In-class problems, Mar 2, 2020

23.4 - 23.6 applying Gauss's law

1. Consider an infinite line of charge with linear charge density λ. Here, we use Gauss's law to determine an expression for the magnitude of its electric field E.

(a) Sketch the electric field lines from the line charge.

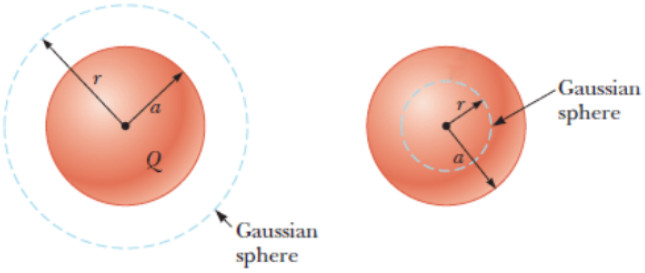
(b) Sketch a Gaussian surface around this line charge. Make the surface so that the $d\vec{A}$'s have a simple direction relative to $\vec{E}$; or that $\vec{E}$ has the same magnitude for all the $d\vec{A}$'s.

(c) Evaluate $\oint \vec{E} \cdot d\vec{A}$. Keep E as E, since we're trying to find an expression for it.

(d) Evaluate $q_{\text{enclosed}}/\epsilon_0$. Write q_{enclosed} in terms of λ and the geometry of your surface

(e) Solve for E

2. Consider a solid sphere of radius a, with a uniformly distributed charge, $\rho = Q_{\text{total}}/\frac{4}{3}\pi a^3$. Use Gauss's law to determine the magnitude of the electric field



(a) outside the sphere, $r > a$.

(b) inside the sphere, $r < a$.

(c) Describe E's behavior inside the sphere, use words. Describe E's behavior outside the sphere. Use words.

Due Tue Mar 3, 2020, beginning of class

Skim 23.3 a charged isolated conductor

1. Excess charge is placed on a solid piece of material. Once the system comes to equilibrium, where can the excess charge be found if the material is a

(a) conductor. Use words and add a sketch to further explain what you mean.

(b) insulator. Use words and add a sketch to further explain what you mean.

2. What's the magnitude of the electric field inside a solid piece of conducting material?