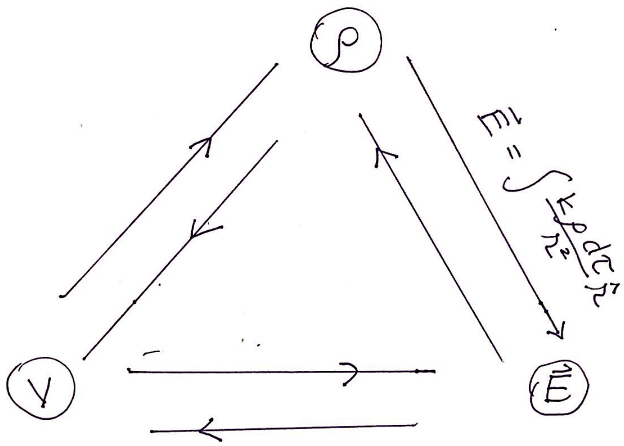
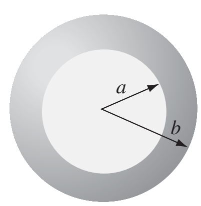
10/4 Tutorial 4–Griffiths' Triangle and Boundary Conditions

1. Griffiths identifies ρ, $\vec{E}$ and V as the three fundamental quantities of electrostatics. I filled in one line for you. For the one I did, the arrow goes from ρ to $\vec{E}$, so I think, what equation do I know that tells me how to find $\vec{E}$ if I know ρ. Without looking, see if you can fill in the equations that belong on the other lines. (We've seen them all.) If you have to look, don't look up the triangle. Look up the equations themselves. Draw it on the board.



2. **A point charge inside a thick, hollow, spherical conductor**

   We start with an uncharged, hollow but thick spherical conductor of inner radius a and outer radius b.



A point charge q is placed at the center of the spherical conductor. The electric field inside a conductor must be zero. (This means in the metal itself, not the hollow part.) Let's call this region 2, where $a < r < b$. So, by telling you it's a conductor, I'm telling you that $\vec{E}_2 = 0$ for the space where $a < r < b$.

(a) How much charge must be induced on the inner surface of the sphere? How do you know?

(b) Find the surface charge density, σ_a for the inner surface.

(c) How much charge must be induced on the outer surface of the sphere? How do you know?

(d) Find the surface charge density, σ_b for the outer surface.

(e) Find the field in region 1, where $r < a$. Call it $\vec{E}_1$

(f) Find the field outside the entire thing, where $r > b$. Call it $\vec{E}_3$.

(g) Find the quantity $\vec{E}_3 - \vec{E}_2$ evaluated when $r = b$ and write it in terms of σ_b

(h) Find the quantity $\vec{E}_2 - \vec{E}_1$ evaluated when $r = a$ and write it in terms of σ_a

(i) This turns out to be a general result! Write a general version.

(j) Find V_3 (assuming a reference point of $V = 0$ as $r \to \infty$.)

(k) Find V_2

(l) Find V_1

(m) Find $V_3 - V_2$ evaluated at $r = b$

(n) Find $V_2 - V_1$ evaluated at $r = a$

(o) This is also a general result! Write a general version.