Fluid Mechanics and Rate Processes: Tutorial 6

P1. Consider a steady, two-dimensional, incompressible flow of a Newtonian fluid with the velocity field $u = -2xy$, $v = y^2 - x^2$, and $w = 0$. **(a)** Does this flow satisfy conservation of mass? **(b)** Find the pressure field $p(x, y)$ if the pressure at point $(x = 0, y = 0)$ is equal to P_a.

P2. A constant-thickness film of viscous liquid flows in laminar motion down a plate inclined at angle θ, as in Fig. P2. The velocity profile is

$$u = C\,y\,(2h - y) \quad \text{and} \qquad v = w = 0$$

Find the constant C in terms of the specific weight and viscosity and the angle θ. Find the volume flux Q per unit width in terms of these parameters.

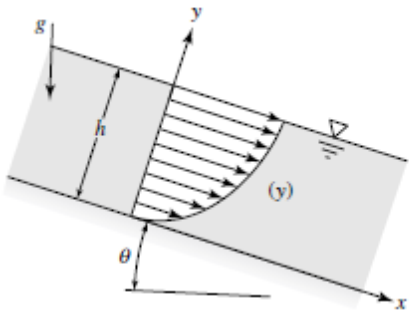

Fig. P2

P3. For the fully developed laminar-pipe-flow solution (as discussed in class), find the axisymmetric stream function $\psi(r, z)$. Use this result to determine the average velocity $V = Q/A$ in the pipe as a ratio of u_{max}.