

Math 103

Final Exam – Spring 2009

May 7, 2009

Part 1: Multiple Choice

7 points
each

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
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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
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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
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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
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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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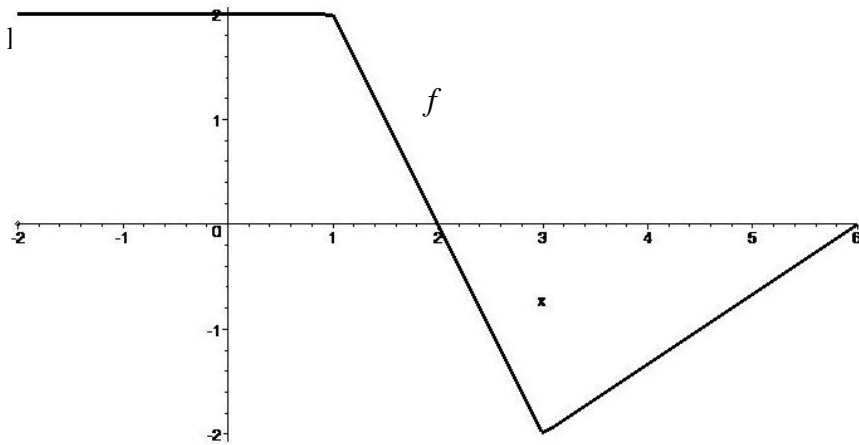
10. Evaluate $\int_e^{e^9} \frac{1}{x\sqrt{\ln x}} dx$.

- 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)