1. Solution to the in-class problem: Solve the initial value problem

\[ \cos(x) = (2y + e^{3y})y' \quad y(0) = 0. \]

First, replace \( y' \) with \( \frac{dy}{dx} \) to get

\[ \cos(x) = (2y + e^{3y}) \frac{dy}{dx}. \]

Separating variables and taking the integral of both sides, we get

\[ \int (2y + e^{3y}) dy = \int \cos(x) dx. \]

Integrating gives

\[ y^2 + \frac{1}{3} e^{3y} = \sin(x) + c. \]

Plugging in the initial condition, we see

\[ 0 + \frac{1}{3} = 0 + c \]

so that

\[ c = \frac{1}{3}. \]

Thus, our solution is

\[ y^2 + \frac{1}{3} e^{3y} = \sin(x) + \frac{1}{3}. \]

2. Reading question: Why do differential equations arising in mixing problems?

Mixing problems are primarily concerned with rates, and in particular functions which depend on rates. Since rates are derivatives, we naturally get differential equations.