3.9

$\vec{E} = \hat{r}10e^{-r} - \hat{z}3z$

for $r = 2;\ z = 0;\ z = 4$

$\int \nabla.\vec{E}dv = \oint \vec{E}.d\vec{s}$?

$$\nabla.\vec{E} = \frac{1}{r}\frac{\partial}{\partial r}(r.10e^{-r}) + \frac{1}{r}\frac{\partial}{\partial \phi}E_{\phi} + \frac{\partial}{\partial z}(-3z)$$

$$= \frac{1}{r}(10e^{-r} - 10re^{-r}) - 3$$

$$= \frac{10e^{-r}}{r}(1-r) - 3$$

$$\int_{z=0}^{4}\int_{\phi=0}^{2\pi}\int_{r=0}^{2} \nabla.Erdrd\phi dz = (4)(2\pi)\int_{0}^{2}[10e^{-r}(1-r) - 3r]dr = 160\pi e^{-2} - 48\pi$$

$$\oint E.ds = \int_{r=0}^{2} 10e^{-r}rd\phi dz - \int_{z=0}^{4} 3zrdrd\phi = 160\pi e^{-2} - 48\pi$$