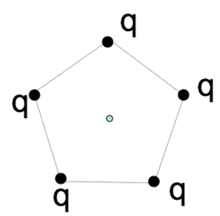
5 charges, q, are arranged in a regular pentagon, as shown.
What is the E field at the center?

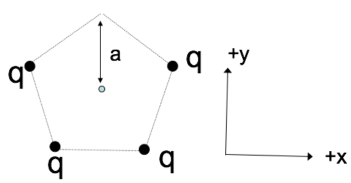


A. Zero
B. Non-zero
C. Really need trig and a calculator to decide

ANNOUNCEMENTS

- Help Session 1420 BPS (4-5pm)
  - Starts this week!
- We will use GitHub Classroom for digital submissions of homework
  - Create a GitHub account
  - Download GitHub Desktop
  - Review Piazza post on usage
  - Come to help session (or my office) if you need/want help

1 of the 5 charges has been removed, as shown.
What's the E field at the center?



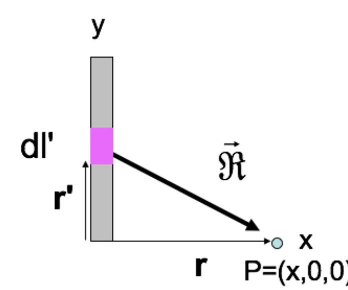
A. $+(kq/a^2)\hat{y}$
B. $-(kq/a^2)\hat{y}$
C. 0
D. Something entirely different!
E. This is a nasty problem which I need more time to solve

To find the E-field at P from a thin line (uniform charge density λ):

$$\mathbf{E}(\mathbf{r}) = \frac{1}{4\pi\varepsilon_0}\int \frac{\lambda dl'}{\mathfrak{R}^2}\hat{\mathfrak{R}}$$

What is $\mathfrak{R}$?

A. x
B. y'
C. $\sqrt{dl'^2 + x^2}$
D. $\sqrt{x^2 + y'^2}$
E. Something else

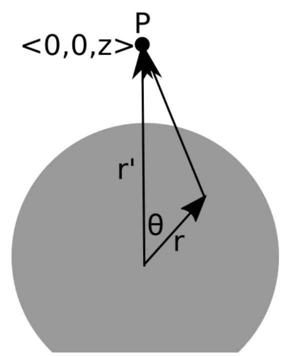


What do you expect to happen to the field as you get really far from the rod?

$$E_x = \frac{\lambda}{4\pi\varepsilon_0} \frac{L}{x\sqrt{x^2 + L^2}}$$

A. E_x goes to 0.
B. E_x begins to look like a point charge.
C. E_x goes to ∞.
D. More than one of these is true.
E. I can't tell what should happen to E_x.

Given the location of the little bit of charge (dq), what is $|\vec{\mathfrak{R}}|$?



A. $\sqrt{z^2 + r'^2}$
B. $\sqrt{z^2 + r'^2 - 2zr' \cos\theta}$
C. $\sqrt{z^2 + r'^2 + 2zr' \cos\theta}$
D. Something else

Which of the following are vectors?

(I) Electric field, (II) Electric flux, and/or (III) Electric charge

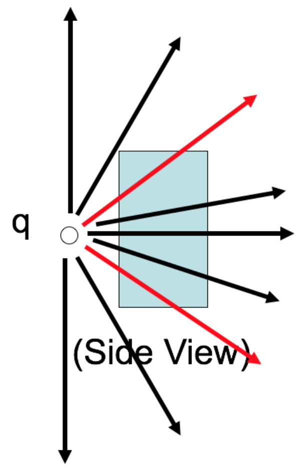
A. I only
B. I and II only
C. I and III only
D. II and III only
E. I, II, and II

A positive point charge $+q$ is placed outside a closed cylindrical surface as shown. The closed surface consists of the flat end caps (labeled A and B) and the curved side surface (C). What is the sign of the electric flux through surface C?

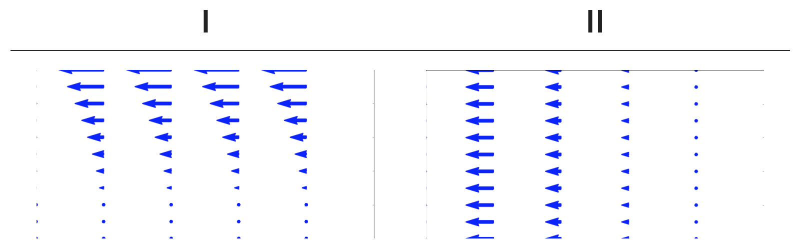
A. positive
B. negative
C. zero

D. not enough information given to decide

Let's get a better look at the side view.



Which of the following two fields has zero divergence?



A. Both do.
B. Only I is zero
C. Only II is zero
D. Neither is zero
E. ???

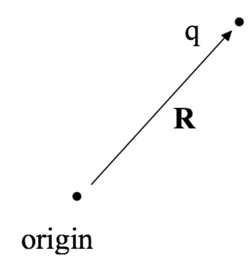
What is the value of:

$$\int_{-\infty}^{\infty} x^2 \delta(x-2)dx$$

A. 0
B. 2
C. 4
D. ∞
E. Something else

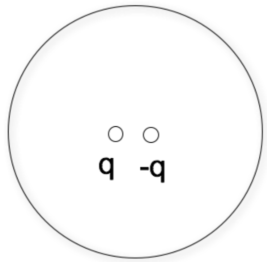
A point charge (q) is located at position $\mathbf{R}$, as shown. What is $\rho(\mathbf{r})$, the charge density in all space?

A. $\rho(\mathbf{r}) = q\delta^3(\mathbf{R})$
B. $\rho(\mathbf{r}) = q\delta^3(\mathbf{r})$
C. $\rho(\mathbf{r}) = q\delta^3(\mathbf{R}-\mathbf{r})$
D. $\rho(\mathbf{r}) = q\delta^3(\mathbf{r}-\mathbf{R})$
E. Something else??



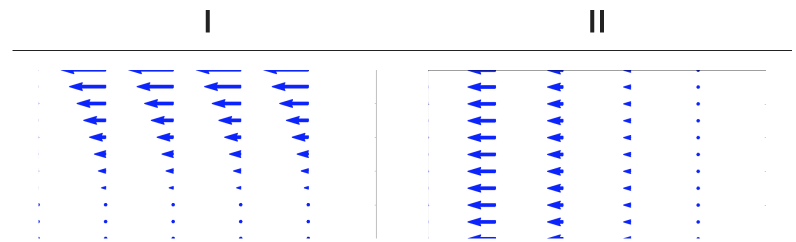
An electric dipole ($+q$ and $-q$, small distance d apart) sits centered in a Gaussian sphere.

What can you say about the flux of $\mathbf{E}$ through the sphere, and $|\mathbf{E}|$ on the sphere?



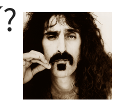
A. Flux = 0, E = 0 everywhere on sphere surface
B. Flux = 0, E need not be zero *everywhere* on sphere
C. Flux is not zero, E = 0 everywhere on sphere
D. Flux is not zero, E need not be zero...

Which of the following two fields has zero curl?



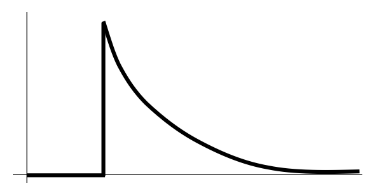
A. Both do.
B. Only I is zero
C. Only II is zero
D. Neither is zero
E. ???

Can superposition be applied to electric potential, V?



$$V_{tot} \stackrel{?}{=} \sum_i V_i = V_1 + V_2 + V_3 + \dots$$

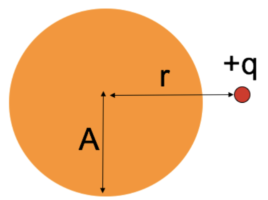
A. Yes
B. No
C. Sometimes



Could this be a plot of $|\mathbf{E}(r)|$? Or $V(r)$? (for SOME physical situation?)

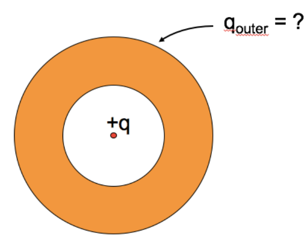
A. Could be $E(r)$, or $V(r)$
B. Could be $E(r)$, but can't be $V(r)$
C. Can't be $E(r)$, could be $V(r)$
D. Can't be either
E. ???

A point charge $+q$ sits outside a **solid neutral conducting copper sphere** of radius A. The charge q is a distance $r > A$ from the center, on the right side. What is the E-field at the center of the sphere? (Assume equilibrium situation).



A. $|E| = kq/r^2$, to left
B. $kq/r^2 > |E| > 0$, to left
C. $|E| > 0$, to right
D. $E = 0$
E. None of these

A neutral copper sphere has a spherical hollow in the center. A charge $+q$ is placed in the center of the hollow. What is the total charge on the outside surface of the copper sphere? (Assume Electrostatic equilibrium.)



A. Zero
B. $-q$
C. $+q$
D. $0 < q_{outer} < +q$
E. $-q < q_{outer} < 0$

The general solution for the electric potential in spherical coordinates with azimuthal symmetry (no ϕ dependence) is:

$$V(r,\theta) = \sum_{l=0}^{\infty} \left(A_l r^l + \frac{B_l}{r^{l+1}} \right) P_l(\cos\theta)$$

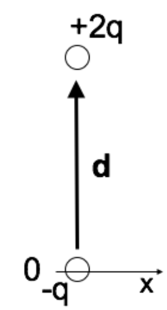
Consider a metal sphere (constant potential in and on the sphere, remember). Which terms in the sum vanish outside the sphere? (Recall: $V \to 0$ as $r \to \infty$)

A. All the A_l's
B. All the A_l's except A_0
C. All the B_l's
D. All the B_l's except B_0
E. Something else

$$\mathbf{p} = \sum_i q_i \mathbf{r}_i$$

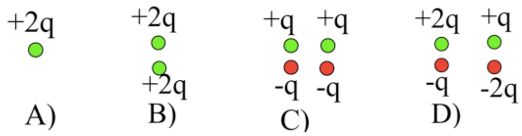
What is the dipole moment of this system?

(BTW, it is NOT overall neutral!)



A. $q\mathbf{d}$
B. $2q\mathbf{d}$
C. $\frac{3}{2}q\mathbf{d}$
D. $3q\mathbf{d}$
E. Someting else (or not defined)

Which charge distributions below produce a potential that looks like $\frac{C}{r^2}$ when you are far away?



E) None of these, or more than one of these!

(For any which you did not select, how DO they behave at large r?)