NAME: *Solutions*

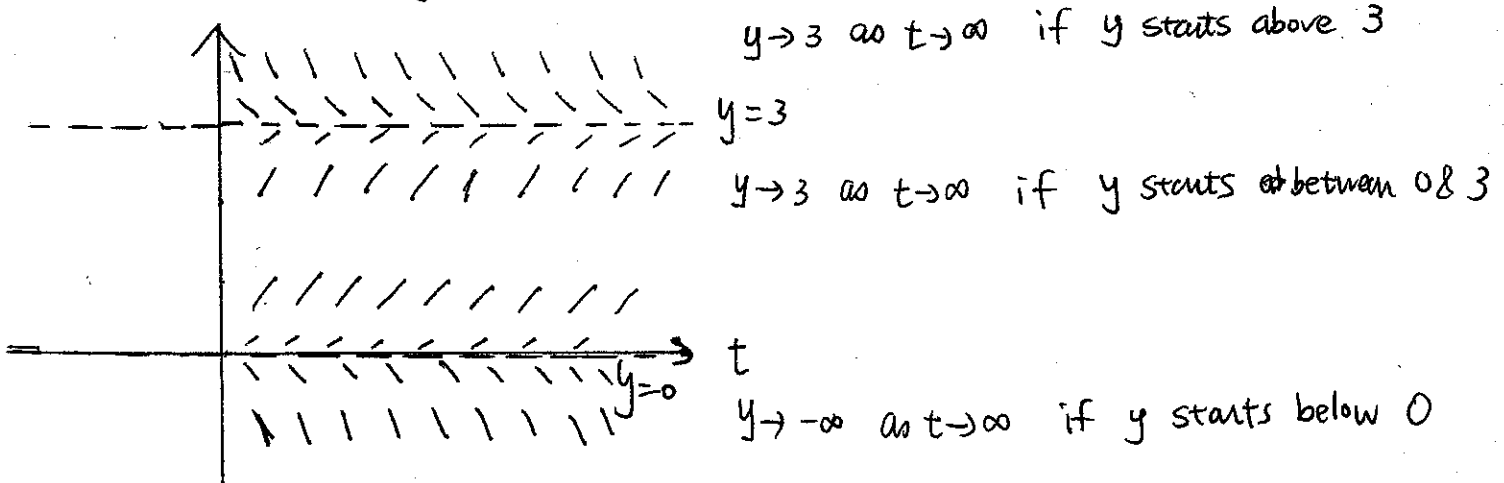### Math 222 Quiz Jan 27, Spring 2016
Show all your work. No calculator.

1. Problem 1. Draw a direction field for the differential equation $y' = y(3 - y)$ and describe the possible behavior of the solution as $t \to \infty$.

$$y' = \frac{dy}{dt} = y(3-y), \qquad y' = 0 \text{ when } y(3-y) = 0 \Rightarrow y = 0, 3$$

$$y < 0, \quad y' = y(3-y) < 0$$

$$0 < y < 3, \quad y' = y(3-y) > 0$$

$$3 < y, \quad y' = y(3-y) < 0$$

$y \to 3$ as $t \to \infty$ if y starts above 3

$y = 3$

$y \to 3$ as $t \to \infty$ if y starts between 0 & 3

$y = 0$

$y \to -\infty$ as $t \to \infty$ if y starts below 0

2. Problem 2. Determine the order of the given differential equation; also state whether the equation is linear or nonlinear.

   (a) $y'' + \sin(t + y) = \sin t$, 2nd order, nonlinear diff. eq.

   (b) $\frac{d^3y}{dt^3} + t\frac{dy}{dt} + \sin(t)y = t^3$, 3rd order, linear diff. eq.

   (c) $y' - ty^2 = 0$. 1st order, nonlinear diff. eq.