1. Find a solution of the next initial value problem

\[ \frac{dy}{dx} = e^{3y} \sin 3x, \quad y(0) = 0. \]

Is this solution unique? Does it exist for all \( x \)? Explain.

2. A cup has been filled with coffee with initial temperature 210° F at 7:00 a.m. The coffee’s temperature was 180° F at 7:15 a.m. Room temperature is 70° F. Find the coffee’s temperature at 7:20 a.m.? (Hint: use Newton’s cooling law.)
3. Find a solution of the next initial value problem

\[ x^2 y' - 2xy = x^3, \quad y(1) = 0. \]

4. Find a general solution of the following differential equation

\[ (y \cos xy + e^{-x})dx + (x \cos xy + \frac{1}{1 + 2y})dy = 0. \]
5. Consider a differential equation

\[ \frac{dx}{dt} = x^2 - 4x + 3 \]

(a) Construct a sketch showing the nature of the solutions \( x(t) \). Find all equilibrium solutions. Determine stability or instability of each equilibrium solution.

(b) Find the solution satisfying the initial condition \( x(0) = 4 \).