4

1. Let f be the function given by $f(x) = (2x-1)^5(x+1)$. Which of the following is an equation for the line tangent to the graph of f at the point where $x = 1$?

(A) $y = 21x + 2$
(B) $y = 21x - 19$
(C) $y = 11x - 9$
(D) $y = 10x + 2$
(E) $y = 10x - 8$

2. Let f be the function defined by $f(x) = \ln(x^2 + 1)$, and let g be the function defined by $g(x) = x^5 + x^3$. The line tangent to the graph of f at $x = 2$ is parallel to the line tangent to the graph of g at $x = a$, where a is a positive constant. What is the value of a ?

(A) 0.246
(B) 0.430
(C) 0.447
(D) 0.790

3. What is the slope of the line tangent to the graph of $y = \frac{e^{-x}}{x+1}$ at $x = 1$?

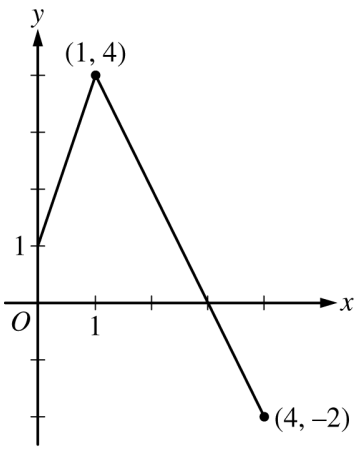
(A) $-\frac{1}{e}$
(B) $-\frac{3}{4e}$
(C) $-\frac{1}{4e}$
(D) $\frac{1}{4e}$
(E) $\frac{1}{e}$

4. An equation of the line tangent to the graph of $f(x) = x(1-2x)^3$ at the point $(1,-1)$ is

(A) $y = -7x + 6$
(B) $y = -6x + 5$
(C) $y = -2x$
(D) $y = 2x - 3$
(E) $y = 7x - 8$

4

5.

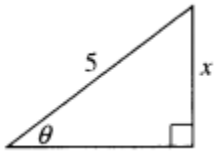


Graph of *f*

The graph of the function *f*, consisting of two line segments, is shown in the figure above. Let *g* be the function given by $g(x) = 2x + 1$, and let *h* be the function given by $h(x) = f(g(x))$. What is the value of $h'(1)$?

(A) -4
(B) -2
(C) 4
(D) 6
(E) nonexistent

6.



In the triangle shown above, if θ increases at a constant rate of 3 radians per minute, at what rate is *x* increasing in units per minute when *x* equals 3 units?

(A) 3
(B) $\frac{15}{4}$
(C) 4
(D) 9
(E) 12

7. A particle moves along the *x*-axis so that at any time t≥0, its velocity is given by *v(t)*=sin(2*t*). If the position of the particle at time $t = \frac{\pi}{2}$ is $x = 4$, what is the particle's position at time $t = 0$?

4

(A) $-\frac{1}{2}$
(B) 2
(C) 3
(D) 5
(E) 8

8. If $y = \sin^3 x$, then $\frac{dy}{dx} =$

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

9. If $f(x) = \cos^3(4x)$, then $f'(x) =$

(A) $3\cos^2(4x)$
(B) $-12\cos^2(4x)\sin(4x)$
(C) $-3\cos^2(4x)\sin(4x)$
(D) $12\cos^2(4x)\sin(4x)$
(E) $-4\sin^3(4x)$

10. Let f be the function given by $f(x) = \cos(2x) + \ln(3x)$. What is the least value of x at which the graph of f changes concavity?

(A) 0.56
(B) 0.93
(C) 1.18
(D) 2.38
(E) 2.44

11. How many critical points does the function $f(x) = (x+2)^5(x-3)^4$ have?

(A) One
(B) Two
(C) Three
(D) Five
(E) Nine

12. If $\arcsin x = \ln y$, then $\frac{dy}{dx} =$

4

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

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

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

(D) $e^{\arcsin x}$

(E) $\frac{e^{\arcsin x}}{1+x^2}$

13.

X	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	3	-2	-3	4

The table above gives values of the differentiable functions f and g and their derivatives at $x = 1$. If $h(x) = (2f(x) + 3)(1 + g(x))$, then h'(1) =

(A) -28

(B) -16

(C) 40

(D) 44

(E) 47

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

(A) $\sin x + \cos x$

(B) $\sin x + x \cos x$

(C) $\sin x - x \cos x$

(D) $x(\sin x + \cos x)$

(E) $x(\sin x - \cos x)$

15. $\frac{d}{dx}(2^x)=$

(A) 2^{x-1}

(B) $\left(2^{x-1}\right)x$

(C) $(2^x)\ln 2$

(D) $\left(2^{x-1}\right)\ln 2$

(E) 2x/ln2

16. If $f(x) = \mathrm{e}^x$, then $\ln(f'(2)) =$

4

(A) 2
(B) 0
(C) $1/e^2$
(D) 2e
(E) e^2

17. If $f(x) = ae^{-ax}$ for $a > 0$, then $f'(x) =$

(A) e^{-ax}
(B) ae^{-ax}
(C) a^2e^{-ax}
(D) $-ae^{-ax}$
(E) $-a^2e^{-ax}$

18. If $f(x) = \ln x$, then $\lim_{x \to 3} \frac{f(x)-f(3)}{x-3}$ is

(A) $\frac{1}{3}$
(B) e^3
(C) ln 3
(D) nonexistent

19. Let *f* and *g* be differentiable functions with the following properties

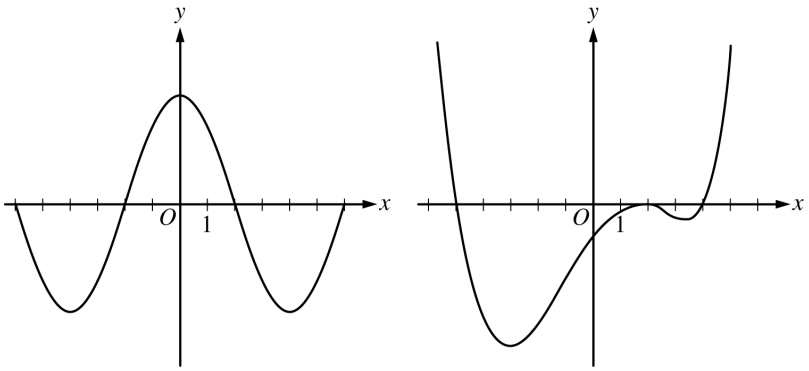
(i) $g(x)>0$ for all x

(ii) $f(0)=1$ If $h(x)=f(x)g(x)$ and $h'(x)=f(x)g'(x)$, then $f(x)=$:

(A) $f'(x)$
(B) $g(x)$
(C) e^x
(D) 0
(E) 1

4

20.



Graph of f Graph of g

The graphs of two differentiable functions f and g are shown above. Given $p(x) = f(x)g(x)$ which of the following statements about $p'(-2)$ is true?

(A) $p'(-2) < 0$

(B) $p'(-2) = 0$

(C) $p'(-2) > 0$

(D) $p'(-2)$ is undefined.

(E) There is not enough information given to conclude anything about $p'(-2)$.

21. 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) $2x(\sin 2x + x \cos 2x)$

22. If $f(x) = e^{2x}\left(x^3 + 1\right)$, then $f'(2) =$

(A) $6e^4$

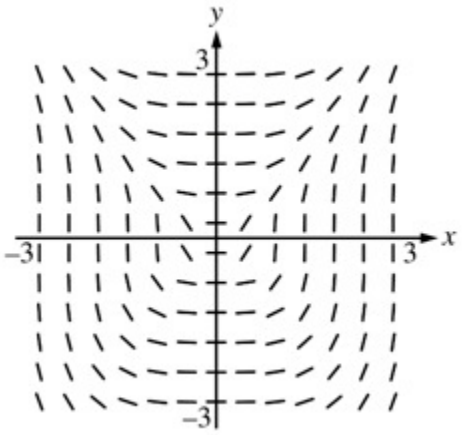
(B) $21e^4$

(C) $24e^4$

(D) $30e^4$

4

23.



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

(A) $\frac{dy}{dx} = \frac{x}{y}$

(B) $\frac{dy}{dx} = \frac{x^2}{y^2}$

(C) $\frac{dy}{dx} = \frac{x^3}{y}$

(D) $\frac{dy}{dx} = \frac{x^2}{y}$

(E) $\frac{dy}{dx} = \frac{x^3}{y^2}$

24. If $y = \frac{\ln x}{x}$, then $\frac{dy}{dx} =$

(A) $\frac{1}{x}$

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

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

(D) $\frac{1 - \ln x}{x^2}$

(E) $\frac{1 + \ln x}{x^2}$

25. If $y = \sin(3x)$, then $\frac{dy}{dx} =$

(A) $-3\cos(3x)$

(B) $-\cos(3x)$

(C) $-\frac{1}{3}\cos(3x)$

(D) $\cos(3x)$

(E) $3\cos(3x)$

26. If $f(x) = \sin x$, then f′(π/3) =

4

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

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

(C) $\frac{\sqrt{2}}{2}$

(D) $\frac{\sqrt{3}}{2}$

(E) $\sqrt{3}$

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

(A) $\cos^3\left(x^2\right)$

(B) $3\sin^2\left(x^2\right)$

(C) $6x\sin^2\left(x^2\right)$

(D) $3\sin^2\left(x^2\right)\cos\left(x^2\right)$

(E) $6x\sin^2\left(x^2\right)\cos\left(x^2\right)$

28. $\frac{d}{dx}\ \ln|\cos(\frac{\pi}{x})|$ is

(A) $\frac{-\pi}{x^2\ \cos(\frac{\pi}{x})}$

(B) $-\tan(\frac{\pi}{x})$

(C) $\frac{1}{\cos(\frac{\pi}{x})}$

(D) $\frac{\pi}{x}\ \tan(\frac{\pi}{x})$

(E) $\frac{\pi}{x^2}\tan(\frac{\pi}{x})$

29. $d/dx(1/x^3 - 1/x + x^2)$ at $x = -1$ is

(A) -6

(B) -4

(C) 0

(D) 2

(E) 6

30. If y = sin x cos x, then at $x = \frac{\pi}{3}$, $\frac{dy}{dx} =$

4

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

31. Suppose that *f* is an odd function; i.e., *f(-x)=-f(x)* for all *x*. Suppose that $f'(x_0)$ exists. Which of the following must necessarily be equal to $f'(-x_0)$?

(A) $f'(x_0)$
(B) $-f'(x_0)$
(C) $\frac{1}{f'(x_0)}$
(D) $-\frac{1}{f'(x_0)}$
(E) None of the above

32. If $y = \frac{1}{2}x^{4/5} - \frac{3}{x^5}$, then $\frac{dy}{dx} =$

(A) $\frac{2}{5x^{1/5}} + \frac{15}{x^6}$
(B) $\frac{2}{5x^{1/5}} + \frac{15}{x^4}$
(C) $\frac{2}{5x^{1/5}} - \frac{3}{5x^4}$
(D) $\frac{2x^{1/5}}{5} + \frac{15}{x^6}$
(E) $\frac{2x^{1/5}}{5} - \frac{3}{5x^4}$

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

(A) -2
(B) $2x + y - 2$
(C) $2x + y$
(D) $4x + 2y - 2$
(E) $y - \frac{y}{x}$

34. If $f(x) = 4x^{-2} + \frac{1}{4}x^2 + 4$, then $f'(2) =$

(A) -62
(B) -58
(C) -3
(D) 0
(E) 1

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

4

(A) $2xe^x$
(B) $x(x + 2e^x)$
(C) $xe^x(x + 2)$
(D) $2x + e^x$
(E) $2x + e$

36. If $f(x) = 7x - 3 + \ln\ x$, then $f'(1) =$
(A) 4
(B) 5
(C) 6
(D) 7
(E) 8

37. If $f(x)=x + \sin x$, then $f'(x) =$
(A) $1 + \cos x$
(B) $1 - \cos x$
(C) $\cos x$
(D) $\sin x - x\cos x$
(E) $\sin x + x\cos x$

38. If $f(x) = (x - 1)^2 \sin x$, then $f'(0) =$
(A) -2
(B) -1
(C) 0
(D) 1
(E) 2

39. The slope of the line tangent to the graph of $y = \ln(1 - x)$ at x = -1 is
(A) -1
(B) -1/2
(C) 1/2
(D) ln 2
(E) 1

40. If $y = x^2(e^x - 1)$, then $\frac{dy}{dx} =$
(A) $2xe^x$
(B) $2xe^x - 2x$
(C) $x^2e^x + 2xe^x - 2x$
(D) $x^2e^x + 2xe^x - x^2 - 2x$

41. What are all values of x for which the function f defined by $f(x) = (x^2 - 3)e^{-x}$ is increasing?

(A) There are no such values of x.

(B) $x < -1$ and $x > 3$

(C) $-3 < x < 1$

(D) $-1 < x < 3$

(E) All values of x

42. The slope of the line tangent to the graph of $y = xe^x$ at $x = \ln 2$ is

(A) $2 \ln 2$

(B) $2 \ln 2 + 2$

(C) $e^2(\ln 2) + e^2$

(D) $2 + \frac{2 \ln 2}{e}$

43. If $y = 5x\sqrt{x^2 + 1}$, then $\frac{dy}{dx}$ at $x = 3$ is

(A) $\frac{5}{2\sqrt{10}}$

(B) $\frac{15}{\sqrt{10}}$

(C) $\frac{15}{2\sqrt{10}} + 5\sqrt{10}$

(D) $\frac{45}{\sqrt{10}} + 5\sqrt{10}$

(E) $\frac{45}{\sqrt{10}} + 15\sqrt{10}$

44. If $y = x\sqrt{2x + 5}$, then $y' =$

(A) $\frac{3x+5}{\sqrt{2x+5}}$

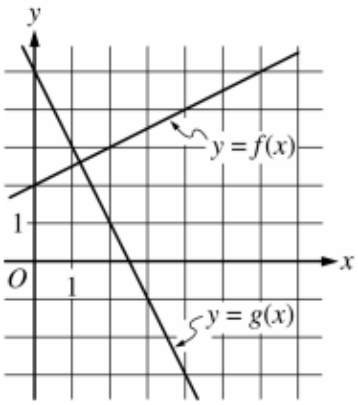
(B) $\frac{1}{\sqrt{2x+5}}$

(C) $\frac{1}{2\sqrt{2x+5}}$

(D) $\frac{5x+10}{2\sqrt{2x+5}}$

4

45.



The figure above shows the graphs of the functions *f* and *g*. If *h(x) = f(x)g(x),* then *h'(2)* =

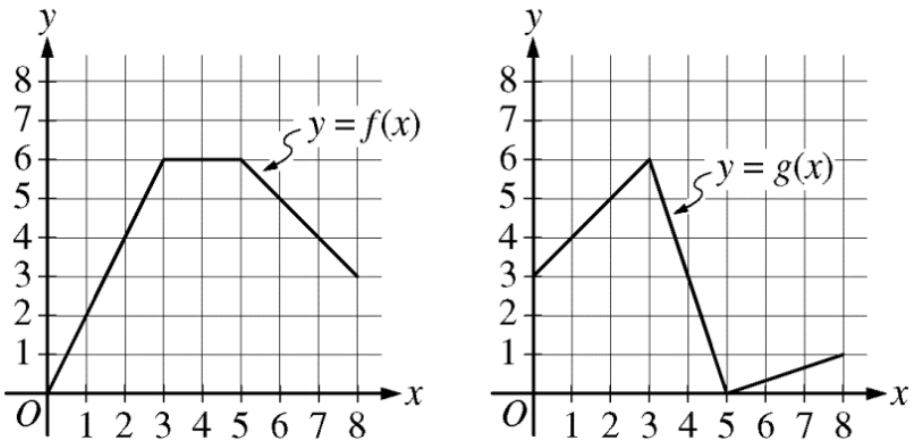
(A) $\frac{13}{2}$

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

(C) -1

(D) $-\frac{11}{2}$

46.



The graphs of the piecewise linear functions f and g are shown above. If the function h is defined by h(x) = f(x)g(x), then h'(2) is

(A) 2

(B) 13

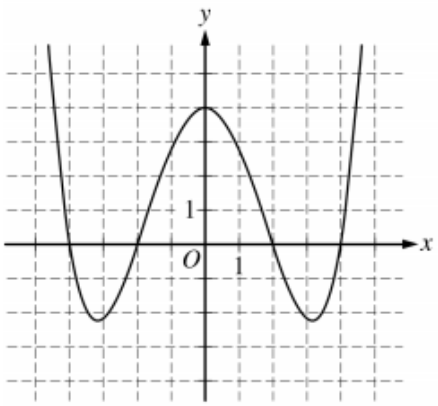
(C) 14

(D) 20

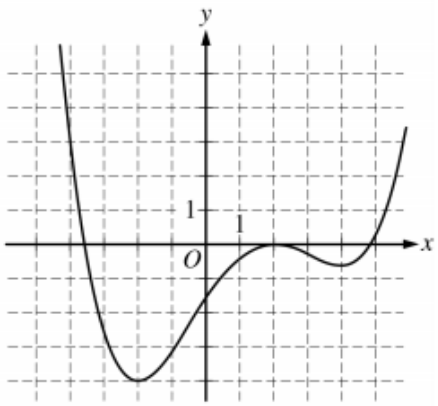
(E) nonexistent

4

47.



Graph of f



Graph of g

The graphs of the differentiable functions f and g are shown above. If the function p is defined by $p(x) = f(x)g(x)$, which of the following must be true about p', the derivative of p ?

(A) p'(-2) < 0

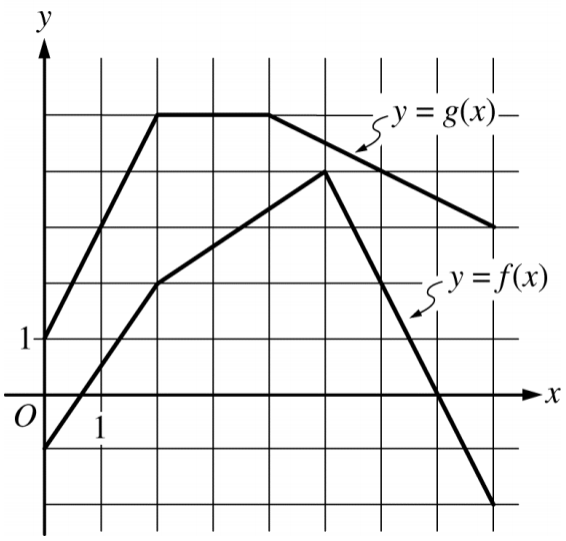
(B) p'(-2) = 0

(C) p'(-2) > 0

(D) p'(0) < 0

(E) p'(0) = 0

48.



The graphs of f and g are shown above. If $h(x) = f(x)g(x)$, then h'(6) =

4

(A) -9
(B) -7
(C) 1
(D) 7
(E) 9

49. The slope of the line tangent to the graph of y = ln(1-x) at x = -1 is

(A) -1
(B) -1/2
(C) 1/2
(D) ln2
(E) 1

50. $\lim_{h \to 0} \frac{e^{2+h} - e^2}{h}$ is

(A) 0
(B) e^2
(C) $2e^2$
(D) nonexistent

51. $\lim_{h \to 0} \frac{e^{(2+h)} - e^2}{h} =$

(A) 0
(B) 1
(C) $2e$
(D) e^2
(E) $2e^2$

52. Let R be the region bounded by the graphs of $y = 2x$ and $y = 4x - x^2$. What is the area of R ?

(A) $\frac{2}{3}$
(B) $\frac{4}{3}$
(C) $\frac{16}{3}$
(D) $\frac{28}{3}$

53. If $f(x) = \ln x$, then $\lim_{x \to 2} \frac{f(2) - f(x)}{x - 2} =$

4

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

54. $\lim_{x \to 0} \frac{5^x - 1}{x} =$

(A) 0
(B) $\ln 5$
(C) $5 \ln 5$
(D) 1

55. $\lim_{h \to 0} \frac{\cos\left(\frac{\pi}{5} + h\right) - \cos\left(\frac{\pi}{5}\right)}{h}$ is

(A) $-\sin\left(\frac{\pi}{5}\right)$
(B) $\sin\left(\frac{\pi}{5}\right)$
(C) $\cos\left(\frac{\pi}{5}\right)$
(D) nonexistent

56. If $f(x) = \sin x$, then $\lim_{x \to 2\pi} \frac{f(2\pi) - f(x)}{x - 2\pi} =$

(A) -2π
(B) -1
(C) 1
(D) 2π

57. $\lim_{x \to 0} \frac{2^x - 1}{x} =$

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

58. If $f(x) = 12x^{\frac{1}{2}} + 3x + \frac{32}{x} + 5$, then $f'(4) =$

(A) 4
(B) 8
(C) 9
(D) 13

59. Let f and g be differentiable functions such that $f'(1) = 2$ and $g'(1) = 6$. If $h(x) = 5f(x) - 4g(x) + 3x^2 - 2$, what is the value of $h'(1)$?

4

(A) -10
(B) -8
(C) 2
(D) 40

60. Let f be the function defined by $f(x) = bx^2 + 3bx + b^2 + \frac{1}{x^2}$, where b is a nonzero constant. Which of the following is an expression for $f'(x)$, the derivative of $f(x)$?

(A) $2bx + 3b - \frac{2}{x}$
(B) $2bx + 3b - \frac{2}{x^3}$
(C) $2bx + 3b + b^2 - \frac{2}{x^3}$
(D) $x^2 + 3x + 2b$

61. Let f and g be differentiable functions such that $f'(0) = 3$ and $g'(0) = 7$. If $h(x) = 3f(x) - 2g(x) - 5\cos x - 3$, what is the value of $h'(0)$?

(A) -8
(B) -5
(C) 1
(D) 28

62. Let f be the function given by $f(x) = 3\sin x + 8e^x$. What is the value of $f'(0)$?

(A) 3
(B) 5
(C) 8
(D) 11

63. Let f be the function given by $f(x) = 2\cos x + 3e^x$. What is the value of $f'(0)$?

(A) -3
(B) 0
(C) 3
(D) 5

64. Let f be the function given by $f(x) = 5x^3 - 3x - 7$. What is the value of $f'(-2)$?

(A) -114
(B) 17
(C) 50
(D) 57

65. If $y = \sqrt{x^9}$, then $\frac{dy}{dx} =$

4

(A) $\frac{9\sqrt{x^7}}{2}$

(B) $3\sqrt{x^8}$

(C) $\frac{1}{2\sqrt{x^9}}$

(D) $\frac{2\sqrt{x^{11}}}{11}$

66. Let f be the function given by $f(x) = 2x^3 - 4x^2 - 5$. What is the value of $f'(-1)$?

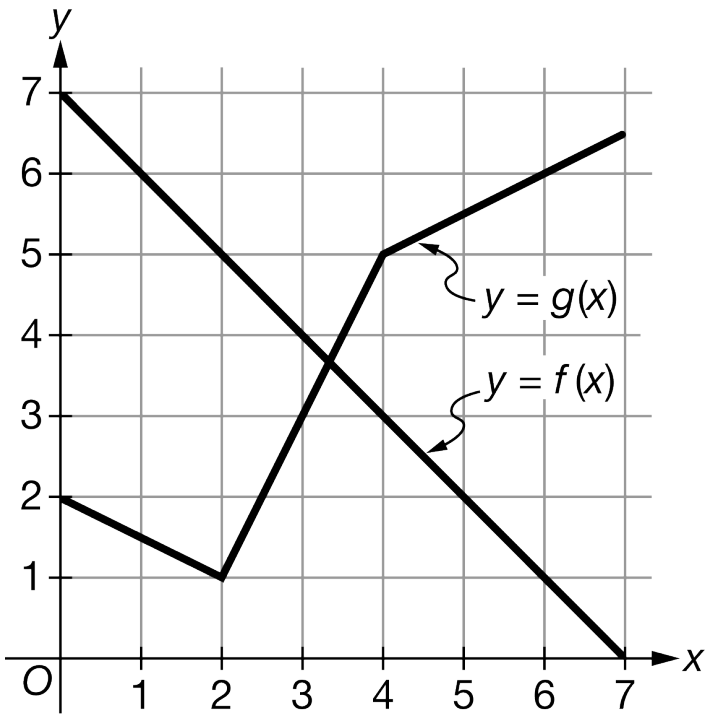
(A) -14

(B) 6

(C) 9

(D) 14

67.



The graphs of the linear function f and the piecewise linear function g are shown in the figure above. If $h(x) = f(x)g(x)$, then $h'(3) =$

(A) -11

(B) -2

(C) 2

(D) 5

68. If $f(x) = \ln(x)\cos(4x)$, then $f'(x) =$

4

(A) $-\frac{4\sin(4x)}{x}$

(B) $\frac{\cos(4x)}{x} - \ln(x)\sin(4x)$

(C) $\frac{\cos(4x)}{x} - 4\ln(x)\sin(4x)$

(D) $\frac{\cos(4x)}{x} + 4\ln(x)\sin(4x)$

69. If $g(x) = x^2\sqrt{x+1}$, then $g'(3) =$

(A) $\frac{3}{2}$

(B) $\frac{39}{4}$

(C) $\frac{57}{4}$

(D) 36

70. If $f(x) = \ln x \cos x$, then $f'(x) =$

(A) $-\frac{\sin x}{x}$

(B) $\frac{\sin x}{x}$

(C) $\frac{\cos x}{x} - \ln x \sin x$

(D) $\frac{\cos x}{x} + \ln x \sin x$

71. Let f be a differentiable function such that $f(3) = 4$ and $f'(3) = 5$. If $g(x) = x^2 f(x)$, what is the value of $g'(3)$?

(A) 11

(B) 24

(C) 30

(D) 69

72. If $f(x) = e^x \sin x$, then $f'(x) =$

(A) $e^x \cos x$

(B) $-e^x \cos x$

(C) $e^x(\sin x + \cos x)$

(D) $e^x(\sin x - \cos x)$

73. Let f be a differentiable function such that $f(2) = 2$ and $f'(2) = 5$. If $g(x) = x^3 f(x)$, what is the value of $g'(2)$?

(A) 17

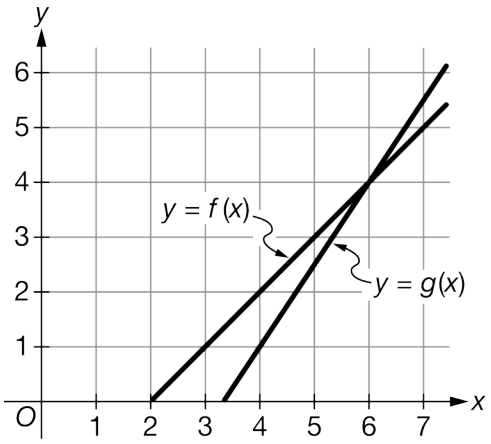
(B) 24

(C) 60

(D) 64

4

74.



The graphs of the linear function f and the linear function g are shown in the figure above. If $h(x) = f(x)g(x)$, then $h'(4) =$

(A) -2

(B) $\frac{3}{2}$

(C) $\frac{7}{2}$

(D) 4

75.

x	$f(x)$	$f'(x)$	$g(x)$	$g'(x)$
1	2	-4	-5	3
2	-3	1	8	4

The table above gives values of the differentiable functions f and g and their derivatives at selected values of x. If h is the function defined by $h(x) = f(x)g(x) + 2g(x)$, then $h'(1) =$

(A) 32

(B) 30

(C) -6

(D) -16

76. If $f'(x) = x^2$ and $g'(x) = 3e^x$ and if $h(x) = f(x)g(x)$, then $h'(x)$ could be

(A) $3x^2e^x$

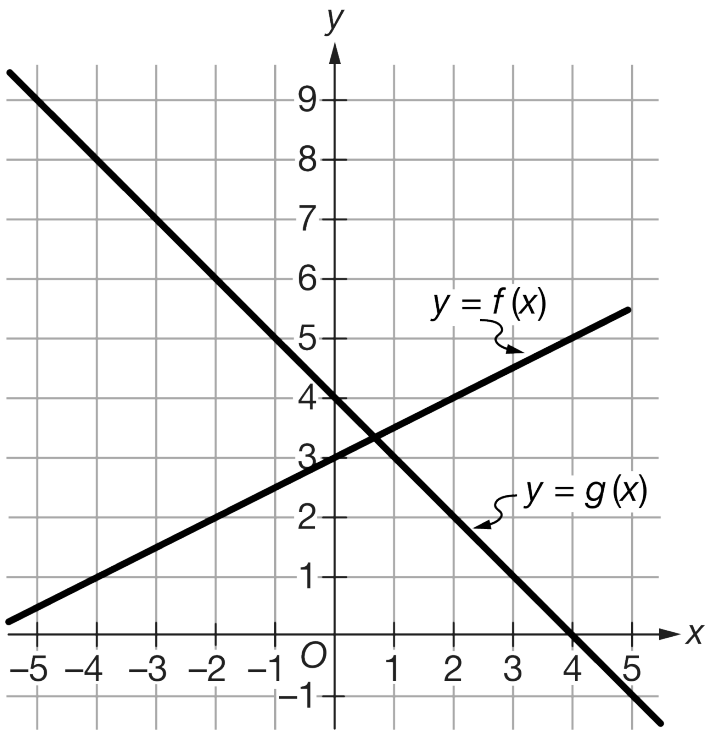
(B) $x^3e^x + 3x^2e^x$

(C) $x^3e^x + x^2e^x$

(D) $3x^2e^x + 6xe^x$

4

77.



The graphs of the linear functions f and g are shown above. If $h(x) = f(x) + g(x)$, then $h'(x) =$

(A) $\frac{3}{2}$

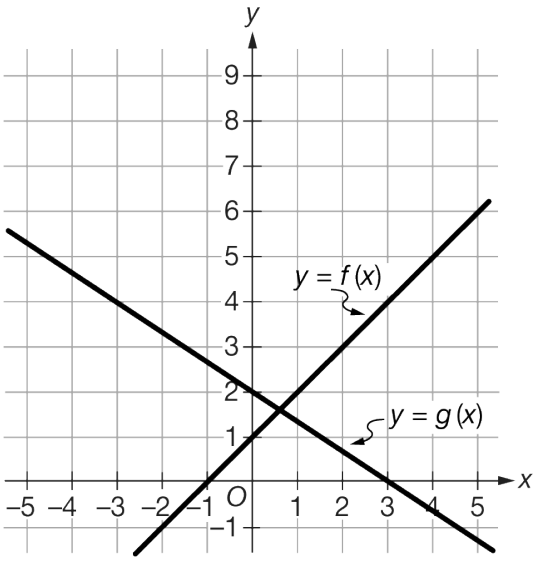
(B) 0

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

(D) $-\frac{1}{2}x + 7$

4

78.



The graphs of the linear functions f and g are shown above. If $h(x) = f(x) + g(x)$, then $h'(x) =$

(A) $\frac{5}{3}$

(B) 0

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

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

79. The base of a solid is the region in the first quadrant bounded by the y-axis, the x-axis, the graph of $y = e^x$, and the vertical line $x = 1$. For this solid, each cross section perpendicular to the x-axis is a square. What is the volume of the solid?

(A) $e - 1$

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

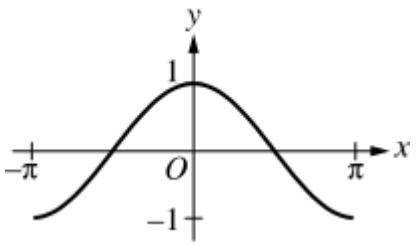
(C) $e^2 - 1$

(D) $2e^2 - 2$

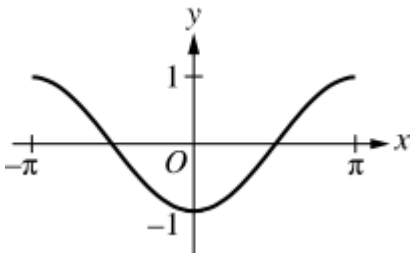
80. Which of the following could be the graph of $y = \frac{\cos(x+0.001) - \cos(x)}{0.001}$?

4

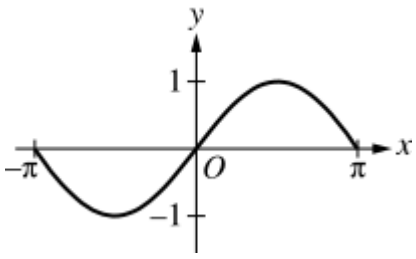
(A)



(B)



(C)



(D)