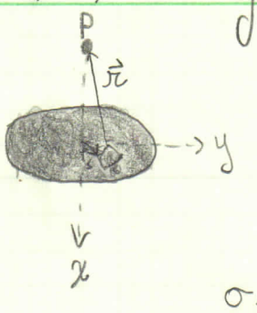
2.6



$\vec{r} = s\hat{s} + z\hat{z} = s\cos\phi\hat{x} + s\sin\phi\hat{y} + z\hat{z}$

$r = \sqrt{s^2+z^2}$

$\hat{r} = \dfrac{s\hat{s}+z\hat{z}}{\sqrt{s^2+z^2}} = \dfrac{s\cos\phi\hat{x}+s\sin\phi\hat{y}+z\hat{z}}{\sqrt{s^2+z^2}}$

$\sigma = \text{const} \quad da' = s\,ds\,d\phi \quad dq = \sigma\,da' = \sigma\,s\,ds\,d\phi$

$$E = k\int \frac{\sigma\hat{r}}{r^2}\,da' = k\sigma\left[\int_0^R\int_0^{2\pi} \frac{s^2\cos\phi}{(s^2+z^2)^{3/2}}\hat{x}\,d\phi\,ds + \int_0^R\int_0^{2\pi} \frac{s^2\sin\phi}{(s^2+z^2)^{3/2}}\hat{y}\,d\phi\,ds + \int_0^R\int_0^{2\pi} \frac{sz\hat{z}}{(s^2+z^2)^{3/2}}\,d\phi\,ds\right]$$

$$E = 2\pi z k\sigma\hat{z}\int_0^R \frac{s\,ds}{(s^2+z^2)^{3/2}} = 2\pi z k\sigma\hat{z}\left[\frac{1}{\sqrt{s^2+z^2}}\right]_0^R = -2\pi z k\sigma\hat{z}\left[\frac{1}{\sqrt{R^2+z^2}} - \frac{1}{z}\right]$$

$$E = 2\pi k\sigma\hat{z}\left[\frac{\sqrt{R^2+z^2}-z}{\sqrt{R^2+z^2}}\right] = \frac{\sigma}{2\varepsilon_0}\left[\frac{\sqrt{R^2+z^2}-z}{\sqrt{R^2+z^2}}\right]\hat{z}$$