ENEE 380

For the purpose of studying for Exam II (Spring '09) Here are some problems that appeared on past exams.

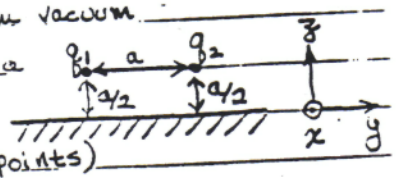
Problem 2: A very thin, uncharged, perfectly conducting, spherical shell has an outer radius R_0. Initially the space inside the shell and outside the shell is vacuum. Then gas is continuously pumped into the region surrounded by the shell. When the gas pressure inside the shell reaches a critical value p_0, the shell explodes.

Now consider an identical shell with vacuum inside and outside the shell. An amount of charge Q is deposited on the shell.

(a) What is the total electrostatic energy in this configuration?

(b) What is the largest Q can be without causing the shell to explode?

Problem 2. Two point charges are located in vacuum in $z \geq 0$ with the region $z < 0$ occupied by a perfect conductor. See diagram.



(a) What is the force $\underline{F}_1$ acting on q_1? (12 points)

(b) What is the total charge on the surface of the perfect conductor ($z=0$)?

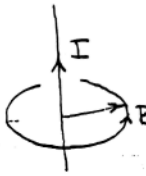
Problem 1 A long round wire of radius a and conductivity σ is coated with a material of conductivity 2σ and thickness $a/4$.

(a) Assuming that a voltage V_0 is applied across a length l of this wire, find $\underline{J}$ and $\underline{E}$ in the core ($r<a$) and the coating material ($a<r<5a/4$).

(b) What is the resistance per unit length?

over →

Given information for problems 3 and 4



The magnetic field from an infinitely long thin straight wire carrying a current I along the z-axis in the positive z-direction is $\underline{B} = (\mu_0 I / 2\pi r)\, \underline{a}_\phi$.

Problem 3 Derive the above result for $\underline{B}$ using Ampere's law.

Problem 4 An infinitely long line current carries a current of 1 Ampere along the x-axis in the positive x-direction. A second infinitely long line current carries a 2 Ampere current along the y-axis in the positive y-direction. What is $\underline{B}$ at $x=y=z=1$ meter?

Problem 5 The region $x<0$ is vacuum. The region $x>0$ has a magnetic permeability $\mu = 2\mu_0$. The magnetic field in $x<0$ is $\underline{B} = (5\underline{a}_x + 4\underline{a}_y + 3\underline{a}_z)$ Webers/m^2. What is $\underline{B}$ in $x>0$?