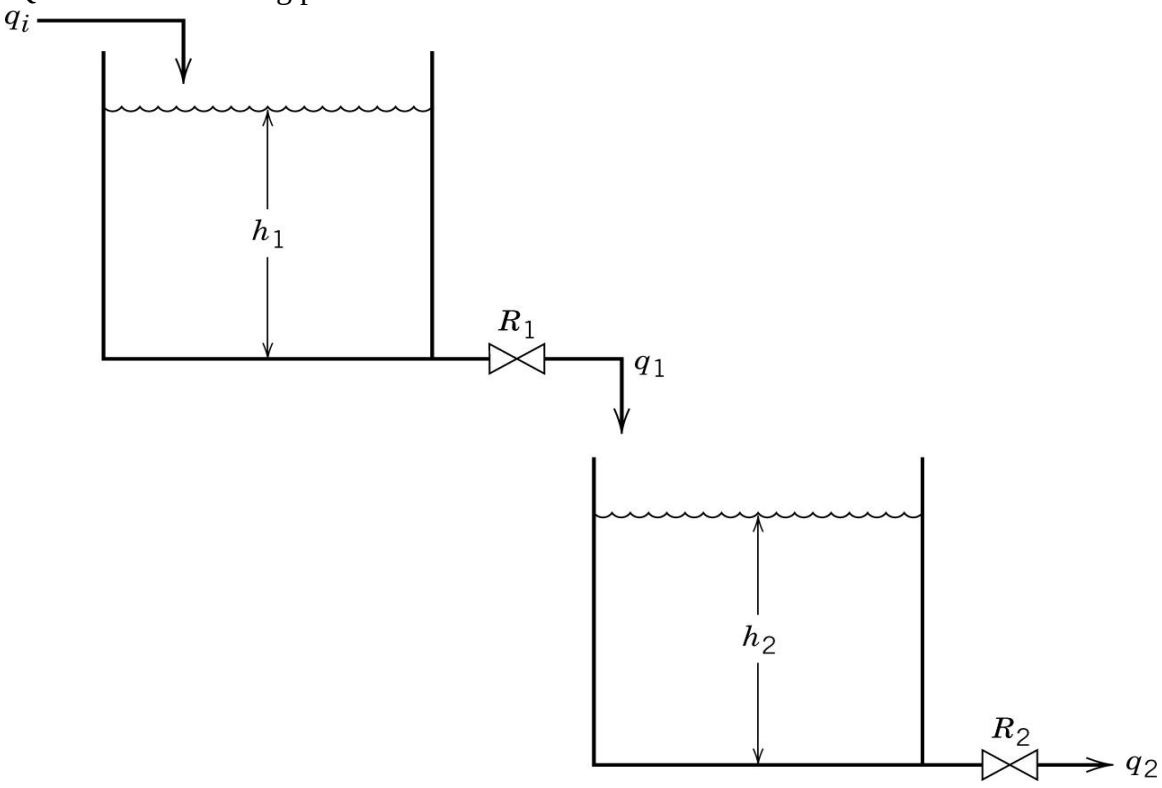
Q.1 For the following process



a) Find the transfer function relating changes in flow rate from second tank, Q_2'(s), to changes in flow rate into the first tank, Q_i'(s). Assume that the two tanks have different cross-sectional areas A_1 & A_2 and valves resistance R_1 and R_2. Outlet flow rate from each tank is linear to the height of liquid in the tank.

b) Show how this transfer function is related to the individual transfer functions, $H_1(s)/Q_i(s)$, $Q_1(s)/H_1(s)$, $H_2(s)/Q_1(s)$, and $Q_2(s)/H_2(s)$

Q.2 For the process modeled by

$$2\frac{dy_1}{dt} = -2y_1 - 3y_2 + 2u_1$$

$$\frac{dy_2}{dt} = 4y_1 - 6y_2 + 2u_1 + 4u_2$$

Find the four transfer functions relating the outputs (y1, y2) to the inputs (u1, u2). The u and y are the deviation variables.

Q.3 Consider the following transfer function:

$$G(s) = \frac{Y(s)}{U(s)} = \frac{5}{10s+1}$$

a) What is the steady-state gain?
b) If U(s) = 2/s, what is the value of output y(t) when t approaches infinity?
c) For the same U(s), what is the value of output when t = 10? What is the output when expressed as a fraction of the new steady-state value?
d) If u(t) is the unit impulse at t = 0, what is the output when t approaches infinity?