

1. If $y = (x^3 + 1)^2$, then $\frac{dy}{dx} =$

- (A) $(3x^2)^2$ (B) $2(x^3 + 1)$ (C) $2(3x^2 + 1)$ (D) $3x^2(x^3 + 1)$ (E) $6x^2(x^3 + 1)$
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2. $\int_0^1 e^{-4x} dx =$

- (A) $\frac{-e^{-4}}{4}$ (B) $-4e^{-4}$ (C) $e^{-4} - 1$ (D) $\frac{1}{4} - \frac{e^{-4}}{4}$ (E) $4 - 4e^{-4}$
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3. For $x \geq 0$, the horizontal line $y = 2$ is an asymptote for the graph of the function f . Which of the following statements must be true?

(A) $f(0) = 2$
(B) $f(x) \neq 2$ for all $x \geq 0$
(C) $f(2)$ is undefined.
(D) $\lim_{x \rightarrow 2} f(x) = \infty$
(E) $\lim_{x \rightarrow \infty} f(x) = 2$

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4. If $y = \frac{2x+3}{3x+2}$, then $\frac{dy}{dx} =$

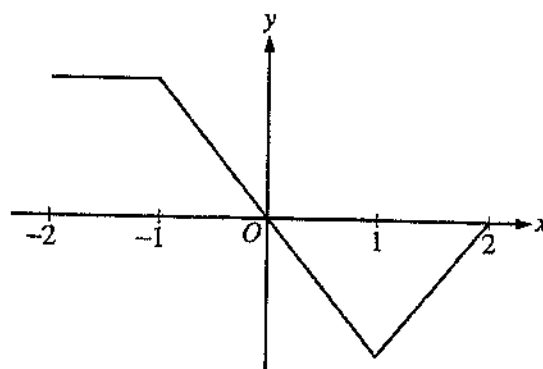
(A) $\frac{12x+13}{(3x+2)^2}$ (B) $\frac{12x-13}{(3x+2)^2}$ (C) $\frac{5}{(3x+2)^2}$ (D) $\frac{-5}{(3x+2)^2}$ (E) $\frac{2}{3}$

5. $\int_0^{\pi/4} \sin x \, dx =$

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

6. $\lim_{x \rightarrow \infty} \frac{x^3 - 2x^2 + 3x - 4}{4x^3 - 3x^2 + 2x - 1} =$

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

Graph of f'

7. The graph of f' , the derivative of the function f , is shown above. Which of the following statements is true about f ?
- (A) f is decreasing for $-1 \leq x \leq 1$.
 - (B) f is increasing for $-2 \leq x \leq 0$.
 - (C) f is increasing for $1 \leq x \leq 2$.
 - (D) f has a local minimum at $x = 0$.
 - (E) f is not differentiable at $x = -1$ and $x = 1$.

8. $\int x^2 \cos(x^3) dx =$

(A) $-\frac{1}{3} \sin(x^3) + C$

(B) $\frac{1}{3} \sin(x^3) + C$

(C) $-\frac{x^3}{3} \sin(x^3) + C$

(D) $\frac{x^3}{3} \sin(x^3) + C$

(E) $\frac{x^3}{3} \sin\left(\frac{x^4}{4}\right) + C$

9. If $f(x) = \ln(x + 4 + e^{-3x})$, then $f'(0)$ is

(A) $-\frac{2}{5}$

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

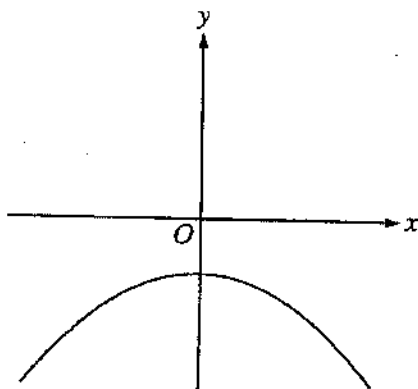
(C) $\frac{1}{4}$

(D) $\frac{2}{5}$

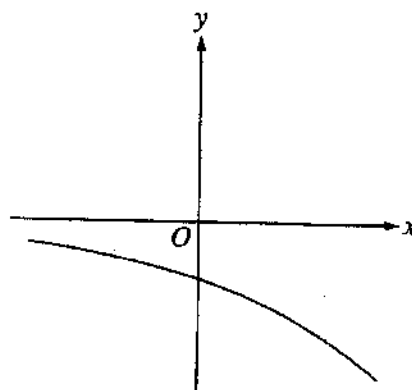
(E) nonexistent

10. The function f has the property that $f(x)$, $f'(x)$, and $f''(x)$ are negative for all real values x . Which of the following could be the graph of f ?

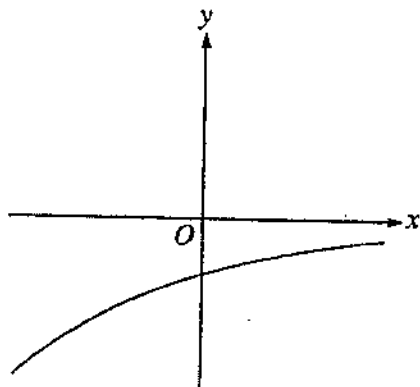
(A)



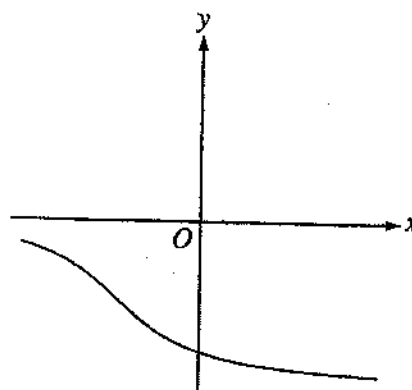
(B)



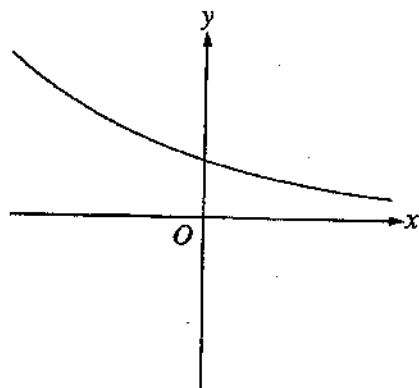
(C)



(D)



(E)

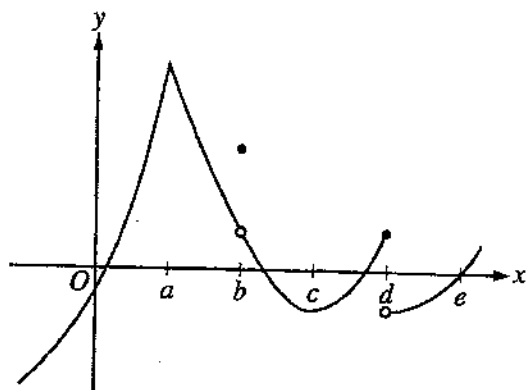


11. Using the substitution $u = 2x + 1$, $\int_0^2 \sqrt{2x+1} \, dx$ is equivalent to

- (A) $\frac{1}{2} \int_{-1/2}^{1/2} \sqrt{u} \, du$ (B) $\frac{1}{2} \int_0^2 \sqrt{u} \, du$ (C) $\frac{1}{2} \int_1^5 \sqrt{u} \, du$ (D) $\int_0^2 \sqrt{u} \, du$ (E) $\int_1^5 \sqrt{u} \, du$

12. The rate of change of the volume, V , of water in a tank with respect to time, t , is directly proportional to the square root of the volume. Which of the following is a differential equation that describes this relationship?

- (A) $V(t) = k\sqrt{t}$
(B) $V(t) = k\sqrt{V}$
(C) $\frac{dV}{dt} = k\sqrt{t}$
(D) $\frac{dV}{dt} = \frac{k}{\sqrt{V}}$
(E) $\frac{dV}{dt} = k\sqrt{V}$

Graph of f

13. The graph of a function f is shown above. At which value of x is f continuous, but not differentiable?
- (A) a (B) b (C) c (D) d (E) e

14. If $y = x^2 \sin 2x$, then $\frac{dy}{dx} =$

- (A) $2x \cos 2x$
(B) $4x \cos 2x$
(C) $2x(\sin 2x + \cos 2x)$
(D) $2x(\sin 2x - x \cos 2x)$
(E) $2x(\sin 2x + x \cos 2x)$

15. Let f be the function with derivative given by $f'(x) = x^2 - \frac{2}{x}$. On which of the following intervals is f decreasing?

(A) $(-\infty, -1]$ only

(B) $(-\infty, 0)$

(C) $[-1, 0)$ only

(D) $(0, \sqrt[3]{2}]$

(E) $[\sqrt[3]{2}, \infty)$

16. If the line tangent to the graph of the function f at the point $(1, 7)$ passes through the point $(-2, -2)$, then $f'(1)$ is

(A) -5

(B) 1

(C) 3

(D) 7

(E) undefined

17. Let f be the function given by $f(x) = 2xe^x$. The graph of f is concave down when
- (A) $x < -2$ (B) $x > -2$ (C) $x < -1$ (D) $x > -1$ (E) $x < 0$

x	-4	-3	-2	-1	0	1	2	3	4
$g'(x)$	2	3	0	-3	-2	-1	0	3	2

18. The derivative g' of a function g is continuous and has exactly two zeros. Selected values of g' are given in the table above. If the domain of g is the set of all real numbers, then g is decreasing on which of the following intervals?
- (A) $-2 \leq x \leq 2$ only
(B) $-1 \leq x \leq 1$ only
(C) $x \geq -2$
(D) $x \geq 2$ only
(E) $x \leq -2$ or $x \geq 2$
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19. A curve has slope $2x + 3$ at each point (x, y) on the curve. Which of the following is an equation for this curve if it passes through the point $(1, 2)$?

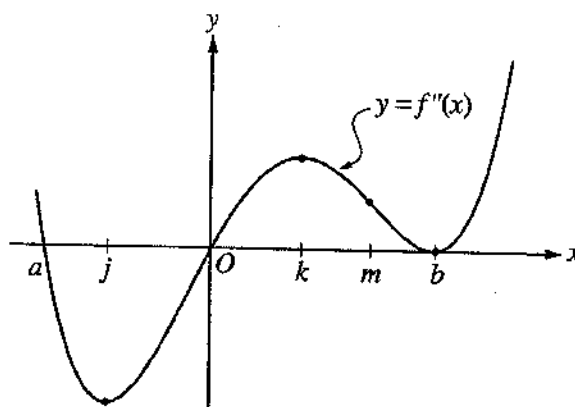
- (A) $y = 5x - 3$
- (B) $y = x^2 + 1$
- (C) $y = x^2 + 3x$
- (D) $y = x^2 + 3x - 2$
- (E) $y = 2x^2 + 3x - 3$

$$f(x) = \begin{cases} x + 2 & \text{if } x \leq 3 \\ 4x - 7 & \text{if } x > 3 \end{cases}$$

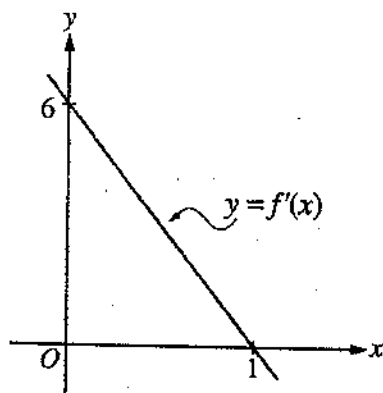
20. Let f be the function given above. Which of the following statements are true about f ?

- I. $\lim_{x \rightarrow 3} f(x)$ exists.
- II. f is continuous at $x = 3$.
- III. f is differentiable at $x = 3$.

- (A) None
- (B) I only
- (C) II only
- (D) I and II only
- (E) I, II, and III



21. The second derivative of the function f is given by $f''(x) = x(x - a)(x - b)^2$. The graph of f'' is shown above. For what values of x does the graph of f have a point of inflection?
- (A) 0 and a only (B) 0 and m only (C) b and j only (D) 0, a , and b (E) b , j , and k



22. The graph of f' , the derivative of f , is the line shown in the figure above. If $f(0) = 5$, then $f(1) =$
- (A) 0 (B) 3 (C) 6 (D) 8 (E) 11

23. $\frac{d}{dx} \left(\int_0^{x^2} \sin(t^3) dt \right) =$

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

24. Let f be the function defined by $f(x) = 4x^3 - 5x + 3$. Which of the following is an equation of the line tangent to the graph of f at the point where $x = -1$?

(A) $y = 7x - 3$
(B) $y = 7x + 7$
(C) $y = 7x + 11$
(D) $y = -5x - 1$
(E) $y = -5x - 5$

25. A particle moves along the x -axis so that at time $t \geq 0$ its position is given by $x(t) = 2t^3 - 21t^2 + 72t - 53$. At what time t is the particle at rest?

(A) $t = 1$ only
(B) $t = 3$ only
(C) $t = \frac{7}{2}$ only
(D) $t = 3$ and $t = \frac{7}{2}$
(E) $t = 3$ and $t = 4$

26. What is the slope of the line tangent to the curve $3y^2 - 2x^2 = 6 - 2xy$ at the point $(3, 2)$?

- (A) 0 (B) $\frac{4}{9}$ (C) $\frac{7}{9}$ (D) $\frac{6}{7}$ (E) $\frac{5}{3}$

27. Let f be the function defined by $f(x) = x^3 + x$. If $g(x) = f^{-1}(x)$ and $g(2) = 1$, what is the value of $g'(2)$?

- (A) $\frac{1}{13}$ (B) $\frac{1}{4}$ (C) $\frac{7}{4}$ (D) 4 (E) 13

28. Let g be a twice-differentiable function with $g'(x) > 0$ and $g''(x) > 0$ for all real numbers x , such that $g(4) = 12$ and $g(5) = 18$. Of the following, which is a possible value for $g(6)$?
- (A) 15 (B) 18 (C) 21 (D) 24 (E) 27
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END OF PART A OF SECTION I