Name _____   CM _____

Instructor/Section (Circle one):   Richards – 8   Richards – 9

                                          Mayhew – 8   Mayhew – 9

ES202
Examination III
February 9, 2005

Problem	Points	Score
1	40	
2	60	
Total	100	

Show all work for full credit.

One equation/notes page allowed (1 side, 8-1/2 x 11 sheet).

Laptops allowed but no pre-prepared worksheets, etc.

Problem 1 (40 points)

A siphon is used to drain a hot tub located on the roof of a building that is 30 m high. The siphon tube is suspended 2 m above the top of the water level in the hot tub and extends down to a lower floor (see figure). The diameter of the siphon tube is 3 cm.

Assume NO LOSSES of mechanical energy; water temperature is uniform at 35 °C [ρ_{water} = 994 kg/m^3] and atmospheric pressure is 100 kPa

(a) When the siphon is operating how are the following pressures related. Fill in the blank with >, =, < or X meaning cannot determine with given information.

    (1) P_2 _____ P_1

    (2) P_3 _____ P_1

    (3) P_4 _____ P_1

    (4) Cannot determine with given information

(b) Find h that produces a flow rate of 0.0087 m^3/sec. (Assume the water stays a liquid throughout the process.)

(c) Determine the pressure at Point 2, in kPa.

(d) The water temperature is 35 °C and will "boil" at a pressure of 5.628 kPa. Will the water boil anywhere during the draining process at this flow rate? Support your answer.
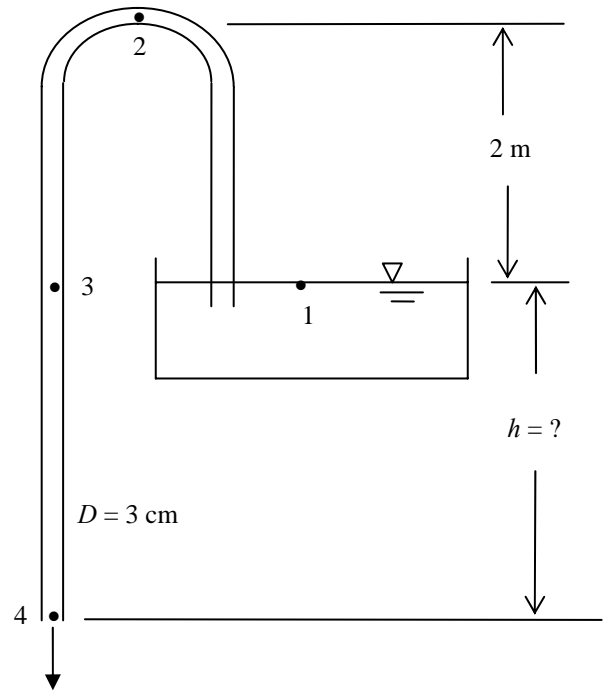
Problem 2 (60 points)

A water fountain is installed at a remote location by attaching a 20-mm-diameter cast iron pipe directly to a water main through which water is flowing at 20°C. The entrance to the cast iron pipe is sharp-edged, and the 20-m-long piping system involves three 90° miter bends without vanes, a fully-open gate valve, and an angle valve with $K_L = 5$ when fully open. The elevation difference between the supply pipe and the fountain is negligible.
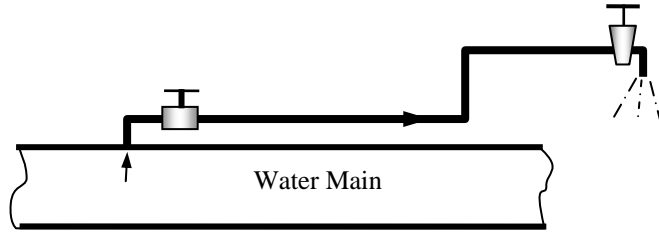
Water Main

Water properties @ 20°C

$\rho = 998 \text{ kg/m}^3$

$\mu = 1.002 \times 10^{-3} \text{ kg/(m-s)}$

$c_p = 4.182 \text{ kJ/(kg-K)}$

$P_{sat} = 2.339 \text{ kPa}$

Determine the water main pressure that is required to produce a water velocity of 5 m/s in the cast iron pipe.