1. Solve the initial-value problem:

\[ y' = \frac{1}{1 + t^2} + e^{3t} \quad y(1) = 0 \]

2. Show steps in computing the solution of

\[ ty' + 3y = t \]

which passes through the point \((2, 1/4)\).
Consider the differential equation \( y' = \frac{y^4}{3} \). Use it to answer the parts (a)-(d).

(a) Make a sketch showing the the equilibrium line and the behavior of solutions which begin above the equilibrium and those which begin below the equilibrium.

(b) Compute and sketch the solution which passes through the point \((1, 2)\).

(c) Find the point at which the solution you found in part (b) crosses the vertical line \( t = 2 \).

(d) Explain why a solution cannot go from one side of the horizontal \( t \)-axis to the other.
4 Draw a direction field for the differential equation $y' = t - y^2 + 2$. It is enough that you indicate the “bewhiskered” isoclines for $m = 0$, $m = 1$, and $m = -1$ all on one graph. Indicate the approximate shape of the solution of the initial-value problem

$$y' = t - y^2 + 2 \quad y(-1) = -1.$$ 

Do not solve this initial-value problem. Just indicate the shape of its graph.
Here are four direction fields.

Each of the following blanks corresponds to one of the above direction-field plots.

(A) ___  (B) ___  (C) ___  (D) ___

In each blank, enter the number of the best corresponding differential equation from this list:

(1) \( y' = y(1 - y) \)  \( \quad \)  (4) \( y' = y(y - 1) \)
(2) \( y' = (y - 1/10)^2(y - 1) \)  \( \quad \)  (5) \( y' = t(t - 1) \)
(3) \( y' = t(y - t) \)  \( \quad \)  (6) \( y' = (y - 1/5)(y - 1) \)
A huge tank contains 100 gal of a solution in which 50 lbs of salt has been dissolved. All of a sudden, they begin pumping a solution containing 1.5 lbs/gal of salt into the tank at a rate of 2 gal/min. Simultaneously, they begin drawing off well mixed solution at 1 gal/min from the tank.

Show steps in using a differential equation to determine a formula for the amount of salt in the tank $t$ minutes after the pumping begins.

If the tank has not overflowed after 100 min, how much salt does it contain?