Interactive Problem Set 8, SP212 Spring 2013

Topic: 23.7 - 23.8, Gauss' Law for Cylindrical Symmetry and for Planar Symmetry

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IPS 8.1 (in-class) A very long straight wire has a cross section with radius R. The charge per unit length is λ. Charge is uniformly distributed through the volume of the solid wire.

- Find the electric field at distance r from the wire where $r > R$.
- Find the electric field at all r where $r < R$.
- Check that your answers agree at $r = R$.

IPS 8.2 (homework) A variation on the above: Suppose now the wire has a tunnel drilled down its center, so now we have an inner radius a and an outer radius b. Charge is spread uniformly through the volume between a and b.

- Find the electric field for all r where $r < a$.
- Find the electric field for all r where $a < r < b$.
- Find the electric field for all r where $r > b$.
- Check your answers for agreement at $r = a$ and $r = b$.

IPS 8.3 (in-class) A very large thin sheet occupies the xy plane. This sheet has a uniform surface charge density σ. Find the electric field $\vec{E}$ for all points above and below the sheet.

There is a subtle difference here between this case and that of the surface of a conductor, so we need to start this one from scratch. The result will be similar but not exactly the same.

IPS 8.4 (homework) A proton is released from somewhere above the surface of a charged sheet that occupies the xy plane (the distance to the edges of the sheet is *VERY LARGE* compared to the distance above the sheet from where the proton is released). The surface charge density of the sheet is $\sigma = 3.00 \times 10^{-}6$ C/m^2.

- What is the acceleration of the proton?
- Qualitatively, as the proton moves away from the sheet, when does the acceleration of the proton start to decrease?

IPS 8.5 (homework) Continuing with the previous problem. Let us investigate the other extreme: Suppose the proton is centered above the sheet but it is very very very *FAR* away from the sheet. Suppose the sheet edge length measures 0.07 m and the proton is 70.0 m away. What is the acceleration of the proton in this case?

Reading for next class: WPC Chapter 24 Electric Potential.