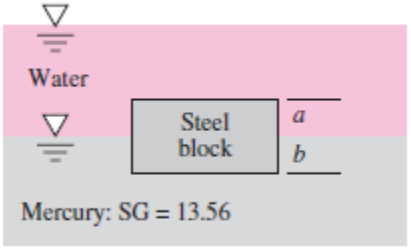
ESO204A: Fluid Mechanics and Rate Processes
TUTORIAL 3 PROBLEMS

August-November 2017

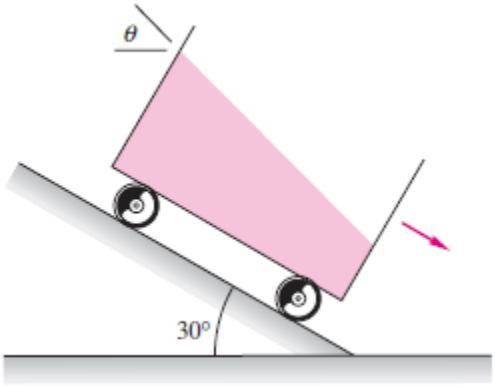
1. Review of Tutorial 2

2. A uniform block of steel (SG = 7.85) will "float" at a mercury-water interface as in Fig. P2.122. What is the ratio of the distances *a* and *b* for this condition?



P2.122

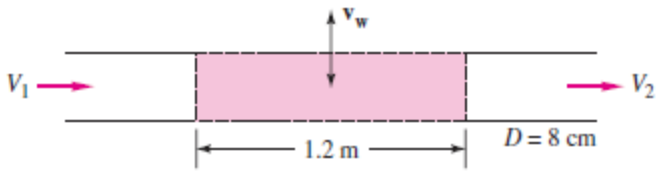
3. The tank of water in Fig. P2.147 accelerates uniformly by freely rolling down a 30° incline. If the wheel are frictionless, what is the angle θ? Can you explain this interesting result?



P2.147

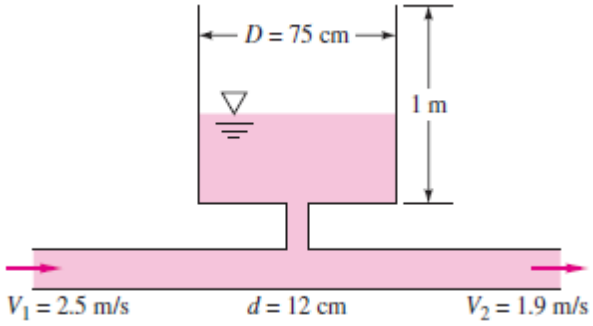
4. A very tall 10-cm-diameter vase contains 1178 cm^3 of water. When spun steadily to achieve rigid-body rotation, a 4-cm-diamter dry spot appears at the bottom of the vase. What is the rotation rate, in r/min, for this condition?

5. Water flowing through an 8-cm-diameter pipe enter a porous section, as in Fig. P3.10, which allows a uniform radial velocity v_w through the wall surfaces for a distance of 1.2 m. If the entrance average velocity V_1 is 12 m/s, find the exit velocity V_2 if (a) v_w = 15 cm/s out of the pipe walls or (b) v_w = 10 cm/s into the pipe. (c) What value of v_w will make V_2 = 9 m/s?



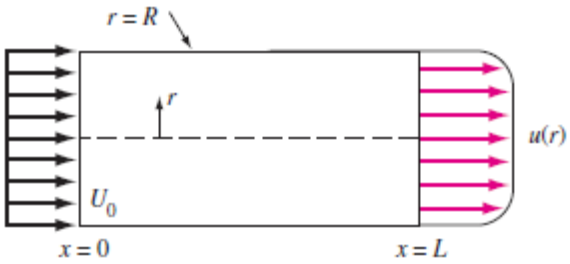
P3.10

6. The pipe flow in Fig. P3.12 fills a cylindrical surge tank as shown. At time t = 0, the water depth in the tank is 30 cm. Estimate the time required to fill the remainder of the tank.



P3.12

7. Water, assumed incompressible, flows steadily through the round pipe in Fig. P3.15. The entrance velocity is constant $u = U_0$, and the exit velocity approximates turbulent flow, $u = u_{max}\left(1 - r/R\right)^{1/7}$. Determine the ratio U_0 / u_{max} for this flow.



P3.15