Hw#1

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Problem 1: Nondimensionalizing Navier Stokes
Using the nondimensionalization given, show that eq 12-14 hold.
Solution.

Problem 2: Convert the Navier-Stokes equations to cylindrical coordinates to show that stated equations hold.
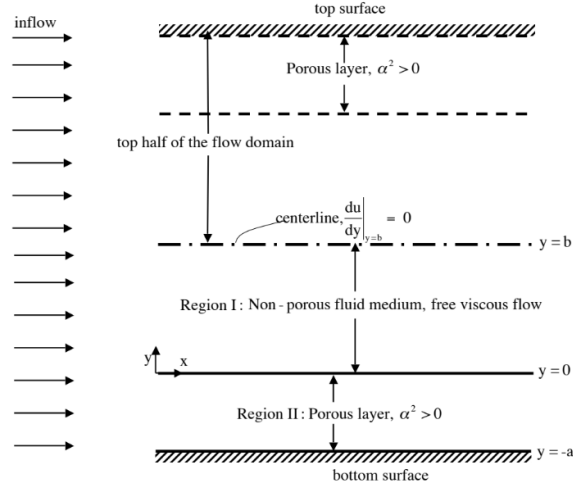
Solution.

Figure 1: Problem 3 setup

Problem 3: Channel flow between porous layers

Derive a simplified two-dimensional representation of flow between porous layers. Consider a channel as shown in figure 1. The flow field is assumed symmetric about the centerline $y = b$, and the analysis should be restricted to the bottom half of the system. The flow is assumed to be steady $(u_t = 0)$ and fully developed $u_x = 0$, and zero in cross-stream direction $(v = 0)$.

Region I: Write the simplified x-momentum equation within the free shear flow region $\alpha^2 = 0$ along with appropriate boundary condtions.

Region II: Write down appropriate boundary conditions and simplified equations of motion.

Solve coupled system of ODEs.

Solution.