Interactive Problem Set 7, SP212 Spring 2013

Topic: 23.5 - 23.6, also 23.9 Gauss' Law for Spherical Symmetry and for Conductors

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IPS 7.1 (in-class) A solid sphere of radius R carries a charge Q distributed uniformly throughout it's volume.

- Find the electric field at all radii $r > R$.
- Find the electric field at all radii $r < R$. *Only use the enclosed charge!*

IPS 7.2 (homework) A variation on the above: Suppose now the sphere has a centered hollow cavity, so now we have an inner radius a and an outer radius b. The charge Q is distributed uniformly through the volume between these radii.

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

IPS 7.3 (in-class) Here are the three essential ideas you must know about conductors:

- The electric field inside the volume of any conductor is 0.
- Any charge + or - resides on the surfaces of the conductor (this includes inside cavity surfaces).
- Just off these surfaces outside of the conducting volume any non-zero electric field is perpendicular to the surface (directed towards or away from the surface).

Use these ideas to show the key result (this result does appear on the formula sheet), that the size of the electric field just off the surface anywhere on the conductor is related to the value of the surface charge density σ right there by,

$$E = \frac{\sigma}{\epsilon_0}$$

IPS 7.4 (in-class) At some vicinity just off the surface of a conducting drum of a photocopying machine, the magnitude of the electric field is 2.00×10^5 N/C. What is the surface charge density on the drum here?

Reading for next class: From the text, study figures 23-12 on page 615 and 23-15 on page 617 and convince yourself of the following claims,

- For cylindrical symmetry, their is no flux associated with the caps of our Gaussian cylinder (we just use the curved sides).
- For planar symmetry, there is no flux associated with the curved sides (we just use the caps).