

This picture represents the field lines of a single positive point charge.

What is the divergence in the boxed region? What is the divergence of the whole field?

- A. Boxed region is zero; whole field is zero
- B. Boxed region is non-zero; whole field is zero
- C. Boxed region is zero; whole field is non-zero
- D. Boxed region is non-zero; whole field is non-zero
- E. ???

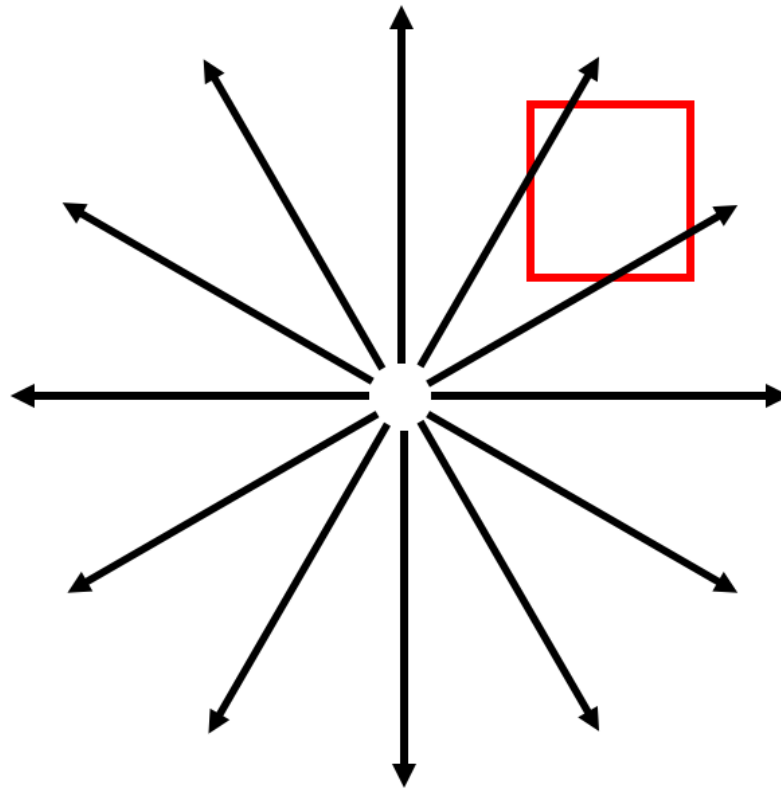
Activity: For a the electric field of a point charge,

$$\mathbf{E}(\mathbf{r}) = \frac{1}{4\pi\epsilon_0} \frac{q}{r^2} \hat{r}, \text{ compute } \nabla \cdot \mathbf{E}.$$

Hint: The front fly leaf of Griffiths suggests that the we take:

$$\frac{1}{r^2} \frac{\partial}{\partial r} (r^2 E_r)$$

Remember this?



What is the value of:

$$\int_{-\infty}^{\infty} x^2 \delta(x - 2) dx$$

A. 0

B. 2

C. 4

D. ∞

E. Something else

Activity: Compute the following integrals. Note anything special you had to do.

- Row 1-2: $\int_{-\infty}^{\infty} x e^x \delta(x - 1) dx$
- Row 3-4: $\int_{-\infty}^{\infty} \log(x) \delta(x - 2) dx$
- Row 5-6: $\int_{-\infty}^0 x e^x \delta(x - 1) dx$
- Row 6+: $\int_{-\infty}^{\infty} (x + 1)^2 \delta(4x) dx$

Compute:

$$\int_{-\infty}^{\infty} x^2 \delta(3x + 5) dx$$

A. $25/3$

B. $-5/3$

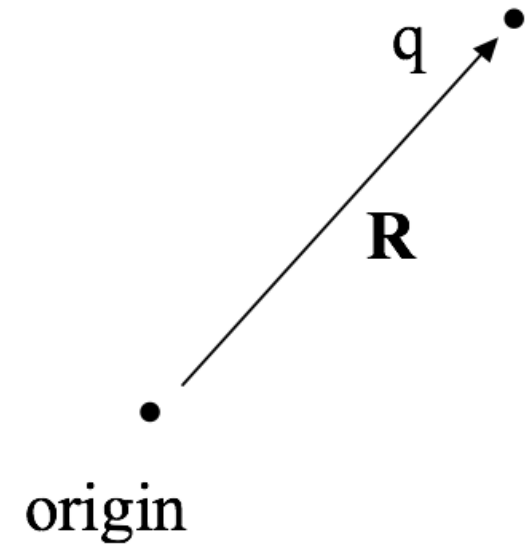
C. $25/27$

D. $25/9$

E. Something else

A point charge (q) is located at position \mathbf{R} , as shown. What is $\rho(\mathbf{r})$, the charge density in all space?

- A. $\rho(\mathbf{r}) = q\delta^3(\mathbf{R})$
- B. $\rho(\mathbf{r}) = q\delta^3(\mathbf{r})$
- C. $\rho(\mathbf{r}) = q\delta^3(\mathbf{R} - \mathbf{r})$
- D. $\rho(\mathbf{r}) = q\delta^3(\mathbf{r} - \mathbf{R})$
- E. Something else??



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

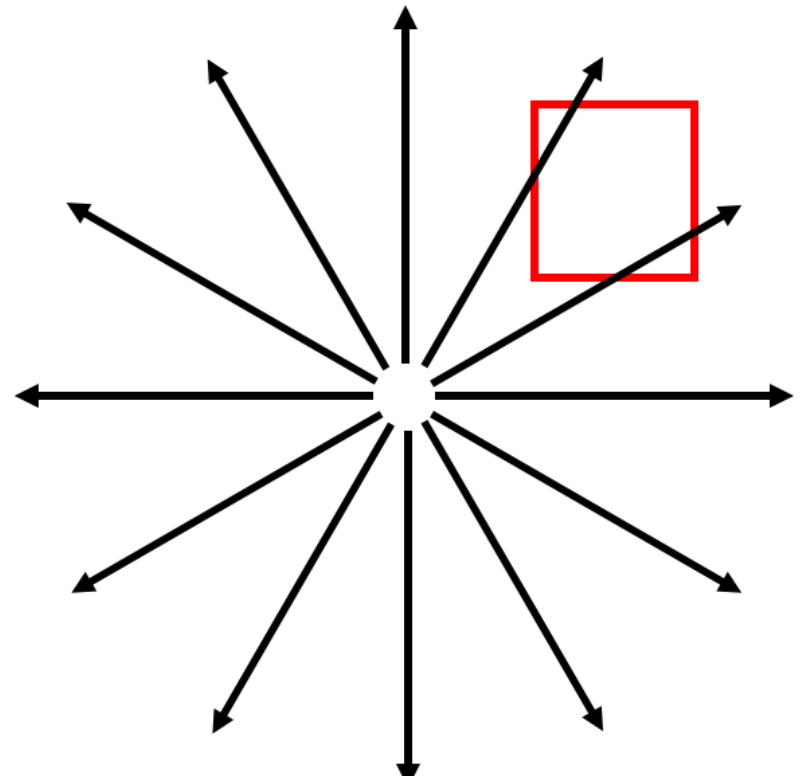
- A. $\delta(x)$ is dimensionless ('no units')
- B. [m]: Unit of length
- C. [m²]: Unit of length squared
- D. [m⁻¹]: 1 / (unit of length)
- E. [m⁻²]: 1 / (unit of length squared)

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

- A. [m]: Unit of length
- B. [m²]: Unit of length squared
- C. [m⁻¹]: 1 / (unit of length)
- D. [m⁻²]: 1 / (unit of length squared)
- E. None of these.

What is the divergence in the boxed region?

- A. Zero
- B. Not zero
- C. ???



We have shown twice that $\nabla \cdot \mathbf{E} = 0$ using what seem to be appropriate vector identities. But physically, $\nabla \cdot \mathbf{E} = \rho/\epsilon_0$.

What is going on?!

- A. We broke physics - let's call it a day
- B. There's some trick to get out of this and that makes me uncomfortable
- C. I can see what we need to do
- D. ???