

**Math 103**  
**Final Exam – Spring 2009**  
**May 7, 2009**

7 points  
each

**Part 1: Multiple Choice**

In each of the following questions, circle the correct answer. For full credit, work must be shown. A correct answer without supporting work will receive no credit.

1. If  $f(x) = e^{-x^2}$ , then  $f''(0) =$

- A) 2            C)  $\frac{2}{e}$             E)  $\frac{1}{e}$             G) 1  
B) -2           D) 0            F)  $e$             H) None of these
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2.  $\int_{\pi/4}^{\pi/3} \sin^3(t) \cos(t) dt =$

- A)  $\frac{1}{16}$             C)  $\frac{5}{16}$             E)  $\frac{-3}{64}$             G)  $\frac{3}{16}$   
B)  $\frac{5}{32}$             D)  $\frac{9}{16}$             F)  $\frac{5}{64}$             H) None of these
- 

3. The value of  $c$  for which  $f(x) = x + \frac{c}{x}$  has a local minimum at  $x = 3$  is

- A) 4            C) -9            E) -3            G) 6  
B) 3            D) -6            F) 9            H) None of these
- 

4. The hypotenuse  $AB$  of a right triangle  $ABC$  remains constant at 5 feet as both legs are changing. One leg,  $AC$  is decreasing at the rate of 2 feet per second. In order for the hypotenuse to remain 5 feet, the other leg  $BC$  is increasing. The rate, in square feet per second, at which the **area** is changing when  $AC = 3$  is

- A)  $\frac{25}{4}$             C)  $\frac{7}{2}$             E)  $\frac{-3}{2}$             G)  $\frac{-7}{4}$   
B)  $\frac{3}{2}$             D)  $\frac{-7}{2}$             F)  $\frac{7}{4}$             H) None of these
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5. Suppose  $f(3) = 2$ ,  $f'(3) = 5$ , and  $f''(3) = -2$ . Let  $g(x) = [f(x)]^2$ . Then  $g''(3) =$

- A) 42      C) 21      E) 5      G) -20  
B) 20      D) 10      F) 38      H) None of these
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6. The velocity of a particle in motion along a line is  $v(t) = \ln(2 - t^2)$  for  $t$  in  $[0, \sqrt{2})$ .

Find the acceleration when the object is at rest.

- A) 0      C) -2      E)  $-\frac{1}{2}$       G) -1  
B) 2      D)  $\frac{1}{2}$       F) 1      H) None of these
- 

7. If  $x^2 - xy + y^3 = 13$ , then find  $\frac{dy}{dx}$  evaluated at  $(4, 1)$ .

- A) 0      C)  $\frac{3}{2}$       E)  $\frac{7}{2}$       G)  $\frac{9}{7}$   
B) -2      D) -1      F) 9      H) 7
- 

8. The relative maximum value of the function  $y = \frac{\ln x}{x}$  is

- A) 1      C)  $\frac{1}{e}$       E)  $e$       G)  $\frac{1}{e^2}$   
B) 0      D)  $\frac{2}{e}$       F)  $\frac{e}{2}$       H) None of these

9. Evaluate  $\lim_{x \rightarrow 0} \frac{8x}{\sin(4x) + 2 \tan(x)}$ .

- A)  $\frac{4}{3}$       C)  $\frac{1}{2}$       E)  $-\frac{1}{2}$       G) undefined  
B) 2      D) 4      F) 0      H) None of these
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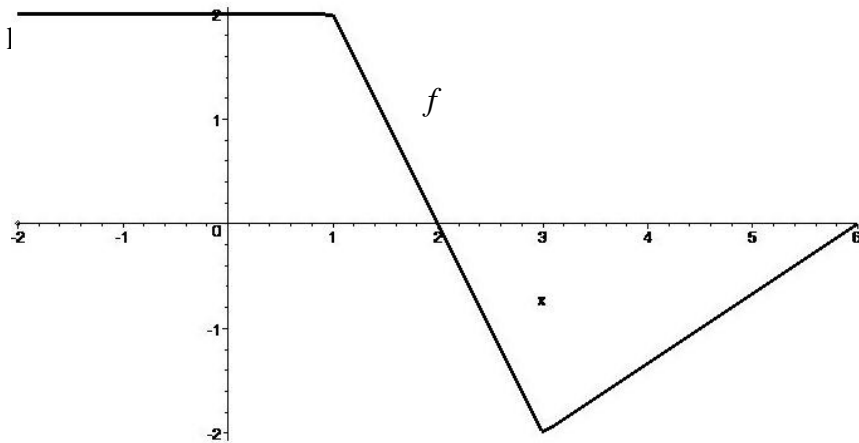
10. Evaluate  $\int_e^{e^9} \frac{1}{x\sqrt{\ln x}} dx$ .

- A) 16      C) 3      E) 5      G) 8  
 B) 2      D) 4      F) 6      H) None of these
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**Part 2: Free Response**

10 points  
each

In each of the following questions, answer the subsequent parts. For full credit, work must be shown. A correct answer without supporting work will receive no credit.



11. The figure above shows the graph of  $f$ , whose domain is the closed

interval  $[-2, 6]$ . Let  $F(x) = \int_1^x f(t) dt$ .

- a) Find  $F(-2)$  and  $F(6)$ .
- b) For what values of  $x$  is  $F$  increasing?
- c) Find the maximum value and minimum value of  $F$ .

12. An open rectangular box has one side of its base 4 feet long and is to have a volume of 200 cubic feet. Find the dimensions for which the amount of material needed to construct the box is as small as possible.

13. A particle is moving on a straight line. The velocity of the particle for  $0 \leq t \leq 30$  is shown in the table below for the selected values of  $t$ .

$t$ (sec.)	0	3	6	9	12	15	18	21	24	27	30
$v(t)$ (m/sec)	0	7.5	10.1	12	13	13.5	14.1	14	13.9	13	12.2

a) Using the midpoints of five subintervals of equal length, find the approximate

value of  $\int_0^{30} v(t) dt$ .

b) During what intervals of time is the acceleration negative?

**ANSWERS:**

**1. B**

**2. F**

**3. F**

**4. G**

**5. A**

**6. C**

**7. H**

**8. C**

**9. A**

**10. D**

**11.**

a)  $F(-2) = 6, F(6) = -3$     b)  $(-2, 2)$

c) Max. value of  $F$ : 1

Max. value of  $F$ : -6

**12. 10' x 4' x 5'**

**13. a) 360 m.    b) (18,30)**