

GATE PH - 2012

EE24BTECH11061 - Rohith Sai

SINGLE CORRECT 1 MARK EACH

- 1) Identify the CORRECT statement for the following vectors $\mathbf{a} = 3i + 2j$ and $\mathbf{b} = i + 2j$
- a) The vectors \mathbf{a} and \mathbf{b} are linearly independent
 b) The vectors \mathbf{a} and \mathbf{b} are linearly dependent
 c) The vectors \mathbf{a} and \mathbf{b} are orthogonal
 d) The vectors \mathbf{a} and \mathbf{b} are normalized
- 2) Two uniform thin rods of equal length, L , and masses M_1 and M_2 are joined together along the length. The moment of inertia of the combined rod of length $2L$ about an axis passing through the mid-point and perpendicular to the length of the rod is,
- a) $(M_1 + M_2) \frac{L^2}{12}$
 b) $(M_1 + M_2) \frac{L^2}{6}$
 c) $(M_1 + M_2) \frac{L^2}{3}$
 d) $(M_1 + M_2) \frac{L^2}{2}$
- 3) The space-time dependence of the electric field of a linearly polarized light in free space is given by $x E_0 \cos(\omega t - kz)$ where E_0 , ω and k are the amplitude, the angular frequency and the wavevector, respectively. The time averaged energy density associated with the electric field is
- a) $\frac{1}{4} \epsilon_0 E_0^2$
 b) $\frac{1}{2} \epsilon_0 E_0^2$
 c) $\epsilon_0 E_0^2$
 d) $2\epsilon_0 E_0^2$
- 4) If the peak output voltage of a full wave rectifier is 10 V, its d.c. voltage is
- a) 10.0 V
 b) 7.07 V
 c) 6.36 V
 d) 3.18 V
- 5) 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

$$V(x, y) = 0 \text{ for } -a < x < a \text{ and } -a < y < a \\ = \infty \text{ elsewhere}$$

The energy of the first excited state for this particle is given by,

- a) $\frac{\pi^2 \hbar^2}{mq^2}$ c) $\frac{5\pi^2 \hbar^2}{2mq^2}$
 b) $\frac{2\pi^2 \hbar^2}{ma^2}$ d) $\frac{4\pi^2 \hbar^2}{ma^2}$

6) The isothermal compressibility, κ of an ideal gas at temperature T_0 and volume V_0 , is given by

- a) $-\frac{1}{V_0} \frac{\partial V}{\partial P} \Big|_{T_0}$ c) $-V_0 \frac{\partial P}{\partial V} \Big|_{T_0}$
 b) $\frac{1}{V_0} \frac{\partial V}{\partial P} \Big|_{T_0}$ d) $V_0 \frac{\partial P}{\partial V} \Big|_{T_0}$

7) The ground state of sodium atom (^{11}Na) is a $^2S_{1/2}$ state. The difference in energy levels arising in the presence of a weak external magnetic field B , given in terms of Bohr magneton, μ_B , is

- a) μ_B c) $4\mu_B$
 b) $2\mu_B$ d) $6\mu_B$

8) For an ideal Fermi gas in three dimensions, the electron velocity v_F at the Fermi surface is related to electron concentration n as,

- a) $v_F \propto n^{2/3}$ c) $v_F \propto n^{1/2}$
 b) $v_F \propto n$ d) $v_F \propto n^{1/3}$

9) Which one of the following sets corresponds to fundamental particles?

- a) proton, electron and neutron c) electron, photon and neutrino
 b) proton, electron and photon d) quark, electron and meson

10) In case of a Geiger-Muller (GM) counter, which one of the following statements is CORRECT?

- a) Multiplication factor of the detector is of the order of 10^{10} c) Energy of the particles detected can be distinguished
 b) Type of the particles detected can be identified d) Operating voltage of the detector is few tens of Volts

11) A plane electromagnetic wave traveling in free space is incident normally on a glass plate of refractive index $\frac{3}{2}$. If there is no absorption by the glass, its reflectivity is

- a) 4% c) 20%
 b) 16% d) 50%

12) A Ge semiconductor is doped with acceptor impurity concentration of 10^{15} atoms/cm³. For the given hole mobility of 1800 cm²/V-s, the resistivity of this material is

