

Name: \_\_\_\_\_

**Mathematics 105**  
**Exam I**  
**October 9, 2009**

Problem	Possible	Actual
1	15	
2	15	
3	15	
4	20	
5	20	
6	15	
Total	100	

You must show all work to receive credit.

No electronic devices other than calculators are permitted.

Give exact answers (such as  $\ln 5$  or  $e^2$ ) unless requested otherwise.

1. Let  $f''(x) = 6x - 2$ .

(a) Explain why  $f(x)$  has only one inflection point.

(b) Find  $f(x)$  if  $f'(0) = 1$  and  $f(1) = 0$ .

2. Use the limit definition of the derivative to find  $f'(x)$  if  $f(x) = \frac{1}{x^2} + 10092009$ .

3. A function is positive, increasing, and concave up on the interval  $(-4, -2)$ . It is negative, increasing, and concave down on the interval  $(-2, 0)$ . It is positive, decreasing, and concave up on the interval  $(0, 2)$ . It is positive, decreasing, and concave up on the interval  $(2, 4)$ . Sketch a function satisfying this. Where must this function be discontinuous?

4. For each of the following evaluate or explain why it does not exist.

(a)  $\lim_{x \rightarrow 0} \frac{x}{x}$

(b)  $\lim_{x \rightarrow 0} \frac{|x|}{x}$

(c)  $\lim_{h \rightarrow 0} \frac{(2+h)^6 - 2^6}{h}$

(d)  $\lim_{x \rightarrow 4} \frac{\sqrt{x} - 2}{x - 4}$

5. For which values of  $k$ , if any, does the function  $f(x) = (8x + k)/x^2$  have a local minimum at  $x = 4$ ?

6. Let  $f(x) = (x + 1)^2 + (x + 1) - \sqrt{x}$ .

(a) Use a difference quotient and the fact that  $f(3.99)$  is about 27.8926 to estimate  $f'(4)$ .

(b) What is the derivative of  $f(x)$ ?

(c) What is  $f'(4)$ ? Does your answer makes sense in light of part (a)?