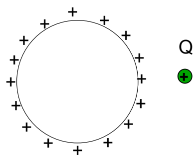
2.29
alt

We place a charge Q just outside an insulating, spherical shell *(fixing* all surface charges uniformly around the sphere)

What is the electric field *inside* the sphere?



A: 0 everywhere inside
B: non-zero everywhere in the sphere
C: Something else
D: Not enough info given

2.29
alt

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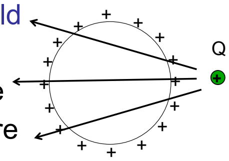

A: 0 everywhere inside
B: non-zero everywhere in the sphere
C: Something else
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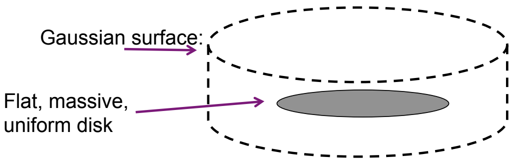
Click only when you are done with the yellow sheet:

What is the answer to the last question:
iv) Where is this E-field's divergence zero?

A) div(E)=0 everywhere
B) div(E)=0 NOwhere
C) div(E)=0 everywhere OUTSIDE the pipe
D) div(E)=0 on the surface of the pipe only
E) Something else!

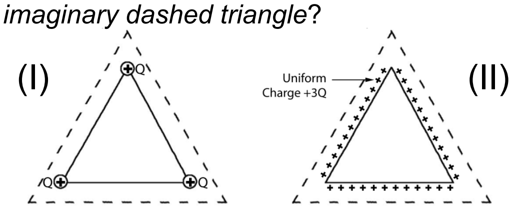
I would like to find the E field directly above the center of a uniform (finite) disk.
Can we use Gauss' law with the Gaussian surface depicted below?



A) Yes, and it would be pretty easy/elegant…
B) Yes, but it's not easy.
C) No. Gauss' law applies, but it can not be used here to compute E directly.
D) No, Gauss' law would not even apply in this case

4

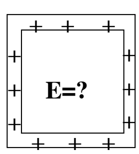
Which is true about **|E|** at points on the *imaginary dashed triangle*?



A. |**E**| same everywhere (uniform) in (I) ONLY
B. |**E**| uniform in (II) ONLY
C. Uniform in both, but *different* in cases I & II
D. Uniform in both, and same in cases I & II.
E. |**E**| varies from point to point in both cases

2.27

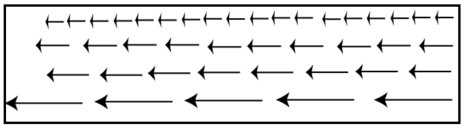
A cubical non-conducting *shell* has a ***uniform*** positive charge density on its surface. (There are no other charges around)
What is the field inside the box?



A: **E**=0 everywhere inside
B: **E** is non-zero everywhere inside
C: **E**=0 only at the very center, but non-zero elsewhere inside.
D: Not enough info given

1.7c

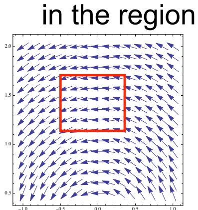
What is the curl of this vector field, in the region shown below?



A. non-zero everywhere
B. Non-zero at a limited set of points
C. zero curl everywhere
D. We need a formula to decide for sure

1.8

What is the curl of this vector field, **V** in the region shown below?

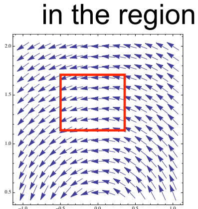


$$\vec{\mathbf{V}} = c\,\hat{\varphi}$$

A. non-zero everywhere
B. Zero at some points, non-zero others
C. zero curl everywhere shown

1.8

What is the curl of this vector field, **V** in the region shown below?



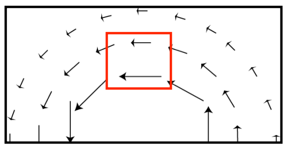
$$\vec{\mathbf{V}} = c\,\hat{\varphi}$$

$$\nabla \times \vec{\mathbf{V}} = \left[\frac{1}{s}\frac{\partial v_z}{\partial \phi} - \frac{\partial v_\phi}{\partial z}\right]\hat{s} + \left[\frac{\partial v_s}{\partial z} - \frac{\partial v_z}{\partial s}\right]\hat{\phi} + \frac{1}{s}\left[\frac{\partial (s v_\phi)}{\partial s} - \frac{\partial v_s}{\partial \phi}\right]\hat{z}$$

A. non-zero everywhere
B. Zero at some points, non-zero others
C. zero curl everywhere shown

1.8

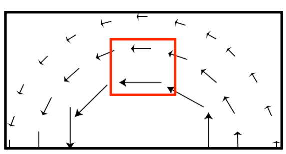
What is the curl of this vector field, in the red region shown below?



A. non-zero everywhere in the box
B. Non-zero at a limited set of points
C. zero curl everywhere shown
D. We need a formula to decide for sure

1.8

What is the curl of this vector field, in the red region shown below?



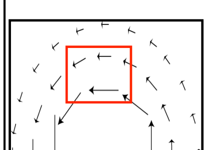
$$\vec{\mathbf{V}} = \frac{c}{s}\hat{\varphi}$$

A. non-zero everywhere in the box
B. Non-zero at a limited set of points
C. zero curl everywhere shown

1.8

What is the curl of this vector field, in the red region shown below?

$$\vec{\mathbf{V}} = \frac{c}{s}\hat{\varphi}$$

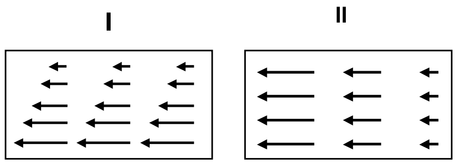


$$\nabla \times \vec{\mathbf{V}} = \left[\frac{1}{s}\frac{\partial v_z}{\partial \phi} - \frac{\partial v_\phi}{\partial z}\right]\hat{s} + \left[\frac{\partial v_s}{\partial z} - \frac{\partial v_z}{\partial s}\right]\hat{\phi} + \frac{1}{s}\left[\frac{\partial (s v_\phi)}{\partial s} - \frac{\partial v_s}{\partial \phi}\right]\hat{z}$$

A. non-zero everywhere in the box
B. Non-zero at a limited set of points
C. zero curl everywhere shown

2.43b/1.7b

Which of the following *could* be a static physical E-field in a small region?



A) Only I B) Only II
C) Both D) Neither
E) Cannot answer without further info

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

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

b) Because E is a conservative field

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

d) All of the above

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

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

$$\vec{\Re} = \mathbf{r} - \mathbf{r}' = (x - x', y - y', z - z')$$

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

(with $\vec{\Re} = \mathbf{r} - \mathbf{r}' = (x-x', y-y', z-z')$)

It is also true that $\frac{\hat{\Re}}{\Re^2} = -\nabla\frac{1}{|\Re|}$

where $\nabla = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)$

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

(with $\vec{\Re} = \mathbf{r} - \mathbf{r}' = (x-x', y-y', z-z')$)

It is also true that $\frac{\hat{\Re}}{\Re^2} = -\nabla\frac{1}{|\Re|}$

where $\nabla = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)$

Question: is the following mathematically ok?

$$\mathbf{E}(\mathbf{r}) = \frac{1}{4\pi\varepsilon_0}\iiint \rho(\mathbf{r}')\left(-\nabla\frac{1}{|\Re|}\right)d\tau' = -\nabla\frac{1}{4\pi\varepsilon_0}\iiint\frac{\rho(\mathbf{r}')}{|\Re|}d\tau'$$

A) Yes B) No C) ???

2.43

Which of the following electrostatic fields could exist in a finite region of space that contains no charges?

A) $Axyz(\hat{i} + \hat{j})$

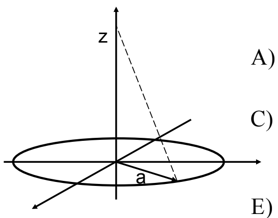
B) $A(xz\hat{i} - xz\hat{j})$

C) $A(-xy\hat{j} + xz\hat{k})$

D) None of these

A uniformly charged ring, in the xy plane, centered on the origin, has radius *a* and total charge Q. V(r = ∞) = 0.

What is the voltage at z on the z-axis?

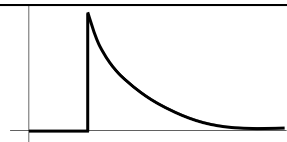


A) $\frac{kQ}{a}$ B) $\frac{kQ}{z}$

C) $\frac{kQ}{\sqrt{a^2+z^2}}$ D) $\frac{kQ}{a^2+z^2}$

E) None of these

2.44



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) ???

2.45

Given a sphere with uniform surface charge density σ what can you say about the potential V *inside* this sphere? (Assume as usual, V(∞)=0)

A) V=0 everywhere inside

B) V = non-zero constant everywhere inside

C) V must vary with position, but is zero at the center.

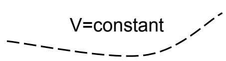
D) None of these.

The voltage is zero at a point in space.

You can conclude that :

A) The E-field is zero at that point.
B) B) The E-field is non-zero at that point
C) You can conclude nothing at all about the E-field at that point

The voltage is constant everywhere along a line in space.



You can conclude that :

A) The E-field has constant magnitude along that line.
B) The E-field is zero along that line.
C) You can conclude nothing at all about the magnitude of **E** along that line.