P3323 Reading Quiz 2-1
August 29, 2016
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1. The flux of the electric field $\mathbf{E}$ through a closed surface S is

$$\Phi_E \equiv \int_S \mathbf{E} \cdot d\mathbf{a}.$$

What are the units of flux?

A)

$$\frac{\text{Coulombs}}{\text{Newton} - \text{meters}}$$

B)

$$\frac{(\text{Coulombs})^2}{\text{Newton} - \text{meters}}$$

C)

$$\frac{(\text{Coulombs})^2}{\text{Newton} - (\text{meters})^2}$$

D)

$$\frac{\text{Newton} - (\text{meters})^2}{\text{Coulomb}}$$

2.

$$\nabla \cdot \left(\frac{\mathbf{r} - \mathbf{r}'}{|\mathbf{r} - \mathbf{r}'|^3} \right) = ?$$

A) zero

B)

∞

C)

$4\pi\delta^3(\mathbf{r} - \mathbf{r}')$

D)

$\delta^3(\mathbf{r} - \mathbf{r}')$

3. An infinite plane carries uniform surface charge density σ. The z-axis is perpendicular to the plane. The electric field a distance d above the plane is ?

A)

$$\frac{\sigma}{4\pi\epsilon_0}\int\int\frac{\hat{\mathbf{z}}}{(x^2+y^2+d^2)}dxdy$$

B)

$$\frac{\sigma}{2\epsilon_0}\hat{z}$$

C)

$$\frac{\sigma}{\epsilon_0}\hat{z}$$

D)

$$\frac{d\sigma}{\epsilon_0}\hat{z}$$

4. What is the electric field inside a sphere that carries a charge density proportional to the distance from the origin, $\rho = kr$, for some constant k. [$Hint$: What are the dimensions of k?]

A)

$$\mathbf{E}(r) = \frac{k}{4\epsilon_0} r^2 \hat{\mathbf{r}}$$

B)

$$\mathbf{E}(r) = \frac{k}{4\epsilon_0} r \hat{\mathbf{r}}$$

C)

$$\mathbf{E}(r) = \frac{k}{4\epsilon_0} \frac{\hat{\mathbf{r}}}{r}$$

D)

$$\mathbf{E}(r) = \frac{k}{4\epsilon_0} \frac{\hat{\mathbf{r}}}{r^2}$$

5. The electric field of a point charge is $\mathbf{E} = \frac{1}{4\pi\epsilon_0}\frac{q}{r^2}\hat{\mathbf{r}}$.
$\nabla \times \mathbf{E} =?$

A)

$4\pi\delta^3(\mathbf{r})$

B)

∇V

C)

zero

D)

$\frac{\rho(\mathbf{r})}{\epsilon_0}$