MA123 — Elem. Calculus Fall 2014
Exam 2 2014-03-13

Name: KEY 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 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 multiple choice questions. Record your answers 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!

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

For grading use:

Number Correct	
	(out of 20 problems)

Total	
	(out of 100 points)

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
	Jack Schmidt	MWF	10:00 am	CB 106
001	Wenwen Du	Tu	8:00 am	CB 349
002	Wenwen Du	Th	8:00 am	CB 349
003	Jinping Zhuge	Tu	12:30 pm	CP 201
004	Wenwen Du	Th	9:30 am	CP 211
005	Jinping Zhuge	Tu	11:00 am	TPC 113
006	Jinping Zhuge	Th	11:00 am	CP 103
	Jack Schmidt	MWF	12:00 pm	CB 118
007	Stephen Sturgeon	Tu	2:00 pm	FB 313
008	John Mosley	Th	2:00 pm	FB 313
009	Stephen Sturgeon	Tu	11:00 am	CB 335
010	John Mosley	Th	11:00 am	CB 335
011	Stephen Sturgeon	Tu	12:30 pm	CP 111
012	John Mosley	Th	12:30 pm	CB 233
013	Sarah Orchard	Tu	11:00 am	CP 111
014	Sarah Orchard	Th	11:00 am	CB 334
015	Sarah Orchard	Tu	12:30 pm	CP 103
	Nicholas Nguyen	MWF	2:00 pm	KAS 213
016	Jiaqi Liu	Th	12:30 pm	CB 201
017	Jiaqi Liu	Tu	2:00 pm	CP 345
018	Jiaqi Liu	Th	2:00 pm	CP 345
019	Hao Wang	Tu	3:30 pm	FB B9
020	Hao Wang	Th	3:30 pm	CP 297
021	Fernando Camacho	Tu	12:30 pm	TPC 212
	Drew Butcher	MWF	3:00 pm	BS 107
022	Hao Wang	Th	2:00 pm	BS 109
023	Fernando Camacho	Tu	9:30 am	CB 349
024	Fernando Camacho	Th	9:30 am	CB 349
025	Isaiah Harney	Tu	3:30 pm	CB 345
026	Isaiah Harney	Th	3:30 pm	CB 345
027	Luis Sordo Vieira	Tu	12:30 pm	CP 220
028	Isaiah Harney	Th	2:00 pm	TPC 212

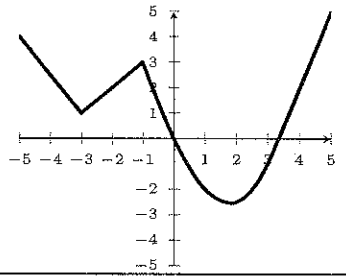
Multiple Choice Questions

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

Possibilities:

(a) -3 only
(b) -3 and -1
(c) -3 and 2
(d) 2 only
(e) -1 only



2. If $f(x) = \frac{7}{x+9}$ then choose the simplified form of $\frac{f(x+h)-f(x)}{h}$:

Possibilities:

(a) $\dfrac{hx^2 + 18hx + 81h - 7}{(x+9)^2}$

(b) $\dfrac{14x + 126 + 7h}{(x+h+9)(x+9)(2x+h)}$

(c) $-\dfrac{7}{(x+h+9)^2}$

(d) $\dfrac{7}{(x+h+9)(x+9)}$

(e) $-\dfrac{7}{(x+h+9)(x+9)}$

$$\frac{f(x+h)-f(x)}{h} = \frac{\frac{7}{(x+h)+9} - \frac{7}{x+9}}{h} = \frac{\frac{7(x+9)}{(x+9)[(x+h)+9]} - \frac{7[(x+h)+9]}{(x+9)[(x+h)+9]}}{h}$$

$$= \frac{7x + 63 - 7x - 7h - 63}{h(x+9)[(x+h)+9]} = \frac{-7h}{h(x+9)[(x+h)+9]}$$

$$= \frac{-7}{(x+9)[(x+h)+9]}$$

3. If $f(x) = \sqrt{x+7}$ then choose the simplified form of $\frac{f(x+h)-f(x)}{h}$:

Possibilities:

(a) $\dfrac{1}{2\sqrt{x+h+7}}$

(b) $\dfrac{h\sqrt{x+7} + \frac{1}{2}}{\sqrt{x+7}}$

(c) $\frac{1}{2}\sqrt{x+h+7} - \frac{1}{2}\sqrt{x+7}$

(d) $\dfrac{1}{\sqrt{x+h+7} + \sqrt{x+7}}$

(e) $\dfrac{\sqrt{x+h+7} - \sqrt{x+7}}{h}$

$$\frac{f(x+h)-f(x)}{h} = \frac{\sqrt{(x+h)+7} - \sqrt{x+7}}{h} \cdot \frac{\sqrt{(x+h)+7} + \sqrt{x+7}}{\sqrt{(x+h)+7} + \sqrt{x+7}}$$

$$= \frac{x+h+7 - (x+7)}{h\left[\sqrt{(x+h)+7} + \sqrt{x+7}\right]} = \frac{h}{h\left[\sqrt{(x+h)+7} + \sqrt{x+7}\right]}$$

$$= \frac{1}{\sqrt{(x+h)+7} + \sqrt{x+7}}$$

4. For the function $f(x) = 2x^3 + x^2 + 4x + 3$, find the equation of the tangent line to graph of f at $x = 1$.

$f'(x) = 6x^2 + 2x + 4$ $\quad f(1) = 10$

Possibilities:

(a) $y = 12x - 2$ $\quad f'(1) = 12 \quad m = 12 \quad pt = (1, f(1)) = (1, 10)$

(b) $y = 12x + 10$

(c) $y = x^3 + 17$ $\quad y - y_0 = m(x - x_0)$

(d) $y = 10$ $\quad y - 10 = 12(x - 1)$

(e) $y = 10x + 2$ $\quad y = 12x - 2$

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5. Find the derivative, $f'(x)$, if $f(x) = \sqrt{5x^3 + 3x + 1}$.

Possibilities:

(a) $(1/2)(5x^3 + 3x + 1)^{-1/2}(15x^2 + 3)$ $\quad f(x) = (5x^3 + 3x + 1)^{1/2}$

(b) $(1/2)(5x^3 + 3x + 1)(15x^2 + 3)$ $\quad f'(x) = \frac{1}{2}(5x^3 + 3x + 1)^{-1/2}(15x^2 + 3)$

(c) $(1/2)(5x^3 + 3x + 1)^{1/2}$

(d) $\dfrac{\sqrt{15x^2 + 3}}{\sqrt{5x^3 + 3x + 1}}$ $\quad$ i.e. $g'(h(x)) \cdot h'(x)$

(e) $\sqrt{15x^2 + 3}$ $\quad$ where $g(x) = x^{1/2}$, $h(x) = 5x^3 + 3x + 1$

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6. Find the derivative, $f'(x)$, if $f(x) = e^{9x^3 + 7x + 2}$.

Possibilities:

(a) $e^{27x^2 + 7}$ $\quad f'(x) = e^{9x^3 + 7x + 2} \cdot (27x^2 + 7)$

(b) $\dfrac{27x^2 + 7}{9x^3 + 7x + 2}$ $\quad$ i.e. $g'(h(x)) \cdot h'(x)$

(c) $(27x^2 + 7)e^x$ $\quad$ where $g(x) = e^x$, $h(x) = 9x^3 + 7x + 2$

(d) $(27x^2 + 7)e^{9x^3 + 7x + 2}$

(e) $\ln(9x^3 + 7x + 2)$

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7. Find the derivative, $f'(x)$, if $f(x) = (6 + 9x)e^{2+9x}$.

Possibilities:

(a) $\dfrac{9}{2 + 9x}$ $\quad f'(x) = (9)e^{2+9x} + (6 + 9x)e^{2+9x} \cdot 9 = 9e^{2+9x}(7 + 9x) = (63 + 81x)e^{2+9x}$

(b) $(9)e^9$ $\quad$ i.e. $g'(x)h(x) + g(x)h'(x)$

(c) $(81)e^9$ $\quad$ where $g(x) = 6 + 9x$, $h(x) = e^{2+9x}$

(d) $(63 + 81x)e^{2+9x}$

(e) $(9)e^{2+9x}$

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8. Find the derivative, $f'(x)$, if $f(x) = \ln(8x^2 + 9x - 1)$.

Possibilities:

(a) $\dfrac{1}{16x+9}$

(b) $(16x+9)e^{8x^2+9x-1}$

(c) $\dfrac{16x+9}{8x^2+9x-1}$

(d) e^{16x+9}

(e) $\ln(8x^2+9x-1)$

$f'(x) = \dfrac{1}{8x^2+9x-1} \cdot (16x+9)$

i.e. $g'(h(x)) \cdot h'(x)$

where $g(x) = \ln x$, $h(x) = 8x^2+9x-1$

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9. Find the derivative, $f'(x)$, if $f(x) = (2+4x)\ln(4+9x)$.

Possibilities:

(a) $4 + \dfrac{9}{4+9x}$

(b) $(4)\ln(4+9x) + \dfrac{18+36x}{4+9x}$

(c) $1/x$

(d) $\dfrac{4}{4+9x}$

(e) $\dfrac{13}{4+9x}$

$f'(x) = 4\ln(4+9x) + (2+4x)\cdot\dfrac{9}{4+9x} = 4\ln(4+9x) + \dfrac{18+36x}{4+9x}$

i.e. $g'(x)h(x) + g(x)h'(x)$

where $g(x) = 2+4x$, $h(x) = \ln(4+9x)$

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10. For the function $f(x) = \ln(5x^2+6x+9)$, find the equation of the tangent line to graph of f at $x = 0$.

Possibilities:

(a) $y = 2\ln(3)\,x + \frac{2}{3}$

(b) $y = 2\ln(3)$

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

(d) $y = \frac{2}{3}x + 2\ln(3)$

(e) $y = 3x + 2\ln(3)$

$f'(x) = \dfrac{10x+6}{5x^2+6x+9}$ $\quad f'(0) = \frac{6}{9} = \frac{2}{3}$ $\quad f(0) = \ln 9 = \ln 3^2 = 2\ln 3$

$m = \frac{2}{3}$ $\quad pt = (0, 2\ln 3)$

$y - y_0 = m(x - x_0)$

$y - 2\ln 3 = \frac{2}{3}(x-0)$

$y = \frac{2}{3}x + 2\ln 3$

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11. Suppose $F(x) = \ln(g(x))$. If $g(2) = 3$, $g'(2) = 5$, and $g''(2) = 7$, then find $F'(2)$.

Possibilities:

(a) $5/3$

(b) $\ln(3)/5$

(c) $3/\ln(5)$

(d) $\ln(7)$

(e) $3/5$

$F'(x) = \frac{g'(x)}{g(x)}$ $\quad F'(2) = \frac{g'(2)}{g(2)} = \frac{5}{3}$

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12. Suppose $F(x) = g(x) \cdot h(x+2)$. If $g(0) = 5$, $g'(0) = 4$, $h(0) = 9$, $h'(0) = 6$, $h(2) = 3$, and $h'(2) = 8$, find $F'(0)$.

Possibilities:

(a) 128

(b) 52

(c) 35

(d) 92

(e) 74

$F'(x) = g'(x)h(x+2) + g(x)h'(x+2)\cdot 1$

$F'(0) = g'(0)h(0+2) + g(0)h'(0+2)$

$= g'(0)h(2) + g(0)h'(2) = (4)(3) + (5)(8) = 52$

---

13. Suppose $F(x) = (g(x))^{13} + 3$. If $g(2) = 7$, $g'(2) = 5$, and $g''(2) = 9$, then find $F'(2)$.

Possibilities:

(a) $5^{13} + 3$

(b) $(13)(7^{12})(5)$

(c) $(13)(7^{12}) + 3$

(d) $7^{13} + 3$

(e) 9

$F'(x) = 13[g(x)]^{12} \cdot g'(x)$

$F'(2) = 13[g(2)]^{12} \cdot g'(2)$

$= 13(7)^{12} \cdot 5$

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14. If $f(x) = 2x^6 + x^4 - x$ then find the second derivative $f''(x)$:

Possibilities:

(a) $60x^4 + 12x^2$

(b) $12x^5 + 30x^4 + 44x^3 + 36x^2 + 16x + 2$

(c) $60x^4 + 72x^2 + 6$

(d) $72x^6 + 16x^4$

(e) $12x^5 + 4x^3 - 1$

$f'(x) = 12x^5 + 4x^3 - 1$

$f''(x) = 60x^4 + 12x^2$

---

15. If $f(x) = (15x + 31)^{25}$ then choose the form of $f''(x)$:

Possibilities:

(a) $25(24)15^{23}$

(b) 0

(c) $25^2\,(15)^{25}\,(15x + 31)$

(d) $25\,(15x + 31)^{24}$

(e) $25(24)\,(15x + 31)^{23}\,(15)^2$

$f'(x) = 25(15x+31)^{24} \cdot 15 =$

$f''(x) = 25 \cdot 24\,(15x+31)^{23} \cdot 15 \cdot 15$

---

16. If an amount of x dollars is invested at 2% interest compounded continuously, and at the end of 5 years the value of the investment is \$3000, find x.

Possibilities:

(a) \$3315.51

(b) \$300

(c) \$2714.51

(d) \$2000

(e) \$588.11

$A(t) = Pe^{rt} = xe^{.02t}$

$A(5) = xe^{(.02)(5)} = 3000$

$x = \frac{3000}{e^{(.02)(5)}} \approx 2714.51$

---

17. The number of a bacteria in a culture doubles every 11 hours. How many hours will it take before 3 times the original number of bacteria is present?

Possibilities:

(a) $\frac{11}{3}$

(b) $\frac{33}{2}$

(c) $\frac{11}{2}$

(d) $11\,\ln(2)/\ln(3)$

(e) $11\,\ln(3)/\ln(2)$

$A(t) = P \cdot 2^{\frac{t}{11}}$

$3P = P \cdot 2^{\frac{t}{11}}$

$3 = 2^{t/11}$

$\ln 3 = \ln 2^{\frac{t}{11}} = \frac{t}{11}\ln 2$

$11 \cdot \frac{\ln 3}{\ln 2} = t$

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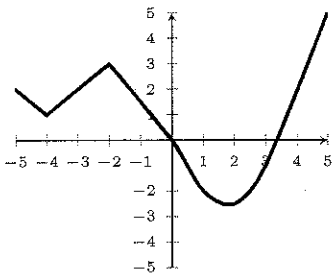
18. The graph of $y = f(x)$ is shown below. The maximum value of $f(x)$ on the interval $[-5, 3]$ occurs at which x?



Possibilities:

(a) -3

(b) -4

(c) 0

(d) 2

(e) -2

---

19. Find the maximum of $g(t) = (t-3)^2 + 4$ on the interval $[0, 5]$

Possibilities:

(a) 3

(b) 8

(c) 13

(d) 4

(e) 16

$g'(t) = 2(t-3)\cdot 1 = 2t-6$

$2t-6=0$

$t=3$

Possibilities

$t=0$ $\quad g(0)=13$ max

$t=3$ $\quad g(3)=4$

$t=5$ $\quad g(5)=8$

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20. Find the minimum of $g(t) = 2t^3 + 3t^2 - 12t + 1$ on the interval $[-1, 3]$

Possibilities:

(a) -16

(b) 14

(c) -6

(d) 46

(e) 21

$g'(t) = 6t^2 + 6t - 12$

$6t^2 + 6t - 12 = 0$

$t^2 + t - 2 = 0$

$(t+2)(t-1) = 0$

$t = -2, 1$

possibilities

$t=-2$ $\quad g(-2)=21$

$t=-1$ $\quad g(-1)=14$

$t=1$ $\quad g(1)=-6$ Min!

$t=3$ $\quad g(3)=46$ max
