**MA123 — Elem. Calculus** Spring 2015
Exam 1 2015-02-12

**Name:** _____ **Sec.:** _____

Do not remove this answer page — you will turn in the entire exam. You have two hours to do this exam. No books or notes may be used. You may use an ACT-approved calculator during the exam, but NO calculator with a Computer Algebra System (CAS), networking, or camera is permitted. Absolutely no cell phone use during the exam is allowed.

The exam consists of two short answer questions and eighteen multiple choice questions. Answer the short answer questions on the back of this page, and record your answers to the multiple choice questions on this page. For each multiple choice question, you will need to fill in the box corresponding to the correct answer. For example, if (a) is correct, you must write

**(a)** (b) (c) (d) (e)

Do not circle answers on this page, but please 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!**

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **3.** | (a) | (b) | (c) | (d) | (e) | **12.** | (a) | (b) | (c) | (d) | (e) |
| **4.** | (a) | (b) | (c) | (d) | (e) | **13.** | (a) | (b) | (c) | (d) | (e) |
| **5.** | (a) | (b) | (c) | (d) | (e) | **14.** | (a) | (b) | (c) | (d) | (e) |
| **6.** | (a) | (b) | (c) | (d) | (e) | **15.** | (a) | (b) | (c) | (d) | (e) |
| **7.** | (a) | (b) | (c) | (d) | (e) | **16.** | (a) | (b) | (c) | (d) | (e) |
| **8.** | (a) | (b) | (c) | (d) | (e) | **17.** | (a) | (b) | (c) | (d) | (e) |
| **9.** | (a) | (b) | (c) | (d) | (e) | **18.** | (a) | (b) | (c) | (d) | (e) |
| **10.** | (a) | (b) | (c) | (d) | (e) | **19.** | (a) | (b) | (c) | (d) | (e) |
| **11.** | (a) | (b) | (c) | (d) | (e) | **20.** | (a) | (b) | (c) | (d) | (e) |

**For grading use:**

| Multiple Choice | Short Answer |
|---|---|
| (5 points each) | (out of 10 points) |

| Total | |
|---|---|
| | (out of 100 points) |

**Short Answer Questions**

*Write your answers on this page.*

*You must show proper, logical, sensible and legible work to be sure you will get full credit.*

1. Find the **average rate of change** of $f(x) = 5x^2 + 7$ from $x = 2$ to $x = 2 + h$. Simplify your answer.

Final answer: _____

2. For the function $f(x) = x^2 - 5x + 3$ find the **equation of the tangent line** to the graph of $f$ at $x = 6$.

Final answer: _____

**Name:** _____

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**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.*

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3. Solve the equation $6x^2 + 102xy + 4y = 5$ for $y$ in terms of $x$

**Possibilities:**

(a) $y = \dfrac{-102 \pm \sqrt{10308}}{12}$

(b) $y = \dfrac{5 - 6x^2 - 102x}{4}$

(c) $y = \dfrac{102x + 4}{6x^2 - 5}$

(d) $y = \dfrac{6x^2 - 5}{102x + 4}$

(e) $y = \dfrac{5 - 6x^2}{102x + 4}$

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4. Evaluate $f(5)$ when $f(x)$ is given by the piecewise definition

$$f(x) = \begin{cases} x^2 - 2 & \text{if } x \leq 3 \\ 5x - 9 & \text{if } 3 < x \leq 7 \\ x^2 - 4x & \text{if } 7 < x \end{cases}$$

**Possibilities:**

(a) 5

(b) DNE

(c) 21

(d) 23

(e) 16

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5. A train travels from city A to city B, then travels from city B to city C. The train leaves city A at time 10:00am and arrives at city B at 12:30pm. The train leaves city B at 3:00pm and arrives at city C at 5:00pm. The average velocity of the train, while travelling from A to B, was 32 miles per hour. The average velocity of the train, while travelling from B to C, was 57 miles per hour. What was the average velocity of the train from city A to city C, including the wait at city B?

**Possibilities:**

(a) (201/7) miles per hour

(b) (89/2) miles per hour

(c) (25/2) miles per hour

(d) (194/7) miles per hour

(e) 89 miles per hour

6. Find the average rate of change of $f(x) = \sqrt{x+3}$ from $x = 6$ to $x = 46$.

**Possibilities:**

(a) $-\frac{8}{23}$

(b) $\frac{1}{10}$

(c) 4

(d) $\frac{43}{46}$

(e) $-\frac{1}{10}$

7. Find a value of $x$ so that the instantaneous rate of change of $f(x) = 6x^2 + 5$ at $x$ is equal to 24.

**Possibilities:**

(a) $x = 1$

(b) $x = 2$

(c) $x = 3$

(d) $x = 4$

(e) $x = 5$

8. Let $f(x) = 6x^2 + 8x + 4$. Find a value $c$ between $x = 1$ and $x = 5$, so that the average rate of change of $f(x)$ from $x = 1$ to $x = 5$ is equal to the instantaneous rate of change of $f(x)$ at $x = c$.

**Possibilities:**

(a) 3

(b) 4

(c) 5

(d) 6

(e) 7

9. If $\lim_{x\to 3} f(x) = 11$ and $\lim_{x\to 3} g(x) = 17$, then what is the value of $\lim_{x\to 3} \dfrac{(x+13)(f(x)+1)}{g(x)}$?

**Possibilities:**

(a) the limit is infinity or does not exist

(b) $\dfrac{11}{17}$

(c) $\dfrac{(3)(11)}{17}$

(d) $\dfrac{(3+13)(11+1)}{17}$

(e) 0

10. Find the limit

$$\lim_{t\to 0^+} \frac{46t^2}{t}$$

**Possibilities:**

(a) $\dfrac{23}{\sqrt{t}}$

(b) 0

(c) 23

(d) This limit either tends to infinity or this limit fails to exist

(e) 46

11. Find the limit

$$\lim_{x\to 0}\left(\frac{12}{x}+\frac{6x-12}{x}\right)$$

**Possibilities:**

(a) 12

(b) This limit does not exist.

(c) 6

(d) 0

(e) 1

12. Find the limit

$$\lim_{n\to\infty}\frac{(n+3)^2}{7n+17}$$

**Possibilities:**

(a) $\frac{1}{7}$

(b) $\frac{1}{24}$

(c) The limit does not exist or approaches infinity

(d) $\frac{1}{17}$

(e) $\frac{9}{7}$

13. For the function

$$f(x) = \begin{cases} |3+9x| & \text{if } x < -2 \\ \sqrt{x^2+5} & \text{if } -2 \le x < 6 \\ 7x^2+3x+4 & \text{if } 6 \le x \end{cases}$$

find $\lim_{x \to 7^+} f(x)$

**Possibilities:**

(a) 368

(b) 66

(c) $\sqrt{41}$

(d) 274

(e) $\sqrt{54}$

14. The graph of $y = f(x)$ is shown below. Compute $\lim_{x \to -2^-} f(x)$.

**Possibilities:**

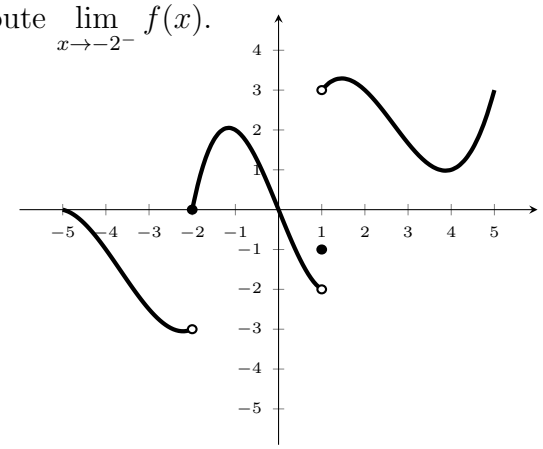
(a) 3

(b) 0

(c) $-1$

(d) $-2$

(e) $-3$



15. Consider the function $f(x) = \begin{cases} x^2 - 2 & \text{if } x < 2 \\ 2x + B & \text{if } x \geq 2 \end{cases}$

Find a value of $B$ so that the function is continuous at $x = 2$.

**Possibilities:**

(a) $-6$

(b) $-5$

(c) $-4$

(d) $-3$

(e) $-2$

16. Find the value of $m$ which makes $f(x)$ differentiable everywhere, where

$$f(x) = \begin{cases} x^2, & \text{if } \quad x \leq 4; \\ m\,(x-4) + 16, & \text{if } \quad x > 4 \end{cases}$$

**Possibilities:**

(a) 6

(b) 7

(c) 8

(d) 9

(e) 10

17. Find the equation of the tangent line to the graph of the function $f(x) = \dfrac{1}{x^2+1} + 5$ at $x = 3$. You may use $f'(x) = -\dfrac{2x}{(x^2+1)^2}$

**Possibilities:**

(a) $y = -\dfrac{3}{50}x + \dfrac{132}{25}$

(b) $y = x^3 + 17$

(c) $y = -\dfrac{3}{50}x + \dfrac{51}{10}$

(d) $y = \dfrac{51}{10}x - \dfrac{384}{25}$

(e) $y = \dfrac{51}{10}$

18. Consider the function $f(x) = 9x^2 + 8x + 2$. Its tangent line at $x = 3$ goes through the point $(9, y_1)$ where $y_1$ is:

**Possibilities:**

(a) 107

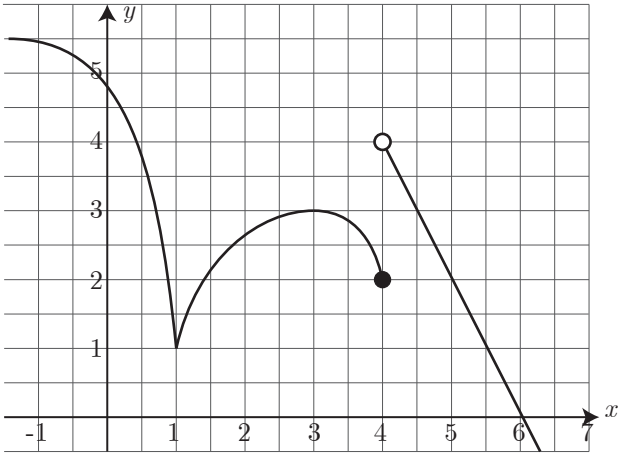
(b) $-79$

(c) 62

(d) 479

(e) 170

19. The graph of $y = f(x)$ is shown below. $f'(\frac{11}{2})$ is approximately :




**Possibilities:**

(a) 2

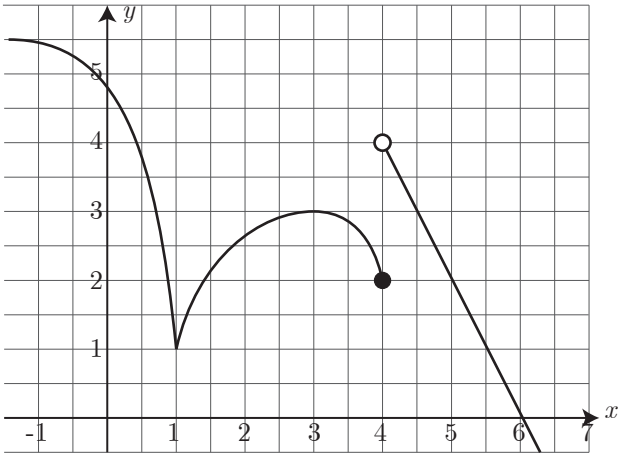
(b) $-2$

(c) $-\frac{1}{2}$

(d) The limit does not exist or tends to infinity

(e) $\frac{1}{2}$

20. The graph of $y = f(x)$ is shown below. The function is differentiable, except at $x =$




**Possibilities:**

(a) x=1 only

(b) x=1, x=3, and x=4

(c) x=4 only

(d) x=1 and x=4

(e) x=1, x=3, x=4, and x=6

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 | Day | Time | Room |
|---|---|---|---|---|
| 001-007 | Jack Schmidt | MWF | 2:00 pm - 2:50 pm | BS 107 |
| 001 | Joseph Lindgren | Tu | 8:00 am | CB 349 |
| 002 | Joseph Lindgren | Tu | 9:30 am | FB 213 |
| 003 | Florian Kohl | Tu | 11:00 am | FB 213 |
| 004 | Carolyn Troha | Tu | 12:30 pm | FB 213 |
| 005 | Sarah Orchard | Tu | 2:00 pm | FB 213 |
| 006 | Sarah Orchard | Tu | 3:30 pm | FB 213 |
| 007 | Jing Wei | Tu | 11:00 am | TPC 113 |
| 008-014 | Jack Schmidt | MWF | 12:00 pm - 12:50 pm | CB 106 |
| 008 | Joseph Lindgren | Th | 8:00 am | CB 349 |
| 009 | Joseph Lindgren | Th | 9:30 am | FB 213 |
| 010 | Sarah Orchard | Th | 11:00 am | FB 213 |
| 011 | Sarah Orchard | Th | 12:30 pm | FB 213 |
| 012 | Yucong Sang | Th | 2:00 pm | FB 213 |
| 013 | Carolyn Troha | Th | 3:30 pm | FB 213 |
| 014 | Hao Wang | Th | 11:00 am | TEB 231 |
| 015-021 | erica Whitaker | MWF | 1:00 pm - 1:50 pm | CB 118 |
| 015 | Jing Wei | Tu | 8:00 am | FB 213 |
| 016 | Yucong Sang | Th | 3:30 pm | CB 201 |
| 017 | Carolyn Troha | Tu | 11:00 am | CP 111 |
| 018 | Yucong Sang | Tu | 12:30 pm | DH 203 |
| 019 | Jing Wei | Tu | 2:00 pm | TPC 109 |
| 020 | Hao Wang | Tu | 3:30 pm | CB 240 |
| 021 | Yucong Sang | Tu | 3:30 pm | CB 246 |
| 022-028 | erica Whitaker | MWF | 2:00 pm - 2:50 pm | CB 106 |
| 022 | Jing Wei | Th | 8:00 am | FB 213 |
| 023 | Hao Wang | Th | 8:00 am | CB 303 |
| 024 | Florian Kohl | Th | 11:00 am | CB 234 |
| 025 | Florian Kohl | Th | 12:30 pm | CB 234 |
| 026 | Hao Wang | Tu | 8:00 am | CB 303 |
| 027 | Florian Kohl | Th | 3:30 pm | CB 244 |
| 028 | Carolyn Troha | Tu | 3:30 pm | CB 201 |

You may use the following formula for the derivative of a quadratic function.

$$\text{If} \quad p(x) = Ax^2 + Bx + C, \quad \text{then} \quad p'(x) = 2Ax + B.$$

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| Total | |
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