MA123 — Elem. Calculus Fall 2014
Exam 3 2014-11-20

Name: _____ Sec.: _____

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GOOD LUCK!

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For grading use:

Number Correct		(out of 20 problems)

Total		(out of 100 points)

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. Find the largest value of A such that the function $f(t) = t^3 - 9t^2 - 48t + 1$ is decreasing for all t in the interval $(0, A)$.

   Possibilities:

   (a) 2

   (b) 8

   (c) -2

   (d) ∞

   (e) 3

2. Suppose $g'(t) = (t - 7)(t - 8)^2(t - 9)$. Find the largest value of A such that the function $g(t)$ is decreasing on the interval $(7, A)$.

   Possibilities:

   (a) 8

   (b) 9

   (c) ∞

   (d) 504

   (e) 7

3. Suppose the derivative of $H(s)$ is given by $H'(s) = -(s^2 + 9)(s^2 + 1)$. Find the value of s in the interval $[-10, 10]$ where $H(s)$ takes on its minimum.

   Possibilities:

   (a) 10

   (b) 9

   (c) 1

   (d) -9

   (e) -10

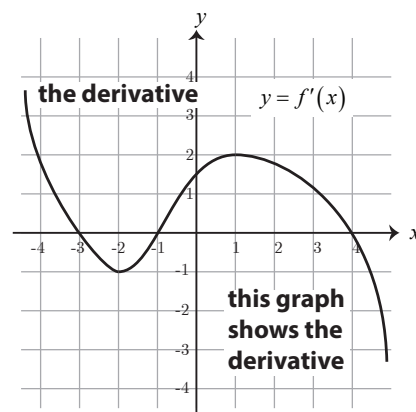4. Suppose the derivative of $g(t)$ is $g'(t) = 7(t-2)(t-4)$. For t in which interval(s) is g concave up?

Possibilities:

(a) $(-\infty, 3)$

(b) $(3, \infty)$

(c) $(2, 4)$

(d) $(-\infty, 2) \cup (4, \infty)$

(e) $(7, 2) \cup (3, 4)$

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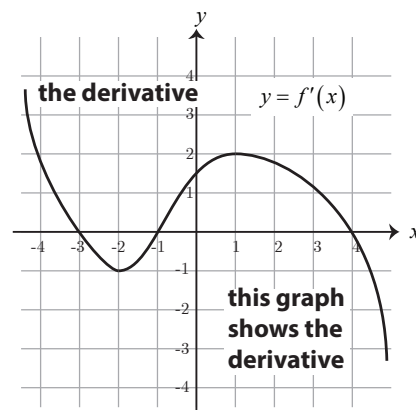   Where is the regular function $f(x)$ increasing?

Possibilities:

(a) $(-\infty, -2)$ and $(1, \infty)$

(b) $(-3, -1)$ and $(4, \infty)$

(c) $(-\infty, -3)$ and $(-1, 4)$

(d) $(-1, 2)$

(e) $(-2, 1)$

the derivative $y = f'(x)$

this graph shows the derivative

6. The following is the graph of the derivative, $f'(x)$, of the function $f(x)$.
   Where is the regular function $f(x)$ concave down?

Possibilities:

(a) $(-2, 1)$

(b) $(-\infty, -3)$ and $(-1, 4)$

(c) $(-3, -1)$ and $(4, \infty)$

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

(e) $(-\infty, -2)$ and $(1, \infty)$

the derivative $y = f'(x)$

this graph shows the derivative

7. Two trains leave the same station at different times, one traveling due East, and the other traveling due North. At 2pm the eastbound train is traveling at 45 mph and is 300 miles from the station, while the northbound train is traveling at 60 mph and is 400 miles from the station. At what rate is the distance between the trains increasing?

   Possibilities:

   (a) 105 mph

   (b) 6 mph

   (c) 75000 mph

   (d) 75 mph

   (e) 500 mph

8. Find the point in the first quadrant that lies on the hyperbola $y^2 - x^2 = 3$ and is closest to the point $(6, 0)$.

   Possibilities:

   (a) $(6, \sqrt{39})$

   (b) $(2, \sqrt{7})$

   (c) $(6, 1)$

   (d) $(0, \sqrt{3})$

   (e) $(3, 2\sqrt{3})$

9. A farmer builds a rectangular pen with 7 vertical partitions (8 vertical sides) using 800 feet of fencing. What is the maximum possible total area of the pen?

   Possibilities:

   (a) $\frac{80000}{9}$

   (b) 800

   (c) 16000

   (d) 10000

   (e) 40000

10. Boyle's Law states that when a sample gas is compressed at a constant temperature, the pressure P and volume V satisfy the equation $PV = c$, where c is a constant. Suppose that at a certain instant the volume is 59 cubic centimeters, the pressure is 5 kPa, and the pressure is increasing at a rate of 4 kPa/min. At what rate is the volume decreasing at this instant?

Possibilities:

(a) $\frac{233}{5}$ cubic centimeters per minute

(b) $\frac{234}{5}$ cubic centimeters per minute

(c) 47 cubic centimeters per minute

(d) $\frac{236}{5}$ cubic centimeters per minute

(e) $\frac{237}{5}$ cubic centimeters per minute

11. A ladder 20 feet long rests against a vertical wall. If the bottom of the ladder slides away from the wall at a rate of 3 feet per second, how fast is the top of the ladder sliding down the wall (in feet per second) when the bottom of the ladder is 16 feet from the wall?

Possibilities:

(a) 5 feet per second

(b) $\frac{4}{3}$ feet per second

(c) 4 feet per second

(d) $\frac{9}{5}$ feet per second

(e) $\frac{12}{5}$ feet per second

12. Estimate the area under the graph of $-x^2 + 20x$ for x between 2 and 8, by using a partition that consists of 3 equal subintervals of $[2, 8]$ and use the right endpoint of each subinterval as a sample point.

Possibilities:

(a) 488

(b) 244

(c) 560

(d) 432

(e) 368

13. 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	6	8	16	22	23

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) 8.00 miles

(b) 3.00 miles

(c) 6.35 miles

(d) 11.50 miles

(e) 7.50 miles

---

14. One way to approximate $\int_3^8 e^{7-2x}\,dx$ is with the sum $\sum_{k=1}^{10} \left((\Delta x)\cdot\left(e^{7-2(3+k\Delta x)}\right)\right)$. What is the best value of Δx to use?

Possibilities:

(a) 1.359079209

(b) 10

(c) 0.01

(d) 3

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

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15. Suppose you estimate the area under the graph of $f(x) = x^3$ from $x = 6$ to $x = 26$ by adding the areas of the rectangles as follows: partition the interval into 20 equal subintervals and use the right endpoint of each interval to determine the height of the rectangle. What is the area of the 6th rectangle?

Possibilities:

(a) 1728

(b) $\frac{6095}{4}$

(c) 1331

(d) 26

(e) 122760

6

16. Evaluate the difference of sums

$$\left(\sum_{k=1}^{6000}(5k^3 + 4)\right) - \left(\sum_{k=3}^{6000}(5k^3 + 4)\right)$$

Possibilities:

(a) 1080000000004

(b) 53

(c) 0

(d) ∞

(e) 18003000

17. Evaluate the sum

$$\sum_{k=1}^{N}\left(5k^2\right)$$

Possibilities:

(a) $5\dfrac{N(N+1)}{2}$

(b) $5N^2 - 5$

(c) $5\dfrac{N(N+1)(2N+1)}{6}$

(d) $5N^2$

(e) $5N^2 + 5$

18. Evaluate the sum $5 + 10 + 15 + 20 + 25 + 30 + \cdots + 95 + 100$.

Possibilities:

(a) 150

(b) 5

(c) 5050

(d) 4

(e) 1050

19. Evaluate the sum $\displaystyle\sum_{k=7}^{200}(5+3k)$.

Possibilities:

(a) 61207

(b) 61300

(c) 605

(d) 60305

(e) 26

20. Evaluate the sum $\displaystyle\sum_{k=3}^{n}(11k)$.

Possibilities:

(a) $\frac{33}{2} + \frac{11}{2}n$

(b) $11n$

(c) $\frac{11}{2}n\,(n+1) - 66$

(d) $\frac{11}{2}n\,(n+1) - 33$

(e) $\frac{11}{2}n\,(n+1)$

1. Summation formulas:

$$\sum_{k=1}^{n} k = \frac{n(n+1)}{2}$$

$$\sum_{k=1}^{n} k^2 = \frac{n(n+1)(2n+1)}{6}$$

2. Areas:

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

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

(c) Rectangle $\quad A = lw$

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

3. Volumes:

(a) Rectangular Solid $\quad V = lwh$

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

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

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

4. Distance:

(a) Distance between (x_1, y_1) and (x_2, y_2)

$$D = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$$

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