

Math 201, Test #3B  
November 23, 2015

This test covers sections 3.7-3.10 and 4.1-4.2 of the textbook.

You may NOT use a calculator or any reference materials during this test.

**Read all instructions carefully!** Little credit, if any, will be given for a problem on which instructions are not followed.

**For each problem, *show your work*, and/or otherwise explain how you got your answer. Correct answers with insufficient justification may not receive full credit, and partial credit for incorrect answers can only be given based on work shown and/or written explanation.**

Please write all work and answers on this test, rather than using any separate sheets of paper. If you find that you need more space than what is provided, write any additional work on the back of the page.



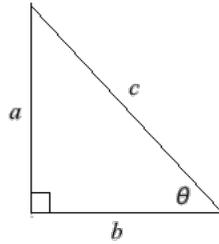
2. A bacteria culture initially contains 40 cells and grows at a rate proportional to its size. After one hour, the population has increased to 100 cells.

(a) Find an expression for the number of bacteria after  $t$  hours.

(b) After how many hours will the population reach 800? (Give an exact answer, not a decimal approximation. Note that a calculator is *not* necessary for this.)

(c) Find the doubling time for the bacteria culture. (As in part (b), give an exact answer, not a decimal approximation.)

3. In the right triangle shown in the diagram,  $a$ ,  $b$ , and  $c$  denote the lengths (in centimeters) of the three sides, and  $\theta$  denotes the measure of the acute angle opposite the side of length  $a$ .



Suppose  $a$  is increasing at a rate of 3 cm per second and  $b$  is increasing at a rate of 1 cm per second. At the moment when  $a = 6$ ,  $b = 8$ , and  $c = 10$ , find each of the following. Simplify each answer, and make sure to include the correct units of measurement.

NOTE: Your score on this problem will be based on your best two (out of three) parts. You will get *extra* credit if (and only if) you get all three parts completely correct.

(a) The rate at which  $c$  is increasing.

(b) The rate at which the area of the triangle is increasing.

(c) The rate at which  $\theta$  is increasing.

4. Use a linear approximation (or differentials) to estimate the value of  $\sqrt{234}$ . (Hint:  $15^2 = 225$ )

5. Find the absolute minimum and maximum values of  $f(x) = 4 \sin^2(x) + 4 \cos(x)$  on  $[0, \pi/2]$

6. Let  $h(x) = 12x^{2/3} - x$ .

(a) Explain why  $h$  satisfies the hypotheses of the Mean Value Theorem on the interval  $[0,8]$ .

(b) Find a number,  $c$ , that satisfies the conclusion of the Mean Value Theorem for  $h$  on the interval  $[0,8]$ . (Note:  $8^{2/3}$  is a whole number; you should be able to find it without a calculator.)

(c) Explain why  $h$  does *not* satisfy the hypotheses of the Mean Value Theorem on the interval  $[-8,8]$ . Be specific!