CM Box __________

ROSE-HULMAN Institute of Technology
Foundation Coalition Sophomore Engineering Curriculum

ES202 – Fluid & Thermal Systems Spring 2003-2004

____
Name

Exam 2

May 11, 2004

Problem 1	______/ 34
Problem 2	______/ 42
Problem 3	______/ 24
Total	______/ 100

Show all work for full credit.

Open book, computer use for computational purposes.

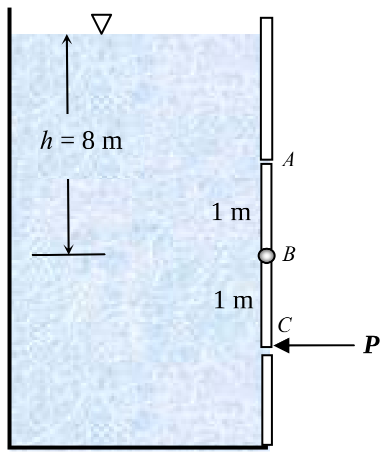
Crunch numbers last!

CM Box ___________

Problem 1 (34 points)

A rectangular gate of negligible mass is pinned at its center point, which is located h = 8 m below the free surface of a water tank. (ρ_{water} = 1000 kg/m^3, μ_{water} = 0.00131 kg/m-s) The gate has a width (into the page) of 1 m.

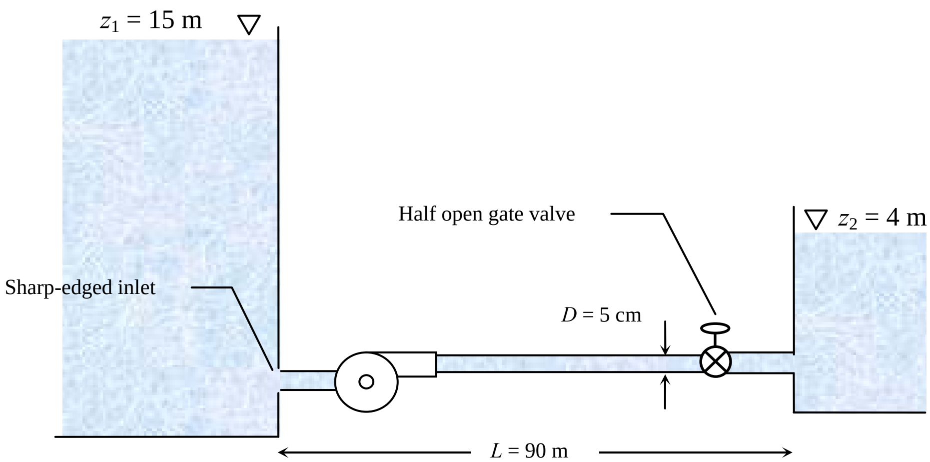
a) For the dimensions shown in the figure, calculate the minimum force P that must be applied at C to keep the gate from opening.
b) Is there any value of P that would keep the gate closed if it were located at A instead of C? Why or why not?



Problem 2 (42 points)

0.006 m^3/s of water (ρ_{water} = 1000 kg/m^3, μ_{water} = 0.00131 kg/m-s) is pumped from one reservoir to another through a 5-cm diameter pipe with a total length of 90 m as shown in the figure. The piping system has a sharp-edged inlet and a half-closed gate valve. The pipe is made of cast iron.

a) Find the head supplied by the pump, in m. Also find the power supplied by the pump, in W.
b) If the pump were removed from the system, what new height, z_1 would be required to provide the same flow rate?



CM Box ____________

Problem 3 (24 points)

a) (3 pts) A pressure gage which measures gage pressure is open to the atmosphere. What does it read? (Circle one)
   i) about 101.3 kPa
   ii) 0
   iii) about 14.7 psi
   iv) none of the above

b) (3 pts) For a static incompressible fluid, pressure… (Circle one)
   i) increases with increasing elevation
   ii) increases with horizontal location
   iii) decreases with horizontal location
   iv) none of the above

c) (4 pts) Viscosity is… (Circle one)
   i) a measure of a fluid's "stickiness"
   ii) relates shear stress to velocity gradient in a flowing fluid
   iii) is responsible for fluid friction
   iv) all of the above

d) (4 pts)
   True / False A liquid is necessarily a fluid.
   True / False A fluid necessarily a liquid.

e) (10 pts) A cylindrical can is floating in water (ρ_{water} = 1000 kg/m^3, μ_{water} = 0.00131 kg/m-s) as shown in the figure. What is the weight of the can, in N?