PHYSICS PG
(FINAL)

1. Lead is a metallic crystal having a structure of

(A) FCC
(B) BCC
(C) HCP
(D) TCP

2. What is the axial relationship of a monoclinic crystal system?

(A) $a = b = c$
(B) $a = b \neq c$
(C) $a \neq b = c$
(D) $a \neq b \neq c$

3. What is the coordination number of a simple cubic structure?

(A) 6
(B) 8
(C) 10
(D) 12

4. Which of the following is a point defect in crystals?

(A) Edge dislocation
(B) Interstitial
(C) Grain boundaries
(D) Cracks

5. The defect that occurs due to a displacement of an ion is known as

(A) Vacancy defect
(B) Schottky defect
(C) Frankel defect
(D) Interstitial defect

6. Which of the following machine works on Pascal’s Law?

(A) Vernier caliper
(B) Hydraulic press
(C) Venturimeter
(D) Aneroid barometer

7. The wave function $\psi$ for a particle in a 1 D box of length L should follow

(A) $\psi = 0$ for $x \leq 0$ and $x \geq L$
(B) $\psi \neq 0$ for $x \leq 0$ and $x \geq L$
(C) $\psi =$ constant for $x \leq 0$ and $x \geq L$
(D) $\psi = \infty$ for $x \leq 0$ and $x \geq L$

8. In $CO_2$ laser, Helium is added to

(A) act as pumping agent
(B) maintain ratio of gases
(C) be a coolant and depopulate lower laser level
(D) regenerate carbon dioxide

9. If $n_1$ and $n_2$ are refractive indices of core and gladding of optical fiber, respectively, then which condition is required to make optical fiber?

(A) $n_1 = 0$
(B) $n_1 = n_2$
(C) $n_1 < n_2$
(D) $n_1 > n_2$

10. In which of the following, there is no distortion due to intermodal dispersion?

(A) Graded index fibre
(B) Multimode step-index fibre
(C) Single mode step-index fibre
(D) Glass fibre

11. The laser used in a DVD writer is

(A) Ruby laser
(B) Diode laser
(C) Low power dye laser
(D) $CO_2$ laser

12. Semiconductor laser can be made using

(A) GaAs
(B) Si
(C) Ge
(D) $SiO_2$

13. In Compton scattering

(A) only energy is conserved
(B) only momentum is conserved
(C) both energy and momentum is conserved
(D) neither energy nor momentum is conserved

14. An electric charge in uniform motion produces

(A) an electric field only
(B) a magnetic field only
(C) both electric and magnetic fields
(D) no such field at all

15. Elements of which column in the periodic table are combined to make compound semiconductors?

(A) First and fourth
(B) Fifth and sixth
(C) Second and fourth
(D) Third and fifth

16. A hole and electron in close proximity would tend to

(A) repel each other
(B) attract each other
(C) have no effect on each other
(D) move circular motion

17. A charged particle is moving along a magnetic field line. The magnetic force on the particle is

(A) along its direction of motion
(B) opposite to its direction of motion
(C) perpendicular to its direction of motion
(D) zero

18. The term 'bias' in electronic circuits usually means

(A) the value of input ac voltage
(B) the condition of current through a *pn*-junction
(C) the value of dc voltage for the device to operate properly
(D) the status of the diode

19. The colour of an LED can be changed by

(A) using different bandgap semiconductors
(B) varying the doping level of the semiconductors
(C) increasing applied voltage
(D) by connecting LEDs serially

20. Which one of the following does **NOT** depend on the energy density of the incident radiation?

(A) Stimulated emission
(B) Spontaneous emission
(C) Stimulated absorption
(D) Transmission

21. Minimum number of energy levels required to obtain lasing action is

(A) 2
(B) 3
(C) 4
(D) 1

22. If $N_1$ and $N_2$ are the number of atoms in energy levels $E_1$ and $E_2$ (given $E_1 < E_2$) in a system, then the condition for stimulated emission is

(A) $N_1 > N_2$
(B) $N_1 = N_2$
(C) $N_2 > N_1$
(D) $N_1 \neq 0, N_2 = 0$

23. Einstein's coefficient for spontaneous emission $(A_{21})$ is

(A) directly proportional to spontaneous emission lifetime
(B) directly proportional to square of spontaneous emission lifetime
(C) inversely proportional to spontaneous emission lifetime
(D) inversely proportional to square of spontaneous emission lifetime

24. The binding energy per nucleon in a heavy nucleus is about

(A) 8.5 MeV
(B) 7.6 MeV
(C) 5.2 MeV
(D) 2.01 MeV

25. If $\lambda$ is the average wavelength of two waves and $\Delta\lambda$ is the wavelength difference between them, then the coherence length $(l_c)$ of the beam is given by

(A) $l_c = \dfrac{\lambda}{\Delta\lambda}$

(B) $l_c = \dfrac{\lambda^2}{\Delta\lambda}$

(C) $l_c = \dfrac{2\lambda}{\Delta\lambda}$

(D) $l_c = \lambda\Delta\lambda$

26. Which one of the following methods can be applied to achieve population inversion in Nd-YAG laser?

(A) Optical pumping using flash lamp or diode laser
(B) Electric discharge
(C) Chemical reaction
(D) Atom-atom collision

27. A metastable energy state in a system has lifetime

(A) same as that of the excited state
(B) shorter than that of the excited state
(C) longer than that of the excited state
(D) same as that of the ground state

28. Which one of the following laws will **NOT** contribute to the Maxwell's equations?

(A) Gauss's law
(B) Faraday's law
(C) Ampere's law
(D) Curie-Weiss law

29. Velocity of light in free space is given by

(A) $c = \sqrt{\dfrac{\varepsilon_0}{\mu_0}}$

(B) $c = \sqrt{\dfrac{\mu_0}{\varepsilon_0}}$

(C) $c = \dfrac{1}{\sqrt{\mu_0 \varepsilon_0}}$

(D) $c = \sqrt{\mu_0 \varepsilon_0}$

30. Which of the following is **NOT** due to total internal reflection of light?

(A) Brilliance of diamond
(B) Mirage
(C) Light propagation in fiber
(D) Rainbow formation

31. Carbon Non Tubes (CNT) are nanostructures with high aspect ratio. What type to confinement does CNT fall into?

(A) Quantum well
(B) Quantum wire
(C) Quantum dot
(D) Quantum box

32. A quantum well is

(A) a 2D structure with confinement in 2 directions
(B) a 2D structure with confinement in 1 directions
(C) a 1D structure with confinement in 2 directions
(D) a 1D structure with confinement in 1 directions

33. Quantum confinement effect lead to energy levels becoming more

(A) continuous
(B) discreet
(C) clustered
(D) overlapping

34. The splitting of white light into its component colours is called

(A) total internal reflection
(B) transmission
(C) polarization
(D) dispersion

35. The relation between $g$ (acceleration due to gravity) and $G$ (gravitational constant) is

(A) $g = \frac{GM}{R^2}$

(B) $g = \frac{GM}{R}$

(C) $g = \frac{G}{R^2 M}$

(D) $g = \frac{G}{R^2}$

36. The magnetic field produced due to a circular wire at its center is

(A) at 45° to the plane of the wire
(B) at 60° to the plane of the wire
(C) in the plane of the wire
(D) perpendicular to the plane of the wire

37. If $\sigma_T$ and $\sigma$ are the thermal and electrical conductivity of the metal respectively, $L$ represents the Lorentz number and $T$ is the temperature in Kelvin, then which of the following relation gives Wiedemann Franz law?

(A) $\frac{\sigma_T}{\sigma} = LT$

(B) $\frac{\sigma}{\sigma_T} = LT$

(C) $\frac{\sigma_T}{\sigma} = \frac{L}{T}$

(D) $\frac{\sigma_T}{\sigma} = \frac{T}{L}$

38. The ionization energy of Li++ is equal to

(A) $6hcR$
(B) $2hcR$
(C) $9hcR$
(D) $hcR$

39. The wave function for the motion of the particle in a one dimensional potential box of length $L$ is given by $\psi_n = A\sin\left(\frac{n\pi x}{L}\right)$ where $A$ is the normalization constant. The value of $A$ is

(A) $\frac{1}{L}$
(B) $\sqrt{2L}$
(C) $\sqrt{\frac{2}{L}}$
(D) $\sqrt{\frac{L}{2}}$

40. A convex lens is made of a material having refractive index 1.2. Both the surfaces of the lens are convex. If it is dipped into water, it will behave like

(A) a convergent lens
(B) a divergent lens
(C) a rectangular slab
(D) a prism

41. A man walks at a speed of 6 km/hr for 1 km and 8 km/hr for the next 1 km. What is his average speed for the walk of 2 km?

(A) $\frac{8}{6}$ km/hr
(B) $\frac{48}{3}$ km/hr
(C) $\frac{6}{8}$ km/hr
(D) $\frac{48}{7}$ km/hr

42. In the Davisson-Germer experiment, the hump is most prominent when the electron is accelerated by

(A) 34 V
(B) 54 V
(C) 60 V
(D) 64 V

43. The crystal system of a compound with unit cell dimensions $a = 1.18$ nm, $b = 0.65$ nm, $c = 0.83$ nm and $\alpha = 43°$, $\beta = 78°$, $\gamma = 95°$ is

(A) triclinic
(B) monoclinic
(C) orthorhombic
(D) hexagonal

44. The rate of spontaneous emission is proportional to

(A) energy density of incident radiation
(B) temperature
(C) population density of higher energy level
(D) population density of lower energy level

45. What is the nature of binding in $CH_4$?

(A) Ionic bond
(B) Metallic bond
(C) Covalent bond
(D) Dispersion

46. The shortest wavelength ($\lambda$) of Balmer series in hydrogen spectrum is given by the equation

(A) $\frac{1}{\lambda} = R_H\left(\frac{1}{4} - \frac{1}{9}\right)$

(B) $\frac{1}{\lambda} = R_H\left(1 - \frac{1}{\infty}\right)$

(C) $\frac{1}{\lambda} = R_H\left(\frac{1}{2} - \frac{1}{\infty}\right)$

(D) $\frac{1}{\lambda} = R_H\left(\frac{1}{4} - \frac{1}{\infty}\right)$

47. The momenta of photon is 2 MeV/c then the total energy of the photon is

(A) 2 MeV

(B) 1 MeV

(C) $\frac{2}{3}$ MeV

(D) $\frac{3}{2}$ MeV

48. The kinetic energy of an electron in an atom is

(A) half of its potential energy
(B) twice its potential energy
(C) equal to its potential energy
(D) thrice its potential energy

49. A distant galaxy is moving from the earth at such a high speed that the blue hydrogen line at a wavelength of 434 nm is recorded at 600 nm, in the red range of the spectrum. Then the speed of the galaxy relative to the earth is

(A) 0.96 c
(B) 0.45 c
(C) 0.36 c
(D) 0.88 c

50. The magnetic flux density at the centre of a square of sides 5 m length and carrying current 10 A is

(A) $2.26 \times 10^{-6}$ Wb/m$^2$

(B) $5.66 \times 10^{-7}$ Wb/m$^2$

(C) $4.50 \times 10^{-8}$ Wb/m$^2$

(D) $3.30 \times 10^{-5}$ Wb/m$^2$

51. If the radius of the first orbit in hydrogen atom is 0.05 nm the radius of the first orbit in He atom is

(A) 0.100 nm
(B) 0.025 nm
(C) 0.050 nm
(D) 0.075 nm

52. When photons encounter, atoms in the photons loses all its energy. In the process two particles are created, an electron and a positron. The process is called as

(A) Compton effect
(B) Bremsstrahlung radiation
(C) Pair production
(D) Photoelectric effect

53. In a non-dispersive medium phase velocity and group velocity is related as

(A) $v_{\text{group}} = v_{\text{phase}}$
(B) $v_{\text{group}} > v_{\text{phase}}$
(C) $v_{\text{group}} < v_{\text{phase}}$
(D) None of the above

54. The thickness of the quarter wave plate made up of quartz for wavelength of 500 nm having refractive index for extraordinary and ordinary ray as 1.553 and 1.544 respectively is

(A) $3.33 \times 10^{-5}$ m
(B) $1.39 \times 10^{-5}$ m
(C) $2.45 \times 10^{-5}$ m
(D) $4.68 \times 10^{-5}$ m

55. In an adiabatic process on a gas with $\gamma = 1.4$ the pressure is increased by 0.5% the volume decreases by about

(A) 0.5%
(B) 0.36%
(C) 0.7%
(D) 1%

56. The change in the wavelength of the $2p$-$1s$ photon when a hydrogen atom is placed in a magnetic field of $2T$ is

(A) 0.0139 nm
(B) 0.00139 nm
(C) 0.139 nm
(D) 1.39 nm

57. When $^{23}$Ne (atomic mass = 22.994465 u) decays to $^{23}$Na (atomic mass = 22.989768 u) by negative beta emission, the maximum kinetic energy of the emitted electrons is

(A) 6.865 meV
(B) 3.635 keV
(C) 7.132 MeV
(D) 4.375 MeV

58. The quantity $\frac{PV}{kT}$ represents

(A) mass of the gas
(B) kinetic energy of the gas
(C) number of moles of the gas
(D) the number of molecules in the gas

59. Ultrasonic waves are

(A) electromagnetic waves
(B) mechanical waves
(C) matter waves
(D) gravitational waves

60. The G. P. Thomson experiment confirmed

(A) the particle nature of electrons
(B) the negative charge of the electrons
(C) wave nature of electrons
(D) very light mass of the electrons

61. When NaCl crystal is subjected to an electric field of 50 V/cm, the resulting polarization is $2.215 \times 10^{-7}$ C/m$^2$, then the relative permittivity of NaCl is

(A) 4.1
(B) 6.0
(C) 3.0
(D) 4.2

62. A block of mass 0.5 kg hanging from a vertical spring executes simple harmonic motion of amplitude 0.1 m and time period 0.314 sec. The maximum force exerted by the spring on the block is

(A) 35 N
(B) 25 N
(C) 45 N
(D) 15 N

63. The diffusion current is proportional to

(A) square of the applied electric field
(B) applied electric field
(C) concentration gradient of charge carriers
(D) None of the above

64. The susceptibility of a paramagnetic material is

(A) inversely proportional to temperature
(B) directly proportional to temperature
(C) independent of temperature
(D) first increases and then decreases

65. The packing factor of the fcc structure is

(A) 52%
(B) 68%
(C) 74%
(D) 38%

66. How much energy must a photon have if it is to have the momentum of a 5 MeV proton?

(A) $1.85 \times 10^{-15}$ J
(B) $3.55 \times 10^{-10}$ J
(C) $1.55 \times 10^{-11}$ J
(D) $5.17 \times 10^{-20}$ J

67. Which of the following is **NOT** an amorphous substance?

(A) Glass
(B) Rubber
(C) Copper
(D) Polymers

68. Magnetic materials that can be readily magnetized in either direction are

(A) low hysteresis loss materials
(B) hard magnetic materials
(C) soft magnetic materials
(D) high hysteresis materials

69. A crystal has bcc structure and its lattice constant is 3.6 Å. What is the atomic radius?

(A) 3.6 Å
(B) 1.56 Å
(C) 1.27 Å
(D) 1.8 Å

70. Ultrasonic waves are produced by using

(A) electromagnetic induction
(B) piezoelectric effect
(C) tuning forks
(D) inverse piezoelectric effect

71. Two bodies of mass *m* and 3 *m* are thrown vertically upward with the same velocity. On coming back to the earth

(A) they will have zero velocity
(B) they will have same velocity
(C) the body of mass 3 *m* will have three times more velocity than that of mass *m*
(D) the body of mass 3 *m* will have one third velocity of that of mass *m*

72. A proton and an $\alpha$-particle have the same kinetic energy. The de Broglie wavelength of those particles can be related as

(A) $\lambda_p = \frac{\lambda_\alpha}{4}$

(B) $\lambda_p = \frac{\lambda_\alpha}{2}$

(C) $\lambda_p = 2\lambda_\alpha$

(D) $\lambda_p = 4\lambda_\alpha$

73. A particle of mass $m$ is suspended from a ceiling through a string of length $L$. The particle moves in a horizontal circle of radius $r$. then the tension in the string is given by

(A) $T = \dfrac{mgL}{\sqrt{L^2 - r^2}}$

(B) $T = \dfrac{mgL}{\left(L^2 - r^2\right)^{3/2}}$

(C) $T = \dfrac{mg}{\left(L^2 - r^2\right)^{3/2}}$

(D) $T = \dfrac{mg}{\left(L^2 - r^2\right)^{1/2}}$

74. An excited atom gives up its excess energy by emitting a photon. The average period that elapses between the excitation of an atom and the time it radiates is $10^{-8}$ sec. The inherent uncertainty in the frequency of the photon is

(A) $5.84 \times 10^{8}$ Hz
(B) $7.96 \times 10^{6}$ Hz
(C) $6.12 \times 10^{10}$ Hz
(D) $9 \times 10^{12}$ Hz

75. For a particle executing simple harmonic motion, the acceleration is proportional to

(A) displacement from the mean position
(B) distance from the mean position
(C) speed
(D) distance travelled since $t = 0$

76. Dulong Petit's law obeys at room temperature for many metals while it fails for light elements such as boron, beryllium because

(A) the Debye's temperature of these elements is very high
(B) the Debye's temperature of them is about 300 K
(C) the Debye's temperature of them is low
(D) None of the above

77. Water and mercury are filled in two cylindrical vessels up to same height. Both vessels have a hole in the wall near the bottom. The velocity of water and mercury coming out of the holes are $v_1$ and $v_2$ respectively then

(A) $v_1 = 13.6 v_2$
(B) $v_1 = \sqrt{13.6}\, v_2$
(C) $v_1 = \frac{v_2}{13.6}$
(D) $v_1 = v_2$

78. The Young's modulus of the steel is $2 \times 10^{11}$ N/m$^2$ and Poisson's ratio is 0.28 then Bulk modulus is

(A) $15 \times 10^{10}$ N/m$^2$
(B) $11 \times 10^{11}$ N/m$^2$
(C) $15 \times 10^{11}$ N/m$^2$
(D) $12 \times 10^{10}$ N/m$^2$

79. If $\psi = Ce^{ikx}$ is an acceptable wave function in the region $-a \le x \le a$ where $k$ and $C$ are constants. Then the value of normalization constants is

(A) $\frac{1}{\sqrt{2a}}$
(B) $\sqrt{2a}$
(C) $\frac{a}{2}$
(D) $\frac{1}{2a}$

80. Calculate the distance through which the mirror of Michelson's interferometer has to be moved between two consecutive positions of maximum distinctness of sodium lines of wavelength 5896 Å and 5890 Å

(A) 28.9 mm
(B) 2.89 mm
(C) 0.289 mm
(D) 0.0289 mm

81. The relation between critical current and critical magnetic field is

(A) $H_C = \frac{I_C}{\pi r^2}$

(B) $H_C = \frac{I_C}{2\pi r}$

(C) $H_C = \frac{I_C}{2\pi r^2}$

(D) $H_C = 2\pi r^2 I_C$

82. The ground state energy of an electron in a one-dimensional infinite potential well of width 2 Å is 4 eV. Its energy in the third excited state is

(A) 36 eV
(B) 20 eV
(C) 58 eV
(D) 64 eV

83. A wave propagates on a string in the positive $x$-direction at a velocity $v$. The shape of the string at $t = t_o$ is given by $g(x, t_o) = A\sin\left(\frac{x}{a}\right)$. Write the wave equation for a general time $t$.

(A) $g(x,t) = A\sin\left(\frac{v}{a}\right)$

(B) $g(x,t) = A\sin\left(\frac{x+vt}{a}\right)$

(C) $g(x,t) = A\sin\left(\frac{x+vt_o-vt}{a}\right)$

(D) $g(x,t) = A\sin\left(\frac{x-vt}{a}\right)$

84. The spacing between the $n^{\text{th}}$ energy level and the next higher level in a one dimensional potential box increases by

(A) $(2n - 1)$
(B) $(2n + 1)$
(C) $(n - 1)$
(D) $(n + 1)$

85. If the source of light used in a Young's double slit experiment is changed from red to violet

(A) the fringes will become brighter
(B) consecutive fringes will come closer
(C) the intensity of minima will increase
(D) the central bright fringe will become a dark fringe

86. When objects at different distances are seen by the eye, which of the following remains constant?

(A) The focal length of the eye lens
(B) The object distance from the eye lens
(C) The radii curvature of the eye lens
(D) The image distance from the eye lens

87. Young's modulus, rigidity modulus and bulk modulus are related as

(A) $\frac{1}{K} = \frac{1}{3n} + \frac{1}{9Y}$

(B) $\frac{1}{n} = \frac{1}{3Y} + \frac{1}{9K}$

(C) $\frac{1}{Y} = \frac{1}{3K} + \frac{1}{9n}$

(D) $\frac{1}{Y} = \frac{1}{3n} + \frac{1}{9K}$

88. A professor reads a greeting card received on his $50^{th}$ birthday with +2.5 *D* glasses keeping the card 25 cm away. Ten years later, he reads his farewell letter with the same glasses but he has to keep the letter 50 cm away. What power of lens should he now use?

(A) +4.5 *D*
(B) –4.5 *D*
(C) –2.5 *D*
(D) +2.5 *D*

89. The intensity produced by a long cylindrical light source at a small distance $r$ from the source is proportional to

(A) $\frac{1}{r^2}$

(B) $\frac{1}{r}$

(C) $\frac{1}{r^3}$

(D) $\frac{1}{r^4}$

90. If $C_1$ and $C_2$ are the root mean square velocities at densities $\rho_1$ and $\rho_2$ respectively then

(A) $\frac{C_1}{C_2} = \sqrt{\frac{\rho_2}{\rho_1}}$

(B) $\frac{C_1}{C_2} = \sqrt{\frac{\rho_2^2}{\rho_1^2}}$

(C) $\frac{C_1}{C_2} = \sqrt{\frac{\rho_1}{\rho_2}}$

(D) $\frac{C_1}{C_2} = \sqrt{\frac{\rho_1^2}{\rho_2^2}}$

91. The criterion of resolution of optical instrument was given by

(A) Newton
(B) Huygen
(C) Rayleigh
(D) Wien

92. The X ray of wavelength 1.54 Å is used to determine the particle size distribution of nano particle. If constant ($K$) depend on the grain shape is 0.9 , full width at half maxima is $4.8 \times 10^{-3}$ and first order Bragg reflection is observed at an angle ($2\theta$) of 31.769° then the particle size estimated as

(A) 25 nm
(B) 35 nm
(C) 30 nm
(D) 20 nm

93. Which of the following bond is highly directional?

(A) Metallic bond
(B) Covalent bond
(C) Ionic bond
(D) Dispersion

94. The de Broglie wavelength of a photon having the same momentum as that of a 2 keV electron is

(A) 27.4 pm
(B) 2.74 pm
(C) 274 nm
(D) 27.4 μm

95. A wheel of perimeter 220 cm rolls on a level road at a speed of 9 km/h. How many revolutions does the wheel make per second?

(A) $\frac{25}{22}$ rev/sec

(B) $\frac{43}{21}$ rev/sec

(C) $\frac{22}{18}$ rev/sec

(D) $\frac{35}{22}$ rev/sec

96. The magnetic moment associated with the first orbit in hydrogen atom is given by

(A) $\dfrac{h}{4\pi me}$

(B) $\dfrac{4\pi m}{he}$

(C) $\dfrac{eh}{4\pi m}$

(D) $\dfrac{meh}{4\pi}$

97. Above Curie temperature the hysteresis loop of a ferroelectric material merges into a

(A) parabola
(B) point
(C) straight line
(D) ellipse

98. Ultraviolet light of wavelength 350 nm and intensity 1 watt/$m^2$ is directed at a potassium surface having work function 2.2 eV. If 0.5% of the incident photons produce photoelectrons, how many are emitted per second if the potassium surface has an area of 1 $cm^2$.

(A) $8.8 \times 10^{11}$ photoelectrons/sec
(B) $8.8 \times 10^{10}$ photoelectrons/sec
(C) $8.8 \times 10^{12}$ photoelectrons/sec
(D) $8.8 \times 10^{14}$ photoelectrons/sec

99. A sphere of mass *m* rolls on a plane surface. The kinetic energy at an instant when its centre moves with speed *v* is

(A) $\dfrac{3}{10}mv^2$

(B) $\dfrac{10}{9}mv^2$

(C) $\dfrac{1}{2}mv^2$

(D) $\dfrac{7}{10}mv^2$

100. The product of uncertainty between position and momentum is given by

(A) $\Delta x \Delta p = h$

(B) $\Delta x \Delta p \leq \frac{h}{4\pi}$

(C) $\Delta x \Delta p \geq \frac{h}{4\pi}$

(D) $\Delta x \Delta p \leq \frac{h}{2}$

101. A source of sound moves towards an observer. Which of the following statement is **CORRECT**?

(A) The frequency of the source is increased
(B) The velocity of sound in the medium is increased
(C) The wavelength of sound in the medium towards the observer is decreased
(D) The amplitude of vibration of the particles is increased

102. The drift current in a p-n junction is

(A) from the n-side to the p-side
(B) from the p-side to the n-side
(C) from the n-side to the p-side if the junction is forward biased and in the opposite direction if it is reverse biased
(D) from the p-side to the n-side if the junction is forward biased and in the opposite direction if it is reverse biased

103. Which of the following polarization is dependent on temperature?

(A) Migrational polarization
(B) Ionic polarization
(C) Orientation polarization
(D) Electronic polarization

104. The resolving power of microscope is

(A) unlimited
(B) limited by the diameter of the objective lens
(C) limited by the wavelength of the light used
(D) limited by the distance of the object

105. Which of the following pairs of physical quantities may be represented in the same unit?

(A) Heat and Temperature
(B) Temperature and mole
(C) Specific heat and heat
(D) Heat and work

106. Calculate the temperature at which the root mean square velocity of a gas will be half of its value at 0°C, assuming the pressure remains constant.

(A) –204.75°C
(B) –250.25°C
(C) –235.55°C
(D) –245.75°C

107. In an elastic collision,

(A) the initial kinetic energy is equal to the final kinetic energy
(B) the final kinetic energy is less than the initial kinetic energy
(C) the kinetic energy is transformed to potential energy
(D) the kinetic energy first increases then decreases

108. A semiconductor device is connected in a series circuit with a battery and a resistance. A current is found to pass through the circuit. If the polarity of the battery is reversed the current drops to almost zero. The device may be

(A) an intrinsic semiconductor
(B) a p-type semiconductor
(C) a n-type semiconductor
(D) a p-n junction

109. The probability of finding the particle in the lowest energy level, of one dimensional potential well of width L and infinite height, is maximum at

(A) $\frac{L}{2}$

(B) $\frac{L}{3}$

(C) $\frac{L}{6}$

(D) $\frac{L}{4}$

110. The ratio of the de Broglie wavelength of electron and proton having same velocity is

(A) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_p}{m_e}}$

(B) $\frac{\lambda_e}{\lambda_p} = \sqrt{\frac{m_e}{m_p}}$

(C) $\frac{\lambda_e}{\lambda_p} = \frac{m_e}{m_p}$

(D) $\frac{\lambda_e}{\lambda_p} = \frac{m_p}{m_e}$

111. The layer of earth's atmosphere in which the ozone layer is present

(A) Troposphere
(B) Stratosphere
(C) Ionosphere
(D) Mesosphere

112. According to De Morgan's theorem $\overline{A+B} =$

(A) $\bar{A} \cdot \bar{B}$
(B) $\bar{A} + \bar{B}$
(C) $A \cdot B$
(D) $\bar{A} \cdot B$

113. In Piezoelectric effect, the production of electricity is by

(A) chemical effect
(B) varying field
(C) temperature
(D) pressure

114. The drift velocity of electron having mobility $1.32 \times 10^{-3}$ $m^2$/Vs under the field 10 V/cm is

(A) 132 m/s
(B) 0.132 m/s
(C) 1.32 m/s
(D) 13.2 m/s

115. The favourable condition for superconductivity is

(A) a weak electron-phonon interaction
(B) a strong phonon-phonon interaction
(C) a strong electron-phonon interaction
(D) a weak phonon-phonon interaction

116. An organic pipe $P_1$ closed at one end vibrating in its first harmonic another pipe $P_2$ open at both ends vibrating in its third harmonic are in resonance with a given tuning fork. The ratio of the length of $P_1$ to that of $P_2$ is

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

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

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

(D) $\frac{1}{3}$

117. If an electron having de Broglie wavelength 1.2 Å is in the fifth excited state of an infinite potential well, the dimension of the potential well is

(A) 6 Å
(B) 3.6 Å
(C) 2.4 Å
(D) 4.8 Å

118. All mesons have the spin of

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

(B) half integral spin $\left(\frac{1}{2}, \frac{3}{2}, \frac{5}{2}, \ldots\right)$

(C) integral spin (0, 1, 2, …)

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

119. The photon emitted by He-Ne laser is

(A) incoherent
(B) coherent
(C) in the UV region
(D) scattered

120. The penetration depth of lead at 0 K is 37 nm and the critical temperature is 7.193 K. Calculate the London penetration depth at 5.2 K.

(A) 43.4 nm
(B) 37 nm
(C) 53 nm
(D) 25.2 nm

121. The velocity of ultrasonic waves is

(A) greater in solids than in air
(B) equal in solids and air
(C) lower in solids than in air
(D) None of the above

122. The Fermi Dirac distribution function has the form

(A) $f(E) = \frac{1}{e^{\Delta E/kT}}$

(B) $f(E) = \frac{1}{e^{-\Delta E/kT}}$

(C) $f(E) = \frac{1}{e^{\Delta E/kT} + 1}$

(D) $f(E) = \frac{1}{e^{\Delta E/kT} - 1}$

123. Compton wavelength of the electron is

(A) $\dfrac{h}{m_0 c}$

(B) $\dfrac{2h}{m_0 c}$

(C) $\dfrac{h}{2m_0 c}$

(D) $\dfrac{h^2}{m_0 c}$

124. In ferrimagnetic materials the magnetic dipoles are

(A) aligned parallel and are of equal magnitude
(B) aligned anti-parallel and are of equal magnitude
(C) aligned parallel and are of different magnitude
(D) aligned anti-parallel and are of different magnitude

125. The first law of thermodynamics is a statement of

(A) conservation of heat
(B) conservation of work
(C) conservation of momentum
(D) conservation of energy

126. In summer, mild wind is often found on the shore of a calm river. This is caused due to

(A) radiation from the soil
(B) conduction between the air and the soil
(C) difference in thermal conductivity of water and soil
(D) convection currents

127. Compton shift is maximum when photon is scattered by an angle

(A) 0°
(B) 45°
(C) 90°
(D) 180°

128. The thermal conductivity of a rod depends on

(A) Length
(B) Mass
(C) Area of cross section
(D) Material of the rod

129. "Every orbital in a subshell is singly occupied with one electron before any one orbital is doubly occupied and all electrons in singly occupied orbitals have the same spin" is known as

(A) Hund's rule
(B) Pauli's exclusion principle
(C) Moseley's law
(D) Lenz's rule

130. If the mobility of electrons in a metal increases, the resistivity

(A) decreases
(B) increases
(C) remains constant
(D) None of the above

131. The impurity atoms with which pure silicon may be doped to make it a p type semiconductor are

(A) Phosphorous
(B) Antimony
(C) Boron
(D) Arsenic

132. If $E_H, J_x$ and $B_Z$ are the Hall field, current density and magnetic field strength then the Hall constant $R_H$ is given by

(A) $R_H = B_Z J_x E_H$

(B) $R_H = \dfrac{B_Z}{J_x E_H}$

(C) $R_H = \dfrac{J_x E_H}{B_Z}$

(D) $R_H = \dfrac{E_H}{B_Z J_x}$

133. The discrete values of energy the atomic oscillators can have are

(A) $n\hbar\omega^2$

(B) $n\hbar\omega$

(C) $n^2\hbar\omega$

(D) $2n\hbar\omega$

134. The area of cross section of the two arms of a hydraulic press are 1 $cm^2$ and 10 $cm^2$ respectively. A force of 5 N is applied on the water in the thinner arm. What force should be applied on the water in the thicker arm so that the water may remain in equilibrium?

(A) 5 N
(B) 10 N
(C) 50 N
(D) 20 N

135. In superconducting state

(A) entropy increases and thermal conductivity decreases
(B) entropy and thermal conductivity decreases
(C) entropy and thermal conductivity increases
(D) entropy decreases and thermal conductivity increases

136. The Fermi level in an n-type semiconductor at 0 K lies

(A) below the donor level
(B) half way between the conduction band and donor level
(C) coincides with intrinsic Fermi level
(D) half way between the valence band and acceptor level

137. A solid sphere and a disc of same radius are falling along an inclined plane without slipping. One reaches earlier than the other due to

(A) different radius of gyration
(B) different size
(C) different friction
(D) different moment of inertia

138. The intrinsic carrier concentration of Si at 300 K is $1.5 \times 10^{16}/\text{m}^3$. If the mobility of holes and electrons are respectively 0.035 $\text{m}^2$/V-s and 0.048 $\text{m}^2$/V-s respectively then conductivity at 300 K is

(A) $1.99 \times 10^{-4}/\Omega\text{-m}$

(B) $5.02 \times 10^{3}/\Omega\text{-m}$

(C) $2.83 \times 10^{-8}/\Omega\text{-m}$

(D) $3.43 \times 10^{-6}/\Omega\text{-m}$

139. Net outflow of flux through a closed surface enclosing charge $q$ is

(A) $q$

(B) $\frac{1}{q}$

(C) $\frac{q}{\varepsilon_0}$

(D) $\frac{q}{4\pi\varepsilon_0}$

140. The orientational polarizability per molecule in a polyatomic gas is given by

(A) $\frac{\mu_m}{2k_B T}$

(B) $\frac{\mu_m^2}{3k_B T}$

(C) $\frac{\mu_m^3}{3k_B T}$

(D) $\frac{\mu_m^2}{3k_B T^2}$

141. The tunnelling of cooper pair through an insulator layer between two superconductors is known as

(A) Esaki effect
(B) Giaever effect
(C) dc Josephson effect
(D) ac Josephson effect

142. In a dielectric, the power loss is proportional to

(A) $\omega$

(B) $\omega^2$

(C) $\frac{1}{\omega}$

(D) $\frac{1}{\omega^2}$

143. The nuclear volume is proportional to

(A) A

(B) $A^{1/3}$

(C) $A^{2/3}$

(D) $A^{-1/3}$

144. An LED is made up of

(A) Phosphorescent material
(B) Germanium
(C) Silicon
(D) Gallium arsenide

145. Identify the key characteristic of an instrumentation amplifier

(A) High CMRR
(B) High output offset
(C) High output impedance
(D) Zero input impedance

146. According to Debye's theory of specific heats at very low temperatures, the specific heat capacity is

(A) directly proportional to the temperature
(B) inversely proportional to the temperature
(C) directly proportional to the cube of temperature
(D) inversely proportional to the cube of temperature

147. Maxwell's thermodynamic relations make use of

(A) temperature and entropy
(B) pressure and volume
(C) temperature entropy and pressure
(D) temperature entropy, pressure, and volume

148. The diamagnetic behavior of a superconductor is known as,

(A) Meissner effect
(B) London effect
(C) A.C. Josephson effect
(D) D.C. Josephson effect

149. The quantum of energy in an elastic wave is called

(A) Magnon
(B) Exciton
(C) Photon
(D) Phonon

150. The Miller indices of the plane parallel to $y$ and $z$-axes are

(A) (100)
(B) (001)
(C) (010)
(D) (111)

# FINAL ANSWER KEY

**Subject Name: 613 PHYSICS**

| SI No. | Key | SI No. | Key | SI No. | Key | SI No. | Key | SI No. | Key |
|---|---|---|---|---|---|---|---|---|---|
| 1 | A | 31 | B | 61 | B | 91 | C | 121 | A |
| 2 | D | 32 | A | 62 | B | 92 | C | 122 | C |
| 3 | A | 33 | B | 63 | C | 93 | B | 123 | A |
| 4 | B | 34 | D | 64 | A | 94 | A | 124 | D |
| 5 | C | 35 | A | 65 | C | 95 | A | 125 | D |
| 6 | B | 36 | D | 66 | C | 96 | C | 126 | D |
| 7 | A | 37 | A | 67 | C | 97 | C | 127 | D |
| 8 | C | 38 | C | 68 | C | 98 | A | 128 | D |
| 9 | D | 39 | C | 69 | B | 99 | D | 129 | A |
| 10 | C | 40 | B | 70 | D | 100 | C | 130 | A |
| 11 | B | 41 | D | 71 | B | 101 | C | 131 | C |
| 12 | A | 42 | B | 72 | C | 102 | A | 132 | D |
| 13 | C | 43 | A | 73 | A | 103 | C | 133 | B |
| 14 | C | 44 | C | 74 | B | 104 | B | 134 | C |
| 15 | D | 45 | C | 75 | A | 105 | D | 135 | B |
| 16 | B | 46 | D | 76 | A | 106 | A | 136 | B |
| 17 | C | 47 | A | 77 | D | 107 | A | 137 | A |
| 18 | C | 48 | A | 78 | A | 108 | D | 138 | A |
| 19 | A | 49 | C | 79 | A | 109 | A | 139 | A |
| 20 | B | 50 | A | 80 | C | 110 | D | 140 | B |
| 21 | B | 51 | B | 81 | B | 111 | B | 141 | C |
| 22 | C | 52 | C | 82 | D | 112 | A | 142 | A |
| 23 | A | 53 | A | 83 | C | 113 | D | 143 | A |
| 24 | B | 54 | B | 84 | B | 114 | C | 144 | D |
| 25 | B | 55 | B | 85 | B | 115 | C | 145 | A |
| 26 | A | 56 | B | 86 | D | 116 | B | 146 | C |
| 27 | C | 57 | D | 87 | D | 117 | B | 147 | D |
| 28 | D | 58 | D | 88 | A | 118 | C | 148 | A |
| 29 | C | 59 | B | 89 | B | 119 | B | 149 | D |
| 30 | D | 60 | C | 90 | A | 120 | A | 150 | A |