Problem 6.13
This problem is from "Advanced Fluid Mechanics Problems" by A.H. Shapiro and A.A. Sonin
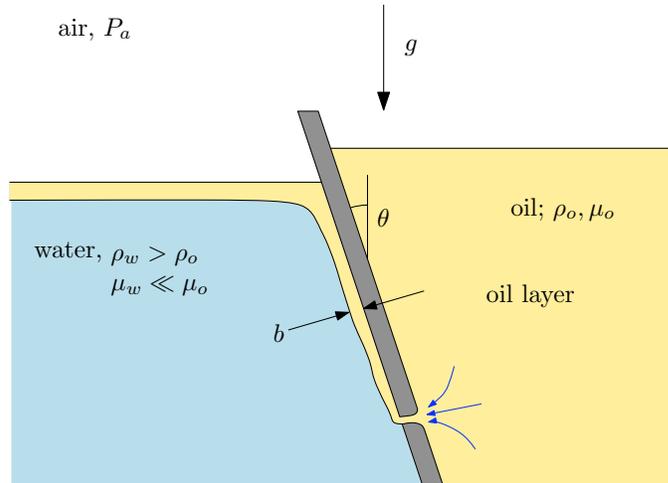
An oil barge has developed a fine crack in its side, running a length L perpendicular to the sketch. Oil leaks out of the crack and runs up the side of the barge (inclined at an angle θ) in a very thin layer, as sketched. Assume that the flow in the oil layer is highly viscous, that the oil is less dense than the water ($\rho_0 < \rho_w$), and that it is much more viscous than water ($\mu_0 \gg \mu_w$).

(a) If the oil layer is found to have a thickness b, what is the oil volume flow rate Q out through the slit?

(b) Describe qualitatively how the field differs when the viscosity of the water is not negligible compared with the oil viscosity.

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