An infinitely long perfectly conducting cylinder of radius \( a \) is centered along the \( z \)-axis. The \( \phi \)-component of the electric field in a charge-free region of space with permittivity \( \varepsilon \) is given by

\[
E_\phi = r - a
\]

Determine the surface charge density \( \rho_s \) on the cylinder.

Potentially useful:

\[
\nabla \cdot \vec{D} = \frac{1}{r} \frac{\partial}{\partial r} (r D_r) + \frac{1}{r} \frac{\partial}{\partial \phi} D_\phi + \frac{\partial}{\partial z} D_z
\]