times 10^{12}$ Hz. Its atomic specific heat would be 3R :

(1) at temperatures less than 120 K

(2) at temperatures higher than 120 K

(3) at 120 K

(4) Nothing can be said

61. Which of following is the spectroscopic ground state $^{2S+1}L_J$ for $M_n^{3+}$ ions of electronic configuration $1s^2\,2s^2\,2p^6\,3s^2\,3p^6\,3d^4$ predicted by Hund's rule ?

(1) $^5D_0$ (2) $^5D_4$ (3) $^5D_3$ (4) $^5D_2$

62. Under LS coupling scheme, the possible spectral terms $^{2S+1}L_J$ for electronic configuration $2S$, $3S$ are :

(1) $^2S_{1/2}, {}^2P_{3/2}, {}^2P_{1/2}$ (2) $^1S_0, {}^3P_1$

(3) $^1S_0, {}^3S_1$ (4) $^3S_0, {}^3S_1$

63. According to Bohr's model, the value of ionization potential of $Li^{2+}$ ion is :

(1) 13.6 eV (2) 27.2 eV

(3) 40.8 eV (4) 122.4 eV

64. Total number of Zeeman components observed in electronic transition $^2D_{5/2} \rightarrow {}^2P_{3/2}$ of an atom in weak field is :

(1) 4 (2) 6 (3) 12 (4) 10

65. A laser beam of wavelength 600 nm with a circular cross section with a radius of 10 nm falls normally on a lens of radius 20 nm and focal length 10 cm. The radius of focused spot is approximately :

(1) 0.3 nm (2) 0.6 nm

(3) 3 μm (4) 6 μm

66. The Coherence length for a laser beam of bandwidth $\Delta\nu = 3000$ Hz would be :

(1) 1 Km (2) 10 m

(3) 100 Km (4) 10 Km

67. Atomic cross-section has dimension of :

(1) Length (2) Area

(3) Volume (4) None of these

68. What is 'LIDAR' ?

(1) Light Detection and Ranging

(2) Light Amplification, Detection and Ranging

(3) Light Amplification by Stimulated Emission of Radiation

(4) None of the above

69. What is stimulated emission of radiation ?

(1) Incident energy is not required for such emission

(2) Incident energy of any energy is required for such emission

(3) Incident energy equal to the difference in energies of two levels is required to trigger such emission

(4) None of these

**70.** In case of alkali spectra, the doublet separation :

(1) Decreases with increasing principal quantum number

(2) Increases with increasing principal quantum number

(3) Increases with increasing orbital quantum number

(4) Increases with decreasing orbital quantum number

**71.** Fourier transform of which of the following function does not exist ?

(1) $e^{-|x|}$ (2) $xe^{-x^2}$

(3) $e^{x^2}$ (4) $e^{-x^2}$

**72.** The electromagnetic theory suggests than the electric vector in the wave suffers a sudden phase change of $\pi$ on reflection from the plane reflecting surface but magnetic vector suffers :

(1) a phase change of $\pi$ (2) a phase change of $2\pi$

(3) a phase change of $\frac{\pi}{2}$ (4) no phase change

**73.** The path difference between the rays reflected from the top and bottom of the film is :

(1) $\mu t \cos r$ (2) $\mu t \sin r$

(3) $2\mu t \cos r$ (4) $2\mu t \sin r$

**74.** Two independent sources can not be coherent because :

(1) They emit light of same frequency

(2) They emit light of almost equal amplitudes

(3) They do not emit light in phase with each other or constant phase difference between them

(4) None of the above

**75.** Consider Fermi-Dirac distribution function $f(E)$ at room temperature where E refers to energy. If $E_F$ is the Fermi energy which of following is true ?

(1) $f(E)$ is a step function

(2) $f(E_F)$ has a value of $\frac{1}{2}$

(3) states with $E < E_F$ are filled completely

(4) $f(E)$ is large and tends to infinity as E decreases below $E_F$

**76.** Condition for statistical equilibrium is :

(1) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = 0$ (2) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} \neq 0$

(3) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = 1$ (4) $\left(\frac{\partial \rho}{\partial t}\right)_{q,p} = -1$

**77.** In case of Bose-Einstein condensation :

(1) Number of particles increases in lower energy levels at low temperatures and high pressure

(2) Number of particles decreases in lower energy levels at low temperatures and high pressure

(3) Number of particles increases in lower energy levels at high temperatures and low pressure

(4) Number of particles decreases in lower energy levels at high temperatures and low pressure

**78.** Choose the ***correct*** statement :

At the same temperature

(1) A Fermion gas will exert the greatest pressure

(2) A Boson gas will exert the greatest pressure

(3) A Fermion gas will exert the least pressure

(4) A Boson gas will exert the pressure more than the Fermion gas

79. Choose the ***correct*** statement :

(1) Internal energy of a Vander Waal's gas at a given temperature increases as the volume increases

(2) Internal energy of a perfect gas at a given temperature increases as the volume increases

(3) Internal energy of a Fermi gas at a given temperature increases as the volume increases

(4) Internal energy of a Fermi gas at a given temperature decreases as the volume increases

80. The specific heat of an ideal Fermi gas in 3-Dimensions at very low temperature (T) varies as :

(1) $T$ (2) $T^2$ (3) $T^3$ (4) $T^{3/2}$

81. Young's modulus is defined as :

(1) Change in volume per unit volume

(2) Ratio of tangential strain to shearing strain

(3) Ratio of stress to longitudinal strain within elastic limits

(4) None of these

82. The relation between restoring couple and bending couple, both act in opposite direction, in relation to a metallic strip bent into arc of a circle of small curvature :

(1) Restoring couple < Bending couple

(2) Restoring couple > Bending couple

(3) Restoring couple = Bending couple

(4) None of these

**83.** In case of heavy dopping, the concentration of impurity is 1 in $10^6$ atoms. If the total number of atoms is $10^{24}$ atoms the number of impurity atoms would be :

(1) 4 (2) $10^{18}$

(3) $4 < N < 10^{18}$ (4) None of the above

**84.** In case of pnp transistor, the current carried by carriers outside the transistor would be :

(1) Holes (2) Electrons

(3) Any electrons/Holes (4) None of these

**85.** For a common base configuration of pnp transistor $\frac{I_C}{I_E} = 0.96$. The maximum current gain in common emitter configuration will be :

(1) 12 (2) 6 (3) 5 (4) 24

**86.** How many free-electrons does a p-type semiconductor contains ?

(1) Many

(2) None

(3) Only those produced by thermal energy

(4) Same number as Holes

**87.** What happens when forward bias is applied to a junction diode ?

(1) Potential barrier is decreased

(2) Potential barrier is increased

(3) Majority charge carrier current is reduced to zero

(4) Minority charge carrier current is reduced to zero

**88.** Which of the following is always used in forward bias arrangement ?

(1) LED (2) Zener diode

(3) Photodiode (4) Varactor diode

89. The value of hybrid parameters depend upon :

(1) Position of Q-point (2) Temperature

(3) Both of the above (4) None of the above

90. In an RC-coupled amplifier, the dc component is blocked by :

(1) Transistor (2) Load resistance

(3) Stray capacitances (4) Coupling capacitor

91. Law of Conservation of total angular momentum states that :

(1) If the total applied (External) torque is zero, total angular momentum is conserved

(2) If the total applied (External) force is zero, total angular momentum is conserved

(3) If the system is in equilibrium, the total angular momentum is conserved

(4) If the system is not in equilibrium, the total angular momentum is conserved

92. Centre of mass of a system of two particles of masses $m_1$ and $m_2$ is defined as :

(1) $\frac{1}{\mu} = \frac{1}{m_1} + \frac{1}{m_2}$

(2) $m = m_1 + m_2$

(3) $\mu = \frac{m_1 + m_2}{m_1 m_2}$

(4) The point whose radius vector $\vec{R}$ is given by $R = \frac{m_1 \vec{r_1} + m_2 \vec{r_2}}{m_1 + m_2}$ where $\vec{r_1}$ and $\vec{r_2}$ are radius vectors of particles of masses $m_1$ and $m_2$ respectively

**93.** Lagrange's equation of motion are :

(1) $\frac{d}{dt}\left(\frac{\partial L}{\partial \dot{q}_j}\right)-\frac{\partial L}{\partial q_j}=0$ (2) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right)-\frac{\partial L}{\partial q_j}=0$

(3) $\frac{d^2}{dt^2}\left(\frac{\partial L}{\partial q_j}\right)-\frac{\partial L}{\partial q_j}=0$ (4) $\frac{d}{dt}\left(\frac{\partial L}{\partial q_j}\right)-\frac{\partial L}{\partial \dot{q}_j}=0$

where $j = 1, 2, 3, \ldots..$

**94.** According to Hamilton's principle, the motion of system from time $t_1$ to time $t_2$ is Such that :

(1) Line integral $I = \int_{t_1}^{t_2} L\, dt$ = Extremum

(2) $I = \int_{t_1}^{t_2} L\, dt = 0$

(3) $\delta I = \int_{t_1}^{t_2} L\, dt$ = Extremum

(4) None of these

**95.** Moment of inertia of solid cylinder about its axis of symmetry is equal to :

(1) $MR^2$ (2) $\frac{1}{2}MR^2$ (3) $\frac{1}{4}MR^2$ (4) $\frac{M}{l}\left[\frac{R^2}{4}\right]$

where $M$ is the total mass of cylinder, $R$ = radius and $l$ length of cylinder.

**96.** Out of infinite number of straight lines which may be drawn parallel to a given direction, the moment of inertia of the body about the one passing through its centre of gravity would be :

(1) least (2) maximum

(3) can have any value (4) None of the above

97. The acceleration of a body rolling down an inclined plane is given by :

(1) $\dfrac{g\sin\theta}{1+\dfrac{R^2}{K^2}}$

(2) $\dfrac{g\sin\theta}{\dfrac{R^2}{K^2}}$

(3) $\dfrac{g\sin\theta}{1+\dfrac{K^2}{R^2}}$

(4) None of the above

98. If $S$ is closed surface enclosing a volume V and $\hat{n}$ is the unit vector normal to the surface and $\vec{r}$ is the position vector, then the value of the integral $\iint \vec{r}\,.\,\hat{n}dS$ is :

(1) 0 (2) $V$ (3) $2V$ (4) $3\,V$

99. Consider the set of vectors $\frac{1}{\sqrt{2}}(1, 1, 0)$, $\frac{1}{\sqrt{2}}(0, 1, 1)$ and $\frac{1}{\sqrt{2}}(1, 0, 1)$ :

(1) the three vectors are orthogonal

(2) the three vectors are linearly independent

(3) the three vectors cannot form a basis in a 3-Dimensional real vector space

(4) $\frac{1}{\sqrt{2}}(1, 0, 0)$ is a linear combination of $\frac{1}{\sqrt{2}}(0, 1, 1)$ and $\frac{1}{\sqrt{2}}(1, 0, 1)$

100. Ferromagnetic domains consists of :

(1) Region in which all atoms have their magnetic moments aligned in a random manner

(2) Region in which alternate atoms have magnetic moments aligned in a direction

(3) Region in which all atoms have aligned their magnetic moments in one direction

(4) None of the above

| Answer Key of M.Sc. Physics Entrance Test held on 22.09.2021 at 3.00 to 4.15 P.M | | | | |
|---|---|---|---|---|
| Question | A | B | C | D |
| 1 | 1 | 2 | 3 | 2 |
| 2 | 4 | 1 | 4 | 1 |
| 3 | 1 | 1 | 3 | 2 |
| 4 | 1 | 2 | 3 | 1 |
| 5 | 2 | 4 | 2 | 3 |
| 6 | 1 | 3 | 1 | 2 |
| 7 | 3 | 3 | 1 | 2 |
| 8 | 4 | 1 | 1 | 1 |
| 9 | 2 | 2 | 4 | 2 |
| 10 | 3 | 3 | 1 | 1 |
| 11 | 2 | 2 | 3 | 3 |
| 12 | 1 | 3 | 3 | 1 |
| 13 | 1 | 3 | 2 | 2 |
| 14 | 2 | 3 | 2 | 1 |
| 15 | 4 | 2 | 4 | 1 |
| 16 | 3 | 3 | 3 | 1 |
| 17 | 3 | 2 | 1 | 2 |
| 18 | 1 | 4 | 1 | 4 |
| 19 | 2 | 3 | 3 | 1 |
| 20 | 3 | 1 | 4 | 1 |
| 21 | 3 | 2 | 1 | 2 |
| 22 | 3 | 1 | 4 | 4 |
| 23 | 2 | 2 | 1 | 3 |
| 24 | 2 | 1 | 1 | 4 |
| 25 | 4 | 3 | 2 | 1 |
| 26 | 3 | 2 | 1 | 2 |
| 27 | 1 | 2 | 3 | 2 |
| 28 | 1 | 1 | 4 | 2 |
| 29 | 3 | 2 | 2 | 2 |
| 30 | 4 | 1 | 3 | 3 |
| 31 | 2 | 3 | 2 | 2 |
| 32 | 4 | 1 | 3 | 1 |
| 33 | 3 | 2 | 3 | 1 |
| 34 | 4 | 1 | 3 | 2 |
| 35 | 1 | 1 | 2 | 4 |
| 36 | 2 | 1 | 3 | 3 |
| 37 | 2 | 2 | 2 | 3 |
| 38 | 2 | 4 | 4 | 1 |
| 39 | 2 | 1 | 3 | 2 |
| 40 | 3 | 1 | 1 | 3 |
| 41 | 3 | 2 | 1 | 2 |
| 42 | 4 | 4 | 2 | 3 |
| 43 | 3 | 3 | 4 | 3 |
| 44 | 3 | 4 | 1 | 3 |
| 45 | 2 | 1 | 1 | 2 |
| 46 | 1 | 2 | 2 | 3 |
| 47 | 1 | 2 | 3 | 2 |
| 48 | 1 | 2 | 3 | 4 |
| 49 | 4 | 2 | 3 | 3 |
| 50 | 1 | 3 | 2 | 1 |

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| Answer Key of M.Sc. Physics Entrance Test held on 22.09.2021 at 3.00 to 4.15 P.M | | | | |
|---|---|---|---|---|
| Question | A | B | C | D |
| 51 | 3 | 3 | 2 | 1 |
| 52 | 1 | 3 | 4 | 2 |
| 53 | 2 | 2 | 3 | 4 |
| 54 | 1 | 2 | 4 | 1 |
| 55 | 1 | 4 | 1 | 1 |
| 56 | 1 | 3 | 2 | 2 |
| 57 | 2 | 1 | 2 | 3 |
| 58 | 4 | 1 | 2 | 3 |
| 59 | 1 | 3 | 2 | 3 |
| 60 | 1 | 4 | 3 | 2 |
| 61 | 1 | 3 | 2 | 1 |
| 62 | 2 | 4 | 1 | 3 |
| 63 | 4 | 3 | 2 | 4 |
| 64 | 1 | 3 | 1 | 3 |
| 65 | 1 | 2 | 3 | 4 |
| 66 | 2 | 1 | 2 | 3 |
| 67 | 3 | 1 | 2 | 2 |
| 68 | 3 | 1 | 1 | 1 |
| 69 | 3 | 4 | 2 | 3 |
| 70 | 2 | 1 | 1 | 1 |
| 71 | 2 | 1 | 1 | 3 |
| 72 | 1 | 2 | 3 | 4 |
| 73 | 2 | 4 | 4 | 3 |
| 74 | 1 | 1 | 3 | 3 |
| 75 | 3 | 1 | 4 | 2 |
| 76 | 2 | 2 | 3 | 1 |
| 77 | 2 | 3 | 2 | 1 |
| 78 | 1 | 3 | 1 | 1 |
| 79 | 2 | 3 | 3 | 4 |
| 80 | 1 | 2 | 1 | 1 |
| 81 | 1 | 1 | 2 | 3 |
| 82 | 3 | 4 | 1 | 3 |
| 83 | 4 | 1 | 1 | 2 |
| 84 | 3 | 1 | 2 | 2 |
| 85 | 4 | 2 | 4 | 4 |
| 86 | 3 | 1 | 3 | 3 |
| 87 | 2 | 3 | 3 | 1 |
| 88 | 1 | 4 | 1 | 1 |
| 89 | 3 | 2 | 2 | 3 |
| 90 | 1 | 3 | 3 | 4 |
| 91 | 2 | 1 | 3 | 1 |
| 92 | 3 | 3 | 1 | 4 |
| 93 | 3 | 4 | 2 | 1 |
| 94 | 3 | 3 | 1 | 1 |
| 95 | 2 | 4 | 1 | 2 |
| 96 | 3 | 3 | 1 | 1 |
| 97 | 2 | 2 | 2 | 3 |
| 98 | 4 | 1 | 4 | 4 |
| 99 | 3 | 3 | 1 | 2 |
| 100 | 1 | 1 | 1 | 3 |

22/09/2021.

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Sajjan 22/09/2021

Rajesh Punia 22/09/21

22/9/2021