MA123 — Elem. Calculus Fall 2016
Final Exam 2016-12-14

Name: _____ **Sec.:** _____

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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	c	d	e
11.	a	b	c	d	e	**21.**	a	b	c	d	e
12.	a	b	c	d	e	**22.**	a	b	c	d	e

For grading use:

Multiple Choice		Short Answer
(number right)	(5 points each)	(out of 10 points)

Total	
	(max 110 points)

Fall 2016 Exam 4 Short Answer Questions

Write answers on this page. You must show appropriate legible work to be sure you will get full credit.

6 pts 1. Find the maximum area of a rectangle whose sides are parallel to the coordinate axes, whose bottom-left corner is at (0, 0), and whose top-right corner is on the graph of $y = 12x - x^2$.
*You must **clearly use calculus** to find **and justify** your answer.*

Maximum area: _____

4 pts 2. Evaluate $\int_0^T \left(e^x + x^{11} + 2\right) dx$. Show steps clearly and circle your final answer. You do **NOT** need to simplify your final answer.

Name: _____

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. A train travels in a straight westward direction along a track. The speed of the train varies, but it is measured at regular time intervals of 1/10 hour. The measurements for the first half hour are:

time	0	.1	.2	.3	.4	.5
speed	0	7	10	15	19	25

Estimate the total distance (in miles) traveled by the train during the first half hour by assuming the speed is a linear function of t on the subintervals. The speed in the table is given in miles per hour. Use all six speed measurements in your estimate.

Possibilities:

(a) 6.35 miles

(b) 3.50 miles

(c) 7.50 miles

(d) 7.60 miles

(e) 12.50 miles

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4. Suppose that the average value of $f(x)$ on $[6, 20]$ is 62. Find the value of $\int_6^{20} f(x)\,\mathrm{d}x$.

Possibilities:

(a) 11284

(b) 434

(c) 898

(d) 1736

(e) 868

---

5. Evaluate the definite integral

$$\int_7^x \frac{4}{\sqrt{t}}\,\mathrm{d}t$$

Possibilities:

(a) $2\sqrt{x} - 2\sqrt{7}$

(b) $8\sqrt{x} - 8\sqrt{7}$

(c) $4\sqrt{x} - 4\sqrt{7}$

(d) $4\sqrt{x}$

(e) $\frac{4}{\sqrt{x}} - \frac{4}{\sqrt{7}}$

6. Find the average value of $f(x) = x^3$ over [1,23].

Possibilities:

(a) 69960.00

(b) 4055.33

(c) 184.33

(d) 265.00

(e) 3180.00

7. Let

$$F(x) = \int_0^x \left(t^2 + t - 42\right)\ \mathrm{d}t$$

For which positive value of x does $F'(x) = 0$?

Possibilities:

(a) 6

(b) 42

(c) 7

(d) 48

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

---

8. Use the Fundamental Theorem of Calculus to compute the derivative, $F'(x)$, of $F(x)$, if

$$F(x) = \int_1^{x+9} \left(t^2 + 6t + 4\right)\ \mathrm{d}t$$

Possibilities:

(a) $(x+9)^2 + 6(x+9) + 4$

(b) $\frac{1}{3}(x+9)^3 + \frac{6}{2}(x+9)^2 + 4(x+9) - \left(\frac{1}{3}1^3 + \frac{6}{2}1^2 + 4(1)\right)$

(c) $\frac{1}{3}x^3 + \frac{6}{2}x^2 + 4x - \left(\frac{1}{3}1^3 + \frac{6}{2}1^2 + 4(1)\right)$

(d) $x^2 + 6x + 4$

(e) $2x + 6$

---

9. Evaluate the integral

$$\int_0^x (6t+9)^{20}\ \mathrm{d}t$$

Possibilities:

(a) $21(6x+9)^{21} - 20 \cdot 9^{21}$

(b) $\dfrac{1}{21}(6x+9)^{21} - \dfrac{9^{21}}{21}$

(c) $\dfrac{1}{21}x^{21} - \dfrac{9^{21}}{21}$

(d) $\dfrac{1}{6(21)}(6x+9)^{21} - \dfrac{9^{21}}{6(21)}$

(e) $\dfrac{1}{20}(6x+9)^{20} - \dfrac{9^{20}}{20}$

10. A car is traveling due east. Its velocity (in miles per hour) at time t hours is given by $v(t) = -2.4t^2 + 14t + 60$. How far did the car travel during the first 7 hours of the trip?

Possibilities:

(a) 282.8 miles

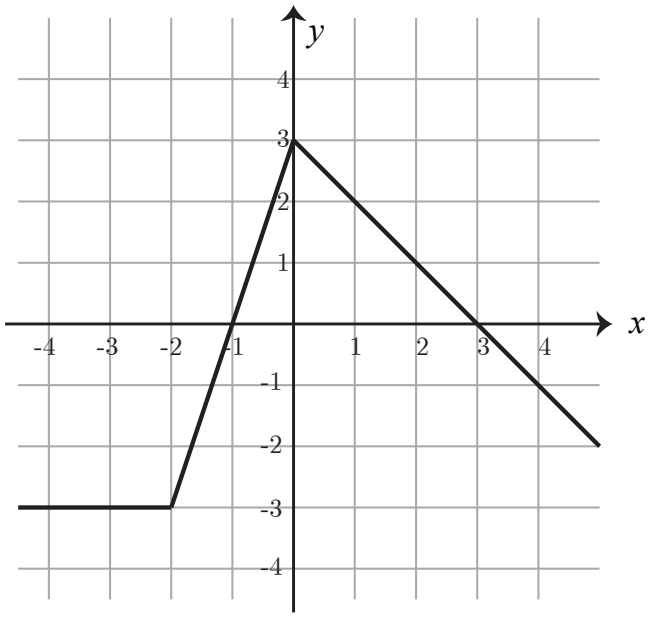
(b) 19.6 miles

(c) 40.4 miles

(d) 69.8 miles

(e) 488.6 miles

11. The graph of $y = f(x)$ shown below consists of straight lines. Evaluate the definite integral $\int_{-3}^{3} f(x)\,\mathrm{d}x$.



Possibilities:

(a) 21.5

(b) 7.5

(c) 1.5

(d) 6

(e) 2.5

12. Suppose that $\int_{9}^{18} f(x)\,\mathrm{d}x = 19$ and $\int_{5}^{18} f(x)\,\mathrm{d}x = 8$. Find the value of $\int_{5}^{9} f(x)\,\mathrm{d}x$.

Possibilities:

(a) -27

(b) 27

(c) $-\dfrac{11}{4}$

(d) -11

(e) 11

13. Let $f(x) = 9x^2 + 5x + 8$. Find a value c between $x = 2$ and $x = 6$, so that the average rate of change of $f(x)$ from $x = 2$ to $x = 6$ is equal to the instantaneous rate of change of $f(x)$ at $x = c$.

Possibilities:

(a) 2

(b) 3

(c) 4

(d) 5

(e) 6

14. For the function

$$f(x) = \begin{cases} |8 + 5x| & \text{if } x < -3 \\ \sqrt{x^2 + 3} & \text{if } -3 \leq x < 4 \\ 2x^2 + 4x + 3 & \text{if } 4 \leq x \end{cases}$$

find $\lim_{x \to 6^+} f(x)$

Possibilities:

(a) $\sqrt{19}$

(b) 38

(c) $\sqrt{39}$

(d) 51

(e) 99

15. For the function $f(x) = \ln(6x^2 + 5x + 7)$, find the equation of the tangent line to the graph of f at $x = 0$.

Possibilities:

(a) $y = \frac{5}{7}x + \ln(7)$

(b) $y = 7$

(c) $y = \ln(7)\,x + 5$

(d) $y = \frac{7}{5}x + \ln(7)$

(e) $y = \dfrac{(12x+5)\,x}{6x^2+5x+7} + \ln(7)$

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

Possibilities:

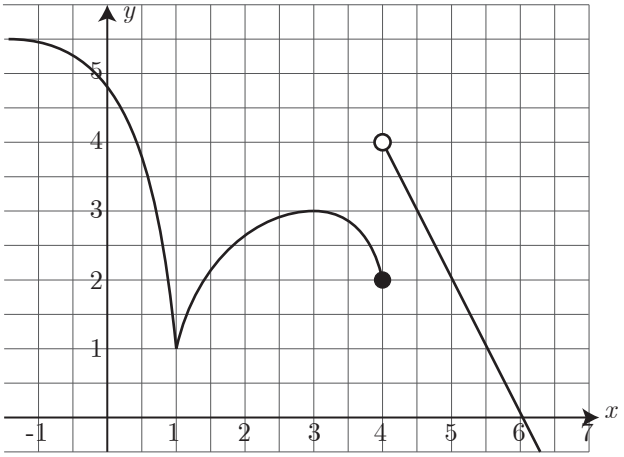
(a) x=4 only

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

(c) x=1 and x=4

(d) x=1 only

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



17. If $f(x) = x^7 + 3x^3 + 9x^2$ then find the second derivative $f''(x)$:

Possibilities:

(a) $7x^6 + 9x^2 + 18x$

(b) $42x^5 + 18x + 18$

(c) $42x^5 + 70x^3 + 32x + 18$

(d) $7x^6 + 21x^5 + 35x^4 + 35x^3 + 30x^2 + 34x + 13$

(e) $49x^7 + 27x^3 + 36x^2$

18. Find the derivative, $f'(x)$, if $f(x) = (19x + 11)\, e^{5x+7}$.

Possibilities:

(a) $(19x + 11)\,(5x + 7)\, e^{5x+6} + 19e^{5x+7}$

(b) $19\,(5x + 7)\, e^{5x+6}$

(c) $19e^5$

(d) $19 \cdot 5e^{5x+7}$

(e) $5\,(19x + 11)\, e^{5x+7} + 19e^{5x+7}$

19. Suppose $g(-3) = 7$ and $g'(-3) = 10$. Find $F'(-3)$ if

$$F(x) = \frac{g(x)}{x^2}$$

Possibilities:

(a) $-\frac{10}{3}$

(b) $\frac{44}{27}$

(c) $\frac{44}{3}$

(d) $-\frac{44}{27}$

(e) $-\frac{44}{9}$

20. Suppose the derivative of $g(t)$ is $g'(t) = 13(t-6)(t-10)$. For t in which interval(s) is g concave up?

Possibilities:

(a) $(8, \infty)$

(b) $(6, 10)$

(c) $(-\infty, 6) \cup (10, \infty)$

(d) $(-\infty, 8)$

(e) $(6, 8) \cup (10, 13)$

21. A farmer currently has harvested 190 bushels of apples that are currently worth \$13.02 per bushel. The way things are going, he expects to be harvesting 4.00 bushels per day, and expects the price to be increasing at \$0.75 per bushel per day. What is the instantaneous rate of change (measured in dollars per day) of the total value of his apples?

Possibilities:

(a) \$194.56 per day

(b) \$194.57 per day

(c) \$194.58 per day

(d) \$194.59 per day

(e) \$194.60 per day

22. The following is the graph of the derivative, $f'(x)$, of the function $f(x)$.
Where is the original function $f(x)$ increasing?

Possibilities:

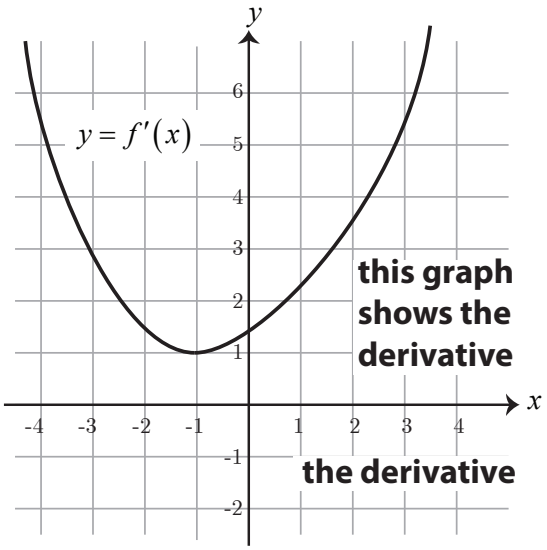
(a) nowhere

(b) $(-1, \infty)$

(c) $(-\infty, -1)$

(d) $(-\infty, \infty)$

(e) $(1, \infty)$



Some Formulas

1. Areas:

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

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

(c) Rectangle $A = lw$

(d) Trapezoid $A = \frac{h_1 + h_2}{2} b$

2. Volumes:

(a) Rectangular Solid $V = lwh$

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

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

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

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