3. 14.22

a) ~~Theoretical~~ theortical

$$\vec{r}'' = a\cos\phi\,\hat{i} + a\sin\phi\,\hat{j}$$

$$Q = \int_0^{2\pi} \lambda\, dl = \int_0^{2\pi} \lambda a\, d\theta = \frac{Q\cancel{a}}{2\pi \cancel{a}} = \frac{Q}{2\pi}$$

$$\vec{r} = x\hat{i} + y\hat{j} + z\hat{k}$$

$$\vec{E}(\vec{r}) = \frac{1}{4\pi\epsilon_0} \int \frac{\lambda(\vec{r} - \vec{r}'')a\, dl'}{|\vec{r} - \vec{r}''|^3}$$

$$E(r) = \frac{1}{4\pi\epsilon_0} \frac{Q}{2\pi} \int_0 \frac{(x\hat{i} + y\hat{j} + z\hat{k} - a\cos\phi\,\hat{i} - a\sin\phi\,\hat{j})\, d\phi}{(|x\hat{i} - a\cos\phi\,\hat{i}|^2 + |y\hat{j} - a\sin\phi\,\hat{j}|^2 + |z|)^{3/2}}$$

$$E(r) = \frac{1}{4\pi\epsilon_0} \frac{Q}{2\pi} \int_0^{2\pi} \frac{(x\hat{i} + y\hat{j} + z\hat{k} - a\cos\phi\,\hat{i} - a\sin\phi\,\hat{j})\, d\phi}{(x^2 - 2ax\cos\phi + y^2 - 2ay\sin\phi + a^2(\cos\phi^2 + \sin\phi^2) + z^2)^{3/2}}$$

o Como aun quedan cosas vectoriales, las separamos por componente para obtener el campo para cada componente

$$E(x) = \frac{1}{4\pi\epsilon_0} \frac{Q}{2\pi} \int_0^{2\pi} \frac{(x - a\cos\phi)\, d\phi}{(x^2 + y^2 + z^2 + a^2 - 2ax\cos\phi - 2a\sin\phi)^{3/2}}$$

$$E(y) = \frac{1}{4\pi\epsilon_0} \frac{Q}{2\pi} \int_0^{2\pi} \frac{(y - a\sin\phi)\, d\phi}{(x^2 + y^2 + z^2 + a^2 - 2ax\cos\phi - 2a\sin\phi)^{3/2}}$$

$$E(z) = \frac{1}{4\pi\epsilon_0} \frac{Q}{2\pi} \int_0^{2\pi} \frac{z\, d\phi}{(x^2 + y^2 + z^2 + a^2 - 2ax\cos\phi - 2a\sin\phi)^{3/2}}$$