

## Introduction to Differential Equations

### Assignment # 1

Date Given: April 11, 2022

Date Due: April 18, 2022

- P1.** (3 points) Draw a direction field for the differential equation  $y' = y(4 - y)$ . Based on the direction field, determine the behavior of  $y$  as  $t \rightarrow \infty$ . If this behavior depends on the initial value of  $y$  at  $t = 0$ , describe the dependency. Note that in this problem the equation is not linear (is not of the form  $y' = ay + b$ ), and the behavior of the solution is somewhat more complicated than for the equations in the text.
- P2.** (2 points) Draw a direction field for the differential equation  $y' = t + 2y$ . Based on the direction field, determine the behavior of  $y$  as  $t \rightarrow \infty$ . If this behavior depends on the initial value of  $y$  at  $t = 0$ , describe the dependency.
- P3.** (2 points) Solve each of the following initial value problems and plot the solutions for several values of  $y_0$ .
- (a)  $dy/dt = y - 5, \quad y(0) = y_0.$

Then describe in a few words the behavior of the solution.

- P4.** (3 points) Determine the order of the differential equation

- (a)  $(1 + y^2) \frac{d^2 y}{dt^2} + \frac{dy}{dt} + y = e^t;$
- (b)  $\frac{dy}{dt} + ty^2 = 0;$
- (c)  $\frac{d^3 y}{dt^3} + t \frac{dy}{dt} + y \cos^2 t = t^3;$

also state whether it is linear or nonlinear.