Math 266B **Guide for Test 3**

Here are some sample questions. Some topics that we covered are not represented by these questions, but are still fair game.

1. Solve each differential equation.

   (a) $\dfrac{dy}{dt} = 2\cos(3t)$, where $y(0) = 7$.

   (b) $\dfrac{dy}{dx} = 2y + 1$, where $y_0 = 3$ for $x_0 = 5$.

   (c) $\dfrac{dr}{ds} = \dfrac{\sin(s)}{e^r}$, where $s_0 = 5$ for $r_0 = 7$.

2. Solve the differential equation $\dfrac{dN}{dt} = 5(N-2)(N-3)$, where $N(0) = 7$.

3. Suppose we know that $\dfrac{dN}{dt} = N(N-1)(N-3)$. (Do **not** try to solve this equation.)

   (a) Find the equilibria, and classify each equilibrium as stable or unstable.

   (b) If $N(0) = 2$ then what value will $\lim_{t\to\infty} N(t)$ have? Justify your answer.

4. That one pond in your home town has become contaminated with a (soluble) polutant at concentration 3 grams/liter. The pond has volume of 50000 liters. Clean rainwater flows into the pond and the average flow rate of the stream leading out of its spillway is 4 liter/minute. How long will it take until the concentration lowers to 1 grams/liter?

5. Consider the difference equation

$$x_{t+1} = \frac{10x_t^2}{9 + x_t^2}\,.$$

   (a) Use the stability criteria to characterize the stability of its equilibria.

   (b) Use cobwebbing to decide to which value x_t converges as $t \to \infty$ if $x_0 = 0.5$, and if $x_0 = 3$.