



Lebanese American University
School of Engineering and Architecture
Department of Mechanical Engineering

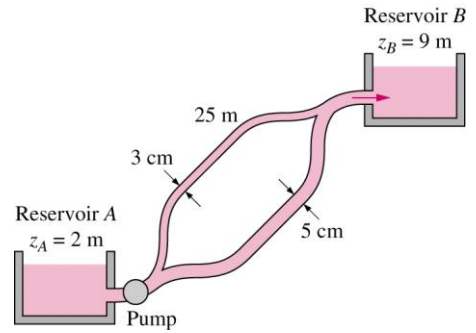
MEE 512 Thermofluids
Midterm, Duration 2 hrs

Dec. 5, 2008

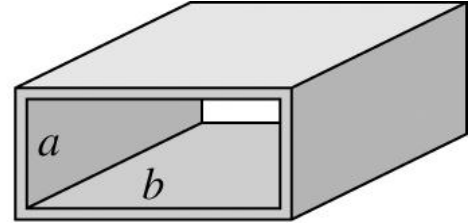
Name:

ID:

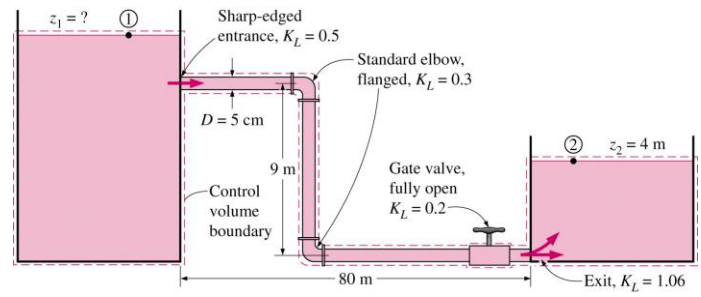
1) (25 pts.) Water at 20°C is to be pumped from a reservoir ($z_A=2$ m) to another reservoir at a higher elevation ($z_B=9$ m) through two 25-m-long plastic pipes connected in parallel. The diameters of the two pipes are 3 cm and 5 cm. Water is to be pumped by a 68 percent efficient motor-pump unit that draws 7 kW of electric power during operation. The minor losses and the head loss in the pipes that connect the parallel pipes to the two reservoirs are considered to be negligible. Determine the total flow rate between the reservoirs and the flow rates through each of the parallel pipes. Hint: Assume turbulent flow and iterate only once if needed. Lay down NEATLY all necessary equations



2) (25 pts.) Heat exchangers often consist of many rectangular passage given in the figure below with $L=30$ cm and a cross section of side length $a=2$ cm and $b=4$ cm. If the average velocity is $V=2$ m/s and the fluid is SAE 10 oil ($\rho = 870$ kg/m³ and $\mu = 0.104$ kg/m·s) at 20°C, estimate the pressure drop.



3) (25 pts.) Water at 10 oC flows from a large reservoir (gravity-driven) to a smaller one through a 5-cm-diameter cast iron piping system as shown. Determine the elevation z_1 for a flow rate of 6 L/s



4) (25 pts.) A cross-flow plate-fin heat exchanger with square cross-section passages is to be used for balanced flow of air, providing an effectiveness of 70%. When the flow rate is 0.33 kg/s, the allowable pressure drop is 330 Pa. Determine the equations as a function of p , H , and L suitable for the exchanger. Evaluate fluid properties at 320 K and 1 atm, and neglect the thermal resistance of the plates and fins. Find the value of p if $H=L$. Hint: take $h_c = h_h$ and assume laminar fully developed with a friction factor of $f = (57.75 L \mu) / (2 \dot{m} p)$ and note that the perimeter of both streams is the same.

