1.4.10 Show that $\nabla \times \mathbf{A} = 0$ if $\mathbf{A} = r^2 \mathbf{u_r}$ in spherical coordinates.

$$\begin{aligned}
\nabla \times \mathbf{A} &= \frac{1}{r \sin\theta}\left(\frac{\partial}{\partial\theta}(A_\phi \sin\theta) - \frac{\partial A_\theta}{\partial\phi}\right)\mathbf{u_r} \\
&\quad + \frac{1}{r}\left(\frac{1}{\sin\theta}\frac{\partial A_r}{\partial\phi} - \frac{\partial}{\partial r}(rA_\phi)\right)\mathbf{u}_\theta \\
&\quad + \frac{1}{r}\left(\frac{\partial}{\partial r}(rA_\theta) - \frac{\partial A_r}{\partial\theta}\right)\mathbf{u}_\phi \\
&= \frac{1}{r \sin\theta}\left(\frac{\partial}{\partial\theta}(0 \cdot \sin\theta) - \frac{\partial}{\partial\phi}(0)\right)\mathbf{u_r} \\
&\quad + \frac{1}{r}\left(\frac{1}{\sin\theta}\frac{\partial}{\partial\phi}(r^2) - \frac{\partial}{\partial r}(r \cdot 0)\right)\mathbf{u}_\theta \\
&\quad + \frac{1}{r}\left(\frac{\partial}{\partial r}(r \cdot 0) - \frac{\partial}{\partial\theta}(r^2)\right)\mathbf{u}_\phi \\
&= 0
\end{aligned}$$