1. Solve \( y' - 3y = t^2, \quad y(0) = 5 \)

2. Solve \( \frac{dy}{dt} + \frac{2}{t} y = t^2y^2 \)
3. Solve \((x + y)dx = (x - y)dy\)

4. Solve \(2 \sin y \cos x \, dx + \cos y \sin x \, dy = 0\)
5. Solve $2x + y^2 + 2xy \frac{dy}{dx} = 0$

6. Solve $(1 + t^2) \frac{dy}{dt} - \frac{1}{(t^2 + 1)^2} = -4ty, \quad y(1) = \pi$
7. Solve \( \frac{3y^2 + 2xy}{2xy + x^2} = \frac{dy}{dx} \)  

Hint: This equation is NOT exact but can be made exact by finding an appropriate integrating factor.
8. A medical lab initially has 1200 flour beetles and plans to use 60 flour beetles a month in its research. To assure a regular supply, it decides to grow its own beetles. Without harvesting, the population of flour beetles obeys the law \( y' = 0.06y \) where \( y(t) \) is the number of beetles in the population where \( t \) is measured in months.

a) Write the differential equation with the initial condition for the number of flour beetles in the population at time \( t \).

b) Solve it!

c) How long can this research go on? (i.e. When will the beetle population reach zero)
9. An 81 gallon tank is initially filled with 25 gallons of brine consisting of 5 lbs of salt. Brine containing \( \frac{1}{2} \text{lb of salt per gallon} \) enters the tank at a rate of 5 gallons per hour. The tank is well stirred and the mixture is allowed to flow out of the tank at a rate of 3 gallons per hour.

a) Write down the differential equation with the initial condition for the amount of salt in the tank at any time \( t \).

b) How much salt is in the tank at the instant the tank starts to overflow?
10. Use Euler’s Method to solve \( y' = 2t + y^2 \), \( y(0) = 1 \). Use \( h = 0.1 \); find the \( y \) values up to \( t = 0.3 \); do NOT round your numerical values. Fill in the following table:

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<tr>
<th>( n )</th>
<th>( t_n )</th>
<th>( y_n )</th>
<th>( y_n' = f(t_n, y_n) )</th>
<th>( y_{n+1} )</th>
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