

## Exam 1

Name:

Section Time (circle):

7:45 (Medini)    8:50 (Beros)    8:50 (Georgiou)    9:55 (Georgiou)    9:55 (Medini)  
11:00 (Kumar)    12:05 (Kumar)    1:20 (Lien)    2:25 (Lien)    3:30 (Beros)

**You must explain all your work to receive credit for your answers**

**No calculators are permitted (or necessary) on this exam.**

**These problems are not arranged in ascending order of difficulty. Work them in an order that will maximize your score. If you need more space, use the back of the page. *Good luck!***

Problem	Score	Problem	Score
1		5	
2		6	
3			
4		Total	

1. (a) [8 points] Compute the following limit:  $\lim_{x \rightarrow -2} \frac{x^3 + 4x^2 + 4x}{x^2 - 4}$

- (b) [10 points] Find all the vertical and horizontal asymptotes of the following function:

$$f(x) = \frac{3x^2 + 6x + 3}{x^2 + 3x + 2}$$

2. [10 points] Using the definition of derivative, compute the derivative of  $f(x) = x$ .

3. Compute the following derivatives using any of the rules we've learned:

(a) [10 points]  $f(x) = \frac{\ln x}{x^2 + 1}$

(b) [10 points]  $f(x) = e^{x \ln x}$

4. [12 points] Suppose that the position of a particle moving along the  $x$ -axis is given by

$$x(t) = 2 + \frac{-2}{1 + e^{t-1}}.$$

Find the time at which the velocity of the particle is the greatest.

5. Let  $f(x) = x \ln x$ .

(a) [10 points] Find the critical points of  $f$ , and the intervals on which  $f$  is increasing and decreasing (note that  $f$  is only defined on  $(0, \infty)$ ).

(b) [10 points] Find the intervals on which  $f$  is concave up and concave down. Also find the inflection points of  $f$ , if any.

6. Suppose that a company loses money throughout an entire year. Let  $f(t)$  be the amount of money (in thousands) the company has after  $t$  months.

(a) [5 points] What is the sign of  $f'(t)$  during the year in question? Say briefly why your answer is correct.

(b) [5 points] At the end of 6 months, the company is losing money at the rate of 9,000 dollars per month. Write an equation (using a derivative) that expresses this fact.

(c) [10 points] Suppose that  $f(t) = (1/12)t^2 - 10t + 300$ . How much money does the company have at the end of 12 months, and how fast is it losing money at that moment?