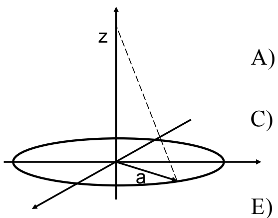
A uniformly charged ring, in the xy plane, centered on the origin, has radius *a* and total charge Q. V(r = ∞) = 0.
What is the voltage at z on the z-axis?

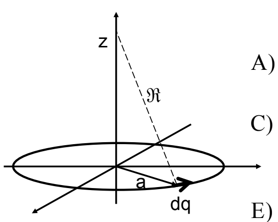


A) $\frac{kQ}{a}$ B) $\frac{kQ}{z}$

C) $\frac{kQ}{\sqrt{a^2+z^2}}$ D) $\frac{kQ}{a^2+z^2}$

E) None of these

A uniformly charged ring, in the xy plane, centered on the origin, has radius *a* and total charge Q. V(r = ∞) = 0.
What is the voltage at z on the z-axis?



A) $\frac{kQ}{a}$ B) $\frac{kQ}{z}$

C) $\frac{kQ}{\sqrt{a^2+z^2}}$ D) $\frac{kQ}{a^2+z^2}$

E) None of these

$$\mathbf{E}(\mathbf{r}) = \frac{1}{4\pi\varepsilon_0}\iiint \frac{\rho(\mathbf{r}')\,\hat{\Re}}{\Re^2}\,d\tau'$$

(with $\vec{\Re} = \mathbf{r} - \mathbf{r}' = (x-x', y-y', z-z')$)

It is also true that $\frac{\hat{\Re}}{\Re^2} = -\nabla\frac{1}{|\Re|}$

where $\nabla = \left(\frac{\partial}{\partial x}, \frac{\partial}{\partial y}, \frac{\partial}{\partial z}\right)$

Question: is the following mathematically ok?

$$\mathbf{E}(\mathbf{r}) = \frac{1}{4\pi\varepsilon_0}\iiint \rho(\mathbf{r}')\left(-\nabla\frac{1}{|\Re|}\right)d\tau' = -\nabla\frac{1}{4\pi\varepsilon_0}\iiint\frac{\rho(\mathbf{r}')}{|\Re|}d\tau'$$

A) Yes B) No C) ???

$$\mathbf{E}(\mathbf{r}) = -\nabla \frac{1}{4\pi\varepsilon_0} \iiint \frac{\rho(\mathbf{r}')}{|\Re|} d\tau'$$

$$\mathbf{E}(\mathbf{r}) = -\nabla V(\vec{r})$$

$$V(\mathbf{r}) = \frac{1}{4\pi\varepsilon_0} \iiint \frac{\rho(\mathbf{r}')}{|\Re|} d\tau' \quad + c$$

Summary:

Def of potential: $V(\mathbf{r}) \equiv -\int_{\mathbf{r}_0}^{\mathbf{r}} \vec{E}(r') \bullet d\vec{r}\,'$

How do you compute it: $V(\mathbf{r}) = \frac{1}{4\pi\varepsilon_0} \iiint \frac{\rho(\mathbf{r}')}{|\Re|} d\tau'$

What good is it? $\mathbf{E}(\mathbf{r}) = -\nabla V(\vec{r})$

Where did it come from? $\nabla \times \vec{\mathbf{E}}(\mathbf{r}) = 0$

Which by Stoke's theorem is mathematically equivalent to: $\oint_{\text{any loop}} \vec{\mathbf{E}}(\mathbf{r}) \bullet d\mathbf{r} = 0$

Tutorial

Please click the letter below when you START working on the following parts:

A) I'm now starting (click right away!)
B) I'm starting ii
C) I'm starting iii
D) I'm starting the 2nd page
E) DONE!

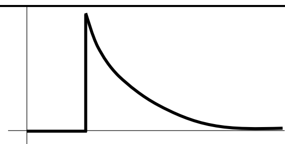
Tutorial

When you are DONE, click in:
What is the slope of V(r) at the origin?

A) Positive
B) Negative
C) Zero
D) It depends!

Be prepared to explain/defend your answer!

2.44



$$\mathbf{E}(\mathbf{r}) = -\nabla V(\vec{r})$$

$$V(\mathbf{r}) \equiv -\int_{\text{origin}}^{\mathbf{r}} \vec{E}(r') \bullet d\vec{r}\,'$$

Could this be a plot of |E|(r)? Or V(r)?
(for SOME physical situation?)

A) Could be E(r), or V(r)

B) Could be E(r), but can't be V(r)

C) Can't be E(r), could be V(r)

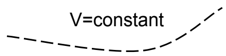
D) Can't be either E) ???

The voltage is zero at a 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 voltage is constant everywhere along a line in space.



You can conclude that :

A) The E-field has constant magnitude along that line.

B) The E-field is zero along that line.

C) You can conclude nothing at all about the magnitude of **E** along that line.

2.45 Given a spherical SHELL with uniform *surface charge* density σ (no other charges anywhere else) what can you say about the potential V *inside* this sphere? (Assume as usual, $V(\infty)=0$)

A) V=0 everywhere inside

B) V = non-zero constant everywhere inside

C) V must vary with position, but is zero at the center.

D) None of these!