WELCOME TO PHY 482

ELECTRODYNAMICS

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IMPORTANT SITES

- Course Webpage: dannycab.github.io/phy482msu_s2019/
- Discord Group: discord.gg/FcktcXz (*Check your email*)

COURSE ACTIVITIES

- Projects:
  - 2 of them; Mar 1 & Apr 29 - 20% each
- In-Class Quizzes:
  - 7 of them; Every other Friday; 1 dropped - 20%
- Homework:
  - 14 of them; Due on Fridays by 5pm; 1 dropped - 40%
- Clickers:
  - Pure Extra Credit - up to 2% bonus

Much more detail on website

Learning is a social and collaborative act!

HOMEWORK HELP SESSION

Evening session once per week (Location TBD)

Question to you: When should we do this?

Reminder: Homework is due on Fridays (expect this first one).

THIS WEEK!!!

- Homework 1 is already up (Due Fri. Jan. 11 at 5pm)
- Read (seriously do this!)
  - Griffiths Ch 7.1.1-7.1.2 (Review? Chs 1-6)
- Download Anaconda distribution of Python

Stay up-to-date by checking website, calendar, and discussion forum regularly.

COMPUTATIONAL HOMEWORK PROBLEMS

- We will be using Python on homework problems this semester.
- Installation instructions appear on the piazza site.
- Homework solutions should take the form of a Jupyter notebook, which you can print to PDF and turn in.
- If you get stuck somewhere, post on piazza, so your classmates benefit from your question.

PROJECTS

INDIVIDUAL PROJECT (MAR. 1)

- Literature review of some interesting topic in E&M (4-5 pages)
- Homework questions will support you on this
  - See syllabus for sample questions
- Paper should be typed, inline references, bibliography, etc.
- Evaluation rubric will be ready in a couple of weeks

PROJECTS

PAIR PROJECT (APR 29)

- Poster presentation of an original contribution (theory and computation)
- Homework questions will support you on this
  - See syllabus for sample questions
- Can be something that has been done before that you just extend
- Evaluation rubric will be ready in a few weeks
- There will be a significant self-evaluation component to this also

QUESTIONS?

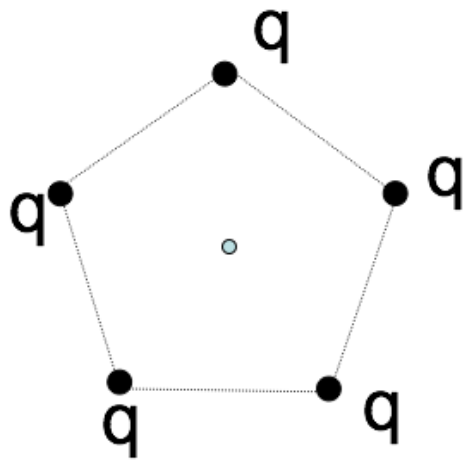
WHAT DO YOU THINK PHY 482 IS ABOUT?

ELECTROMAGNETISM IS THE FOUNDATIONAL FIELD THEORY OF PHYSICS

Think about everything you already know about electromagnetism (it's a lot already!).

Work with a partner to map out the electromagnetism concepts that you know and how they are related to each other.

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

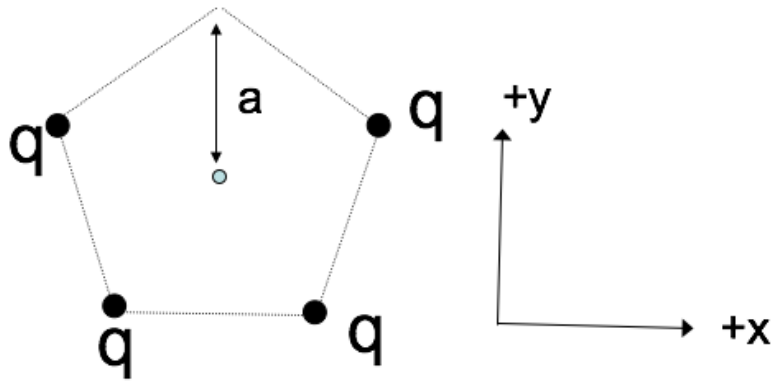


A. Zero

B. Non-zero

C. Really need trig and a calculator to decide

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

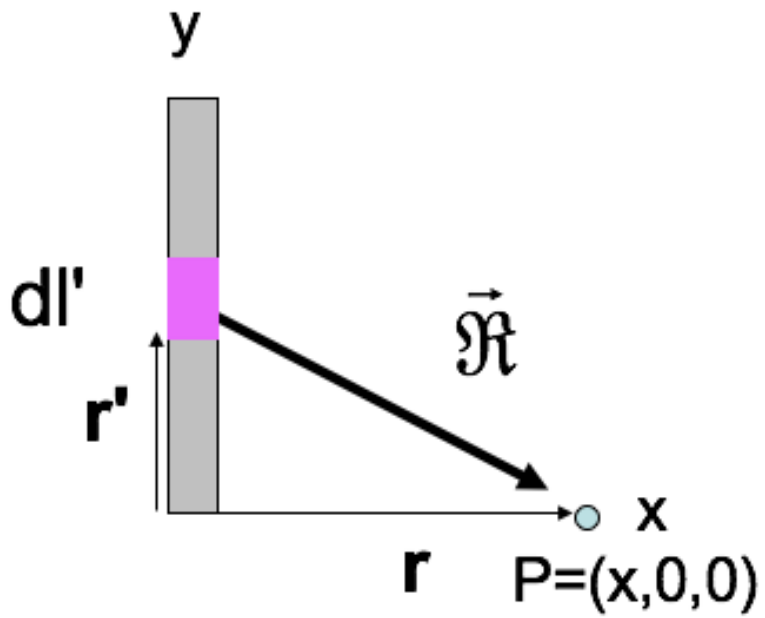
D. Something entirely different!

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):

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

What is 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.

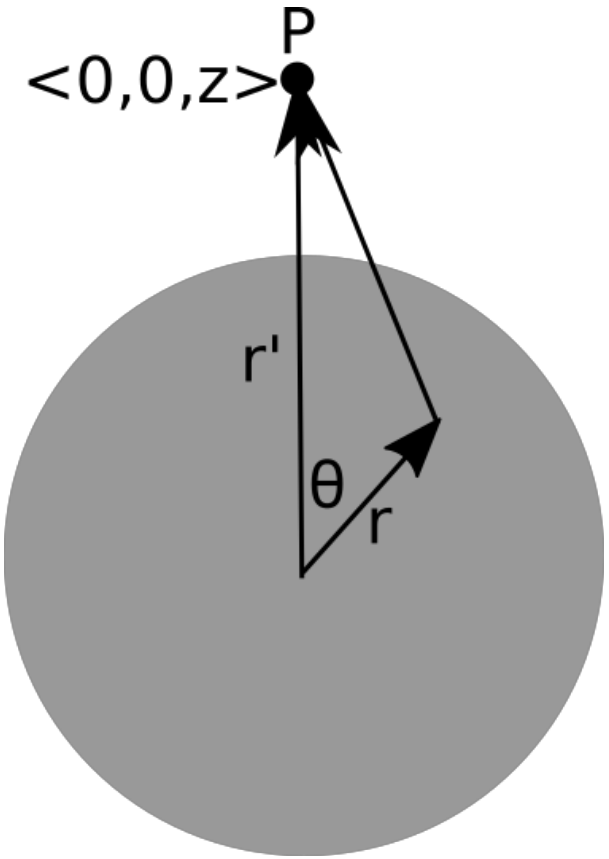
B. E_x begins to look like a point charge.

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 $|\vec{R}|$?



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?

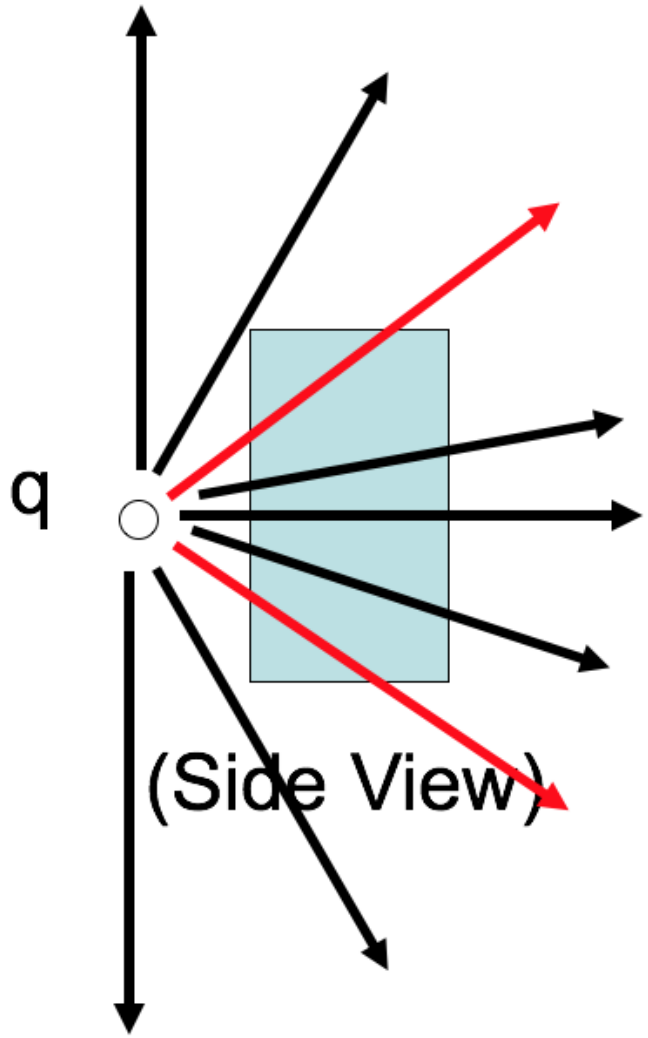
(I) Electric field, (II) Electric flux, and/or (III) Electric charge

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?

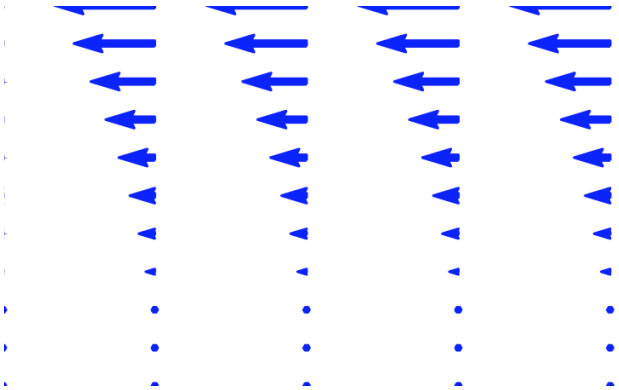
A. positive
B. negative
C. zero
D. not enough information given to decide

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

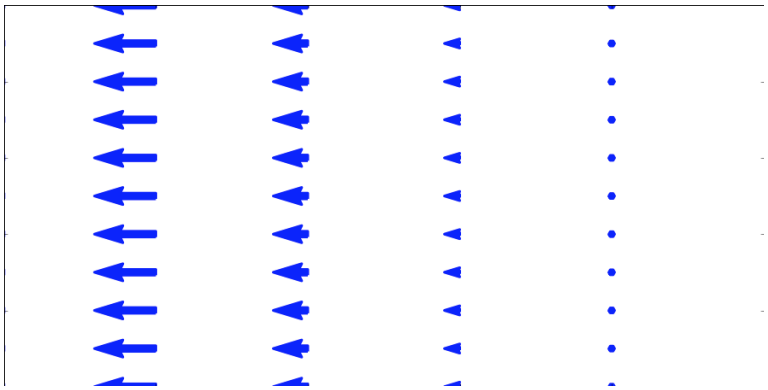


Which of the following two fields has zero divergence?

I



II



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 R, as shown. What is $\rho(r)$, the charge density in all space?

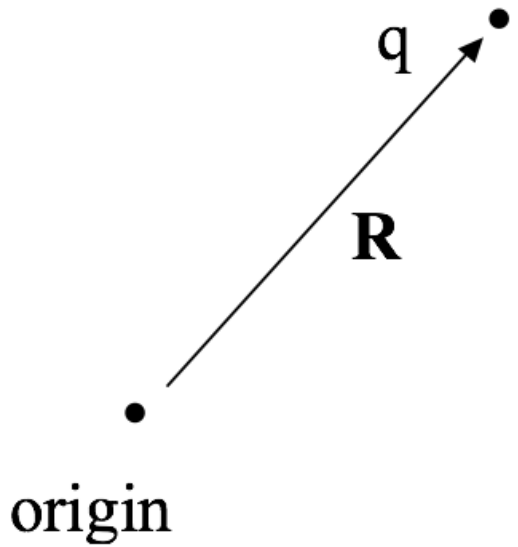
A. $\rho(r) = q\delta^3(R)$

B. $\rho(r) = q\delta^3(r)$

C. $\rho(r) = q\delta^3(R - r)$

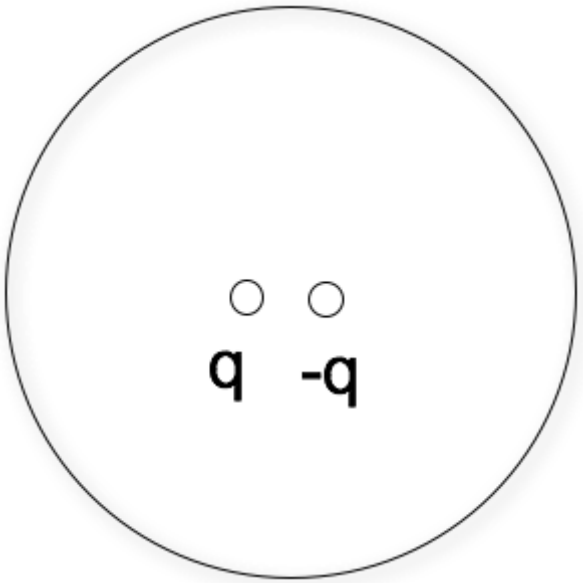
D. $\rho(r) = q\delta^3(r - R)$

E. Something else??



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

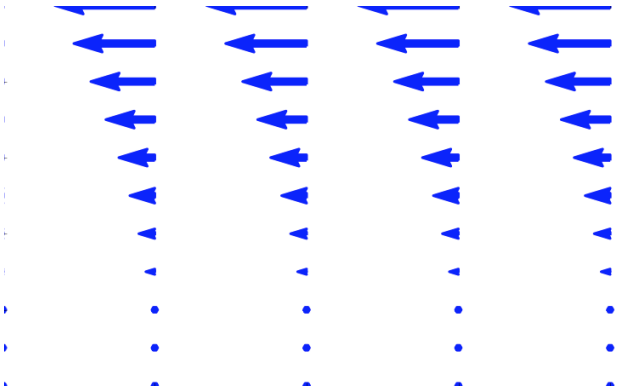
What can you say about the flux of E through the sphere, and |E| on the sphere?



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?

I



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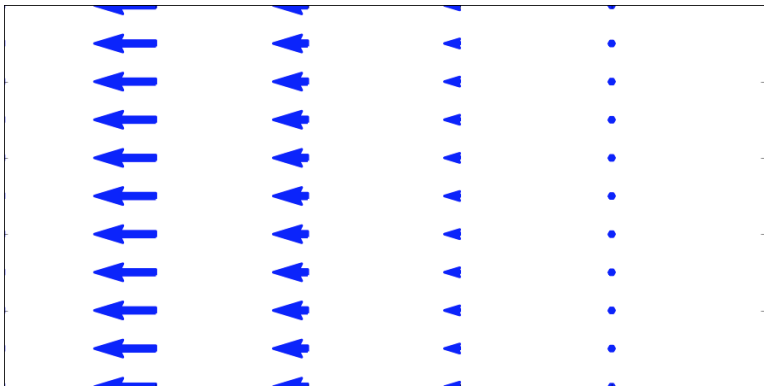


A. Both do.

B. Only I is zero

C. Only II is zero

D. Neither is zero

E. ???

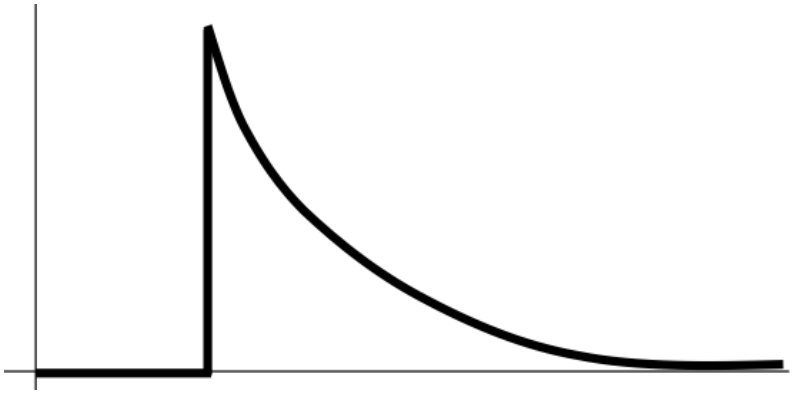
Can superposition be applied to electric potential, V?

$$V_{tot} \overset{?}{=} \sum_i V_i = V_1 + V_2 + V_3 + \ldots$$

A. Yes

B. No

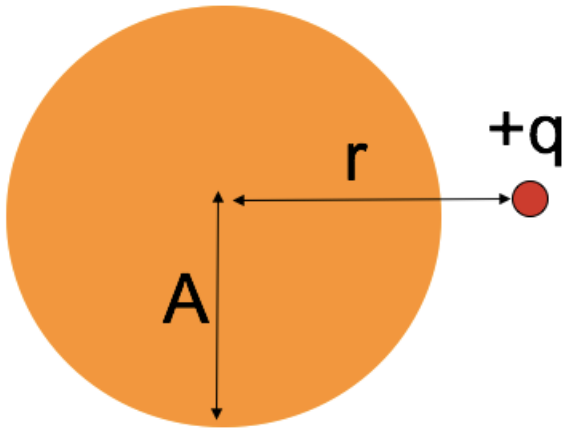
C. Sometimes



Could this be a plot of |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

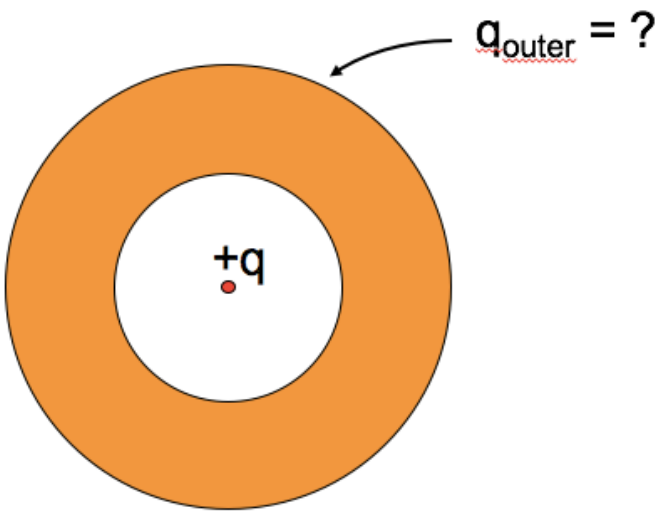
B. $kq/r^2 > |E| > 0$, to left

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. $-q < q_{outer} < 0$