# PH:PHYSICS-2013

AI24BTECH11005 - Bhukya Prajwal Naik

27) If $\mathbf{A}$ and $\mathbf{B}$ are constant vectors, then $\nabla(\mathbf{A}\cdot\mathbf{B}\times\mathbf{r})$ is

a) $\mathbf{A}\cdot\mathbf{B}$ b) $\mathbf{A}\times\mathbf{B}$ c) $\mathbf{r}$ d) Zero

28) $\Gamma(n+\frac{1}{2})$ is equal to [Given $\Gamma(n+1)=n\Gamma(n)$ and $\Gamma(1/2)=\sqrt{\pi}$]

a) $\frac{n!}{2^n}\sqrt{\pi}$ b) $\frac{2n!}{n!2^n}\sqrt{\pi}$ c) $\frac{2n!}{n!2^{2n}}\sqrt{\pi}$ d) $\frac{n!}{2^{2n}}\sqrt{\pi}$

29) The relativistic form of Newton's second law of motion is

a) $F=\frac{mc}{\sqrt{c^2-v^2}}\frac{dv}{dt}$ b) $F=\frac{m\sqrt{c^2-v^2}}{c}\frac{dv}{dt}$ c) $F=\frac{mc^2}{c^2-v^2}\frac{dv}{dt}$ d) $F=m\frac{c^2-v^2}{c^2}\frac{dv}{dt}$

30) Consider a gas of atoms obeying Maxwell-Boltzmann statistics. The average value of $e^{i\mathbf{a}\cdot\mathbf{p}}$ over all the momenta $\mathbf{p}$ of each of the particles (where $\mathbf{a}$ is a constant vector and $a$ is its magnitude, $m$ is the mass of each atom, $T$ is temperature and $k$ is Boltzmann's constant) is,

a) One b) Zero c) $e^{-\frac{1}{2}a^2mkT}$ d) $e^{-\frac{3}{2}a^2mkT}$

31) The electromagnetic form factor $F(q^2)$ of a nucleus is given by,

$$F(q^2)=\exp[-\frac{q^2}{2Q^2}]$$

where $Q$ is a constant. Given that

$$F(q^2)=\frac{4\pi}{q}\int_0^\infty rdr\rho(r)\sin qr$$

$$\int d^3r\rho(r)=1$$

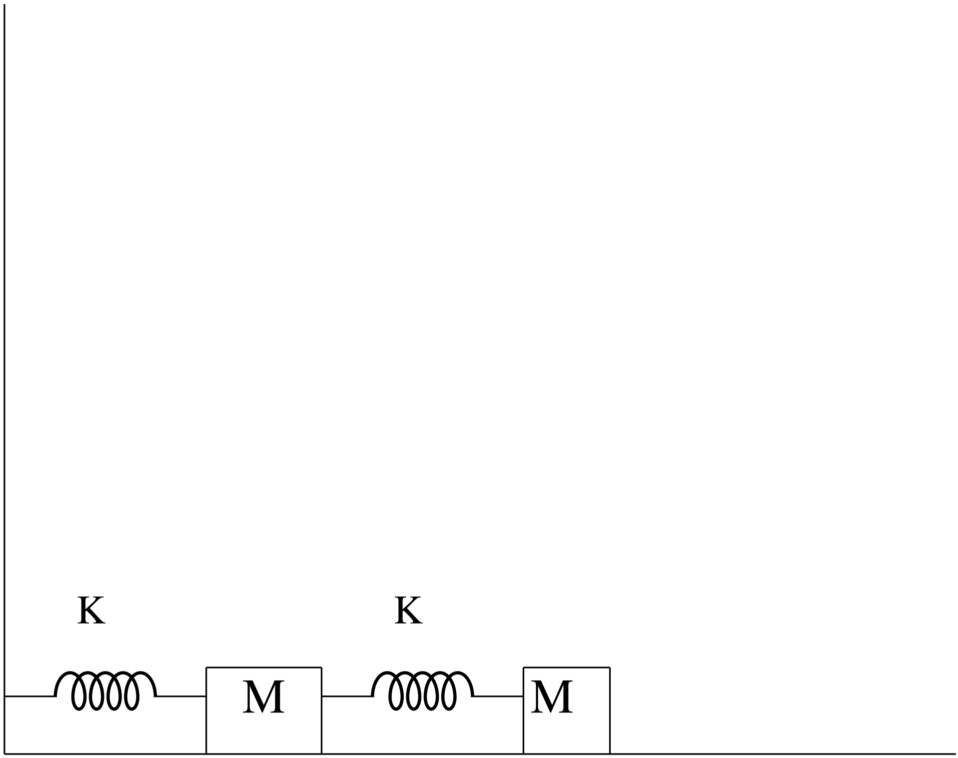
where $\rho(r)$ is the charge density, the root mean square radius of the nucleus is given by, Primeval

a) $\frac{1}{Q}$ b) $\frac{\sqrt{2}}{Q}$ c) $\frac{\sqrt{3}}{Q}$ d) $\frac{\sqrt{6}}{Q}$

32) A uniform circular disk of radius $R$ and mass $M$ is rotating with angular speed $\omega$ about an axis, passing through its center and inclined at an angle 60 degrees with respect to its symmetry axis. The magnitude of the angular momentum of the disk is,

a) $\frac{\sqrt{3}}{4}\omega MR^2$ b) $\frac{\sqrt{3}}{8}\omega MR^2$ c) $\frac{\sqrt{7}}{8}\omega MR^2$ d) $\frac{\sqrt{7}}{4}\omega MR^2$

33) Consider two small blocks, each of mass $M$, attached to two identical springs. One of the springs is attached to the wall, as shown in the figure. The spring constant of each spring is $k$. The masses slide along the surface and the friction is negligible. The frequency of one of the normal modes of the system is,




a) $\sqrt{\frac{3+\sqrt{2}}{2}}\sqrt{\frac{k}{M}}$ b) $\sqrt{\frac{3+\sqrt{3}}{2}}\sqrt{\frac{k}{M}}$ c) $\sqrt{\frac{3+\sqrt{5}}{2}}\sqrt{\frac{k}{M}}$ d) $\sqrt{\frac{3+\sqrt{6}}{2}}\sqrt{\frac{k}{M}}$

34) A charge distribution has the charge density given by $\rho = Q\{\delta(x - x_0) - \delta(x + x_0)\}$. For this charge distribution the electric field at $(2x_0, 0, 0)$

a) $\frac{2Q\hat{x}}{9\pi\epsilon_0 x_0^2}$ b) $\frac{Q\hat{x}}{4\pi\epsilon_0 x_0^3}$ c) $\frac{Q\hat{x}}{4\pi\epsilon_0 x_0^2}$ d) $\frac{Q\hat{x}}{16\pi\epsilon_0 x_0^2}$

35) A monochromatic plane wave at oblique incidence undergoes reflection at a dielectric interface. If $\hat{k}_i, \hat{k}_r$ and $\hat{n}$ are the unit vectors in the directions of incident wave, reflected wave and the normal to the surface respectively, which one of the following expressions is correct?

a) $(\hat{k}_i - \hat{k}_r) \times \hat{n} \neq 0$ b) $(\hat{k}_i - \hat{k}_r) \cdot \hat{n} = 0$ c) $(\hat{k}_i \times \hat{n}) \cdot \hat{k}_r = 0$ d) $(\hat{k}_i \times \hat{n}) \cdot \hat{k}_r \neq 0$

36) In a normal Zeeman effect experiment, spectral splitting of the line at the wavelength 643.8 nm corresponding to the transition $5^1D_2 \rightarrow 5^1P_1$ of cadmium atoms is to be observed. The spectrometer has a resolution of 0.01 nm . The minimum magnetic field needed to observe this is ($m_e = 9.1 \times 10^{-31}$ $kg, e = 1.6 \times 10^{-19} C, c = 3 \times 10^8$ m/s. )

a) $0.26T$
b) $0.52T$
c) $2.6T$
d) $5.2T$

37) The spacing between vibrational energy levels in CO molecule is found to be $8.44 \times 10^{-2}$eV. Given that the reduced mass of CO is $1.14 \times 10^{-26}$ kg, Planck's constant is $6.626 \times 10^{-34}$Js and 1eV = $1.6 \times 10^{-19}$ J. The force constant of the bond in CO molecule is

a) 1.87 $N/m$ b) 18.7 $N/m$ c) 187 $N/m$ d) 1870 $N/m$

38) A lattice has the following primitive vectors (in Å ): $\mathbf{a} = 2(\hat{j}+\hat{k})$, $\mathbf{b} = 2(\hat{k}+\hat{i})$, $\mathbf{c} = 2(\hat{i} + \hat{j})$. The reciprocal lattice corresponding to the above lattice is

a) BCC lattice with cube edge of $(\frac{\pi}{2})$Å$^{-1}$
b) BCC lattice with cube edge of $(2\pi)$Å$^{-1}$
c) FCC lattice with cube edge of $(\frac{\pi}{2})$Å$^{-1}$
d) FCC lattice with cube edge of $(2\pi)$Å$^{-1}$

39) The total energy of an ionic solid is given by an expression $E = -\frac{\alpha e^2}{4\pi\epsilon_0 r} + \frac{B}{r^9}$ where $\alpha$ is Madelung constant , r is the distance between the nearest neighbours in the crystal and B is the constant . If $r_0$ is the equilibrium distance between the nearest neighbours then the value of B is

a) $\frac{\alpha e^2 r_0^8}{36\pi\epsilon_0}$
b) $\frac{\alpha e^2 r_0^8}{4\pi\epsilon_0}$
c) $\frac{2\alpha e^2 r_0^10}{9\pi\epsilon_0}$
d) $\frac{\alpha e^2 r_0^10}{36\pi\epsilon_0}$