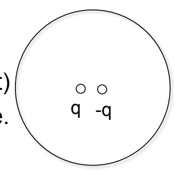
A Gaussian surface which is *not* a sphere has a single charge (q) inside it, *not* at the center. A charge –q sits just outside. What can we say about total electric flux through this surface $\oint \vec{E} \bullet d\vec{a}$?

A) It must be q/ε_0
B) It is NOT necessarily q/ε_0
C) We need more info/details to figure it out!

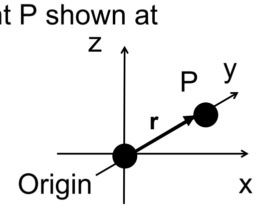
An electric dipole
(+q and –q, small distance d apart) sits centered in a Gaussian sphere.



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 on sphere
C) Flux is not zero, E=0 everywhere on sphere
D) Flux is not zero, E need not be zero…

1.1 In spherical coordinates, what would be the correct description of the position vector "**r**" of the point P shown at (x,y,z) = (0, 2 m, 0)



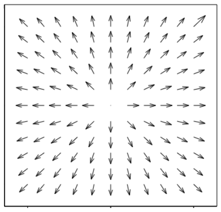
A) $\vec{\mathbf{r}} = (2\ m)\,\hat{r}$
B) $\vec{\mathbf{r}} = (2\ m)\,\hat{r} + \pi\,\hat{\theta}$
C) $\vec{\mathbf{r}} = (2\ m)\,\hat{r} + \pi\,\hat{\theta} + \pi\,\hat{\varphi}$
D) $\vec{\mathbf{r}} = (2\ m)\,\hat{r} + \pi\,\hat{\theta} + \pi/2\,\hat{\varphi}$
E) None of these

MD-1

Consider the vector field

$$\vec{V}(\vec{r}) = c\hat{r}$$

where c = constant .



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)

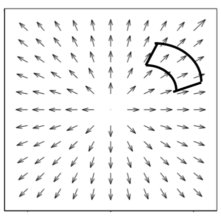
(No fair computing the answer. Get answer from your brain.)

MD-1

Consider the vector field

$$\vec{V}(\vec{r}) = c\hat{r}$$

where c = constant .



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)

(No fair computing the answer. Get answer from your brain.)

You have an E field given by
E = c **r**, (Here c = constant,
r = spherical radius vector)

What is the charge density $\rho(r)$?

A) c B) c r C) 3 c D) 3 c r^2
E) None of these is correct

Given **E** = c **r**,
(c = constant, **r =** spherical radius vector)
We just found ρ(r) = 3c.
What is the total charge Q enclosed by an imaginary sphere centered on the origin, of radius R?

Hint: Can you find it two DIFFERENT ways?

A) (4/3) π c B) 4 π c
C) (4/3) π c R^3 D) 4 π c R^3
E) None of these is correct

What is the value of $\int_{-\infty}^{\infty} x^2 \delta(x-2)dx$

A) 0
B) 2
C) 4
D) ∞
E) Something different!

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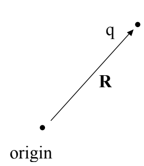
A point charge (q) is located at position **R,** as shown. What is ρ(r), the charge density in all space?

A) $\rho(\vec{\mathbf{r}}) = q\delta^3(\vec{\mathbf{R}})$

B) $\rho(\vec{\mathbf{r}}) = q\delta^3(\vec{\mathbf{r}})$

C) $\rho(\vec{\mathbf{r}}) = q\delta^3(\vec{\mathbf{r}} - \vec{\mathbf{R}})$

D) $\rho(\vec{\mathbf{r}}) = q\delta^3(\vec{\mathbf{R}} - \vec{\mathbf{r}})$



E) None of these/more than one/???

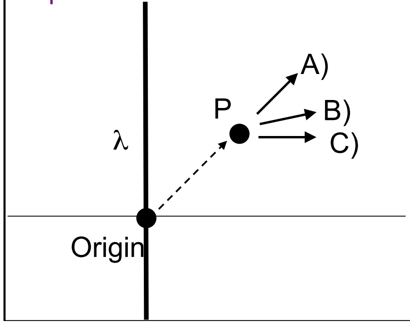
What are the units of $\delta(x)$ if x is measured in meters?

A) δ is dimension less ('no units')
B) [m]: Unit of length
C) [m^2]: Unit of length squared
D) [m^{-1}]: 1 / (unit of length)
E) [m^{-2}]: 1 / (unit of length squared)

What are the units of $\delta^3(\vec{\mathbf{r}})$ if the components of $\vec{\mathbf{r}}$ are measured in meters?

A) [m]: Unit of length
B) [m^2]: Unit of length squared
C) [m^{-1}]: 1 / (unit of length)
D) [m^{-2}]: 1 / (unit of length squared)
E) None of these.

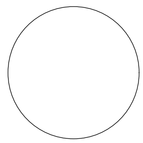
2.17 An infinite rod has uniform charge density λ. What is the direction of the E field at the point P shown?



2.26

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** is non-zero everywhere in the sphere

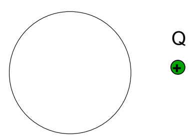
C: **E**=0 only at the very center, but non-zero elsewhere inside the sphere.

D: Not enough info given

2.29
alt

If we now place a charge Q just outside that insulating, spherical shell *(fixing* all surface charges uniformly around the sphere)

What is the electric field *inside* the sphere?



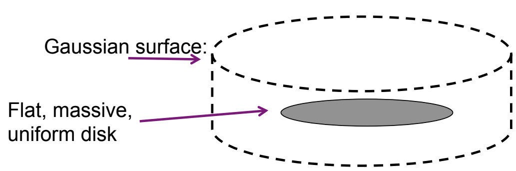
A: 0 everywhere inside

B: non-zero everywhere in the sphere

C: Something else

D: Not enough info given

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



A) Yes, and it would be pretty easy…
B) Yes, but it's not at all easy.
C) No, Gauss' law applies, but it would not have been *useful* to compute E
D) No, Gauss' law would not even apply in this case

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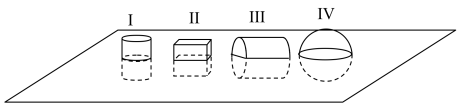
Consider these four closed gaussian surfaces, each of which straddles an infinite sheet of constant areal mass density.
The four shapes are
I: cylinder II: cube III: cylinder IV: sphere
For which of these surfaces does gauss's law, $\oiint \vec{E} \cdot d\vec{\mathbf{A}} = Q_{\text{enclosed}} / \varepsilon_0$ help us find E near the surface??



A) All B) I and II only C) I and IV only D) I, II and IV only
E) Some other combo

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Extras

What is the value of $\int_{-\infty}^{\infty} x^2 \delta(x) dx$

A) 0
B) 1
C) 2
D) 4
E) 5

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What is the value of $\int_{-\infty}^{2}(x^2+1)\delta(x)dx$

A) 0
B) 1
C) 2
D) 4
E) 5

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What is the value of $\int_{0}^{\infty}x^2\delta(x+2)dx$

A) 0
B) 2
C) 4
D) ∞
E) Something different!

24

What is the value of $\int_{-\infty}^{\infty}x^2\delta(x+2)dx$

A) 0
B) 2
C) 4
D) ∞
E) Something different!

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What is the value of $\int_{-\infty}^{\infty} x^2\delta(2-x)dx$

A) 2
B) - 2
C) 4
D) – 4
E) Something different!

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$$\int_{-\infty}^{\infty} f(t)\delta(t-t_0)\,dt = \quad f(t_0)$$

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Recall that $\int_{-\infty}^{\infty} f(t)\delta(t-t_0)\,dt = f(t_0)$

What are the UNITS of $\delta(t-t_0)$ (where t is seconds)

A) sec
B) sec^{-1}
C) unitless
D) depends on the units of f(t)
E) Something different!

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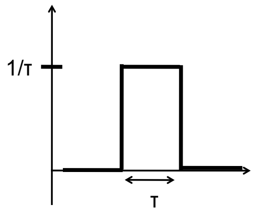

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