

True or False The following mathematical operation makes sense and is technically valid.

$$\nabla \cdot \nabla T(x, y, z)$$

- A. Yes, it will produce a vector field.
- B. Yes, it will produce a scalar field.
- C. No, you can not take the divergence of a scalar field.
- D. I don't remember what this means.

A certain fluid has a velocity field given by $\mathbf{v} = x\hat{x} + z\hat{y}$. Which component(s) of the field contributed to "fluid flux" integral $(\int_S \mathbf{v} \cdot d\mathbf{A})$ through the x-z plane?

- A. v_x
- B. v_y
- C. both
- D. neither

A certain fluid has a velocity field given by $\mathbf{v} = x\hat{x} + z\hat{y}$. If we intend to calculate the "fluid flux" integral $(\int_S \mathbf{v} \cdot d\mathbf{A})$ through the x-z plane, what is $d\mathbf{A}$ in this case? Be specific!

- A. $\langle dx dy, 0, 0 \rangle$
- B. $\langle dx dz, 0, 0 \rangle$
- C. $\langle dy dz, 0, 0 \rangle$
- D. It's none of these

For the same fluid with velocity field given by $\mathbf{v} = x\hat{x} + z\hat{y}$.
What is the value of the "fluid flux" integral ($\int_S \mathbf{v} \cdot d\mathbf{A}$)
through the entire x-y plane?

- A. It is zero
- B. It is something finite
- C. It is infinite
- D. I can't tell without doing the integral

A rod (radius R) with a hole (radius r) drilled down its entire length L has a mass density of $\frac{\rho_0\phi}{\phi_0}$ (where ϕ is the normal polar coordinate).

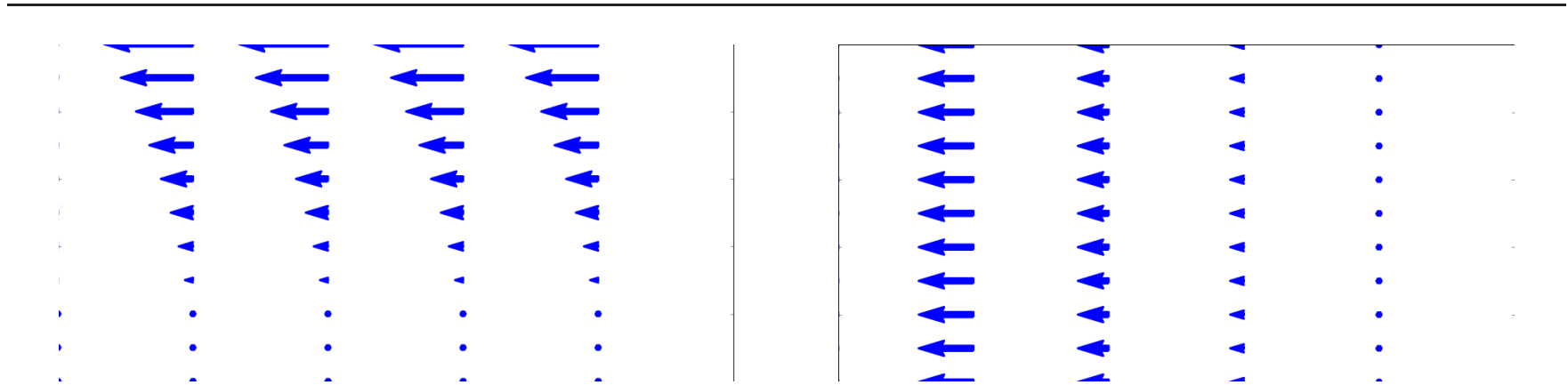
To find the total mass of this rod, which coordinate system should be used (take note that the mass density varies as a function of angle):

- A. Cartesian (x, y, z)
- B. Spherical (r, ϕ, θ)
- C. Cylindrical (s, ϕ, z)
- D. It doesn't matter, just pick one.

Which of the following two fields has zero divergence?

I

II

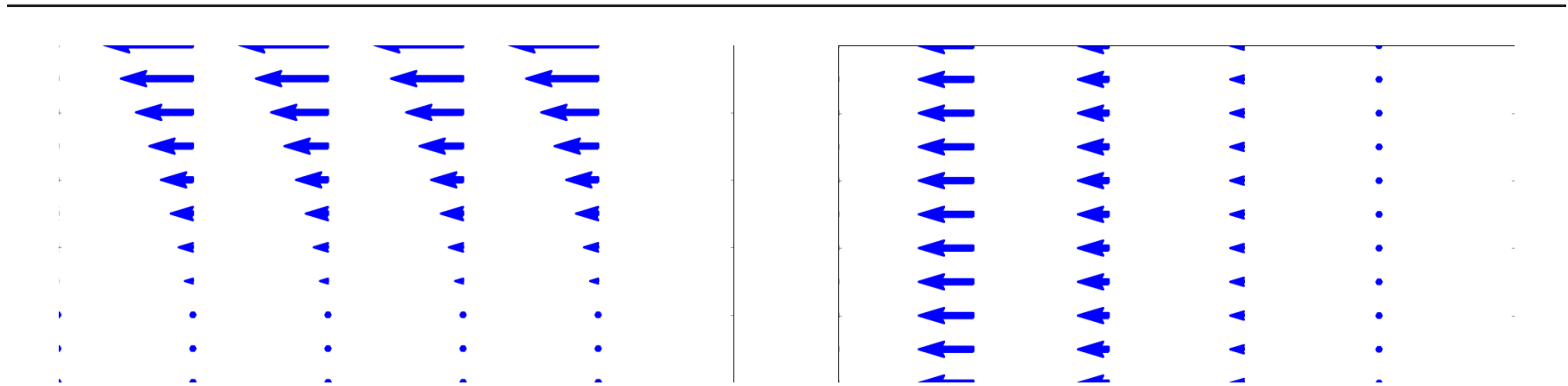


- A. Both do.
- B. Only I is zero
- C. Only II is zero
- D. Neither is zero
- E. ???

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