

NAME _____ TA'S NAME _____

STUDENT ID _____ SECTION _____

Math 124C, 124D
Spring 2004

Midterm 1
April 20, 2004

Point totals are indicated in parentheses. You must show your work to receive credit.

(8) 1. Evaluate the following limits:

a. $\lim_{h \rightarrow 0} \frac{\sqrt{9+h} - 3}{h}$

b. $\lim_{t \rightarrow \infty} \sin^{-1} \left(\frac{t^2}{1+2t^2} \right)$

- (12) 2. Let $P(t)$ denote the population of a community of squirrels at time t in years after the year 1999. Suppose that

$$P(t) = \frac{4000}{1 + Ca^t},$$

where C and a are positive constants and $0 < a < 1$. Suppose also that the population of squirrels in 1999 ($t = 0$) was 1000, and the population of squirrels now ($t = 5$) is 2000.

- a. Determine the constants C and a . (Give exact answers.)
- b. When will the population of squirrels be 2500? (Give a decimal answer.)
- c. What is $\lim_{t \rightarrow \infty} P(t)$? (Give an exact answer.)

(10) 3. Let c be a constant and

$$g(x) = \begin{cases} x + c & x \leq 3 \\ cx^2 - 7 & x > 3 \end{cases}$$

- a. Find all constants c that make g continuous on $(-\infty, \infty)$.
- b. Now let

$$f(x) = \begin{cases} 2 + x & x < 0 \\ 4 + x & x \geq 0. \end{cases}$$

Find all constants c that make $g \circ f$ continuous on $(-\infty, \infty)$.

Note: You must explain why the values of c you have found make the functions continuous and why no other values of c will work.

- (10) 4. Let r be a real number.
- a. Find the equation of the tangent line to the curve $y = x^3 - x$ at the point where $x = r$.
 - b. For which values of r is this tangent line horizontal?

Note: You must show how you evaluate the limits involved; you will not receive credit for using formulas from a previous calculus course.