1.4.9 Show that $\nabla \times \mathbf{A} = 0$ if $\mathbf{A} = \frac{1}{\rho}\mathbf{u}_\rho$ in cylindrical coordinates.

$$\begin{aligned}
\nabla \times \mathbf{A} &= \left(\frac{1}{\rho}\frac{\partial A_z}{\partial \phi} - \frac{\partial A_\phi}{\partial z}\right)\mathbf{u}_\rho \\
&\quad + \left(\frac{\partial A_\rho}{\partial z} - \frac{\partial A_z}{\partial \rho}\right)\mathbf{u}_\phi \\
&\quad + \frac{1}{\rho}\left(\frac{\partial(\rho A_\phi)}{\partial \rho} - \frac{\partial A_\rho}{\partial \phi}\right)\mathbf{u_z} \\
&= \left(\frac{1}{\rho}\frac{\partial}{\partial \phi}(0) - \frac{\partial}{\partial z}(0)\right)\mathbf{u}_\rho \\
&\quad + \left(\frac{\partial}{\partial z}\left(\frac{1}{\rho}\right) - \frac{\partial}{\partial \rho}(0)\right)\mathbf{u}_\phi \\
&\quad + \frac{1}{\rho}\left(\frac{\partial}{\partial \rho}(\rho \cdot 0) - \frac{\partial}{\partial \phi}(0)\right)\mathbf{u_z} \\
&= 0
\end{aligned}$$