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Curl of the Vorticity-Velocity Cross Product

With $\boldsymbol{\omega} = \omega(x, y)\mathbf{k}$ and $\mathbf{u} = u(x, y)\mathbf{i} + v(x, y)\mathbf{j}$,

show by direct calculation that

$$\nabla \times (\boldsymbol{\omega} \times \mathbf{u}) = \left(u \frac{\partial \omega}{\partial x} + v \frac{\partial \omega}{\partial y} \right) \mathbf{k}.$$

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