Name:

Physics 51
Homework #18
November 14, 2016

38-P5*, 35-E12, 35-P1, 35-E9

38-P5* A cube of edge a has its edges parallel to the x, y, and z axes of a rectangular coordinate system. A uniform electric field $\vec{\mathbf{E}}$ is parallel to the y axis and a uniform magnetic field $\vec{\mathbf{B}}$ is parallel to the x axis. Calculate

(a) the rate at which, according to the Poynting vector point of view, energy may be said to pass through each face of the cube and

(b) the net rate at which the energy stored in the cube may be said to change.

■

35-E12 The dipole moment associated with an atom of iron in an iron bar is $2.22\,\mu_{\mathrm{B}}$. Assume that all the atoms in the bar, which is 4.86 cm long and has a cross-sectional area of $1.31\,\mathrm{cm}^2$, have their dipole moments aligned.

(a) What is the dipole moment of the bar?

(b) What torque must be exerted to hold this magnet at right angles to an external field of 1.53 T?

■

35-P1 A thin, plastic disk of radius R has a charge q uniformly distributed over its surface. If the disk rotates at an angular frequency ω about its axis, show that magnetic dipole moment of the disk is

$$\mu = \frac{\omega q R^2}{4}.$$

(Hint: The rotating disk is equivalent to an array of current loops.)

■

35-E9 In the lowest energy state of the hydrogen atom, the most probable distance between the single orbiting electron and the central proton is 5.29×10^{-11} m. Calculate

(a) the electric field and

(b) the magnetic field

set up by the proton at this distance, measured along the proton's axis of spin. See Table 35-1 for the magnetic moment of the proton.

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