> | Code No. | $\mathrm{T}-2127$ |
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## Entrance Examination for Admission to the P.G. Courses in the Teaching Departments, 2024

CSS
PHYSICS WITH SPECIALIZATION IN SPACE PHYSICS / APPLIED ELECTRONICS / RENEWABLE ENERGY / NANO SCIENCE


1. The Question Paper is having 100 Objective Questions, each carrying one mark.
2. The answers are to be $(\checkmark)$ 'tick marked' only in the "Response Sheet" provided.
3. Negative marking : $\mathbf{0 . 2 5}$ marks will be deducted for each wrong answer .

Time : 2 Hours
Max. Marks : 100
To be filled in by the Candidate

| Register <br> Number | in Figures |  |  |  |  |  |  |  |  |
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|  | in words |  |  |  |  |  |  |  |  |

Choose appropriate answer from the options in the questions.
(100 $\times 1$ = 100 marks)

1. In an optic fiber the propagation angle of light must be equal to or less than the
A. Acceptance angle
B. Incident angle
C. Critical angle
D. Refraction angle

2. What is the absorption phenomenon related to the $X$ ray region of electromagnetic spectrum?
A. Valence electron transitions
B. Innercore electron transitions
C. Rotational transitions
D. Vibrational transitions
3. Intermodal dispersion results from the fact that the light waves propagate through a fiber in
A. Different modes
B. Along different routes
C. As a group of velocities
D. With same velocities
4. Which of the following statements is NOT correct?
A. A deuteron can be disintegrated by irradiating it with gamma rays of energy 4 MeV .
B. A deuteron has no excited states.
C. A deuteron has no electric quadrupole moment.
D. The ${ }^{1} S_{0}$ state of deuteron cannot be formed.
5. Which of the following statements is correct about the shear stress distribution in circular pipes with laminar flow?
A. It is linear with maximum value at the centre
B. It is parabolic with zero value at the centre
C. It is linear with zero value at the centre
D. It is parabolic with maximum value at the centre
6. An XOR gate produces an output only when its two inputs are
A. High
B. Low
C. Different
D. Same
7. Race around condition can be avoided in digital logic circuits by using which of the following?
A. Shift register
B. Master slave JK flip flop
C. RS flip flop
D. AND gate
8. How many address lines are needed to address each machine location in a $2048 \times 4$ memory chip?
A. 8
B. 9
C. 10
D. 11
9. When a beam of ordinary white light is passed through a Polaroid plate filter, the intensity of the beam that emerges is:
A. About one-half that of the incident beam
B. Equal to that of the incident beam
C. About 0.9 that of the incident beam
D. Practically zero
10. X-ray of wavelength $\lambda=a$ is reflected from the (111) plane of a simple cubic lattice. If the lattice constant is a , the corresponding Bragg angle (in radian) is
A. $\frac{\pi}{8}$
B. $\frac{\pi}{6}$
C. $\frac{\pi}{4}$
D. $\frac{\pi}{3}$
11. In the nuclear shell model the spin parity of ${ }_{7}^{15} N$ is given by
A. $\left(\frac{1}{2}\right)^{-}$
B. $\left(\frac{1}{2}\right)^{+}$
C. $\left(\frac{3}{2}\right)^{-}$
D. $\left(\frac{3}{2}\right)^{+}$
12. Hologram is the result of
A. interference of object and reference beam
B. polarization of object and reference beam
C. diffraction of object and reference beam
D. both polarization and diffraction of object and reference beam
13. A radioactive element $X$ has a half-life of 30 hours. It decays via alpha, beta and gamma emissions with the branching ratio for beta decay being 0.75 . The partial half-life for beta decay in unit of hours is
A. 12
B. 25
C. 32
D. 40
14. Which one of the following conservation laws is violated in the decay $\tau^{+} \longrightarrow \mu^{+} \mu^{+} \mu^{-}$
A. Angular momentum
B. Total Lepton number
C. Tau number
D. Electric charge
15. Which among the following lasers has a quasi 3 level system?
A. Ruby laser
B. He Ne laser
C. Ar laser
D. Yb: YAG laser
16. The isospin and the strangeness of $\Omega^{-}$baryon are
A. $1,-3$
B. $0,-3$
C. 1,3
D. 0,3
17. Which of the following acts as quenching gas in Geiger Muller counter?
A. Alcohol
B. Argon gas
C. Krypton
D. Hydrogen
18. An electron is accelerated using a cyclotron. If the magnetic field is 1.5 T and the radius of the "Dees" is 1.2 m , what is the kinetic energy of the outgoing particle?
A. $\quad 543 \mathrm{MeV}$
B. $\quad 333 \mathrm{MeV}$
C. 512 MeV
D. 674 MeV
19. The conventional unit cell of BCC has a volume $a^{3}$. The volume of its primitive unit cell is
A. $a^{3}$
B. $a^{3} / 2$
C. $a^{3} / 4$
D. $a^{3} / 8$
20. The dual of the statement $(A+1)=1$ is
A. $\quad \mathrm{A} .1=\mathrm{A}$
B. $\mathrm{A} \cdot 0=0$
C. $A+A=A$
D. $A \cdot A=1$
21. The difference between the field necessary for resonance in the sample and in some arbitrary a chosen compound is which of the following?
A. Field shift
B. Matrix effects
C. Chemical shift
D. Resonance shift
22. A polarizer and analyzer are oriented so that the amount of transmitted light is maximum. Through what angle should either be the turned so that the intensity transmitted light is reduced to 0.25 time maximum intensity
A. $90^{\circ}$
B. $60^{\circ}$
C. $45^{\circ}$
D. $30^{\circ}$
23. For a two-dimensional free electron gas, the electronic density n and the Fermi energy $\mathrm{E}_{\mathrm{F}}$, are related by
A. $\frac{m E_{F}}{\pi \hbar^{2}}$
B. $\frac{m E_{F}}{2 \pi \hbar^{2}}$
C. $\frac{\left(m E_{F}\right)^{3}}{2 \pi \hbar^{2}}$
D. $\frac{\left(m E_{F}\right)^{1 / 3}}{2 \pi \hbar^{2}}$
24. For a three-dimensional crystal having $N$ primitive unit cells with a basis of $p$ atoms, the number of optical branches is
A. 3
B. $3 p$
C. $3 \mathrm{p}-3$
D. $3 \mathrm{~N}-3 \mathrm{p}$
25. Computers with 80286 microprocessor is
A. XT computer
B. AT computers
C. PS/2 computer
D. None of above
26. The semi-empirical mass formula for the binding energy of nucleus contains a surface correction term. This term depends on the mass number $A$ of the nucleus as
A. A
B. $A^{1 / 3}$
C. $\mathrm{A}^{-1 / 3}$
D. $A^{2 / 3}$
27. In order to estimate the specific heat of phonons, the appropriate method to apply would be
A. Einstein model for acoustic phonons and Debye model for optical phonons
B. Einstein model for optical phonons and Debye model for acoustic phonons
C. Einstein model for both optical and acoustic phonons
D. Debye model for both optical and acoustic phonons
28. A Ge semiconductor is doped with acceptor impurity concentration of $10^{15}$ atoms $/ \mathrm{cm}^{3}$. For the given hole mobility of $1800 \mathrm{~cm}^{2} / \mathrm{V}-\mathrm{s}$, the resistivity of the material is
A. $0.288 \Omega \mathrm{~cm}$
B. $\quad 0.732 \Omega \mathrm{~cm}$
C. $3.472 \Omega \mathrm{~cm}$
D. $6.944 \Omega \mathrm{~cm}$
29. The amount of energy available in radio frequency radiation is sufficient for which of the following
A. Excite an atom
B. Vibrate an atom
C. Vibrate a molecule
D. Affect the nuclear spin of an atom
30. Which statement is incorrect?
A. The thermodynamic symbol for entropy is $S$.
B. Gibbs free energy is a state function.
C. For an endothermic process, H is negative.
D. If the work done by the system is greater than the heat absorbed by the system, $E$ is negative.
31. A particle of mass $m$ is confined in a two dimensional square well potential of dimension a. This potential $V(x, y)$ is given by
$V(x, y)=0$ for $-a<x<a$ and $-a<y<a$
$=\infty$ elsewhere
The energy of the first excited state for this particle is given by
A. $\frac{\pi^{2} \hbar^{2}}{m a^{2}}$
B. $\frac{2 \pi^{2} \hbar^{2}}{m a^{2}}$
C. $\frac{4 \pi^{2} \hbar^{2}}{m a^{2}}$
D. $\frac{5 \pi^{2} \hbar^{2}}{8 m a^{2}}$
32. A storage area used to store data to a compensate for the difference in speed at which the different units can handle data is
A. Memory
B. Buffer
C. Accumulator
D. Address
33. The potential of a diatomic molecule as a function of the distance $r$ between the atoms is given by $V(r)=-\frac{a}{r^{6}}+\frac{b}{r^{12}}$. The value of the potential at equilibrium separation between the atoms is:
A. $-\frac{4 a^{2}}{b}$
B. $-\frac{a^{2}}{2 b}$
C. $-\frac{2 a^{2}}{b}$
D. $-\frac{a^{2}}{4 b}$
34. If the energy dispersion of a two-dimensional electron system is $E=u \hbar k$ where $u$ is the velocity and $k$ is the momentum, then the density of states $D(E)$ depends on the energy as
A. $\frac{1}{\sqrt{E}}$
B. $\sqrt{E}$
C. $E$
D. Constant
35. The orbital magnetic dipole moment of an electron in a hydrogen like atom is $1.3115 \times 10^{-23} \mathrm{JT}^{-1}$. Then the state of the electron will be
A. $S$
B. $P$
C. D
D. F
36. Which type of spectroscopy is used to study the structural and chemical properties of materials at the atomic level?
A. Electron Paramagnetic Resonance (EPR)
B. Mass Spectrometry
C. X-ray Photoelectron Spectroscopy (XPS)
D. Raman Spectroscopy
37. If a Si diode is operating in forward bias in a circuit with 12 V supply and $240 \Omega$ resistor, then what will be the voltage drop across the diode
A. 6 V
B. 1.5 V
C. 0.3 V
D. 0.7 V
38. The working of transistor as amplifier is similar to
A. Step up transformer
B. Step down transformer
C. Three diodes in common
D. Triode vacuum tube
39. In a finite potential well, the potential energy outside the box is
A. Zero
B. Infinite
C. Constant
D. Variable
40. The moment of inertia of a solid sphere (radius $R$ and mass $M$ ) about the axis which is at a distance of $R / 2$ from the centre is
A. $\frac{13}{20} M R^{2}$
B. $\frac{3}{20} M R^{2}$
C. $\frac{1}{2} M R^{2}$
D. $\frac{9}{10} M R^{2}$
41. Which of the following is a crystalline solid?
A. Anisotropic substances
B. Isotropic substances
C. Super cooled liquids
D. Amorphous solids
42. A low pass filter is formed by a resistance $R$ and a capacitance $C$. At the cut-off angular frequency $\omega_{c}=1 / R C$ the voltage gain and the phase of the output voltage relative to the input voltage respectively are
A. 0.71 and $-45^{\circ}$
B. 0.71 and $45^{\circ}$
C. 0.5 and $-90^{\circ}$
D. 0.5 and $90^{\circ}$
43. If the analog input to an 8-bit successive approximation ADC is increased from 1.0 V to 2.0 V , then the conversion time will
A. double
B. decrease to half its original value
C. increase four times
D. remain unchanged
44. In a first order phase transition, at the transition temperature, specific heat of the system
A. diverges and its entropy remains the same
B. diverges and its entropy has finite discontinuity
C. remains unchanged and its entropy has finite discontinuity
D. has finite discontinuity and its entropy diverges
45. Which one of the following CANNOT be explained by considering a harmonic approximation for the lattice vibrations in solids?
A. Deby's $T^{3}$ law
B. Dulong Petit's law
C. Optical branches in lattices
D. Thermal expansion
46. Which wave of an earthquake is produced by a rolling effect along the earth's surface?
A. L wave
B. P wave
C. S wave
D. None of the above
47. The binary equivalent of $\mathrm{A}_{16}$ is
A. 1111
B. 1110
C. 1011
D. 1010
48. Constraints that are time dependent.
A. Holonomic
B. Non-Holonomic
C. Scleronomous
D. Rheonomous
49. Which of the following volcanoes is known for its most destructive volcanic eruption in recorded history?
A. Mount Kilimanjaro
B. Mauna Loa
C. Krakatoa
D. Mount St Helens
50. The ratio of change in output towards the change in input at a steady state condition for a given measuring system is referred to as:
A. Linearity
B. Threshold
C. Sensitivity
D. Stability
51. Consider a system whose three energy levels are given by $0, \varepsilon$ and $2 \varepsilon$. The energy level $\varepsilon$ is two fold degenerate and the other two are non-degenerate. The partition function of the system with $\beta=1 / k_{\beta} T 1$ is given by
A. $1+2 e^{\beta \varepsilon}$
B. $2 e^{-\beta \varepsilon}+e^{-2 \beta \varepsilon}$
C. $\left(1+e^{-\beta \varepsilon}\right)^{2}$
D. $1+e^{-\beta \varepsilon}+e^{-2 \beta \varepsilon}$
52. Two gases separated by an impermeable but movable partition are allowed to freely exchange energy. At equilibrium, the two sides will have the same
A. pressure and temperature
B. volume and temperature
C. pressure and volume
D. volume and energy
53. The velocity of a particle executing SHM if its displacement equation is $x(t)=10 \sin (2 \pi t+\varphi)$ is
A. $v=20 \sin (2 \pi t+\varphi)$
B. $v=20 \cos (2 \pi t+\varphi)$
C. $v=10 \sin (2 \pi t+\varphi)$
D. $v=10 \cos (2 \pi t-\varphi)$
54. If uncertainty in position measurement of electron is $0.1 \AA$ then uncertainty in momentum measurement is
A. $\quad 1.158 \times 10^{9} \mathrm{~m} / \mathrm{s}$
B. $\quad 1.158 \times 10^{8} \mathrm{~m} / \mathrm{s}$
C. $1.158 \times 10^{7} \mathrm{~m} / \mathrm{s}$
D. $1.158 \times 10^{6} \mathrm{~m} / \mathrm{s}$
55. In Boss-Einstein condensation, the particles
A. have strong interparticle attraction
B. condense in real space
C. have overlapping wavefunctions
D. have large and positive chemical potential
56. A transistor in common base configuration has ratio of collector current to emitter current $\beta$ and ratio of collector to base current $\alpha$. Which of the following is true?
A. $\beta=\frac{\alpha}{1+\alpha}$
B. $\beta=\frac{\alpha+1}{\alpha}$
C. $\beta=\frac{\alpha}{1-\alpha}$
D. $\beta=\frac{2 \alpha}{1+\alpha}$
57. If a force $F$ is derivable from a potential function $V(r)$, where $r$ is the distance from the origin of the coordinate system, it follows that
A. $\nabla \times F=0$
B. $\nabla \cdot F=0$
C. $\nabla V=0$
D. 0
58. The quantum mechanical operator for the momentum of a particle moving in one dimension is given by
A. $i \hbar \frac{d}{d x}$
B. $-i \hbar \frac{d}{d x}$
C. $i \hbar \frac{d}{d t}$
D. $-\frac{\hbar^{2}}{2 m} \frac{d^{2}}{d x^{2}}$
59. In NMR spectroscopy, the spinning nuclei in a strong magnetic field must be irradiated by which of the following?
A. Perpendicular and stronger field
B. Perpendicular and weaker field
C. Parallel and stronger field
D. Parallel and weaker field
60. The recoil momentum of an atom is $p_{A}$ when it emits an infrared photon of wavelength 1500 nm and it is $\mathrm{nm} \mathrm{p}_{\mathrm{B}}$ when it emits a photon of visible wavelength 500 nm . The ratio $p_{A} / p_{B}$ is
A. $1: 3$
B. $1: \sqrt{3}$
C. $1: 2$
D. $1: \sqrt{2}$
61. The components of a vector potential $A_{i}=\left(A_{0}, A_{1}, A_{2}, A_{3}\right)$ are given by $\mathrm{A}=\mathrm{k}(-\mathrm{xyz}, \mathrm{yzt}, \mathrm{zxt}, \mathrm{xyt})$, where k is a constant. The three components of the electric field are
A. $k(y z, z x, x y)$
B. $k(x, y, z)$
C. $(0,0,0)$
D. $\mathrm{K}(\mathrm{xt}, \mathrm{yt}, \mathrm{zt})$
62. The correct relationship between phase and group velocity of material particle if it is moving with non-relativistic velocity ( $\mathrm{v}<\mathrm{c}$ )
A. $\quad V_{p}=V_{g}$
B. $V_{p}=2 V_{g}$
C. $V_{p}=V_{g} / 2$
D. $V_{p}=V_{g} / \sqrt{2}$
63. OP-AMPs can amplify
A. D.C.
B. A.C.
C. Both A.C. and D.C.
D. None of the above
64. Two bodies of mass $m$ and $2 m$ are connected by a spring constant $k$. The frequency of the normal mode is
A. $\sqrt{\frac{3 k}{2 m}}$
B. $\sqrt{\frac{k}{m}}$
C. $\sqrt{\frac{k}{2 m}}$
D. $\sqrt{\frac{2 k}{3 m}}$
65. A system suffers an increase in internal energy of 80 J and at the same time has 50 J of work done on it. What is the heat change of the system?
A. + 130J
B. -130 J
C. -30 J
D. +30 J
66. The Poisson bracket $\left[x, x p_{y}+y p_{x}\right]$
A. $X$
B. $y$
C. $p_{y}$
D. 0
67. For elliptical orbit the values of energy $E$ and eccentricity $\in$ are
A. $E=0$ and $\in>1$
B. E $>0$ and $\in>1$
C. E $<0$ and $\in<1$
D. E $>0$ and $\in=0$
68. The equation of constraints for a simple pendulum is
A. $r d \theta-I=0$
B. $r d \theta+I=0$
C. $r+I=0$
D. $r-I=0$
69. If the sheet of a bakelite is inserted between the plates of an air capacitor, the capacitance will
A. decrease
B. increase
C. remains unchanged
D. become zero
70. The direction in which electromagnetic waves propagate is the same as that of
A. $\vec{E} \times \vec{B}$
B. $\vec{E} \cdot \vec{B}$
C. $\vec{E}$
D. $\vec{B}$
71. Which of the following rays are not electromagnetic waves?
A. Gamma rays
B. Beta rays
C. Heat rays
D. X rays
72. Which of the following factors are related by work energy principle?
A. force, displacement and time
B. force, velocity, time and mass
C. force, velocity, displacement
D. displacement, time and mass
73. A magnetic dipole of dipole moment m is placed in a non-uniform magnetic field B . If the position vector of the dipole is r , the torque acting on the dipole about the origin is
A. $r \times(m \times B)$
B. $\quad r \times \nabla(m \cdot B)$
C. $m \times B+r \times \nabla(m \cdot B)$
D. $m \times B$
74. When does a fluid become turbulent?
A. High viscosity of fluid
B. Reynolds number is greater than 2000
C. Reynolds number is less than 2000
D. The density of the fluid is low
75. A circularly polarized monochromatic plane wave is incident on a dielectric interface at Brewaster angle. Which one of the following statements is correct?
A. The reflected light is plane polarized in the plane of incidence and the transmitted light is circularly polarized.
B. The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is plane polarized in the plane of incidence.
C. The reflected light is plane polarized perpendicular to the plane of incidence and the transmitted light is elliptically polarized.
D. There will be no reflected light and the transmitted light is circularly polarized.
76. Which of the following occurs without a change in the internal energy?
A. Isochoric process
B. Isenthalpic process
C. Steady-state process
D. None of the above
77. A planet of mass $m$ moves in a circular orbit of radius or in the gravitational potential $V=-k / r$ where k is a positive constant. The orbit angular momentum of the planet is
A. $2 r_{0} \mathrm{~km}$
B. $\sqrt{2 r_{0} k m}$
C. $r_{0} k m$
D. $\sqrt{r_{0} k m}$
78. Which one of the following thermodynamic quantities is not a state function?
A. Gibbs free energy
B. work
C. entropy
D. internal energy
79. Non-inverting amplifier circuits have
A. A very high input impedance
B. A very low input impedance
C. A low output impedance
D. None of the above
80. Which one of the following commutation relations relating angular momentum is NOT CORRECT?
A. $\left[L_{z}, L_{+}\right]=\hbar L_{+}$
B. $\left[L_{X}, L_{Y}\right]=i \hbar L_{z}$
C. $\left[L_{Z}, L_{-}\right]=\hbar L_{-}$
D. $\left[L^{2}, L_{z}\right]=0$
81. The entropy will usually increase when
I. a molecule is broken into two or more smaller molecules.
II. a reaction occurs that results in an increase in the number of moles of gas.
III. a solid changes to a liquid.
IV. a liquid changes to a gas.
A. I only
B. II and III
C. I, III and IV
D. I, II, III and IV
82. The order of magnitude of the energy gap of a typical superconductor is
A. 1 MeV
B. 1 KeV
C. 1 eV
D. 1 meV
83. The standard heat of combustion of ethanol, $\mathrm{C}_{2} \mathrm{H}_{5} \mathrm{OH}$, is $1372 \mathrm{~kJ} / \mathrm{mol}$ ethanol. How much heat (in kJ) would be liberated by completely burning a 20.0 g sample?
A. 686 kJ
B. 519 kJ
C. 715 kJ
D. 597 kJ
84. Multi user systems provided cost savings for small business because they use a single processing unit to link several
A. Personal computers
B. Workstations
C. Dumb terminals
D. Mainframes
85. The temperature at which a system goes through a reversible isothermal process without transferring heat is
A. triple point of water
B. boiling point of water
C. absolute zero
D. none of the above
86. Which of the following processes is reversible?
A. Isothermal compression
B. Transfer of heat by radiation
C. Transfer of heat by conduction
D. Electrical heating of a nichrome wire
87. Which of the following method is used exclusively in fluid mechanics?
A. Eulerian method
B. Lagrangian method
C. Hamiltonian method
D. None
88. A liquid compressed in a cylinder has a volume of $0.04 \mathrm{~m}^{2}$ at $50 \mathrm{~N} / \mathrm{cm}^{2}$ and a volume of $0.039 \mathrm{~m}^{3}$ at $150 \mathrm{~N} / \mathrm{cm}^{2}$. The bulk modulus of elasticity of liquid is
A. $\quad 400 \mathrm{~N} / \mathrm{cm}^{2}$
B. $\quad 4000 \mathrm{~N} / \mathrm{cm}^{2}$
C. $40000 \mathrm{~N} / \mathrm{m}^{2}$
D. $40 \mathrm{~N} / \mathrm{cm}^{2}$
89. In a photoelectric effect experiment, a monochromatic light source emitting photon with energy greater than the work function of the metal under test is used. If the power of the light source is doubled, which one of the following statements is correct?
A. The number of emitted photoelectrons remains the same
B. The stopping potential remains the same
C. The number of emitted photoelectrons decreases
D. The stopping potential doubles
90. Let ( $\mathrm{p}, \mathrm{q}$ ) and ( $\mathrm{P}, \mathrm{Q}$ ) be two pairs of canonical variables. The transformation $Q=q^{a} \cos b p$ and $P=q^{a} \sin b p$
A. $a=2, b=1 / 2$
B. $a=1 / 2, b=2$
C. $a=1 / 2, b=1 / 2$
D. $a=2, b=1$
91. An optic fiber excels at rejecting
A. Cross talk
B. Electromagnetic interference
C. Radio-frequency interference
D. All of the above
92. For a particle moving in a central potential, which one of the following statements is correct?
A. The motion is restricted to a plane due to the conservation of angular momentum
B. The motion is restricted to a plane due to the conservation of energy only
C. The motion is restricted to a plane due to the conservation of linear momentum
D. The motion is not restricted to a plane
93. Two relativistic particles with opposite velocities collide head-on and come to rest by sticking with each other. Which of the following quantities is/are conserved in the collision?
A. Total momentum
B. Total potential energy
C. Total kinetic energy
D. Total rest mass
94. Two matrices $A$ and $B$ are said to be similar if $B=P^{-1} A P$ for some invertible matrix $P$. Which of the following statements is NOT TRUE?
A. $\quad \operatorname{Det} A=\operatorname{Det} B$
B. Trace of $A=$ Trace of $B$
C. A and $B$ have the same eigenvectors
D. $A$ and $B$ have the same eigenvalues
95. To detect trace amounts of gaseous species in a mixture of gases, the preferred probing tool is
A. Ionization spectroscopy with X-rays
B. NMR spectroscopy
C. ESR spectroscopy
D. Laser spectroscopy
96. A spherical air bubble is embedded in a glass slab. It will behave like a
A. Cylindrical lens
B. Achromatic lens
C. Converging lens
D. Diverging lens
97. The expression for time period of a spring mass system, where $m$ is the mass which is connected with two springs with spring $k_{1}$ and $k_{2}$ respectively in parallel.
A. $T=2 \pi \sqrt{\frac{m}{k_{1}+k_{2}}}$
B. $T=2 \pi \sqrt{\frac{m}{k_{1} k_{2}}}$
C. $T=2 \pi \sqrt{\frac{m}{k_{1}}}$
D. $T=2 \pi \sqrt{\frac{m}{k_{2}}}$
98. Consider a system of 3 fermions which can occupy any of the 4 available energy states with equal probability. The entropy of the system is
A. $k_{B} \ln 2$
B. $2 k_{B} \ln 2$
C. $2 k_{B} \ln 4$
D. $3 k_{B} \ln 4$
99. A ball of mass $m$ collides with a wall with speed $v$ and rebounds on the same line with same speed. If the mass of the wall is taken as infinite, the work done by the ball on the wall is
A. $m v^{2}$
B. $2 m v^{2}$
C. $\frac{1}{2} m v^{2}$
D. Zero
100. The atomic packing fraction in diamond structure
A. $54 \%$
B. $68 \%$
C. $74 \%$
D. $35 \%$

## ANSWER SHEET

|  | A | B | C | D | E |  |  |  |  |  |  | E |  |  | A | B | C |  | E | 76 |  | A B | C | D | E |
| :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: | :---: |
| 2 | A | B | C | D | E | 27 | A | A | B | C | D | E | 52 |  | A | B | C | D | E | 77 | A | A B | C | D | E |
| 3 | A | B | C | D | E | 28 | A | A | B C | C | D | E | 53 |  | A | B | C D | D | E | 78 | A | A B | C | D | E |
| 4 | A | B | C | D | E | 9 | A | A | B C | C | D | E | 54 |  | A | B | C | D | E | 79 | A | A B | C | D | E |
| 5 | A | B | C | D | E | 0 | A |  | B | C | D | E | 55 |  | A | B | C | D | E | 80 | A | A B | C | D | E |
| 6 | A | B | C | D | E | 1 | A | A | B | C | D | E | 56 |  | A | B | C | D | E | 81 | A | A B | C | D | E |
| 7 | A | B | C | D | E | 2 |  | A ${ }^{\text {A }}$ | B | C D | D | E | 57 |  | A | B | C | D | E | 82 | A | A B | C | D | E |
| 8 | A | B | C | D | E | 3 | A | A | B | C D | D | E | 58 |  | A | B | C | D | E | 83 | A | A B | C | D | E |
| $9$ | A | B | C | D | E | 4 | A | A ${ }^{\text {A }}$ | B C | C | D | E |  |  | A | B | C | D | E |  |  | A B | C | D | E |
|  | A | B | C | D | E |  | A | A ${ }^{\text {a }}$ | B | C | D | E |  |  | A | B | C | D | E | 85 | A | A B | C | D | E |
|  | A | B | C | D | E | 6 | A | A B | B | C | D | E |  |  | A | B | C | D | E | 86 | A | A B | C | D | E |
| $12[$ | A | B | C | D | E | 37 | A | A ${ }^{\text {d }}$ | B | C D | D | E | 62 |  | A | B | C | D | E | 87 | A | A B | C | D | E |
| 13 | A | B | C | D | E | 8 | A | A | B C | D | D | E | 63 |  | A ${ }^{\text {d }}$ | B | C | D | E | 88 | A | A ${ }^{\text {a }}$ | C | D | E |
|  | A | B | C | D | E | A | A | A ${ }^{\text {a }}$ | 3 C |  | D | E | 64 |  | A ${ }^{\text {B }}$ | B | C D | D | E | 89 |  | A ${ }^{\text {B }}$ | C | D | E |
|  | A | B | C | D | E |  | A | A | B C | D | D | E |  |  | A | B | C D | D | E | 90 |  | A ${ }^{\text {a }}$ | C | D | E |
|  | A | B | C | D | E |  | A | A ${ }^{\text {a }}$ | B C | C | D | E |  |  | A | B | C D | D | E | 91 | A | A B | C | D | E |
|  | A | B | C | D | E |  | A | A ${ }^{\text {a }}$ | B ${ }^{\text {c }}$ | D | D | E |  |  | A | B | C | D | E | 92 |  | A ${ }^{\text {A }}$ | C | D | E |
|  | A | B | C | D | E |  | A | A B | 3 C | C | D | E |  |  | A ${ }^{\text {B }}$ | B | C D | D | E | 93 |  | A B | C | D | E |
|  | A | B | C | D | E |  | A | A B | B C | C D | D | E |  |  | A | B | C D | D | E | 94 |  | A B | C | D | E |
|  | A | B | C | D | E |  | A | A B | B C | D | D | E |  |  | A B | B | C D | D | E | 95 |  | A B | C | D | E |
|  | A | B | C | D | E |  | A | A B | B C | D | D | E |  |  | A ${ }^{\text {B }}$ | B | C D | D | E | 96 |  | A B | C | D | E |
|  | A | B | C | D | E |  | A | A B | $B$ | D | D | E |  |  | A ${ }^{\text {B }}$ | B | C D | D | E | 97 |  | A B | C | D | E |
|  | A | B | C | D | E |  | A | A B | B C | C | D | E |  |  | A B | B | C D | D | E | 98 |  | A B | C | D | E |
|  | A | B | C | D | E |  | A | A ${ }^{\text {B }}$ | B C | C ${ }^{\text {D }}$ | D | E |  |  | A ${ }^{\text {B }}$ | B | C D | D | E | 99 |  | A B | C | D | E |
|  | A | B | C | D | E |  |  |  | B C |  | D | E |  |  |  |  | C D | D | E |  |  |  | C | D | E |

