1. Problem 1

$$\mathrm{A} \rightarrow \mathrm{B} + \mathrm{C}$$

(a)

$$\delta = 1$$

No pressure drop

$$\begin{aligned} C_A &= C_{A0}\left(\frac{1-X}{1+X}\right)\frac{T_0}{T} \\ -r'_A &= k(T)C_A \end{aligned}$$

Design equation

$$\begin{aligned} \frac{dX}{dW} &= \frac{-r'_A}{v_0 C_{A0}} \\ \frac{dX}{dW} &= \frac{k(T)C_{A0}\left(\frac{1-X}{1+X}\right)\frac{T_0}{T}}{v_0 C_{A0}} \\ \frac{dX}{dW} &= \frac{k(T)}{v_0}\left(\frac{1-X}{1+X}\right)\frac{T_0}{T} \\ k(T) &= 0.133\exp\left[\frac{E}{R}\left(\frac{1}{450}-\frac{1}{T}\right)\right] \\ \frac{dX}{dW} &= \frac{0.133\exp\left[\frac{E}{R}\left(\frac{1}{450}-\frac{1}{T}\right)\right]}{v_0}\left(\frac{1-X}{1+X}\right)\frac{T_0}{T} \end{aligned}$$

Solve the differential equation with the following parameters

$$\begin{aligned} E &= 31400 \\ T_0 &= 450 \\ R &= 8.314 \\ v_0 &= 20 \end{aligned}$$

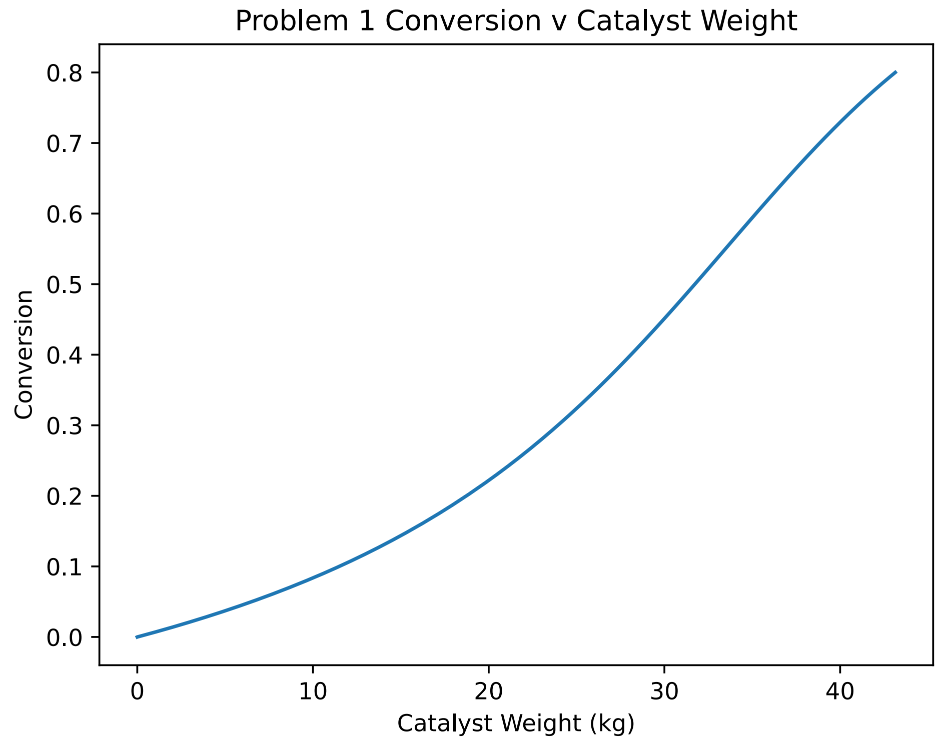
Temperature dependence

$$\begin{aligned} T &= \frac{X\left[-\Delta H^\circ_{\mathrm{Rx}}(T_R)\right] + \sum \Theta_i C_{P_i} T_0 + X\Delta C_P T_R}{\left[\sum \Theta_i C_{P_i} + X\Delta C_P\right]} \\ \Delta C_P = 15 + 25 - 40 &= 0 \\ \sum \Theta_i C_{P_i} = 0\cdot 15 + 0\cdot 25 + 1\cdot 40 &= 40 \\ H^\circ_{\mathrm{Rx}}(T_R) = -40000 - 50000 + 70000 &= -20000 \\ T &= \frac{20000X + 40\cdot 405}{40} \end{aligned}$$

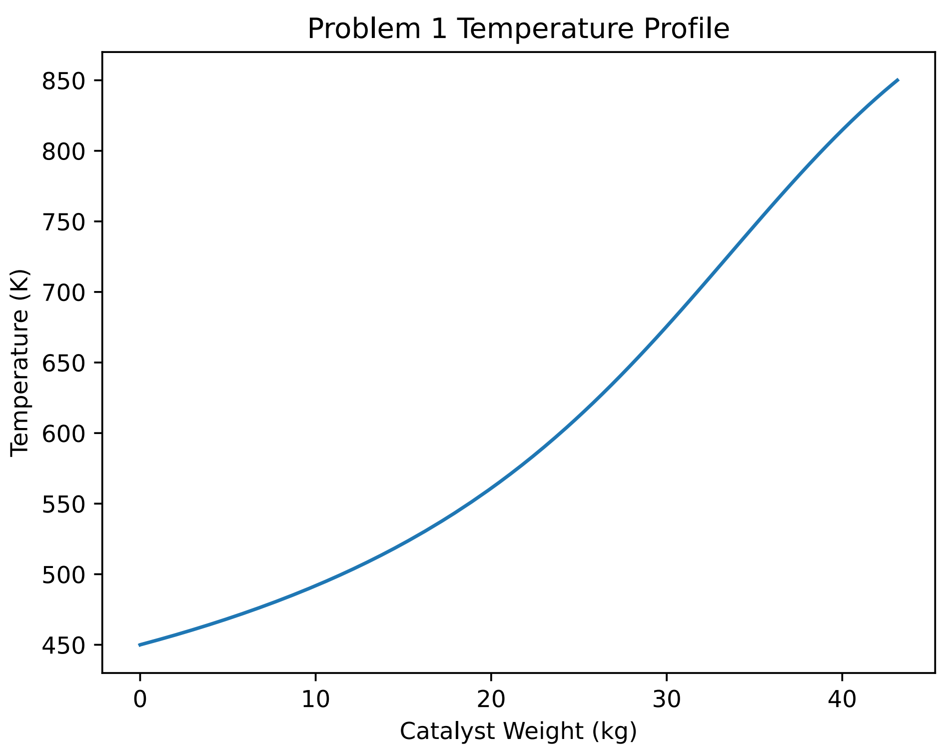
Use $T(X)$ to compue T in the differential equation

$$T = 450 + 500X$$

Conversion plot:




Temperature plot:




(b)

Heat analysis

$$\dot{Q} = F_{A0}\left(\sum \Theta_i C_{P_i}\left(T - T_{i0}\right) - X\left[H^\circ_{\mathrm{Rx}}(T_R) + \Delta C_P(T - T_R)\right]\right)$$
$$\dot{Q} = F_{A0}\left(C_{P_A}\left(T - T_{A0}\right) - X H^\circ_{\mathrm{Rx}}(T_R)\right)$$

2. Problem 1

$$E = mc^2$$

3. Problem 1

$$E = mc^2$$

4. Problem 1

$$E = mc^2$$