Midterm 1 / 2011.10.13 / Calculus for the Biosciences / MAT 1193.005

Name: ____

Please show all work. Supply brief narration with your solutions and draw conclusions.

1. A researcher starts a bacterial culture in a petri dish. A day later the colony is 40 million strong. The next day it reaches 60 million. Assuming the growth is exponential, what was the initial size?

2. The level of a hormone varies according to $s(t) = 4 + 2\cos(0.4t)$ where time t is measured in months. Find and illustrate on a graph
   (a) Initial size and the size after a month.
   (b) The instantaneous rates of change at those two times.
   (c) The average rate of change during that period of time.

3. Find the derivatives of

$$\text{(a) } t3^{2^t} \qquad \text{(b) } \frac{\ln t}{\sqrt{t}}$$

4. Find the second derivative of $f(t) = \dfrac{1}{t^2+1}$ and use it to describe the curvature of the graph of f for $t \geq 0$.

5. A population x_t has *per capita* production $\dfrac{2}{x_t+1}$. Write down the discrete dynamical system for x_t. Find equilibria and do some cobwebbing on a graph to determine their stability. Find the derivative of the updating function. What are its values at each equilibrium? Describe in words what happens in the long run.

   Hint: $x_{t+1} = f(x_t)$, where the updating function f is the per capita production times the size.

1	2	3	4	5	total (50)	%

Prelim. course grade: %