Homework problems on Fluid Dynamics

(1.63J/2.21J)

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MT-adhesion.tex.

Separating a flat object from a smooth surface

It is a common experience that lifting an ice block from a wet plane surface, a sunking ship from the seabed, or separating two pieces of glasses from each other, are difficult. This is because of the slow flow in the very thin gap produces an adhesive force.

Refering to Figure 1, consider a two dimensional problem for simplicity. If a plate of finite width L originally rests on top of a rigid and smooth plane $z = 0$ with a small gap $h_o \ll L$. At time $t = 0$, a vertical force is applied to pull the plate upward. Let the fluid viscosity be μ and density be ρ. Find the rate of separation as a function of F, L and the fluid properties.

Instead of pulling a plate up by force, solve the problem if the plate drops downward by its own weight W.

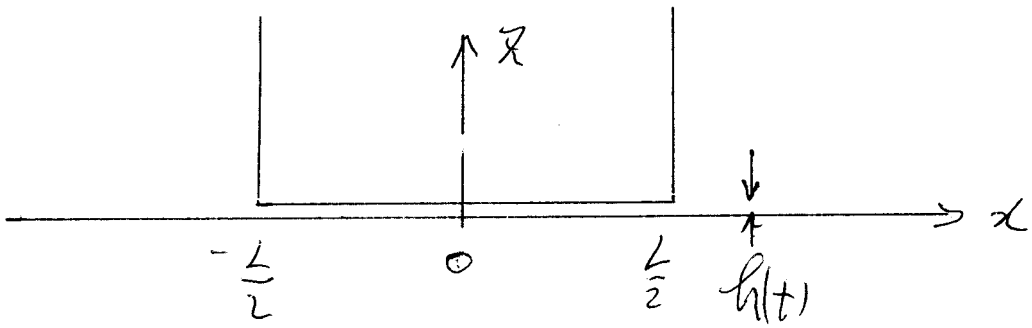

Figure 1: Adhesion between two planes