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

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

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