The electric field throughout a region of space is given by the formula $\vec{\boldsymbol{E}} = Ay\hat{\boldsymbol{x}} + Bx\hat{\boldsymbol{y}}$, where (x, y) are the coordinates of a point in space, and A, B are constants. What is $\vec{\boldsymbol{E}} \cdot \hat{\boldsymbol{y}}$?

A) Ay

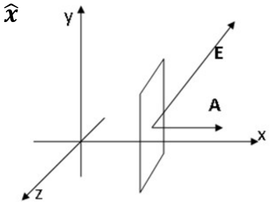
B) Bx

C) Ax

D) By

E) None of these

The electric field on a surface with area vector $\vec{\boldsymbol{A}} = A\,\hat{\boldsymbol{x}}$ is given by $\vec{\boldsymbol{E}} = E_x\,\hat{\boldsymbol{x}} + E_y\,\hat{\boldsymbol{y}}$, where E_x and E_y are constants. The flux through the area shown is…



A) $\sqrt{E_x{}^2 + E_y{}^2} \cdot A$ (note: the dot means "times", not "dot product")

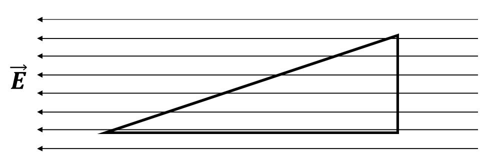
B) $(E_x + E_y) \cdot A$

C) $E_x \cdot A$

D) $E_y \cdot A$

E) None of these

Which surface has a greater magnitude of flux?



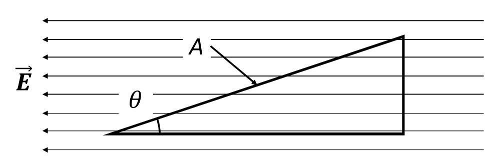
A) The vertical surface

B) The angled surface

C) They both have the same flux

D) Can not determine without knowing the charge distribution creating the electric field

What is the magnitude of the flux through the angled surface?



A) EA

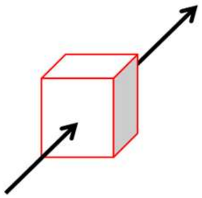
B) $EA\cos\theta$

C) $EA\sin\theta$

D) $EA\tan\theta$

E) $EA/2$

The one electric field line that passes through the box is normal to both the front and back surfaces. What is the net electric flux through the closed cubic surface shown below?

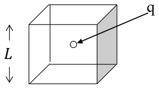


A) Zero

B) Positive

C) Negative

A charge q is located at the center of an gaussian cubical box, side length L, as shown. A student is asked: What is the electric flux Φ_E though the right (shaded) face of the cube?



A) kq

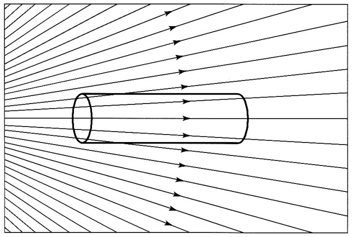
B) $\frac{kq}{L^2}$

C) $4kq$

D) $\frac{4kq}{L^2}$

E) None of these

The net electric flux through the closed cylindrical surface shown is…

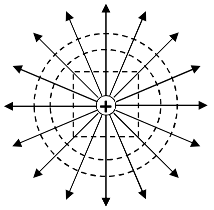


A) Zero

B) Positive

C) Negative

Three closed surfaces enclose a point charge. The three surfaces are a small cube, a small sphere, and a larger sphere – all centered on the charge. Which surface has the largest flux through it?



A) small cube

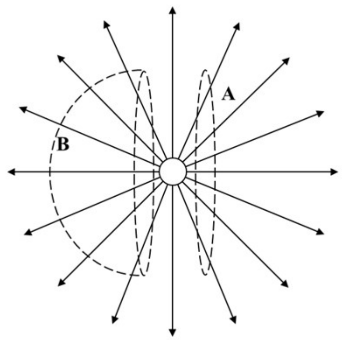
B) smaller sphere

C) larger sphere

D) impossible to tell without more information

E) all three have the same flux

Two open surfaces are in an E field. Surface A is a flat circular disk of radius R. Surface B is a hollow-cup hemisphere of the same radius R.



Which surface has a greater flux through it?

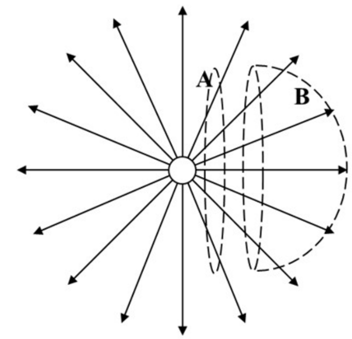
A) A

B) B

C) Both surfaces have the same flux

D) Not enough info

Two open surfaces are in an E field. Surface A is a flat circular disk of radius R. Surface B is a hollow-cup hemisphere of the same radius R.



Which surface has a greater flux through it?

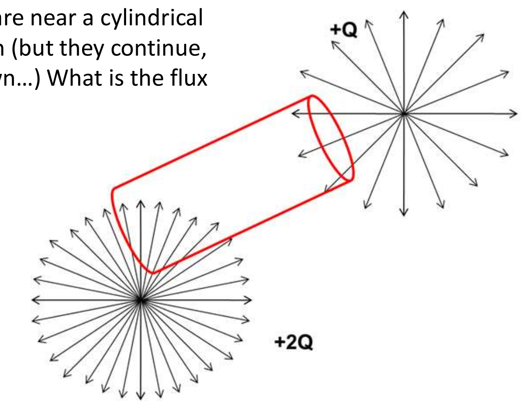
A) A

B) B

C) Both surfaces have the same flux

D) Not enough info

Two charges (and only two) are near a cylindrical surface. Field lines are shown (but they continue, of course, and this isn't shown…) What is the flux through the surface?



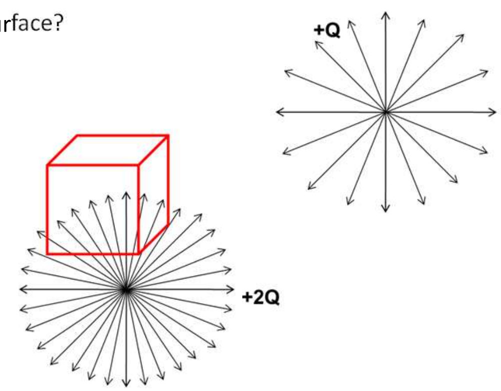
A) Zero

B) Positive

C) Negative

D) not enough info

What is the flux through the surface?



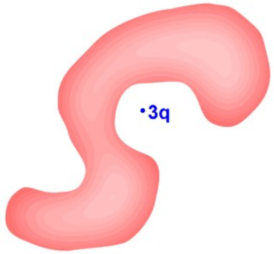
A) Zero

B) Positive

C) Negative

D) not enough info

Consider the closed surface shown below. The electric flux through the surface is…



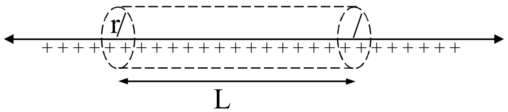
A) Zero

B) Positive

C) Negative

D) not enough info

To compute the E-field around an infinite line of charge (with charge per length λ) a student draws the cylindrical gaussian surface of radius r and length L.



The LHS of Gauss's Law, $\oint_{surface} \vec{\boldsymbol{E}} \cdot d\vec{\boldsymbol{A}}$ reduces to…

A) $E2\pi r^2$

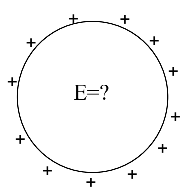
B) $E2\pi rL$

C) $E(2\pi r^2 + 2\pi rL)$

D) $E\pi r^2$

E) None of the above

A spherical shell has a uniform positive charge density on its surface. (There are no other charges around) What is the electric field inside the sphere?



A) $E = 0$ everywhere inside

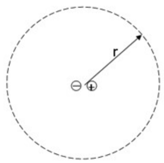
B) $E = 0$ nowhere inside

C) $E = 0$ only at the very center

D) Not enough info to answer

A dipole sits near the origin. We draw an imaginary Gaussian sphere (radius r) around it. Gauss's law says: $\oint \vec{\boldsymbol{E}} \cdot d\vec{\boldsymbol{A}} = \frac{q_{enclosed}}{\varepsilon_0}$

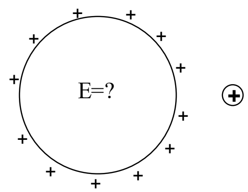
Do we conclude that $E = 0$ everywhere on the sphere?



A) Yes, $E = 0$ everywhere

B) No, E is not zero at all points on that sphere

A spherical ***insulating*** shell with uniform positive charge density on its surface is near a positive point charge. Because it is an insulator, the charge on the shell does not move around in response to the point charge. Is the electric field inside the sphere zero?

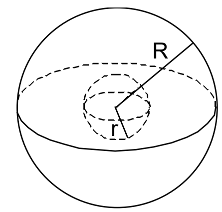


A) $E = 0$ inside

B) $E \neq 0$ inside

C) Not enough info to answer

A sphere of radius R has a total charge +Q spread uniformly throughout its volume. What is the total charge enclosed by the small centered sphere of radius r?



A) $Q\frac{4}{3}\pi r^3$

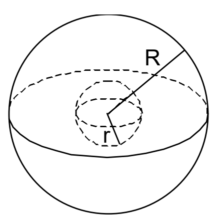
B) $Q\frac{r^2}{R^2}$

C) $Q\frac{r^3}{R^3}$

D) $Q\frac{R^3}{r^3}$

E) None of these

If the electric field at distance r from the center of the sphere is E, what is the flux, $\oint_{surfa} \vec{\boldsymbol{E}} \cdot d\vec{\boldsymbol{A}}$, out of the small sphere?



A) $\mathrm{E}\pi r^2$

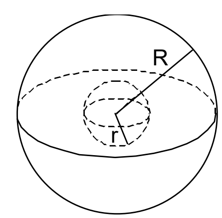
B) $\mathrm{E}4\pi r^2$

C) $\mathrm{E}4\pi R^2$

D) $\mathrm{E}\frac{4}{3}\pi r^2$

E) $\mathrm{E}\frac{4}{3}\pi R^2$

Within the sphere, how does the E- field magnitude, E, depend on distance, r, from the origin?



A) $\mathrm{E} \propto r$

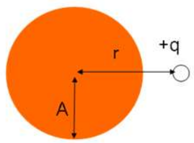
B) $\mathrm{E} \propto r^2$

C) $\mathrm{E} \propto r^3$

D) E is a nonzero constant within the sphere

E) $\mathrm{E} = 0$ within the sphere

A point charge +q sits outside a solid neutral copper sphere of radius A. What is the magnitude of the E-field at the center of the sphere?



A) $E = \frac{kq}{r^2}$

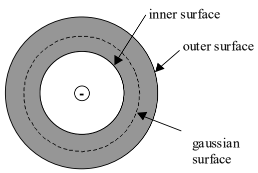
B) $E = \frac{kq}{A^2}$

C) $E = \frac{kq}{(r-A)^2}$

D) $E = 0$

E) None of these

A negative point charge with charge -Q sits in the interior of a spherical metal shell. The conducting metal shell has no net charge. What is the total charge on the outer surface of the shell? [Hint: consider the Gaussian surface shown]



A) -Q

B) +Q

C) +2Q

D) zero

E) some other answer

The small sphere is touched to the outside of the negatively charged, large sphere. After it is removed, the small sphere will be…

A) negatively charged.

B) positively charged.

C) uncharged.

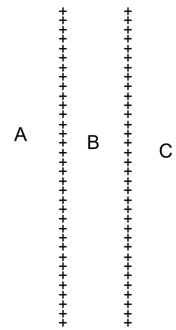
The small sphere is touched to the inside of the negatively charged, large sphere. After it is removed, the small sphere will be…

A) negatively charged.

B) positively charged.

C) uncharged.

Two infinite planes are uniformly charged with the same charge per area σ. The field in region A has magnitude…



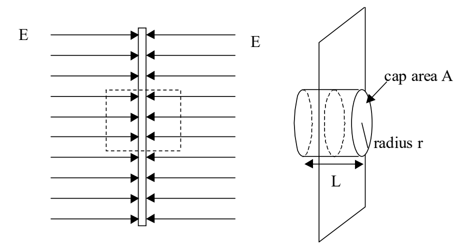
A) zero

B) $\frac{\sigma}{\epsilon_0}$

C) $\frac{\sigma}{2\epsilon_0}$

D) $\frac{\sigma}{4\epsilon_0}$

A uniform, infinite plane of negative charge creates a uniform E-field of magnitude E perpendicular to the plane and pointing toward the plane as shown. An imaginary gaussian surface in the shape of a right cylinder is shown. (This shape is sometimes called a "pillbox".) The flux through surface is..



A) $-EA$

B) $+2EA$

C) $(-2A + L\pi r^2)E$

D) $L\pi r^2$E

E) None of these

The non-zero electric field everywhere on a closed surface is constant: $\vec{\boldsymbol{E}}$ = constant (meaning the vector $\vec{\boldsymbol{E}}$ is everywhere constant in magnitude and direction). Is the following calculation correct?

$$\oint \vec{\boldsymbol{E}} \cdot d\vec{\boldsymbol{A}} = E \oint dA = EA$$

A) Definitely correct

B) Definitely incorrect

C) Possibly correct – depends on details of the surface

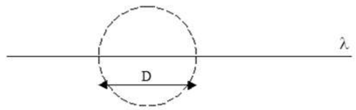
The small sphere is given a negative charge and is then inserted into the large sphere without making contact. What happens to the large sphere?

A) Nothing, it remains neutral everywhere

B) The inner surface becomes positive and the outer negative

C) The inner surface becomes negative and the outer positive

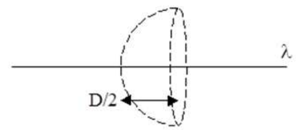
A long, straight line of charge has charge density λ C/m. Does Gauss's Law allow you to easily compute the flux $\oint \vec{E} \cdot d\vec{A}$ through a *spherical* surface of diameter D, centered on the line as shown?



A) Yes, it does.

B) No, it doesn't.

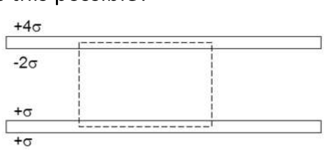
Consider now the *open* hemispherical surface (shaped like a bowl) centered on the line as shown. Does Gauss's Law allow you to easily compute the flux $\oint \vec{E} \cdot d\vec{A}$ through a this surface? [Take the outward normal direction as positive.]



A) Yes, it does.

B) No, it doesn't.

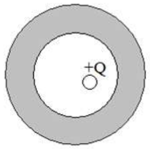
Consider two very large, charged, parallel metal plates in static equilibrium. Consider also the Gaussian surface shown. Suppose someone tells you they've analyzed the situation and determined that the charge densities on the four surfaces are as shown. Is this possible?



A) Yes, it's possible.

B) No, it's impossible.

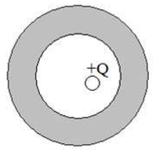
Consider a point charge $+Q$ off-center within a spherical metal shell. Does Gauss's Law allow you to easily compute the total charge on the inside surface of the shell?



A) Yes, it does.

B) No, it doesn't.

Does the total charge on the inside surface of the shell depend on the total net charge of the whole shell?



A) Yes, it does.

B) No, it doesn't.