

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.

ANNOUNCEMENTS

- Homework 1 is due Friday in class
- Homework 2 is posted and covers through section 2.1
 - It is due next Wednesday
 - We will come back to section 1.5 later
- Make sure you have registered your clicker!
 - I will start shaming people publically on Friday.
 - <https://goo.gl/cVfzS5>

You are trying to compute the work done by a force,
 $\mathbf{F} = a\hat{x} + x\hat{y}$, along the line $y = 2x$ from $\langle 0, 0 \rangle$ to $\langle 1, 2 \rangle$.

What is $d\mathbf{l}$?

A. dl

B. $dx \hat{x}$

C. $dy \hat{y}$

D. $2dx \hat{x}$

E. Something else

You are trying to compute the work done by a force, $\mathbf{F} = a\hat{x} + x\hat{y}$, along the line $y = 2x$ from $\langle 0, 0 \rangle$ to $\langle 1, 2 \rangle$. Given that $d\mathbf{l} = dx \hat{x} + dy \hat{y}$, which of the following forms of the integral is correct?

A. $\int_0^1 a \, dx + \int_0^2 x \, dy$

B. $\int_0^1 (a \, dx + 2x \, dx)$

C. $\frac{1}{2} \int_0^2 (a \, dy + y \, dy)$

D. More than one is correct

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

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).

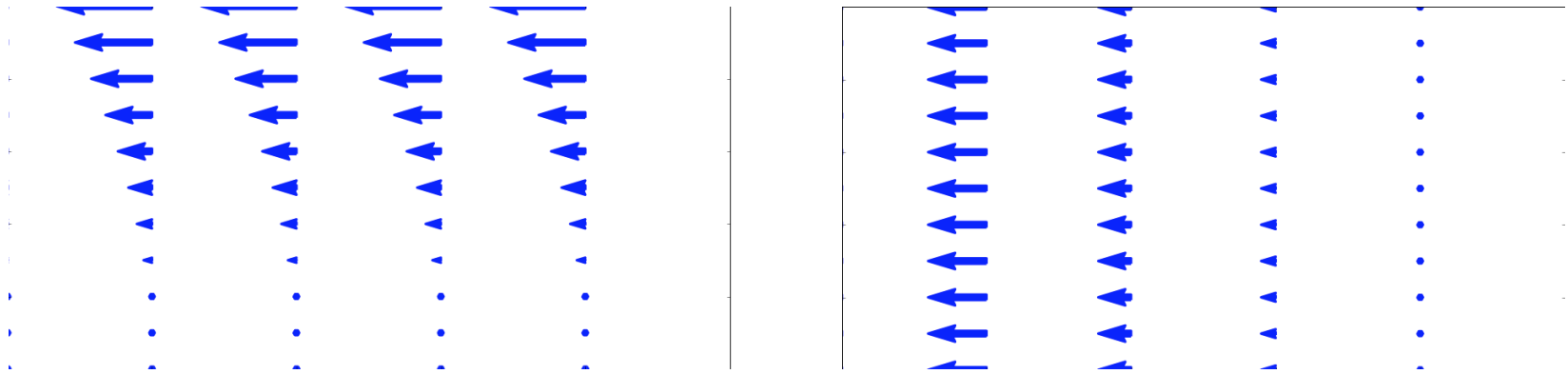
To find the total mass of this rod, which coordinate system should be used (take note that the mass density varies as a function of angle):

- 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

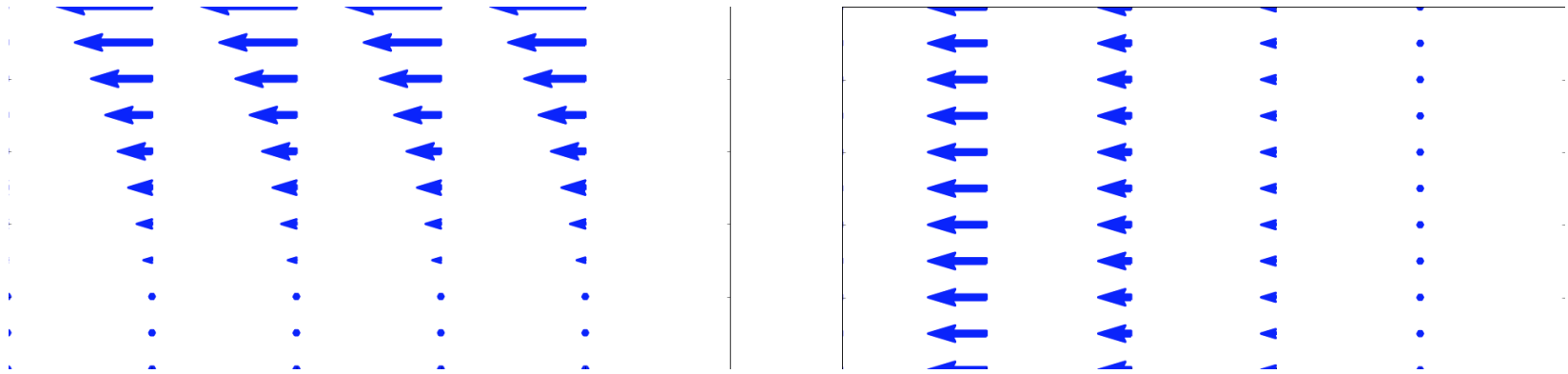


- A. Both do.
- B. Only I is zero
- C. Only II is zero
- D. Neither is zero
- E. ???

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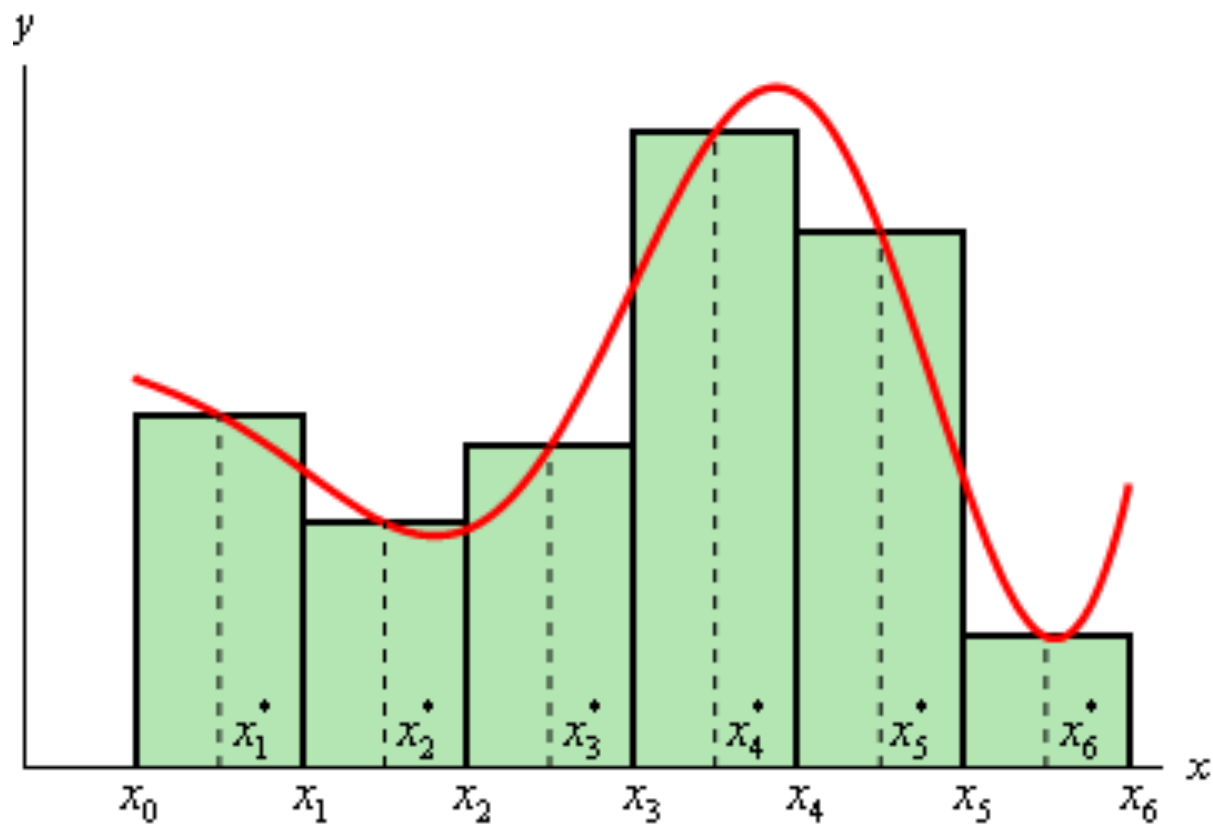
Consider a vector field defined as the gradient of some well-behaved scalar function:

$$\mathbf{v}(x, y, z) = \nabla T(x, y, z).$$

What is the value of $\oint_C \mathbf{v} \cdot d\mathbf{l}$?

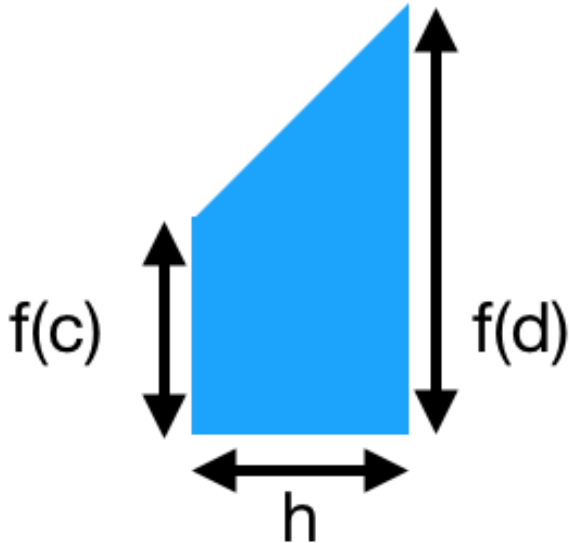
- A. Zero
- B. Non-zero, but finite
- C. Can't tell without a function for T

NUMERICAL INTEGRATION



Consider this trapezoid

What is the area of this trapezoid?



A. $f(c)h$

B. $f(d)h$

C. $f(c)h + \frac{1}{2}f(d)h$

D. $\frac{1}{2}f(c)h + \frac{1}{2}f(d)h$

E. Something else

The trapezoidal rule for a function $f(x)$ gives the area of the k th slice of width h to be,

$$A_k = \frac{1}{2}h (f(a + (k - 1)h) + f(a + kh))$$

What is the approximate integral, $I(a, b) = \int_a^b f(x)dx$,
 $I(a, b) \approx$

- A. $\sum_{k=1}^N \frac{1}{2}h (f(a + (k - 1)h) + f(a + kh))$
- B. $h \left(\frac{1}{2}f(a) + \frac{1}{2}f(b) + \frac{1}{2} \sum_{k=1}^{N-1} f(a + kh) \right)$
- C. $h \left(\frac{1}{2}f(a) + \frac{1}{2}f(b) + \sum_{k=1}^{N-1} f(a + kh) \right)$
- D. None of these is correct.
- E. More than one is correct.

The trapezoidal rule takes into account the value and slope of the function. The next "best" approximation will also take into account:

- A. Concavity of the function
- B. Curvature of the function
- C. Unequally spaced intervals
- D. More than one of these
- E. Something else entirely