1a. $\rho = \varepsilon_0 \nabla \cdot \vec{E}$

$= \varepsilon_0 \, \partial/\partial x \, x = \boxed{\varepsilon_0}$

b. $\oint \vec{E} \cdot d\vec{a} = -\int_{x=0} E_x \cdot dy\,dz + \int_{x=2} E_x \, dy\,dz$

$= -E_x(0) \cdot 4 + E_x(2) \cdot 4$

$= \boxed{8}$

c. $Q_{enc} = \int \rho \, d\tau = 8\varepsilon_0$

$= \varepsilon_0 \oint \vec{E} \cdot d\vec{a}$

2. $\int (r^2 + r \cdot \vec{a}) \, \delta^3(\vec{r} - \vec{b}) \, d\tau$

$= b^2 + \vec{b} \cdot \vec{a}$

3a. $\oint \vec{E} \cdot d\vec{a} = 4\pi r^2 E$

$Q_{enc} = 4\pi \int_0^r k r \cdot r^2 \, dr \quad r < R$

$= 4\pi \cdot \frac{k r^4}{4}$

$= \pi k r^4 \quad r < R$

$= \pi k R^4 \quad r > R$

$$\Rightarrow \boxed{\begin{aligned} \vec{E} &= \frac{k r^2}{4\varepsilon_0} \hat{r} \quad r < R \\ &= \frac{k R^4}{4\varepsilon_0 r^2} \hat{r} \quad r > R \end{aligned}}$$

3b. $\Delta V = -\int_{\infty}^{R} E_r \, dr$

$$= -\int_{\infty}^{R} \frac{kR^4}{4\varepsilon_0 r^2} \, dr$$

$$= \frac{kR^4}{4\varepsilon_0 r}\Big|_{\infty}^{R} = \boxed{\frac{kR^3}{4\varepsilon_0}}$$

4a. $\vec{E} = -\nabla V$

$$= -\sin\varphi \, \hat{s} - \frac{1}{s} \cdot s \cos\varphi \, \hat{\varphi}$$

$$= -\sin\varphi \, \hat{s} - \cos\varphi \, \hat{\varphi}$$

b. $W = \frac{\varepsilon_0}{2} \int E^2 \, d\tau$

$$= \frac{\varepsilon_0}{2} \int (\sin^2\varphi + \cos^2\varphi) \, d\tau$$

$$= \varepsilon_0/2 \int d\tau$$

$$= \varepsilon_0/2 \cdot \pi s^2 \cdot L$$

$$\Rightarrow \boxed{W/L = \frac{\pi \varepsilon_0 s^2}{2}}$$