Problem 3: solution

By combining the molar balance for each component $j$, the rate law for each reaction $i$, and the ideal gas law, we obtain six differential equations where the independent variables is the volume $V$ and the dependent variables are the molar flux of each component, $n_j$:

$$\frac{dn_j}{dV} = f(V, n_j) = \frac{dn_j}{dV} = \sum_i \alpha_{ij} r_i$$

where:

$$r_i = k_i(T) \prod_j C_j^{\nu_{ij}}$$

$$C_j = \frac{n_j}{Q_v}$$

$$Q_v = \frac{RT}{p} \sum_j n_j$$

The following figure shows the evolution of the concentration of each component with the size (volume) of the reactor.