



**BANARAS HINDU UNIVERSITY (B.H.U.)**  
**(Physics) M.Sc. Entrance Examination, 2017**  
**Question Booklet Series – 1**

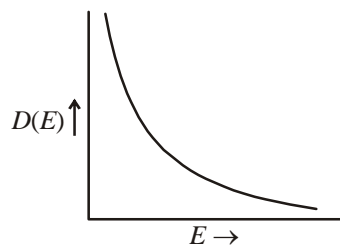
- If  $N$  atoms of a gas is mixed with  $N$  atoms of the same gas, the entropy of mixing of the gases in thermodynamics is  
 (a)  $2 kN \ln 2$       (b)  $kN \ln 2$       (c) zero      (d)  $\ln 2$   
 where  $k$  is Boltzmann constant
- The heat involved in going reversibly between two states can be made integrable when multiplied with an integrating factor  
 (a)  $\frac{1}{V}$       (b)  $T$       (c)  $\frac{1}{T}$       (d)  $S$
- In an isothermal expansion of 10 gm of nitrogen, its volume becomes 4 times of initial volume. The change in entropy of nitrogen if molecular weight of nitrogen = 28 and for 1 gm-mole gas, gas constant  $R = 8.3 \text{ J/mole-K}$ , is  
 (a) 4.1 joule/K      (b) 41 joule/K      (c) 4.1 erg/K      (d) 4.1 cal/K
- The function which remains constant if the thermodynamics process is carried out isobarically and isothermally is called  
 (a) Internal energy      (b) Gibbs' function      (c) Helmholtz function      (d) Enthalpy
- Which of the following gives volume,  $V$ ?  
 (a)  $\left(\frac{\partial G}{\partial P}\right)_T$       (b)  $\left(\frac{\partial U}{\partial V}\right)_S$       (c)  $-\left(\frac{\partial G}{\partial T}\right)_P$       (d)  $\left(\frac{\partial U}{\partial S}\right)_V$   
 where the symbols have their usual meanings.
- Fermi level represents the energy level with probability of its occupation of  
 (a) 0%      (b) 25%      (c) 50%      (d) 100%
- The steady state conditions in diffusion are governed by  
 (a) Fick's second law      (b) Fick's first law      (c) Both (a) and (b)      (d) Maxwell-Boltzmann's law
- The electronic polarizability  $\alpha_e$  of a monoatomic gas atom, if  $r$  is the radius of orbit of electron is  
 (a)  $4\pi \epsilon_0$       (b)  $4\pi \epsilon_0 r$       (c)  $4\pi \epsilon_0 r^3$       (d)  $4\pi \epsilon_0 r^2$
- With increase in temperature, the orientational polarization in general  
 (a) Decreases      (b) Increases      (c) Remains same      (d) None of these
- The probability of occupation of an energy level  $E$ , when  $E - EF = KT$ , is given by  
 (a) 0.73      (b) 0.63      (c) 0.5      (d) 0.27
- The frequency associated with 20 mm wavelength microwaves is  
 (a) 100 MHz      (b) 400 MHz      (c) 73 MHz      (d) 15 GHz



12. Total current density,  $\vec{J}_i$  equals  
 (a) sum of current density due to free charge carriers and displacement current density  
 (b) current density due to free charge carriers only  
 (c) displacement current density only  
 (d) none of these
13. The capacitance of two concentric metal shells, with radii  $a$  and  $b$  is  
 (a)  $\frac{Q}{4\pi\epsilon_0} \left( \frac{1}{a} - \frac{1}{b} \right)$  (b)  $4\pi\epsilon_0 \frac{ab}{(b-a)}$  (c)  $\frac{1}{4\pi\epsilon_0} \cdot \frac{ab}{(b-a)}$  (d)  $4\pi\epsilon_0 Q \left( \frac{1}{a} - \frac{1}{b} \right)$
14. For glass-air interface ( $n_g = 1.5$  and  $n_a = 1$ ) for normal incidence the reflection coefficient is  
 (a) 0.2 (b) 0.04 (c) 0.98 (d) 0.96
15. The total energy density associated with an electromagnetic wave in free space is  
 (a)  $\frac{1}{2} \epsilon_0 E_{\text{rms}}^2$  (b)  $\epsilon_0 E_{\text{rms}}^2$  (c)  $2\epsilon_0 E_{\text{rms}}^2$  (d) None of these
16. Electric flux associated with a small surface area  $d\vec{s}$  in an electric field  $\vec{E}$  is given by  
 (a)  $\vec{E} \cdot d\vec{s}$  (b)  $\epsilon_0 \vec{E} \cdot d\vec{s}$  (c)  $\oint_s \vec{E} \cdot d\vec{s}$  (d)  $\vec{E} \times d\vec{s}$
17. If a Gaussian surface encloses no charge, which of the following is true for a point inside it  
 (a) Electric field must be zero (b) Electric potential is zero  
 (c) Electric field and potential are zero (d) None of these
18. Energy is not transferred by  
 (a) Transverse progressive wave (b) Longitudinal progressive wave  
 (c) Stationary wave (d) Electromagnetic wave
19. The relation between permeability and susceptibility in C.G.S. system is  
 (a)  $\mu = \mu_0(1 + \chi)$  (b)  $\mu = 1 + 4\pi\chi$  (c)  $\mu = \frac{\mu_0}{4\pi}(1 + \chi)$  (d)  $\mu = 1 + \chi$
20. Lorentz unit is  
 (a)  $\frac{eB}{4\pi mc}$  (b)  $\frac{eB}{4\pi m}$  (c)  $\frac{eB}{4\pi hmc}$  (d)  $\frac{eB}{4\pi h}$
21. The unit of magnetic moment is  
 (a) erg-gauss (b)  $\text{erg}^{-1} \text{gauss}^{-1}$  (c) m-gauss (d) Bohr magneton
22. Very low temperature can be produced by  
 (a) Adiabatic demagnetisation of a paramagnetic salt  
 (b) Adiabatic magnetisation of a paramagnetic salt  
 (c) Isothermal magnetisation of diamagnetic salt  
 (d) Isothermal demagnetisation of diamagnetic salt
23. The SI unit of  $\vec{B}$  is  
 (a) Tesla (b) Gauss (c) Tesla mt Amp<sup>2</sup> (d) Amp-mt<sup>2</sup>
24. A solenoid having a resistance of  $5 \Omega$  and self inductance of 4 Henry, is connected to a battery of emf 10 volt and negligible resistance. After how long, current will become 1 A in it ?  
 (a) 1.1 sec (b) 10.55 sec (c) 2 sec (d) 2.2 sec
25. An L-C-R circuit will oscillate if

- (a)  $R > LC$                       (b)  $R < 2\sqrt{\frac{L}{C}}$                       (c)  $R > 2\sqrt{\frac{L}{C}}$                       (d)  $R = \frac{L}{C}$
26. The lag angle between the current and applied emf in a series LR circuit is given by  
 (a)  $\tan^{-1} \frac{1}{WLR}$                       (b)  $\tan^{-1} \frac{WL}{R}$                       (c)  $\tan^{-1} WLR$                       (d)  $\tan^{-1} (R)$
27. The quality factor of a series L-C-R circuit is given by  
 (a)  $\frac{1}{WLR}$                       (b) WCR                      (c)  $\frac{WL}{R}$                       (d) WLR
28. For a good conductor, the skin depth varies as  
 (a) Inversely as angular frequency  $\omega$                       (b) Directly as  $\omega$   
 (c) Inversely as  $\sqrt{\omega}$                       (d) Directly as  $\sqrt{\omega}$
29. The dielectric constant,  $\epsilon$  of water is 80. This does not justify its refractive index  $n = 1.33$ , violating the expression  $n^2 = \epsilon$ . This is because,  
 (a) The water molecule has no permanent dipole moment  
 (b) The boiling point of water is  $100^\circ\text{C}$   
 (c) The two quantities are measured at different frequencies  
 (d) Water is transparent to visible light
30. Propagation of electromagnetic waves in a medium with frequency dependence phase velocity is called  
 (a) Reflection                      (b) Refraction                      (c) Polarization                      (d) Dispersion
31. If  $\sigma$  be conductivity and  $\epsilon$ , permittivity of a medium with sinusoidal time varying electric field  $E$  of angular frequency,  $\omega$ , then the ratio of displacement current density to the conduction current density will be  
 (a)  $\frac{\sigma}{E\epsilon}$                       (b)  $\frac{\omega\epsilon}{\sigma}$                       (c)  $\frac{\sigma}{\omega\epsilon}$                       (d)  $\frac{E\epsilon}{\omega}$
32. For sinusoidally varying electric field, the conduction current and the displacement current differ in phase by  
 (a) 180 degree                      (b) Zero degree                      (c) 90 degree                      (d) 45 degree
33. A bubbled (input inverted) OR gate is equivalent to  
 (a) NOR gate                      (b) NAND gate                      (c) NOT gate                      (d) XNOR gate
34. The most suitable gate for comparing two bits is  
 (a) AND                      (b) OR                      (c) NAND                      (d) X-OR
35. Which of the following gates cannot be used as an inverter ?  
 (a) NAND                      (b) AND                      (c) NOR                      (d) X-NOR
36. How many NOR gates are required to obtain AND operation ?  
 (a) 2                      (b) 3                      (c) 4                      (d) 1
37. The velocity of an electron in first orbit of H atom is (approximately)  
 (a) C                      (b)  $2.2 \times 10^6$  m/sec                      (c)  $5 \times 10^7$  m/sec                      (d)  $22 \times 10^7$  m/sec
38. For overlap interaction between nearest neighbour of the type,  $\phi(r) = B \exp\left(-\frac{r}{\rho}\right)$ ,  $B$  and  $\rho$  are constants, the equilibrium spacing in terms of  $B$  and  $\rho$  is  
 (a)  $\rho \log e B$                       (b)  $\rho/B$                       (c)  $B/\rho$                       (d)  $\rho B$
39. If a charged particle having charge  $q$  and mass  $m$  is accelerated through a potential difference of  $V$  volts, the de-Broglie wavelength associated with the particle is

- (a)  $\frac{h}{\sqrt{2meV}}$       (b)  $\frac{h}{\sqrt{2mqV}}$       (c)  $\frac{h}{\sqrt{2qV}}$       (d)  $\frac{h}{\sqrt{2mV}}$
40. Number of atoms in a unit cell in BCC lattice is  
 (a) 8      (b) 1      (c) 2      (d) 4
41. Atomic packing factor for FCC lattice is approximately  
 (a) 34%      (b) 52%      (c) 68%      (d) 74%
42. Nearest neighbour distance in a simple cubic lattice with lattice parameter  $a$  is  
 (a)  $a\sqrt{\frac{3}{2}}$       (b)  $a$       (c)  $\sqrt{2} a$       (d)  $\sqrt{3} a$
43. For a simple cubic lattice, the ratio of density of point in (111) and (110) planes is  
 (a)  $\frac{2}{3}$       (b)  $\frac{\sqrt{2}}{\sqrt{3}}$       (c)  $\frac{9}{4}$       (d)  $\frac{2}{5}$
44. If Fermi energy of electrons in a metal at some temperature  $T$  is 5.5 eV. the average electron energy at same temperature will be given by  
 (a) 33 eV      (b) 5.5 eV      (c) 3.3 eV      (d) Zero eV
45. Which of the following characteristics does not necessarily apply to an op-amp ?  
 (a) High gain      (b) Low power  
 (c) High input impedance      (d) Low output impedance
46. Common mode gain in a differential amplifier is  
 (a) Very high      (b) Very low      (c) Always unity      (d) Infinite
47. A certain noninverting amplifier has an  $R$  of 1 k $\Omega$  and an  $R_f$  of 100 k $\Omega$ . The closed loop gain is  
 (a)  $10^6$       (b)  $10^3$       (c) 101      (d) 100
48. A phase-shift oscillator has  
 (a) Three RC circuits      (b) Three LC circuits      (c) a T-type circuit      (d) a  $\Pi$ -type circuit
49. The figure given below shows the density of electron states versus energy for a free electron gas in



- (a) Three-dimensions      (b) One-dimension      (c) Two-dimensions      (d) None of these
50. Specific impedance of free space is  
 (a) 377  $\Omega$       (b) 500  $\Omega$       (c) 50  $\Omega$       (d) 100  $\Omega$
51. Zero-point is related to  
 (a) Quantization      (b) Lasers      (c) Uncertainty      (d) Duality
52. Stern-Gerlach experiment demonstrated  
 (a) Uncertainty principle      (b) Quantization of angular momentum  
 (c) Duality      (d) None of these

53. The distance between (100) planes in a simple cubic crystal with unit cell side  $a$  is  
 (a)  $a$  (b)  $\frac{a}{\sqrt{2}}$  (c)  $\frac{a}{\sqrt{3}}$  (d)  $\frac{a}{2}$
54. The term value,  $T$  of a state is  
 (a)  $\frac{E}{hc}$  (b)  $-\frac{E}{hc}$  (c)  $\frac{E}{2\pi hc}$  (d)  $-\frac{E}{2\pi hc}$
55. The spectral term value corresponding to the ionisation potential of Hg-atom is  $84178.5 \text{ cm}^{-1}$ . The ionisation potential of Hg-atom is  
 (a) 15 V (b) 10.4 V (c) 13.6 V (d) 1 V
56. Which of the following best describe the relation between orbital angular momentum and corresponding magnetic moment of electron in an atom?  
 (a)  $\vec{p}_e = \frac{-2m}{e} \vec{\mu}_e$  (b)  $\vec{p}_e = \frac{2m}{e} \vec{\mu}_e$  (c)  $\vec{p}_e = \frac{2m}{\hbar} \vec{\mu}_e$  (d)  $\vec{p}_e = \vec{\mu}_e$
57. If a well collimated beam of Cu is allowed to pass through non-homogeneous magnetic field in Stern-Gerlach experiment, we get  
 (a) One trace (b) Double trace (c) No trace (d) None of these
58. For  $^1S_0$  state  
 (a)  $J = 1$  (b)  $J = 0$  (c)  $J = 3/2$  (d)  $J = 5/2$
59. The magnitude of  $\vec{L}$ , for a d-electron, in one-electron atomic system is  
 (a) 2 (b)  $\sqrt{5} \hbar$  (c)  $\sqrt{3} \hbar$  (d)  $\sqrt{7} \hbar$
60. In alkali spectral series, when one goes towards higher value of  $n$ ,  
 (a) Doublet separation increases (b) Doublet separation decreases  
 (c) Separations remains the same (d) (a) and (c)
61. The transition  $n^2 p \rightarrow 3^2 S$ ,  $n = 3, 4, 5, \dots$  in alkali atom gives  
 (a) Sharp series (b) Principal series (c) Diffuse series (d) Fundamental series
62. In the following lines of a doublet :  

$$^2S_{1/2} \leftarrow ^2P_{1/2}, \quad ^2S_{1/2} \leftarrow ^2P_{3/2}$$
 (a) 1st line is stronger (b) 2nd line is stronger  
 (c) Both lines have the same intensity (d) Intensity of 2nd line is half that of 1st
63. For the level  $^3D_3$ , the Lange's splitting factor  $g$  is  
 (a)  $7/3$  (b)  $5/3$  (c)  $4/3$  (d) Zero
64. In normal Zeeman effect, selection rule  $\Delta M_L = 0$  gives  
 (a)  $\Pi$  components (b)  $\sigma$  components  
 (c) unpolarized components (d)  $\gamma$ -components
65. If one state is occupied (or allowed) for one microparticle and is denied for other particles, the particles are  
 (a) Bosons (b) Fermions (c) Phonons (d) Photons
66. The main component responsible for the fall of gain of an RC coupled amplifier in low frequency range is  
 (a) The active device itself (b) Coupling capacitance

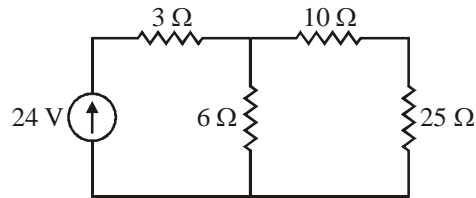
- (c) Load resistance (d) Junction capacitance
67. Compared to a CB amplifier, the CE amplifier has  
 (a) Lower input resistance (b) higher output resistance  
 (c) Lower current amplification (d) Higher current amplification
68.  $r^n \vec{r}$  is solenoidal for  
 (a)  $n = 3$  (b)  $n = -3$  (c)  $n = 2$  (d)  $n = -2$
69. If  $I = \int_0^{\infty} e^{-au^2} du$ , then  
 (a)  $I = \sqrt{\Pi/a}$  (b)  $I = \frac{1}{2} \sqrt{\Pi/a}$  (c)  $I = \frac{3}{8} \sqrt{\frac{\Pi}{a}}$  (d)  $I = \sqrt{\frac{\Pi}{2a}}$
70. The coefficient of  $t^n$  in the expansion of the function  $e^{\frac{x}{2}(t-\frac{1}{t})}$  is called  
 (a) The Legendre function (b) The Bessel function of first kind of order  $n$   
 (c) Laguerre function (d) Hermite polynomial of order  $n$
71.  $H_{n-1}(x) + H_{n+1}(x)$  equals (where terms have their usual meaning)  
 (a)  $\frac{2n}{x} H_n(x)$  (b)  $2n H_n(x)$  (c)  $2H'_n(x)$  (d)  $H_{n+2}(x)$
72. Transpose conjugate of two matrices  $A$  and  $B$  i.e.,  $(AB)^+$  equals  
 (a)  $A^+ B^+$  (b)  $B^+ A^+$  (c)  $B' A'$  (d)  $AB$
73. The product of a singular matrix with its adjoint gives  
 (a) a unitary matrix (b) a null matrix (c) a diagonal matrix (d) None of these
74. The generalised momenta is defined by  
 (a)  $p_j = \frac{\partial L}{\partial q_j}$  (b)  $p_j = \frac{\partial H}{\partial q_j}$  (c)  $p_j = \frac{\partial L}{\partial \dot{q}_j}$  (d)  $p_j = \frac{\partial H}{\partial \dot{q}_j}$
75. If  $\delta(x)$  is delta function then  
 (a)  $x \delta(x) = x$  (b)  $x \delta x = \delta x$  (c)  $x \delta(x) = 0$  (d)  $\delta(x) = \infty$
76. 1 m Curie is equal to  
 (a)  $3.7 \times 10^7$  disintegrations/sec (b)  $3.7 \times 10^{10}$  disintegrations/sec  
 (c)  $10^6$  disintegrations/sec (d)  $10^3$  disintegrations/sec
77. Nuclei with even mass numbers have  
 (a) Zero or integral spin (b) Half integral spin  
 (c) Imaginary spin (d) None of these
78. In Mosley's law,  $\sqrt{v} = a(z-b)$ , the screening constant  $b$  for  $K$  series is  
 (a) 1 (b) 7.4 (c) 19.6 (d) 2.7
79. For crystals, having two atoms per primitive cell, square of angular frequency of lattice vibration is given by

$$\omega^2 = \frac{C/2}{M_1 + M_2} K^2 a^2 \text{ corresponds to}$$

- (a) Optical branch (b) Acoustical branch  
(c) To both acoustical and optical branches (d) Band gap
80. The wave vector associated with free electron at Fermi surface has magnitudes  
(a)  $\left(\frac{2mE_F}{\hbar^2}\right)^{1/2}$  (b)  $\frac{2mE_F}{\hbar^2}$  (c)  $\left(\frac{2m}{\hbar^2}\right)^{1/2}$  (d)  $\left(\frac{2mE_F}{\hbar^2}\right)^{3/2}$
81. The total forward electric current, including the effects of both holes and electrons, in a p-n junction is given by  
(a)  $I = I_0(e^{eV/kT} - 1)$  (b)  $I = I_0(e^{-eV/kT} - 1)$   
(c)  $I = I_0$  (d)  $I = I_0 e^{eV/kT}$   
where the terms have their usual meaning.
82. Compton wavelength  $h/m_e c$  equals  
(a) 0.024 Å (b) 0.012 Å (c) 2.4 nm (d)  $2.4 \times 10^{-11}$  m
83. According to free electron theory of metals, potential experienced by electrons inside the metal is  
(a) A constant large potential (b) A variable potential  
(c) Zero potential (d) Periodic potential
84. Energy equivalent to rest mass of electrons is  
(a) 1.02 MeV (b) 0.51 MeV (c) 1.53 MeV (d) 0.51 keV
85. A particle is moving with 90% of the velocity of light. Ratio of its relativistic mass with its rest mass is  
(a) 2.29 (b) 3.00 (c) 5.00 (d) 2.00
86. In a solenoidal, magnetic field is maximum at  
(a) Its centre (b) Ends (c) Away from it (d) None of these
87. Two interfering coherent waves have amplitudes in the ratio 2 : 1. The ratio of maximum to minimum intensity is  
(a) 9 : 1 (b) 3 : 1 (c) 12 : 1 (d) 4 : 1
88. In Fresnel's biprism, coherent sources are formed due to  
(a) Division of amplitude (b) Multiple reflection  
(c) Division of wavefront (d) Reflection
89. In colour photography  
(a) Progressive wave-formation is used (b) The formation of stationary waves is used  
(c) Diffraction is used (d) Reflection is used
90. In case of Newton's ring, central ring will be dark in  
(a) Reflected system of light (b) Transmitted system  
(c) In reflected as well as transmitted system (d) In case plano-convex lens is silvered
91. Diffraction of light can be exhibited by light with an obstacle having dimension of the order of  
(a) 100 cm (b) 10 cm (c)  $10^{-5}$  cm (d) 10 m
92. At polarising angles, reflected and refracted rays are  
(a) Parallel (b) Antiparallel (c) at  $90^\circ$  (d) at  $45^\circ$



93. The Thevenin equivalent voltage for the network shown is



- (a) 24 V                      (b) 12 V                      (c) 16 V                      (d) 8 V

94. A certain JFET has a  $g_m = 4 \text{ ms}$ . With an ac drain resistance of  $1.5 \text{ k}\Omega$ , the ideal voltage gain is

- (a)  $6 \times 10^3$                       (b) 2.6                      (c) 6                      (d)  $2.6 \times 10^3$

95. The wavelength associated with an electron accelerated through a potential difference 100 V is

- (a)  $1.2 \text{ \AA}$                       (b)  $12.2 \text{ \AA}$                       (c) 12 nm                      (d) 1.22 pm

96. The typical de-Broglie wavelength of an electron in a metal at T kelvin is

- (a)  $\lambda = \frac{1}{\sqrt{3mKT}}$                       (b)  $\lambda = \frac{h}{\sqrt{3mKT}}$                       (c)  $\lambda = \frac{h/2}{\sqrt{3mKT}}$                       (d)  $\lambda = \frac{h}{\sqrt{2mKT}}$

97. Show neutrons are incident on a sample of Uranium containing both  ${}_{92}^{235}\text{U}$  and  ${}_{92}^{238}\text{U}$  isotopes, then

- (a) Both isotopes will undergo fission and breakup  
 (b) Only  ${}_{92}^{235}\text{U}$  atoms undergo fission  
 (c) Only  ${}_{92}^{238}\text{U}$  atoms undergo fission  
 (d) None of the isotopes will break up

98. The half life of  ${}^{218}\text{P}_0$  is 3 minute. What fraction of a 10 gm sample of  ${}^{218}\text{P}_0$  will remain after 15 minutes ?

- (a) 1/5                      (b) 1/25                      (c) 1/32                      (d) 1/64

99. Hard magnetic material is characterized by

- (a) High coercive force and low residual magnetic induction  
 (b) Low coercive force and high residual magnetic induction  
 (c) Only low coercive force  
 (d) High coercive force and high residual magnetic induction

100. The density of carriers in a pure semiconductor is proportional to

- (a)  $\exp\left(\frac{-E_g}{KT}\right)$                       (b)  $\exp\left(\frac{-2E_g}{KT}\right)$                       (c)  $\exp\left(\frac{-E_g}{KT^2}\right)$                       (d)  $\exp\left(\frac{-E_g}{2KT}\right)$

101. Imperfection arising due to the displacement of an ion from a regular site to an interstitial site maintaining overall electrical neutrality of ionic crystal is called

- (a) Frenkel imperfection                      (b) Schottky imperfection  
 (c) Point imperfection                      (d) Volume defect

102. Miller indices of the diagonal plane of a cube are

- (a) (200)                      (b) (111)                      (c) (010)                      (d) (110)

103. If the load resistance of a capacitor filtered full wave rectifier is reduced, the ripple voltage

- (a) Increases                      (b) Decreases                      (c) Is not affected                      (d) has a different frequency

104. If one of the diodes in a bridge full wave rectifier opens, the output is

- (a) 0 V                      (b) One-fourth the amplitude of the input voltage  
 (c) a half-wave rectified voltage                      (d) a 100 Hz voltage



105. When operated in cutoff and saturation, the transistor acts like  
 (a) a linear amplifier (b) a switch (c) a variable capacitor (d) a variable resistor
106. The low frequency response of an amplifier is determined in part by  
 (a) the voltage gain (b) the type of transistor  
 (c) the supply voltage (d) a variable resistor
107. If the rate of change of current in a current carrying coil is unity, then the induced emf is equal to  
 (a) Coefficient of self induction (b) Magnetic flux linked with the coil  
 (c) Number of turns in the coil (d) Thickness of the coil
108. The velocity of the ejected photoelectrons depends upon the  
 (a) Frequency of incident light (b) Intensity of incident light  
 (c) Both (a) and (b) (d) Neither (a) nor (b)
109. In the electron in a hydrogen atom jumps from an orbit with level  $n_i = 3$  to an orbit with level  $n_f = 2$ , the emitted radiation has a wavelength given by  
 (a)  $\lambda = \frac{36}{5R}$  (b)  $\lambda = \frac{5R}{36}$  (c)  $\lambda = \frac{6}{R}$  (d)  $\lambda = \frac{R}{6}$   
 where  $R$  is Rydberg constant.
110. Consider  $\alpha$ -particles,  $\beta$ -particles and  $\gamma$ -rays, each having an energy of 0.5 MeV. In the increasing order of penetrating powers, the radiations are  
 (a)  $\alpha, \beta, \gamma$  (b)  $\alpha, \gamma, \beta$  (c)  $\beta, \gamma, \alpha$  (d)  $\gamma, \beta, \alpha$
111. The wavelength of  $\gamma$ -rays is of the order of  
 (a)  $10^{-7}$  meter (b)  $10^{-10}$  meter (c)  $10^{-12}$  meter (d)  $10^{-8}$  meter
112.  $[L^2, L_x]$  equals  
 (a)  $i\hbar L_x$  (b)  $i\hbar L_y$  (c) Zero (d)  $\hbar L_z$
113. An electron falls from rest in a region with potential difference of 100 V. The de Broglie wavelength associated with electron will be nearly  
 (a) 12.3 nm (b) 1.23 nm (c) 123 nm (d) 0.123 nm
114. An electromagnetic wave going through vacuum is described by  
 $E = E_0 \sin(kx - \omega t)$  and  $B = B_0 \sin(kx - \omega t)$ , then  
 (a)  $E_0 K = B_0 \omega$  (b)  $E_0 B_0 = \omega K$  (c)  $E_0 \omega = B_0 K$  (d)  $\frac{E_0}{B_0} = \omega/K$
115. The energy density of states of an electron in a one-dimensional potential well of infinitely high walls is (the symbols have their usual meaning)  
 (a)  $\frac{L\sqrt{m}}{\pi\hbar\sqrt{2E}}$  (b)  $\frac{Lm}{\pi\hbar\sqrt{E}}$  (c)  $\frac{Lm}{\pi\hbar\sqrt{2E}}$  (d)  $\frac{L\sqrt{m}}{2\pi\hbar E}$
116. The commutator  $[x, px]$ , where  $x$  and  $px$  are position and momentum operator respectively, is  
 (a)  $2i\hbar px$  (b)  $-i\hbar px$  (c)  $2i\hbar x px$  (d)  $-2i\hbar x px$

117. Value of  $[f(x), px^2]$  is
- (a)  $i\hbar$                       (b)  $i\hbar \frac{\partial f}{\partial x}$                       (c)  $i\hbar \frac{\partial f}{\partial px}$                       (d)  $n i\hbar$
118. The equation of states of a dilute gas at very high temperature is described by  $\frac{pV}{K_B T} = 1 + \frac{B(T)}{V}$ , where  $V$  is the volume per particle and  $B(T)$  is a – ve quantity. One can conclude that this is a property of
- (a) a van der Waals' gas                      (b) an ideal Fermi gas  
(c) an ideal Bose gas                      (d) an ideal inert gas
119. Which of the following relations between the particle number density  $n$  and temperature  $T$  must hold good for a gas consisting of non-interacting particles to be described by quantum statistics ?
- (a)  $\frac{n}{T^{1/2}} \ll 1$                       (b)  $\frac{n}{T^{3/2}} \ll 1$   
(c)  $\frac{n}{T^{3/2}} \gg 1$                       (d)  $\frac{n}{T^{1/2}}$  and  $\frac{n}{T^{3/2}}$  can have any values
120. If the kinetic energy of a body is twice its rest mass energy, what will be the ratio of relativistic mass to the rest mass of the body
- (a) 3                      (b) 1                      (c)  $\frac{1}{2}$                       (d) 2

