MA 123 — Elementary Calculus Fall 2009
FINAL EXAM 12/14/2009

Name: _____ **Sec.:** _____

Do not remove this answer page — you will return the whole exam. You will be allowed two hours to complete this test. No books or notes may be used. You may use a graphing calculator during the exam, but NO calculator with a Computer Algebra System (CAS) or a QWERTY keyboard is permitted. Absolutely no cell phone use during the exam is allowed.

The exam consists of 15 multiple choice questions. Record your answers on this page by filling in the box corresponding to the correct answer. For example, if (b) is correct, you must write

[a] [**b**] [c] [d] [e]

Do not circle answers on this page, but please do circle the letter of each correct response in the body of the exam. It is your responsibility to make it CLEAR which response has been chosen. You will not get credit unless the correct answer has been marked on both this page and in the body of the exam.

GOOD LUCK!

1. [a] [b] [c] [d] [e]

2. [a] [b] [c] [d] [e]

3. [a] [b] [c] [d] [e]

4. [a] [b] [c] [d] [e]

5. [a] [b] [c] [d] [e]

6. [a] [b] [c] [d] [e]

7. [a] [b] [c] [d] [e]

8. [a] [b] [c] [d] [e]

9. [a] [b] [c] [d] [e]

10. [a] [b] [c] [d] [e]

11. [a] [b] [c] [d] [e]

12. [a] [b] [c] [d] [e]

13. [a] [b] [c] [d] [e]

14. [a] [b] [c] [d] [e]

15. [a] [b] [c] [d] [e]

For grading use:

number of correct problems	**(out of 15)**
Total	**(out of 100 pts)**

Please make sure to list the correct section number on the front page of your exam.
In case you forgot your section number, consult the following table:

Section #	**Instructor**	**Lectures**
001	P. Koester	MWF 8:00 am - 8:50 am, CP 153
002	P. Koester	MWF 12:00 - 12:50 pm, BS 107
003	T. Chapman	TR 8:00 am - 9:15 am, CP 153
004	M. Shaw	MWF 2:00 pm- 2:50 pm, BS 107
005	M. Shaw	MWF 1:00 pm-1:50 pm, BS 107
006-009	D. Leep	MWF 10:00 am - 10:50 am, CB 114
401	D. Little	TR 6:00 pm-7:15 pm, CB 347
402	D. Little	TR 7:30 pm-8:45 pm, CB 347

Multiple Choice Questions

Show all your work on the page where the question appears.
Clearly mark your answer both on the cover page on this exam
and in the corresponding questions that follow.

1. Find the equation of the tangent line to the graph of the function $y = \dfrac{9}{x}$ at the point $x = 3$.

Possibilities:

(a) $y = 3x + 3$

(b) $y = 6x - 1$

(c) $y = -x + 6$

(d) $y = x - 6$

(e) $y = -6x + 3$

---

2. Find

$$\int_1^2 (12x^2 + 12x^{-2})\, dx.$$

Possibilities:

(a) 31

(b) 32

(c) 33

(d) 34

(e) 35

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3. Suppose that $f(x) = \begin{cases} 12 - x^2 & \text{if } x \leq 4 \\ 2x - 3 & \text{if } x > 4. \end{cases}$

Find $\lim\limits_{x \to 4^+} f(x)$.

Possibilities:

(a) 4

(b) 5

(c) 6

(d) 7

(e) 8

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4. Suppose that $f(x) = 2\sqrt{x^2+9}$. Find

$$\lim_{h\to 0} \frac{f(4+h)-f(4)}{h}.$$

Possibilities:

(a) 1.2

(b) 1.3

(c) 1.4

(d) 1.5

(e) 1.6

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5. What is the largest possible product you can form from two non-negative numbers x, y that satisfy the relation $x^2 + y = 48$.

Possibilities:

(a) 122

(b) 124

(c) 126

(d) 128

(e) 130

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6. Suppose that $h(x) = f(x)^3$ and that the equation of the tangent line to the graph of $y = f(x)$ at $x = 3$ is given by $y = 2 + 10(x-3)$. Find $h'(3)$.

Possibilities:

(a) 104

(b) 108

(c) 112

(d) 116

(e) 120

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7. Two quantities F and G are functions of time. Suppose that $F(t)G(t) = 12$ for all values of t. When $t = 4$, suppose that $F(4) = 2$ and $F'(4) = 6$. Then find $G'(4)$.

Possibilities:

(a) -15

(b) -16

(c) -17

(d) -18

(e) -19

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8. Find $f'(0)$ if $f(x) = \dfrac{e^{4x}}{2x^2 + 4}$.

Possibilities:

(a) $.2$

(b) $.4$

(c) $.6$

(d) $.8$

(e) 1

---

9. Find the maximum value of the function $f(x) = \dfrac{\ln(x)}{x}$ on the interval $[1/2, 50]$.

Possibilities:

(a) $1/e$

(b) 1

(c) e

(d) $e - 1$

(e) $e - 2$

---

10. A bacteria culture starts with $6,000$ bacteria and the population quadruples after 5 hours. Find an expression for the number $P(t)$ of bacteria after t hours.

Possibilities:

(a) $P(t) = 6000e^{(\ln(5)/4)t}$

(b) $P(t) = 6000e^{(\ln(4)/5)t}$

(c) $P(t) = 6000e^{(\ln(4)+5)t}$

(d) $P(t) = 6000e^{(\ln(5)+4)t}$

(e) $P(t) = 6000e^{5\ln(4)t}$

---

11. Find the intervals where the function $f(x) = x^3 + 3x^2 - 45x + 7$ is increasing.

Possibilities:

(a) $(-\infty, -5)$ and $(3, \infty)$

(b) $(-\infty, 3)$ and $(5, \infty)$

(c) $(3, 5)$

(d) $(-5, -3)$

(e) $(-\infty, -5)$ and $(-3, \infty)$

---

12. Suppose that the derivative $f'(x) = x^3 + 3x^2 - 45x + 7$. Find the intervals where the graph of the function $y = f(x)$ is concave downward.

Possibilities:

(a) $(-\infty, -5)$ and $(3, \infty)$

(b) $(-\infty, 3)$ and $(5, \infty)$

(c) $(-5, 3)$

(d) $(-5, -3)$

(e) $(-\infty, -5)$ and $(-3, \infty)$

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13. Suppose that $F(x) = \displaystyle\int_2^x \sqrt{t^2+t+1}\ dt$. Find $F'(6)$.

Possibilities:

(a) $\sqrt{43}$
(b) $\sqrt{7}$
(c) $\sqrt{43} - \sqrt{7}$
(d) $\sqrt{7} - \sqrt{43}$
(e) 11

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14. Find the limit

$$\lim_{n\to\infty} \frac{4+8+12+16+\cdots+4n}{n^2}.$$

Possibilities:

(a) 1
(b) 1.5
(c) 2
(d) 2.5
(e) 3

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15. Find

$$\int_0^1 3x^2 e^{x^3}\ dx.$$

Possibilities:

(a) $e+2$
(b) $e+1$
(c) e
(d) $e-1$
(e) $e-2$

Some Formulas

1. **Summation formulas:**

$$\sum_{k=1}^{n} k = \frac{n(n+1)}{2}$$

$$\sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}$$

2. **Areas:**

   (a) Triangle $A = \frac{bh}{2}$

   (b) Circle $A = \pi r^2$

   (c) Rectangle $A = lw$

   (d) Trapezoid $A = \frac{b_1 + b_2}{2}\, h$

3. **Volumes:**

   (a) Rectangular Solid $V = lwh$

   (b) Sphere $V = \frac{4}{3}\pi r^3$

   (c) Cylinder $V = \pi r^2 h$

   (d) Cone $V = \frac{1}{3}\pi r^2 h$