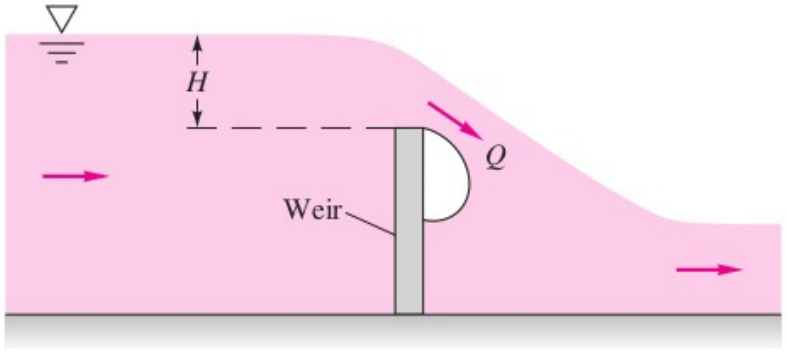
P5.32 A *weir* is an obstruction in a channel flow that can be calibrated to measure the flow rate, as in Fig. P5.32. The volume flow Q varies with gravity g, weir width b into the paper, and upstream water height H above the weir crest. If it is known that Q is proportional to b, use the pi theorem to find a unique functional relationship $Q(g, b, H)$.



P5.32

7–71 A liquid of density ρ and viscosity μ is pumped at volume flow rate $\dot{V}$ through a pump of diameter D. The blades of the pump rotate at angular velocity ω. The pump supplies a pressure rise ΔP to the liquid. Using dimensional analysis, generate a dimensionless relationship for ΔP as a function of the other parameters in the problem. Identify any established nondimensional parameters that appear in your result. *Hint*: For consistency (and whenever possible), it is wise to choose a length, a density, and a velocity (or angular velocity) as repeating variables.

7–76 Consider a liquid in a cylindrical container in which both the container and the liquid are rotating as a rigid body (solid-body rotation). The elevation difference h between the center of the liquid surface and the rim of the liquid surface is a function of angular velocity ω, fluid density ρ, gravitational acceleration g, and radius R (Fig. P7–76). Use the method of repeating variables to find a dimensionless relationship between the parameters. Show all your work. *Answer: $h/R = f(\text{Fr})$*

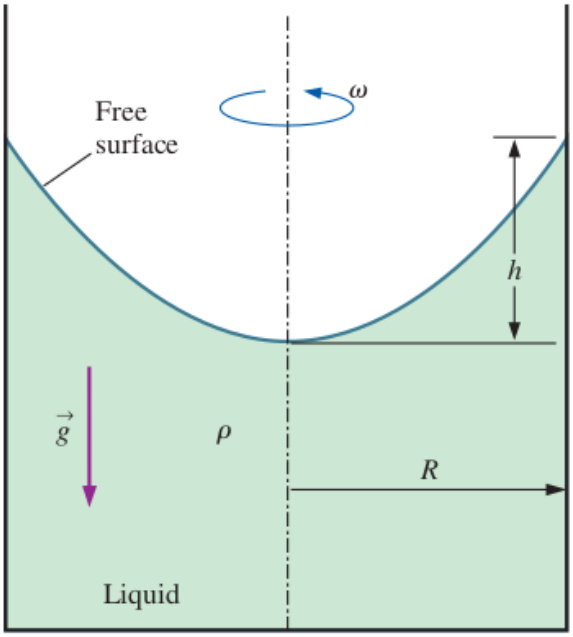


FIGURE P7–76

P5.77 A dam spillway is to be tested by using Froude scaling with a one-thirtieth-scale model. The model flow has an average velocity of 0.6 m/s and a volume flow of 0.05 m^3/s. What will the velocity and flow of the prototype be? If the measured force on a certain part of the model is 1.5 N, what will the corresponding force on the prototype be?

P5.78 A prototype spillway has a characteristic velocity of 3 m/s and a characteristic length of 10 m. A small model is constructed by using Froude scaling. What is the minimum scale ratio of the model that will ensure that its minimum Weber number is 100? Both flows use water at 20°C.