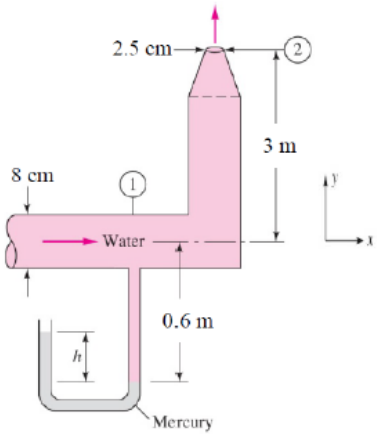
Mechanical, Automotive and Materials Engineering
Fluid Mechanics I
MECH3233-F23

Assignment Problems Set #7

Due: Thursday, November 9, 2023, at 11:59 p.m.

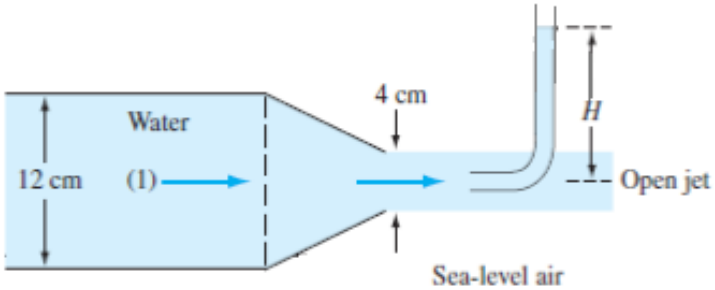
Problem 1 (6 points): In the figure below the water at 20°C (ρ_{water} = 998 kg/m^3) exits into the atmosphere at section 2. A mercury manometer with $\rho_{mercury}$ = 13550 kg/m^3 is connected in Section 1. If V_1 = 0.5 m/s and all losses are neglected, determine:

a) Velocity of the jet at Section 2 (**1 point**)
b) The height *h* in m of the manometer at Section 1 (**5 points**)



Problem 2 (4 points) In Fig. P3.127 the open jet of water at 20°C (ρ_w= 998 kg/m^3) exits a nozzle into sea-level air (p_a =101325 Pa) and strikes a stagnation tube as shown. If the pressure at the centerline at section 1 is 110 kPa (abs), and losses are neglected, estimate

(*a*) the mass flow in kg/s and (**3 points**)
(*b*) the height *H* of the fluid in the stagnation tube (**1 point**).

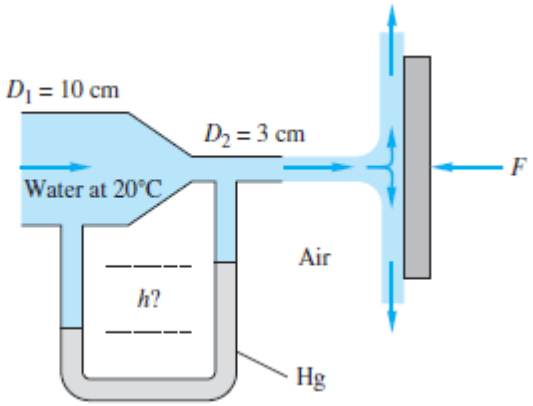


P3.127

Problem 3 (6 points) Water (ρ_w = 998 kg/m^3) flows through a circular nozzle, exits into the air as a jet, and strikes a plate, as shown in Fig. P3.114. The force required to hold the plate steady is 70 N. Assuming steady, frictionless, one-dimensional flow, estimate

(*a*) the velocities at sections (1) and (2) (**2 points**)

(*b*) the mercury (ρ_{Hg} = 13550 kg/m^3) manometer reading *h* (**4 points**).



Problem 4 (4 points) Air at 105 kPa and 37°C flows upward through a 6-cm-diameter inclined pipe at a rate of 65 L/s. The pipe diameter is then reduced to 4 cm through a reducer. The pressure change across the reducer is measured by a water (ρ = 1000 kg/m^3) manometer. The elevation difference between the two points on the pipe where the two arms of the manometer are attached is 0.20 m. Determine the differential height, *h* between the fluid levels of the two arms of the manometer. Take that the gas constant of air is R = 0.287 kPa·m^3/kg·K.