Name: _____CM Box: _____

Circle your section:

Lui – 01 Lui – 02 Richards – 03 Richards – 04

Sanders – 05 Sanders – 06 Mech – 07

ES 202
Fluid & Thermal Systems

Examination III
February 10, 2006

Problem	Score
1	/ 20
2	/ 80
Total	/100

Clearly show all work for credit.

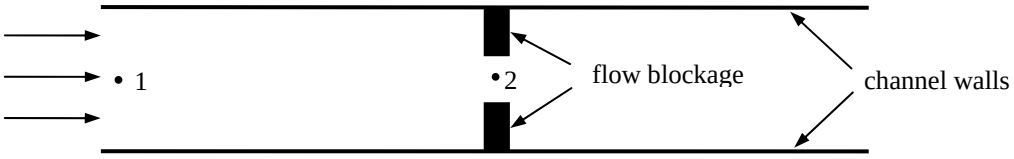
Open table ONLY

One side of an 8.5" x 11" equation sheet is allowed.
Laptops allowed

Density of water at standard conditions is assumed to be 1000 kg/m^3 in this exam.

Problem 1 (20 points)

a) Which one of the following statements correctly compares the ***static pressure*** measured at Station 1 and that at Station 2?



i. $P_1 > P_2$

ii. $P_1 = P_2$

iii. $P_1 < P_2$

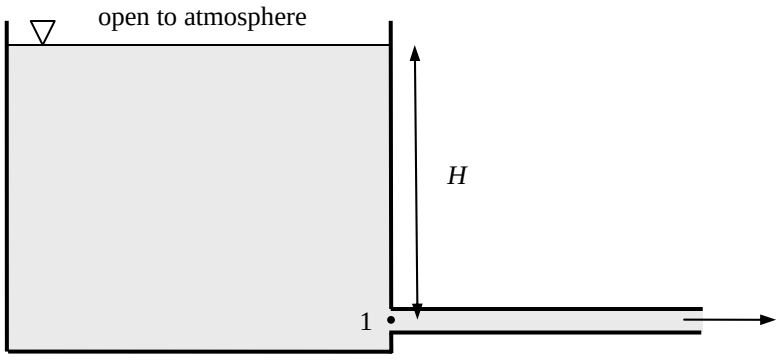
iv. cannot be determined from the given information

b) Which one of the following statements correctly compares the ***static pressure*** measured at the inlet of the long pipe section.

i. $P_1 > P_{atm} + \rho g H$

ii. $P_1 = P_{atm} + \rho g H$

iii. $P_1 < P_{atm} + \rho g H$



iv. cannot be determined from the given information

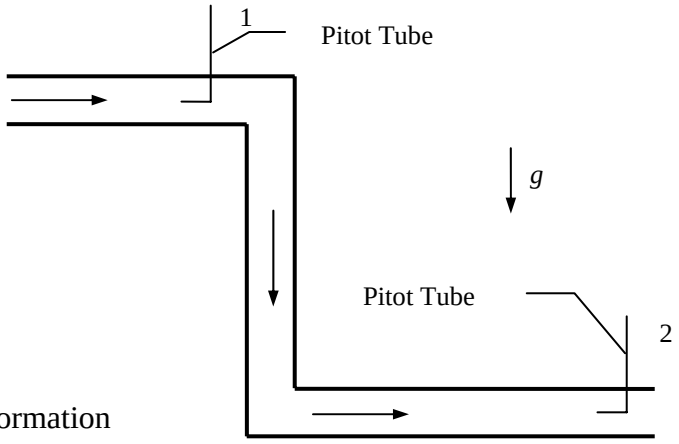
c) Liquid water flows through a vertical piping system with two 90^o bends. Two Pitot tubes are located as shown and attached to pressure gages. In the ABSENCE of fluid friction, which one of the following statements correctly compares the pressure measurement on the two Pitot tubes?

i. reading at 1 > reading at 2

ii. reading at 1 = reading at 2

iii. reading at 1 < reading at 2

iv. cannot be determined from the given information



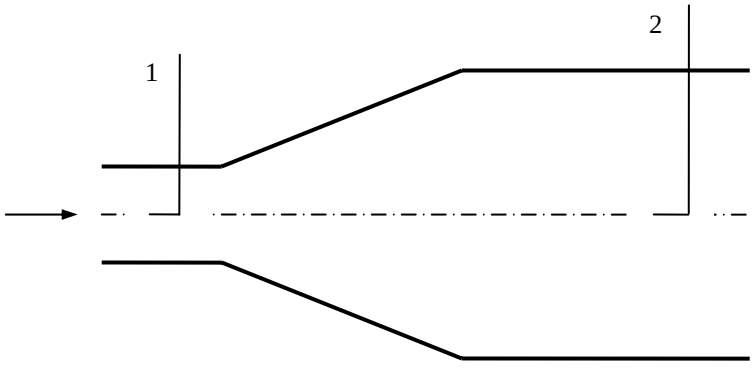
d) Low-speed air flows through a diverging section of a diffuser. Two Pitot tubes are loated as shown and attached to pressure gages. In the ABSENCE of fluid friction, which one of the following statements correctly compares the pressure measurement on the two Pitot tubes?

i. reading at 1 > reading at 2

ii. reading at 1 = reading at 2

iii. reading at 1 < reading at 2

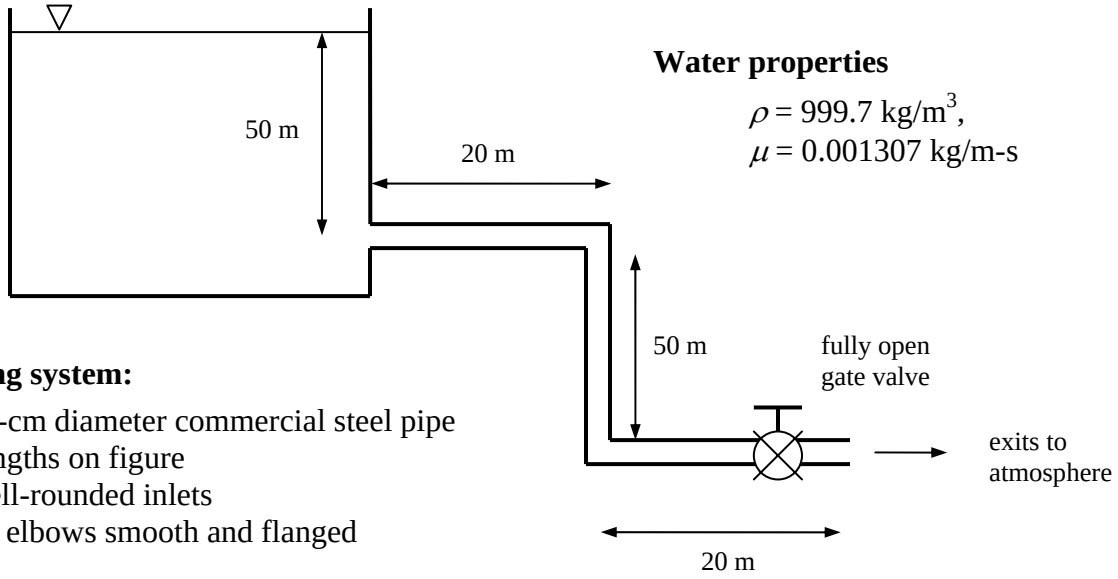
iv. cannot be determined from the given information



Problem 2 (80 points)

Part (a) (15 points) --- Water flows from a large supply reservoir through a 7.5-cm diameter commercial steel pipe with length dimensions indicated in the following figure. The inlet to the pipe is well-rounded and all 90^o elbows are smooth and flanged.

Assuming fluid ***friction is negligible***, what is the maximum flow speed in the pipe?



Water properties

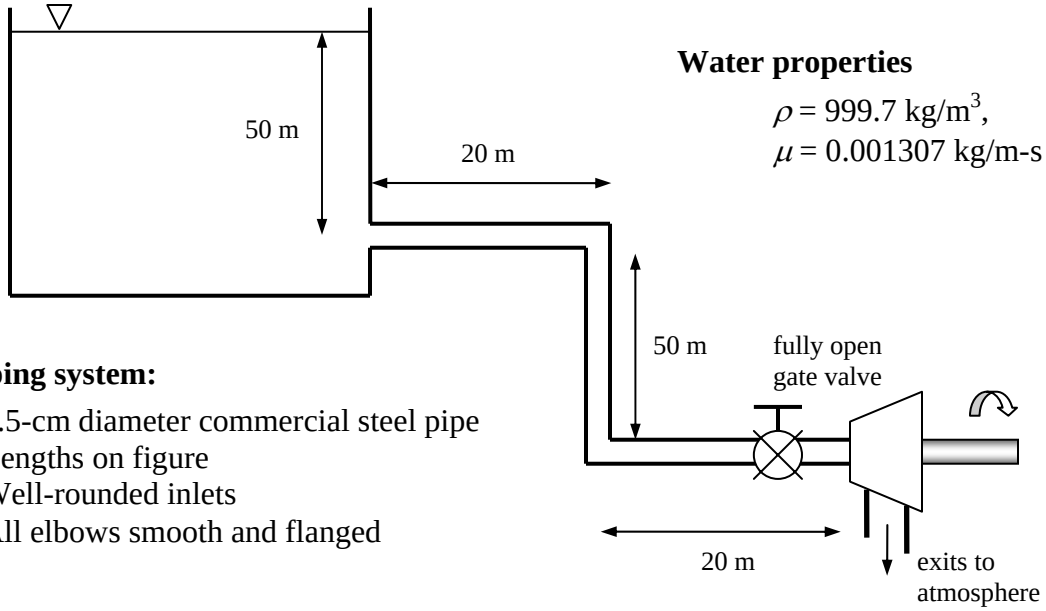
ρ = 999.7 kg/m^3,
μ = 0.001307 kg/m-s

Piping system:

7.5-cm diameter commercial steel pipe
Lengths on figure
Well-rounded inlets
All elbows smooth and flanged

Part (b) (65 points) --- A turbine is added to the exit of the piping system described in Part (a) as shown in the figure below. The water velocity in the pipe is 5 m/s when the turbine is operating and ***friction effects cannot be neglected*** in the piping system.

Determine the power developed by the turbine if its efficiency is 80%.



Water properties

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Piping system:

7.5-cm diameter commercial steel pipe
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Well-rounded inlets
All elbows smooth and flanged