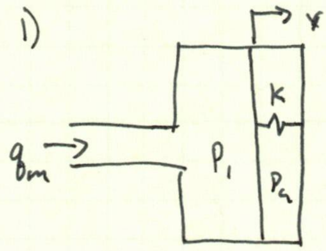
Diego Colón

1)



$\sum F_x = P_1 A - P_a A - Kx = 0$

$C\dot{P}_1 = (q_m)_{in} - (q_m)_{out}$

$A\dot{P}_1 - \underline{K}\dot{x} = 0$

$$C \frac{K}{A}\dot{x} = q_m$$

$$C = \frac{q_m}{K/A\,\dot{x}} = \frac{q_m A}{K\dot{x}}$$

$$\boxed{C = \frac{A q_m}{K\dot{x}}}$$

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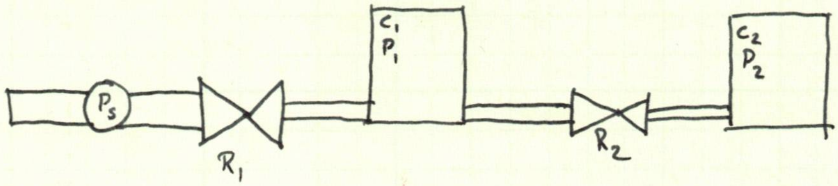
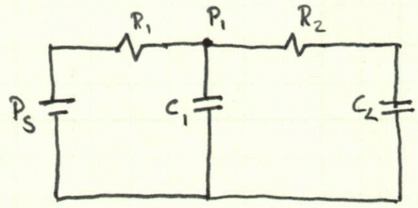
2)

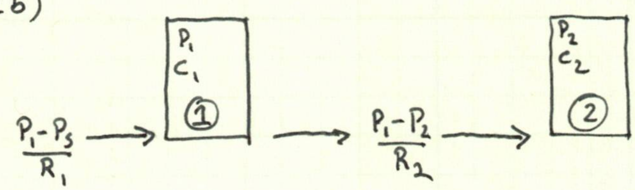


$\dot{m} = C\dot{p}$

2a)



2b)



1: $\dot{m}_1 = C_1 \dot{p}_1$

$$\frac{P_s - P_1}{R_1} - \frac{P_1 - P_2}{R_2} = C_1 \dot{P}_1$$

$$C_1 \dot{P}_1 - \left(\frac{1}{R_1} + \frac{1}{R_2}\right) P_1 = -\left(\frac{P_s}{R_1} + \frac{P_2}{R_2}\right)$$

2: $\dot{m}_2 = C_2 \dot{p}_2$

$$\frac{P_1 - P_2}{R_2} = C_2 \dot{P}_2$$

$$C_2 \dot{P}_2 + \frac{1}{R_2} P_2 = \frac{P_1}{R_2}$$

$$\boxed{\begin{aligned} C_1 \dot{P}_1 + \left(\frac{1}{R_1} + \frac{1}{R_2}\right) P_1 &= \frac{P_s}{R_1} + \frac{P_2}{R_2} \\ C_2 \dot{P}_2 + \frac{1}{R_2} P_2 &= \frac{P_1}{R_2} \end{aligned}}$$

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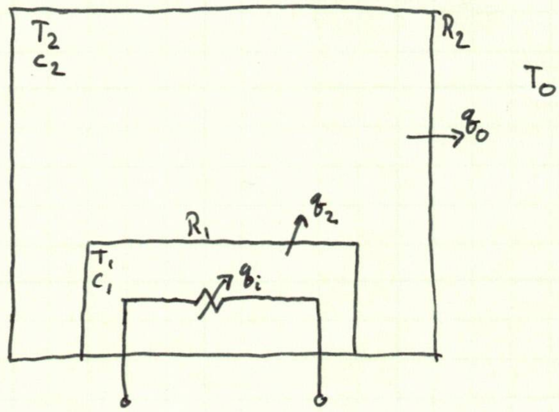
3)



$$C\dot{T} = q_{in} - q_{out}$$

$$q = \frac{1}{R}\,dT$$

$$C_1\dot{T}_1 = q_i - \frac{1}{R_1}(T_1 - T_2) \longrightarrow C_1\dot{T}_1 + \frac{1}{R_1}T_1 = q_i + \frac{1}{R_1}T_2$$

$$C_2\dot{T}_2 = \frac{1}{R_1}(T_1 - T_2) - \frac{1}{R_2}(T_2 - T_o) \longrightarrow C_2\dot{T}_2 + \left(\frac{1}{R_1} + \frac{1}{R_2}\right)T_2 = \frac{1}{R_1}T_1 + \frac{1}{R_2}T_o$$

If C_2 were a really small number, the increase in temperature $\dot{T}_2$ would have to be really large to balance and keep equality.

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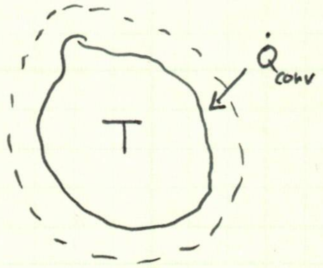
4



T_∞ $\rho, \forall, c_p, A, h$

$E_{sensor} = \rho c_p \forall (T_\infty - T_0)$ $\dot{E} = -\frac{1}{R}(T_\infty - T_0)$

$\dot{E}_{sensor} = \dot{Q}_{conv}$

$\rho \forall c_p \dot{T} = hA(T_\infty - T)$

$$\boxed{\frac{\rho \forall c_p}{hA} \dot{T} = T_\infty}$$

$$\boxed{\tau = \frac{\rho \forall c_p}{hA}}$$

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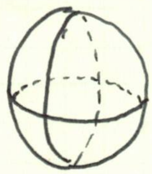
5)



$D = 25E\text{-}3\,m$
$T_S = 95°C$
$\rho_s = 7920\ kg/m^3$
$c_p = 500\ J/kg°C$

$T_A = 22°C$

$$\dot{E} = -\frac{1}{R}[T_S - T_A]$$

$$\rho c_p V \dot{T}_S = -\frac{1}{R}[T_S - T_A] \quad ; \quad R = \frac{1}{hA}$$

$$\rho c_p V \dot{T}_S = -hA[T_S - T_A]$$

$$h = \frac{\rho c_p V \dot{T}_S}{A[T_A - T_S]} \quad , \quad V = \frac{4}{3}\pi\left(\frac{D}{2}\right)^3 \quad , \quad A = 4\pi\left(\frac{D}{2}\right)^2$$

$$h = \frac{1}{6}\frac{\rho D c_p \dot{T}_s}{[T_A - T_s]}$$

$\rho = 7920\ kg/m^3$
$D = 25E\text{-}3\ m$
$c_p = 500\ J/kg°C$
$T_S = 76°C$
$T_A = 22°C$
$\dot{T}_S = -0.05\ °C/s$

$$h = \cancel{0.387}\ 15.27\ \frac{W}{m^2°C}$$

$$\boxed{h = 15.27\ W/m^2°C}$$