MA 113 Calculus I — Spring 2017
Exam 3 — Tuesday, April 11, 2017

Name: ____________________________

Section: ____________________________

Last 4 digits of student ID #: ________

This exam has five true/false questions (two points each), ten multiple choice questions (five points each) and four free response questions (ten points each). Additional blank sheets are available if necessary for scratch work. No books or notes may be used. Turn off your cell phones and do not wear ear-plugs during the exam. You may use a calculator, but not one which has symbolic manipulation capabilities.

On the true/false and multiple choice problems:

1. You must give your *final answers* in the *front page answer box* on the front page of your exam.
2. Carefully check your answers. No credit will be given for answers other than those indicated on the *front page answer box*.

On the free response problems:

1. Clearly indicate your answer and the reasoning used to arrive at that answer *(unsupported answers may not receive credit)*,
2. Give exact answers, rather than decimal approximations to the answer (unless otherwise stated).

Each free response question is followed by space to write your answer. Please write your solutions neatly in the space below the question. You are not expected to write your solution next to the statement of the question.

True/False		
1	T	F
2	T	F
3	T	F
4	T	F
5	T	F

Multiple Choice					
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

Overall Exam Scores

Question	Score	Total
TF		10
MC		50
16		10
17		10
18		10
19		10
Total		100

Record the correct answer to the following problems on the front page of this exam.

1. True or False: In summation notation, $5 + 10 + 17 + 26 + 37 = \sum_{i=2}^{6}(i^2 + 1)$.

2. True or False: If $f'(x) = 2x + 1$ and $f(0) = 2$, then $f(x)$ must be $x^2 + x + 2$.

3. True or False: If $f'(c) = 0$ and $f''(c) < 0$, then f is concave up at c.

4. True or False: If the temperature of a piece of metal triples every hour, then after three hours the temperature is 81 times the initial temperature.

5. True or False: If $f(x)$ is a polynomial, then $f'(0) \neq 0$.

6. The solution to

$$\frac{dy}{dt} = 3(y - 2)$$

satisfying $y(0) = 10$ is

(A) $y = 2 + 8e^{3y}$

(B) $y = 10e^{3y}$

(C) $y = 8e^{3y-6}$

(D) $y = e^{3y}$

(E) None of the above

Record the correct answer to the following problems on the front page of this exam.

7. Find

$$\lim_{x\to\infty} \frac{x^2 - x - 7}{2 + \sin(x)}.$$

   (A) $1/2$
   (B) $-\infty$
   (C) ∞
   (D) The limit does not exist.
   (E) None of the above.

8. The definite integral $\displaystyle\int_{2\pi}^{4\pi} \cos(x)\,dx$ is equal to

   (A) 1
   (B) $-\pi$
   (C) π
   (D) 0
   (E) None of the above

9. The estimate of the area under the curve $f(x) = x^3$ from $x = 0.5$ to $x = 1.5$ using four rectangles and right-hand endpoints is

   (A) 1.6875 and is an underestimate of the actual area.
   (B) 0.875 and is an underestimate of the actual area.
   (C) 1.6875 and is an overestimate of the actual area.
   (D) 0.875 and is an overestimate of the actual area.
   (E) None of the above.

Record the correct answer to the following problems on the front page of this exam.

10. Find two real numbers whose difference is 50 and whose product is the minimum possible among all such pairs.

    (A) $50, 0$
    (B) $15, -35$
    (C) $0, -50$
    (D) $30, -20$
    (E) None of the above

11. The expression $\lim_{n\to+\infty} \sum_{i=1}^{n} \left[\left(1+\frac{1}{n}\right) e^{\cos(1+\frac{1}{n})} \cdot \frac{1}{n} \right]$ equals

    (A) $\int_1^2 x e^{\cos(x)}\, dx$
    (B) $\int_0^1 x e^{\cos(x)}\, dx$
    (C) $\int_1^2 (1+x) e^{\cos(1+x)}\, dx$
    (D) $\int_0^3 x e^{\cos(x)}\, dx$
    (E) None of the above.

12. Find the most general antiderivative of $2x + x^{-1} - \cos(x) + e^x$

    (A) $x^2 - 1 + \sin(x) + e^x + C$
    (B) $x^2 - \ln(x) - \sin(x) + e^x$
    (C) $x^2 + \ln|x| + \sin(x) + e^x + C$
    (D) $x^2 + \ln|x| - \sin(x) + e^x + C$
    (E) None of the above

Record the correct answer to the following problems on the front page of this exam.

13. Compute the value of $\sum_{i=1}^{2}\sum_{j=3}^{6}(2i+j)$

    (A) 52

    (B) 60

    (C) 30

    (D) 21

    (E) None of the above

14. The function $e^{|x|}$ has an absolute minimum at $x = 0$ because:

    (A) $f'(0) = 0$ and $f''(0) > 0$

    (B) $f'(x) > 0$ for $x > 0$ and $f'(x) < 0$ for $x < 0$, with $f'(0)$ undefined

    (C) $f(x)$ is not differentiable at $x = 0$ and $f''(0) > 0$

    (D) this is the statement of the mean value theorem

    (E) None of the above

15. If $f(x)$ has three local max/min values on $(-\infty, \infty)$, what must be true?

    (A) $f'(x)$ has three solutions to $f'(x) = 0$

    (B) $f''(x)$ has three solutions to $f''(x) = 0$

    (C) there are three values for which either $f'(x) = 0$ or $f'(x)$ is not defined

    (D) $f'(x)$ is not a function

    (E) None of the above

Free Response Questions: Show your work!

16. (a) State the Mean Value Theorem.

(b) Find all values c that satisfy the conditions of the mean value theorem for

$$f(x) = \sin(x) - \cos(x)$$

on the interval $[a, b] = [2\pi, 4\pi]$.

Free Response Questions: Show your work!

17. (a) Evaluate the following limit. Be sure to explain your reasoning.

$$\lim_{x \to -\infty} x^2 e^x$$

(b) Find all values of A for which we can use L'Hopital's rule to evaluate

$$\lim_{x \to 3} \frac{x^2 + Ax - 3}{x - 3}.$$

Then use L'Hopital's rule to evaluate the limit.

Free Response Questions: Show your work!

18. Consider the function $f(x) = x^3/3 - (3/2)x^2 + 2x - 2$. Use methods of Calculus to solve the following. Be sure to show your work and explain how you obtained your answers.

    (a) Find the interval(s) where the function $f(x)$ is increasing and the interval(s) where the function $f(x)$ is decreasing.

    (b) Find the interval(s) where the graph of $f(x)$ is concave up and the interval(s) where the graph of $f(x)$ is concave down.

Free Response Questions: Show your work!

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19. In this problem you will determine the minimum possible perimeter for a rectangle whose area is 2017.

    (a) Draw a picture of the rectangle and label/name all quantities.

    (b) Write the perimeter as a function of one variable, and state the domain of the perimeter function that agrees with the physical constraints of the problem.

    (c) Use methods of Calculus to determine what the dimensions of the rectangle are that provide minimal perimeter length.