

5. The figure above shows the graph of the function f . Which of the following statements are true?

- I. $\lim_{x \rightarrow 2^-} f(x) = f(2)$
- II. $\lim_{x \rightarrow 6^-} f(x) = \lim_{x \rightarrow 6^+} f(x)$
- III. $\lim_{x \rightarrow 6} f(x) = f(6)$

- (A) II only
- (B) III only
- (C) I and II only
- (D) II and III only
- (E) I, II, and III

A A

6. $\frac{d}{dx}(\sin^3(x^2)) =$

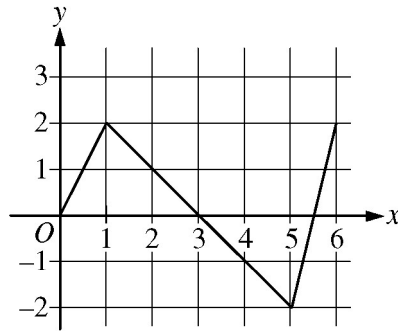
- (A) $\cos^3(x^2)$
- (B) $3\sin^2(x^2)$
- (C) $6x\sin^2(x^2)$
- (D) $3\sin^2(x^2)\cos(x^2)$
- (E) $6x\sin^2(x^2)\cos(x^2)$



9. The function f has a first derivative given by $f'(x) = x(x - 3)^2(x + 1)$. At what values of x does f have a relative maximum?
- (A) -1 only (B) 0 only (C) -1 and 0 only (D) -1 and 3 only (E) -1 , 0 , and 3

$$f(x) = \begin{cases} \frac{x^2 - 7x + 10}{b(x - 2)} & \text{for } x \neq 2 \\ b & \text{for } x = 2 \end{cases}$$

10. Let f be the function defined above. For what value of b is f continuous at $x = 2$?
- (A) -3 (B) $\sqrt{2}$ (C) 3 (D) 5 (E) There is no such value of b .



Graph of f'

11. For $0 \leq x \leq 6$, the graph of f' , the derivative of f , is piecewise linear as shown above. If $f(0) = 1$, what is the maximum value of f on the interval?

- (A) 1 (B) 1.5 (C) 2 (D) 4 (E) 6

12. Let f be the function given by $f(x) = 9^x$. If four subintervals of equal length are used, what is the value of the right Riemann sum approximation for $\int_0^2 f(x) dx$?

- (A) 20 (B) 40 (C) 60 (D) 80 (E) 120

A A

13. $\frac{d}{dx}\left(\frac{x+1}{x^2+1}\right) =$

(A) $\frac{x^2 + 2x - 1}{(x^2 + 1)^2}$

(B) $\frac{-x^2 - 2x + 1}{x^2 + 1}$

(C) $\frac{-x^2 - 2x + 1}{(x^2 + 1)^2}$

(D) $\frac{3x^2 + 2x + 1}{(x^2 + 1)^2}$

(E) $\frac{1}{2x}$

A A

14. The velocity of a particle moving along the x -axis is given by $v(t) = \sin(2t)$ at time t . If the particle is at $x = 4$ when $t = 0$, what is the position of the particle when $t = \frac{\pi}{2}$?
- (A) 2 (B) 3 (C) 4 (D) 5 (E) 6

A A

19. For what values of x does the graph of $y = 3x^5 + 10x^4$ have a point of inflection?

- (A) $x = -\frac{8}{3}$ only
- (B) $x = -2$ only
- (C) $x = 0$ only
- (D) $x = 0$ and $x = -\frac{8}{3}$
- (E) $x = 0$ and $x = -2$

20. $\lim_{x \rightarrow 2} \frac{\ln(x+3) - \ln(5)}{x-2}$ is

- (A) 0
- (B) $\frac{1}{5}$
- (C) $\frac{1}{2}$
- (D) 1
- (E) nonexistent

A A

21. Functions w , x , and y are differentiable with respect to time and are related by the equation $w = x^2y$. If x is decreasing at a constant rate of 1 unit per minute and y is increasing at a constant rate of 4 units per minute, at what rate is w changing with respect to time when $x = 6$ and $y = 20$?

- (A) -384 (B) -240 (C) -96 (D) 276 (E) 384

22. Let f be the function defined by $f(x) = 2x^3 - 3x^2 - 12x + 18$. On which of the following intervals is the graph of f both decreasing and concave up?

- (A) $(-\infty, -1)$ (B) $(-1, \frac{1}{2})$ (C) $(-1, 2)$ (D) $(\frac{1}{2}, 2)$ (E) $(2, \infty)$

A A

25. If $y = x^2 - 2x$ and $u = 2x + 1$, then $\frac{dy}{du} =$

- (A) $\frac{2(x^2 + x - 1)}{(2x + 1)^2}$ (B) $6x^2 - 3x - 2$ (C) $4x$ (D) $x - 1$ (E) $\frac{1}{x - 1}$

26. For $x > 0$, $\frac{d}{dx} \int_1^{\sqrt{x}} \frac{1}{1+t^2} dt =$

- (A) $\frac{1}{2\sqrt{x}(1+x)}$ (B) $\frac{1}{2\sqrt{x}(1+\sqrt{x})}$ (C) $\frac{1}{1+x}$ (D) $\frac{\sqrt{x}}{1+x}$ (E) $\frac{1}{1+\sqrt{x}}$

A A

27. A particle moves on the x -axis so that at any time t , $0 \leq t \leq 1$, its position is given by $x(t) = \sin(2\pi t) + 2\pi t$. For what value of t is the particle at rest?

- (A) 0 (B) $\frac{1}{8}$ (C) $\frac{1}{4}$ (D) $\frac{1}{2}$ (E) 1

CALCULUS AB
SECTION I, Part B
Time—50 minutes
Number of questions—17

A GRAPHING CALCULATOR IS REQUIRED FOR SOME QUESTIONS ON THIS PART OF THE EXAM.

Directions: Solve each of the following problems, using the available space for scratch work. After examining the form of the choices, decide which is the best of the choices given and fill in the corresponding circle on the answer sheet. No credit will be given for anything written in the exam book. Do not spend too much time on any one problem.

BE SURE YOU ARE USING PAGE 3 OF THE ANSWER SHEET TO RECORD YOUR ANSWERS TO QUESTIONS NUMBERED 76–92.

YOU MAY NOT RETURN TO PAGE 2 OF THE ANSWER SHEET.

In this exam:

- (1) The exact numerical value of the correct answer does not always appear among the choices given. When this happens, select from among the choices the number that best approximates the exact numerical value.
- (2) Unless otherwise specified, the domain of a function f is assumed to be the set of all real numbers x for which $f(x)$ is a real number.
- (3) The inverse of a trigonometric function f may be indicated using the inverse function notation f^{-1} or with the prefix “arc” (e.g., $\sin^{-1}x = \arcsin x$).

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76. A particle moves along a straight line so that at time $t > 0$ the position of the particle is given by $s(t)$, the velocity is given by $v(t)$, and the acceleration is given by $a(t)$. Which of the following expressions gives the average velocity of the particle on the interval $[2, 8]$?

(A) $\frac{1}{6} \int_2^8 a(t) dt$

(B) $\frac{1}{6} \int_2^8 s(t) dt$

(C) $\frac{s(8) - s(2)}{6}$

(D) $\frac{v(8) - v(2)}{6}$

(E) $v(8) - v(2)$

77. If $\sin\left(\frac{1}{x^2 + 1}\right)$ is an antiderivative for $f(x)$, then $\int_1^2 f(x) dx =$

(A) -0.281

(B) -0.102

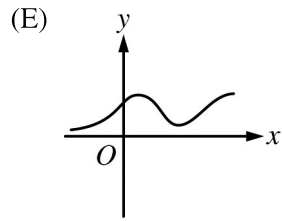
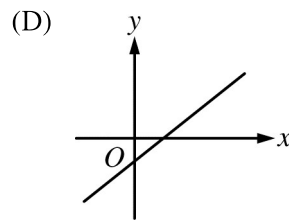
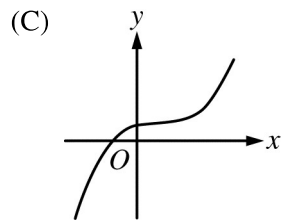
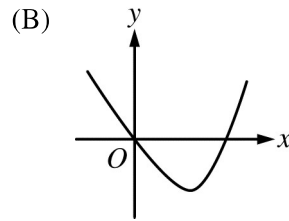
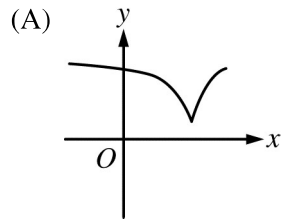
(C) 0.102

(D) 0.260

(E) 0.282

B**B****B****B****B****B****B****B****B**

78. The function f is differentiable and increasing for all real numbers x , and the graph of f has exactly one point of inflection. Of the following, which could be the graph of f' , the derivative of f ?



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79. A vase has the shape obtained by revolving the curve $y = 2 + \sin x$ from $x = 0$ to $x = 5$ about the x -axis, where x and y are measured in inches. What is the volume, in cubic inches, of the vase?

- (A) 10.716 (B) 25.501 (C) 33.666 (D) 71.113 (E) 80.115

x	$f(x)$
1	2.4
3	3.6
5	5.4

80. The table above gives selected values of a function f . The function is twice differentiable with $f''(x) > 0$. Which of the following could be the value of $f'(3)$?

- (A) 0.6 (B) 0.7 (C) 0.9 (D) 1.2 (E) 1.5

B**B****B****B****B****B****B****B****B**

81. At time $t = 0$ years, a forest preserve has a population of 1500 deer. If the rate of growth of the population is modeled by $R(t) = 2000e^{0.23t}$ deer per year, what is the population at time $t = 3$?

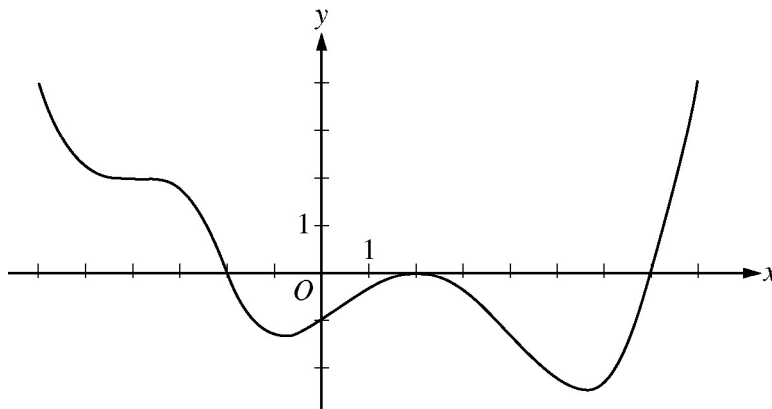
(A) 3987

(B) 5487

(C) 8641

(D) 10,141

(E) 12,628

B**B****B****B****B****B****B****B****B**Graph of f'

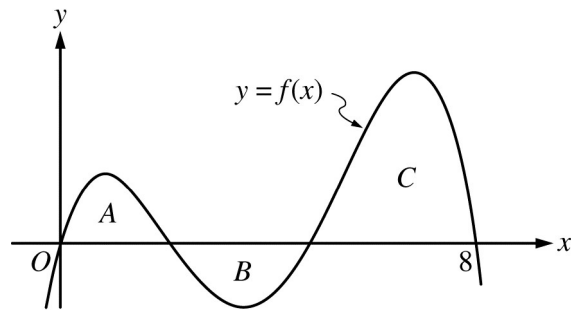
82. The figure above shows the graph of f' , the derivative of function f , for $-6 < x < 8$. Of the following, which best describes the graph of f on the same interval?
- (A) 1 relative minimum, 1 relative maximum, and 3 points of inflection
 - (B) 1 relative minimum, 1 relative maximum, and 4 points of inflection
 - (C) 2 relative minima, 1 relative maximum, and 2 points of inflection
 - (D) 2 relative minima, 1 relative maximum, and 4 points of inflection
 - (E) 2 relative minima, 2 relative maxima, and 3 points of inflection

B**B****B****B****B****B****B****B****B**

83. Let f and g be continuous functions such that $\int_0^6 f(x) dx = 9$, $\int_3^6 f(x) dx = 5$, and $\int_3^0 g(x) dx = -7$. What is

the value of $\int_0^3 \left(\frac{1}{2} f(x) - 3g(x) \right) dx$?

- (A) -23 (B) -19 (C) $-\frac{17}{2}$ (D) 19 (E) 23

B**B****B****B****B****B****B****B****B**

84. The regions A , B , and C in the figure above are bounded by the graph of the function f and the x -axis. The area of region A is 14, the area of region B is 16, and the area of region C is 50. What is the average value of f on the interval $[0, 8]$?

- (A) 6 (B) 10 (C) $\frac{40}{3}$ (D) $\frac{80}{3}$ (E) 48

85. A particle moves along the x -axis so that its velocity at time $t \geq 0$ is given by $v(t) = \frac{t^2 - 1}{t^2 + 1}$. What is the total distance traveled by the particle from $t = 0$ to $t = 2$?

- (A) 0.214 (B) 0.320 (C) 0.600 (D) 0.927 (E) 1.600

B**B****B****B****B****B****B****B****B**

86. Line ℓ is tangent to the graph of $y = e^x$ at the point (k, e^k) . What is the positive value of k for which the y -intercept of ℓ is $\frac{1}{2}$?

(A) 0.405

(B) 0.768

(C) 1.500

(D) 1.560

(E) There is no such value of k .

87. A differentiable function f has the property that $f'(x) \leq 3$ for $1 \leq x \leq 8$ and $f(5) = 6$. Which of the following could be true?

I. $f(2) = 0$

II. $f(6) = -2$

III. $f(7) = 13$

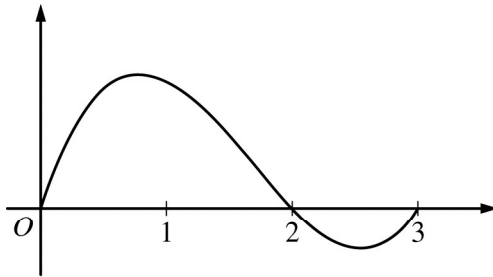
(A) I only

(B) II only

(C) I and II only

(D) I and III only

(E) II and III only

B**B****B****B****B****B****B****B****B**Graph of f

88. The graph of the differentiable function f is shown in the figure above. Let h be the function defined by $h(x) = \int_0^x f(t) dt$. Which of the following correctly orders $h(2)$, $h'(2)$, and $h''(2)$?

- (A) $h(2) < h'(2) < h''(2)$
- (B) $h'(2) < h(2) < h''(2)$
- (C) $h'(2) < h''(2) < h(2)$
- (D) $h''(2) < h(2) < h'(2)$
- (E) $h''(2) < h'(2) < h(2)$

B**B****B****B****B****B****B****B****B**

89. What is the area of the region enclosed by the graphs of $y = e^x - 2$, $y = \sin x$, and $x = 0$?
- (A) 0.239 (B) 0.506 (C) 0.745 (D) 2.340 (E) 3.472

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90. A particle moves along a line so that its velocity is given by $v(t) = -t^3 + 2t^2 + 2^{-t}$ for $t \geq 0$. For what values of t is the speed of the particle increasing?
- (A) $(0, 0.177)$ and $(1.256, \infty)$
(B) $(0, 1.256)$ only
(C) $(0, 2.057)$ only
(D) $(0.177, 1.256)$ only
(E) $(0.177, 1.256)$ and $(2.057, \infty)$

B**B****B****B****B****B****B****B****B**

91. Let F be a function defined for all real numbers x such that $F'(x) > 0$ and $F''(x) > 0$. Which of the following could be a table of values for F ?

(A)

x	$F(x)$
1	-3
2	-4
3	-6
4	-9

(B)

x	$F(x)$
1	-3
2	-1
3	3
4	19

(C)

x	$F(x)$
1	-3
2	0
3	3
4	6

(D)

x	$F(x)$
1	-3
2	5
3	11
4	13

(E)

x	$F(x)$
1	-3
2	-4
3	-3
4	0

B**B****B****B****B****B****B****B****B**

x	$f(x)$	$g(x)$	$f'(x)$
-4	0	-9	5
-2	4	-7	4
0	6	-4	2
2	7	-3	1
4	10	-2	3

92. The table above gives values of the differentiable functions f and g , and f' , the derivative of f , at selected values of x . If $g(x) = f^{-1}(x)$, what is the value of $g'(4)$?

- (A) $-\frac{1}{3}$ (B) $-\frac{1}{4}$ (C) $-\frac{3}{100}$ (D) $\frac{1}{4}$ (E) $\frac{1}{3}$