

**MIT Department of Mechanical Engineering**  
**2.25 Advanced Fluid Mechanics**

**Problem 10.16**

*This problem is from “Advanced Fluid Mechanics Problems” by A.H. Shapiro and A.A. Sonin*

Consider the two-dimensional, steady, non-viscous flow of an incompressible fluid, with no body forces present. The flow has vorticity.

- a) Show that the vorticity remains constant on each streamline.
- b) Show that the stream function is governed by the equation

$$\frac{\partial \psi}{\partial y} \left( \frac{\partial^3 \psi}{\partial x^3} + \frac{\partial^3 \psi}{\partial x \partial y^2} \right) = \frac{\partial \psi}{\partial x} \left( \frac{\partial^3 \psi}{\partial y^3} + \frac{\partial^3 \psi}{\partial x^2 \partial y} \right) \quad (10.16a)$$

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