Math Review

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A differential length along an arc centered at the origin is ?

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A differential area in Cartesian coordinates is $dxdy$.

A differential length along an arc centered at the origin is $Rd\phi$.

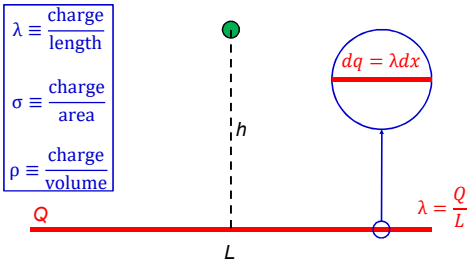
A differential area in polar coordinates is $(dr)(rd\phi)$.

Charge Densities

$\lambda \equiv \frac{\text{charge}}{\text{length}}$

$\sigma \equiv \frac{\text{charge}}{\text{area}}$

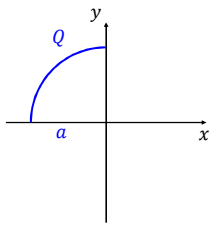
$\rho \equiv \frac{\text{charge}}{\text{volume}}$



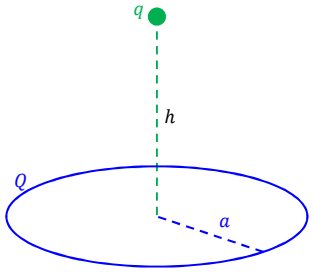
Charge Distributions and Densities

Charge Distribution	Charge Density	dQ
linear	$\lambda = \frac{Q}{L}$	$\left(\frac{Q}{L}\right)dx$
"linear" along arc	$\lambda = \frac{Q}{r\Delta\theta}$	$\left(\frac{Q}{r\Delta\theta}\right)rd\phi = \frac{Q}{\Delta\theta}d\phi$
Cartesian area	$\sigma = \frac{Q}{ab}$	$\left(\frac{Q}{ab}\right)dxdy$
Polar area	$\sigma = \frac{Q}{\pi R^2}$	$\left(\frac{Q}{\pi R^2}\right)dr(rd\phi)$

Example: Determine the electric field at the origin due to a charge Q uniformly distributed along a circular arc of radius a from $\phi_i = \frac{\pi}{2}$ to $\phi_f = \pi$.



Example: Determine the force on a charge q located a distance h above the center of a uniform ring of charge Q with radius a.



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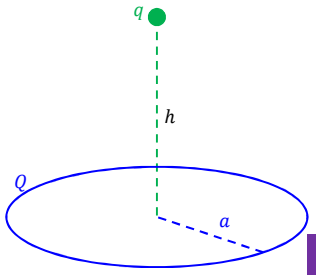
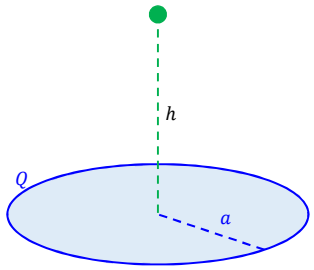


What happens if $h = 0$?

Example: Determine the electric field a distance h above a uniform disk of charge Q with radius a.



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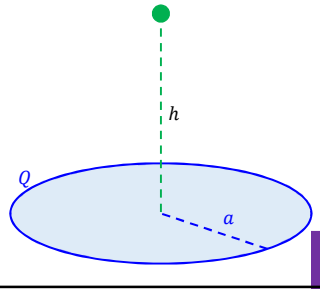

What happens if $a \to \infty$?