Problem 1D.1

Uniform rotation of a fluid.

(a) Verify that the velocity distribution in a fluid in a state of pure rotation (i.e., rotating as a rigid body) is \( \mathbf{v} = [\mathbf{\omega} \times \mathbf{r}] \), where \( \mathbf{w} \) is the angular velocity (a constant) and \( \mathbf{r} \) is the position vector, with components \( x, y, z \).

(b) What are \( \nabla \mathbf{v} + (\nabla \mathbf{v})^\dagger \) and \( (\nabla \cdot \mathbf{v}) \) for the flow field in (a)?

(c) Interpret Eq. 1.2-7 in terms of the results in (b).