Physics 322 Homework Set #1 Winter 2009

Due in class 1/16/09

1. Problem 5.1 in your textbook.

2. Problem 5.2 in your textbook.

3. A current, I, flows in the $\hat{z}$ direction down a wire that has a square cross section of side length a.

a.) If the current is uniformly distributed on the surface of the wire, what in the surface current density, $\vec{K}$?

b.) If the current is uniformly distributed within the volume of the wire, what is the volume current density, $\vec{J}$?

c.) If the current is distributed in the volume such that $\vec{J}(x,y) = \vec{J}_0(x^2+y^2)/a^2$, what is $\vec{J}_0$ in terms of I and a ? (Here, $\vec{J}_0$ is a constant and the center of the wire is at $(x,y) = (0,0)$.)

4. a.) A uniformly charged cylinder (ρ = constant within the cylinder) of radius, b, and length, L, rotates about its axis at a constant angular velocity, ω. The total charge of the cylinder is Q. What is the current density, $\vec{J}$, within the cylinder?

b.) A uniformly charged sphere of radius, a, centered at the origin rotates about the $\hat{z}$ axis at a constant angular velocity, ω. The total charge of the sphere is Q. What is the current density, $\vec{J}(r,\theta,\phi)$, within the sphere?

c.) A disk rotates at constant angular velocity. ω, about its axis. The disk carries a uniform surface charge per unit area, σ. What is the surface current density, $\vec{K}$, at a distance, s, from the rotation axis?

5. Problem 5.8 in your textbook.

6. Problem 5.11 in your textbook.