On Wednesday, you took an assessment of electromagnetism concepts.

How did that assessment feel for you?

A. I think it went fine; I felt like I knew most of the answers.
B. I was concerned about one or two questions; but most of the questions were familiar.
C. I guessed (or left blank) most of the questions; none of the questions really felt familiar.

ANNOUNCEMENTS

- Homework Help Session
  - Wednesday 6-7pm+ in 1300 BPS
  - Thursday 6-7pm+ in 1400 BPS
- Any trouble installing/using Python?
  - Check the Piazza forum for help

LECTURE 2: MATHEMATICAL PRELIMINARIES

$$\nabla \cdot \mathbf{E} = \frac{\rho}{\epsilon_0} \qquad \int \mathbf{E} \cdot d\mathbf{A} = \int \frac{\rho}{\epsilon_0} d\tau$$

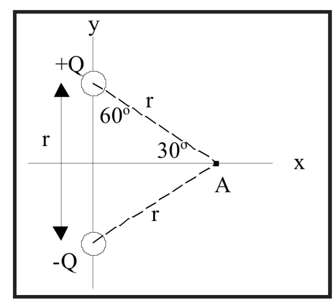
$$\nabla \cdot \mathbf{B} = 0 \qquad \int \mathbf{B} \cdot d\mathbf{A} = 0$$

$$\nabla \times \mathbf{E} = -\frac{\partial \mathbf{B}}{\partial t} \qquad \int \mathbf{E} \cdot d\mathbf{l} = -\int \frac{\partial \mathbf{B}}{\partial t} \cdot d\mathbf{A}$$

$$\nabla \times \mathbf{B} = \mu_0 \mathbf{J} + \mu_0 \epsilon_0 \frac{\partial \mathbf{E}}{\partial t} \qquad \int \mathbf{B} \cdot d\mathbf{A} = \mu_0 \int \left(\mathbf{J} + \epsilon_0 \frac{\partial \mathbf{E}}{\partial t}\right)$$

Two charges +Q and -Q are fixed a distance r apart. The direction of the force on a test charge -q at A is...

A. Up
B. Down
C. Left
D. Right
E. Some other direction, or $F = 0$



In a typical Cartesian coordinate system, vector $\mathbf{A}$ lies along the $+\hat{x}$ direction and vector $\mathbf{B}$ lies along the $-\hat{y}$ direction. What is the direction of $\mathbf{A} \times \mathbf{B}$?

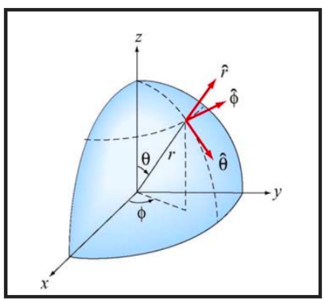
A. $-\hat{x}$
B. $+\hat{y}$
C. $+\hat{z}$
D. $-\hat{z}$
E. Can't tell

In a typical Cartesian coordinate system, vector $\mathbf{A}$ lies along the $+\hat{x}$ direction and vector $\mathbf{B}$ lies along the $-\hat{y}$ direction. What is the direction of $\mathbf{B} \times \mathbf{A}$?

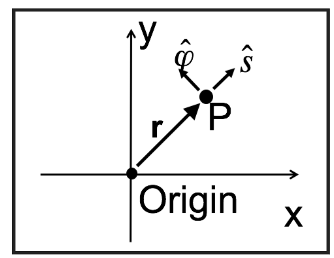
A. $-\hat{x}$
B. $+\hat{y}$
C. $+\hat{z}$
D. $-\hat{z}$
E. Can't tell

YOU DERIVE IT

Consider the radial unit vector ($\hat{r}$) in the spherical coordinate system as shown in the figure to the right. Determine the components of this unit vector in the Cartesian (x, y, z) system.



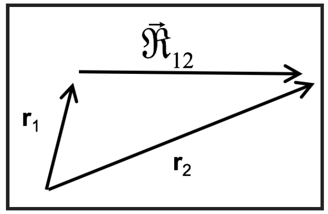
In cylindrical (2D) coordinates, what would be the correct description of the position vector $\mathbf{r}$ of the point P shown at $(x, y) = (1, 1)$?



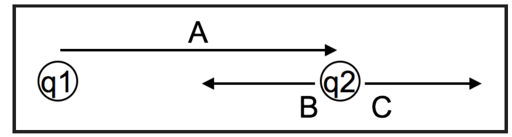
A. $\mathbf{r} = \sqrt{2}\hat{s}$
B. $\mathbf{r} = \sqrt{2}\hat{s} + \pi/4\hat{\phi}$
C. $\mathbf{r} = \sqrt{2}\hat{s} - \pi/4\hat{\phi}$
D. $\mathbf{r} = \pi/4\hat{\phi}$
E. Something else entirely

How is the vector $\mathfrak{R}_{12}$ related to $\mathbf{r}_1$ and $\mathbf{r}_2$?

A. $\mathfrak{R}_{12} = \mathbf{r}_1 + \mathbf{r}_2$
B. $\mathfrak{R}_{12} = \mathbf{r}_1 - \mathbf{r}_2$
C. $\mathfrak{R}_{12} = \mathbf{r}_2 - \mathbf{r}_1$
D. None of these



Coulomb's Law: $\mathbf{F} = \frac{kq_1q_2}{|\mathfrak{R}|^2}\hat{\mathfrak{R}}$ where $\mathfrak{R}$ is the relative position vector. In the figure, q_1 and q_2 are 2 m apart. Which arrow **can** represent $\hat{\mathfrak{R}}$?



A. A
B. B
C. C
D. More than one (or NONE) of the above
E. You can't decide until you know if q_1 and q_2 are the same or opposite charges

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