$$\vec{E} = \frac{\rho_s}{4\pi\varepsilon_0}\int \frac{\vec{R}}{|\vec{R}|^{\frac{3}{2}}}d\vec{s} = \frac{\rho_s}{4\pi\varepsilon_0}\int \frac{(-\rho\hat{\mathrm{a}}\rho + h\hat{\mathrm{a}}z)}{(\rho^2+h^2)^{\frac{3}{2}}}\rho d\rho d\phi\hat{\mathrm{a}}z \tag{1}$$

$$\vec{E} = \frac{\rho_s}{4\pi\varepsilon_0}\int \frac{h\hat{\mathrm{a}}z}{(\rho^2+h^2)^{\frac{3}{2}}}\rho d\rho d\phi\hat{\mathrm{a}}z = \frac{\rho_s}{4\pi\varepsilon_0}\int_0^{2\pi}\int_0^{\infty} \frac{h\hat{\mathrm{a}}z}{(\rho^2+h^2)^{\frac{3}{2}}}\rho d\rho d\phi\hat{\mathrm{a}}z = \tag{2}$$

$$= -\frac{\rho_s h}{2\varepsilon_0}(\rho^2+h^2)^{-\frac{1}{2}} \tag{3}$$

$$\vec{E} = \frac{\rho_s}{2\varepsilon_0}\hat{\mathrm{a}}z[V/m] \tag{4}$$

$$V = -\int \vec{E}.d\vec{l} = -\int_0^d \frac{\rho_s}{\varepsilon_0}dz = -\frac{\rho_s}{\varepsilon_0}d \tag{5}$$

$$C = \frac{Q}{V} = \frac{\varepsilon_0\rho_s A}{\rho_s d} = \frac{\varepsilon_0 A}{d} \tag{6}$$

$$W = \frac{1}{2}\int \vec{D}.\vec{E}dv = \frac{1}{2}\varepsilon_0\int |\vec{E}|^2 dv = \frac{\rho_s^2}{2\varepsilon_0}\int_0^A\int_0^d dzdA = \tag{7}$$

$$= \frac{\rho_s^2 dA}{2\varepsilon_0 A^2} = \frac{Q^2 d}{2A\varepsilon_0} = \frac{1}{2}CV^2 \tag{8}$$