ECEN 3400 Spring 2014	Homework #3	**Vince Coghlan**

1) **9.18:**

The inner conductor of the coaxial cable in Fig. P9.18 can slide along the cylindrical hole inside the dielectric filling. If the cable is connected to a voltage V, find the electric force acting on the inner conductor.

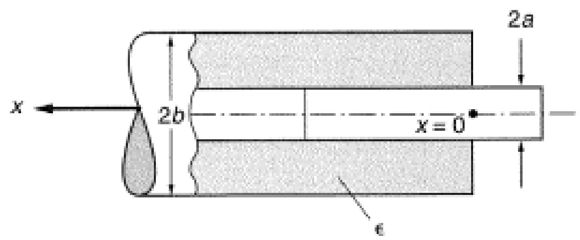

Figure P9.18 Coaxial cable with sliding conductor

The capacitance of a length of cable will be:

$$C = \frac{2\pi\epsilon_1 x}{\ln(b/a)} + \frac{2\pi\epsilon_0 (L-x)}{\ln(b/a)}$$

The Electric force will be:

$$F = \frac{dW}{dx}$$

where

$$W = \frac{1}{2}CV^2 = \frac{1}{2}\left(\frac{2\pi\epsilon_1 x}{\ln(b/a)} + \frac{2\pi\epsilon_0 (L-x)}{\ln(b/a)}\right)V^2$$

This means that:

$$F = \frac{V^2\pi(\epsilon_1 - \epsilon_0)}{\ln(b/a)}$$

2) **10.3:**

A conductive wire has the shape of a hollow cylinder with inner radius a and outer radius b. A current I flows through the wire. Plot the current density as a function of radius, $J(r)$. If the conductivity of the wire is σ, what is the resistance of the wire per unit length?

The current density will be

$$J = \frac{I}{A} = \frac{I}{\pi b^2 - \pi a^2}$$

The resistance of the wire will be $\frac{A}{\sigma L}$ and so the resistance per unit length will be $\frac{A}{\sigma}$ or $\frac{\pi(b^2-a^2)}{\sigma}$.

3) **10.8:**

The resistivity of a wire segment of length l and cross-sectional area S varies along its length as $\rho(x) = \rho_0(1 + x/l)$. Determine the wire segment resistance.

Since

$$\rho(x) = \rho_0(1 + x/l)$$

and

$$R = \rho\frac{l}{A}$$

then

$$R(x) = \rho_0(1 + \frac{x}{l})\frac{l}{A}$$

$$R(x) = \frac{\rho_0 l}{A} + \frac{\rho_0 x}{A}$$

4) **11.11:**

Find the expression for determining resistivity from a four-point probe measurement, as in Fig. P11.11.

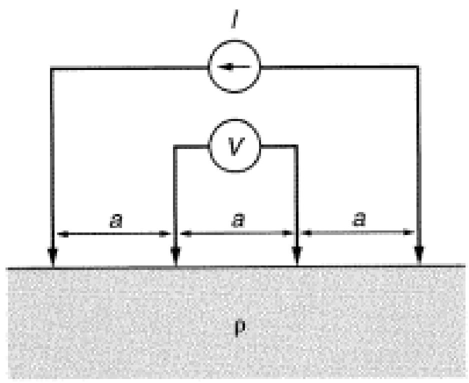

Figure P11.11 A four-point probe measurement

The potential we are going to measure can be found as in the example problem:

$$V = \int_{\text{probe 1}}^{\text{probe 2}} E \cdot dl = \int_{\text{probe 1}}^{\text{probe 2}} \rho J \cdot dl$$

The first thing we need to do is find the current density:

$$J = \frac{I}{A}$$

Then we can form the integral:

$$V = \int_{\text{probe 1}}^{\text{probe 2}} \frac{RI}{l} \cdot dl = RI \ln 2a$$

And we find

$$\rho = \frac{Vl}{IA \ln 2a}$$

According to the internet the equation should be:

$$\rho = \frac{V\pi}{I \ln 2}$$

Which is not what I have, so I dont know where I went wrong.

5) **12.6:**

(1) Find the magnetic flux density vector at point P in the field of two very long straight wires with equal currents I flowing through them. Point P lies in the symmetry plane between the two wires and is x away from the plane defined by the two wires. The front view of the wires is shown in Fig. P12.6a, and the top view in Fig. P12.6b. (2) What is the magnetic flux density equal to at any point in that plane if the current in one wire is I and in the other $-I$?

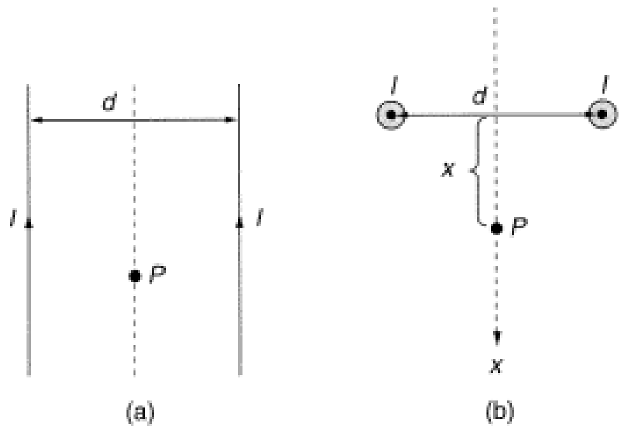

Figure P12.6 Two wires with equal currents:
(a) front view, (b) top view

6) **12.7:**

Determine the magnetic flux density along the axis normal to the plane of a circular loop. The loop radius is a and current intensity in it is I.

7)

Look up the properties of nichrome wire used in many heating elements. I am leaving it up to you to decide what are the 6 most relevant properties as far as an electric heater is concerned. Summarize them in a table. List your source (it cannot be Wikipedia, but you can use it to help you find sources.)

8)

Look up the smallest and largest current that electric fuses are manufactured for. What are they made of and how large are they? List your sources, same comment as above.