MA 113 Calculus I — Spring 2019
Exam 3 — Tuesday, 9 April 2019

Name: ______________________

Section: ______________________

Last 4 digits of student ID #: ________

This is a two-hour exam. This exam has 12 multiple choice questions (five points each) and 4 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-buds during the exam. You may use a calculator, but not one which has symbolic manipulation capabilities.

On the multiple choice problems:

- Select your answer by placing an X in the appropriate square of the multiple choice answer box on the front page of the exam.
- Carefully check your answers. No credit will be given for answers other than those indicated on the *multiple choice answer box.*

On the free response problems:

- Clearly indicate your answer and the reasoning used to arrive at that answer *(unsupported answers may not receive credit)*,
- 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.

Multiple Choice Answers

Question					
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

Exam Scores

Question	Score	Total
MC		60
13		10
14		10
15		10
16		10
Total		100

1. A 5-kg quantity of radioactive material decays to 1 kg after 10 years. If the mass of the material at time t is $m(t) = Ae^{kt}$, find k.

   (A) $\dfrac{\ln(5)}{10}$

   (B) $\dfrac{-\ln(5)}{10}$

   (C) $\dfrac{-\ln(10)}{5}$

   (D) $\ln(1/2)$

   (E) None of the above

2. Suppose $f(x)$ has domain $(-\infty, \infty)$. If $f'(a) = 0$ and $f'(a) > 0$ for every $x > a$ and $f'(a) < 0$ for every $x < a$, then which of the following must be true?

   (A) $f(x)$ is decreasing on $(-\infty, \infty)$

   (B) $f(x)$ is increasing on $(-\infty, \infty)$

   (C) $f(x)$ has an absolute maximum at $x = a$

   (D) $f(x)$ has an absolute minimum at $x = a$

   (E) None of the above

3. Find the value of $\displaystyle\lim_{x\to\infty} \frac{12421x}{2781\ln(x) + 147}$.

   (A) ∞

   (B) $-\infty$

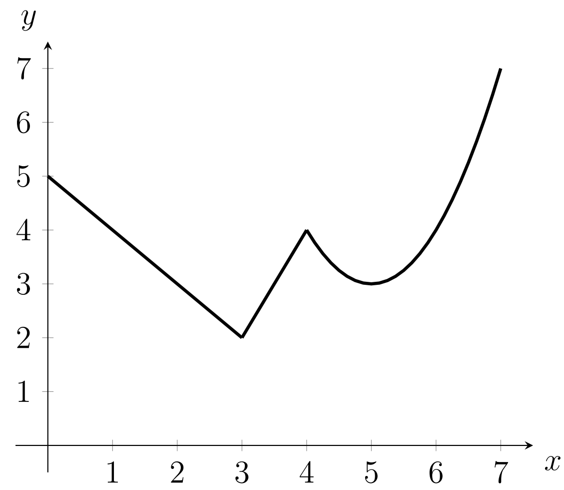
   (C) 0

   (D) $\dfrac{12421}{2781}$

   (E) None of the above

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

4. Let $f(x)$ be the function whose graph is shown below. How many critical numbers does $f(x)$ have on the interval $(0, 7)$?



(A) 0
(B) 1
(C) 2
(D) 3
(E) None of the above.

5. Calculate the value of $\int_1^2 f(x)\,dx$ given the information that $\int_0^1 f(x)\,dx = 10$ and $\int_0^2 f(x)\,dx = 7$.

(A) 1
(B) $7/10$
(C) -3
(D) $3/10$
(E) None of the above.

6. If $f(x) = \dfrac{1}{x^2+5}$, we have that $f(x)$ is concave up when which of the following is true?

(A) $6x^2 - 10$ is positive
(B) $6x^2 - 10$ is negative
(C) $2x$ is positive
(D) $2x$ is negative
(E) None of the above

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

7. Find the absolute maximum and absolute minimum output of the function $f(x) = x^3 - 4x^2 + 5x + 9998$ on the interval $[0, 2]$.

   (A) Max 10000, Min 9998
   (B) Max 9998, Min 10000
   (C) Max 0, Min 1
   (D) Max 1, Min 0
   (E) None of the above.

8. Find the dimensions of the rectangle with area 200 square inches that has minimum perimeter.

   (A) length 400, width 400
   (B) length $\sqrt{200}$, width $\sqrt{200}$
   (C) length $\sqrt{400}$, width $\sqrt{400}$
   (D) length $\sqrt{800}$, width $\sqrt{800}$
   (E) None of the above.

9. Calculate R_4 for $f(x) = 6 - x$ over the interval $[6, 8]$.

   (A) -2
   (B) -3
   (C) $-5/2$
   (D) $-3/2$
   (E) None of the above

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

10. For $f(x) = 3x^2 + 1$ on the interval $[0, 1]$, find the point c that satisfies the conclusion of the Mean Value Theorem.

    (A) $c = 0$
    (B) $c = 1$
    (C) $c = 1/3$
    (D) $c = 2/3$
    (E) None of the above

11. Find the value of $\sum_{i=0}^{3} 2i$.

    (A) 10
    (B) 12
    (C) 6
    (D) 8
    (E) None of the above.

12. Evaluate the indefinite integral $\int (\sin x + x)\, dx$.

    (A) $-\cos x + x^2/2 + C$
    (B) $-\cos x + x^2 + C$
    (C) $\cos x + x^2/2 + C$
    (D) $\cos x + x^2/2 + C$
    (E) None of the above

Free Response Questions: Show your work!

13. Recall that $\sum_{i=1}^{n} i = \frac{n(n+1)}{2}$.

    (a) Find the value of $\sum_{i=1}^{12} (5i + 2)$.

    (b) Calculate L_3 for $f(x) = 2 + x^2$ over the interval $[0, 3]$.

Free Response Questions: Show your work!

14. Find the point(s) on the hyperbola $y = \dfrac{9}{x}$ that is (are) closest to $(0, 0)$. (Hint: minimize the square of an appropriate distance function.)

Free Response Questions: Show your work!

15. (a) Find the value of $\lim_{x \to 0} \dfrac{\sin 6x}{\tan 7x}$.

(b) If $f''(x) = 3x + 1$ where $f(0) = 2$ and $f(1) = 2$, find $f(x)$.

Free Response Questions: Show your work!

16. This problem concerns the definition of the derivative using limits.

    (a) State the Mean Value Theorem.

    (b) Suppose that $g(x)$ is differentiable for all x and that $-2 \leq g'(x) \leq 4$ for all x. Also assume that $g(1) = 3$. Find the largest possible value for $g(3)$.