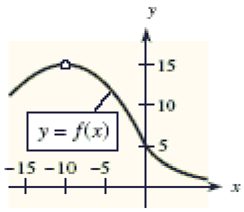
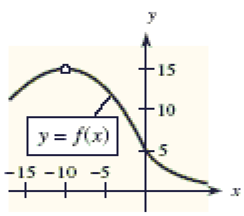
Chapter 9 Derivatives

1. A graph of $y = f(x)$ is shown and a c-value is given. For this problem, use the graph to find $\lim_{x \to c} f(x)$.
   $c = -10$



A) –5
B) 5
C) –15
D) 15
E) does not exist
Ans: D

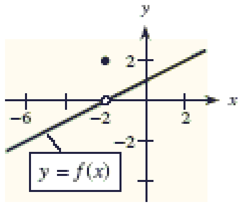
2. A graph of $y = f(x)$ is shown and a c-value is given. For this problem, use the graph to find $f(c)$.
   $c = -10$



A) 0
B) –10
C) 10
D) 15
E) does not exist
Ans: E

3. A graph of $y = f(x)$ is shown and a *c*-value is given. For this problem, use the graph to find $\lim_{x \to c} f(x)$.

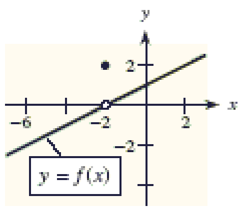
$c = -2$



A) 0
B) 2
C) –6
D) –4
E) does not exist
Ans: A

4. A graph of $y = f(x)$ is shown and a *c*-value is given. For this problem, use the graph to find $f(c)$.

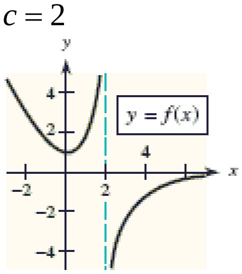
$c = -2$



A) 0
B) 2
C) –4
D) –6
E) does not exist
Ans: B

5. Use the graph of $y = f(x)$ and the given *c*-value to find $\lim_{x \to c^-} f(x)$.

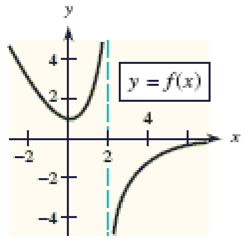
$c = 2$



A) –2
B) 0
C) 6
D) 2
E) does not exist
Ans: E

6. Use the graph of $y = f(x)$ and the given c-value to find $\lim_{x \to c^+} f(x)$.

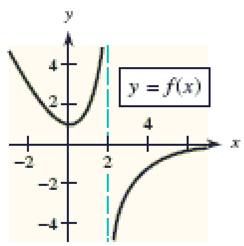
$c = 2$



A) 6
B) 0
C) 4
D) 2
E) does not exist
Ans: E

7. Use the graph of $y = f(x)$ and the given c-value to find $\lim_{x \to c} f(x)$.

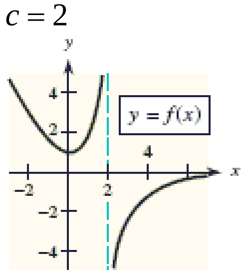
$c = 2$



A) –2
B) 0
C) 2
D) 4
E) does not exist
Ans: E

8. Use the graph of $y = f(x)$ and the given c-value to find $f(c)$.

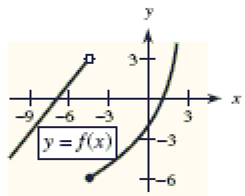
$c = 2$



A) 2
B) 4
C) 6
D) 0
E) does not exist
Ans: E

9. Use the graph of $y = f(x)$ and the given c-value to find $\lim_{x \to c^-} f(x)$.

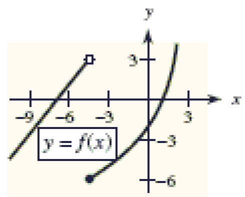
$c = -4.5$



A) −6
B) –8
C) 3
D) 2
E) does not exist
Ans: C

10. Use the graph of $y = f(x)$ and the given c-value to find $\lim_{x \to c^+} f(x)$.

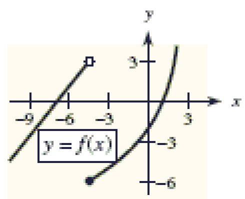
$c = -4.5$



A) −6
B) –7
C) –4
D) 3
E) does not exist
Ans: A

11. Use the graph of $y = f(x)$ and the given c-value to find $\lim_{x \to c} f(x)$.

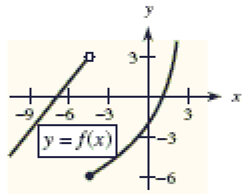
$c = -4.5$



A) –8
B) -6
C) 3
D) –1
E) does not exist
Ans: E

12. Use the graph of $y = f(x)$ and the given c-value to find $f(c)$.

$c = -4.5$



A) -6
B) –7
C) 1
D) 3
E) does not exist
Ans: A

13. Complete the table and use it to predict the limit, if it exists.

$f(x) = \dfrac{3x+2}{\frac{1}{3} - x^2}$

$\lim_{x \to -0.5} f(x) = ?$

x	$f(x)$
–0.51	
–0.501	
–0.5001	
↓	↓
–0.5	?
↑	↑
–0.4999	
–0.499	
–0.49	

A) 12.0
B) –6.0
C) 6.0
D) –0.5
E) does not exist
Ans: C

14. Complete the table and use it to predict the limit, if it exists.

$$f(x) = \begin{cases} 3x - 1 & \text{for } x < 1 \\ 3 - 7x - x^2 & \text{for } x \geq 1 \end{cases}$$

$\lim_{x \to 1} f(x) = ?$

x	$f(x)$
0.9	
0.99	
0.999	
↓	↓
1	?
↑	↑
1.001	
1.01	
1.1	

A) –2
B) 2
C) –5
D) 5
E) does not exist
Ans: E

15. Use properties of limits and algebraic methods to find the limit, if it exists.

$\lim_{x \to 3} (6x^3 - 13x^2 + 4x + 15)$

A) –72
B) 72
C) 88
D) –88
E) does not exist
Ans: B

16. Use properties of limits and algebraic methods to find the limit, if it exists.

$$\lim_{x \to 1/2} \frac{-3-4x}{4x^2+5}$$

A) $\frac{5}{6}$

B) $\frac{1}{6}$

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

D) $-\frac{5}{6}$

E) does not exist

Ans: D

17. Use properties of limits and algebraic methods to find $\lim_{x \to 8} \frac{x^2-64}{x-8}$, if the limit exists.

A) 0

B) 16

C) ∞

D) –16

E) 8

Ans: B

18. Use properties of limits and algebraic methods to find the limit, if it exists.

$$\lim_{x \to -5} \frac{x^2+17x+72}{x^2+8x}$$

A) $\frac{4}{5}$

B) $-\frac{4}{5}$

C) $-\frac{5}{4}$

D) $\frac{5}{4}$

E) does not exist

Ans: B

19. Use properties of limits and algebraic methods to find the limit, if it exists.

$$\lim_{x \to 6} \frac{x^2 - 2x - 63}{x^2 - 13x + 36}$$

A) $-\frac{13}{2}$
B) $\frac{13}{2}$
C) $\frac{2}{13}$
D) $-\frac{2}{13}$
E) does not exist
Ans: B

20. Use properties of limits and algebraic methods to find the limit, if it exists.

$$\lim_{x \to 2} f(x), \text{ where } f(x) = \begin{cases} 11 - 7x & \text{for } x < 2 \\ x^2 - 5x & \text{for } x \geq 2 \end{cases}$$

A) 3
B) 6
C) –6
D) –3
E) does not exist
Ans: E

21. Use properties of limits and algebraic methods to find the limit, if it exists.

$$\lim_{x \to 8} \frac{x^2 - 8x + 15}{x - 8}$$

A) 0
B) 3
C) 5
D) 15
E) does not exist
Ans: E

22. Use properties of limits and algebraic methods to find the limit, if it exists.

$$\lim_{h \to 0} \frac{6(x+h)^2 - 6x^2}{h}$$

A) 0
B) $2x$
C) $6x$
D) $12x$
E) does not exist
Ans: D

23. Graph the function with a graphing utility and use it to predict the limit. Check your work either by using the table feature of the graphing utility or by finding the limit algebraically.

$$\lim_{x\to 3}\frac{x^3-6x^2-16x}{x^2-11x+24}$$

A) $\frac{11}{5}$
B) 15
C) $\frac{5}{11}$
D) 0
E) does not exist
Ans: E

24. Graph the function with a graphing utility and use it to predict the limit. Check your work either by using the table feature of the graphing utility or by finding the limit algebraically.

$$\lim_{x\to 5}\frac{x^2-5x+6}{x^2-8x+15}$$

A) $\frac{5}{2}$
B) $-\frac{3}{2}$
C) $\frac{3}{2}$
D) 0
E) does not exist
Ans: E

25. Graph the function with a graphing utility and use it to predict the limit. Check your work either by using the table feature of the graphing utility or by finding the limit algebraically.

$$\lim_{x\to 9}\frac{x^3-9x^2}{3x^2-31x+36}$$

A) 0
B) 81
C) $\frac{81}{23}$
D) $\frac{81}{5}$
E) does not exist
Ans: C

26. If $\lim_{x\to -5}\left[f(x)+g(x)\right]=5$ and $\lim_{x\to -5} g(x)=12$, find $\lim_{x\to -5} f(x)$.

A) 12
B) 5
C) –5
D) –7
E) does not exist
Ans: D

27. If $\lim_{x\to -5}\left[f(x)+g(x)\right]=2$ and $\lim_{x\to -5} g(x)=5$, find $\lim_{x\to -5}\{[f(x)]^2-[g(x)]^2\}$.

A) 34
B) –16
C) –21
D) 0
E) does not exist
Ans: B

28. If $\lim_{x\to -4}\left[f(x)+g(x)\right]=2$ and $\lim_{x\to -4} g(x)=13$, find $\lim_{x\to -4}\dfrac{5g(x)}{f(x)-g(x)}$.

A) $-\dfrac{13}{11}$
B) $-\dfrac{13}{24}$
C) $-\dfrac{65}{11}$
D) $-\dfrac{65}{24}$
E) does not exist
Ans: D

29. If the profit function for a product is given by $P(x)=60x-6x^2-1820$, find $\lim_{x\to 20} P(x)$.

A) –3020
B) –180
C) 1780
D) 20
E) does not exist
Ans: A

30. If the revenue for a product (in dollars) is $R(x) = 500x - 0.7x^2$ and the average revenue per unit is $\overline{R}(x) = \dfrac{R(x)}{x}, x > 0$, find $\lim_{x \to 100} \dfrac{R(x)}{x}$.

A) $430 per unit
B) $570 per unit
C) $360 per unit
D) $0 per unit
E) does not exist
Ans: A

31. If the revenue for a product (in dollars) is $R(x) = 500x - 0.9x^2$, and the average revenue per unit is $\overline{R}(x) = \dfrac{R(x)}{x}, x > 0$, find $\lim_{x \to 0^+} \dfrac{R(x)}{x}$.

A) $500 per unit
B) $0.9 per unit
C) $90 per unit
D) $0 per unit
E) does not exist
Ans: A

32. Suppose that the cost C in dollars of obtaining water that contains p percent impurities is given by $C(p) = \dfrac{1100}{p} - 11$. Find $\lim_{p \to 10^-} C(p)$, if it exists.

A) $0
B) $11
C) $99
D) $1100
E) does not exist
Ans: C

33. Suppose that the cost C in dollars of obtaining water that contains p percent impurities is given by $C(p) = \dfrac{1200}{p} - 12$. Find $\lim_{p \to 0^+} C(p)$, if it exists.

A) $0
B) $12
C) $120
D) $1200
E) does not exist
Ans: E

34. A certain calling card costs 5.7 cents per minute to make a call, rounded up to the nearest minute. However, when the card is used at a pay phone, there is an additional 57 cent connection fee. If $C = C(t)$ is the charge from a pay phone for a call lasting t minutes, create a table of charges for calls lasting close to 1 minute and use it to find the following limit, if it exists.

$\lim_{t \to 1^-} C(t)$

A) $0
B) $0.57
C) $0.63
D) $0.68
E) does not exist
Ans: C

35. A certain calling card costs 6.5 cents per minute to make a call, rounded up to the nearest minute. However, when the card is used at a pay phone, there is an additional 65 cent connection fee. If $C = C(t)$ is the charge from a pay phone for a call lasting t minutes, create a table of charges for calls lasting close to 1 minute and use it to find the following limit, if it exists.

$\lim_{t \to 1^+} C(t)$

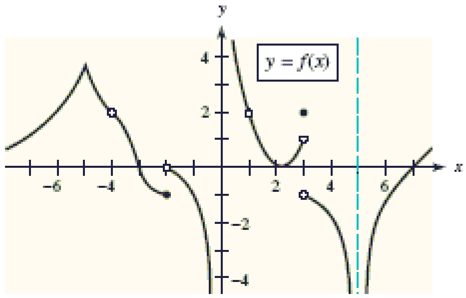
A) $0
B) $0.65
C) $0.71
D) $0.78
E) does not exist
Ans: D

36. A certain calling card costs 4.2 cents per minute to make a call, rounded up to the nearest minute. However, when the card is used at a pay phone, there is an additional 42 cent connection fee. If $C = C(t)$ is the charge from a pay phone for a call lasting t minutes, create a table of charges for calls lasting close to 1 minute and use it to find the following limit, if it exists.

$\lim_{t \to 1} C(t)$

A) $0
B) $0.42
C) $0.46
D) $0.50
E) does not exist
Ans: E

37. For the given *x*-value, use the figure to determine whether the function is continuous or discontinuous at that *x*-value.



$x = -2$

A) discontinuous
B) continuous
Ans: A

38. Determine whether the function is continuous or discontinuous at the given *x*-value.

$y = \dfrac{x^2 - 3}{x + 2}, \quad x = -5$

A) continuous
B) discontinuous
Ans: A

39. Determine whether the function is continuous or discontinuous at the given *x*-value.

$f(x) = \begin{cases} x^2 + 6 & \text{if } x \le -2 \\ 3x^2 - 2 & \text{if } x > -2 \end{cases} \qquad x = -2$

A) discontinuous
B) continuous
Ans: B

40. Determine whether the given function is continuous. If it is not, identify where it is discontinuous.

$y = 5x^2 - 3x + 4$

A) discontinuous at $x = 6$
B) discontinuous at $x = 0$
C) discontinuous at $x = -6$
D) discontinuous at $x = 12$
E) continuous everywhere
Ans: E

41. Determine whether the given function $g(x)=\dfrac{25x^2+6x+5}{x+4}$ is continuous. If $g(x)$ is not continuous, identify where it is discontinuous and which condition(s) fails to hold.

A) $g(x)=\dfrac{25x^2+6x+5}{x+4}$ is discontinuous at $x=5$ since $g(5)$ is not defined and $\lim_{x\to 5} g(x)$ does not exist.

B) $g(x)=\dfrac{25x^2+6x+5}{x+4}$ is discontinuous at $x=4$ since $g(4)$ is not defined and $\lim_{x\to 4} g(x)$ does not exist.

C) $g(x)=\dfrac{25x^2+6x+5}{x+4}$ is discontinuous at $x=-4$ since $g(-4)$ is not defined and $\lim_{x\to -4} g(x)$ does not exist.

D) $g(x)=\dfrac{25x^2+6x+5}{x+4}$ is continuous.

E) $g(x)=\dfrac{25x^2+6x+5}{x+4}$ is discontinuous at $x=-5$ since $g(-5)$ is not defined and $\lim_{x\to -5} g(x)$ does not exist.

Ans: C

42. Determine whether the given function is continuous. If it is not, identify where it is discontinuous. You can verify your conclusions by graphing the function with a graphing utility, if one is available.

$$y=\frac{7x^2+4x+8}{x+1/2}$$

A) discontinuous at $x=1/2$
B) discontinuous at $x=-1$
C) discontinuous at $x=1$
D) discontinuous at $x=-1/2$
E) continuous everywhere
Ans: D

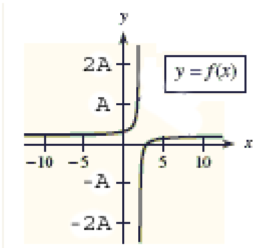
43. Determine whether the given function is continuous. If it is not, identify where it is discontinuous and which condition fails to hold. You can verify your conclusions by graphing the function with a graphing utility, if one is available.

$$y=\frac{3x-4}{x^2+9}$$

A) discontinuous at $x=-9$
B) discontinuous at $x=3$
C) discontinuous at $x=-3$
D) discontinuous at $x=9$
E) continuous everywhere
Ans: E

44. This problem contains a function and its graph, where $A = 25$. Use the graph to determine, as well as you can, the vertical asymptote. Check your conclusion by using the function to determine the vertical asymptote analytically.

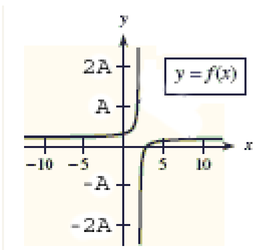
$$f(x) = \frac{5(x-3)}{x-2}$$



A) $x = 9$
B) $x = 0$
C) $x = -1$
D) $x = 2$
E) no vertical asymptote
Ans: D

45. This problem contains a function and its graph, where $A = 20$. Use the graph to determine, as well as you can, $\lim_{x\to+\infty} f(x)$. Check your conclusion by using the function to determine $\lim_{x\to+\infty} f(x)$ analytically.

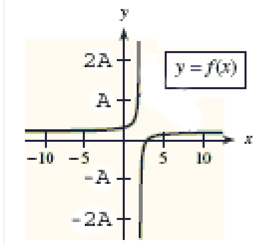
$$f(x) = \frac{4(x-3)}{x-2}$$



A) –5
B) 4
C) –1
D) 0
E) does not exist
Ans: B

46. This problem contains a function and its graph, where $A = 15$. Use the graph to determine, as well as you can, $\lim_{x \to -\infty} f(x)$. Check your conclusion by using the function to determine $\lim_{x \to -\infty} f(x)$ analytically.

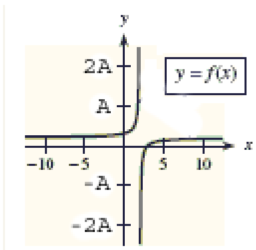
$$f(x) = \frac{3(x-3)}{x-2}$$



A) 8
B) 0
C) −1
D) 3
E) does not exist
Ans: D

47. This problem contains a function and its graph, where $A = 10$. Use the graph to determine, as well as you can, the horizontal asymptote. Check your conclusion by using the function to determine the horizontal asymptote analytically.

$$f(x) = \frac{2(x-3)}{x-2}$$



A) $y = -4$
B) $y = 0$
C) $y = 2$
D) $y = -1$
E) $y = -10$
Ans: C

48. Use analytic methods to evaluate the limit and determine which type of asymptote (if any) it represents. You can verify your conclusion by graphing the function with a graphing utility, if one is available.

$$\lim_{x \to -\infty} \frac{7}{x^2 - 5x}$$

A) limit $= 0$, vertical asymptote
B) limit $= 0$, horizontal asymptote
C) limit $= 5$, horizontal asymptote
D) limit $= 5$, vertical asymptote
E) does not exist
Ans: B

49. Use analytic methods to evaluate the limit and determine which type of asymptote (if any) it represents. You can verify your conclusion by graphing the function with a graphing utility, if one is available.

$$\lim_{x \to +\infty} \frac{9x^2 + 2x}{9x^2 - 11x}$$

A) limit $= 1$, vertical asymptote
B) limit $= 9$, horizontal asymptote
C) limit $= 9$, vertical asymptote
D) limit $= 1$, horizontal asymptote
E) does not exist
Ans: D

50. Use analytic methods to evaluate the limit and determine which type of asymptote (if any) it represents. You can verify your conclusion by graphing the function with a graphing utility, if one is available.

$$\lim_{x \to -\infty} \frac{15x^3 - 4}{5x^2 + 16x}$$

A) limit $= 15$, horizontal asymptote
B) limit $= 15$, vertical asymptote
C) limit $= 3$, horizontal asymptote
D) limit $= 3$, vertical asymptote
E) does not exist, no asymptote
Ans: E

51. Graph the function using a window with $0 \le x \le 300$ and $-6 \le y \le 6$. What does the graph indicate about $\lim_{x \to +\infty} f(x)$?

$$f(x) = \frac{6x^3 - 7x}{5 - 2x^3}$$

A) -3
B) 3
C) 6
D) 0
E) does not exist
Ans: A

52. Use a table utility with x-values larger than 10,000 to investigate $\lim_{x\to+\infty} f(x)$. What does the table indicate about $\lim_{x\to+\infty} f(x)$?

$f(x)=\dfrac{3x^3-7x}{7-3x^3}$

A) -1
B) 1
C) 3
D) 0
E) does not exist
Ans: A

53. Use analytic methods to find any point of discontinuity for the given function.

$f(x)=\dfrac{9000x}{4300-5x}$

A) $x=860$
B) $x=-1800$
C) $x=1800$
D) $x=-860$
E) continuous everywhere
Ans: A

54. Use analytic methods to find the limit as $x\to+\infty$ for the given function.

$f(x)=\dfrac{6000x}{2750-2x}$

A) 3000
B) 1375
C) -1375
D) -3000
E) does not exist
Ans: D

55. Use analytic methods to find the limit as $x\to-\infty$ for the given function.

$f(x)=\dfrac{1000x}{4000-10x}$

A) -100
B) 400
C) -400
D) 100
E) does not exist
Ans: A

56. Suppose that the average number of minutes M that it takes a new employee to assemble one unit of a product is given by $M = \dfrac{90+80t}{9t+8}$, where t is the number of days on the job. Is this function continuous for all values of t?
A) no
B) yes
Ans: A

57. Suppose that the average number of minutes M that it takes a new employee to assemble one unit of a product is given by $M = \dfrac{20+70t}{2t+6}$, where t is the number of days on the job. Is this function continuous at $t = 6$?
A) no
B) yes
Ans: B

58. Suppose that the average number of minutes M that it takes a new employee to assemble one unit of a product is given by $M = \dfrac{30+80t}{5t+3}$, where t is the number of days on the job. Is this function continuous for all $t \geq 0$?
A) yes
B) no
Ans: A

59. Suppose that the average number of minutes M that it takes a new employee to assemble one unit of a product is given by $M = \dfrac{60+30t}{2t+2}$, where t is the number of days on the job. What is the domain for this application?
A) $t < 0$
B) $t \neq -1$
C) $t > 0$
D) $t > -1$
E) $t < -1$
Ans: C

60. Suppose that the cost C of removing p percent of the particulate pollution from the exhaust gases at an industrial site is given by $C(p)=\dfrac{4700p}{100-p}$. Describe any discontinuities for $C(p)$. Explain what each discontinuity means.
   A) $C(p)$ is discontinuous at $p=100$. This means that not all pollution can be removed.
   B) $C(p)$ is discontinuous at $p=100$. This means that none of the pollution can be removed.
   C) $C(p)$ is continuous everywhere.
   D) $C(p)$ is discontinuous at $p=0$. This means that not all pollution can be removed.
   E) $C(p)$ is discontinuous at $p=0$. This means that none of the pollution can be removed.
   Ans: A

61. The percent p of particulate pollution that can be removed from the smokestacks of an industrial plant by spending C dollars is given by $p=\dfrac{100C}{3{,}100+C}$. Find the percent of the pollution that could be removed if spending C were allowed to increase without bound.
   A) 3,100%
   B) 31,000%
   C) 0%
   D) 200%
   E) 100%
   Ans: E

62. The monthly charge in dollars for x kilowatt-hours (kWh) of electricity used by a residential consumer of Excelsior Electric Membership Corporation from November through June is given by the function
$$C(x)=\begin{cases}10+0.094x & \text{if } 0\le x\le 100\\ 19.4+0.075(x-100) & \text{if } 100<x\le 900\\ 79.4+0.05(x-900) & \text{if } x>900\end{cases}.$$
   What is the monthly charge if 1600 kWh of electricity is consumed in a month? Round your answer to two decimal places.
   A) \$1600.00
   B) \$160.40
   C) \$131.90
   D) \$79.40
   E) \$114.40
   Ans: E

63. The monthly charge in dollars for x kilowatt-hours (kWh) of electricity used by a residential consumer of Excelsior Electric Membership Corporation from November through June is given by the function

$$C(x) = \begin{cases} 10 + 0.094x & \text{if } 0 \le x \le 100 \\ 19.4 + 0.075(x - 100) & \text{if } 100 < x \le 800 \\ 71.9 + 0.05(x - 800) & \text{if } x > 800 \end{cases}.$$

Is C continuous at $x = 100$?

A) yes
B) no
Ans: A

64. The monthly charge in dollars for x kilowatt-hours (kWh) of electricity used by a residential consumer of Excelsior Electric Membership Corporation from November through June is given by the function

$$C(x) = \begin{cases} 10 + 0.094x & \text{if } 0 \le x \le 100 \\ 19.4 + 0.075(x - 100) & \text{if } 100 < x \le 900 \\ 79.4 + 0.05(x - 900) & \text{if } x > 900 \end{cases}.$$

Is C continuous at $x = 900$?

A) yes
B) no
Ans: A

65. For the given function, find the average rate of change over the specified interval.

$f(x) = 5 - 9x - 3x^2$ over $(-8, -4)$

A) 0
B) –3
C) 3
D) –27
E) 27
Ans: E

66. Given $f(x) = x^2 + 9x + 8$, find the average rate of change of $f(x)$ over the following pair of intervals using a calculator if desired:

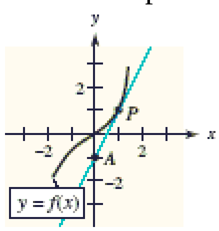
$(6.9, 7)$ and $(6.99, 7)$.

A) 11.45 and 11.54
B) 23.1 and 23.19
C) 22.9 and 22.99
D) 6.9 and 6.99
E) 97.9 and 97.99
Ans: C

67. Let $f(x) = 6x^2 - 4x.$ Use the definition of derivative and the Procedure/Example table in this section to verify that $f'(x) = 12x - 4.$ Then, find the instantaneous rate of change of $f(x)$ at $x = -8.$
A) –100
B) 416
C) –52
D) –92
E) 352
Ans: A

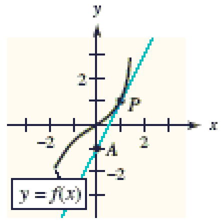
68. Let $f(x) = 7x^2 - 7x.$ Use the definition of derivative and the Procedure/Example table in this section to verify that $f'(x) = 14x - 7.$ Then, find the slope of the tangent to the graph of $y = f(x)$ at $x = -8.$
A) –119
B) 504
C) –63
D) –105
E) 392
Ans: A

69. The tangent line to the graph of $f(x)$ at $x = 1$ is shown. On the tangent line, *P* is the point of tangency and *A* is another point on the line. Use the coordinates of *P* and *A* to find the slope of the tangent line.



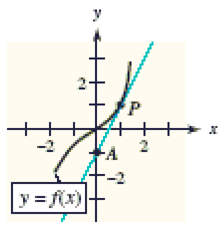
A) 2
B) 1
C) –5
D) –2
E) does not exist
Ans: A

70. The tangent line to the graph of $f(x)$ at $x = 1$ is shown. On the tangent line, *P* is the point of tangency and *A* is another point on the line. Find $f'(1)$.



A) 2
B) 0
C) –1
D) –2
E) does not exist
Ans: A

71. The tangent line to the graph of $f(x)$ at $x = 1$ is shown. On the tangent line, *P* is the point of tangency and *A* is another point on the line. Find the instantaneous rate of change of $f(x)$ at *P*.



A) –5
B) 2
C) 0
D) –4
E) does not exist
Ans: B

72. For the function in this problem, find the derivative, by using the definition.
$f(x) = 2x^2 - 5x + 5$
A) $2x^2 - 5$
B) $2x^2 - 5x$
C) $4x$
D) $2x - 5$
E) $4x - 5$
Ans: E

73. For the function in this problem, find the instantaneous rate of change of the function at the given value.
$f(x) = 4x^2 - 5x + 6;\ x = 1$
A) 0
B) 9
C) –1
D) 3
E) 13
Ans: D

74. For the function in this problem, find the slope of the tangent line at the given value.
$f(x) = 5x^2 - 2x + 6;\ x = 3$
A) 28
B) 17
C) 13
D) 16
E) 32
Ans: A

75. For the function in this problem, approximate $f'(2)$ by using the numerical derivative feature of a graphing utility.
$f(x) = 8x^3 - 5x + 4$
A) 59
B) 91
C) 58
D) 101
E) 43
Ans: B

76. For the function in this problem, approximate $f'(-1)$ by computing $\frac{f(-1+h) - f(-1)}{h}$ with $h = 0.0001$.
$f(x) = 4x^3 - 9x + 7$
A) 3.0120
B) 3.1204
C) 2.9988
D) 3.0012
E) 2.8804
Ans: C

77. For the function in this problem, approximate $f'(x)$ near the point $(2,14)$ by graphing the function on a graphing utility. Then, zoom in near the point until the graph appears straight, pick two points, and find the slope of the line you see. Round your answer to three decimal places.

$f(x)=2x^3-5x+8$

A) 90.760
B) 88.620
C) 90.976
D) 19.012
E) 20.220
Ans: D

78. For the function in this problem, approximate $f'(–4)$ by using the numerical derivative feature of a graphing utility. Round your answer to three decimal places.

$f(x)=\dfrac{2x+5}{3x-4}$

A) 0.188
B) –0.090
C) –1.437
D) 0.090
E) 1.437
Ans: B

79. For the function in this problem, approximate $f'(–3.3)$ by computing

$\dfrac{f(-3.3+h)-f(-3.3)}{h}$ with $h=0.0001$.

$f(x)=\dfrac{9x+5}{2x-5}$

A) –0.5968
B) –0.4159
C) –19.0972
D) –0.4087
E) –21.4817
Ans: D

80. For the function in this problem, approximate $f'(x)$ near $(3.7, 1.208)$ by graphing the function on a graphing utility. Then, zoom in near the point until the graph appears straight, pick two points, and find the slope of the line you see. Round your answer to four decimal places.

$$f(x) = \frac{3x+4}{5x-6}$$

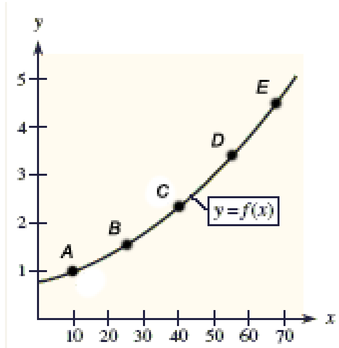
A) –0.2432
B) –0.2338
C) –0.0646
D) –0.1241
E) –0.0633
Ans: A

81. Use the given table to approximate $f'(-2)$ as accurately as you can.

x	–2.1	–2	–1.99	–1.9
$f(x)$	26.460	24.000	23.761	21.660

A) 23.940
B) 2.394
C) –2.394
D) –23.940
E) 23.761
Ans: D

82. In the figure given in this problem, at points A and D draw an approximate tangent line and then use it to answer the following question. Is $f'(x)$ greater at point A or at point D?



A) point A
B) point D
Ans: B

83. Find $f'(-1)$ and $f(-1)$ given the equation of the line tangent to the graph of $f(x)$ at $(-1,8)$ is $x+16y=127$.

A) $f'(-1)=127; f(-1)=8$

B) $f'(-1)=-\frac{1}{16}; f(-1)=8$

C) $f'(-1)=-\frac{1}{16}; f(-1)=127$

D) $f'(-1)=16; f(-1)=127$

E) $f'(-1)=-\frac{1}{127}; f(-1)=8$

Ans: B

84. If the instantaneous rate of change of $g(x)$ at $(-4,-1)$ is $1/7$, write the equation of the line tangent to the graph of $g(x)$ at $x=-4$.

A) $x=-\frac{1}{7}y+\frac{3}{7}$

B) $x=\frac{1}{7}y+\frac{3}{7}$

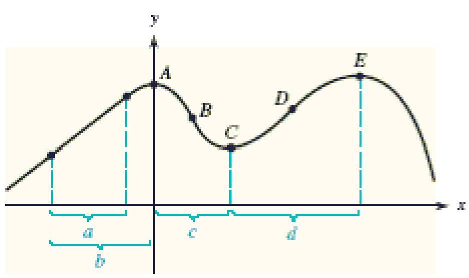
C) $x=\frac{1}{7}y-\frac{3}{7}$

D) $y=\frac{1}{7}x-\frac{3}{7}$

E) $y=\frac{1}{7}x+\frac{3}{7}$

Ans: D

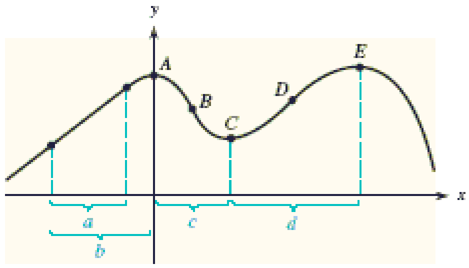
85. Because the derivative of a function represents both the slope of the tangent to the curve and the instantaneous rate of change of the function, it is possible to use information about one to gain information about the other. In this problem, use the graph of the function $y=f(x)$ given in the figure.



Over what interval(s) (*a*) through (*d*) is the rate of change of $f(x)$ positive?

A) a c d
B) c
C) a c
D) c d
E) a b d
Ans: E

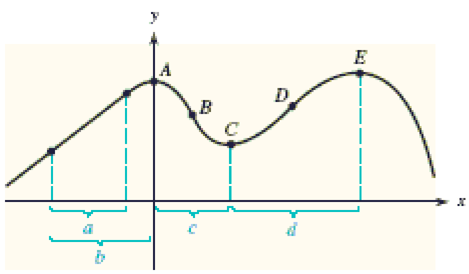
86. Because the derivative of a function represents both the slope of the tangent to the curve and the instantaneous rate of change of the function, it is possible to use information about one to gain information about the other. In this problem, use the graph of the function $y = f(x)$ given in the figure.



Over what interval(s) (*a*) through (*d*) is the rate of change of $f(x)$ negative?

A) a c
B) b
C) c d
D) c
E) a b
Ans: D

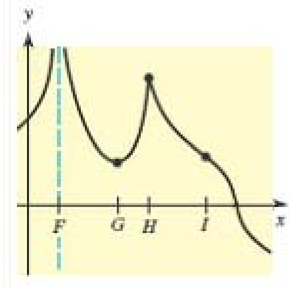
87. Because the derivative of a function represents both the slope of the tangent to the curve and the instantaneous rate of change of the function, it is possible to use information about one to gain information about the other. In this problem, use the graph of the function $y = f(x)$ given in the figure.



At what point(s) *A* through *E* is the rate of change of $f(x)$ equal to zero?

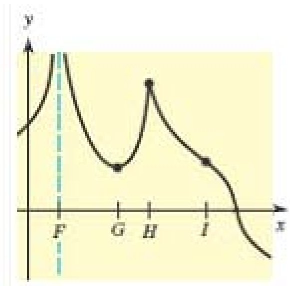
A) A C E
B) A D
C) A B C
D) A C D
E) D
Ans: A

88. Given the graph of $y = f(x)$ in the figure, determine all x-values from F, G, H, or I for which the function is continuous.



A) F
B) G H I
C) F G H I
D) F G
E) F I
Ans: B

89. Given the graph of $y = f(x)$ in the figure, determine all x-values from F, G, H, or I for which the function is differentiable.



A) H I
B) F G H
C) G H I
D) F H
E) F G H I
Ans: C

90. Find the slope of the tangent to the graph of $f(x)$ at any point.
$f(x) = 6x^2 + 2x$
A) $12x + 2$
B) $24x + 2$
C) $6x + 2$
D) $6x^2 + 2x$
E) $4x$
Ans: A

91. Find the slope of the tangent at $x = 2$.

$f(x) = 2x^2 + 6x$

A) 2
B) 10
C) 14
D) 20
E) 0
Ans: C

92. Write the equation of the line tangent to the graph of $f(x)$ at $x = -1$.

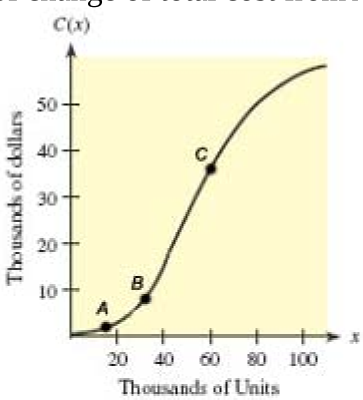
$f(x) = 6x^2 + 9x$

A) $y = -3x - 2$
B) $y = -3x + 2$
C) $y = -3x$
D) $y = -3x - 6$
E) $y = -3x + 6$
Ans: D

93. The total revenue function (in dollars) for a blender is $R(x) = 70x - 0.09x^2$, where x is the number of units sold. What is the average rate of change in revenue $R(x)$ as x increases from 10 to 20 units?

A) \$68.20 per unit
B) \$66.40 per unit
C) \$78.20 per unit
D) \$205.50 per unit
E) \$67.30 per unit
Ans: E

94. Suppose the figure shows the total cost graph for a company. Arrange the average rates of change of total cost from *A* to *B*, *B* to *C*, and *A* to *C* from smallest to greatest.



A) A to B then A to C then B to C
B) B to C then A to C then A to B
C) A to B then B to C then A to C
D) A to C then A to B then B to C
E) B to C then A to B then A to C
Ans: A

95. Suppose the total revenue function for a blender is $R(x) = 81x - 0.08x^2$ dollars where x is the number of units sold. What function gives the marginal revenue?

A) $\overline{MR} = R'(x) = 81 - 0.16x$

B) $\overline{MR} = R'(x) = 81 - 0.08x$

C) $\overline{MR} = R'(x) = 81 + 0.16x$

D) $\overline{MR} = R'(x) = 81 + 0.08x$

E) $\overline{MR} = R'(x) = 0.08 + 162x$

Ans: A

96. Suppose the total revenue function for a blender is $R(x) = 69x - 0.05x^2$ dollars where x is the number of units sold. What is the marginal revenue when 500 units are sold, and what does it mean?

A) 44. Selling an additional unit when 500 have been sold increases revenue by $44.

B) 19. Selling an additional unit when 500 have been sold increases revenue by $19.

C) 69. Selling an additional unit when 500 have been sold increases revenue by $69.

D) 44. Selling an additional unit when 500 have been sold decreases revenue by $44.

E) 19. Selling an additional unit when 500 have been sold decreases revenue by $19.

Ans: B

97. Suppose the total revenue function for a blender is $R(x) = 86x - 0.09x^2$ dollars where x is the number of units sold. What is the marginal revenue when 500 units are sold, and what does it mean?

A) 41. Selling an additional unit when 500 have been sold increases revenue by $41.

B) –4. Selling an additional unit when 500 have been sold increases revenue by $4.

C) 86. Selling an additional unit when 500 have been sold increases revenue by $86.

D) 41. Selling an additional unit when 500 have been sold decreases revenue by $41.

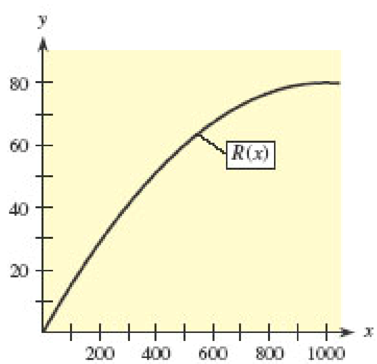
E) –4. Selling an additional unit when 500 have been sold decreases revenue by $4.

Ans: E

98. Suppose the total revenue function for a blender is $R(x) = 80x - 0.08x^2$ dollars where x is the number of units sold. What is the marginal revenue when 500 units are sold, and what does it mean?
A) 40. Selling an additional unit when 500 have been sold increases revenue by $40.
B) 1. Selling an additional unit when 500 have been sold increases revenue by $1.
C) 80. Selling an additional unit when 500 have been sold increases revenue by $80.
D) 40. Selling an additional unit when 500 have been sold decreases revenue by $40.
E) 0. Selling an additional unit when 500 have been sold does not change the revenue.
Ans: E

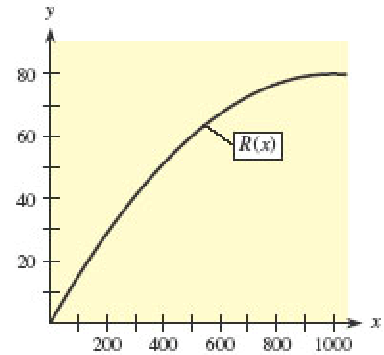
99. If the total revenue function for a toy is $R(x) = 6x$ dollars and the total cost function is $C(x) = 400 + 0.02x^2 + 2x$ dollars. What is the instantaneous rate of change of profit if 30 units are produced and sold? Explain its meaning.
A) 2.80. Selling an additional unit when 30 have been sold increases profit by $2.80.
B) 3.40. Selling an additional unit when 30 have been sold increases profit by $3.40.
C) 3.20. Selling an additional unit when 30 have been sold increases profit by $3.20.
D) 6.00. Selling an additional unit when 30 have been sold increases profit by $6.00.
E) 298.00. Selling an additional unit when 30 have been sold increases profit by $298.00.
Ans: A

100. Suppose the graph shows a manufacturer's total revenue, in thousands of dollars, from the sale of x cellular telephones to dealers. Is the marginal revenue greater at 100 cell phones or at 700 ?



A) 100
B) 700
Ans: A

101. Suppose the graph shows a manufacturer's total revenue, in thousands of dollars, from the sale of x cellular telephones to dealers. Decide whether the sale of the 401st cell phone or the 801st brings in more revenue.



A) The 401st phone
B) The 801st phone
Ans: A

102. Find the derivative of the function.
$y = 8x^4 - 9x^2 + 7x - 9$
A) $32x^4 - 18x^2 + 7x - 9$
B) $32x^3 - 18x + 7$
C) $8x^3 - 9x + 7$
D) $32x^3 - 18x$
E) $8x^4 - 9x^2 + 7x - 9$
Ans: B

103. Find the derivative of the function.
$h(x) = 14x^{20} + 7x^{10} - 2x^7 + 3x - 5$
A) $266x^{19} + 63x^9 - 12x^6 + 3$
B) $280x^{20} + 70x^{10} - 14x^7 + 3x$
C) $14x^{19} + 7x^9 - 2x^6 + 3$
D) $280x^{19} + 70x^9 - 14x^6 + 3$
E) $266x^{20} + 63x^{10} - 12x^7 + 3x$
Ans: D

104. At the indicated point, find the slope of the tangent to the curve.
$R(x) = 9x + 4x^2,\ \ x = -2$
A) 1
B) 52
C) 13
D) 17
E) –7
Ans: E

105. At the indicated point, find the instantaneous rate of change of the function.

$R(x) = 11x + 7x^2, \ \ x = -1$

A) –3
B) 84
C) 18
D) 25
E) 4
Ans: A

106. Find the derivative of the function.

$y = 3x^{-1} - 3x^{-2} + 10$

A) $-3x^{-2} - 6x^{-3}$
B) $-3x^{-2} + 6x^{-3}$
C) $-3 - 6x^{-1}$
D) $-3x^{-2} - 3x^{-3}$
E) $-3x^{-1} + 3x^{-2}$
Ans: B

107. Find the derivative of the function.

$f(x) = 3x^{-4/3} - 6x^{-8/3}$

A) $-4x^{-7/3} - 16x^{-11/3}$
B) $-4x^{-1/3} + 16x^{-5/3}$
C) $-4x^{-7/3} + 16x^{-11/3}$
D) $-4x^{-1/3} - 16x^{-5/3}$
E) $-12x^{-7/3} - 48x^{-11/3}$
Ans: C

108. Find the derivative of the function.

$h(x) = \frac{6}{x^6} - \frac{2}{x^2} + 4\sqrt{x}$

A) $\frac{6}{x^7} - \frac{2}{x^3} + \frac{4}{\sqrt{x}}$
B) $\frac{36}{x^7} - \frac{4}{x^3} + \frac{2}{\sqrt{x}}$
C) $-\frac{36}{x^5} + \frac{4}{x^1} + \frac{2}{\sqrt{x}}$
D) $-\frac{6}{x^7} + \frac{2}{x^3} + \frac{4}{\sqrt{x}}$
E) $-\frac{36}{x^7} + \frac{4}{x^3} + \frac{2}{\sqrt{x}}$
Ans: E

109. Write the equation of the tangent line to each curve at the indicated point. As a check, graph both the function and the tangent line.

$y = x^9 - 6x^5 - 7$ at $x = 1$

A) $y = -21x - 9$

B) $y = -21x + 9$

C) $y = -21x - 13$

D) $y = -21x + 13$

E) $y = -21x$

Ans: B

110. Find the coordinates of points where the graph of $f(x)$ has horizontal tangents. As a check, graph $f(x)$ and see whether the points you found look as though they have horizontal tangents.

$f(x) = \frac{1}{3}x^3 + 2x^2 - 21x + 29$

A) $\left(-7, \frac{479}{3}\right), \left(7, -\frac{283}{3}\right)$

B) $\left(7, \frac{1165}{3}\right), \left(-3, -\frac{303}{3}\right)$

C) $\left(-7, \frac{479}{3}\right), \left(-3, -\frac{303}{3}\right)$

D) $\left(7, \frac{1165}{3}\right), \left(3, -\frac{21}{3}\right)$

E) $\left(-7, \frac{479}{3}\right), \left(3, -\frac{21}{3}\right)$

Ans: E

111. Find the coordinates of points where the graph of $f(x)$ has horizontal tangents. As a check, graph $f(x)$ and see whether the points you found look as though they have horizontal tangents.

$f(x) = 3x^5 - 20x^3 + 7$

A) $(0, 71), (-2, 7), (2, -57)$

B) $(0, 7), (-2, -57), (2, 71)$

C) $(0, 7), (-2, 71), (2, -57)$

D) $(0, -57), (-2, 71), (2, 7)$

E) $(0, -57), (-2, 7), (2, 71)$

Ans: C

112. Find the derivative at the given *x*-value with the appropriate rule.

$y = 8 - 30\sqrt{x}$ at $x = 9$

A) –10
B) –82
C) 10
D) –5
E) 0
Ans: D

113. Find the derivative at the given *x*-value with the numerical derivative feature of a graphing utility.

$y = 4 - 6\sqrt{x}$ at $x = 4$

A) –1.5
B) –8
C) 3
D) –3
E) 0
Ans: A

114. Calculate the derivative of the function with the appropriate formula.

$f(x) = 4x^5 + 2x - \pi^6 + 7$

A) $20x^4 + 2 - 6\pi^5$
B) $4x^4 + 2 - \pi^5$
C) $20x^5 + 2x - 6\pi^6 + 7$
D) $4x^4 + 2$
E) $20x^4 + 2$
Ans: E

115. The tangent line to a curve at a point closely approximates the curve near the point. In fact, for *x*-values close enough to the point of tangency, the function and its tangent line are virtually indistinguishable. This problem explores this relationship. Write the equation of the tangent line to the curve at the indicated point. To check your answer, use a graphing utility to graph both the function and its tangent line, and repeatedly zoom in on the point of tangency until the function and the tangent line cannot be distinguished.

$f(x) = 7x - x^3$ at $x = 2$

A) $y = -5x + 16$
B) $y = x + 16$
C) $y = -5x$
D) $y = -5x + 4$
E) $y = x + 4$
Ans: A

116. For the function given, find $f'(x)$.

$f(x) = x^3 - 6x - 4$

A) $x^2 - 6$
B) $3x^2 - 4$
C) $3x^2 - 6$
D) $3x^3 - 6x$
E) $x^3 - 6x$
Ans: C

117. For the function given, find all x-value(s) where $f'(x) = 0$.

$f(x) = x^3 - 12x - 7$

A) $x = -2, x = 2$
B) $x = 0, x = 2$
C) $x = -2$
D) $x = 2$
E) $x = -2, x = 0$
Ans: A

118. For the function given, find all x-values where $f'(x) > 0$.

$f(x) = x^3 - 75x - 8$

A) $x < -5$
B) $x < -5$ or $x > 5$
C) $x < 5$
D) $x > -5$
E) $x < 5$ and $x > -5$
Ans: B

119. For the function given, find all x-values where $f'(x) < 0$.

$f(x) = x^3 - 27x - 5$

A) $x < -3$
B) $x < -3$ or $x > 3$
C) $x < 3$
D) $x > -3$
E) $x < 3$ and $x > -3$
Ans: E

120. For the function given, find all x-values where $f(x)$ has a local maximum point.
$f(x) = x^3 - 48x - 3$
A) $x = -4$
B) $x = 4$
C) $x = -4$ and $x = 4$
D) $x = 0$
E) no such x-values exist
Ans: A

121. For the function given, find all x-values where $f(x)$ has a local minimum point.
$f(x) = x^3 - 12x - 7$
A) $x = 0$
B) $x = 2$
C) $x = -2$ and $x = 2$
D) $x = -2$
E) no such x-values exist
Ans: B

122. For the function given, find all x-values where the graph of $f(x)$ is rising.
$f(x) = x^3 - 27x - 8$
A) $x < -3$
B) $x < -3$ or $x > 3$
C) $x < 3$
D) $x > -3$
E) $x < 3$ and $x > -3$
Ans: B

123. For the function given, find all x-values where the graph of $f(x)$ is falling.
$f(x) = x^3 - 12x - 5$
A) $x < -2$
B) $x < -2$ or $x > 2$
C) $x < 2$
D) $x > -2$
E) $x < 2$ and $x > -2$
Ans: E

124. Suppose that a wholesaler expects that his monthly revenue (in dollars) for small television sets will be $R(x) = 300x - 0.01x^2, \quad 0 \le x \le 600$, where x is the number of units sold. Find the marginal revenue, and interpret your answer when the quantity sold is $x = 300$.

A) 30. The additional revenue from the 301st unit is about $30.
B) 3. The additional revenue from the 301st unit is about $3.
C) 6. The additional revenue from the 301st unit is about $6.
D) 294. The additional revenue from the 301st unit is about $294.
E) 297. The additional revenue from the 301st unit is about $297.

Ans: D

125. The monthly output of a certain product is $Q(x) = 400x^{17/2}$ where x is the capital investment in millions of dollars. Find dQ/dx, which can be used to estimate the effect on the output if an additional capital investment of $1 million is made.

A) $\frac{dQ}{dx} = 3400x^{15/2}$
B) $\frac{dQ}{dx} = 3400x^{17/2}$
C) $\frac{dQ}{dx} = 3400x^{19/2}$
D) $\frac{dQ}{dx} = 6800x^{19/2}$
E) $\frac{dQ}{dx} = 6800x^{17/2}$

Ans: A

126. Suppose that the demand for a product depends on the price p according to $D(p) = \frac{20000}{p^2} - \frac{1}{2}, \quad p > 0$, where p is in dollars. Find and explain the meaning of the instantaneous rate of change of demand with respect to price when $p = 20$.

A) –2.50. If price increases by $1, the demand will decrease approximately 2.50 units.
B) 5.00. If price increases by $1, the demand will increase approximately 5.00 units.
C) –5.00. If price increases by $1, the demand will decrease approximately 5.00 units.
D) 2.50. If price increases by $1, the demand will increase approximately 2.50 units.
E) –99.50. If price increases by $1, the demand will decrease approximately 99.50 units.

Ans: C

127. Suppose that the total cost function, in dollars, for a certain commodity is given by $C(x) = 41,000 + 170x + 0.03x^2$, where x is the number of units produced. Find the instantaneous rate of change of the average cost $\overline{C} = \frac{41,000}{x} + 170 + 0.03x$ for any level of production.

A) $-41,000x^{-2}$
B) $-41,000x^{-2} + 0.03$
C) $41,000x^{-2} + 0.03$
D) 0.06
E) $41,000x^{-2}$

Ans: B

128. Suppose that the total cost function, in dollars, for a certain commodity is given by $C(x) = 40,000 + 100x + 0.06x^2$, where x is the number of units produced. The average cost is given by $\overline{C} = \frac{40,000}{x} + 100 + 0.06x$ for any level of production. Find the level of production where the instantaneous rate of change of the average cost equals zero.

A) $x = 200.00$
B) $x = 666.67$
C) $x = 816.50$
D) $x = 1000.00$
E) $x = 87.36$

Ans: C

129. Suppose that the cost C (in dollars) of processing the exhaust gases at an industrial site to ensure that only p percent of the particulate pollution escapes is given by $C(p) = \frac{100(100 - p)}{p}$. Find the rate of change of cost C with respect to the percent of particulate pollution that escapes when $p = 5$ (percent) and interpret your answer.

A) 0. The cost would not change if 6% instead of 5% of the particulate pollution were allowed to escape.
B) 1900. The cost would increase by approximately $1900 if 6% instead of 5% of the particulate pollution were allowed to escape.
C) 1900. The cost would decrease by approximately $1900 if 6% instead of 5% of the particulate pollution were allowed to escape.
D) –400. The cost would decrease by approximately $400 if 6% instead of 5% of the particulate pollution were allowed to escape.
E) –400. The cost would increase by approximately $400 if 6% instead of 5% of the particulate pollution were allowed to escape.

Ans: D

130. Suppose that for fiddler crabs, the allometric relationship between the weight C of the claw and the weight W of the body is given by $C = 0.18W^{1.56}$. Find the function that gives the rate of change of claw weight with respect to body weight.

A) $\frac{dC}{dW} = 0.2808W^{1.56}$

B) $\frac{dC}{dW} = 0.2808W^{2.56}$

C) $\frac{dC}{dW} = 0.2808W^{0.56}$

D) $\frac{dC}{dW} = 0.5616W^{0.56}$

E) $\frac{dC}{dW} = 0.5616W^{1.56}$

Ans: C

131. Find $\frac{ds}{dt}$ if $s = \left(t^7 + 9\right)\left(t^3 - 9\right)$.

A) $7t^9 - 7t^6 + 27t^2$

B) $10t^9 + 63t^6 + 3t^2$

C) $7t^9 + 63t^6 + 27t^2$

D) $10t^9 - 7t^6 + 3t^2$

E) $10t^9 - 63t^6 + 27t^2$

Ans: E

132. If $y = \left(10x^7 + 4\right)\left(12x^6 - 6x^4 - 11\right)$, find $\frac{dy}{dx}$.

A) $\frac{dy}{dx} = 1560x^{12} + 660x^{10} + 770x^6 + 288x^5 + 96x^3$

B) $\frac{dy}{dx} = 1560x^{12} - 660x^{10} - 770x^6 + 288x^5 - 96x^3$

C) $\frac{dy}{dx} = 1560x^{12} - 660x^{10} - 70x^6 - 288x^5 - 96x^3$

D) $\frac{dy}{dx} = 1560x^{12} - 660x^{10} - 770x^6 + 2880x^5 + 96x^3$

E) $\frac{dy}{dx} = 1560x^{12} - 660x^{10} + 840x^6 + 288x^5 + 96x^3$

Ans: B

133. Find the derivative, but do not simplify your answer.

$y=\left(4x^4-9x^9-3x\right)\left(3x^5-8x^8+5x^5-2\right)$

A) $\left(4x^4-9x^9-3x\right)\left(15x^4-64x^7+25x^4\right)+\left(16x^3-81x^8-3\right)\left(3x^5-8x^8+5x^5-2\right)$

B) $\left(15x^4-64x^7+25x^4\right)+\left(16x^3-81x^8-3\right)$

C) $\left(16x^3-81x^8-3\right)\left(15x^4-64x^7+25x^4\right)$

D) $\left(16x^3-81x^8-3\right)\left(3x^5-8x^8+5x^5-2\right)-\left(4x^4-9x^9-3x\right)\left(15x^4-64x^7+25x^4\right)$

E) $\left(4x^4-9x^9-3x\right)\left(15x^4-64x^7+25x^4\right)-\left(16x^3-81x^8-3\right)\left(3x^5-8x^8+5x^5-2\right)$

Ans: A

134. Find the derivative of the equation $y=\left(\sqrt[5]{x}-6\sqrt[4]{x}+1\right)\left(x^3-8x-7\right)$, but do not simplify your answer.

A) $y'=\left(\sqrt[5]{x}-6\sqrt[4]{x}+1\right)\left(3x^2+8\right)+\left(x^3-8x-7\right)\left(\frac{1}{5\sqrt[5]{x^4}}+\frac{3}{2\sqrt[4]{x^3}}\right)$

B) $y'=\left(\sqrt[5]{x}-6\sqrt[4]{x}+1\right)\left(3x^2\right)+\left(x^3-8x-7\right)\left(\frac{1}{\sqrt[5]{x^4}}+\frac{3}{2\sqrt[4]{x^3}}\right)$

C) $y'=\left(\sqrt[5]{x}-6\sqrt[4]{x}+1\right)\left(3x^2-8\right)+\left(x^3-8x-7\right)\left(\frac{1}{5\sqrt[5]{x^4}}-\frac{3}{2\sqrt[4]{x^3}}\right)$

D) $y'=\left(\sqrt[5]{x}-6\sqrt[4]{x}+1\right)\left(3x^3+8\right)+\left(x^3-8x+7\right)\left(\frac{1}{5\sqrt[5]{x^4}}+\frac{3}{2\sqrt[4]{x^3}}\right)$

E) $y'=\left(\sqrt[5]{x}+6\sqrt[4]{x}+1\right)\left(3x^2\right)+\left(x^3-8x+7\right)\left(\frac{1}{\sqrt[5]{x^4}}-\frac{3}{2\sqrt[4]{x^3}}\right)$

Ans: C

135. For the given function, find the slope of the tangent line at $x=-1$.

$y=\left(x^3-3\right)\left(x^2-6x+9\right)$

A) 0
B) 16
C) –64
D) 80
E) does not exist

Ans: D

136. For the given function, find the instantaneous rate of change at $x = 4$.

$y = \left(x^2 - 2\right)\left(x^2 - 6x + 6\right)$

A) 12
B) –44
C) –28
D) 0
E) does not exist
Ans: A

137. Find the indicated derivative and simplify.

$C'(x)$ for $C(x) = \dfrac{4x^3}{8x^4 + 5}$

A) $-\dfrac{8x^2\left(8x^4 + 15\right)}{\left(8x^4 + 5\right)^2}$

B) $\dfrac{x^2\left(8x^4 - 15\right)}{\left(8x^4 + 5\right)^2}$

C) $-\dfrac{x^2\left(8x^4 + 15\right)}{\left(8x^4 + 5\right)^2}$

D) $-\dfrac{4x^2\left(8x^4 - 15\right)}{\left(8x^4 + 5\right)^2}$

E) $\dfrac{4x^2\left(8x^4 + 15\right)}{\left(8x^4 + 5\right)^2}$

Ans: D

138. Find the indicated derivative and simplify.

$\frac{dy}{dx}$ for $y=\frac{1-8x^2}{x^4-8x^2+4}$

A) $\frac{2x\left(4x^4+x^2-12\right)}{\left(x^4-8x^2+4\right)^2}$

B) $\frac{2x\left(4x^3-x-12\right)}{\left(x^4-8x^2+4\right)^2}$

C) $\frac{4x\left(4x^4-x^2-12\right)}{\left(x^4-8x^2+4\right)^2}$

D) $\frac{4x\left(4x^3+x-12\right)}{\left(x^4-8x^2+4\right)^2}$

E) $\frac{4x\left(4x^4+x^2-12\right)}{\left(x^4-8x^2+4\right)^2}$

Ans: C

139. Find the indicated derivative and simplify.

$\frac{dy}{dx}$ for $y=500x-\frac{400x}{6x+1}$

A) $200\frac{180x^2+60x-1}{\left(6x+1\right)^2}$

B) $200\frac{180x^2-60x+1}{\left(6x+1\right)^2}$

C) $100\frac{180x^2+1}{\left(6x+1\right)^2}$

D) $200\frac{60x+1}{\left(6x+1\right)^2}$

E) $100\frac{180x^2+60x+1}{\left(6x+1\right)^2}$

Ans: E

140. Find $\frac{dy}{dx}$ for $y = \frac{10\sqrt{x}-1}{1-10\sqrt{x^3}}$ and simplify.

A) $\frac{dy}{dx} = \frac{5x^{-3/2}+300x-15x^{1/2}}{\left(1-10x^{3/2}\right)^2}$

B) $\frac{dy}{dx} = \frac{5x^{-1/2}+100x-15x^{1/2}}{\left(1-10x^{3/2}\right)^2}$

C) $\frac{dy}{dx} = \frac{5x^{-1/2}+200x-30x^{1/2}}{\left(1-10x^{3/2}\right)^2}$

D) $\frac{dy}{dx} = \frac{5x^{-3/2}-200+300x-15x^{1/2}}{\left(1-10x^{3/2}\right)}$

E) $\frac{dy}{dx} = \frac{5x^{-1/2}-100+300x-30x^{1/2}}{\left(1-10x^{3/2}\right)}$

Ans: B

141. Find the indicated derivative and simplify.

$f'(x)$ for $f(x) = \frac{(x+3)(x-8)}{x^2+8}$

A) $\frac{11x^2-56x-40}{\left(x^2+8\right)^2}$

B) $\frac{5x^2-32x-40}{\left(x^2+8\right)^2}$

C) $\frac{5x^2+64x-40}{\left(x^2+8\right)^2}$

D) $\frac{11x^2-32x-40}{\left(x^2+8\right)^2}$

E) $\frac{11x^2-64x-40}{\left(x^2+8\right)^2}$

Ans: C

142. For the given function, find the slope of the tangent line at $x = -1$.

$y = \dfrac{x-4}{x+3}$

A) $\dfrac{7}{8}$

B) $\dfrac{7}{4}$

C) $-\dfrac{5}{2}$

D) $\dfrac{4}{7}$

E) $-\dfrac{2}{5}$

Ans: B

143. For the given function, find the instantaneous rate of change of the function at $x = -1$.

$y = \dfrac{x-9}{x+4}$

A) $\dfrac{13}{27}$

B) $-\dfrac{10}{3}$

C) $\dfrac{13}{9}$

D) $\dfrac{9}{13}$

E) $-\dfrac{3}{10}$

Ans: C

144. Write the equation of the tangent line to the graph of the function at the indicated point. Check the reasonableness of your answer by graphing both the function and the tangent line.

$y = (7x^2 + 2x + 1)(5 - 7x)$ at $x = 0$

A) $y = 3x$

B) $y = 3x + 15$

C) $y = 3x - 5$

D) $y = 3x + 5$

E) $y = 3x - 15$

Ans: D

145. Write the equation of the tangent line to the graph of the function at the indicated point. Check the reasonableness of your answer by graphing both the function and the tangent line.

$y = \frac{x-5}{5-x^2}$ at $x = -2$

A) $y = 58x + 51$
B) $y = 29x - 51$
C) $y = 58x - 51$
D) $y = 58x$
E) $y = 29x + 51$
Ans: E

146. Use the numerical derivative feature of a graphing utility to find the derivative of the function at the given *x*-value.

$f(x) = \frac{9\sqrt[3]{x} + 5}{x+1}$ at $x = 4$

A) –4.00015666
B) 1.60006266
C) –0.53335422
D) –0.80003133
E) 4.00015666
Ans: C

147. Find the derivative of the given function, and use this to find *x*-values where the function has horizontal tangent lines.

$y = \frac{4x^2}{7x-2}$

A) $x = 0, x = -\frac{14}{2}$
B) $x = 0, x = \frac{2}{7}$
C) $x = 0, x = \frac{7}{2}$
D) $x = 0, x = -\frac{1}{7}$
E) $x = 0, x = \frac{4}{7}$
Ans: E

148. If the cost C (in dollars) of removing p percent of the particulate pollution from the exhaust gases at an industrial site is given by

$$C(p) = \frac{1,500p}{120 - p},$$

find the rate of change of C with respect to p.

A) $\frac{2,250,000}{(120-p)^2}$

B) $\frac{180,000}{(120-p)^2}$

C) $\frac{14,400}{(120-p)^2}$

D) $\frac{1,500}{(120-p)}$

E) $\frac{120}{(120-p)}$

Ans: B

149. Suppose the revenue (in dollars) from the sale of x units of a product is given by the equation $R(x) = \frac{70x^2 + 71x}{2x + 2}$. Find the marginal revenue when 45 units are sold. Round your answer to the nearest dollar.

A) $R'(45) \approx \$36$

B) $R'(45) \approx \$70$

C) $R'(45) \approx \$35$

D) $R'(45) \approx \$34$

E) $R'(45) \approx \$71$

Ans: C

150. McRobert's TV Shop sells 500 sets per month, at a price of \$800 per unit. Market research indicates that the shop can sell one additional set for each \$1 it reduces the price. The total revenue (in dollars) is given by $R(x) = (500 + x)(800 - x)$, where x is the number of additional sets beyond the original 500. What is the marginal revenue if 500 more units are sold?

A) \$2300

B) -\$200

C) \$300

D) -\$700

E) \$1300

Ans: D

151. The reaction R to an injection of a drug is related to the dosage x (in milligrams) according to the equation $R(x) = x^2\left(300 - \frac{x^8}{10}\right)$ where 1000 mg is the maximum dosage. If the rate of reaction with respect to the dosage defines the sensitivity to the drug, find the sensitivity.

A) sensitivity: $600x - x^9$
B) sensitivity: $600x - x^8$
C) sensitivity: $600x - x^7$
D) sensitivity: $300x - x^{10}$
E) sensitivity: $300x - x^9$

Ans: A

152. Suppose that the proportion P of voters who recognize a candidate's name t months after the start of the campaign is given by $P(t) = \frac{18t}{t^2 + 100} + 0.1$. Find the rate of change of P when $t = 2$, and explain its meaning.

A) $P'(2) \approx 0.173$
In the next month the recognition will increase about 17.3%.
B) $P'(2) \approx 1.160$
In the next month the recognition will increase about 16%.
C) $P'(2) \approx 0.160$
In the next month the recognition will increase about 16%.
D) $P'(2) \approx 0.840$
In the next month the recognition will increase about 17.3%.
E) $P'(2) \approx 0.173$
In the next month the recognition will increase about 16%.

Ans: C

153. Suppose the lowest temperature recorded in Indianapolis, Indiana, was $0°F$. If x is the wind speed in miles per hour and $x \geq 5$, then the wind chill (in degrees Fahrenheit) for an air temperature of $0°F$ can be approximated by the function $f(x) = \frac{289.179 - 58.5737x}{x + 4}$. At what rate is the wind chill changing when the wind speed is 10 mph? Round your answer to two decimal places.

A) $f'(x) \approx -0.28$
B) $f'(x) \approx -2.67$
C) $f'(x) \approx 2.67$
D) $f'(x) \approx 0.28$
E) $f'(x) \approx -3.67$

Ans: B

154. Suppose that for selected years from 1970 to 2006, the following table shows the percent of total U.S. workers who are female.

Year	% Female
1970	33.7
1975	34.2
1980	34.5
1985	34.7
1990	34.9
1995	35.1
2000	35.2
2005	35.3
2006	35.3

Assume these data can be modeled with the function $p(t) = \frac{80.7t + 1508}{2.23t + 44.8}$ where $p(t)$ is the percent of the U.S. workforce that is female and t is the number of years past 1970. Find the function that models the instantaneous rate of change of the percent of U.S. workers who are female.

A) $p'(t) = \frac{3615.36}{(2.23t + 44.8)^2}$

B) $p'(t) = \frac{3362.84}{(2.23t + 44.8)^2}$

C) $p'(t) = \frac{252.52}{(2.23t + 44.8)^2}$

D) $p'(t) = \frac{121695.60}{(2.23t + 44.8)^2}$

E) $p'(t) = \frac{67558.40}{(2.23t + 44.8)^2}$

Ans: C

155. Suppose that for selected years from 1970 to 2006, the following table shows the percent of total U.S. workers who are female.

Year	% Female
1970	27.9
1975	29.3
1980	30.3
1985	31.1
1990	31.6
1995	32.1
2000	32.4
2005	32.8
2006	32.8

Assume these data can be modeled with the function $p(t) = \dfrac{76.7t + 1388}{2.13t + 49.8}$ where $p(t)$ is the percent of the U.S. workforce that is female and t is the number of years past 1970. Find the instantaneous rate of change in 2000 and 2006 by using the function that models the instantaneous rate of change of the percent of U.S. workers who are female. Round your answer to three decimal places.

A) $p'(30) = 0.295;\ p'(36) = 0.239$

B) $p'(30) = 0.229;\ p'(36) = 0.185$

C) $p'(30) = 8.235;\ p'(36) = 6.655$

D) $p'(30) = 5.347;\ p'(36) = 4.321$

E) $p'(30) = 0.067;\ p'(36) = 0.054$

Ans: E

156. Find $\dfrac{dy}{du}\dfrac{du}{dx}$ and $\dfrac{dy}{dx}$.

$y = u^7$ and $u = 2x^2 + 9x$

A) $7\left(4x^2 + 9x\right)^7 \left(4x + 9\right)$

B) $6\left(2x^2 + 9x\right)^6 \left(4\right)$

C) $6\left(2x^2 + 9x\right)^7 \left(4x + 9\right)$

D) $7\left(3x^2 + 9x\right)^8 \left(x + 9\right)$

E) $7\left(2x^2 + 9x\right)^6 \left(4x + 9\right)$

Ans: E

157. Differentiate the given function.

$k(x) = \frac{9}{7}(6x^4 - x + 3)^{14}$

A) $126(6x^4 - x + 3)^{13}\left(24x^3 - x\right)$

B) $18(6x^4 - x + 3)^{13}\left(24x^3 - 1\right)$

C) $18(24x^3 - 1)^{13}$

D) $18(6x^4 - x - 3)^{15}\left(4x^3 - 1\right)$

E) $9(6x^4 - x + 6)^{13}\left(24x^4 - 1\right)$

Ans: B

158. Differentiate the given function.

$p\left(q\right) = (q^3 + 6)^{-3}$

A) $-\frac{9q^2}{\left(q^3 + 6\right)^5}$

B) $-\frac{3q^2}{\left(q^3 + 6\right)^4}$

C) $-\frac{9q^2}{\left(q^3 + 6\right)^4}$

D) $-\frac{3q^2}{\left(q^3 + 6\right)^2}$

E) $-\frac{3q^3}{\left(q^3 + 6\right)^4}$

Ans: C

159. Differentiate the function $g(x)=\frac{1}{7x^3+1}$.

A) $g'(x)=-\frac{1}{\left(7x^3+1\right)^2}$

B) $g'(x)=\frac{21x^2}{\left(7x^3+1\right)^2}$

C) $g'(x)=-\frac{21x^2}{\left(7x^3+1\right)^2}$

D) $g'(x)=-\frac{7x^2}{\left(7x^3+1\right)^2}$

E) $g'(x)=\frac{7x^2}{\left(7x^3+1\right)^2}$

Ans: C

160. Differentiate the given function.

$y=\frac{1}{(3x^3+7x+1)^{5/2}}$

A) $-\frac{5}{2}\left(3x^3+7x+1\right)^{-\frac{7}{2}}$

B) $-\frac{5}{2}\left(9x^2+7\right)^{-\frac{3}{2}}\left(3x^3+7x+1\right)$

C) $-\frac{5}{2}\left(3x^3+7x+1\right)^{-\frac{3}{2}}\left(9x^2+7\right)$

D) $-\frac{7}{2}\left(3x^3+7x+1\right)^{-\frac{3}{2}}\left(3x^3+7x+1\right)$

E) $-\frac{5}{2}\left(3x^3+7x+1\right)^{-\frac{7}{2}}\left(9x^2+7\right)$

Ans: E

161. Differentiate the given function.

$y = \sqrt{6x^3 + 4x}$

A) $\frac{1}{2}\left(18x^2 + 4\right)^{-1/2}$

B) $\frac{1}{2}\left(6x^3 + 4x\right)^{-1/2}$

C) $\frac{1}{2}\left(18x^3 + 4x\right)^{-1/2}\left(6x^3 + 4\right)$

D) $\frac{1}{2}\left(6x^3 + 4x\right)^{-1/2}\left(18x^2 + 4\right)$

E) $-\frac{1}{2}\left(6x^3 + 4x\right)^{-3/2}\left(18x^2 + 4\right)$

Ans: D

162. Differentiate the given function.

$y = \frac{(9x+1)^4 - 9x}{11}$

A) $\frac{9}{11}\left[4\left(9x+1\right)^3 - 1\right]$

B) $\frac{1}{11}\left[4\left(9x+1\right)^3 - 9\right]$

C) $\frac{9}{11}\left[\left(9x+1\right)^4 - 9\right]$

D) $\frac{9}{11}\left[4\left(x+1\right)^3 - 9\right]$

E) $\frac{1}{11}\left[36\left(9x+1\right)^3 - 1\right]$

Ans: A

163. For the given function, find the slope of the tangent line at $x = 0$. A graphing utility's numerical derivative feature may be used to check your work.

$y = (4x^3 - 4x + 1)^3$

A) –4
B) –12
C) 3
D) –6
E) –48

Ans: B

164. For the given function, find the instantaneous rate of change at $x=1$. A graphing utility's numerical derivative feature may be used to check your work.
$y=(2x^3-4x+1)^3$ at $x=1$
A) 3
B) 2
C) 6
D) 0
E) 12
Ans: C

165. Write the equation of the line tangent to the graph of the given function at the indicated point. As a check, graph both the function and the tangent line you found to see whether it looks correct.
$y=\sqrt{3x^2-2}$ at $x=3$
A) $y=-1.8x+0.4$
B) $y=1.8x-0.4$
C) $y=-1.8x-0.4$
D) $y=1.8x+0.4$
E) $y=1.8x$
Ans: B

166. Find $f'(x)$ for the given function.
$f(x)=3-(x^2-4)^2$
A) $-4x\left(x^2-4\right)$
B) $2x\left(x^2-4\right)$
C) $-x\left(x^2-4\right)$
D) $x\left(x^2-4\right)$
E) $-2x\left(x^2-4\right)$
Ans: A

167. Find all x-values for which the slope of the tangent is 0 for the given function.
$f(x)=3-(x^2-4)^2$
A) $x=2,-2$
B) $x=2,-2,0$
C) $x=2,-2,4$
D) $x=-2,0$
E) $x=2,0$
Ans: B

168. Find all points (x, y) where the slope of the tangent is 0 for the given function.

$f(x) = 6 - (x^2 - 1)^2$

A) $(1,6),(-1,6),(0,5)$

B) $(1,1),(-1,1),(0,5)$

C) $(1,6),(-1,6),(1,7)$

D) $(-1,6),(0,6)$

E) $(1,7),(0,5)$

Ans: A

169. Differentiate the given function.

$y = \dfrac{7}{(8x)^8}$

A) $\dfrac{448}{(8x)^9}$

B) $-\dfrac{56}{(8x)^9}$

C) $-\dfrac{448}{(8x)^9}$

D) $\dfrac{56}{(8x)^9}$

E) $-\dfrac{56}{(8x)^7}$

Ans: C

170. Differentiate the given function.

$y = \dfrac{7x^6}{6}$

A) $6x^5$

B) $7x^6$

C) $7x^7$

D) $42x^5$

E) $7x^5$

Ans: E

171. Differentiate the given function.

$y = \frac{5}{6x^6}$

A) $-\frac{30}{x^7}$

B) $-\frac{5}{x^6}$

C) $-\frac{30}{x^6}$

D) $-\frac{5}{x^7}$

E) $-\frac{6}{x^7}$

Ans: D

172. Differentiate the given function.

$y = \frac{(7x)^4}{4}$

A) $7(7x)^4$

B) $7(4x)^3$

C) $7(7x)^3$

D) $(7x)^3$

E) $(28x)^3$

Ans: C

173. Ballistics experts are able to identify the weapon that fired a certain bullet by studying the markings on the bullet. Tests are conducted by firing into a bale of paper. Suppose the distance *s*, in inches, that the bullet travels into the paper is given by $s = 54 - (6 - 10t)^3$ for $0 \le t \le 0.3$ second, find the velocity of the bullet one-tenth of a second after it hits the paper.

A) $s'(0.1) = 750$ in/sec

B) $s'(0.1) = 1080$ in/sec

C) $s'(0.1) = 1470$ in/sec

D) $s'(0.1) = 450$ in/sec

E) $s'(0.1) = 882$ in/sec

Ans: A

174. The revenue (in dollars) from the sale of x units of a product is $R = 19(3x+1)^{-1} + 70x - 50$. Find the marginal revenue when 21 units are sold and interpret your result.
   A) 140. So, if the sales go from 21 units sold to 20 units sold, the revenue will increase by about $140.
   B) 20. So, if the sales go from 21 units sold to 22 units sold, the revenue will increase by about $20.
   C) 21. So, if the sales go from 21 units sold to 22 units sold, the revenue will increase by about $21.
   D) 280. So, if the sales go from 21 units sold to 20 units sold, the revenue will increase by about $280.
   E) 70. So, if the sales go from 21 units sold to 22 units sold, the revenue will increase by about $70.
   Ans: E

175. Suppose that the weekly sales volume y (in thousands of units sold) depends on the price per unit of the product according to $y = 38(5p+1)^{-4/9}$, $p > 0$ where p is in dollars. What is the rate of change in sales volume when the price is $27? Round your answer to three decimal places.
   A) $y'(27) \approx 0.070$ thousand units per dollar
   B) $y'(27) \approx -1.070$ thousand units per dollar
   C) $y'(27) \approx -0.070$ thousand units per dollar
   D) $y'(27) \approx -1.140$ thousand units per dollar
   E) $y'(27) \approx 0.140$ thousand units per dollar
   Ans: C

176. A chain of auto service stations has found that its monthly sales volume y (in dollars) is related to the price p (in dollars) of an oil change according to $y = \frac{80,000}{\sqrt{p+9}}$, $p > 10$.
   What is the rate of change of sales volume when the price is $70? Interpret your answer.
   A) –4500. If the price of an oil change goes from $70 to $71, the monthly sales volume will decrease by $4500.
   B) –114. If the price of an oil change goes from $70 to $71, the monthly sales volume will increase by $114.
   C) –114. If the price of an oil change goes from $70 to $71, the monthly sales volume will decrease by $114.
   D) –57. If the price of an oil change goes from $70 to $71, the monthly sales volume will decrease by $57.
   E) –57. If the price of an oil change goes from $70 to $71, the monthly sales volume will increase by $57.
   Ans: D

177. The daily sales S (in thousands of dollars) attributed to an advertising campaign are given by $S = 1 + \frac{5}{t+5} - \frac{30}{(t+5)^2}$ where t is the number of weeks the campaign runs.

What is the rate of change of sales at $t = 3$? Round your answer to five decimal places.

A) $S'(3) \approx 0.03906$ thousands of dollars per week

B) $S'(3) \approx 1.35192$ thousands of dollars per week

C) $S'(3) \approx 0.13672$ thousands of dollars per week

D) $S'(3) \approx 2.19026$ thousands of dollars per week

E) $S'(3) \approx 0.19531$ thousands of dollars per week

Ans: A

178. The data entry speed (in words per minute) of a data clerk trainee is $S = 30\sqrt{0.8x+4}, \quad 0 \le x \le 200$, where x is the number of hours of training he has had. What is the rate at which his speed is changing and what does this rate mean when he has had 40 hours of training?

A) If the training hours are increased from 40 to 41 hours, the student's typing speed will increase about 2.00 words per minute.

B) If the training hours are increased from 40 to 41 hours, the student's typing speed will increase about 5.00 words per minute.

C) If the training hours are increased from 40 to 41 hours, the student's typing speed will increase about 2.50 words per minute.

D) If the training hours are increased from 40 to 41 hours, the student's typing speed will decrease about 2.00 words per minute.

E) If the training hours are increased from 40 to 41 hours, the student's typing speed will decrease about 1.50 words per minute.

Ans: A

179. If an IRA is a variable-rate investment for 20 years at rate r percent per year, compounded monthly, then the future value S that accumulates from an initial investment of \$1000 is $S = 1000\left[1+\frac{0.01r}{12}\right]^{240}$. What is the rate of change of S with respect to r and what does it tell us if the interest rate is 3%? Round your answer to two decimal places.

A) The future value increases by approximately \$418.44 when the interest rate increases from 3% to 4%.
B) The future value increases by approximately \$363.24 when the interest rate increases from 3% to 4%.
C) The future value increases by approximately \$757.88 when the interest rate increases 3%.
D) The future value increases by approximately \$318.74 when the interest rate increases 3%.
E) The future value increases by approximately \$629.48 when the interest rate increases from 3% to 4%.

Ans: B

180. The table gives the yearly U.S. federal budget deficit (as a negative value) or surplus (as a positive value) in billions of dollars from 1990 to 2004.

Year	Deficit or Surplus	Year	Deficit or Surplus
1990	−221.2	1998	70.0
1991	−269.4	1999	124.4
1992	−290.4	2000	237.0
1993	−255.0	2001	127.0
1994	−203.1	2002	−159.0
1995	−164.0	2003	−374.0
1996	−107.5	2004	−445.0
1997	−22.0		

Source: Budget of the United States Government

Assume the federal budget deficit (or surplus) can be modeled with the function $D(t) = -1975(0.1t-1)^3 + 3357.4(0.1t-1)^2 - 1064.6(0.1t-1) - 205.4$, where D is in billions of dollars and t is the number of years past 1980. Use the model to find and interpret the instantaneous rate of change of the U.S. federal deficit (or surplus) in 1994.

A) This model predicts a budget deficit increase of \$722.6 billion from 1994 to 1995.
B) This model predicts a budget deficit increase of \$67.3 billion from 1994 to 1995.
C) This model predicts a budget deficit decrease of \$673.3 billion from 1994 to 1995.
D) This model predicts a budget deficit decrease of \$67.3 billion from 1994 to 1995.
E) This model predicts a budget deficit decrease of \$722.6 billion from 1994 to 1995.

Ans: D

181. The table gives the yearly U.S. federal budget deficit (as a negative value) or surplus (as a positive value) in billions of dollars from 1990 to 2004.

Year	Deficit or Surplus	Year	Deficit or Surplus
1990	−221.2	1998	70.0
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1997	−22.0		

Source: Budget of the United States Government

Assume the federal budget deficit (or surplus) can be modeled with the function $D(t) = -1975(0.1t-1)^3 + 3357.4(0.1t-1)^2 - 1064.6(0.1t-1) - 205.4$, where D is in billions of dollars and t is the number of years past 1980. Use the data to find an average rate of change that approximates the instantaneous rate in 1996.

A) The budget deficit increased by an average rate of \$85.5 billion from 1996 to 1997.
B) The budget deficit increased by an average rate of \$831.3 billion from 1996 to 1997.
C) The budget deficit decreased by an average rate of \$85.5 billion from 1996 to 1997.
D) The budget deficit decreased by an average rate of \$83.1 billion from 1996 to 1997.
E) The budget deficit decreased by an average rate of \$469.9 billion from 1996 to 1997.
Ans: C

182. Find the derivative of the given function. Simplify and express the answer using positive exponents only.
$f(x) = 2\pi^8$
A) $16\pi^7$
B) $2\pi^8$
C) 16
D) 0
E) π
Ans: D

183. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$g(x) = 9x^7 + \frac{9}{x}$

A) $63x^6 - \frac{9}{x^2}$

B) $63x^6 + \frac{9}{x^2}$

C) $7x^6 - \frac{1}{x}$

D) $9x^6 + \frac{9}{x^2}$

E) $7x^6 - \frac{9}{x^2}$

Ans: A

184. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$y = \left(x^3 - 9x^2 + 4\right)\left(x^3 - 2\right)$

A) $6x^5 + 45x^4 + 18x^2 + 36x$

B) $6x^5 - 45x^4 + 6x^2 + 36x$

C) $6x^5 - 45x^4 + 12x^2 + 36x$

D) $6x^5 - 45x^4 + 12x^2 + 18x$

E) $6x^5 + 5x^4 + 6x^2 + 4x$

Ans: B

185. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$$y = \frac{4 + 5x^2 - x^4}{4 + x^4}$$

A) $-\dfrac{2x\left(5x^4 + 16x^2 - 20\right)}{\left(4 + x^4\right)^2}$

B) $-\dfrac{2x\left(5x^4 - 16x^2 + 20\right)}{\left(4 + x^4\right)}$

C) $-\dfrac{2x\left(5x^4 - 16x^2 + 20\right)}{\left(4 + x^4\right)^2}$

D) $-\dfrac{x\left(5x^4 + 16x^2 - 20\right)}{\left(4 + x^4\right)}$

E) $-\dfrac{x\left(5x^4 - 16x^2 + 20\right)}{\left(4 + x^4\right)^2}$

Ans: A

186. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$$y = \frac{7}{2}(8x^4 - 3x^2 + 2)^8$$

A) $28(8x^4 - 3x^2 + 2)^7\left(16x^2 - 3\right)$

B) $112x(8x^4 - 3x^2 + 2)^7\left(32x^2 - 3\right)$

C) $56x(8x^4 - 3x^2 + 2)^7\left(16x^2 - 3\right)$

D) $28x(8x^4 - 3x^2 + 2)^7\left(32x^2 - 3\right)$

E) $112x(8x^4 - 3x^2 + 2)^7\left(16x^2 - 3\right)$

Ans: C

187. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$y = 8x^4\left(8x^2+1\right)^3$

A) $8x^3\left(56x^5+1\right)\left(8x^2+1\right)^2$

B) $32x^3\left(20x^2+1\right)\left(8x^2+1\right)^2$

C) $8x^3\left(20x^5+1\right)\left(8x^2+1\right)^2$

D) $32\left(20x^2+1\right)\left(8x^2+1\right)^3$

E) $32\left(80x^2+1\right)\left(8x^2+1\right)^3$

Ans: B

188. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$f(x) = \left(8x^4+1\right)\left(x^4+7x\right)^2$

A) $4\left(x^3+7\right)\left(48x^7+280x^4+4x^3+7\right)$

B) $4x\left(x^3+7\right)\left(48x^7+168x^4+x^3+7\right)$

C) $2\left(x^3+7\right)\left(48x^7+168x^4+x^3+7\right)$

D) $2\left(x^3+7\right)\left(48x^7+280x^4+4x^3+7\right)$

E) $2x\left(x^3+7\right)\left(48x^7+168x^4+4x^3+7\right)$

Ans: E

189. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$$y = \frac{\left(7x^2 - 4\right)^3}{5x^2 + 6}$$

A) $\dfrac{\left(7x^2 - 4\right)^2 \left(5x^2 - 73\right)}{\left(5x^2 + 6\right)^2}$

B) $\dfrac{8x\left(7x^2 + 4\right)^2 \left(7x^2 + 73\right)}{\left(5x^2 + 6\right)^2}$

C) $\dfrac{4x\left(7x^2 - 4\right)^2 \left(35x^2 + 73\right)}{\left(5x^2 + 6\right)^2}$

D) $\dfrac{8x\left(7x^2 - 4\right)^2 \left(35x^3 + 73\right)}{\left(5x^2 + 6\right)^2}$

E) $\dfrac{4\left(7x^2 - 4\right)^2 \left(7x^3 + 73\right)}{\left(5x^2 + 6\right)^2}$

Ans: C

190. Find the derivative of the function $R(x) = \left[x^4\left(x^4 + 13x\right)\right]^4$. Simplify and express the answer using positive exponents only.

A) $R'(x) = 4x^4\left(x^4 + 13\right)^3\left(x^3 + 65\right)$

B) $R'(x) = 4x^{16}\left(x^4 + 13x\right)^3\left(8x^3 + 65\right)$

C) $R'(x) = 4x^4\left(x^{16} + 13x\right)^3\left(x^3 + 65\right)$

D) $R'(x) = x^{16}\left(x^{16} + 13x\right)^3\left(8x^3 + 65\right)$

E) $R'(x) = x^4\left(x^4 + 13\right)^3\left(8x^3 + 65\right)$

Ans: B

191. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$y=\left(\frac{8-x^7}{x^2}\right)^3$

A) $\frac{3\left(x^7-8\right)^2\left(5x^7+1\right)}{x^7}$

B) $-\frac{3\left(x^7-8\right)^2\left(5x^7+1\right)}{x^5}$

C) $-\frac{3\left(x^7-8\right)^2\left(5x^7+16\right)}{x^7}$

D) $\frac{3\left(x^7-8\right)^2\left(5x^7+16\right)}{x^5}$

E) $-\frac{3\left(x^7+8\right)^2\left(5x^7-16\right)}{x^7}$

Ans: C

192. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$y=(4x^3-5x)^3\left(8x^2-3\right)^2$

A) $x^2\left(8x^2-3\right)\left(4x^2-5\right)^2\left(416x^4-388x^2+45\right)$

B) $x^2\left(8x^2+3\right)\left(4x^2+5\right)^2\left(416x^4-388x^2-45\right)$

C) $x^2\left(8x^2-3\right)\left(4x^2+5\right)^2\left(416x^5-388x^3-45\right)$

D) $x\left(8x^2-3\right)\left(4x^2+5\right)^2\left(416x^5-388x^3+45\right)$

E) $x\left(8x^2-3\right)\left(4x^2-5\right)^2\left(416x^5-388x^3-45\right)$

Ans: A

193. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$g(x) = \dfrac{\sqrt[3]{5x-3}}{4x}$

A) $\dfrac{9+10x}{4x^2(5x-3)^{2/3}}$

B) $\dfrac{9-10x}{12x^2(5x-3)^{2/3}}$

C) $\dfrac{9-5x}{4x^2(5x-3)^{2/3}}$

D) $\dfrac{3-10x}{4x^2(5x-3)^{2/3}}$

E) $\dfrac{3+5x}{12x^2(5x-3)^{2/3}}$

Ans: B

194. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$c(x) = 9x\sqrt{x^3+7}$

A) $\dfrac{9(5x^3-14)}{2(x^3+7)^{1/2}}$

B) $\dfrac{9(3x^3-14)}{2(x^3+7)^{1/2}}$

C) $\dfrac{9(3x^3-14)}{(x^3+7)^{1/2}}$

D) $\dfrac{9(5x^3+14)}{2(x^3+7)^{1/2}}$

E) $\dfrac{9(3x^3+14)}{(x^3+7)^{1/2}}$

Ans: D

195. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$$g(x) = \frac{5\left(x^3 - 7\right)^5}{4}$$

A) $\dfrac{75x^2\left(x^3 + 7\right)^5}{4}$

B) $\dfrac{75x^2\left(x^3 - 7\right)^4}{4}$

C) $\dfrac{75x\left(x^3 + 7\right)^4}{4}$

D) $\dfrac{25x^2\left(x^3 - 7\right)^5}{4}$

E) $\dfrac{25x\left(x^3 - 7\right)^4}{4}$

Ans: B

196. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$$g(x) = \frac{\left(9x^3 - 7\right)^3}{7}$$

A) $\dfrac{27x^2\left(x^3 + 7\right)^2}{7}$

B) $\dfrac{27x\left(x^3 - 7\right)^2}{7}$

C) $\dfrac{81x^2\left(9x^3 - 7\right)^2}{7}$

D) $\dfrac{27x\left(x^3 - 7\right)^3}{7}$

E) $\dfrac{27x^2\left(x^3 - 7\right)^2}{7}$

Ans: C

197. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$$g(x)=\frac{9}{7\left(x^3-6\right)^4}$$

A) $-\dfrac{108x^2}{7\left(x^3-6\right)^5}$

B) $-\dfrac{3x^2}{7\left(x^3-6\right)^5}$

C) $-\dfrac{108x^2}{\left(x^3-6\right)^5}$

D) $-\dfrac{9}{7\left(x^3-6\right)^5}$

E) $-\dfrac{9}{7\left(x^3-6\right)^3}$

Ans: A

198. Find the derivative of the given function. Simplify and express the answer using positive exponents only.

$$g(x)=\frac{8}{\left(7x^3-6\right)^9}$$

A) $-\dfrac{1512x^2}{\left(7x^3-6\right)^{10}}$

B) $-\dfrac{3x^2}{7\left(x^3-6\right)^{10}}$

C) $-\dfrac{1512x^2}{\left(x^3-6\right)^8}$

D) $-\dfrac{216}{\left(7x^3-6\right)^{10}}$

E) $-\dfrac{8}{7\left(x^3-6\right)^8}$

Ans: A

199. The total physical output P of workers is a function of the number of workers, x. The function $P = f(x)$ is called the physical productivity function. Suppose that the physical productivity of x construction workers is given by $P = 12(4x+3)^3 - 14$, find the marginal physical productivity, $\frac{dP}{dx}$.

A) $\frac{dP}{dx} = 36(4x+3)^2$

B) $\frac{dP}{dx} = 144(4x+3)^4 - 14x$

C) $\frac{dP}{dx} = 36(4x+3)^4 - 14$

D) $\frac{dP}{dx} = 12(4x+3)^2 - 14x$

E) $\frac{dP}{dx} = 144(4x+3)^2$

Ans: E

200. Suppose that the revenue function for a certain product is given by $R(x) = 50(2x+1)^{-1} + 30x - 20$, where x is in thousands of units and R is in thousands of dollars. Find the marginal revenue (in thousands of dollars per unit) when 1000 units are sold.

A) –70.00
B) 24.44
C) 70.00
D) 18.89
E) –18.89

Ans: D

201. If the national consumption function is given by $C(y) = 2(y+6)^{1/2} + 0.7y + 2$, find the marginal propensity to consume, $\frac{dC}{dy}$.

A) $\frac{dC}{dy} = \frac{1}{(y+6)^{1/2}} + 0.7$

B) $\frac{dC}{dy} = \frac{2}{(y+6)} + 0.7$

C) $\frac{dC}{dy} = 2(y+6)^{3/2} + 0.7y$

D) $\frac{dC}{dy} = (y+6)^{3/2} + 0.7$

E) $\frac{dC}{dy} = \frac{2}{(y+6)^{3/2}} + 0.7y$

Ans: A

202. Suppose that the demand function for q units of an appliance priced at \$$p$ per unit is given by $p = \frac{350(q+2)}{(q+4)^2}$, find the rate of change of price with respect to the number of appliances.

A) $p' = \frac{-350q + 2800}{(q+4)^3}$

B) $p' = \frac{350q}{(q+4)^2}$

C) $p' = \frac{350}{(q+4)^4}$

D) $p' = -\frac{350q}{(q+4)^3}$

E) $p' = -\frac{(350q + 2800)}{(q+4)^4}$

Ans: D

203. When squares of side x inches are cut from the corners of a 13-inch-square piece of cardboard, an open-top box can be formed by folding up the sides. The volume of this box is given by $V = x(13-2x)^2$, find the rate of change of volume with respect to the size of the squares.

A) $V'(x) = x^2 + 13x + 169$

B) $V'(x) = 12x^2 - 104x - 13$

C) $V'(x) = 12x^2 - 104x + 169$

D) $V'(x) = x^2 + 104x - 13$

E) $V'(x) = 2x^2 - 13x + 169$

Ans: C

204. Suppose that sales (in dollars) are directly related to an advertising campaign according to $S = 1000\left(1 + \frac{3t-8}{(t+3)^2}\right)$, where t is the number of weeks of the campaign. Find the rate of change of sales after 9 weeks and interpret your answer.

A) –1.16. So, during the 10th week, the model predicts that sales will decrease approximately \$1.16.
B) –13.89. So, during the 10th week, the model predicts that sales will decrease approximately \$13.89
C) –1.16. So, during the 10th week, the model predicts that sales will increase approximately \$1.16.
D) –13.89. So, during the 10th week, the model predicts that sales will increase approximately \$13.89
E) 0. So, during the 10th week, the model predicts that sales will remain constant.

Ans: A

205. Find the second derivative of $f(x) = 2x^{10} - 14x^5 - 17x^3 + 6$.

A) $f''(x) = 20x^9 - 70x^4 - 51x^2$
B) $f''(x) = 2(90x^9 - 140x^4 - 51x^2)$
C) $f''(x) = 20x^8 - 70x^3 - 51x$
D) $f''(x) = 60x^8 - 140x^3 - 51x^2$
E) $f''(x) = 2(90x^8 - 140x^3 - 51x)$

Ans: E

206. Find the second derivative.

$h(x) = x^9 - \frac{1}{x^9}$

A) $90x^7 - \frac{72}{x^{11}}$
B) $90x^7 + \frac{90}{x^{11}}$
C) $72x^7 - \frac{90}{x^{11}}$
D) $90x^7 - \frac{72}{x^7}$
E) $72x^7 + \frac{90}{x^7}$

Ans: C

207. Find the second derivative.

$y = x^4 - 5\sqrt{x}$

A) $\left(20x^2 + \frac{5}{x^{3/2}}\right)$

B) $\left(12x^2 + \frac{5}{4x^{3/2}}\right)$

C) $\left(12x^2 - \frac{5}{x^{3/2}}\right)$

D) $\left(12x^2 - \frac{5}{4x^{3/2}}\right)$

E) $\left(20x^2 - \frac{5}{4x^{3/2}}\right)$

Ans: B

208. Find the third derivative.

$y = 8x^3 - 9x^2 + 3x$

A) 48
B) $48x$
C) 24
D) $24x$
E) 0
Ans: A

209. Find the third derivative.

$y = \frac{5}{x^5}$

A) $\frac{-1050}{x^7}$

B) $\frac{1050}{x^8}$

C) 0

D) $\frac{210}{x^7}$

E) $\frac{-1050}{x^8}$

Ans: E

210. If $y = x^4 - x^{1/2}$, find $\frac{d^2y}{dx^2}$.

A) $\frac{d^2y}{dx^2} = 4x^3 - \frac{1}{2}x^{-1/2}$

B) $\frac{d^2y}{dx^2} = 12x^2 + \frac{1}{4}x^{-3/2}$

C) $\frac{d^2y}{dx^2} = 4x^3 + \frac{1}{2}x^{1/2}$

D) $\frac{d^2y}{dx^2} = 12x^2 - \frac{1}{2}x^{3/2}$

E) $\frac{d^2y}{dx^2} = 12x^3 - \frac{1}{4}x^{-3/2}$

Ans: B

211. Find the indicated derivative.
If $f(x) = 5\sqrt{x-3}$, find $f'''(x)$.

A) $\frac{3}{8(x-3)^{5/2}}$

B) $\frac{-1}{4(x-3)^{3/2}}$

C) $\frac{15}{8(x-3)^{5/2}}$

D) $\frac{-5}{4(x-3)^{3/2}}$

E) $\frac{15}{4(x-3)^{5/2}}$

Ans: C

212. Find the indicated derivative.
Find $y^{(4)}$ if $y = x^7 - 8x^3$.

A) $210x^4$

B) $210x^3$

C) $210x^3 - 48x$

D) $840x^4 - 48x$

E) $840x^3$

Ans: E

213. Find the indicated derivative.

Find $f^{(4)}(x)$ if $f(x)=\sqrt{6x}$.

A) $-\dfrac{15\sqrt{6}}{16(x)^{7/2}}$

B) $-\dfrac{15}{16(6x)^{7/2}}$

C) $\dfrac{15\sqrt{6}}{16(x)^{5/2}}$

D) $\dfrac{15}{16(6x)^{7/2}}$

E) $\dfrac{15\sqrt{6}}{16(x)^{7/2}}$

Ans: A

214. Find $f^{(4)}(x)$ if $f(x)=\dfrac{5}{3x}$.

A) $f^{(4)}(x)=\dfrac{40}{x^5}$

B) $f^{(4)}(x)=-\dfrac{10}{x^4}$

C) $f^{(4)}(x)=-\dfrac{40}{x^5}$

D) $f^{(4)}(x)=0$

E) $f^{(4)}(x)=\dfrac{5}{3}$

Ans: A

215. Find the indicated derivative.

$y^{(5)}$ if $\dfrac{d^2y}{dx^2} = \sqrt[3]{7x+8}$.

A) $\dfrac{192{,}080}{81(7x+8)^{11/3}}$

B) $-\dfrac{3430}{27(7x+8)^{8/3}}$

C) $-\dfrac{192{,}080}{81(7x+8)^{11/3}}$

D) $\dfrac{3430}{27(7x+8)^{8/3}}$

E) $-\dfrac{98}{9(7x+8)^{5/3}}$

Ans: D

216. Find the indicated derivative.

Find $f^{(3)}(x)$ if $f'(x) = \dfrac{3x^2}{x^2+2}$.

A) $-\dfrac{12(2-3x^2)}{(x^2+2)^3}$

B) $\dfrac{12(2-3x^2)}{(x^2+2)^3}$

C) $-\dfrac{144x(2-x^2)}{(x^2+2)^4}$

D) $-\dfrac{144(2-x^2)}{(x^2+2)^4}$

E) $\dfrac{144x(2-x^2)}{(x^2+2)^4}$

Ans: B

217. If $f(x) = 15x^2 - x^3$, what is the rate of change of $f'(x)$ at $(3,108)$?

A) $f''(3) = 63$

B) $f''(3) = 21$

C) $f''(3) = 72$

D) $f''(3) = 12$

E) $f''(3) = 27$

Ans: D

218. Use the numerical derivative feature of a graphing utility to approximate the given second derivative to two decimal places.

$f''(4)$ for $f(x) = \frac{x^2}{8} - \frac{9}{x^2}$

A) 1.28
B) 0.04
C) –1.28
D) –0.04
E) 0.00
Ans: B

219. Find $f'(x)$ and $f''(x)$.

$f(x) = 7 + 8x - 3x^3$

A) $f'(x) = 8 - 9x^2,\ f''(x) = 18x$

B) $f'(x) = 18x,\ f''(x) = 18$

C) $f'(x) = 9x^2,\ f''(x) = 18x$

D) $f'(x) = 8 - 9x^2,\ f''(x) = 18$

E) $f'(x) = -1,\ f''(x) = 0$

Ans: A

220. Identify x-values where $f''(x) = 0,\ f''(x) > 0,$ and $f''(x) < 0.$

$f(x) = 4 + 8x - 8x^3$

A) $x = -48, x > -48, x < -48$

B) $x = 48, x < 48, x > 48$

C) $x = 48, x > 48, x < 48$

D) $x = 0, x > 0, x < 0$

E) $x = 0, x < 0, x > 0$

Ans: E

221. Identify x-values where $f'(x)$ has a maximum point or a minimum point, where $f'(x)$ is increasing, and where $f'(x)$ is decreasing.

$f(x) = 1 + 8x - 9x^3$

A) $x = -54, x > -54, x < -54$
B) $x = 54, x < 54, x > 54$
C) $x = 54, x > 54, x < 54$
D) $x = 0, x > 0, x < 0$
E) $x = 0, x < 0, x > 0$
Ans: E

222. If the formula describing the distance s (in feet) an object travels as a function of time t (in seconds) is $s = 100 + 150t - 13t^2$. What is the acceleration of the object when $t = 5$?
A) 0 ft/sec^2
B) –26 ft/sec^2
C) 20 ft/sec^2
D) 26 ft/sec^2
E) –20 ft/sec^2
Ans: B

223. Suppose that the revenue (in dollars) from the sale of a product is given by $R = 100 + 0.8x^2 - 0.005x^3$, where x is the number of units sold. How fast is the marginal revenue $\overline{MR}$ changing when $x = 50$?
A) 1.57 dollars per unit per unit
B) –42.5 dollars per unit per unit
C) 42.5 dollars per unit per unit
D) –0.1 dollars per unit per unit
E) 0.1 dollars per unit per unit
Ans: E

224. The amount of photosynthesis that takes place in a certain plant depends on the intensity of light x according to the equation $f(x) = 155x^2 - 20x^3$, how fast is the rate of change of photosynthesis with respect to the intensity changing when $x = 1$? when $x = 2$?
A) $f''(1) = 250;\ f''(2) = 70$
B) $f''(1) = 150;\ f''(2) = -10$
C) $f''(1) = 190;\ f''(2) = 70$
D) $f''(1) = 95;\ f''(2) = 35$
E) $f''(1) = 345;\ f''(2) = 225$
Ans: C

225. The revenue (in thousands of dollars) from the sale of a product is $R = 17x + 29(5x+1)^{-1} - 40$ where x is the number of units sold. At what rate is the marginal revenue $\overline{MR}$ changing when the number of units being sold is 20? Round your answer to four decimal places.

A) $R''(20) \approx 0.0003$

B) $R''(20) \approx 0.0906$

C) $R''(20) \approx 0.0007$

D) $R''(20) \approx 0.0284$

E) $R''(20) \approx 0.0014$

Ans: E

226. The sales of a product S (in thousands of dollars) are given by $S = \frac{200x}{x+30}$, where x is the advertising expenditure (in thousands of dollars). Find the rate of change of sales with respect to advertising expenditure. Use the second derivative to find how this rate is changing at $x = 10$.

A) 3.75
B) –0.19
C) 0.00
D) –3.75
E) –0.09
Ans: B

227. The daily sales S (in thousands of dollars) that are attributed to an advertising campaign are given by $S = 2 + \frac{3}{t+8} - \frac{16}{(t+8)^2}$ where t is the number of weeks the campaign runs. Find the rate of change of sales at any time t and use the second derivative to find how this rate is changing at $t = 16$. Round your answer to four decimal places, when applicable.

A) $S'(t) = \frac{3}{(t+8)^2} - \frac{16}{(t+8)^3}$; $S''(16) \approx -0.0003$

B) $S'(t) = -\frac{3}{(t+8)^2} + \frac{32}{(t+8)^3}$; $S''(16) \approx 0.0001$

C) $S'(t) = \frac{3}{(t+8)^2} - \frac{32}{(t+8)^3}$; $S''(16) \approx -0.0001$

D) $S'(t) = -\frac{3}{(t+8)^2} + \frac{16}{(t+8)^3}$; $S''(16) \approx 0.0003$

E) $S'(t) = -\frac{3}{(t+8)} + \frac{2}{(t+8)^3}$; $S''(16) \approx 0.0052$

Ans: B

228. The following table shows the numbers of U.S. cellular subscriberships (in millions) from 1985 to 2002.

Year	Subscriberships	Year	Subscriberships
1985	0.340	1994	24.134
1986	0.682	1995	33.786
1987	1.231	1996	44.043
1988	2.069	1997	55.312
1989	3.509	1998	69.209
1990	5.283	1999	86.047
1991	7.557	2000	109.478
1992	11.033	2001	128.375
1993	16.009	2002	140.767

Source: The CTIA Semi-Annual Wireless Industry Survey

Assume that the number of U.S. cellular subscriberships, in millions, can be modeled by the function $S(t) = 0.0003967t^{4.2322}$, where t is the number of years past 1980. Find the function that models the instantaneous rate of change of the U.S. cellular subscriberships.

A) $S''(t) = 0.0017t^{3.2322}$

B) $S'(t) = 0.0017t^{3.2322}$

C) $S''(t) = 0.0054t^{2.2322}$

D) $S'(t) = 0.0054t^{2.2322}$

E) $S'(t) = 0.0003967t^{4.2322}$

Ans: B

229. The following table shows the numbers of U.S. cellular subscriberships (in millions) from 1985 to 2002.

Year	Subscriberships	Year	Subscriberships
1985	0.340	1994	24.134
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1992	11.033	2001	128.375
1993	16.009	2002	140.767

Source: The CTIA Semi-Annual Wireless Industry Survey

Assume that the number of U.S. cellular subscriberships, in millions, can be modeled by the function $S(t) = 0.0003848t^{4.2356}$, where t is the number of years past 1980. Use the second derivative to estimate how fast the rate of increase in subscriberships was changing in 1990 in millions of subscriberships per year per year.

A) –125.03
B) 125.03
C) 0.91
D) –0.91
E) 0
Ans: C

230. Total revenue is in dollars and x is the number of units. Suppose that the total revenue function for a commodity is $R(x) = 25x - 0.01x^2$. Find $R(20)$, and tell what it represents.

A) \$24.60. This represents the revenue from the sale of 20 units.
B) \$499.80. This represents the marginal revenue from the sale of 20 units.
C) \$500.00. This represents the marginal revenue from the sale of 20 units.
D) \$496.00. This represents the revenue from the sale of 20 units.
E) \$0.20. This represents the revenue from the sale of 20 units.
Ans: D

231. Total revenue is in dollars and x is the number of units. Suppose that the total revenue function for a commodity is $R(x) = 28x - 0.04x^2$. Find the marginal revenue function.

A) $R'(x) = 28x - 0.04x^2$
B) $R'(x) = 28x - 0.08x^2$
C) $R'(x) = 28x - 0.08$
D) $R'(x) = 28 - 0.04x$
E) $R'(x) = 28 - 0.08x$
Ans: E

232. Total revenue is in dollars and x is the number of units. Suppose that the total revenue function for a commodity is $R(x)=12x-0.01x^2$. Find the marginal revenue at $x=30$, and tell what it predicts about the sale of the next unit.
A) 11.70. The selling of the next unit increases revenue by $11.70.
B) 11.40. The selling of the next unit increases revenue by $11.40.
C) –351.00. The selling of the next unit decreases revenue by $351.00.
D) –30.00. The selling of the next unit decreases revenue by $30.00.
E) –12.00. The selling of the next unit decreases revenue by $12.00.
Ans: B

233. Total revenue is in dollars and x is the number of units. Suppose that the total revenue function for a commodity is $R(x)=30x-0.07x^2$. Find $R(51)-R(50)$, and explain what this value represents.
A) $1347.93 is the marginal revenue from the 51st unit.
B) $1325.00 is the marginal revenue from the 51st unit.
C) $23.00 is the marginal revenue from the 51st unit.
D) $26.50 is the actual revenue from the 51st unit.
E) $22.93 is the actual revenue from the 51st unit.
Ans: E

234. Total revenue is in dollars and x is the number of units. Suppose that in a monopoly market, the demand function for a product is given by $p=160-0.8x$, where x is the number of units and p is the price in dollars. Find the total revenue from the sale of 100 units.
A) $8000.00
B) $15,920.00
C) $0.80
D) $100.00
E) $80.00
Ans: A

235. Total revenue is in dollars and x is the number of units. Suppose that in a monopoly market, the demand function for a product is given by $p=100-0.3x$, where x is the number of units and p is the price in dollars. Find and interpret the marginal revenue at 100 units.
A) 70. The 101st unit will bring in $70 more in marginal revenue.
B) 100. The 101st unit will bring in $100 more in marginal revenue.
C) 40. The 101st unit will bring in $40 more in revenue.
D) 7000. The 101st unit will bring in $7000 more in revenue.
E) 4000. The 101st unit will bring in $4000 more in revenue.
Ans: C

236. Total revenue is in dollars and x is the number of units. Suppose that in a monopoly market, the demand function for a product is given by $p = 120 - 0.1x$, where x is the number of units and p is the price in dollars. Is more revenue expected from the 101st unit sold or from the 201st unit sold?
A) The 101st unit will bring in more in revenue.
B) The 201st unit will bring in more in revenue.
Ans: A

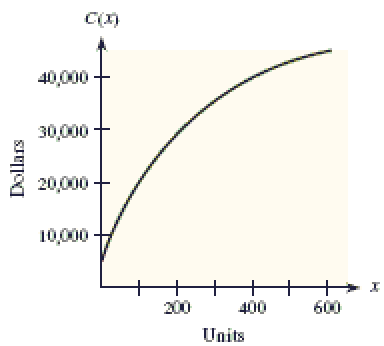
237. In this problem, cost is in dollars and x is the number of units. Find the marginal cost function for the given cost function.
$C = 0.7x^3 - 3.7x^2 + 5x + 12$
A) $\overline{MC} = 2.1x^2 - 7.4x + 5$
B) $\overline{MC} = 0.7x^2 - 3.7x + 5$
C) $\overline{MC} = 2.1x^2 + 7.4x + 5$
D) $\overline{MC} = 0.7x^2 + 3.7x + 5$
E) $\overline{MC} = 4.2x - 7.4$
Ans: A

238. Suppose that the cost function for a commodity is $C(x) = 200 + 3x + \frac{1}{15}x^2$ dollars. Find the marginal cost at $x = 4$ units and tell what this predicts about the cost of producing 1 additional unit.
A) 3.27. The cost to produce the 4th unit is predicted to be \$3.27.
B) 3.00. The cost to produce the 4th unit is predicted to be \$3.00.
C) 213.07. The cost to produce the 5th unit is predicted to be \$213.07.
D) 3.53. The cost to produce the 5th unit is predicted to be \$3.53.
E) 12.00. The cost to produce the 5th unit is predicted to be \$12.00.
Ans: D

239. Suppose that the cost function for a commodity is $C(x) = 500 + 2x + \frac{1}{12}x^2$ dollars. Calculate $C(5) - C(4)$ to find the actual cost of producing the 5th unit.
A) \$3.50
B) \$2.00
C) \$2.75
D) \$2.67
E) \$2.08
Ans: C

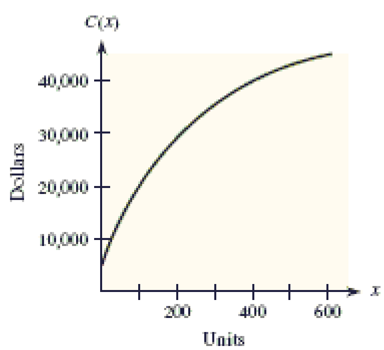
240. If the cost function for a commodity is $C(x)=\frac{1}{44}x^3+5x^2+4x+3$ dollars, find the marginal cost at $x=9$ units, and tell what this predicts about the cost of producing 2 additional units.
A) $50.84. The cost of producing 2 additional units is approximately $101.68.
B) $199.05. The cost of producing 2 additional units is approximately $199.05.
C) $99.52. The cost of producing 2 additional units is approximately $99.52.
D) $99.52. The cost of producing 2 additional units is approximately $199.05.
E) $11.23. The cost of producing 2 additional units is approximately $22.45.
Ans: D

241. The graph of a company's total cost function is shown. Will the 101st item or the 201st item cost more to produce?



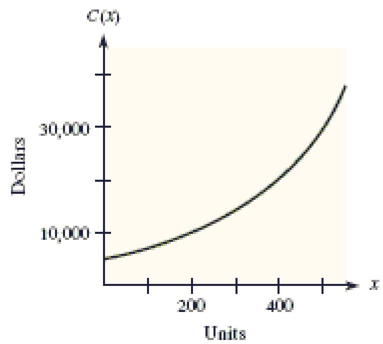
A) 101st
B) 201st
Ans: A

242. The graph of a company's total cost function is shown. Does this total cost function represent a manufacturing process that is getting more efficient or less efficient as the production level increases?



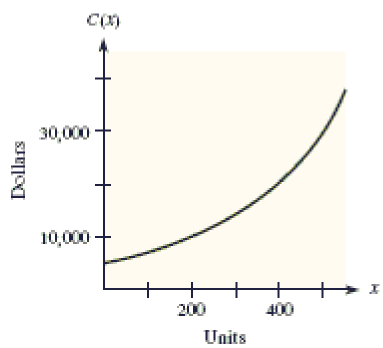
A) less efficient
B) more efficient
Ans: B

243. The graph of a company's total cost function is shown. Will the 101st item or the 401st item cost more to produce?



A) 101st
B) 401st
Ans: B

244. The graph of a company's total cost function is shown. Does this total cost function represent a manufacturing process that is getting more efficient or less efficient as the production level increases?



A) less efficient
B) more efficient
Ans: A

245. In this problem, cost, revenue, and profit are in dollars and x is the number of units. Suppose that the total revenue function is given by $R(x) = 76x$, and that the total cost function is given by $C(x) = 200 + 20x + \frac{1}{6}x^2$. Find $P(100)$.

A) $7600.00
B) $3866.67
C) $3733.33
D) $53.33
E) $22.67
Ans: C

246. In this problem, cost, revenue, and profit are in dollars and x is the number of units. Suppose that the total revenue function is given by $R(x) = 128x$, and that the total cost function is given by $C(x) = 300 + 30x + \frac{1}{6}x^2$. Find the marginal profit function.

A) $\overline{MP} = -172 - \frac{1}{3}x$

B) $\overline{MP} = -172 - \frac{1}{6}x$

C) $\overline{MP} = 98 - \frac{1}{6}x$

D) $\overline{MP} = -30 - \frac{1}{3}x$

E) $\overline{MP} = 98 - \frac{1}{3}x$

Ans: E

247. In this problem, cost, revenue, and profit are in dollars and x is the number of units. Suppose that the total revenue function is given by $R(x) = 123x$, and that the total cost function is given by $C(x) = 100 + 40x + \frac{1}{5}x^2$. Find $\overline{MP}$ at $x = 100$, and explain what it predicts.

A) 123.00. The profit will increase by approximately $123.00 from the sale of the 101st item.

B) 43.00. The profit will increase by approximately $43.00 from the sale of the 101st item.

C) 0.00. The profit will increase by approximately $0.00 from the sale of the 101st item.

D) 63.00. The profit will decrease by approximately $63.00 from the sale of the 101st item.

E) 83.00. The profit will decrease by approximately $83.00 from the sale of the 101st item.

Ans: B

248. In this problem, cost, revenue, and profit are in dollars and x is the number of units. Suppose that the total revenue function is given by $R(x) = 116x$, and that the total cost function is given by $C(x) = 200 + 50x + \frac{1}{9}x^2$. Find $P(201) - P(200)$, and explain what this value represents.

A) 21.44. The sale of the 201st unit will increase profit by $21.44.

B) 21.44. The sale of the 201st unit will decrease profit by $21.44.

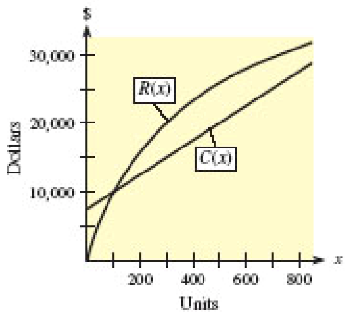
C) 21.33. The sale of the 201st unit will increase profit by $21.33.

D) 21.56. The sale of the 201st unit will increase profit by $21.56.

E) 21.56. The sale of the 201st unit will decrease profit by $21.56.

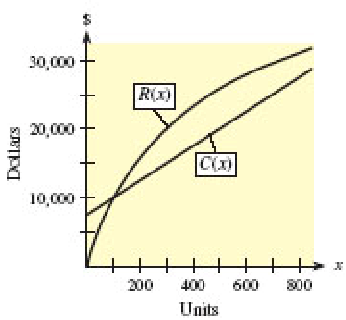
Ans: A

249. The graphs of a company's total revenue function $R(x)$ and total cost function $C(x)$ are shown. From the sale of 100 items, 500 items, and 800 items, rank from smallest to largest the amount of profit received.



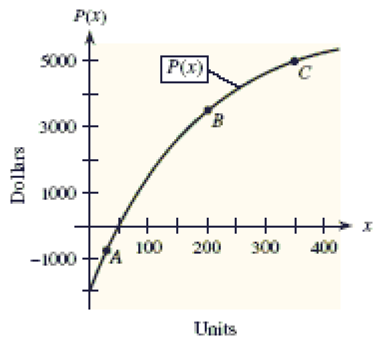
A) 800, 500, 100
B) 100, 800, 500
C) 800, 100, 500
D) 500, 100, 800
E) 500, 800, 100
Ans: B

250. The graphs of a company's total revenue function $R(x)$ and total cost function $C(x)$ are shown. The cost function is a linear function of the number of units sold. From the sale of the 51st item, 401st item, and 801st item, rank from smallest to largest the amount of profit received.



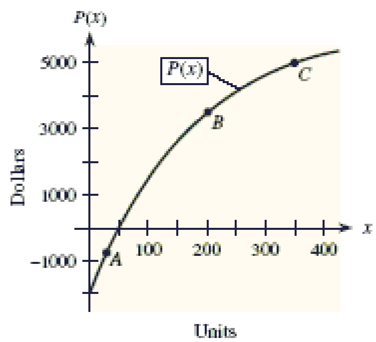
A) 801st, 51st, 401st
B) 401st, 801st, 51st
C) 801st, 401st, 51st
D) 51st, 801st, 801st
E) 51st, 401st, 801st
Ans: C

251. The graph of a company's profit function is shown. For the given problem, use the graph to answer the following question about points *A*, *B*, and *C*. Rank from smallest to largest the amounts of profit received at these points.



A) B C A
B) A B C
C) A C B
D) C A B
E) B A C
Ans: B

252. The graph of a company's profit function is shown. For the given problem, use the graph to answer the following questions about points *A*, *B*, and *C*. Rank from smallest to largest the marginal profit at these points.



A) C A B
B) A C B
C) C B A
D) B A C
E) A B C
Ans: C

253. Graph the marginal profit function for the profit function $P(x)=19x-0.1x^2-100$, where $P(x)$ is in dollars and x is the number of units. What level of production and sales will give a zero marginal profit?
A) 0
B) 185
C) 95
D) 5
E) 190
Ans: C

254. Graph the marginal profit function for the profit function $P(x)=20x-0.5x^2-100$, where $P(x)$ is in dollars and x is the number of units. At what level of production and sales will profit be at a maximum?
A) 0
B) 20
C) 34
D) 6
E) 40
Ans: B

255. Graph the marginal profit function for the profit function $P(x)=18x-0.1x^2-500$, where $P(x)$ is in dollars and x is the number of units. What is the maximum profit?
A) $0.00
B) $310.00
C) $145.68
D) $34.32
E) $180.00
Ans: B

256. The cost per unit of producing a product is $50+5x$ dollars, where x represents the number of units produced per week. If the equilibrium price determined by a competitive market is $\$160$, how many units should the firm produce and sell each week to maximize its profit?
A) 22
B) 11
C) 121
D) none
E) as many as possible
Ans: B

