EECS117a, Spring 1994
Midterm 1
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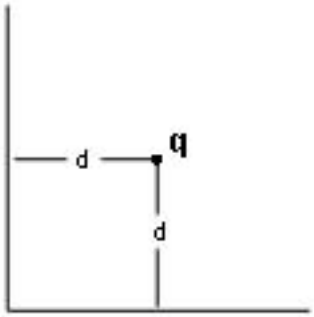
First Midterm
closed book, each problem equal weight

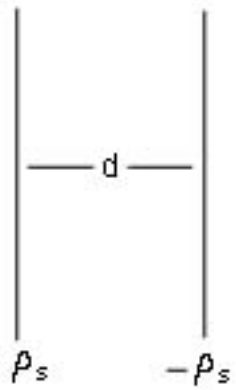
Problem #1

For a charge *q* above two sheets of metal forming a corner, as shown in the diagram, calculate the actual electric fields, in the metal sheets, and in the space above and below the metal sheets. Find the total force on the charge, including its direction. Find an expression for the charge distribution induced on the surface of the metal sheets.



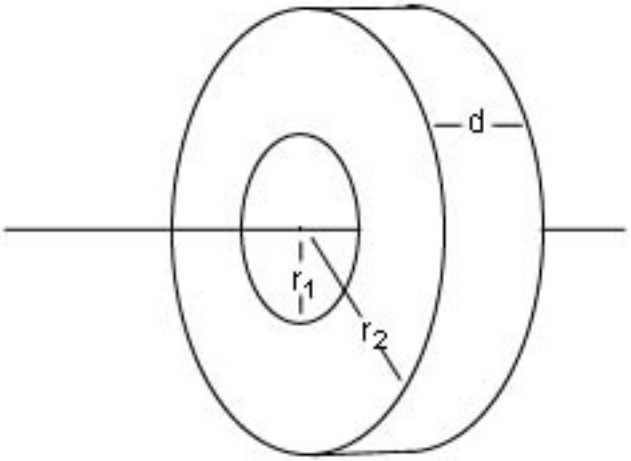
Problem #2

Using Gauss's Law, find the fields around and between two sheets of charge, with a sheet charge density of *RHOs* on one and *-RHOs* on the other. Find the potential difference between the sheets. How much energy is consumed per unit area to bring these charges into this configuration?



Problem #3

Find the additional inductance added to a straight wire by placing a ferite bead around it, if the ferrite bead has an inside radius of *r1* , and outside radius of *r2* , a thickness of *d* , and a permeability of *mu* .



Problem #4

Use the appropriate theorem (Divergence, Gauss's or Stokes', etc., to simplify and solve the following problems.

4a)

given:

$$\vec{D} = \hat{x}x + \hat{y}xy^2z - \hat{z}xyz^2$$

determine the value of the total surface integral

$$\oint\oint D \cdot \hat{n}\,dS$$

where S is the surface of a cube bounded by the planes where x = 0, x = a, y = 0, y = a, z = 0, z = a.

4b)

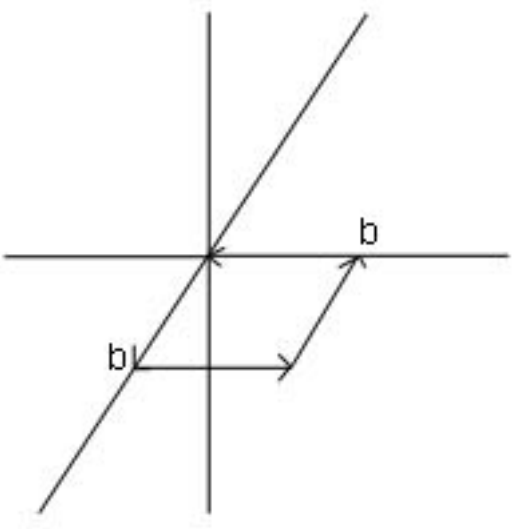
Given

$$\vec{H} = \hat{x}(2xy^2z - 8y) + \hat{y}2x^2y - \hat{z}(x^2z^2 + y^2)$$

Determine the value of the line integral

$$\oint \vec{H} \cdot d\vec{l}$$

taken in the x-y plane over the square shown in the diagram along the straight lines from the point (x = 0, y = 0, z = 0) to the point (x = b, y = 0, z = 0), from (x = 0, y = 0, z = 0) to (x = b, y = b, z = 0), from (x = b, y = b, z = 0) to (x = 0, y = b, z = 0), from (x = 0, y = b, z = 0) to (x = 0, y = 0, z = 0).



Problem #5

A coil of N turns is tightly and uniformly wound on a wooden (*mu = mu0*) torroidal core as shown. Using the circuital law {integral of}H*d*l = I, investigate the possible components of the magnetic field, (i.e. H*phi*, H*r*, H*z*).
What components exist and where. (do not calculate them). Determine the magnetic field within the core, i.e. within the cross section ($b < r < b + a$)