Homework 10

Due Friday 5/2/2014 by 5pm in my box in physics or in the box outside my office if the physics office is locked. If you want the homework graded before the final exam, get the homework to me by noon May 1st.

Griffiths' 4 Problems (3rd Edition numbers are the same)

7.1(a) and (b)

7.4

7.8

7.12

7.13

7.15

7.16

Problem E.10.1 A wire of length 2ℓ runs along the x-axis and is centered at the origin. The wire is thinner in the middle than at the two ends. The cross-sectional area of the wire is given by $A(x) = A_0(a^2 + x^2)$, where A_0 and a are constants. Make the approximation that the current density depends only on x. Compute the resistance of the wire.

Problem E.10.2 The $x - y$ plane is the boundary between two regions $z > 0$ and $z < 0$ with different electric and magnetic fields. The fields below the plane are

$$\vec{E}_- = \gamma(\hat{x} + 2\hat{y})$$

and

$$\vec{B}_- = \alpha(\hat{x} + \hat{z})$$

The plane has a surface charge density σ and a surface current density $\vec{K} = \Gamma\hat{y}$. Γ, γ, and α are constants. Find the electric and magnetic field above the plane ($z > 0$). Note, while this problem is electro/magnetostatic, it could be altered to include time dependent terms.

Problem E.10.3 A circular ring of conducting wire is in a region with changing magnetic field as shown below. The radius of the ring is increasing as $a(t) = a_1 t^2$, where a_1 is constant. The magnetic field is $B(t) = B_0 t^2$ in the direction drawn with B_0 constant. The conductivity of the wire is σ and it has cross-sectional area A_w. Compute the current flowing the the wire as a function of time and give its direction.