Special Problem 3-4.1

The current density in a certain region is given by the vector field:

\[
\mathbf{J}(\mathbf{r}) = \frac{-1}{r} \hat{a}_r + \frac{r^2}{\sin \theta} \hat{a}_\theta
\]

a) Find the time derivative of the charge density within this region.

b) By how much does the charge density at point \( \mathbf{r} = \hat{a}_x \) change in 2 seconds?