CHEN 311 Introduction to Fluids Engineering

Exam 2

Tuesday 26 November 2013

06:30 pm – 08:00 pm Bechtel ELH

Name: _____

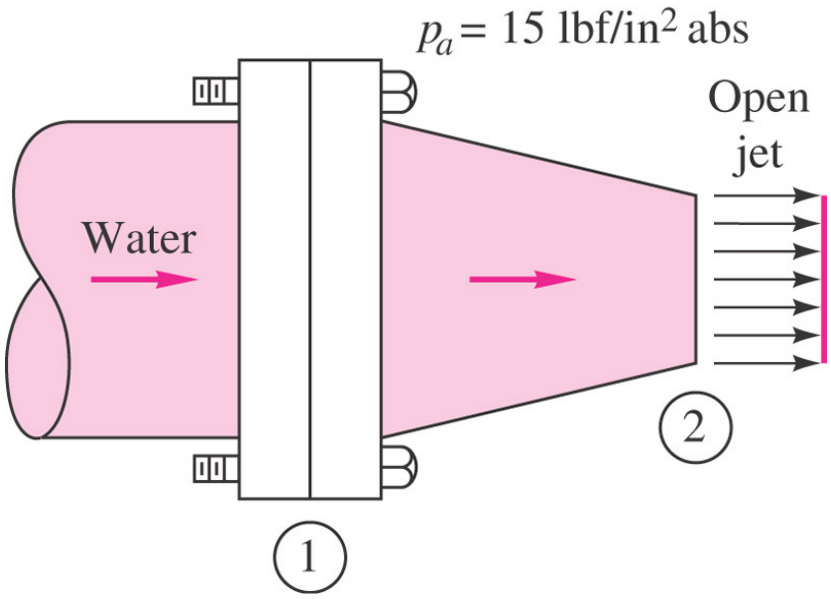
Instructions:

- This exam is closed book.
- Make sure you sign your exam booklet. Failure to do so will result in a 2 points deduction on your exam grade.
- The exam duration is **90 minutes**.
- Answer all questions on your exam booklet, **starting each problem on a new page.** You may annotate the figures in the question sheet, but make sure you refer to them in your answer.
- State your assumptions and show your work leading to the final answer.
- **Return this exam question sheet with your exam booklet**.

Good luck!

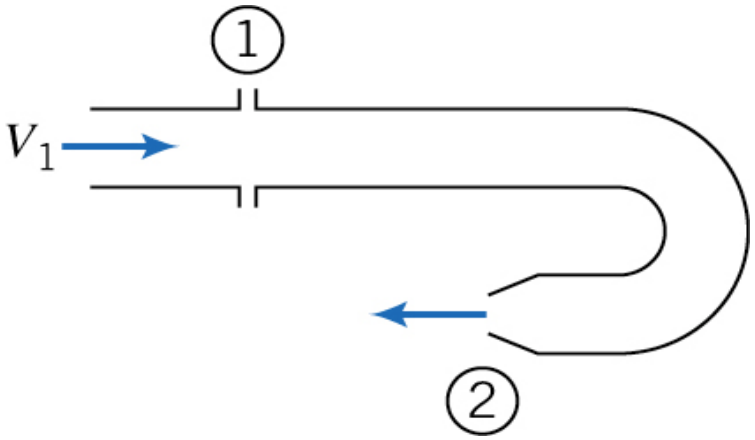
Prof. Walid Saad- Fall 2013
Chemical Engineering Program
American University of Beirut

Problem 1: (25 points)



The horizontal nozzle in the figure has $D_1 = 12$ in, $D_2 = 6$ in, with $P_1 = 38$ psia, and $V_2 = 56$ ft/s. Find the magnitude of the force F (in lbf) provided by the bolts to hold the nozzle in place.

Problem 2: (25 points)



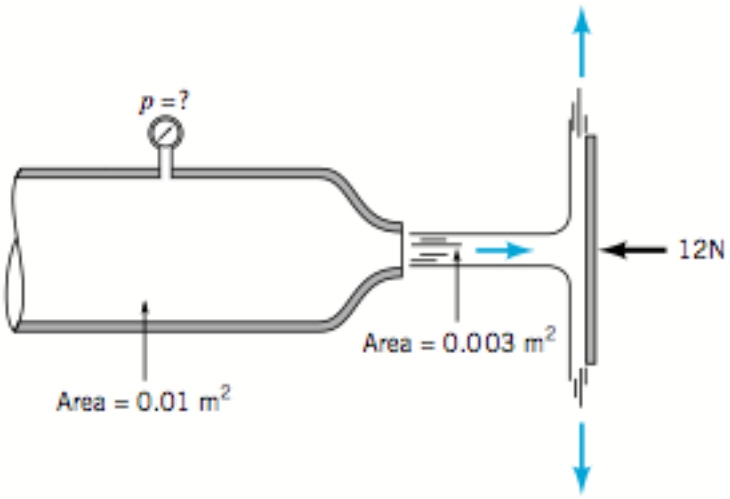
Water is flowing steadily through the 180° elbow shown above. The water discharges to the atmospheric pressure.

Find the magnitude and direction of the horizontal component of the force required to hold the elbow in place.

Given:

- At the inlet to the elbow (1) the gage pressure is 103 kPa.
- Uniform properties over the inlet and outlet
- A_1= 2500 mm^2
- A_2= 650 mm^2
- V_1= 3 m/s

Problem 3: (25 points)

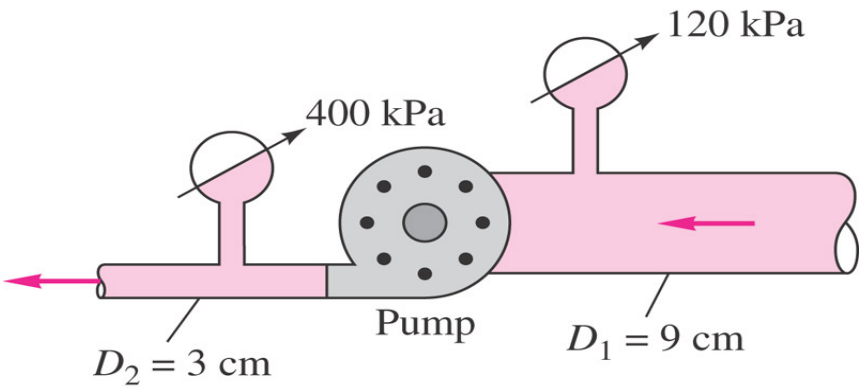


Air flows into the atmosphere from a nozzle and strikes a vertical plate as shown in the figure above. A horizontal force of 12 N is required to hold the plate in place.

Determine the reading on the pressure gage.

Assume the flow to be incompressible and frictionless.

Problem 4: (25 points)



The horizontal pump in the figure discharges water at 57 m^3/h. Neglecting losses, what power in kW is delivered to the water by the pump?

Potentially Useful data:

Air density: 1.23 Kg/m^3

Water density= 62.4 lb/ft^3=$1000\ kg/m^3$

1hp= 550 ft.lb/s= 745.7 W

g= 9.8 m/s^2= 32.2 ft/s^2