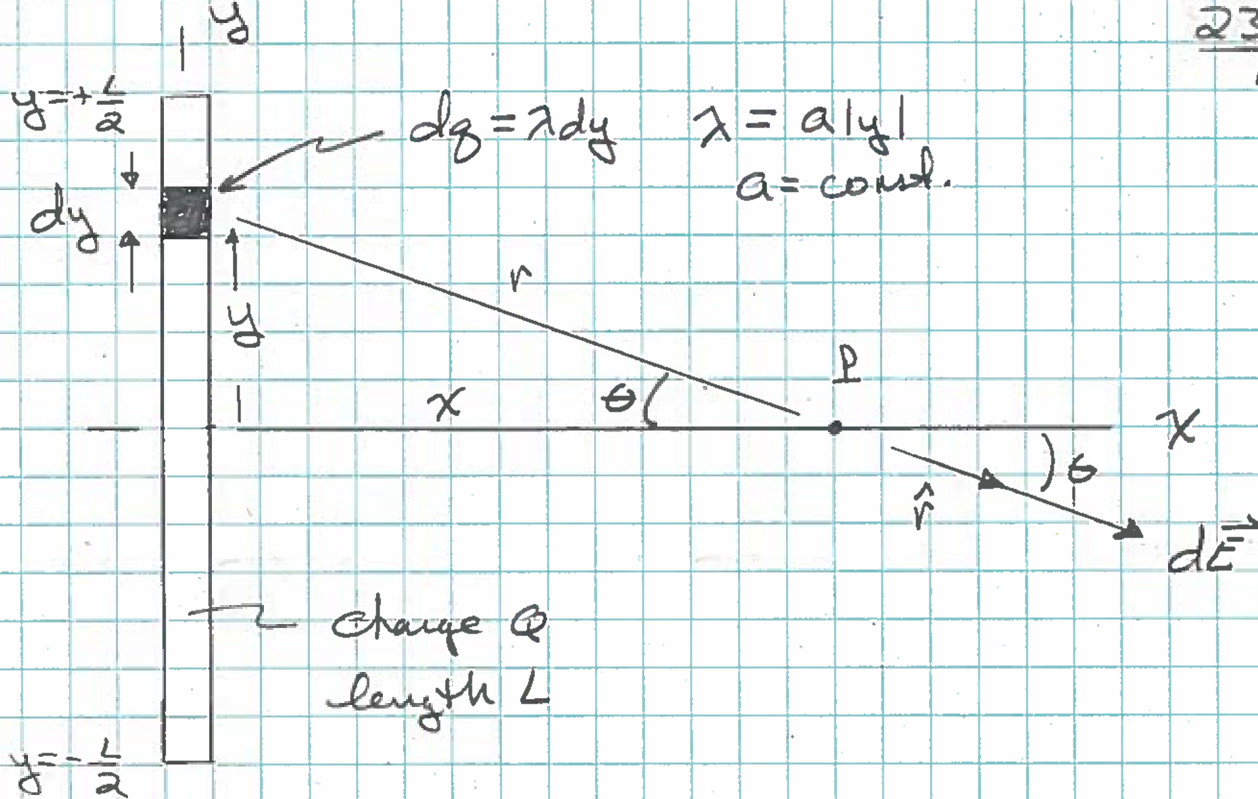
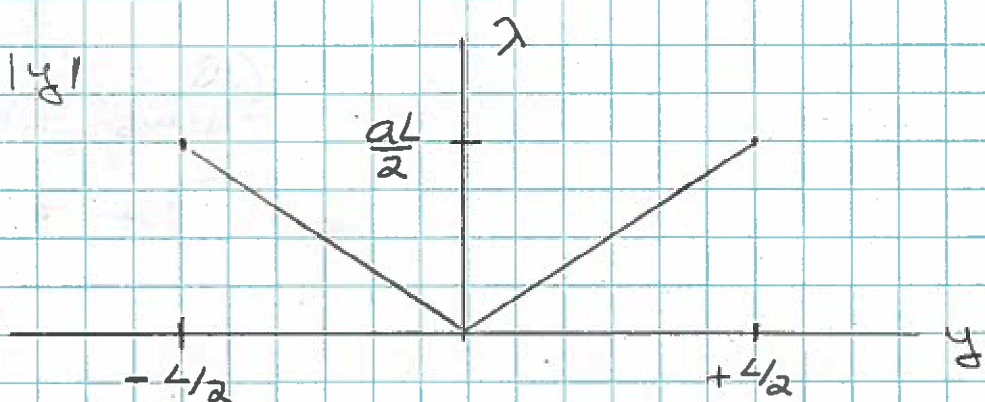


a.) $\lambda = a|y|$



b.) Total Charge, $Q = \int_{Rod} dq = \int_{-L/2}^{L/2} \lambda dy = a \int_{-L/2}^{L/2} |y| dy$

Since $|y|$ is an even function

$$\int_{-L/2}^{L/2} = 2 \int_{0}^{L/2} \quad \text{and } |y| = y \text{ for } y = 0 \to L/2$$

So: $Q = 2a \int_0^{L/2} y\,dy = 2a\left(\frac{y^2}{2}\right)\Big|_0^{L/2} = \frac{aL^2}{4}$

$\therefore \quad \underline{a = \frac{4Q}{L^2}}$

c.) See Sketch:

at P: $d\vec{E} = \frac{K\,dq}{r^2}\hat{r}$

$$dq = \lambda\,dy$$

$$r^2 = x^2+y^2$$

$$\hat{r} = \cos\theta\,\hat{i} - \sin\theta\,\hat{j}$$

and, $\cos\theta = \frac{x}{r} = \frac{x}{\sqrt{x^2+y^2}}$

$$\sin\theta = \frac{y}{r} = \frac{y}{\sqrt{x^2+y^2}}$$

So

$$d\vec{E} = \frac{K\lambda\,dy}{(x^2+y^2)}\left\{\frac{x}{\sqrt{x^2+y^2}}\hat{i} - \frac{y}{\sqrt{x^2+y^2}}\hat{j}\right\}$$

Now, by symmetry, the y-component integrates to zero.

So:

$$dE_x = \frac{K\lambda x\,dy}{(x^2+y^2)^{3/2}} \qquad \text{and } \lambda = a|y|$$

$$E_x = \int_{Rod} dE_x = Kax\int_{-L/2}^{L/2}\frac{|y|}{(x^2+y^2)^{3/2}}dy$$

Now, the integrand is even, so $\int_{-L/2}^{L/2} \rightarrow 2\int_0^{L/2}$

and $|y| = y$ for $y = 0 \rightarrow L/2$

So:

$$E_x = 2Ka x \int_0^{L/2} \frac{y}{(x^2+y^2)^{3/2}}\,dy$$

Using integral Tables;

$$E_x = 2Kax \left\{ -\frac{1}{\sqrt{x^2+y^2}} \right\} \Bigg|_0^{L/2}$$

$$= -2Kax \left\{ \frac{1}{\sqrt{x^2+L^2/4}} - \frac{1}{x} \right\}$$

$$= 2Ka \left\{ 1 - \frac{x}{\sqrt{x^2+L^2/4}} \right\}$$

and $a = 4Q/L^2$

$\therefore$

$$E_x = \frac{8KQ}{L^2} \left\{ 1 - \frac{x}{\sqrt{x^2+L^2/4}} \right\}$$