

Quiz #3: Gauss' Law

Problem 1 (2 points)

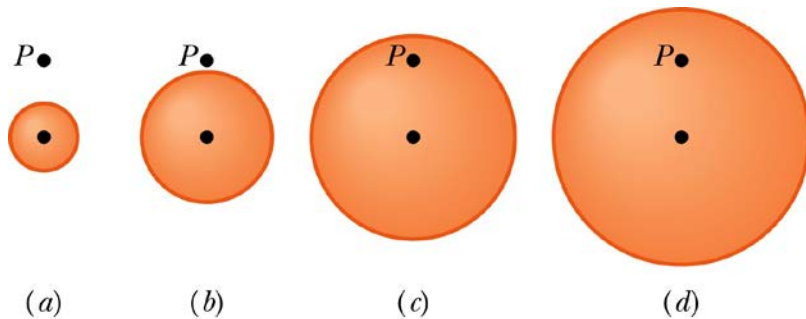
Consider Gauss' law: $\oint \vec{E} \cdot d\vec{A} = \frac{q_{encl}}{\epsilon_0}$.

Which of the following must true?

- a) \vec{E} must be the electric field due to the enclosed charge.
- b) If $q_{encl} = 0$, then $\vec{E} = 0$ everywhere on the Gaussian surface.
- c) If the Gaussian surface only encloses three charges that have charge $+q$, $+q$ and $-2q$, then the integral is zero.
- d) If a charge is placed outside the Gaussian surface, then it cannot affect \vec{E} at any point on the surface.
- e) Two of the above.

Problem 2 (3 points)

The figure below shows four solid non-conducting spheres, each with charge Q uniformly distributed throughout its volume. (a) Rank the spheres according to their volume charge density, greatest first. The figure also shows a point P for each sphere, all at the same distance from the center of the sphere. (b) Rank the spheres according to the magnitude of the electric field they produce at point P, greatest first. (c) Now assume that the four spheres are conducting (and each has charge Q). Rank the spheres according to the magnitude of the electric field they produce at point P, greatest first.



- a)
- b)
- c)

Problem 3 (5 points)

In the figure to the right, a solid non-conducting sphere of radius $a = 5.00$ cm is concentric with a spherical conducting shell of inner radius $b = 10.00$ cm and outer radius $c = 12.5$ cm. The sphere has a net charge of $+35.0$ pC and the shell has a net charge of -25.0 pC.

What is the magnitude of the electric field at a radial distance of
(a) $r = 3.00$ cm, (b) $r = 8.00$ cm, (c) $r = 12.0$ cm, and (d) $r = 15.0$ cm?

(e) What is the net charge in the inner and outer surfaces of the shell?

