

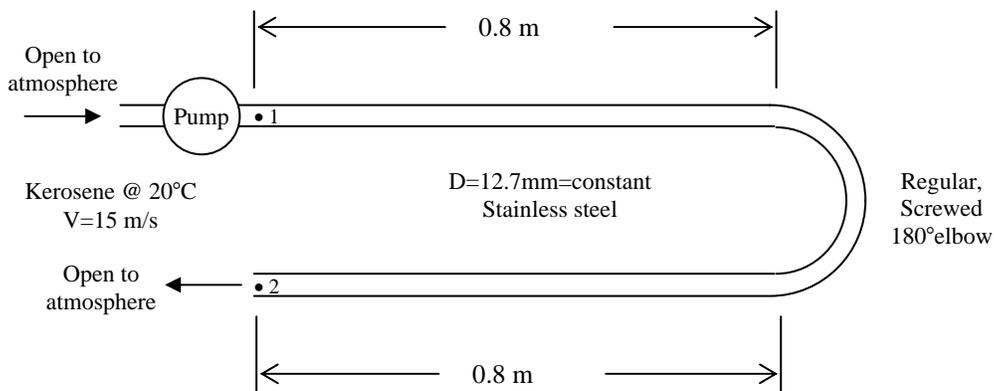
Name \_\_\_\_\_ CM Box \_\_\_\_\_ Mayhew Sanders 5 6

**ES202**  
Examination 2  
January 24, 2001

Problem	Score
1	/40
2	/25
3	/35
Total	/100

Show all work for credit  
Open book - Fluids (White) and Thermo (Wark & Richards)

1. (40 points) Kerosene at  $20^{\circ}\text{C}$  is pumped through a new stainless steel pipe of diameter of 12.7 mm (0.5 inches). The  $180^{\circ}$  elbow has a "regular" radius and is screwed onto the straight pipes. The length of the elbow is negligible compared to the length of the straight pipe. The velocity of the kerosene is 15 m/s. Assume the flow is steady and incompressible, and has negligible change in elevation.
  - a. (30 points) Find the pressure drop  $p_1 - p_2$  (kPa) due to friction in the pipe.
  - b. (10 points) Find the pump power (kW) required for this flow. Assume  $V = 15$  m/s and  $p = p_{\text{atm}}$  at the pump inlet.





3. (35 points) Refrigerant 134a flows steadily through the nozzle shown below.
- (30 points) Find the exit temperature  $T_2$ .
  - (5 points) Find the exit diameter  $D_2$ .

