Name:_____
M555: Differential Equations I (Su.19)
Good Problems 1
Sections 1.1-3, 2.1-2

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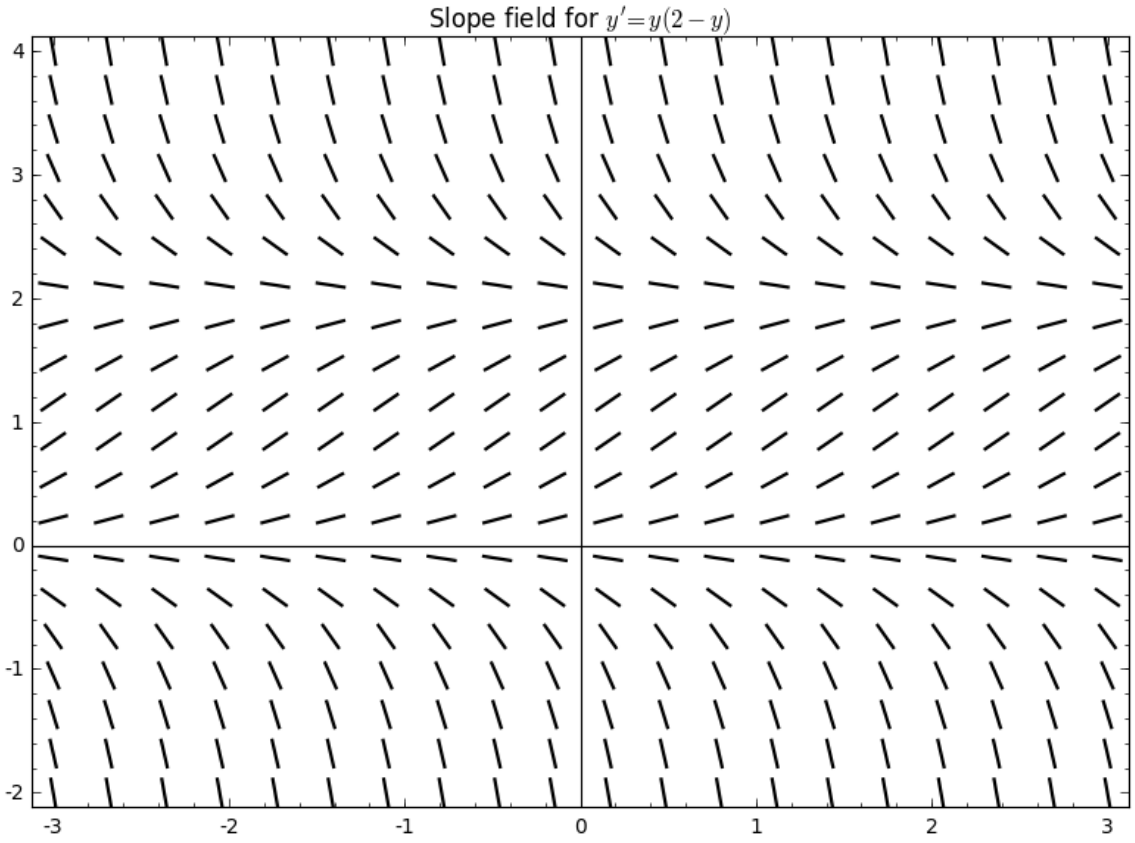
Instructions. Complete all problems, showing enough work. All work must be done on this paper. You may not use any notes or electronic devices. All you need is a pencil and your brain.

1. A field mouse population satisfies the differential equation

$$\frac{dp}{dt} = \frac{p}{2} - 450,$$

where p represents the population (in thousands) at time t (in years). If the initial population of field mice is $p(0) = 450$, find the time that the population will go extinct. Leave your answer in terms of a logarithm.

2. Given below is the slope field for the differential equation $y' = y(2-y)$. Plot and label the equilibrium solution(s), and sketch three non-equilibrium solution curves with distinctly different behavior.



Find the general solution of the DE. You do not need to solve for y explicitly.

3. Solve the initial value problem

$$\begin{cases} y' = \dfrac{3x^2}{2y-4}, \\ y(1) = 0. \end{cases}$$

What is the domain of the solution?

4. Solve the differential equation by making the change of variables $v = \frac{y}{x}$.

$$\frac{dy}{dx} = \frac{x^2 + xy + y^2}{x^2}$$

Be sure to give your solution in terms of x and y.

5. Solve the initial value problem

$$\begin{cases} y' = \dfrac{\cos t}{t^2} - \dfrac{2}{t} y, \\ y(\pi) = 0, \quad t > 0. \end{cases}$$