

Problem 2B.1

Different choice of coordinates for the falling film problem. Rederive the velocity profile and the average velocity in §2.2, by replacing x by a coordinate \bar{x} measured away from the wall; that is, $\bar{x} = 0$ is the wall surface, and $\bar{x} = \delta$ is the liquid–gas interface. Show that the velocity distribution is then given by

$$v_z = (\rho g \delta^2 / \mu) \left[(\bar{x} / \delta) - \frac{1}{2} (\bar{x} / \delta)^2 \right] \cos \beta \quad (2B.1-1)$$

and then use this to get the average velocity. Show how one can get Eq. 2B.1-1 from Eq. 2.2-18 by making a change of variable.