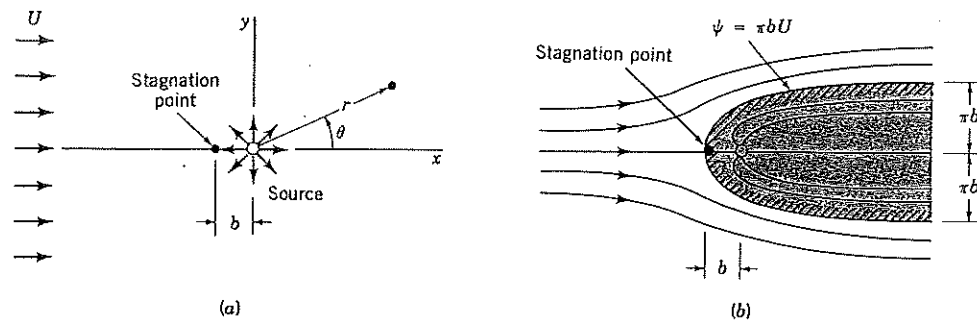


Assignment 5

1. Consider a 2 dimensional flow from a source located at $x = -a$ and a sink at $x = a$. In the dipole limit, show that for small angles, the stream function $\psi = -K/r \sin \theta$.
2. Consider a source in a uniform flow shown below.



■ FIGURE 6.24 The flow around a half-body: (a) superposition of a source and a uniform flow; (b) replacement of streamline $\psi = \pi b U$ with solid boundary to form half-body.

- a) Show the stagnation point is at $x = -b$ where $b = m / 2\pi U$
 - b) Show $\psi(x = -b) = m/2$
 - c) Find the equation of the streamline passing through the stagnation point.
 - d) Derive an expression for the pressure along the streamline found in part c.
3. Couette Flow: Derive an expression for the speed between a fixed bottom plate and a top plate moving with velocity U .
 4. Poiseuille Flow.
 - a) Write down 3 equations for r , θ and z resulting from the Navier Stokes equations.
 - b) Find an expression for the velocity $v_z(r)$ in the pipe using the boundary condition $v_z(r = R) = 0$.
 - c) Find an expression for the volume flow rate.