Monday Reading Assessment: Unit 1, Gauss' Law

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February 10, 2020

1 Gauss' Law

1. Observe Fig. 1. This question is about objects with spherical symmetry. Which of the following charge distributions

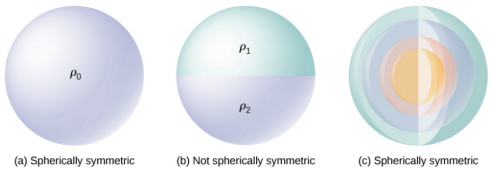

Figure 1: Charge distributions with (a) spherical symmetry (b) no spherical symmetry (c) spherical symmetry.

has *spherical* symmetry?

- A: A long line of charge, uniformly spread in one dimension
- B: A disk of charge, evenly spread in two-dimensions
- C: A point charge
- D: A shell of charge with radius R, evenly spread over the shell

Which of the following charge distributions has *spherical* symmetry?

- A: A sphere of charge, with positive charge out to a radius r, then negative charge out to a radius R
- B: A sphere of charge, with positive charge on one hemisphere, and negative charge on the other hemisphere
- C: A sphere of charge, with positive charge from $0 \leq \phi < \pi/2$, negative charge from $\pi/2 \leq \phi < \pi$, positive charge from $\pi \leq \phi < 3\pi/2$, and negative charge from $3\pi/2 \leq \phi < 2\pi$
- D: A shell of charge with radius R, with random charge density

2. Use Gauss' law to show that (a) the E-field a distance r from a point charge Q is $E = Q/\left(4\pi\epsilon_0 r^2\right)$. (b) Show that the E-field a distance r from the origin inside a uniformly charged sphere with charge density ρ and radius R that is centered at the origin is a linear function of r. *Hint: draw the sphere, and then draw a shell of radius r with $r < R$. How much charge is enclosed?* (c) Far outside the sphere, how does the E-field depend on r? *Hint: this is true for anything, if you are far enough away.*