Problem 2.56)

a) $\rho_{\text{bound}}^{(\text{e})}(\boldsymbol{r},t) = -\boldsymbol{\nabla}\cdot\boldsymbol{P}(\boldsymbol{r},t) = -\frac{\partial P_z}{\partial z} = -P_0\kappa\,\delta(y)\cos(\kappa z-\omega t).$

$\boldsymbol{J}_{\text{bound}}^{(\text{e})}(\boldsymbol{r},t) = \frac{\partial \boldsymbol{P}}{\partial t} = -P_0\omega\delta(y)\cos(\kappa z-\omega t)\hat{\boldsymbol{z}}.$

$\boldsymbol{\nabla}\cdot\boldsymbol{J} + \frac{\partial\rho}{\partial t} = \frac{\partial J_z}{\partial z} + \frac{\partial\rho}{\partial t} = P_0\omega\kappa\delta(y)\sin(\kappa z-\omega t) - P_0\kappa\omega\,\delta(y)\sin(\kappa z-\omega t) = 0.$

b) $\rho_{\text{bound}}^{(\text{e})}(\boldsymbol{r},t) = 0.$

$\boldsymbol{J}_{\text{bound}}^{(\text{e})}(\boldsymbol{r},t) = \mu_{\text{o}}^{-1}\boldsymbol{\nabla}\times\boldsymbol{M} = \mu_{\text{o}}^{-1}\left(\frac{\partial M_y}{\partial x}\hat{\boldsymbol{z}} - \frac{\partial M_y}{\partial z}\hat{\boldsymbol{x}}\right) = \mu_{\text{o}}^{-1}M_0\kappa\,\delta(y)\sin(\kappa z-\omega t)\hat{\boldsymbol{x}}.$

$\boldsymbol{\nabla}\cdot\boldsymbol{J} + \frac{\partial\rho}{\partial t} = \frac{\partial J_x}{\partial x} + \frac{\partial\rho}{\partial t} = 0.$