Fluid Mechanics Homework #3

繳交期限：**2019/10/09(三) 09:10**

共五題，題號為：**2-106,3-20,52,79,83**

題號的對照書本是 **Yunus A. Cengel and John M. Cimbala "Fluid Mechanics: Fundamentals and Applications 3/e (SI Units) "**

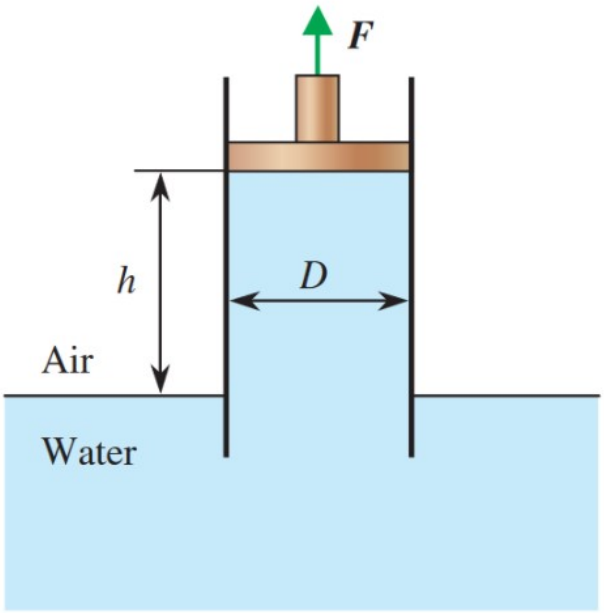
$2-106$

Derive a relation for the capillary rise of a liquid between two large parallel plates a distance t apart inserted into the liquid vertically. Take the contact angle to be ϕ.

$the\ capillary\ rise: h,\ the\ surface\ tension\ of\ liquid: \sigma_s$
$the\ density\ of\ liquid: \rho,\ the\ gravitational\ acceleration: g$

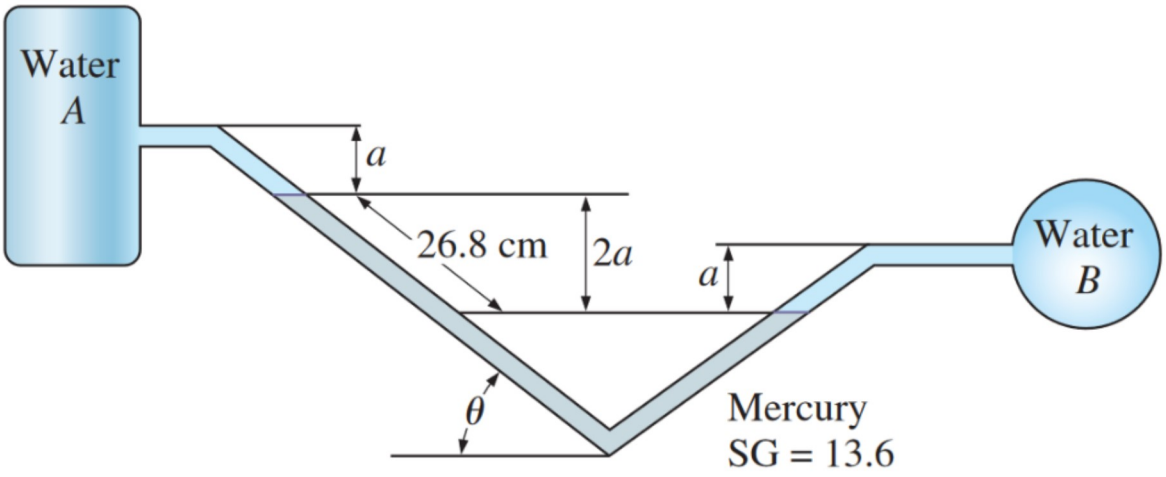
$3-20$

Water from a reservoir is raised in a vertical tube of internal diameter $D = 30$ cm under the influence of the pulling force F of a piston. Determine the force needed to raise the water to a height of $h = 1.5$ m above the free surface. What would your response be for $h = 3$ m? Also, taking the atmospheric pressure to be 96 kPa, plot the absolute water pressure at the piston face as h varies from 0 to 3 m.



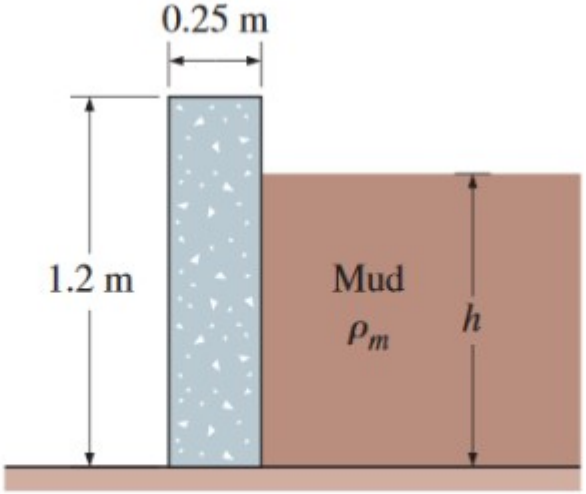
3 – 52

Two water tanks are connected to each other through a mercury manometer with inclined tubes, as shown in Fig. P3–58. If the pressure difference between the two tanks is 20 kPa, calculate a and θ.



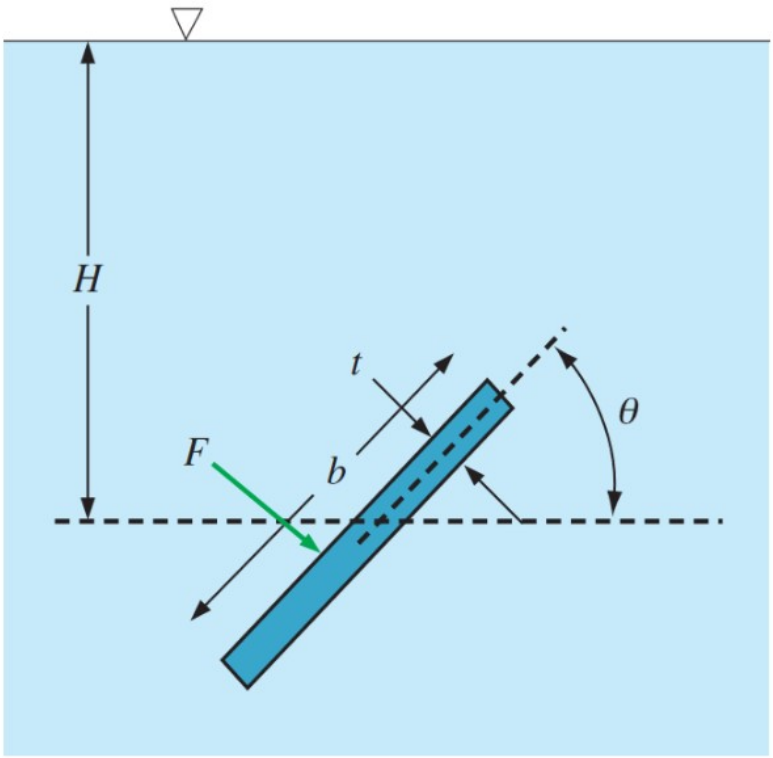
3 – 79

A retaining wall against a mud slide is to be constructed by placing 1.2-m-high and 0.25-m-wide rectangular concrete blocks ($\rho = 2700$ kg/m^3) side by side, as shown in Fig. P3–86. The friction coefficient between the ground and the concrete blocks is $f = 0.4$, and the density of the mud is about 1400 kg/m^3. There is concern that the concrete blocks may slide or tip over the lower left edge as the mud level rises. Determine the mud height at which (*a*) the blocks will overcome friction and start sliding and (*b*) the blocks will tip over.



3 – 83

Consider a flat plate of thickness t, width w into the page, and length b submerged in water, as in Fig. P3–90. The depth of water from the surface to the center of the plate is H,



and angle θ is defined relative to the center of the plate. (*a*) Generate an equation for the force F on the upper face of the plate as a function of (at most) H, b, t, w, g, ρ, and θ. Ignore atmospheric pressure. In other words, calculate the force that is *in addition to* the force due to atmospheric pressure. (*b*) As a test of your equation, let $H = 1.25$ m, $b = 1$ m, $t = 0.2$ m, $w = 1$ m, $g = 9.807$ m/s^2, $\rho = 998.3$ kg/m^3, and $\theta = 30^\circ$. If your equation is correct, you should get a force of 11.4 kN.