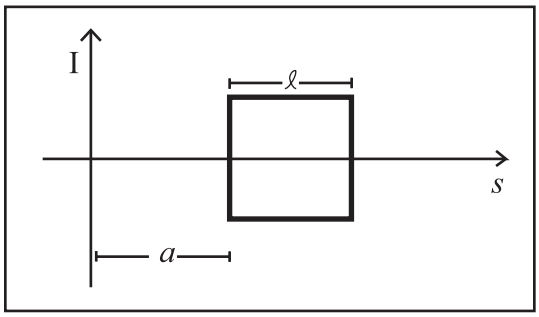
Electricity and Magnetism - Practice Final Exam 2- Spring 2014

Work four of the six problems. Place the problems in the order you wish them graded. The first two problems form the first half test; the second two problems form the second half test. If you turn in all six problems, then 75% of your score on the last two problems will be used to replace your lowest test score (for better of worse).

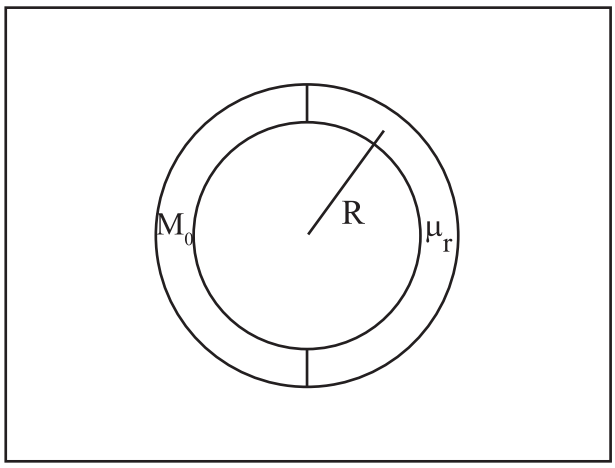
Problem 4.1 A copper pipe has inner radius a and outer radius b. The pipe is a length ℓ long. The conductivity of the copper increases exponentially with ℓ., $\sigma(x) = \sigma_0 \exp(x/\ell)$. Compute the resistance of the pipe.

Problem 4.2 An infinite straight wire carries a time varying current $I(t) = I_0 \sin(\omega t)$. A distance a from a square loop of wire with resistance R and side length ℓ. Both the infinite wire and the loop are in the plane of the page. Compute the current induced in the square loop.



Problem 4.3 A cylindrical region of space of radius a co-axial with the z axis contains a time varying electric field $\vec{E}(t) = E_0 \sin(\omega t)\hat{z}$ where E_0 and ω are constant. Compute the magnetic field in the region.

Problem 4.4 A ring of radius R is composed a permanent magnetic material with magnetization M_0 and a linear magnetic material with relative permeability μ_r. Each occupy half the radius as drawn. Compute the magnetic field in the linear magnetic material.



Problem 4.5 A spherically symmetric system of electric charge has volume charge density $\rho = \gamma r$ for $r < a$ and $\rho = 0$ for $r > a$. The region $r < a$ also contains a linear dielectric with dielectric constant κ. Compute $\vec{D}$ and $\vec{E}$ everywhere.

Problem 4.6 A disk of radius a lies in the $x - y$ plane. The disk has surface charge density γs where γ is a constant. Compute the electric field a distance R along the positive z axis.