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Université d'Ottawa
Faculté de génie

Département de
Génie Chimiqu et Biologique

University of Ottawa
Faculty of Engineering

Department of
Chemical Engineering

CHG 2312 – Fluid Flow
Assignment #2

Question 1:
Water enters one end of a perforated pipe 0.2 m in diameter, with a velocity of 6 m/s. the discharge through the pipe wall has a velocity profile which varies with axial distance as illustrated in Figure 1. If the flow is steady and incompressible, find the discharge velocity, U, in m/s.

$$\upsilon = U\frac{2-\sqrt{x}}{4}$$

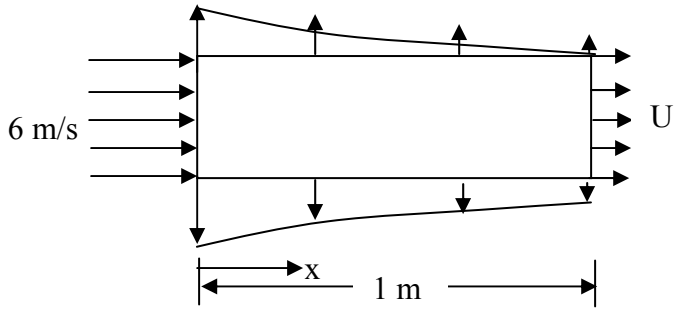

Figure 1

Question 2:
A stream of liquid moving at low speed leaves a nozzle pointed directly downward. The velocity may be considered uniform across the nozzle exit and the effects of friction may be ignored. At the nozzle exit, the jet velocity and area are V_o and A_o, respectively. Determine the variation of jet area with elevation.

Question 3:
Water flows steadily up the vertical 0.1-m-diameter pipe and out the nozzle, which is 0.05 m in diameter, discharging to atmospheric pressure (Figure 2). The stream velocity at the nozzle exit must be 20 m/s.

a) Calculate the minimum gauge pressure required at section 1.
b) If the device were inverted, what would be the required minimum pressure at section 1 to maintain the nozzle exit velocity at 20 m/s?

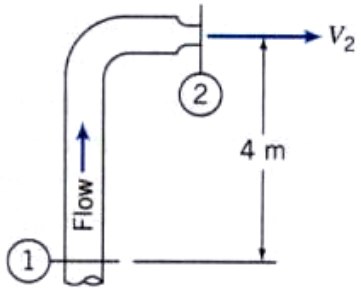

Figure 2

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Question 4:
Water (ρ_w = 999 kg/m^3, μ = 0.98x10^{-3} Pa.s) flowing through an orifice meter. Pressure taps (Figure 4) causes the mercury monometer (ρ_m = 13600 kg/m^3) to deflect 135 mm. The pipe section has an internal diameter of 10 cm and is inclined at 30° from the horizontal. If the orifice has a throat diameter of 6 cm, what is the mass flow rate of water in the pipeline?

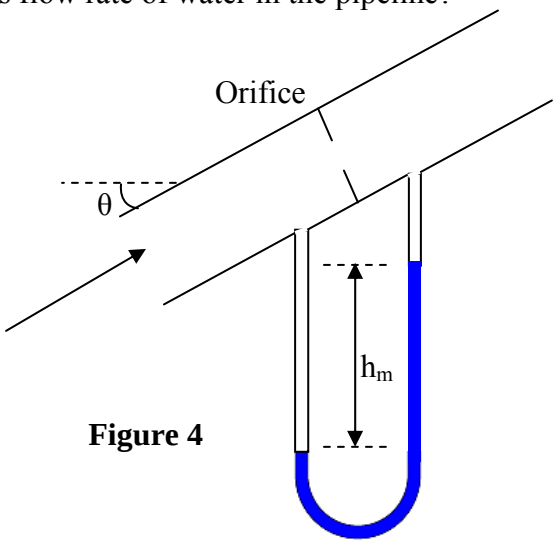

Figure 4

Question 5:
Air in a 6 inch diameter line flows through a venturi meter with a 3 inch throat diameter. Assume that the upstream pressure is 60 psi and that the flow is isothermal at 68°F. Determine the maximum possible mass flow rate of air for which the assumption of incompressible flow is a valid engineering approximation. Compute the corresponding differential pressure reading on a mercury manometer.