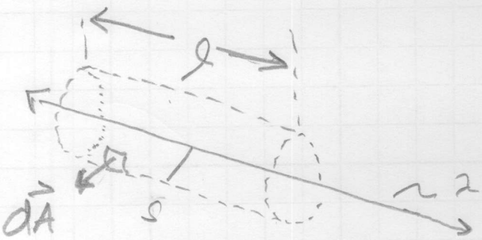
2-13



$$\nabla \cdot \vec{E} = \frac{\rho}{\varepsilon_0}$$

$$\int_V \nabla \cdot \vec{E}\, d\tau = \int_V \frac{\rho}{\varepsilon_0} d\tau$$

$$\oint_S \vec{E} \cdot d\vec{A} = \frac{1}{\varepsilon_0} \int \rho\, d\tau$$ total charge in the Gaussian surface

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$$d\vec{A} = s\, d\theta\, dl\, \hat{s}$$

$$\vec{E} = E(s)\, \hat{s}$$ by symmetry

$$\vec{E} \cdot d\vec{A} = E(s)\, s\, d\theta\, dl$$

$$\oint_S E(s)\, s\, d\theta\, dl = \frac{1}{\varepsilon_0} \lambda l$$

$$E(s)\, s \int_0^l \int_0^{2\pi} d\theta\, dl = \frac{\lambda l}{\varepsilon_0}$$

$$E(s)\, s\, 2\pi \cancel{l} = \frac{\lambda \cancel{l}}{\varepsilon_0}$$

$$E(s) = \frac{1}{2\pi\varepsilon_0} \frac{\lambda}{s}$$

$$\boxed{\therefore\ \vec{E}(s) = \frac{1}{2\pi\varepsilon_0} \frac{\lambda}{s}\, \hat{s}}$$

Same as Example 2.1