1. (20 points) Solve the initial value problem
\[ 2y'' - 8y' - 10y = 0, \quad y(0) = -1, \quad y'(0) = 13. \]

2. (20 points) Consider the initial value problem (IVP)
\[ y' = y - x^2, \quad y(1) = 2. \]
   
   (a) (5 points) For this IVP, write down Euler’s method for \( y_{n+1} \) in terms of \( y_n \) for a general stepsize \( h \).
   
   (b) (5 points) Using one step of Euler’s method approximate \( y(4) \).
   
   (c) (10 points) Using three steps of Euler’s method approximate \( y(4) \).

3. (20 points) Find the general solution of the differential equation
\[ \frac{dy}{dx} = 2xy^3 + e^x \cos(y) - 3x^2y^2 + e^x \sin(y) + 1/y. \]

4. (20 points) Pure water flows at a constant rate of 4 L/min into a large tank that initially held 200 L of a brine solution. The solution inside the tank is kept well stirred and flows out of the tank at a rate of 1 L/min.
   
   (a) (4 points) How much solution is in the tank at time \( t \) minutes?
   
   (b) (16 points) If the tank originally held 2 kg of salt, determine the mass of salt in the tank after \( t \) minutes.

5. (20 points) Find the general solutions to the following differential equations:
   
   (a) (10 points)
\[ \frac{dy}{dx} = e^{2x-3y}. \]

   (b) (10 points)
\[ y'' + 18y' + 81y = 0. \]