MA123 — Elem. Calculus Fall 2018
Exam 3 2018-11-15

Name: _____ **Sec.:** _____

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

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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:

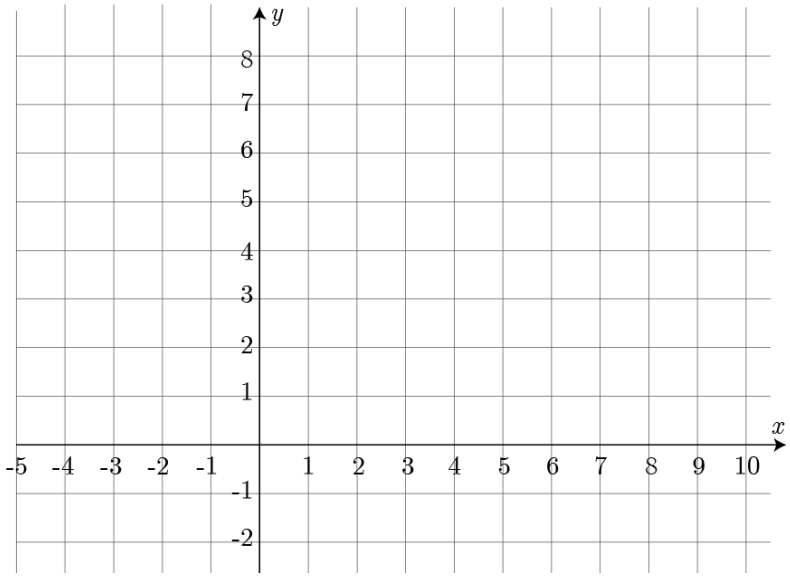
Multiple Choice		Short Answer
(number right)	(5 points each)	(out of 10 points)

Total	
	(out of 100 points)

Fall 2018 Exam 3 Short Answer Questions

Write your answers on this page.

1. Sketch the graph of a **continuous** function $y = f(x)$ which satisfies the following:
   $f(1) = 2$; $f'(x) \geq 0$ for all x; f is concave up for $x < 2$ and concave down for $x > 2$.



2. Find the area of the largest rectangle with one corner at the origin, the opposite corner in the first quadrant on the graph of the parabola $f(x) = 192 - 4x^2$, and sides parallel to the axes.
   *You must **CLEARLY USE CALCULUS** to find and justify your answer.*

Largest Possible Area: _____

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.

3. Where is the function $f(t) = t^3 - 6t^2 - 63t + 5$ decreasing?

   Possibilities:

   (a) $-3 < t < 7$

   (b) $f(t)$ is always decreasing

   (c) $t < -3$ and $t > 7$

   (d) $t < 2$

   (e) $t > 2$

4. Where is the function $f(t) = t^3 - 6t^2 - 63t + 5$ concave up?

   Possibilities:

   (a) $-3 < t < 7$

   (b) $t > 2$

   (c) $f(t)$ is always concave up

   (d) $t < 2$

   (e) $t < -3$ and $t > 7$

5. Suppose the derivative of $g(t)$ is $g'(t) = 4(t-8)(t-9)(t-5)$. For t in which interval(s) is g increasing?

Possibilities:

(a) $(\frac{22}{3} - \frac{1}{3}\sqrt{13}, \frac{22}{3} + \frac{1}{3}\sqrt{13})$

(b) $(-\infty, 5) \cup (8, 9)$

(c) $(5, 8) \cup (9, \infty)$

(d) $(-\infty, \frac{22}{3} - \frac{1}{3}\sqrt{13}) \cup (\frac{22}{3} + \frac{1}{3}\sqrt{13}, \infty)$

(e) $(4, 5) \cup (8, 9)$

6. Suppose the derivative of $g(t)$ is $g'(t) = 13(t-4)(t-8)$. For t in which interval(s) is g concave up?

Possibilities:

(a) $(4, 8)$

(b) $(-\infty, 6)$

(c) $(-\infty, 4) \cup (8, \infty)$

(d) $(4, 6) \cup (8, 13)$

(e) $(6, \infty)$

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

Possibilities:

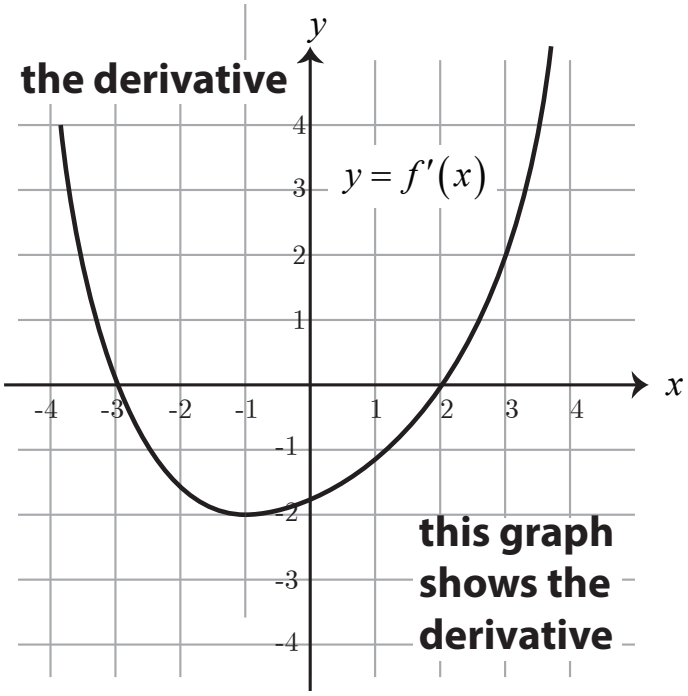
(a) $(-\infty, -1)$

(b) $(-2, \infty)$

(c) $(-3, 2)$

(d) $(-\infty, -3)$ and $(2, \infty)$

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



8. The following is the graph of the derivative, $f'(x)$, of the function $f(x)$.
Where is the original function $f(x)$ concave up?

Possibilities:

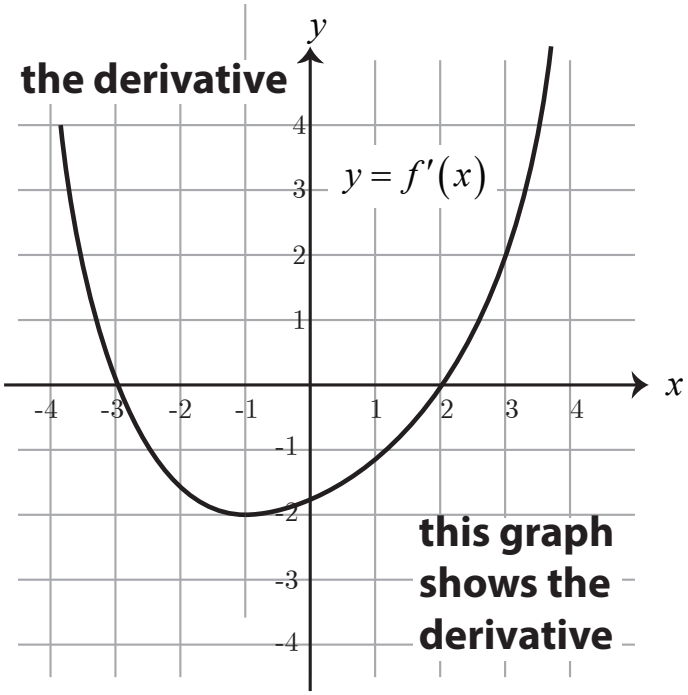
(a) $(-1, \infty)$

(b) $(-2, \infty)$

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

(d) $(-\infty, -3)$ and $(2, \infty)$

(e) $(-3, 2)$



9. Find the critical numbers of the function

$$f(x) = \frac{4x}{8x^2 + 648}.$$

Possibilities:

(a) $-\frac{4}{8}, \frac{4}{648}$

(b) $-81, 4$

(c) $-9, 9$

(d) $-\sqrt{\frac{1}{9}}, \sqrt{\frac{1}{9}}$

(e) $-81, 0$

10. Consider the graph of the original function, $f(x)$.
For this function, what are the signs of $f'(-3)$ and $f''(-3)$?

Possibilities:

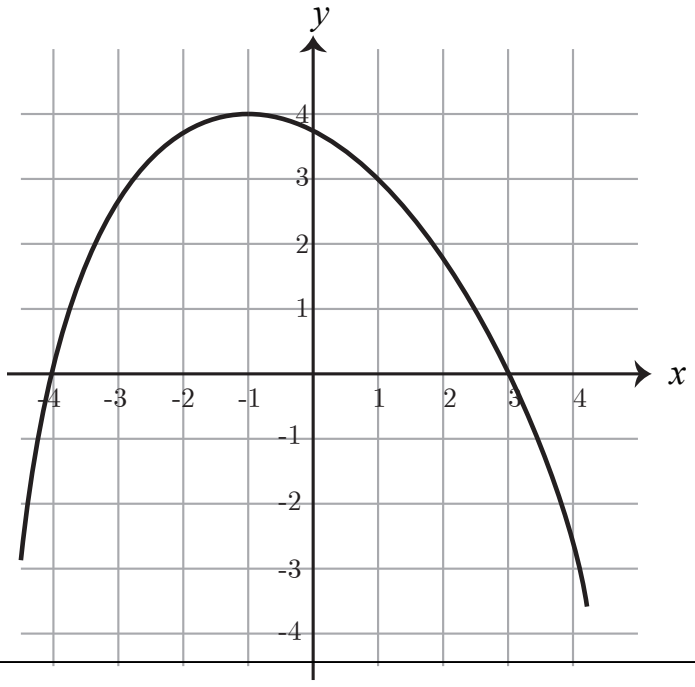
(a) $f'(-3) > 0$ and $f''(-3) < 0$

(b) $f'(-3) = 0$ and $f''(-3) < 0$

(c) $f'(-3) > 0$ and $f''(-3) > 0$

(d) $f'(-3) < 0$ and $f''(-3) < 0$

(e) $f'(-3) < 0$ and $f''(-3) > 0$



11. A farmer builds a rectangular pen with 5 vertical partitions (6 vertical sides) using 600 feet of fencing. What is the maximum possible total area of the pen?

Possibilities:

(a) 22500

(b) 15000

(c) 600

(d) 7500

(e) $\frac{45000}{7}$

12. A landscape architect wishes to enclose a rectangular garden on one side by a brick wall costing \$70 per foot, and on the other three sides by a metal fence costing \$30 per foot. If the area of the garden is 300 square feet, find the lowest possible cost to enclose the garden.

Possibilities:

(a) \$2684.78

(b) \$2684.28

(c) \$2682.78

(d) \$2683.78

(e) \$2683.28

13. Given the function $f(x) = \begin{cases} x & \text{if } x < 26 \\ 26 & \text{if } x \geq 26 \end{cases}$

evaluate the definite integral

$$\int_0^{36} f(x)\, \mathrm{d}x$$

Possibilities:

(a) 597

(b) 598

(c) 599

(d) 600

(e) 601

14. The graph of $y = f(x)$ shown below includes a semicircle and a straight line. Evaluate the definite integral $\int_{-2}^{4} f(x)\, \mathrm{d}x$.

Possibilities:

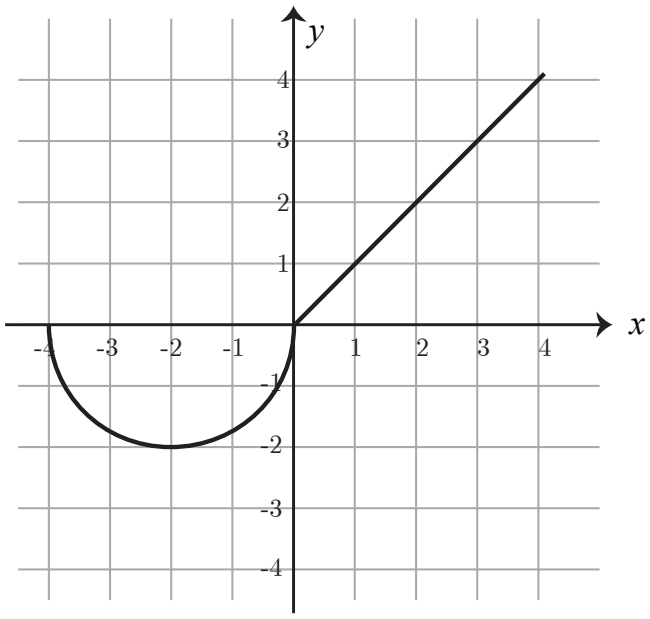
(a) $-2\pi - 8$

(b) $-2\pi + 8$

(c) $\pi + 8$

(d) $2\pi + 8$

(e) $-\pi + 8$



15. Suppose that $\int_3^{37} f(x)\,\mathrm{d}x = 13$, $\int_3^{12} f(x)\,\mathrm{d}x = 27$, and $\int_{18}^{37} f(x)\,\mathrm{d}x = 45$. Find the value of $\int_{12}^{18} f(x)\,\mathrm{d}x$.

Possibilities:

(a) 85

(b) 5

(c) -656

(d) -59

(e) -85

16. Suppose that $\int_4^{17} f(x)\,\mathrm{d}x = 13$. Find the value of $\int_4^{17} (3f(x) + 6)\,\mathrm{d}x$.

Possibilities:

(a) 57

(b) 45

(c) 117

(d) 141

(e) 52

17. Find the **average value** of $f(x)$ on the interval [7, 15] given that $f(x) = \begin{cases} 30 & \text{if } x < 10 \\ -70 & \text{if } x \geq 10. \end{cases}$

Possibilities:

(a) $-\frac{65}{2}$

(b) 6

(c) -20

(d) -130

(e) $-\frac{25}{2}$

18. Estimate the area under the graph of $y = -x^2 + 30x$ for x between 2 and 10, by using a partition that consists of 4 equal subintervals of $[2, 10]$ and use the left endpoint of each subinterval as a sample point.

Possibilities:

(a) $\frac{3328}{3}$

(b) 960

(c) 1248

(d) 624

(e) 1360

19. Suppose you estimate the area under the graph of $f(x) = \dfrac{1}{x}$ from $x = 6$ to $x = 24$ by adding the areas of the rectangles as follows: partition the interval into 6 equal subintervals and use the right endpoint of each interval to determine the height of the rectangle. What is the area of the 4^{th} rectangle?

Possibilities:

(a) $\frac{341}{280}$

(b) $\frac{1}{5}$

(c) $\frac{1}{6}$

(d) $\ln(3) - \ln(5) + \ln(2)$

(e) $\frac{1}{18}$

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20. 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	5	10	15	18	27

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) 13.50 miles

(b) 6.00 miles

(c) 7.50 miles

(d) 2.50 miles

(e) 6.15 miles

Some Formulas

1. Areas:

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

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

(c) Rectangle $A = lw$

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

2. Volumes:

(a) Rectangular Solid $V = lwh$

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

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

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

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