VE230 Quiz 3

1 Question 1

(a) Starting with Ohm's law as expressed in Eq(1) applied to a resistor of length l, conductivity σ, and uniform cross-section S, verify the point form of Ohm's law represented by Eq(2).

$$V_{12} = (\frac{l}{\sigma S})I = RI \tag{1}$$

$$\mathbf{J} = \sigma \mathbf{E} \;\; (A/m^2) \tag{2}$$

(b) A long,wound wire of radius α and conductivity σ is coated with a material of conductivity 0.1σ. What must be the thickness of the coating so that the resistance per unit length of the uncoated wire is reduced by 50%?

(c) Suppose we have the same coated wire as in part (b). Assuming a total current I in the coated wire, find $\mathbf{J}$ and $\mathbf{E}$ in both the core and the coating material.

2 Question 2

Two lossy dielectric media with permitivities and conductivities (ϵ_1, σ_1) and (ϵ_2, σ_2) are in contact. An electric field with a magnitude E_1 is incident from medium 1 upon the interface at an angle α_1 measured from the common normal, as in Figure.1
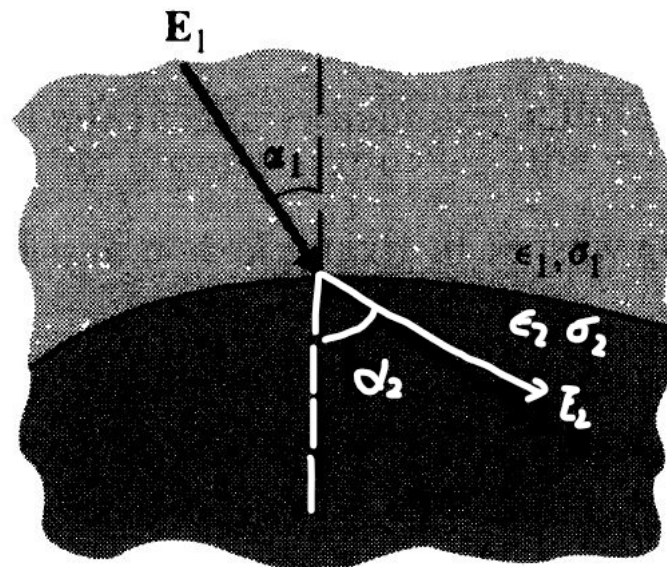

Figure 1: Boundary between two lossy dielectric media

(a) Find the magnitude and direction of $\mathbf{E_2}$ in medium 2.
(b) Find the surface charge density at the interface.
(c) Compare the results in parts(a) and (b) with the case in which both media are perfect dielectrics.