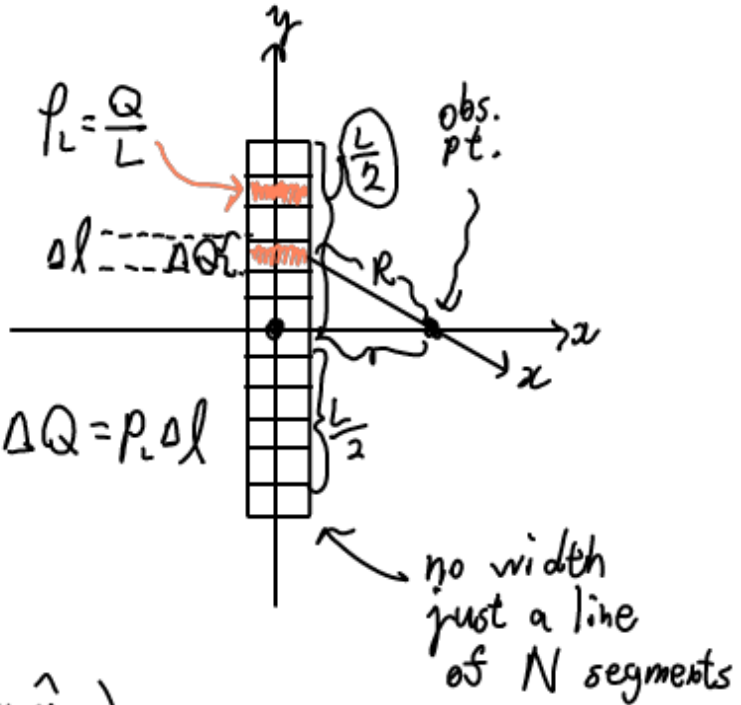
Fields (cont.)

$\rho_L = \frac{C}{m}$ Line charge Density

$\rho_S = \frac{C}{m^2}$

$\rho_V = \frac{C}{m^3}$



$$\vec{E}_{\Delta Q} = \frac{k\,\Delta Q}{R^2}\left(\frac{x\hat{x} - y\hat{y}}{R}\right)$$

$$R = \sqrt{x^2 + y^2}$$

$$\vec{E} = \sum_{j=1}^{N} \frac{\Delta Q\, k\,(x\hat{x} - y_i\hat{y})}{(x^2 + y_i^2)^{\frac{3}{2}}} \qquad \Delta Q_i = \Delta Q$$

$$= k\Delta Q\, x\hat{x} \sum_{i=1}^{N} \frac{1}{(x^2 + y_i^2)^{\frac{3}{2}}} - k\Delta Q\,\hat{y} \sum_{i=1}^{N} \frac{y_i}{(x^2 + y_i^2)^{3/2}}$$

$$\Delta Q_i = \rho_L \Delta L = \rho_L \Delta y$$

$$|\vec{E}_x| = E_x = k \sum \frac{x\,\Delta Q}{(x^2 + y_i^2)^{3/2}}$$

$$|\vec{E}_y| = E_y = k \int_{y=-\frac{L}{2}}^{\frac{L}{2}} \frac{\rho_L\, y\, dy}{(x^2 + y^2)^{3/2}}$$

$\lim \Delta y \to dy$

$$E_x = k \int_{y=-\frac{L}{2}}^{\frac{L}{2}} \frac{x\,\rho_L\, dy}{(x^2 + y^2)^{3/2}} = \rho_L\, k\, x \left(\frac{y}{x^2\sqrt{x^2 + y^2}}\right)\Bigg|_{-\frac{L}{2}}^{\frac{L}{2}}$$

$$E_x = \frac{k|Q|}{x\sqrt{x^2+\left(\frac{L}{2}\right)^2}}$$

$$\int \frac{dy}{(x^2+y^2)^{3/2}}$$

$\frac{y}{x} = \tan\theta$

let $y = x\tan\theta$

$\frac{dy}{d\theta} = x\sec^2\theta$

$dy = x\sec^2\theta\, d\theta$

$$\int \frac{x\sec^2\theta}{x^3\sec^3\theta}$$

$$\frac{1}{x^2}\int \frac{1}{\sec\theta}$$

$$\int \cos\theta$$

$\Rightarrow \sin\theta = \frac{y}{\sqrt{(x^2+y^2)}}$