

Rose-Hulman Institute of Technology
Foundation Coalition Sophomore Engineering Curriculum

ES202 – Fluid & Thermal Systems

Winter 2002-2003

Circle one:

Sanders - 01, Sanders - 02, Mayhew - 07, Mayhew - 08,

_____ **Name**

_____ **CM**

Exam 1

Jan 13, 2003

Problem 1	_____ / 45
Problem 2	_____ / 40
Problem 3	_____ / 15
Total	_____ / 100

Show all work for full credit.

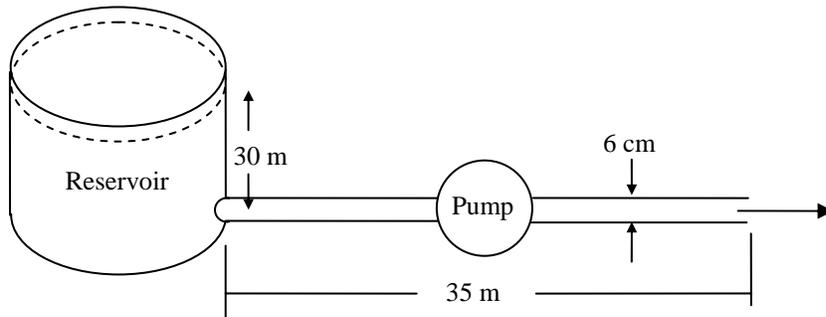
Open book, 1 equation sheet, computer use for computational purposes.

Crunch numbers last!

Problem 1 (45 points)

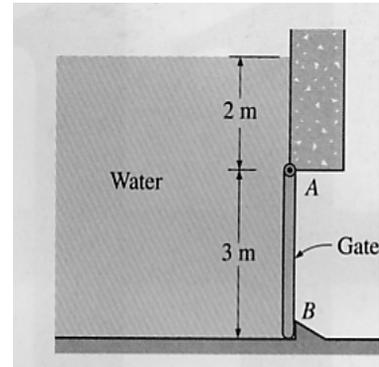
Water is to be discharged from a reservoir using a horizontal cast iron pipe. The pipe is 35 m long and has a 6-cm diameter. The pipe entrance from the reservoir is sharp-edged. The water level in the reservoir is 30 m above the centerline of the pipe. Take the density of water to be 1000 kg/m^3 and the dynamic viscosity to be 1.138×10^{-3}

- What is the velocity at the pipe exit assuming there are NO LOSSES and there is NO PUMP?
- A pump is added to make the volumetric flow rate $0.6 \text{ m}^3/\text{min}$. A fully-open gate valve is added as a shutoff valve. Losses associated with the connection of the pump are negligible. DETERMINE the pumping power required.



Problem 2 (40 points)

A 3-m-high, 6-m-wide rectangular gate is hinged at the top edge at A and is restrained by a fixed ridge at B. Determine the force that the ridge at B applies to the gate. The fluid is water with density 1000 kg/m^3 .



Problem 3 (15 points)

a) For a laminar flow in a straight pipe, when the relative roughness of the pipe increases, friction factor
increases decreases stays the same

b) A turbine is a steady-state energy conversion device which is built in order to get
_____ as an output, and must be supplied with
_____ as an input.

c) Consider a 3-kg copper cube and a 3-kg copper ball submerged in a liquid. Will the buoyant forces acting on these two bodies be the same or different? Briefly explain your answer.