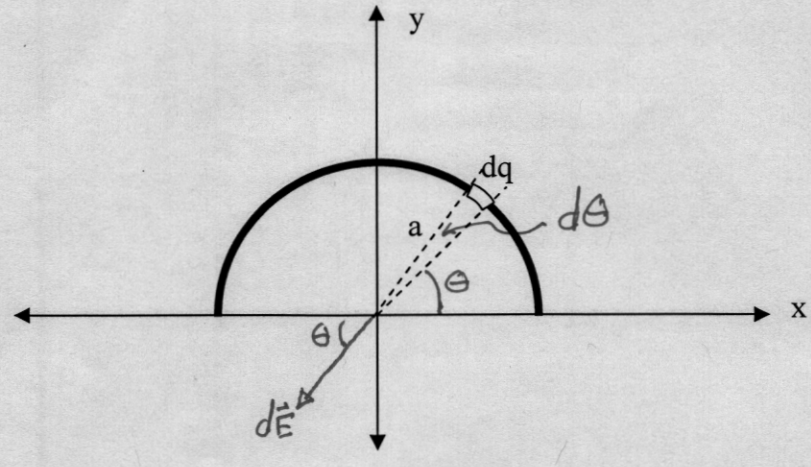
Name_____ Section 1121/3321

A semi-circular arc of radius, a, has a **constant** charge density, λ, and is oriented as shown on the sketch below. Your goal is to set up the integrals necessary to evaluate the electric field **at the origin** of the given coordinate system. You do not need to evaluate the integral.



1. On the sketch is an infinitesimally small piece of the charged arc labeled dq. It is exaggerated in size to allow you to label $d\theta$ and θ. Do that now. (1 point)

2. This piece of charge, dq, causes a small electric field at the origin, $d\vec{E}$. Draw and label $d\vec{E}$ and indicate its orientation by correctly labeling the angle, θ, corresponding to the angle drawn in part 1. (2 points)

3. Remembering that the semi-circular arc has a constant charge density, λ, write an expression for dq in terms of λ and the dimensions labeled on the sketch. (2 points)

$$dq = \lambda a \, d\theta$$

4. Remembering that dq is very small and looks like a point charge ($E=kq/r^2$), write an expression for the magnitude of $d\vec{E}$. (2 points)

$$|d\vec{E}| = \frac{k\,dq}{r^2} = \frac{k\lambda \cancel{a}\, d\theta}{a^{\cancel{2}}} = \frac{k\lambda}{a}\, d\theta$$

6. Write expressions for the x and y ~~coordinates~~ components of $d\vec{E}$. (2 points)

$$dE_x = \frac{k\lambda}{a} \cos\theta \, d\theta$$

$$dE_y = \frac{k\lambda}{a} \sin\theta \, d\theta$$

7. To determine the electric field at the origin, you would integrate the expressions in part 6. What variable would you integrate over and what are the limits of integration for that variable? (1 point)

θ, $0 \rightarrow \pi$ RADIANS