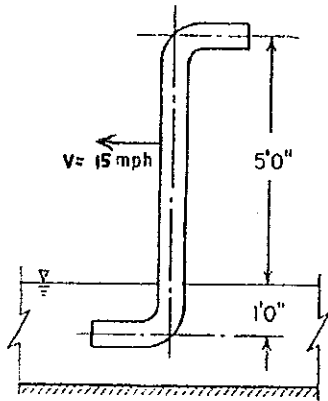
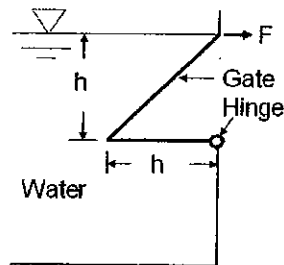


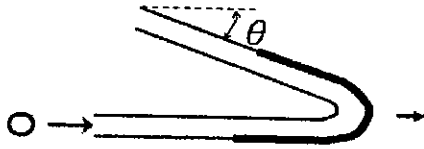
1. The wave drag on a model of a ship is 16 N at a speed of 3 m/s. For a prototype twelve times as long, what will the corresponding speed and wave drag be if the liquid is the same in each case? (15%)
2. A scoop made of 6-in. pipe is being pushed through a trough of still water in the direction shown in the figure, with a velocity  $v$  equal to 15 mph. Assuming that enough water is picked up to make the pipe run full, and that no energy is dissipated, determine the horsepower necessary to push the scoop through the water. (25%)



3. A gate having a width 1 m is located in the side of a water tank as shown in the figure. It is held in position by the force  $F$ . Friction at the hinge and the weight of the gate can be neglected. Determine the require value of  $F$  (magnitude and direction). Specific weight of water is  $\gamma$ . (20%)



4. As shown in the figure, a horizontal water jet having a cross section of  $A$  with a uniform speed of  $V$ , strikes a moving vane, which is turned through an angle. If gravity and viscous effects are negligible. Find the force exerted on the vane, which moves to right with horizontal velocity  $u$ , less than  $V$ . (water density is  $\rho$ ) (write down the linear momentum equation, then derive for the solution step by step) (20%)



5. The pump shown in the figure adds 6 kilowatt to the water as it pumps water from the lower lake to the upper lake. The elevation difference between the lake surfaces is  $h = 12$  m and the head loss is 6 m. Determine the flowrate. (20%)

