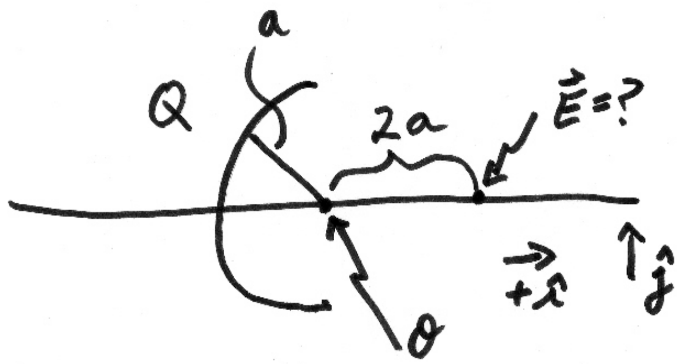
4B Final Exam Winter 2006 Name_________________________

1. (10 points) **Find the electric field as a function of the distance from the center (but $r < R$ only) of a uniformly charged solid dielectric sphere** of total charge Q and radius R . A full, detailed solution is expected for full credit.

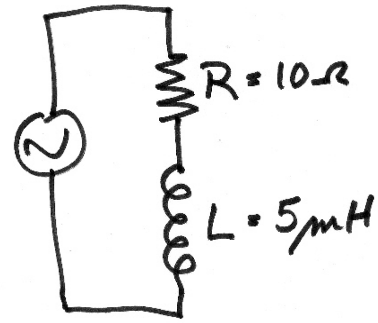
2. (10 points) **Find the potential, V, at the edge of a uniformly charged dielectric disk.** The disk has a total charge Q and radius a.

3. (10 points) Given a circular half ring of charge (total charge Q, radius *a*) **find the E field vector a distance 2a from its center.** Use a full formal vector treatment and coordinate system as given in the diagram. Your result will be as an integral (or integrals) with limits and ready to integrate in one variable.

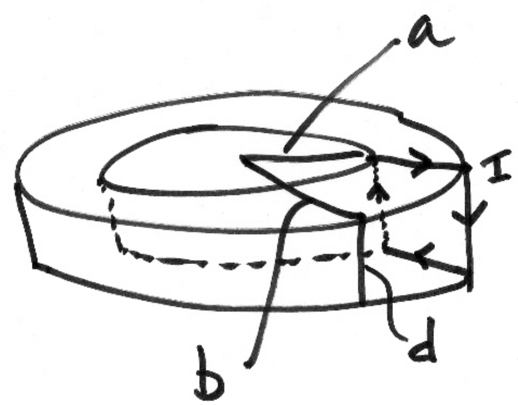


4. (10 points) **How much work would it take an applied force to separate a system of two opposite charges of the same magnitude, where one charge of mass *m* is in an orbit of radius, *r*, about the other fixed charge (in other words, the hydrogen atom as an example).** The final separation would be infinity with both charges having zero kinetic energy. This is equivalent to finding the famous "ionization energy" of the hydrogen atom.

5. (10 points) Given the following LR series circuit (there is no capacitance here) as shown in the diagram. Construct a phasor diagram and **find the numerical value of the angular frequency, ω, (not f, just ω) that would give a phase angle of 45 degrees between the current in the circuit and the driving voltage.** Show all your work.



6. (10 points) **Find the magnetic energy** stored within a rectangular toroid of inner radius *a* and outer radius, *b*, and height *d* carrying a current I with N total turns.



7. (10 points) Prove that the magnetic field (a static magnetic field, not changing in time), B, field can do no work. For full credit, your argument would be partly verbal and partly mathematical.