

2008 AP  
Calculus AB  
Multiple  
Choice Exam

Section 1

No Calculator Active

2008 AP  
Calculus AB  
Multiple  
Choice Exam

Section 2

Calculator Active

AP Calculus 2008 Multiple Choice

1.  $\lim_{x \rightarrow \infty} \frac{(2x-1)(3-x)}{(x-1)(x+3)}$  is

- (A) -3      (B) -2      (C) 2      (D) 3      (E) nonexistent
- 

2.  $\int \frac{1}{x^2} dx =$

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

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3. If  $f(x) = (x-1)(x^2+2)^3$ , then  $f'(x) =$

(A)  $6x(x^2+2)^2$

(B)  $6x(x-1)(x^2+2)^2$

(C)  $(x^2+2)^2(x^2+3x-1)$

(D)  $(x^2+2)^2(7x^2-6x+2)$

(E)  $-3(x-1)(x^2+2)^2$

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4.  $\int (\sin(2x) + \cos(2x)) dx =$

(A)  $\frac{1}{2}\cos(2x) + \frac{1}{2}\sin(2x) + C$

(B)  $-\frac{1}{2}\cos(2x) + \frac{1}{2}\sin(2x) + C$

(C)  $2\cos(2x) + 2\sin(2x) + C$

(D)  $2\cos(2x) - 2\sin(2x) + C$

(E)  $-2\cos(2x) + 2\sin(2x) + C$

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5.  $\lim_{x \rightarrow 0} \frac{5x^4 + 8x^2}{3x^4 - 16x^2}$  is

- (A)  $-\frac{1}{2}$       (B) 0      (C) 1      (D)  $\frac{5}{3} + 1$       (E) nonexistent

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$$f(x) = \begin{cases} \frac{x^2 - 4}{x - 2} & \text{if } x \neq 2 \\ 1 & \text{if } x = 2 \end{cases}$$

6. Let  $f$  be the function defined above. Which of the following statements about  $f$  are true?

- I.  $f$  has a limit at  $x = 2$ .
- II.  $f$  is continuous at  $x = 2$ .
- III.  $f$  is differentiable at  $x = 2$ .

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

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7. A particle moves along the  $x$ -axis with velocity given by  $v(t) = 3t^2 + 6t$  for time  $t \geq 0$ . If the particle is at position  $x = 2$  at time  $t = 0$ , what is the position of the particle at  $t = 1$ ?

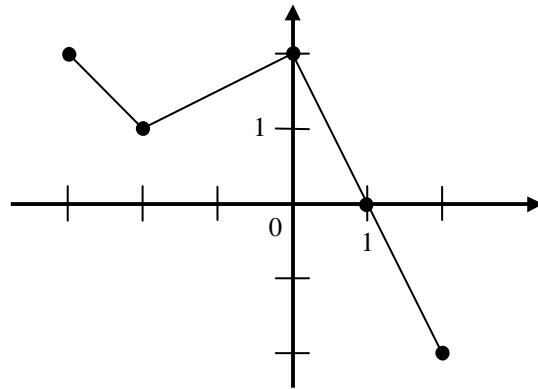
- (A) 4      (B) 6      (C) 9      (D) 11      (E) 12

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8. If  $f(x) = \cos(3x)$ , then  $f'\left(\frac{\pi}{9}\right) =$

- (A)  $\frac{3\sqrt{3}}{2}$       (B)  $\frac{\sqrt{3}}{2}$       (C)  $-\frac{\sqrt{3}}{2}$       (D)  $-\frac{3}{2}$       (E)  $-\frac{3\sqrt{3}}{2}$

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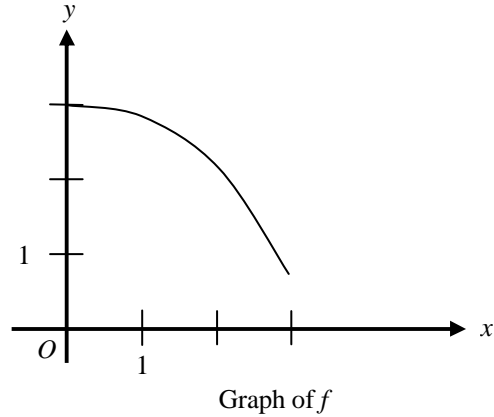
Graph of  $f$

9. The graph of the piecewise linear function  $f$  is shown in the figure above. If

$g(x) = \int_{-2}^x f(t) dt$ , which of the following values is greatest?

- (A)  $g(-3)$    (B)  $g(-2)$    (C)  $g(0)$    (D)  $g(1)$    (E)  $g(2)$

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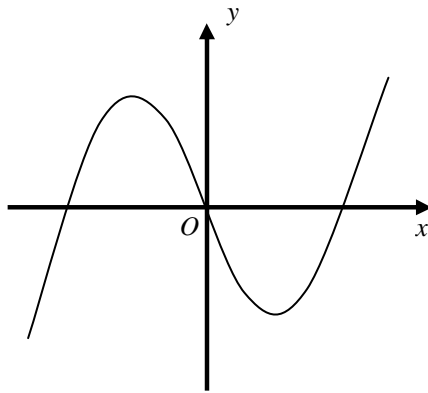


10. The graph of function  $f$  is shown above for  $0 \leq x \leq 3$ . Of the following, which has the least value?

- (A)  $\int_1^3 f(x) dx$
- (B) Left Riemann sum approximation of  $\int_1^3 f(x) dx$  with 4 subintervals of equal length
- (C) Right Riemann sum approximation of  $\int_1^3 f(x) dx$  with 4 subintervals of equal length
- (D) Midpoint Riemann sum approximation of  $\int_1^3 f(x) dx$  with 4 subintervals of equal length
- (E) Trapezoidal sum approximation of  $\int_1^3 f(x) dx$  with 4 subintervals of equal length

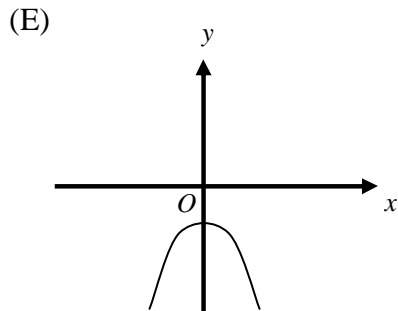
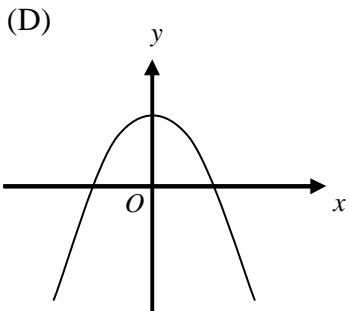
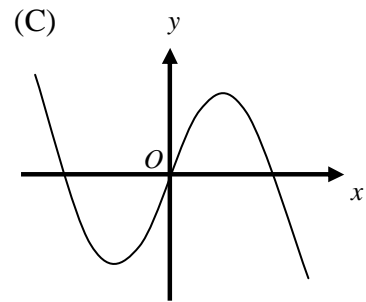
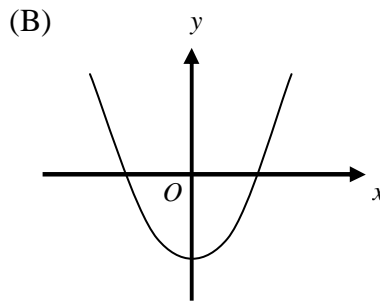
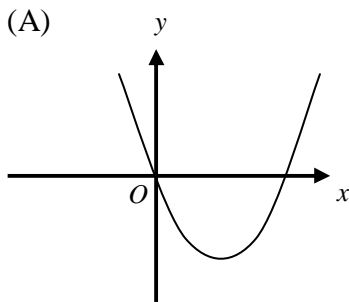


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Graph of  $f$

11. The graph of a function  $f$  is shown above. Which of the following could be the graph of  $f'$ , the derivative of  $f$ ?



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12. If  $f(x) = e^{(2/x)}$ , then  $f'(x) =$

- (A)  $2e^{(2/x)} \ln x$     (B)  $e^{(2/x)}$     (C)  $e^{(-2/x^2)}$     (D)  $-\frac{2}{x^2}e^{(2/x)}$     (E)  $-2x^2e^{(2/x)}$

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13. If  $f(x) = x^2 + 2x$ , then  $\frac{d}{dx}(f(\ln x)) =$

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

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|          |   |   |    |   |
|----------|---|---|----|---|
| $x$      | 0 | 1 | 2  | 3 |
| $f''(x)$ | 5 | 0 | -7 | 4 |

14. The polynomial function  $f$  has selected values of its second derivative  $f''$  given in the table above. Which of the following statements must be true?

- (A)  $f$  is increasing on the interval  $(0, 2)$ .
  - (B)  $f$  is decreasing on the interval  $(0, 2)$ .
  - (C)  $f$  has a local maximum at  $x = 1$ .
  - (D) The graph of  $f$  has a point of inflection at  $x = 1$ .
  - (E) The graph of  $f$  changes concavity in the interval  $(0, 2)$ .
- 

15.  $\int \frac{x}{x^2 - 4} dx =$

- (A)  $\frac{-1}{4(x^2 - 4)^2} + C$
- (B)  $\frac{1}{2(x^2 - 4)} + C$
- (C)  $\frac{1}{2} \ln|x^2 - 4| + C$
- (D)  $2 \ln|x^2 - 4| + C$
- (E)  $\frac{1}{2} \arctan\left(\frac{x}{2}\right) + C$

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16. If  $\sin(xy) = x$ , then  $\frac{dy}{dx} =$

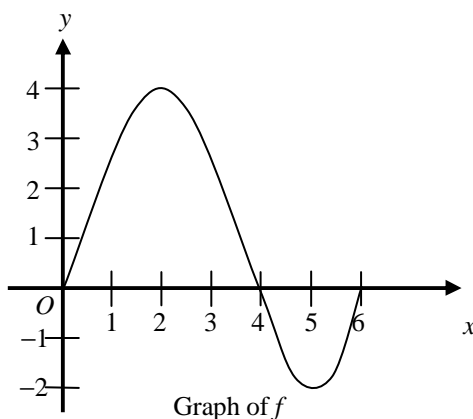
(A)  $\frac{1}{\cos(xy)}$

(B)  $\frac{1}{x \cos(xy)}$

(C)  $\frac{1 - \cos(xy)}{\cos(xy)}$

(D)  $\frac{1 - y \cos(xy)}{x \cos(xy)}$

(E)  $\frac{y(1 - \cos(xy))}{x}$



17. The graph of the function  $f$  shown above has horizontal tangents at  $x = 2$  and  $x = 5$ . Let  $g$  be the function defined by  $g(x) = \int_0^x f(t) dt$ . For what values of  $x$  does the graph of  $g$  have a point of inflection?

- (A) 2 only      (B) 4 only      (C) 2 and 5 only      (D) 2, 4, and 5      (E) 0, 4, and 6

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18. In the  $xy$ -plane, the line  $x + y = k$ , where  $k$  is a constant, is tangent to the graph of  $y = x^2 + 3x + 1$ . What is the value of  $k$ ?

- (A)  $-3$       (B)  $-2$       (C)  $-1$       (D)  $0$       (E)  $1$

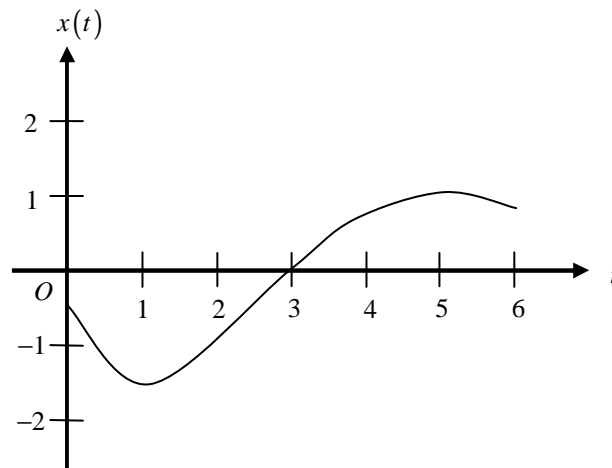
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19. What are all horizontal asymptotes of the graph of  $y = \frac{5 + 2^x}{1 - 2^x}$  in the  $xy$ -plane?

- (A)  $y = -1$  only  
(B)  $y = 0$  only  
(C)  $y = 5$  only  
(D)  $y = -1$  and  $y = 0$   
(E)  $y = -1$  and  $y = 5$

20. Let  $f$  be a function with a second derivative given by  $f''(x) = x^2(x-3)(x-6)$ . What are the  $x$ -coordinates of the points of inflection of the graph of  $f$ ?

- (A) 0 only
- (B) 3 only
- (C) 0 and 6 only
- (D) 3 and 6 only
- (E) 0, 3, and 6



21. A particle moves along a straight line. The graph of the particle's position  $x(t)$  at time  $t$  is shown above for  $0 < t < 6$ . The graph has horizontal tangents at  $t=1$  and  $t=5$  and a point of inflection at  $t=2$ . For what values of  $t$  is the velocity of the particle increasing?

- (A)  $0 < t < 2$
- (B)  $1 < t < 5$
- (C)  $2 < t < 6$
- (D)  $3 < t < 5$  only
- (E)  $1 < t < 2$  and  $5 < t < 6$

22. A rumor spreads among a population of  $N$  people at a rate proportional to the product of the number of people who have heard the rumor and the number of people who have not heard the rumor. If  $p$  denotes the number of people who have heard the rumor, which of the following differential equations could be used to model this situation with respect to time  $t$ , where  $k$  is a positive constant?

(A)  $\frac{dp}{dt} = kp$

(B)  $\frac{dp}{dt} = kp(N - p)$

(C)  $\frac{dp}{dt} = kp(p - N)$

(D)  $\frac{dp}{dt} = kt(N - t)$

(E)  $\frac{dp}{dt} = kt(t - N)$

23. Which of the following is the solution to the differential equation  $\frac{dy}{dx} = \frac{x^2}{y}$  with the initial condition  $y(3) = -2$ ?

(A)  $y = 2e^{-9+x^3/3}$

(B)  $y = -2e^{-9+x^3/3}$

(C)  $y = \sqrt{\frac{2x^3}{3}}$

(D)  $y = \sqrt{\frac{2x^3}{3} - 14}$

(E)  $y = -\sqrt{\frac{2x^3}{3} - 14}$

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24. The function  $f$  is twice differentiable with  $f(2) = 1$ ,  $f'(2) = 4$ , and  $f''(2) = 3$ . What is the value of the approximation of  $f(1.9)$  using the line tangent to the graph of  $f$  at  $x = 2$ ?

(A) 0.4

(B) 0.6

(C) 0.7

(D) 1.3

(E) 1.4



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$$f(x) = \begin{cases} cx + d & \text{for } x \leq 2 \\ x^2 - cx & \text{for } x > 2 \end{cases}$$

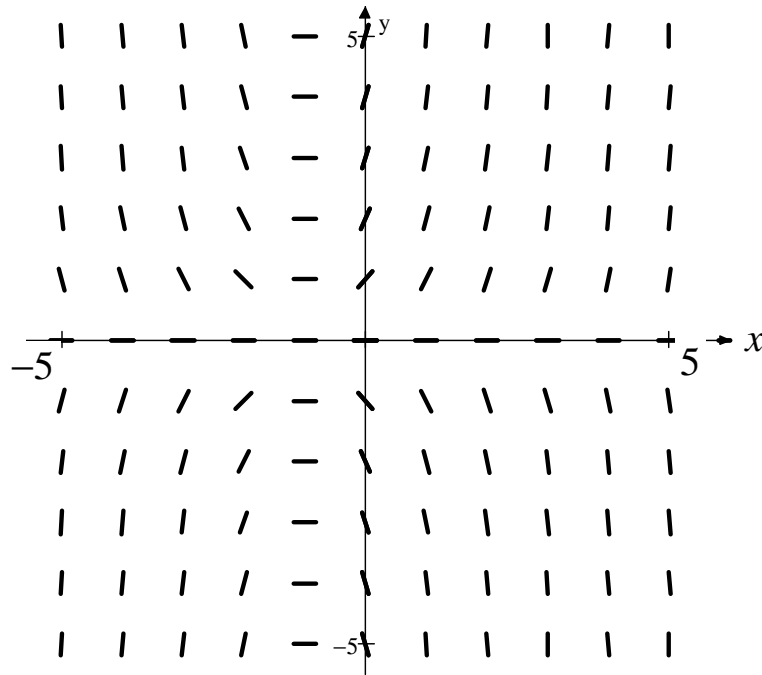
25. Let  $f$  be the function defined above, where  $c$  and  $d$  are constants. If  $f$  is differentiable at  $x = 2$ , what is the value of  $c + d$ ?

- (A)  $-4$       (B)  $-2$       (C)  $0$       (D)  $2$       (E)  $4$
- 

26. What is the slope of the line tangent to the curve  $y = \arctan(4x)$  at the point at which  $x = \frac{1}{4}$ ?

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

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27. Shown above is a slope field for which of the following differential equations?

(A)  $\frac{dy}{dx} = xy$

(B)  $\frac{dy}{dx} = xy - y$

(C)  $\frac{dy}{dx} = xy + y$

(D)  $\frac{dy}{dx} = xy + x$

(E)  $\frac{dy}{dx} = (x+1)^3$

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28. Let  $f$  be a differentiable function such that  $f(3) = 15$ ,  $f(6) = 3$ ,  $f'(3) = -8$ , and  $f'(6) = -2$ . The function  $g$  is differentiable and  $g(x) = f^{-1}(x)$  for all  $x$ . What is the value of  $g'(3)$ ?

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

(B)  $-\frac{1}{8}$

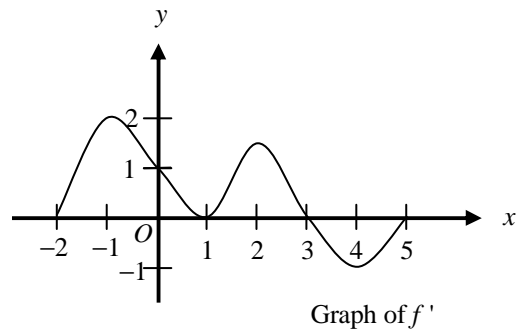
(C)  $\frac{1}{6}$

(D)  $\frac{1}{3}$

(E) The value of  $g'(3)$  cannot be determined from the information given.

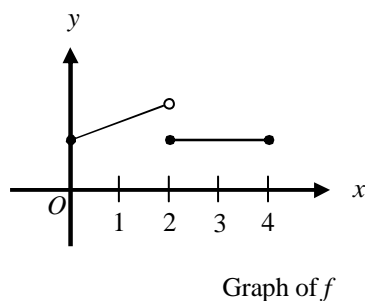
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76. The graph of  $f'$ , the derivative  $f$ , is shown above for  $-2 \leq x \leq 5$ . On what intervals is  $f$  increasing?

- (A)  $[-2, 1]$  only
- (B)  $[-2, 3]$
- (C)  $[3, 5]$  only
- (D)  $[0, 1.5]$  and  $[3, 5]$
- (E)  $[-2, -1]$ ,  $[1, 2]$ , and  $[4, 5]$



77. The figure above shows the graph of a function  $f$  with domain  $0 \leq x \leq 4$ . Which of the following statements are true?

I.  $\lim_{x \rightarrow 2^-} f(x)$  exists.

II.  $\lim_{x \rightarrow 2^+} f(x)$  exists.

III.  $\lim_{x \rightarrow 2} f(x)$  exists.

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

78. The first derivative of the function  $f$  is defined by  $f'(x) = \sin(x^3 - x)$  for  $0 \leq x \leq 2$ . On what interval(s) is  $f$  increasing?

- (A)  $1 \leq x \leq 1.445$   
 (B)  $1 \leq x \leq 1.691$   
 (C)  $1.445 \leq x \leq 1.875$   
 (D)  $0.577 \leq x \leq 1.445$  and  $1.875 \leq x \leq 2$   
 (E)  $0 \leq x \leq 1$  and  $1.691 \leq x \leq 2$

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79. If  $\int_{-5}^2 f(x) dx = -17$  and  $\int_5^2 f(x) dx = -4$ , what is the value of  $\int_{-5}^5 f(x) dx$ ?

- (A) -21      (B) -13      (C) 0      (D) 13      (E) 21

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80. The derivative of the function  $f$  is given by  $f'(x) = x^2 \cos(x^2)$ . How many points of inflection does the graph of  $f$  have on the open interval  $(-2, 2)$ ?

- (A) One      (B) Two      (C) Three      (D) Four      (E) Five

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81. If  $G(x)$  is an antiderivative for  $f(x)$  and  $G(2) = -7$ , then  $G(4) =$

(A)  $f'(4)$

(B)  $-7 + f'(4)$

(C)  $\int_2^4 f(t) dt$

(D)  $\int_2^4 (-7 + f(t)) dt$

(E)  $-7 + \int_2^4 f(t) dt$

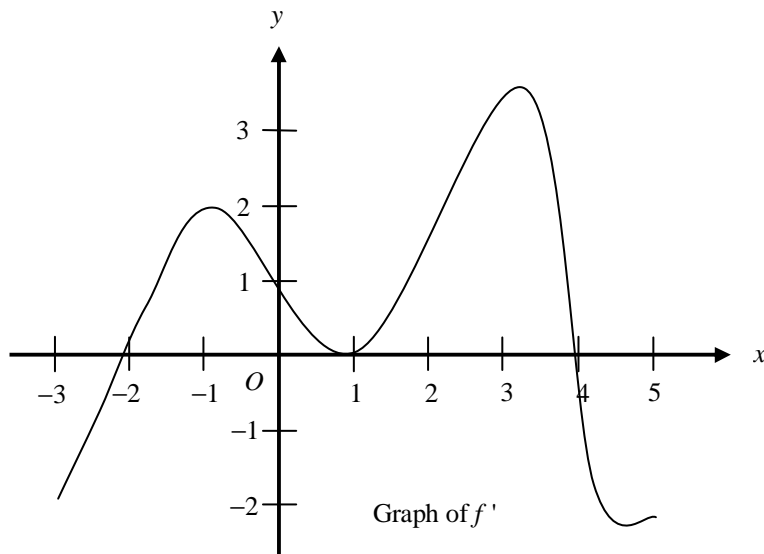
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82. A particle moves along a straight line with velocity given by  $v(t) = 7 - (1.01)^{-t^2}$  at time  $t \geq 0$ . What is the acceleration of the particle at time  $t = 3$ ?

- (A)  $-0.914$     (B)  $0.055$     (C)  $5.486$     (D)  $6.086$     (E)  $18.087$

83. What is the area enclosed by the curves  $y = x^3 - 8x^2 + 18x - 5$  and  $y = x + 5$ ?

- (A) 10.667
- (B) 11.833
- (C) 14.583
- (D) 21.333
- (E) 32



84. The graph of the derivative of a function  $f$  is shown in the figure above. The graph has horizontal tangent lines at  $x = -1$ ,  $x = 1$ , and  $x = 3$ . At which of the following values of  $x$  does  $f$  have a relative maximum?

- (A)  $-2$  only
- (B)  $1$  only
- (C)  $4$  only
- (D)  $-1$  and  $3$  only
- (E)  $-2$ ,  $1$ , and  $4$



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|         |      |      |       |      |
|---------|------|------|-------|------|
| $x$     | -4   | -3   | -2    | -1   |
| $f(x)$  | 0.75 | -1.5 | -2.25 | -1.5 |
| $f'(x)$ | -3   | -1.5 | 0     | 1.5  |

85. The table above gives values of a function  $f$  and its derivative at selected values of  $x$ . If  $f'$  is continuous on the interval  $[-4, -1]$ , what is the value of  $\int_{-4}^{-1} f'(x) dx$ ?

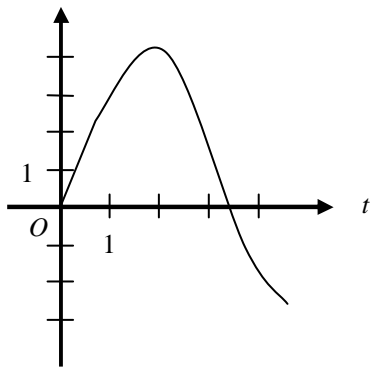
- (A) -4.5      (B) -2.25      (C) 0      (D) 2.25      (E) 4.5

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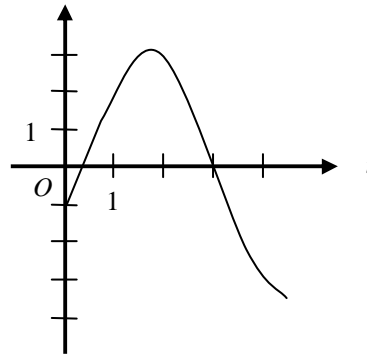
|        |    |   |   |   |    |
|--------|----|---|---|---|----|
| $t$    | 0  | 1 | 2 | 3 | 4  |
| $v(t)$ | -1 | 2 | 3 | 0 | -4 |

86. The table gives selected values of the velocity,  $v(t)$ , of a particle moving along the  $x$ -axis. At time  $t = 0$ , the particle is at the origin. Which of the following could be the graph of the position,  $x(t)$ , of the particle for  $0 \leq t \leq 4$ ?

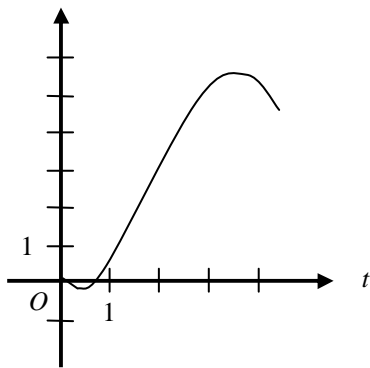
(A)  $x(t)$



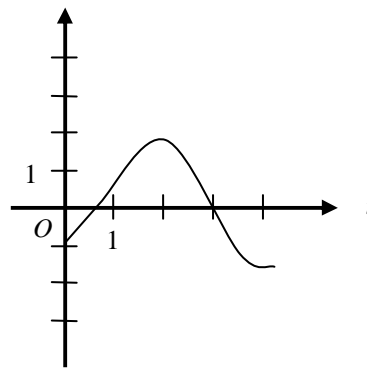
(B)  $x(t)$



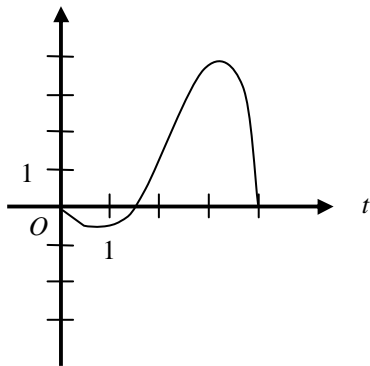
(C)  $x(t)$



(D)  $x(t)$



(E)  $x(t)$



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87. An object traveling in a straight line has position  $x(t)$  at time  $t$ . If the initial position is  $x(0) = 2$  and the velocity of the object is  $v(t) = \sqrt[3]{1+t^2}$ , what is the position of the object at time  $t = 3$ ?

- (A) 0.431      (B) 2.154      (C) 4.512      (D) 6.512      (E) 17.408

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88. The radius of a sphere is decreasing at a rate of 2 centimeters per second. At the instant when the radius of the sphere is 3 centimeters, what is the rate of change, in square centimeters per second, of the surface area of the sphere? (The surface area  $S$  of a sphere with radius  $r$  is  $S = 4\pi r^2$ )

- (A)  $-108\pi$       (B)  $-72\pi$       (C)  $-48\pi$       (D)  $-24\pi$       (E)  $-16\pi$

89. The function  $f$  is continuous for  $-2 \leq x \leq 2$  and  $f(-2) = f(2) = 0$ . If there is no  $c$ , where  $-2 < c < 2$ , for which  $f'(c) = 0$ , which of the following statements must be true?

- (A) For  $-2 < k < 2$ ,  $f'(k) > 0$ .
- (B) For  $-2 < k < 2$ ,  $f'(k) < 0$ .
- (C) For  $-2 < k < 2$ ,  $f'(k)$  exists.
- (D) For  $-2 < k < 2$ ,  $f'(k)$  exists, but  $f'$  is not continuous.
- (E) For some  $k$ , where  $-2 < k < 2$ ,  $f'(k)$  does not exist.

90. The function  $f$  is continuous on the closed interval  $[2, 4]$  and twice differentiable on the open interval  $(2, 4)$ . If  $f'(3) = 2$  and  $f''(x) < 0$  on the open interval  $(2, 4)$ , which of the following could be a table of values for  $f$ ?

(A)

| $x$ | $f(x)$ |
|-----|--------|
| 2   | 2.5    |
| 3   | 5      |
| 4   | 6.5    |

(B)

| $x$ | $f(x)$ |
|-----|--------|
| 2   | 2.5    |
| 3   | 5      |
| 4   | 7      |

(C)

| $x$ | $f(x)$ |
|-----|--------|
| 2   | 3      |
| 3   | 5      |
| 4   | 6.5    |

(D)

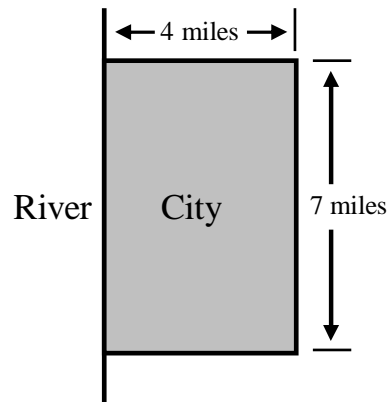
| $x$ | $f(x)$ |
|-----|--------|
| 2   | 3      |
| 3   | 5      |
| 4   | 7      |

(E)

| $x$ | $f(x)$ |
|-----|--------|
| 2   | 3.5    |
| 3   | 5      |
| 4   | 7.5    |

91. What is the average value of  $y = \frac{\cos x}{x^2 + x + 2}$  on the closed interval  $[-1, 3]$ ?

- (A)  $-0.085$     (B)  $0.090$     (C)  $0.183$     (D)  $0.244$     (E)  $0.732$
- 



92. A city located beside a river has a rectangular boundary as shown in the figure above. The population density of the city at any point along a strip  $x$  miles from the river's edge is  $f(x)$  persons per square mile. Which of the following expressions gives the population of the city?

- (A)  $\int_0^4 f(x) dx$   
(B)  $7 \int_0^4 f(x) dx$   
(C)  $28 \int_0^4 f(x) dx$   
(D)  $\int_0^7 f(x) dx$   
(E)  $4 \int_0^7 f(x) dx$