Consider a vector field $\mathbf{F}$. If the curl of that vector field is zero ($\nabla \times \mathbf{F} = 0$), which of the following are true?

I. $\int \nabla \times \mathbf{F} \cdot d\mathbf{A} = 0$

II. $\oint \mathbf{F} \cdot d\mathbf{l} = 0$

III. $\int_A^B \mathbf{F} \cdot d\mathbf{l}_1 = \int_A^B \mathbf{F} \cdot d\mathbf{l}_2$

IV. $\vec{F}$ is the gradient of some scalar function f, $\vec{F} = \nabla f$.

A. Only I
B. I and II
C. II and III
D. I, II, and III
E. Some other combination

ANNOUNCEMENTS

- Exam 1 next Wednesday
  - Topics: Charge, Electric field, δ functions, Electric potential
  - Sections: Ch 1.1-1.5 and 2.1-2.3
- More detailed information coming this Wednesday!

Is the following mathematical operation ok?

$$\nabla \times \left(\frac{1}{4\pi\epsilon_0} \int\int\int_V \frac{\rho(\mathbf{r}')d\tau'}{\mathfrak{R}^2} \hat{\mathfrak{R}} \right) = \frac{1}{4\pi\epsilon_0} \int\int\int_V \left(\nabla \times \frac{\rho(\mathbf{r}')d\tau'}{\mathfrak{R}^2} \hat{\mathfrak{R}} \right)$$

A. Yup. It's just fine and I can say why
B. I think it's fine, but I'm not sure I know why
C. No, we can't exchange the curl and an integral!
D. I'm not sure.

Is it mathematically ok to do this?

$$\mathbf{E} = \frac{1}{4\pi\varepsilon_0}\int_V \rho(\mathbf{r}')d\tau'\left(-\nabla\frac{1}{\mathfrak{R}}\right)$$

$$\longrightarrow \mathbf{E} = -\nabla\left(\frac{1}{4\pi\varepsilon_0}\int_V \rho(\mathbf{r}')d\tau'\frac{1}{\mathfrak{R}}\right)$$

A. Yes
B. No
C. ???

If $\nabla \times \mathbf{E} = 0$, then $\oint_C \mathbf{E} \cdot d\mathbf{l} =$

A. 0
B. something finite
C. ∞
D. Can't tell without knowing C

Can superposition be applied to electric potential, V?

$$V_{tot} \stackrel{?}{=} \sum_i V_i = V_1 + V_2 + V_3 + \ldots$$

A. Yes
B. No
C. Sometimes

The potential is zero at some point in space.

You can conclude that:

A. The E-field is zero at that point
B. The E-field is non-zero at that point
C. You can conclude nothing at all about the E-field at that point

The potential is constant everywhere along in some region of space.

You can conclude that:

A. The E-field has a constant magnitude in that space.
B. The E-field is zero in that space.
C. You can conclude nothing at all about the magnitude of $\mathbf{E}$ along that line.