## Math 111 Final Exam December 19, 2016 Problem(s)

	Problem(s)	Score	Total
Time:2 hour and 30 minutes			
<b>Instructions:</b> Show all work for full credit.			
No outside materials of calculators allowed.			
for extra space. Clearly label when doing so.			
Name:			
<b>ID</b> #:			
Instructor/Section:			
"I pledge by my honor that I have abided by the			
NJIT Academic Integrity Code."			
(Signature)			
1. Find the area enclosed by the curves			

y = 2x and  $y = x^2$  (5 points)

- 2. Consider the function  $y = e^{-x^2}$ 
  - a. Find and classify any critical points (**3 points**)
  - b. Find any asymptotes and analyze the end behavior of the function (2 points)
  - c. Find any points of inflection and the intervals that the function is concave up or concave down. (**3 points**)
  - d. Sketch a graph of this function using the information above (3 points)

3. Use optimization techniques to determine the point(s) on the graph of  $y = x^2 + 1$  that are closest to the point (0,2) (5 points)

4. Find the absolute maximum and absolute minimum of the function  $y = (x + 1)^{4/3}$  on the range  $-9 \le x \le 0$ . (5 points)

5. Suppose that  $f(x) = \sec(x)\sin(x)$ . Find the equation of the tangent line to f(x) at the point on the curve where  $x = \pi/6$  (5 points)

6. Find the average value of the function  $y = \frac{3x}{(x^2+1)^2}$  over the range  $0 \le x \le 2$  (3 points)

- 7. Evaluate the following integrals (6 points): a.  $\int \sin(\pi x) \cos(\pi x) dx$

b. 
$$\int \frac{(2x-\sqrt{x})^2}{\sqrt{x}} dx$$

8. Evaluate the following integrals (9 points):

a. 
$$\int \frac{e^{3x}}{3e^{-x}} dx$$

b. 
$$\int_0^1 \frac{e^x}{e^{x+1}} dx$$

c. 
$$\int \frac{\ln(x)}{x} dx$$

9. Evaluate the following limits (**16 points**). a.  $\lim_{x\to 0} x \csc(x)$ 

c. 
$$\lim_{x \to \infty} \frac{x^2}{xe^{-x}}$$

b. 
$$\lim_{x \to 9} \frac{\sqrt{x}-3}{x-9}$$

d.  $\lim_{x \to 0} \frac{\tan(3x)}{x}$ 

10. Find the derivative y'(x) for the following (**12 points**): a. y = sin(3x)arcsin(3x) + 2C (where C is an unknown constant)

b.  $y = \tan\left[\sqrt[3]{1-x}\right]$ 

c. 
$$y = \frac{\ln(x)}{x^2 + 1}$$

- 11. A function f(x) is graphed, as shown below. Find the following (12 points):
  - a. Find  $\lim_{x \to 1} f(x)$  showing right and left limits
  - b. Find f(1) and state why or why not the function is continuous here.
  - c. Find  $\lim_{x\to 2} f(x)$  showing right and left limits
  - d. Find f(2) and state why or why not the function is continuous here.
  - e. Find the derivative f '(2.7)

f. 
$$\int_{2.5}^{3.5} f(x) dx$$



12. Suppose that an isosceles right triangle is slowly expanding outwards with both legs of the triangle increasing at a rate of 10 cm/min. At the moment that the legs are 2 cm, how fast is the hypotenuse increasing in length? Fully simplify your answer. (5 points)

13. Find the derivative y'(x) for the following (8 points): a.  $y = x^2y^2 + e^{5x}$ 

b. 
$$y = x^x$$