Problem Set 3

(1) Your new proportional controller arrives from eBay. On one end, the controller has an input port that is to be fed a signal that ranges from 0 to 100%. Beside it is a set point knob that ranges from 0 to 100%. At the other end is a port for the output signal, and a bias knob, both with the same range. In the middle is the gain knob, marked from 0 to 100, and a switch that makes the gain be either + or -.

You decide to check it out on the bench. You put the set point to 50% and supply a steady 50% signal to the input port. You turn the bias knob to 40%, and verify that the output is 40%.

a) You set the gain to 2 and drop the input to 45%. What happens to the output?
b) You set the gain to -2 and the input to 55%. What is the output?
c) You set the gain to 3 and arrange for the input to ramp from 50% to 80% over 10 minutes. When does the output hit a limit? What is it?
d) You set the gain to 50. At what input value does the output become 0?

(2) Well, they goofed again. You told them, as in the last paragraph of Section 3.15, to set the controller gain to be positive, but they managed to make it negative. Redo Figure 3.21-1 for negative gains. Explain what's happening in the closed loop when the controller gain has been given the wrong sign.

(3) Control the liquid level in a tank against inflow disturbances by manipulating the outlet flow. Use a proportional controller. Derive the equation to describe closed-loop response. Present the special case of a step disturbance.