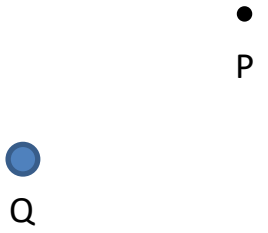
CONCEPT: ELECTRIC FIELDS WITH CALCULUS

- Electric field due to POINT charges can be given in vector form → $\vec{\mathbf{E}} = \mathbf{k}\frac{\mathbf{Q}}{\mathbf{r}^2}\,\hat{\mathbf{r}}$
  - Unit vector $\hat{\mathbf{r}}$ simply gives *direction* of $\vec{\mathbf{E}}$.
- To simplify, we will use $\vec{\mathbf{r}} = \mathbf{r}\,\hat{\mathbf{r}}$ → $\vec{\mathbf{E}} =$ _____
  - Vector $\vec{\mathbf{r}}$ points *from* charge **Q** *to* measuring point **P.**

Point Charge

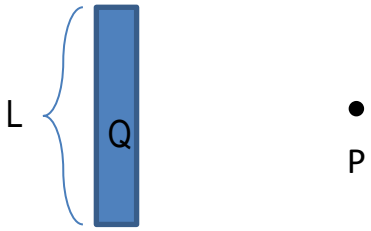
$\vec{\mathbf{E}} = \mathbf{k}\frac{\mathbf{Q}}{\mathbf{r}^3}\vec{\mathbf{r}}$



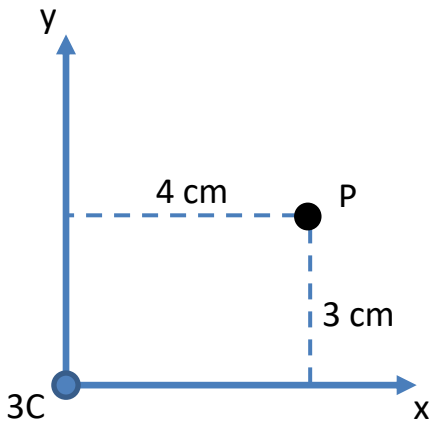
Charge Distribution

- Must _____ tiny pieces of Electric Field

$\vec{\mathbf{E}} =$ _____ = _____

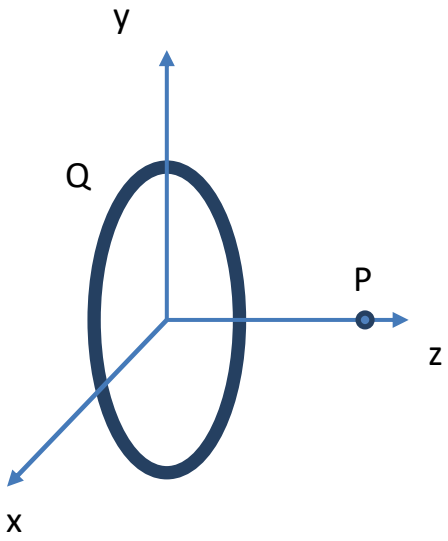


EXAMPLE: What is the vector form of the electric field at the point *P* indicated in the figure below?



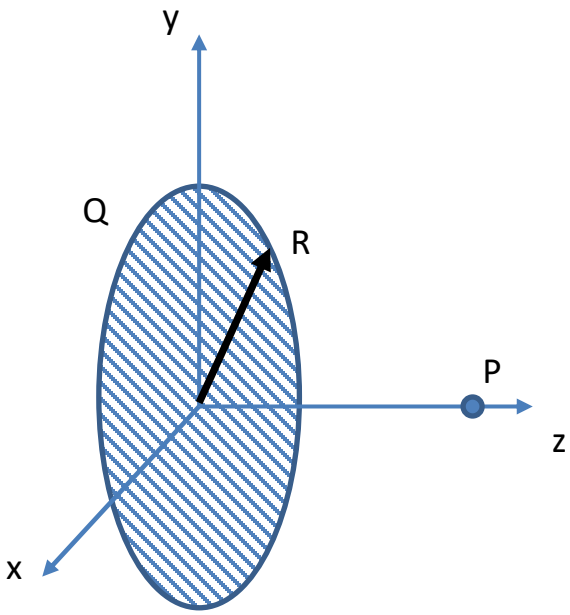
EXAMPLE: ELECTRIC FIELD DUE TO RING OF CHARGE

What is the electric field along at point P in the following figure, a distance *z* from the center of a ring with radius R?



EXAMPLE: ELECTRIC FIELD DUE TO A DISK OF CHARGE

What is the electric field of the following solid disk, with a charge Q, at a distance *z* along the z-axis, as indicated by P?
(*Hint: The surface charge density is* $\sigma = {}^{Q}/_{A}$)



EXAMPLE: ELECTRIC FIELD DUE TO LINE OF CHARGE

What is the electric field at a distance *z* along the z-axis, as indicated by P, due to a line of charge 2*a* long, with a charge Q, as shown in the following figure?