Consider Example 3.2.9 of your text (pp. 67-68). Use MATLAB to obtain the full numerical solution to the boundary value problem described by equations 3.2.195-3.2.200. Note that the boundary value solver bvp4c can only solve systems of first-order equations. Therefore you must recast this problem as a system of first-order equations. Use the following values for the constants in the problem:

\[
\begin{align*}
D_1 &= 1.99 \times 10^{-5} \text{ m}^2/\text{s} \\
D_2 &= 4.55 \times 10^{-6} \text{ m}^2/\text{s} \\
k &= 3.33 \times 10^{-3} \text{ m}^3/\text{mol.s} \\
C_{10} &= 1.2 \text{ mol/m}^3 \\
C_{2L} &= 0.8 \text{ mol/m}^3 \\
L &= 0.4 \text{ m}
\end{align*}
\]

(a) Submit a plot of the concentration profiles of species 1 & 2 in the film (on the same plot). Do they make sense qualitatively?
(b) Calculate the flux of species 1 at \( z = L \).
(c) How big must \( k \) become before the approximation of equations 3.2.207 – 3.2.209 becomes valid?
(d) How does the result of part (a) change if \( D_1 = 4.55 \times 10^{-7} \text{ m}^2/\text{s} \)? Is this result expected?