Warm-up for Monday, February 7th, 2022

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Objects of Electromagnetism

Objects of Electromagnetism

What type of *object* is $\vec{f}(x, y, z) \cdot \vec{g}(x, y, z)$?

- A: A scalar
- B: A pseudoscalar
- C: A vector
- D: A pseudovector

Objects of Electromagnetism

What type of *object* is $\vec{f}(x, y, z) \times \vec{g}(x, y, z)$?

- A: A scalar
- B: A pseudoscalar
- C: A vector
- D: A pseudovector

Objects of Electromagnetism

What type of *object* is $\vec{h}(x, y, z) \cdot (\vec{f}(x, y, z) \times \vec{g}(x, y, z))$?

- A: A scalar
- B: A pseudoscalar
- C: A vector
- D: A pseudovector

Objects of Electromagnetism

What type of *object* is $\nabla f(x, y, z)$?

- A: A scalar
- B: A pseudoscalar
- C: A vector
- D: A pseudovector

Objects of Electromagnetism

What type of *object* is $\frac{\partial f(x,y,z)}{\partial x}$?

- A: A scalar
- B: A pseudoscalar
- C: A vector
- D: A pseudovector

Objects of Electromagnetism

What type of *object* is $\nabla \cdot \vec{f}(x, y, z)$?

- A: A scalar
- B: A pseudoscalar
- C: A vector
- D: A pseudovector

Objects of Electromagnetism

What type of *object* is $\nabla \times \vec{f}(x, y, z)$?

- A: A scalar
- B: A pseudoscalar
- C: A vector
- D: A pseudovector

Objects of Electromagnetism

What type of *object* is $\nabla \cdot (\nabla f(x, y, z))$?

- A: A scalar
- B: A pseudoscalar
- C: A vector
- D: A pseudovector

Objects of Electromagnetism

This object is the Laplacian of f:

$$\nabla \cdot (\nabla f(x, y, z)) = \nabla^2 f \tag{1}$$

Of all the possible *second derivatives* of the above objects this is the one we will encounter the most. The rest are zero or less important (grad of divergence). When you see a second derivative, think guilty until proven innocent, in EM.

Using the Gradient

Problem 1.12

The height of a certain hill (in meters) is given by

$$h(x, y) = 10(2xy - 3x^2 - 4y^2 - 18x + 28y + 12) \qquad (2)$$

where y is the distance (in km) North, and x is the distance East of South Hadley.

- Where is the top of the hill located?
- How high is the hill?
- How steep is the slope in meters per kilometer at a point 1 kilometer North and 1 kilometer East of South Hadley? In what direction is the slope steepest, at that point?