1. (25 points) Consider the arrangement of two concentric conducting shells of radii, R_i and R_o. If the outside shell was charged with $+Q$ and the inside shell was charged with $-Q$, **how much work would this require?** Let the magnitude of the charge on each shell be the same.

2. (25 points) Refer to the diagram. Find the potential at the surface of the positively charged sphere relative to a zero potential at infinity. For meaningful credit, this problem *must* be done using the line integral of the electric field approach. Don't forget the presence of the negative point charge to the left of the sphere.
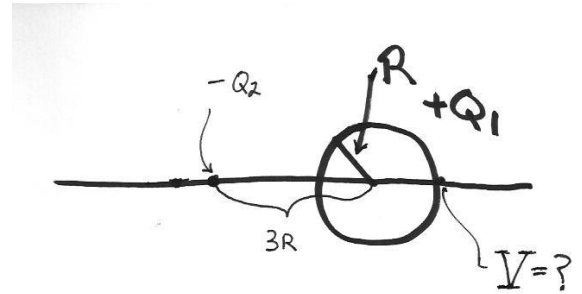
3. (25 points) A particle of mass m and charge +q is projected with an initial velocity v_i radially inward from the surface of a solid dielectric sphere but with a non-concentric hollow as shown in the diagram. The path of the body is indicated in the diagram. Let the uniform charge density of the sphere be given as ρ. **Find the value of the initial velocity of the particle such that its speed when it gets to the center of the sphere is zero.**
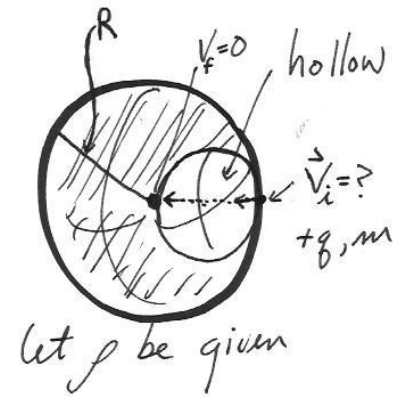
4. (25 points) Using a full formal vector treatment, find the electric field at the point indicated in the diagram. Your final answer should be one integral in dθ.