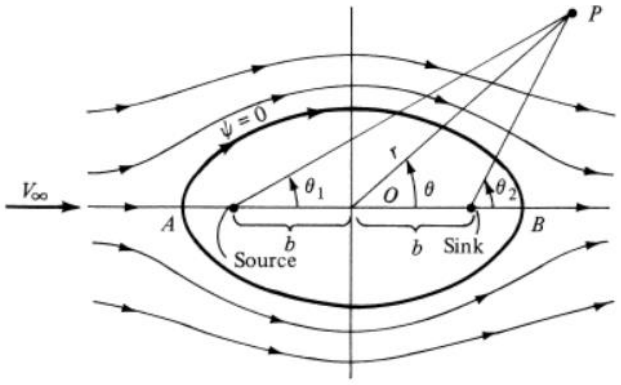
ME 572 Aerodynamic Design
HW #5 (Due at 11:59 pm on Friday, Mar 22)

Problem 1 [10 pt]
Derive the equations that show the locations of the stagnation points (A and B) in the synthesized flow field (uniform flow + source flow + sink flow) given below.
Given the knowledge that the stagnation points must lie on the axis aligned with the direction of V_∞.



Problem 2 [10 pt]
Given the stream function for a doublet flow:

$$\psi = -\frac{\kappa}{2\pi}\frac{\sin\theta}{r}.$$

Derive the velocity potential for this doublet flow.

Problem 3 [10 pt]
Consider the nonlifting flow over a circular cylinder of a given radius, where V_∞ = 25 ft/s. The velocity at a specific point in the flow field is given as V_r = 10 ft/s, and V_θ = 20 ft/s. Now, if V_∞ is doubled, that is, V_∞ = 50 ft/s, calculate the velocity at the same point.

Problem 4 [10 pt]
There is a circular cylinder spinning in a freestream flow with a velocity of 24 m/s at standard sea level conditions. If the measured lift on this cylinder is 6 N/m per span, calculate the circulation around the cylinder. If the diameter of the cylinder is 0.25 m, what is the lift coefficient of the cylinder. Now if the circulation is kept the same, but the freestream velocity is doubled, what is the lift coefficient? (Round the final answer to three decimal places)