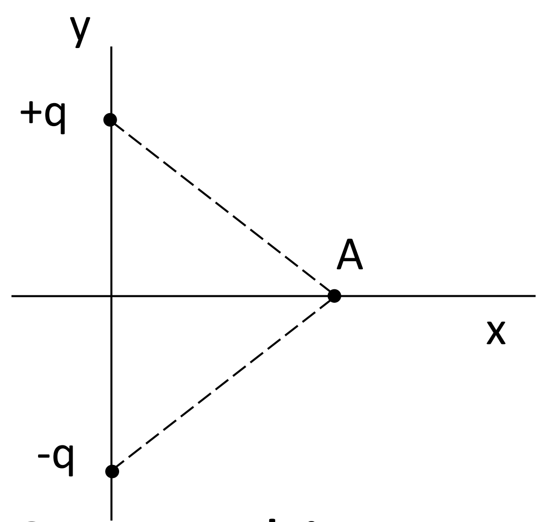
R1

Electricity and Magnetism II

Griffiths Chapter 1-6 Review

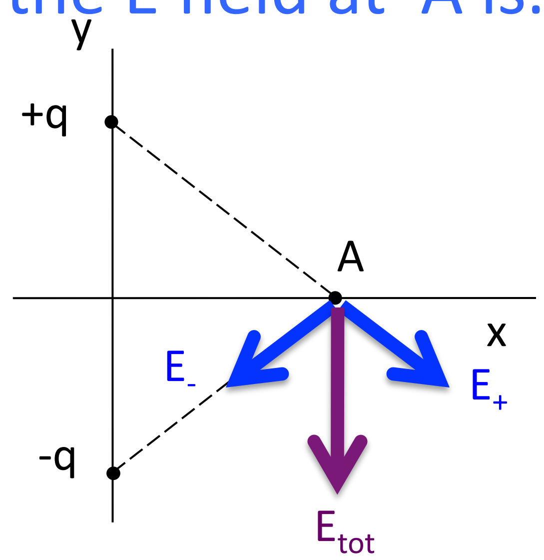
Clicker Questions

Two charges +q and -q are on the y-axis, symmetric about the origin. Point A is an empty point in space on the x-axis. The direction of the E field at A is…



A. Up
B. Down
C. Left
D. Right
E. Some other direction, or E = 0, or ambiguous

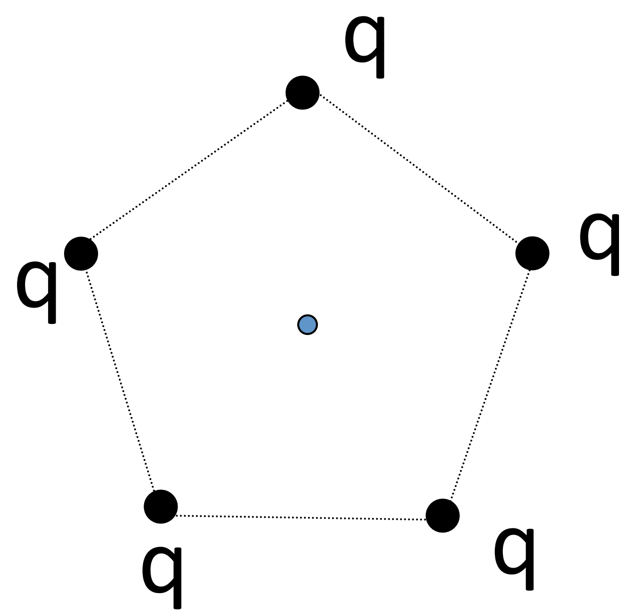
Two charges +q and -q are on the y-axis, symmetric about the origin. Point A is an empty point in space on the x-axis. The direction of the E field at A is…



A. Up
B. Down
C. Left
D. Right
E. Some other direction, or E = 0, or ambiguous

R4

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



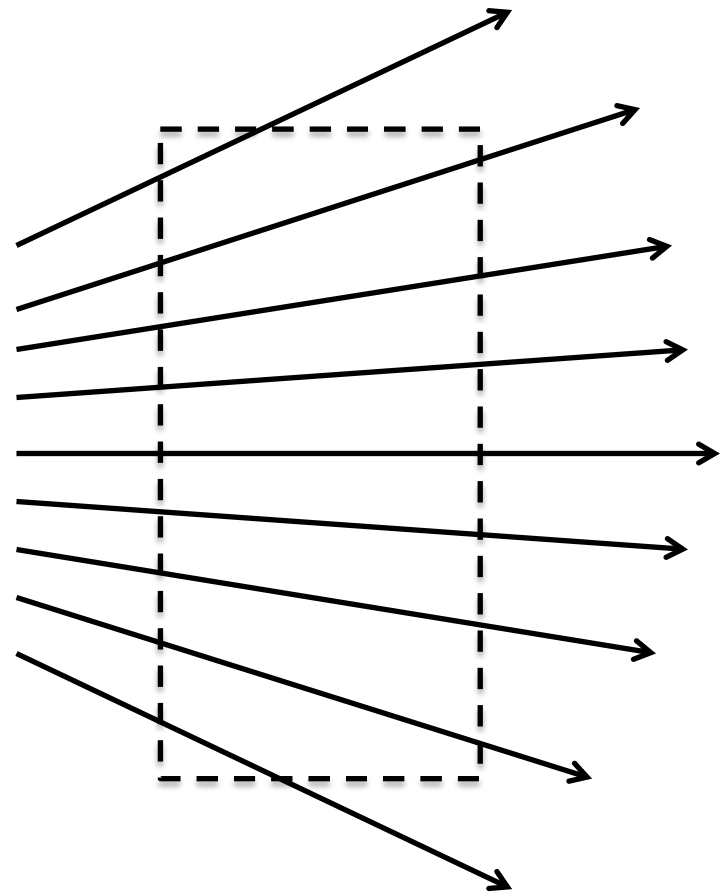
A) Zero

B) Non-zero

C) Really need trig and a calculator to decide for sure

D) Not quite sure how to decide...

Consider the vector field shown by this field line diagram.



Inside the dotted box,
the divergence of the field is:

A) zero everywhere

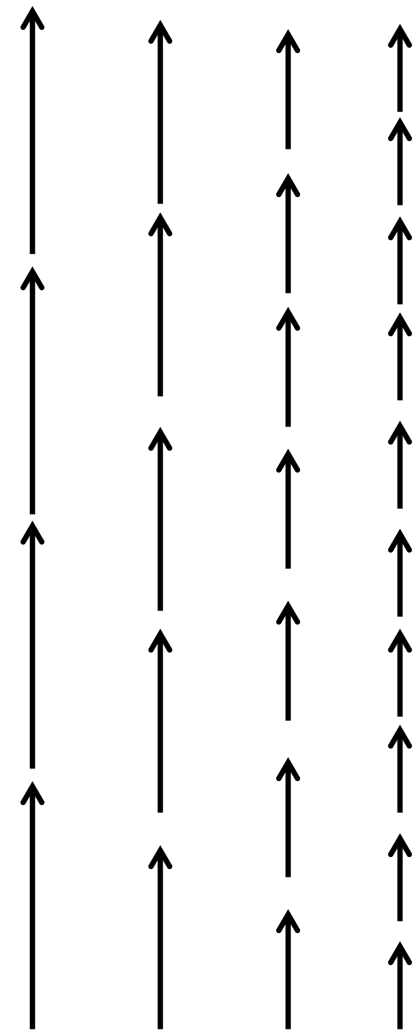
B) non-zero everywhere

C) zero some places and non-zero other places

D) impossible to tell without more information

Consider the vector field shown.
Could this be a B-field?

A) yes, sure!
B) no, impossible!
C) not enough info to answer question



The curl of this field is :

A) zero everywhere
B) non-zero everywhere
C) zero some places and non-zero other places
D) impossible to tell without more information

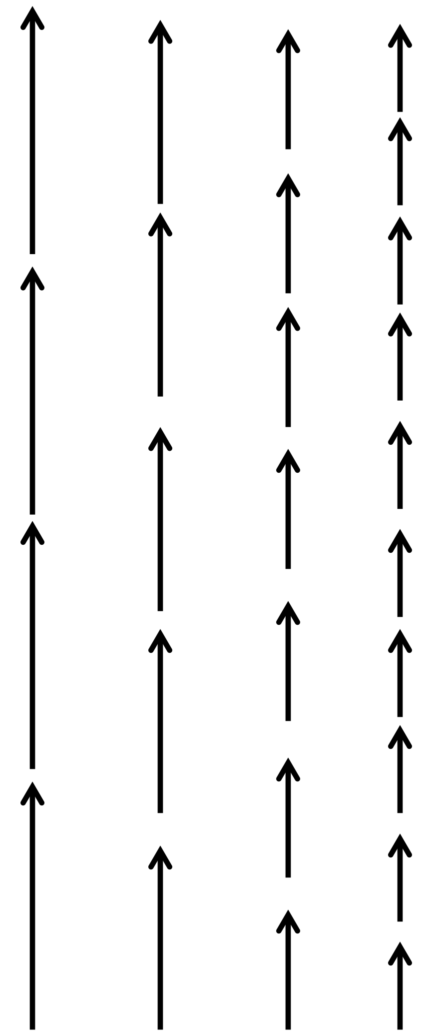
Same B-field as in last question.
The current density **j** is ..

A) everywhere zero

B) non-zero and into page

C) non-zero and out of page

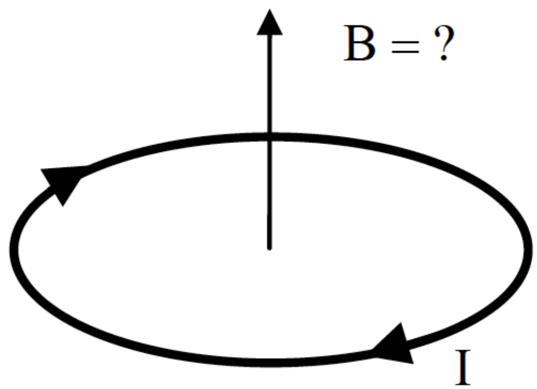
D) non-zero and in plane of page



Can you use Ampere's Law to compute the B-field at center of circular loop carrying current I?

A) Yes

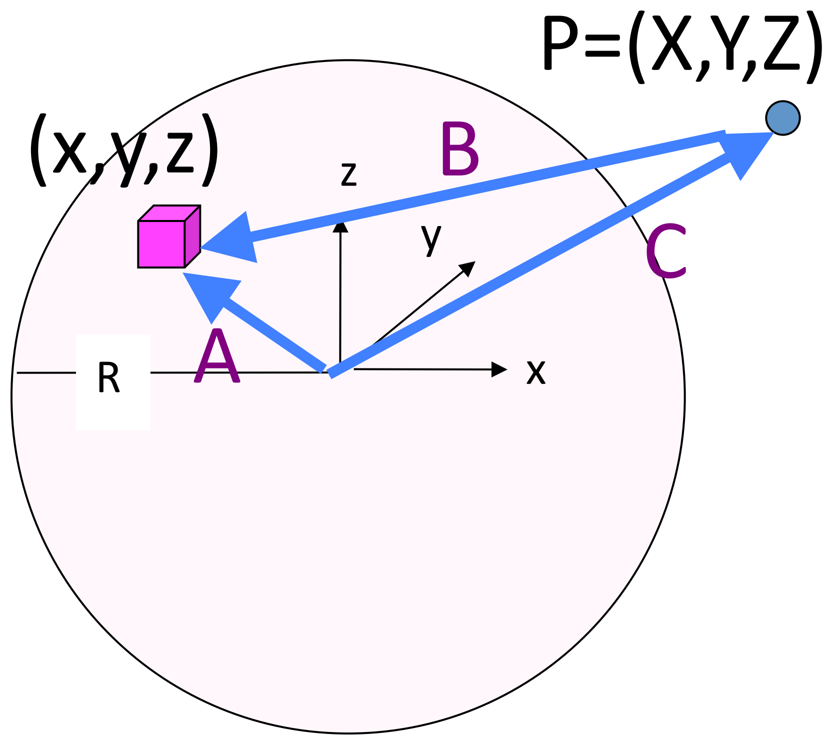
B) No



To find **E** at P from a <u>negatively</u> charged sphere (radius R, volume charge density ρ),

$$\vec{\mathbf{E}} = \frac{1}{4\pi\varepsilon_0}\iiint \frac{\hat{\mathfrak{r}}}{\mathfrak{r}^2}\ \rho\, d\tau'$$

What is $\vec{\mathfrak{r}}$ (given the small volume element shown)?

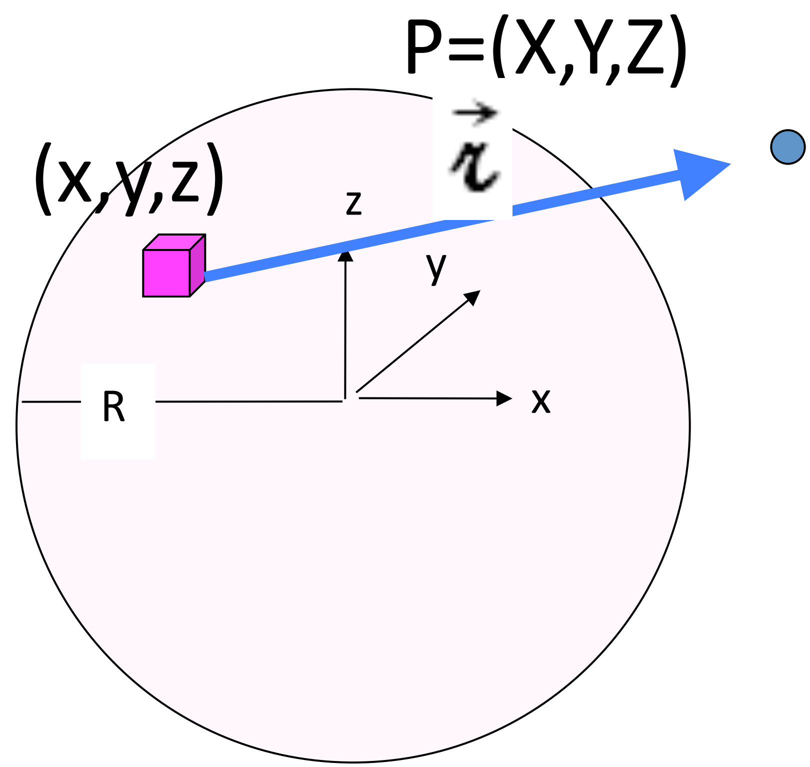


D) None of these

E) Answer is ambiguous

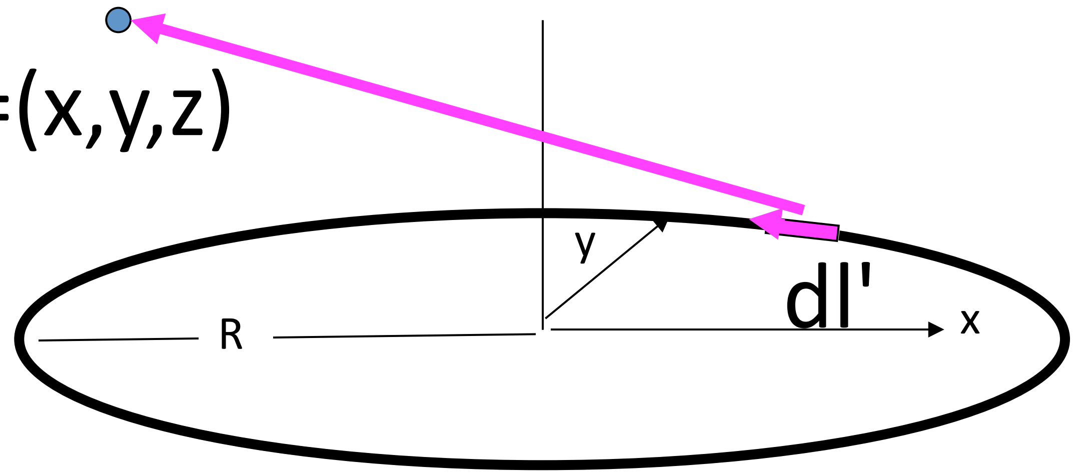
To find **E** at P from a negatively charged sphere (radius R, volume charge density ρ),

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



R11

To find E at P from a thin ring (radius R, charge density λ), which is the correct formula for the x-component of $\vec{\mathfrak{R}}$?



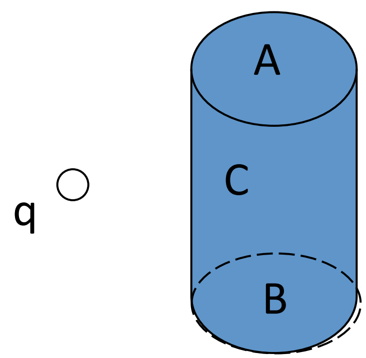
A) x-x’
B) (x-x’)/R
C) (x-R cos ϕ’)
D) $(x - x')/\mathrm{Sqrt}[(x-x')^2+(y-y')^2+(z-z')^2]$
E) More than one of the above is correct!

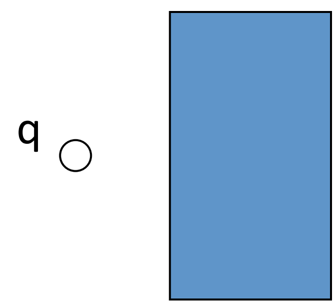
R12

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) To be sure, this requires calculating!



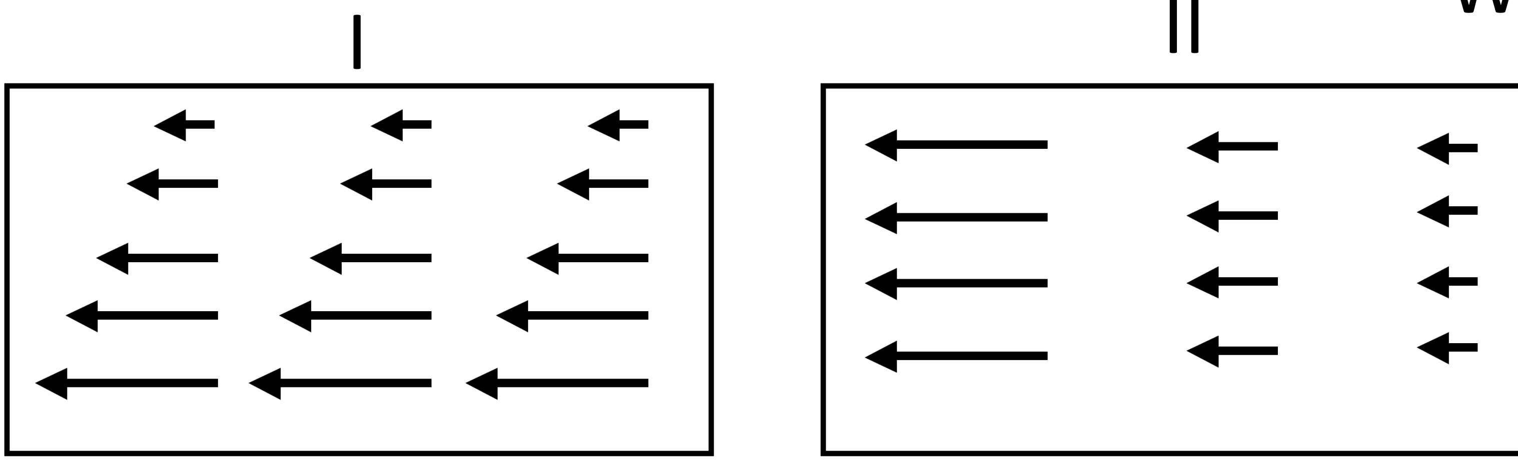


(Side View)

Can you think of more than one argument?

Which of the following could be a (physical) electrostic field in the region shown?

Why?



A) Both

B) Only I

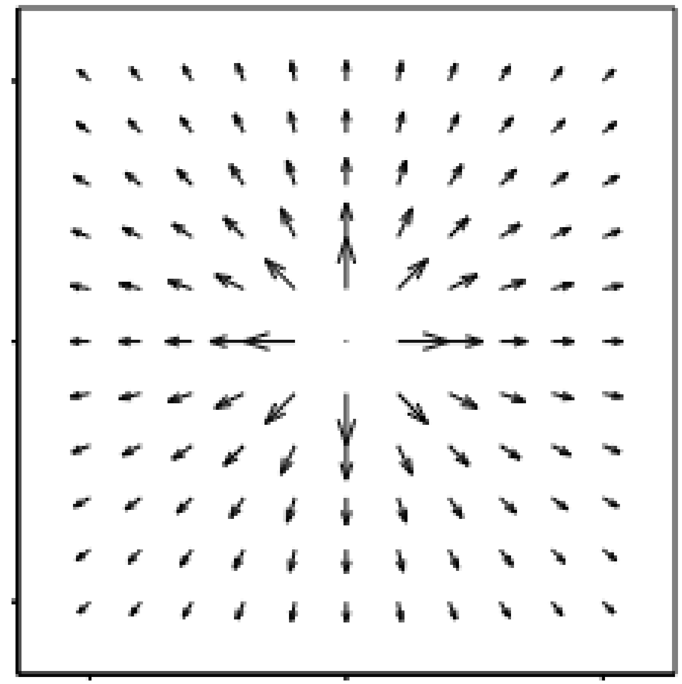
C) Only II

D) Neither

E) ??

R14

Consider the 3D vector field in spherical coordinates, where c = constant .



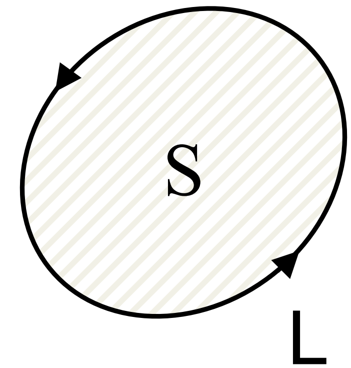
$$\vec{V}(\vec{r}) = c\left(\frac{\hat{r}}{r^2}\right)$$

The divergence of this vector field is:

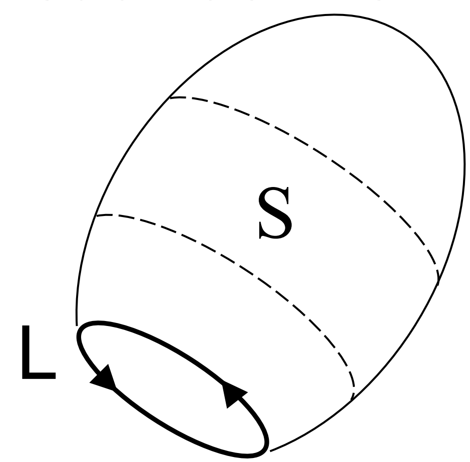
A) Zero everywhere except at the origin
B) Zero everywhere including the origin
C) Non-zero everywhere, including the origin.
D) Non-zero everywhere, except at origin (zero at origin)
E) Not quite sure how to get this (without computing from the front flyleaf of Griffiths!)

Stokes' Theorem says that for a surface S bounded by a perimeter L, any vector field B obeys

$$\int_{S} \nabla \times \vec{B} \cdot d\vec{a} = \oint_{L(S)} \vec{B} \cdot d\vec{l}$$



Does Stokes' Theorem apply for *any* surface S bounded by a perimeter L, even one such as this balloon-shaped surface S :



A) Yes
B) No
C) Sometimes

R16

Why is $\oint \vec{E} \cdot d\vec{l} = 0$ in electrostatics?

a) Because $\nabla \times \vec{\mathrm{E}} = 0$

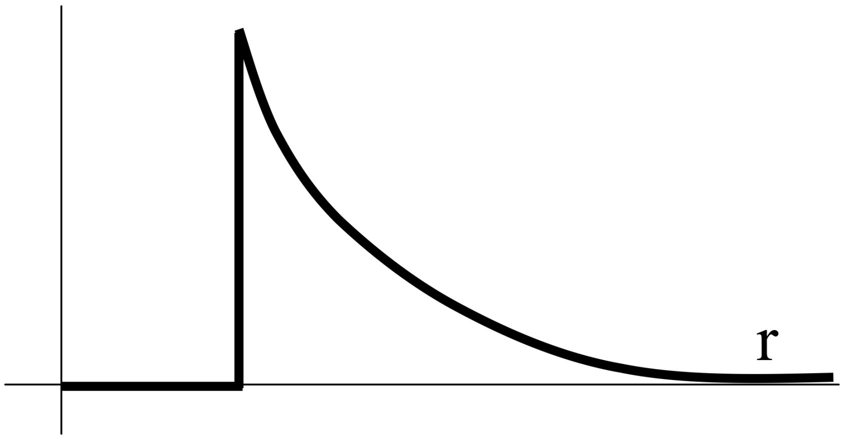
b) Because E is a conservative field

c) Because the potential (voltage) between two points is independent of the path

d) All of the above

e) NONE of the above - it's not always true!

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)

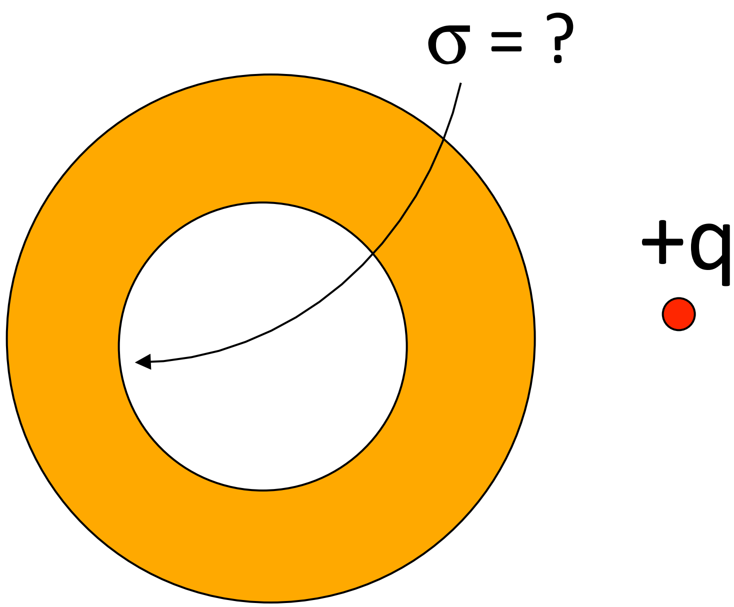
D) Can't be either

E) ???

Given a thin spherical *shell* with uniform *surface charge* density σ (and no other charges anywhere else) what can you say about the potential V *inside* this sphere? (Assume as usual, $V(\infty)=0$)

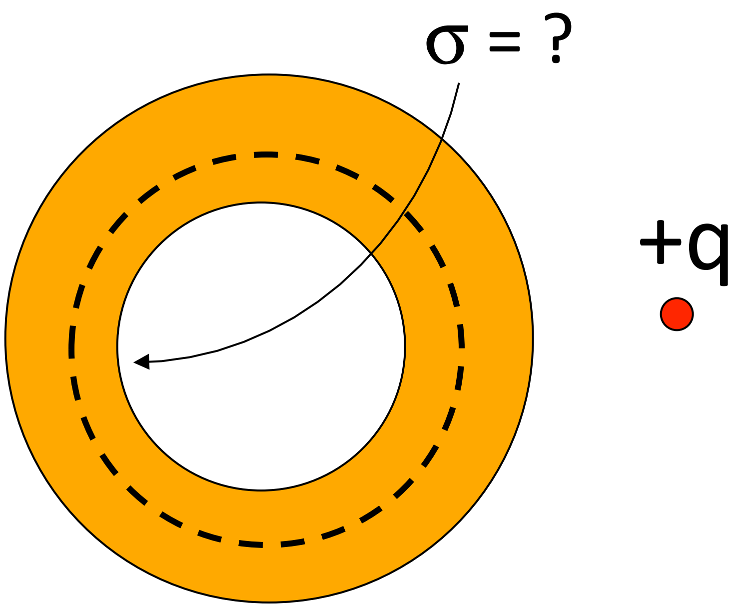
A) V=0 everywhere inside
B) V = non-zero constant everywhere inside
C) V must vary with position, but 0 at the center.
D) None of these/something else/not sure.

A point charge +q is near a neutral copper sphere with a hollow interior space. In equilibrium, the surface charge density σ on the interior of the hollow space is..



A) Zero everywhere
B) Non-zero, but with zero net total charge on interior surface
C) Non-zero, with non-zero net total charge on interior surface.

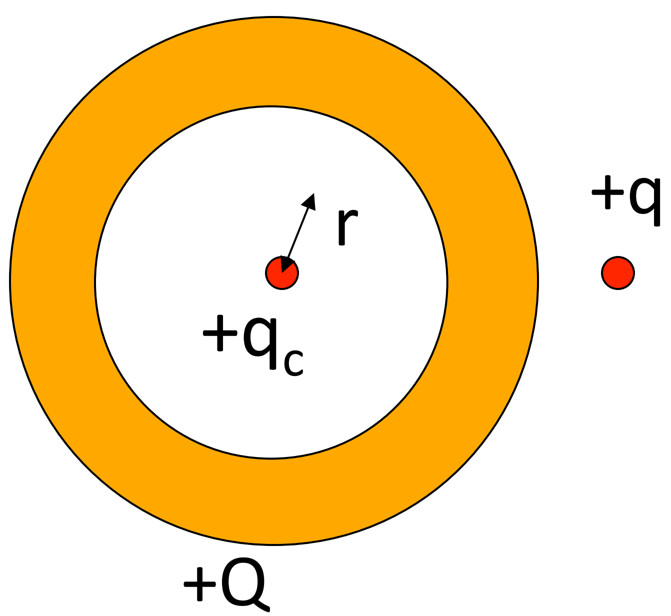
A point charge +q is near a neutral copper sphere with a hollow interior space. In equilibrium, the surface charge density σ on the interior wall of the hollow conductor is..



A) Zero everywhere
B) Non-zero, but with zero net total charge on interior surface
C) Non-zero, with non-zero net total charge on interior surface.

A HOLLOW copper sphere has total charge +Q.
A point charge +q sits outside.
A charge q_c is in the hole, right at the center.
(As usual, assume static equilibrium.)

What is the magnitude of the E-field a distance r from q_c, (but, still inside the hole) .



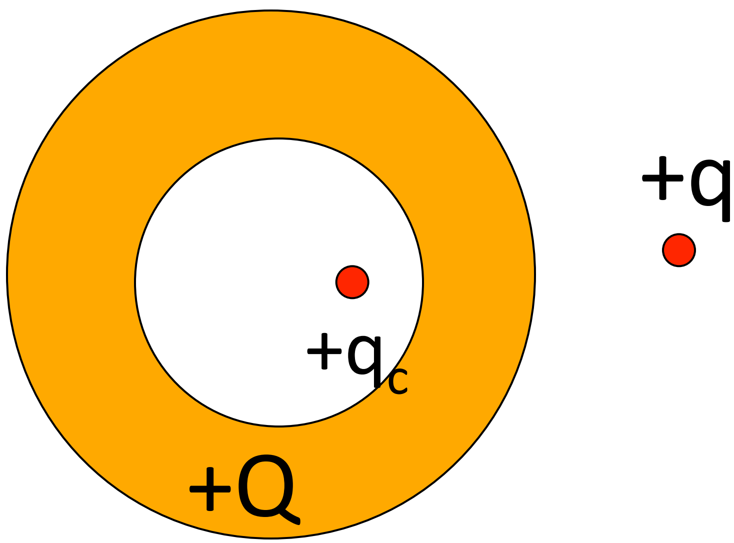
A) $|E| = kq_c/r^2$

B) $|E| = k(q_c-Q)/r^2$

C) $|E| = 0$

D) None of these! / it's hard to compute

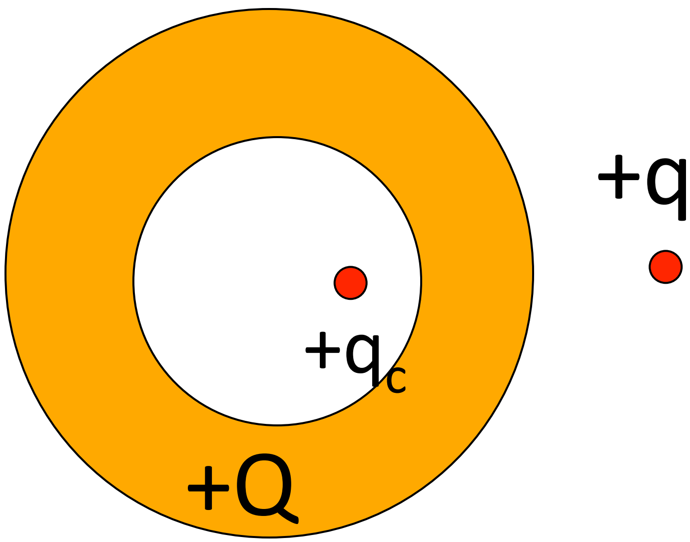
A HOLLOW copper sphere has total charge +Q.
A point charge +q sits outside.
A charge, q_c, is in the hole, SHIFTED right a bit.
(Assume static equilibrium.)
What does the E field look like in the hole?



A) It's zero in there
B) Simple Coulomb field (straight away from q_c, right up to the wall)
C) Simple (but *not* B)
D) Complicated/ it's hard to compute

R23

A HOLLOW copper sphere has total charge +Q.
A point charge +q sits outside.
A charge, $+q_c$, is in the hole, SHIFTED right a bit.
(Assume static equilibrium.)
What does the charge distribution look like on the inner surface of the hole?

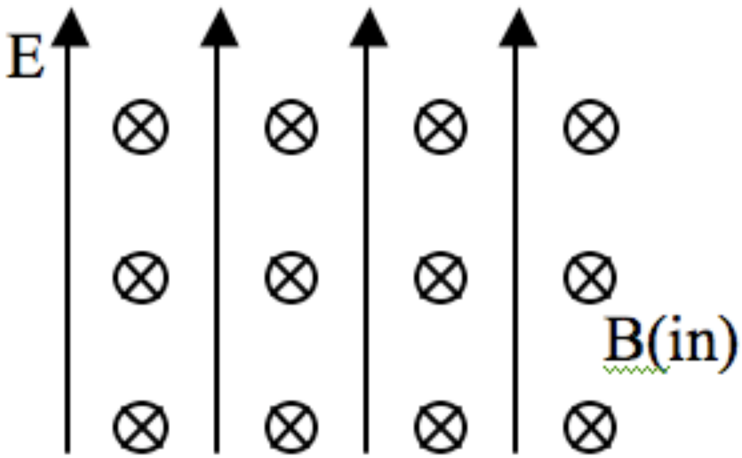


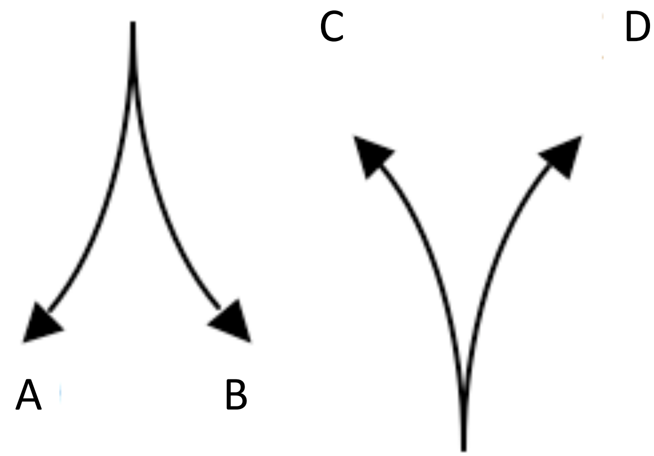
A) All -, uniformly spread out
B) - close to q_c, + opposite q_c
C) All -, but more close to q_c and fewer opposite
D) All + but more opposite q_c and fewer close
E) Not enough information

A proton (q=+e) is released from rest in a uniform **E** and uniform **B** (as shown).

E points up, **B** points into the page.

Which of the paths will the proton initially follow?





E. It will remain stationary

(To think about: what happens after longer times?)

Current I flows down a wire (length L) with a square cross section (side *a)* If it is uniformly distributed over the entire wire area, what is the magnitude of the volume current density?

A) $J = I/a^2$

B) $J = I/a$

C) $J = I/(a^2L)$

D) $J = I/a^3$

E) None of the above!

Current I flows down a wire (length L) with a square cross section (side *a)* If it is uniformly distributed over the outer surfaces only, what is the magnitude of the surface current density *K*?

A) $K = I/a^2$ B) $K = I/a$

C) $K = I/(4a)$ D) $K = I/(a^2 L)$

E) None of the above

To think about: does it seem physically correct to you that charges WOULD distribute evenly over the outer surface?

What is B at the point shown?

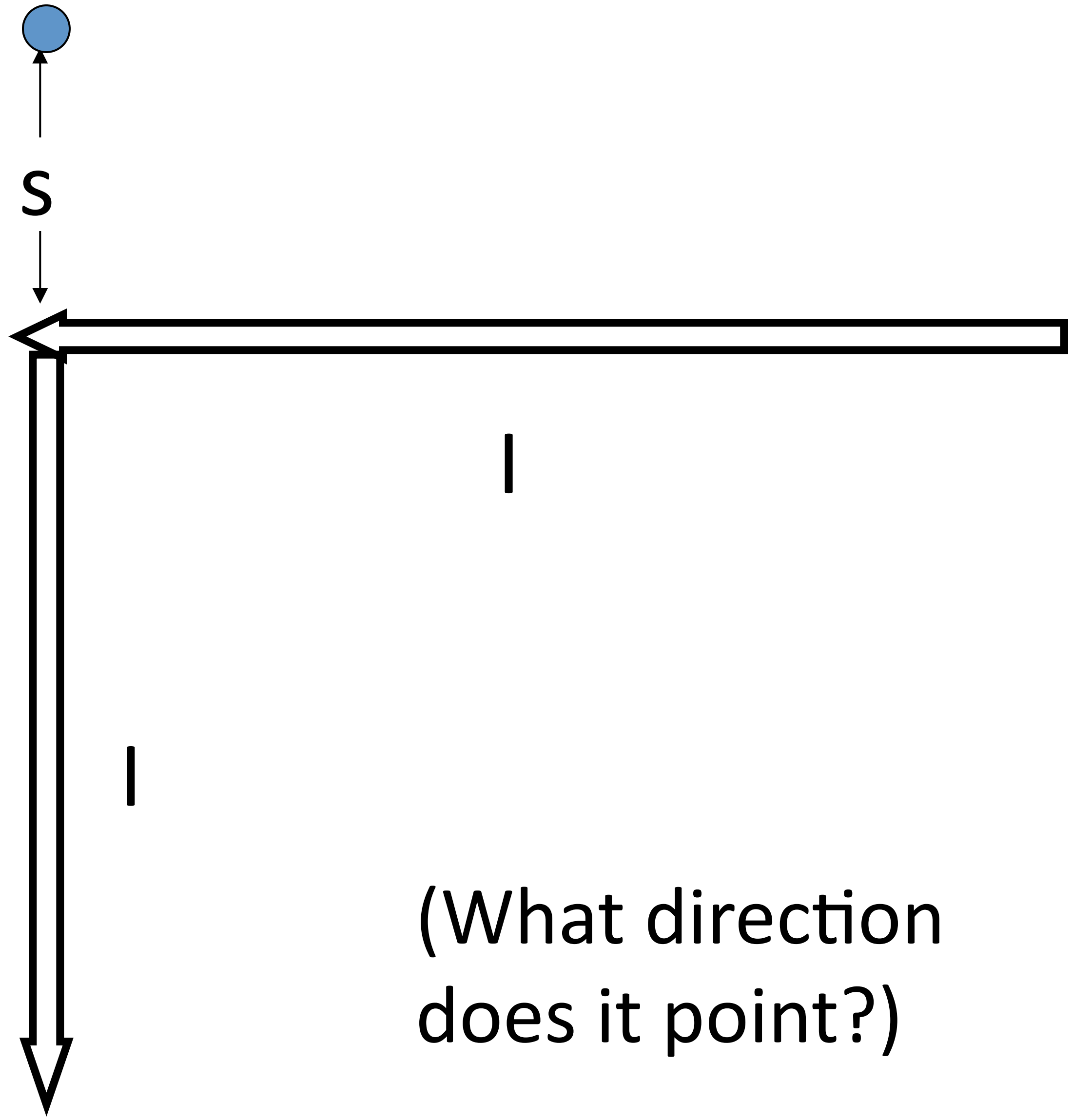
A) $\dfrac{\mu_0}{\pi\ s} I$

B) $\dfrac{\mu_0}{2\pi\ s} I$

C) $\dfrac{\mu_0}{4\pi\ s} I$

D) $\dfrac{\mu_0}{8\pi\ s} I$

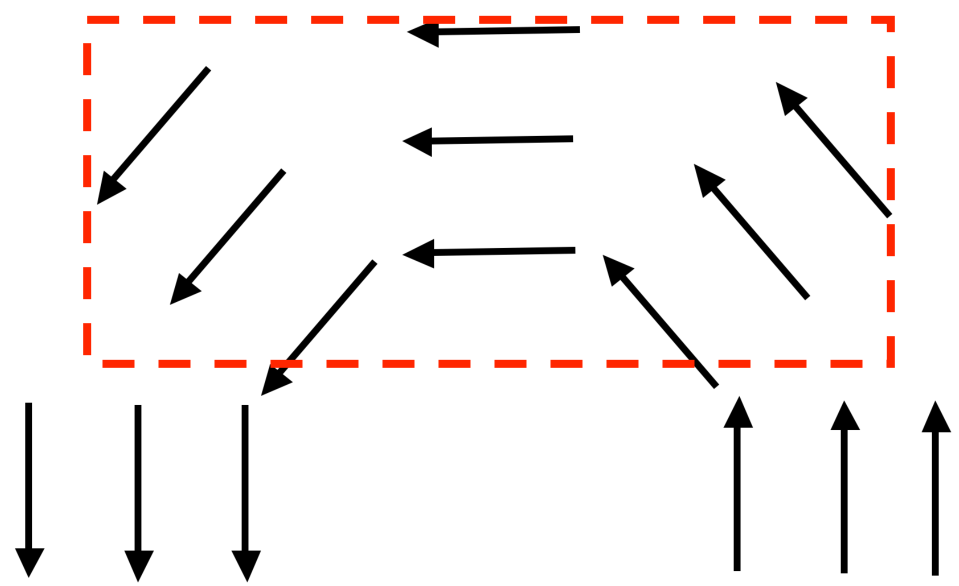
E) None of these



(What direction does it point?)

R28

If the arrows represent a B field (note that |B| is the same everywhere), is there a **J** (perpendicular to the page) in the dashed region?



$$\vec{B} = B_0\hat{\varphi}$$

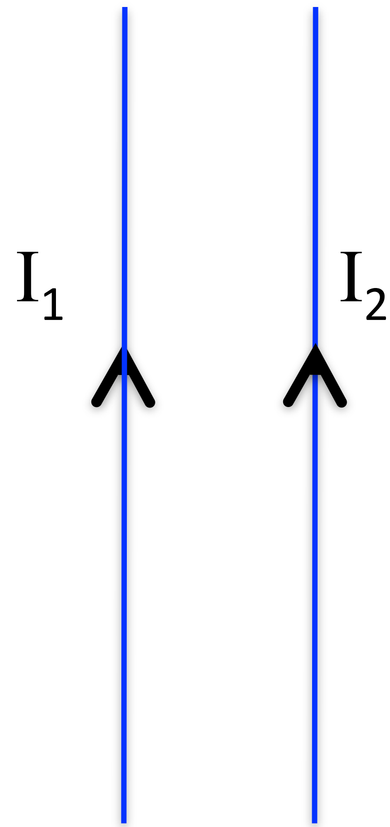
A. Yes, (J is non-zero in that region)

B. No, (J=0 throughout that region)

C. ??/Need more information to decide

I have two very long, parallel wires each carrying a current I_1 and I_2, respectively. In which direction is the force on the wire with the current I_2?

A) Up
B) Down
C) Right
D) Left
E) Into or out of the page



(How would your answer change if you would reverse the direction of the currents?)