

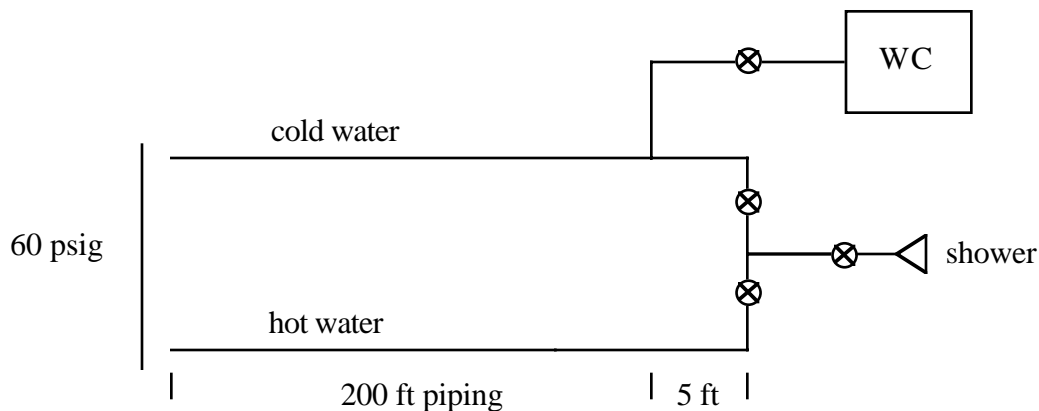
1. Consider the bathroom piping network depicted below. You are asked to determine the change in the outlet temperature of the shower head when the water closet is activated (a very practical problem considering the bathrooms in undergraduate dorms). The system is governed by the following parameters: The cold water stream is at 50°F and the hot at 160°F . Both feed into the piping network with a pressure of 60 psig. The resistance of the pipe prior to the cold water T is equivalent to 200 ft of pipe. The WC has a resistance equivalent to a gate valve either $1/4$ open ($K=20$) or fully closed. Under normal operating conditions, the shower hot water valve is a gate valve $1/2$ open ($K=4.4$) and the cold $1/2$ open. The shower head has a resistance equivalent to a gate valve $1/4$ open. All piping is smooth 1 in ID tubing. The contribution of both the cold and hot streams to the shower temperature is proportional to the flow rate of each stream. Make any simplifications or assumptions you feel are necessary to obtain a solution to this problem with a reasonable amount of effort (but state these assumptions clearly).

a. Develop the equations governing the flow rates in each of the streams

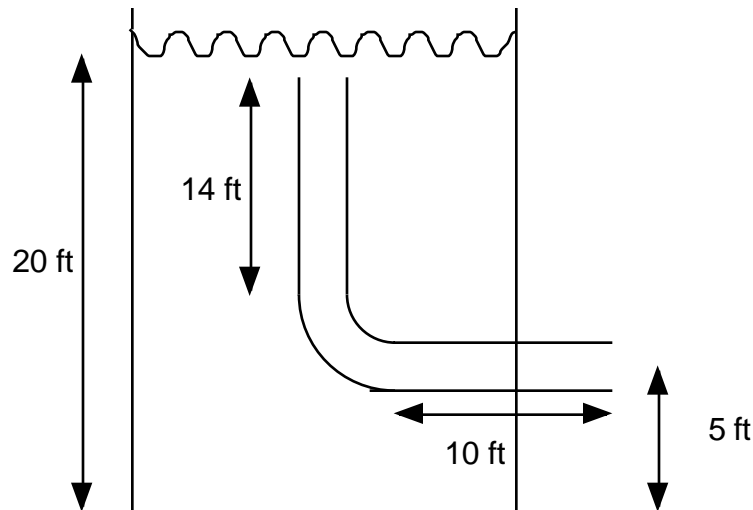
b. Adapt the solution from problem 20 of last semester to calculate the total flow rate and water temperature of the shower with the WC off. Calculate the same with the WC activated. (Hint: It doesn't take much adaptation!) The link is:

<http://www.nd.edu/~dtl/cheg258/notes/l22/notes.html>

c. As an engineer, how would you improve the plumbing to reduce this temperature difference (and so avoid potential scalding)?



2. You are designing an overflow drain for a tank as depicted below. It is required that the pipe must handle a flow rate of 50 gal/minute. What is the minimum diameter of the drain pipe?



3. A recycle pump is installed on a CSTR as depicted below. Where should the pump be placed on the recycle stream? If we want to throttle the flow from the pump, where should the metering valve be placed? Briefly justify your answer.

