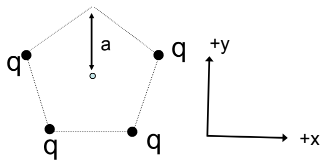
2.6

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

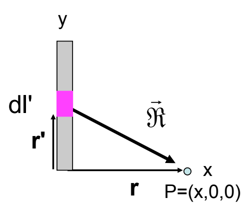


A) $+(kq/a^2)\,\mathbf{j}$
B) $-(kq/a^2)\,\mathbf{j}$
C) 0
D) Something entirely different!
E) This is a nasty problem which I need more time to solve

2.10 To find the E- field at P=(x,y,z) from a thin line (uniform linear charge density λ):

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

What is $\mathfrak{R} = |\vec{\mathfrak{R}}|$?



A) X B) y'

C) $\sqrt{dl'^2 + x^2}$ D) $\sqrt{x^2 + y'^2}$

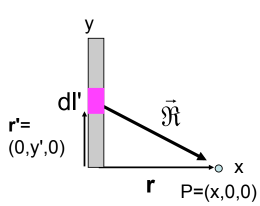
E) Something *completely* different!!

2.11

$$\vec{\mathbf{E}}(\vec{\mathbf{r}}) = \int \frac{\lambda\,\mathrm{dl}'}{4\pi\varepsilon_0 \mathfrak{R}^3}\vec{\mathfrak{R}} \quad \text{,so} \quad \mathbf{E}_x(x,0,0) = \frac{\lambda}{4\pi\varepsilon_0}\int \ldots$$

$A)\ \int \frac{dy'\,x}{x^3}$

$B)\ \int \frac{dy'\,x}{(x^2 + y'^2)^{3/2}}$



$C)\ \int \frac{dy'\,y'}{x^3}$

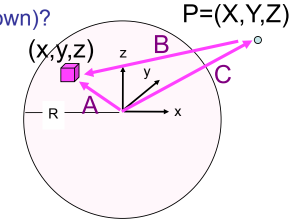
$D)\ \int \frac{dy'\,y'}{(x^2 + y'^2)^{3/2}}$ $E)$ Something else

2.14

To find **E** at P from a negatively charged sphere (radius R, uniform volume charge density ρ) using

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\int \frac{1}{\Re^2}\hat{\Re}\,\rho\,d\tau'$$

what is $\vec{\Re}$ (given the small volume element shown)?



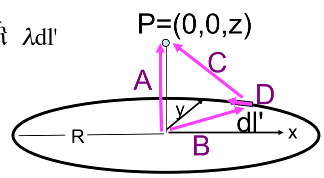
D) None of these

2.12

To find the E- field at P from a thin ring (radius R, uniform linear charge density λ):

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\int \frac{1}{\Re^2}\hat{\Re}\;\lambda dl'$$

what is $\vec{\Re}$?

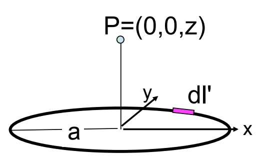


E) NONE of the arrows shown correctly represents $\vec{\Re}$

Only when you finish Part 3-vi:

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\int \frac{1}{\Re^2}\hat{\Re}\;\lambda dl'$$

What is $\Re$ here?



A) $\sqrt{a^2+z^2}$

B) a

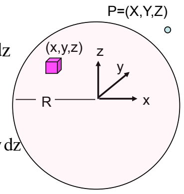
C) $\sqrt{dl'^2+z^2}$

D) z

E) Something *completely* different!!

2.15

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\int \frac{1}{\Re^2}\hat{\Re}\,\rho\,d\tau \quad = \frac{1}{4\pi\varepsilon_0}\bullet(....?)$$



A) $\int \frac{(X,Y,Z)}{\left((X-x)^2+(Y-y)^2+(Z-z)^2\right)}\rho\,dx\,dy\,dz$

B) $\int \frac{(X,Y,Z)}{\left((X-x)^2+(Y-y)^2+(Z-z)^2\right)^{3/2}}\rho\,dx\,dy\,dz$

C) $\int \frac{(X-x,Y-y,Z-z)}{\left((X-x)^2+(Y-y)^2+(Z-z)^2\right)}\rho\,dx\,dy\,dz$

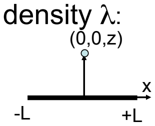
D) $\int \frac{(X-x,Y-y,Z-z)}{\left((X-x)^2+(Y-y)^2+(Z-z)^2\right)^{3/2}}\rho\,dx\,dy\,dz$

E) None of these

2.16

Griffiths p. 63 finds E a distance z from a line segment with charge density λ:

$$\vec{\mathbf{E}} = \frac{1}{4\pi\varepsilon_0}\frac{2\lambda L}{z\sqrt{z^2+L^2}}\hat{\mathbf{k}}$$



What is the approx. form for E, if z<<L?

$$E = \frac{2\lambda}{4\pi\varepsilon_0}\cdot(...)$$

A) 0 B) 1 C) 1/z D) 1/z^2

E) None of these is remotely correct.

Deep questions to ponder

- Is Coulomb's force law valid for *all* separation distances? (How about r=0?)
- What is the physics origin of the r^2 dependence of Coulomb's force law?
- What is the physics origin of the $1/\varepsilon_0$ dependence of Coulomb's force law?
- What is the physics origin of the 1/4π factor in Coulomb's force law?
- What really *is* electric charge?
- Why is electric charge quantized (in units of *e*)?
- What really is *negative* vs. *positive* electric charge (i.e. –*e* vs. +*e*)?
- Why does the Coulomb force vary as the *product* of charges q_1q_2?
- What really is the *E*-field associated with e.g. a point electric charge, *e*?
- Are electric field lines real? Do they *really* exist in space and time?