MIT Department of Mechanical Engineering
2.25 Advanced Fluid Mechanics

Kundu & Cohen 6.4
This problem is from "Fluid Mechanics" by P. K. Kundu and I. M. Cohen 4th Edition

(a) Take a plane source of strength m at point $(-a, 0)$, a plane sink of equal strength at $(a, 0)$, and superpose a uniform stream U directed along the x-axis.

(b) Show that there are two stagnation points located on the x-axis at points

$$\pm a \left(\frac{m}{\pi a U} + 1 \right)^{1/2}.$$

(c) Show that the streamline passing through the stagnation points is given by $\psi = 0$. Verify that the line $\psi = 0$ represents a closed oval-shaped body, whose maximum width h is given by the solution of the equation

$$h = a \cot \left(\frac{\pi U h}{m} \right).$$

The body generated by the superposition of a uniform stream and a source-sink pair is called a *Rankine body*. It becomes a circular cylinder as the source–sink pair approach each other.

2.25 Advanced Fluid Mechanics
Fall 2013