

Name: _____

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

1. A population of three million bacteria is introduced into petri dish and grows exponentially, doubling in size every five hours. Write down the size of the culture as a function of time. When will the colony reach eighty million?
2. The size of tumor under treatment varies according to $s(t) = 5 + 2 \cos(0.1t)$ where time t is measured in days. Find and illustrate on a graph
 - (a) Initial size and the size after a week.
 - (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

(a) $2^{\sin(t^3)}$ (b) $\ln(t)/t$

4. Find the second derivative of $f(t) = t/(1 + t)$ 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 $x_t/(1 + x_t^2)$. Write down the discrete dynamical system for x_t . Find equilibria and use the slope criterion to determine their stability.

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: %