SB: Foundations of Calculus **Second Quiz, 7/19/2013**

Do all problems. Show your work. An answer alone may not receive full credit.

No texts, notes, or calculators may be used on this exam.

Problem 1 (8 points) Compute the exact value of the second derivative of $\sin(g(x))$ at $x = 2$, assuming that $g(2) = \frac{\pi}{3}$, $g'(2) = 5$, and $g''(2) = 3$.

Problem 2 (8 points) Compute the derivatives of the functions shown. In this problem, you may write only the answers and get full credit. *Please* do not "simplify" the answers!

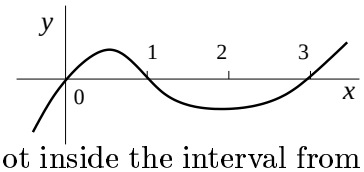
a) $5 + \dfrac{1}{x+3} - 17(\ln x)^6$

b) $e^{(x^2 \cos x)}$

Problem 3 (6 points) Suppose a population of bacteria grows at a rate directly proportional to the number of bacteria present at any time. If there are 30 bacteria at 9 AM and 100 bacteria at noon, what is the *doubling time* for this population of bacteria? Give your answer as well as you can in terms of values of standard functions.

Note The doubling time is the amount of time needed for the bacterial population to double (multiply by 2).

Problem 4 (6 points) A graph of a twice differentiable function f is shown to the right. (It is intended that the graph cross the horizontal axis at $x = 0$, $x = 1$, and $x = 3$.)



a) Explain why the equation $f'(x) = 0$ must have at least one root inside the interval from 0 to 1. Your explanation should be written in complete English sentences, and should use a specific result from this course, specifically indicating the relevance of the result.

b) Explain why the equation $f''(x) = 0$ must have at least one root inside the interval from 0 to 3. Your explanation should be written in complete English sentences, and should use a specific result from this course, specifically indicating the relevance of the result. Your conclusion from a) and other work may be used here.