CHECKING FOR UNDERSTANDING

Communicating Mathematics

Read and study the lesson to answer each question.

1. **Define** the limit of a function.
2. **Sketch** the graph of $y = \frac{x^2 - 16}{x - 4}$. Does the graph confirm that $\lim\limits_{x \to 4} \frac{x^2 - 16}{x - 4} = 8$?
3. **Explain** the steps you follow to find $\lim\limits_{x \to s} f(x)$.
4. A student in your class says, "The limit of the sum of two functions is the sum of the limits of the functions." When is the statement *not* correct?
5. **Show** that $\lim\limits_{x \to 0} x^2 = 0$ by using the fact that $x \cdot x = x^2$.
6. **Express** $\lim\limits_{x \to 3} (x - 1)^3$ in two different ways.

Guided Practice

Evaluate each limit.

7. $\lim\limits_{x \to 2} 6x$
8. $\lim\limits_{x \to 3} (x^2 + 4x - 5)$
9. $\lim\limits_{x \to 1} \frac{x - 2}{x + 2}$
10. $\lim\limits_{x \to 5} \sqrt{25 - x^2}$
11. $\lim\limits_{x \to 3} \frac{x - 4}{x + 1}$
12. $\lim\limits_{x \to -2} \frac{x^2 - 4}{x^2 + 4}$
13. $\lim\limits_{x \to 3} \frac{x^2 - x - 6}{x - 3}$
14. $\lim\limits_{x \to 0} \frac{2x^3}{x}$
15. $\lim\limits_{x \to -1} \frac{x^2 + 3x + 2}{x^2 + 4x + 3}$

Evaluate the limit of $f(g(x))$ as x approaches 0 for each $f(x)$ and $g(x)$.

16. $f(x) = 4x - 4$, $g(x) = 8x + 1$
17. $f(x) = 5x + 2$, $g(x) = x^2 - 1$

Use Theorem 10 to evaluate each limit.

18. $\lim\limits_{x \to 0} \frac{\sin^2 x}{x}$
19. $\lim\limits_{x \to 0} \frac{\sin 3x}{5x}$

EXERCISES

Practice

Evaluate each limit.

20. $\lim\limits_{x \to 2} (x^2 - 4x + 1)$
21. $\lim\limits_{x \to 0} (4x + 1)$
22. $\lim\limits_{x \to 2} x^2$
23. $\lim\limits_{x \to 1} \frac{x + 1}{x + 2}$
24. $\lim\limits_{x \to 6} (7x - 22)$
25. $\lim\limits_{x \to 1} (x^2 + 4x + 3)$
26. $\lim\limits_{n \to 0} \left(5^n + \frac{1}{5^n}\right)$
27. $\lim\limits_{x \to 3} \frac{x^2 - 9}{x + 3}$

28. $\lim_{n \to 3} \frac{n^2 - 9}{n - 3}$

29. $\lim_{x \to 2} \frac{x^2 - 4}{x^3 - 8}$

30. $\lim_{x \to 4} \frac{x - 4}{x^2 - 16}$

31. $\lim_{x \to -2} (x^4 - x^2 + x - 2)$

32. $\lim_{x \to -2} \frac{x^3 - 8}{x - 2}$

33. $\lim_{x \to 2} \frac{x^2 - x - 2}{x^2 - 4}$

34. $\lim_{x \to 0} \frac{(1 + x)^2 - 1}{x}$

35. $\lim_{n \to 0} \frac{n^2}{n^4 + 1}$

36. $\lim_{x \to -1} \sqrt{x^2 - 1}$

37. $\lim_{x \to 1} \sqrt{\frac{2x + 1}{2x - 1}}$

Evaluate the limit of $f[g(x)]$ as x approaches 1 for each $f(x)$ and $g(x)$.

38. $f(x) = 2x + 1$
$g(x) = x - 3$

39. $f(x) = 7x - 2$
$g(x) = 9x + 2$

40. $f(x) = 3x - 4$
$g(x) = 2x + 5$

41. $f(x) = x^2 + 3$
$g(x) = 2x - 1$

Use Theorem 10 to evaluate each limit.

42. $\lim_{x \to 0} \frac{\sin(-x)}{x}$

43. $\lim_{x \to 0} \frac{1 - \cos x}{x^2}$

44. $\lim_{x \to 0} \frac{\sin \sqrt[3]{x}}{\sqrt[3]{x}}$

Graphing Calculator

Evaluate each limit. Then use a graphing calculator to verify your answer.

45. $\lim_{x \to \frac{1}{2}} \frac{6x - 3}{x(1 - 2x)}$

46. $\lim_{x \to 0} \frac{\sin 6x}{x}$

47. $\lim_{x \to 4} \frac{\sqrt{x} - 2}{4 - x}$

Critical Thinking

48. A function is **bounded** if there is a real number M such that $|f(x)| < M$ for all x in the domain of $f(x)$. Suppose a certain function $f(x)$ is defined for all real numbers and is bounded.

a. Do you think that $f(x)$ has a limit as x approaches infinity? If so, what could the value of that limit be? Explain.

b. If $f(x)$ is strictly increasing, do you think that $f(x)$ has a limit as x approaches infinity? If so, what could the value of that limit be? Explain.

Applications and Problem Solving

49. **Physics** Refer to the application at the beginning of the lesson. The limit of the sum of the lengths of the pendulum swings as n approaches infinity is the distance the pendulum will travel before it comes to rest. Find that limit.

50. **Chemistry** Acetylcholine is a chemical that is released at automatic nerve endings to transmit nerve impulses. The chemical is formed in body tissue and one of its many functions is to slow the heart rate. It has been found that the effect of acetylcholine on a frog's heart is given by the formula $f(x) = \frac{x}{a + bx}$ for $0 \leq x \leq 1$, where a and b are positive constants, x is the concentration of acetylcholine, and $f(x)$ is a measure of the degree of response. Find $\lim_{x \to \frac{2}{3}} f(x)$ when $a = 8$ and $b = 6$.

$$\frac{d}{dx}\frac{(x+1)^2}{(x-1)^2} = \frac{(x-1)^2(2)(x+1) - (x+1)^2(2)(x-1)}{(x-1)^4}$$

$$= \frac{(x^2-2x+1)(2x+2) - (x^2+2x+1)(2x-2)}{(x-1)^4}$$

$$= \frac{-4(x^2-1)}{(x-1)^4} \text{ or } \frac{-4(x+1)}{(x-1)^3} \qquad x^2-1=(x+1)(x-1)$$

CHECKING FOR UNDERSTANDING

Communicating Mathematics

Read and study the lesson to answer each question.

1. **Explain** how the formula $\frac{f(a+h)-f(a)}{h}$ is related to the tangent line of a function at a point $(a, f(a))$.
2. Write three different expressions for the derivative of $y = f(x)$.
3. **Explain** the product rule for differentiation in your own words.
4. Find the derivative of $x^4(3x^5 - 2x^3)$ using two different methods.
5. What does the symbol $\frac{du}{dx}$ represent?

Guided Practice

Find the derivative of each function.

6. $f(x) = 2x$
7. $f(x) = 7x - 3$
8. $f(x) = -x$
9. $f(x) = 2x^2$
10. $f(x) = x^3$
11. $f(x) = 6x^2$
12. $f(x) = (2x-3)(x+5)$
13. $f(x) = (3x+1)(2x^2-5x)$
14. $f(x) = (x-2x^2)^2$
15. $f(x) = x^2(x^2+1)^{-3}$
16. $f(x) = \sqrt{4x^2-1}$
17. $f(x) = \frac{2x+3}{4x-1}$
18. $f(x) = \frac{x^3-1}{x^4+1}$
19. $f(x) = -3x - \frac{6}{x+2}$

EXERCISES

Practice

Find the derivative of each function.

20. $f(x) = x$
21. $f(x) = 6x - 4$
22. $f(x) = -4x - 2$
23. $f(x) = 5x^2 - x$
24. $f(x) = x^4 - 2x^2$
25. $f(x) = x^5 + 3$
26. $f(x) = x^{\frac{1}{2}}$
27. $f(x) = \sqrt[3]{x}$
28. $f(x) = x^2(x^2-3)$
29. $f(x) = (x^3-2x)(3x^2)$
30. $f(x) = 8x^4(1-9x^2)$
31. $f(x) = (x^2+4)^3$
32. $f(x) = (x^3-2x+1)^4$
33. $f(x) = \sqrt{x^2-1}$
34. $f(x) = x^2(x+1)^{-1}$
35. $f(x) = (x^2-4)^{-\frac{1}{2}}$
36. $f(x) = \frac{x+1}{x^2-4}$
37. $f(x) = \left(\frac{x+1}{x-1}\right)^2$
38. $f(x) = x\sqrt{1-x^3}$

39. $f(x) = 2x^3 + \frac{2}{x^3}$

40. $f(x) = \sqrt{2x} - \sqrt{2}x$

41. $f(x) = \left(1 + \frac{1}{x}\right)\left(2 - \frac{1}{x}\right)$

42. $f(x) = 3x - \frac{\frac{2}{x} - \frac{3}{x-1}}{x-2}$

Critical Thinking

43. Suppose $v = f(x)$ is a differentiable function such that $v \neq 0$. Derive a formula for $\frac{d\left(\frac{1}{v}\right)}{dx}$.

Applications and Problem Solving

44. **Business** The total cost function for an electric company is estimated to be $C(t) = 32.07 - 0.79t + 0.02142t^2 - 0.0001t^3$, where t is the total output and $C(t)$ is total fuel cost in dollars.

a. Find the marginal cost function.

b. Evaluate the marginal cost function when $t = 70$.

c. If possible, find the number of units produced when the marginal cost is 0.6.

45. **Physics** Suppose a ball has been shot upward with an initial velocity of 96 feet per second. Then the equation $h(t) = 256 + 96t - 16t^2$ gives the height of the ball in feet after t seconds.

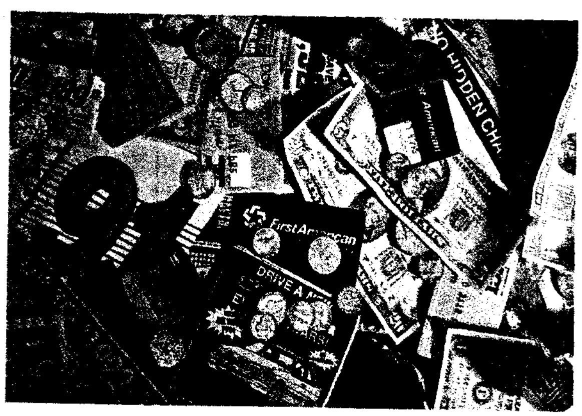
a. The derivative of the function for the height of the ball gives the rate of change of the height, or the velocity of the ball. Find the velocity function.

b. Find the velocity of the ball after 2 seconds.

c. Is the velocity increasing or decreasing?

d. What is the velocity of the ball when it hits the ground?

46. **Economics** The consumption function expresses the relationship between the national income, I, and the national consumption, $C(I)$. The marginal propensity to consume, $\frac{dC}{dI}$, is the rate of change of consumption with respect to income. For a certain period of time, the consumption function for the United States was $C(I) = \frac{5(2\sqrt{I^3} + 3)}{I + 10}$, where C and I are measured in billions of dollars.



a. Write a formula for the marginal propensity to consume for this time.

b. What was the marginal propensity to consume at this time if the national income was 100 billion dollars?

c. The marginal propensity to save, $\frac{dS}{dI}$, indicates how fast savings change with respect to income. The formula for the marginal propensity to save is $1 - \frac{dC}{dI}$. What was the marginal propensity to save for the given consumption function if the national income was 150 billion dollars?

Example 4

APPLICATION

Demographics

Refer to the application at the beginning of the lesson. The marketing manager for College Connections, Inc. has determined that the life table function for the region of the country that she is considering is $\ell(t) = 12,000\sqrt{100 - t}$. Under the appropriate conditions, the integral of the life table function gives a function that can be used to determine the number of people in the population that are t years old or younger. Find the integral of $\ell(t)$.

$$\int 12,000\sqrt{100-t}\,dt = 12,000\int \sqrt{100-t}\,dt$$

Let $u = (100 - t)$, then $\frac{du}{dt} = -1.$

$$12,000\int \sqrt{100-t}\,dt = 12,000\int \sqrt{u}\cdot -\frac{du}{dt}\cdot dt$$ *$\sqrt{100-t} = \sqrt{u}$, $1 = -(-1)$ or $-\frac{du}{dt}$*

$$= 12,000\int -\sqrt{u}\,du$$ *Simplify.*

$$= 12,000\int -u^{\frac{1}{2}}\,du$$ *$\sqrt{u} = u^{\frac{1}{2}}$*

$$= 12,000\left(-\frac{u^{\frac{1}{2}+1}}{\frac{1}{2}+1}\right) + C$$ *Use the second formula.*

$$= 12,000\left(-\frac{2}{3}u^{\frac{3}{2}}\right) + C$$

$$= -8000u^{\frac{3}{2}} + C$$

$$= -8000(100-t)^{\frac{3}{2}} + C$$

The integral of the life table function is $-8000(100 - t)^{\frac{3}{2}} + C$.

MATH JOURNAL

Describe the most challenging topic you studied this year. Explain why it was a challenge.

CHECKING FOR UNDERSTANDING

Communicating Mathematics

Read and study the lesson to answer each question.

1. **Explain** what the notation $\int_a^b f(x)\,dx$ means in relation to $f(x)$.
2. **Describe** the relationship between integration and differentiation.

Guided Practice

Find each integral.

3. $\int 5\,dx$
4. $\int 2x\,dx$
5. $\int 3x^2\,dx$
6. $\int (2x - 3)\,dx$
7. $\int (5x^4 + 2x)\,dx$
8. $\int \sqrt{2x}\,dx$

EXERCISES

Practice **Find each integral.**

9. $\int 10\, dx$

10. $\int (2x - 12)\, dx$

11. $\int (3x^2 - 8x^3 + 5x^4)\, dx$

12. $\int (x^4 - 5)\, dx$

13. $\int 5x^3\, dx$

14. $\int (\pi x + \sqrt{x})\, dx$

15. $\int (x + 5)^{20}\, dx$

16. $\int \sqrt{1 + x}\, dx$

17. $\int (-2x + 3)\, dx$

18. $\int \frac{-2x}{\sqrt{1 - x^2}}\, dx$

19. $\int \frac{1}{x - 1}\, dx$

20. $\int \left(\frac{x + 1}{\sqrt[3]{x^2 + 2x + 2}}\right) dx$

Find the antiderivative of each function.

21. $f(x) = 8x^4$

22. $f(x) = 4\sqrt[3]{x}$

23. $f(x) = x^5 - \frac{1}{x^4}$

24. $f(x) = \frac{2}{x^3}$

25. $f(x) = \frac{2}{\sqrt{x}}$

26. $f(x) = \frac{2}{1 - 4x}$

Critical Thinking

27. Find $\int \frac{1}{x^2} \left(\frac{x + 1}{x}\right)^{\frac{1}{3}} dx$. (*Hint: Substitute* $u = \frac{x + 1}{x}$.)

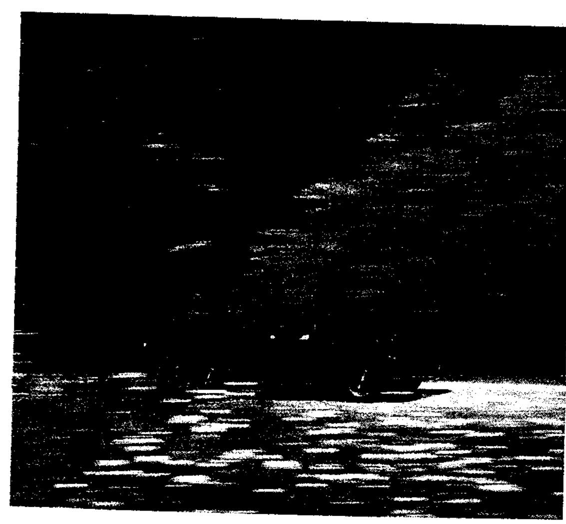
Applications and Problem Solving

28. **Physics** If a function $v(t)$ describes the velocity of a moving object at time t, then the function $s(t)$ that describes the distance from a given point to the object at time t can be found by integrating $v(t)$.

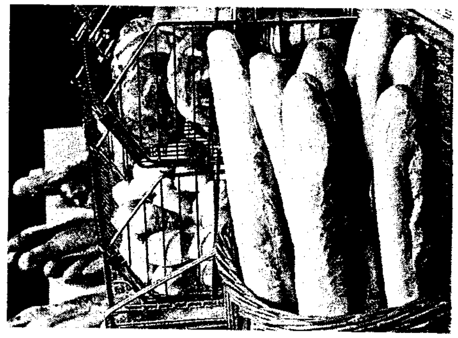
a. A car is moving at a constant velocity of 45 miles per hour. Write an equation that describes the distance that the car has traveled after t hours.

b. If the car described in part a is 104 miles from the given point at time $t = 2$, write an equation that describes the position of the car at time t.

c. The velocity of a rocket is given by $v(t) = -32t + 100$. If the rocket is launched from a point 50 feet above the ground, write an equation that describes the distance the rocket has traveled after t seconds.



29. **Business** For Suds Inc., the marginal revenue from the sale of the xth pound of soap is found by $m(x) = 4 - 0.02x$ when $0 \leq x \leq 400$. If Suds sells no soap, they will lose \$300. Write an equation that describes the total revenue for Suds Inc.



30. **Business** The buyer for Food King Grocery has found that the marginal daily demand for their home made French bread can be described by the function $D'(x) = -3.2x + 20$ where x is the price charged for a loaf of bread and $D'(x)$ is the number of loaves.
    a. Find a daily demand function for this product.
    b. If the daily demand for French bread is 65 loaves when the price is 85¢ per loaf, what will the daily demand be if the price is increased to 95¢ per loaf?

Mixed Review

31. Michael Thomas, the manager of the paint department at Builder's Headquarters, is mixing paint for a spring sale. There are 32 units of yellow dye, 54 units of brown dye, and an unlimited supply of base paint available. Mr. Thomas plans to mix as many gallons as possible of Autumn Wheat and Harvest Brown paint. Each gallon of Autumn Wheat requires 4 units of yellow dye and 1 unit of brown dye. Each gallon of Harvest Brown paint requires 1 unit of yellow dye and 6 units of brown dye. Find the maximum number of gallons of paint that Mr. Thomas could mix. **(Lesson 2-6)**
32. Verify that $1 + \sin 2x = (\sin x + \cos x)^2$ is an identity. **(Lesson 7-4)**
33. Simplify $7^{\log_7 2x}$. **(Lesson 11-4)**
34. Find the first three iterates of the function $f(x) = 0.5x - 1$ using $x_o = 8$. **(Lesson 13-1)**
35. How many vertices are there in a graph with 15 edges if each vertex has degree 2? **(Lesson 16-1)**
36. Find the area between the graph of $y = x^2$ and the x-axis for the interval from $x = 2$ to $x = 7$. **(Lesson 17-3)**.
37. **College Entrance Exam** Choose the best answer.
    Sherry mixes a pounds of peanuts that cost b cents per pound with c pounds of rice crackers that cost d cents per pound to make Oriental Peanut Mix. What should the price in cents for a pound of Oriental Peanut Mix be if Sherry is to make a profit of 10¢ per pound?

    (A) $\frac{ab + cd}{a + c} + 10$ **(B)** $\frac{b + d}{a + c} + 10$ **(C)** $\frac{ab + cd}{a + c} + 0.10$

    (D) $\frac{b + d}{a + c} + 0.10$ **(E)** $\frac{b + d + 10}{a + c}$

Portfolio

Review items in your portfolio. Make a table of contents of the items, noting why each item was chosen. Replace any items that are no longer appropriate.

$$A = A_1 + A_2$$
$$= \left|\frac{1}{4}\right| + \left|-\frac{1}{4}\right|$$
$$= \frac{1}{2}$$

The area is $\frac{1}{2}$ square unit.

CHECKING FOR UNDERSTANDING

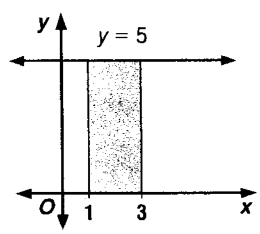
Communicating Mathematics

Read and study the lesson to answer each question.

1. What relationship does the fundamental theorem of calculus establish for differentiation and integration?
2. When you find an indefinite integral of a function, a constant C is added to the function. Why is it not necessary to add the constant when you are finding a definite integral?
3. **Explain** why you must take the absolute value when finding the area between a curve and the x-axis.

Guided Practice

Use integration to find each area.

4.


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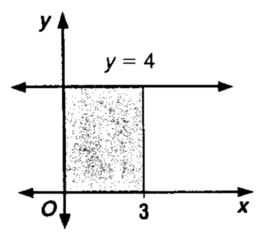

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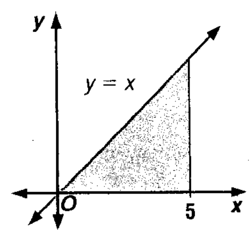

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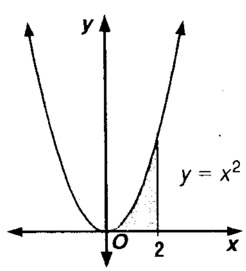

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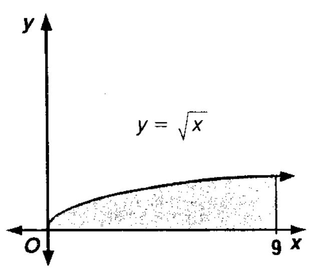

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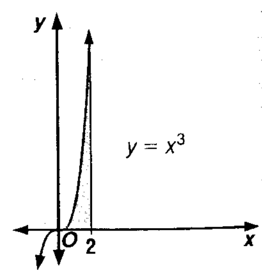


Evaluate each definite integral.

10. $\int_0^1 (2x + 3)\, dx$
11. $\int_0^1 (3x^2 + 6x + 1)\, dx$
12. $\int_0^3 \left(\frac{1}{2}x - 4\right) dx$
13. $\int_{-4}^{-1} (5x + 14)\, dx$

Graph each function. Then, find the area between the function and the x-axis for the given interval using integration.

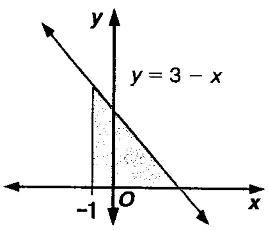
14. $f(x) = 2x + 3$ for $x = 1$ to $x = 4$

15. $f(x) = x^2$ for $x = -2$ to $x = 2$

EXERCISES

Practice Use integration to find the area of each shaded region.

16.



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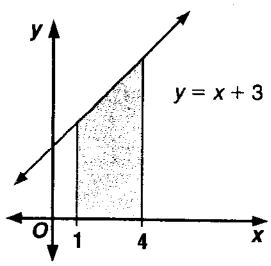

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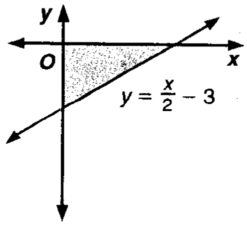

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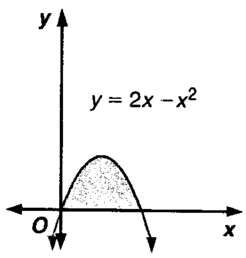

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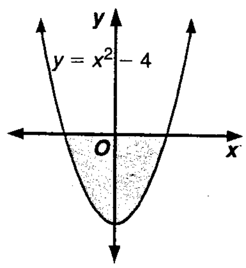

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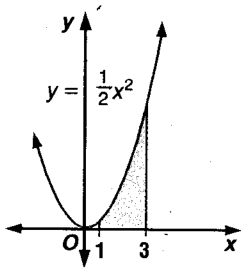


Evaluate each definite integral.

22. $\int_0^3 x\,dx$

23. $\int_{-1}^1 (x+1)^2\,dx$

24. $\int_{-1}^1 (4x^3 + 3x^2)\,dx$

25. $\int_1^4 \left(x^2 + \frac{2}{x^2}\right)\,dx$

26. $\int_{-1}^1 12x(x+1)(x-1)\,dx$

27. $\int_4^5 (x^2 + 6x - 7)\,dx$

28. $\int_0^2 (x - 4x^2)\,dx$

29. $\int_{-1}^0 (1 - x^2)\,dx$

30. $\int_1^4 (3x^2 - 6x)\,dx$

31. $\int_{-2}^3 (x+2)(x-3)\,dx$

Graph each function. Then, find the area between the graph of the function and the x-axis for the given interval by integrating.

32. $f(x) = -x$ for $x = 1$ to $x = 4$

33. $f(x) = x^3$ for $x = -1$ to $x = 2$

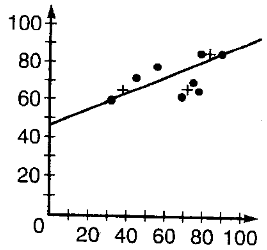
34. $f(x) = -x^2$ for $x = 0$ to $x = 5$

35. $f(x) = -x^3$ for $x = -4$ to $x = 0$

36. $f(x) = \dfrac{3x^2 - 18x + 15}{5}$ for $x = 0$ to $x = 6$

37. $f(x) = 9 - 3x^2$ for $x = 0$ to $x = 3$

23. $\frac{2}{5}$ 25. $\frac{11}{850}$ 27. $\frac{5}{18}$ 29. 42, 65, 65, 66, 69, 70, 72, 76, 77, 77, 77, 80, 82, 82, 86, 89, 89, 91, 95, 99 31. 77.45
33. 77 35. 9 37. about 0.595
39.



41. no 43. $\{A, D\}, \{A, C\}, \{A, B\}$ 45. cycle 47. No; the degrees of vertices A and C are not even.

CHAPTER 17 LIMITS, DERIVATIVES, AND INTEGRALS

Pages 920-922 Lesson 17-1

7. 12 9. $-\frac{1}{3}$ 11. $-\frac{1}{4}$ 13. 5 15. $\frac{1}{2}$ 17. -3 19. $\frac{3}{5}$
21. 1 23. $\frac{2}{3}$ 25. 8 27. 0 29. $\frac{1}{3}$ 31. 8 33. $\frac{3}{4}$ 35. 0
37. $\sqrt{3}$ 39. 75 41. 4 43. $\frac{1}{2}$ 45. -6 47. $-\frac{1}{4}$ 49. 1
51. 30,000 53. $f'(x) = 8x - 8$ 55. $\frac{41\sqrt{10}}{20} \approx 6.48$
57. 20.68 59. 7.9, 8.6, 8.6 61. C

Pages 928-930 Lesson 17-2

7. 7 9. $4x$ 11. $12x$ 13. $18x^2 - 26x - 5$
15. $\frac{-2x(2x^2-1)}{(x^2+1)^4}$ 17. $-\frac{14}{\sqrt{(4x-1)^2}}$ 19. $-3 + \frac{6}{(x+2)^2}$
21. 6 23. $10X - 1$ 25. $5x^4$ 27. $\frac{1}{3\sqrt[3]{x^2}}$ 29. $15x^4 - 18x^2$
31. $6x(x^2+4)^2$ 33. $\frac{x}{\sqrt{x^2-1}}$ 35. $\frac{-x}{\sqrt{(x^2-4)^3}}$ 37. $\frac{-4(x+1)}{(x-1)^3}$
39. $6x^2 - \frac{6}{x^4}$ 41. $-\frac{1}{x^2} + \frac{2}{x^3}$ 45a. $h'(t) = 96 - 32t$ b. 32 ft/s
c. decreasing d. -160 ft/s 49. $\pm1, \pm2, \pm\frac{1}{2}, \pm\frac{1}{4}, \pm\frac{1}{8}$ 53. $-\frac{1}{27}$
55. 0

Pages 935-937 Lesson 17-3

3. $A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{i}{n}\right)^2\left(\frac{1}{n}\right)$; $\frac{1}{3}$ 5. $A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{i}{n}\right)\left(\frac{1}{n}\right)$; $\frac{1}{2}$
7. $A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{5i}{n}\right)\left(\frac{5}{n}\right) - \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{2i}{n}\right)\left(\frac{2}{n}\right)$; $10\frac{1}{2}$
9. $A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{2i}{n}\right)^2\left(\frac{2}{n}\right)$; $\frac{8}{3}$ 11. $A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{i}{n}\right)^5\left(\frac{1}{n}\right)$; $\frac{1}{6}$
13. $A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{7i}{n}\right)^4\left(\frac{7}{n}\right) - \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{4i}{n}\right)^4\left(\frac{4}{n}\right)$; $\frac{15783}{5}$
15. $A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{ai}{n}\right)^2\left(\frac{a}{n}\right) - \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{bi}{n}\right)^2\left(\frac{b}{n}\right)$; $\frac{b^3-a^3}{3}$
17. $A = \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{2i}{n}\right)\left(\frac{2}{n}\right) + \lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{4i}{n}\right)\left(\frac{4}{n}\right)$; 10 19. $\frac{1}{4}$
21. $\frac{b^3-a^3}{3}$ 25. 36 feet 27. $y^2 + 3x + 7y = 0$ 29. $-\frac{1}{x^2} + \frac{2}{x^3}$

Page 937 Mid-Chapter Review

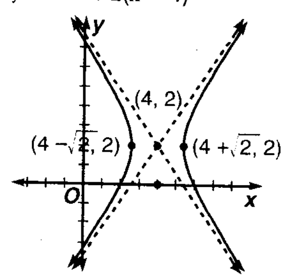
1. 6 3. -6 5. 1 7. 0 9. 1 11. $2x - 2$ 13. $\frac{36}{x^{10}}$
15. $\frac{1}{x^2\sqrt{x^2-1}}$

Pages 942-944 Lesson 17-4

3. $5x + C$ 5. $x^3 + C$ 7. $x^5 + x^2 + C$ 9. $10x + C$
11. $x^3 - 2x^4 + x^5 + C$ 13. $\frac{5}{4}x^4 + C$ 15. $\frac{(x+5)^{21}}{21} + C$
17. $-x^2 + 3x + C$ 19. $\ln|x - 1| + C$ 21. $\frac{8}{5}x^5 + C$
23. $\frac{x^6}{6} + \frac{1}{3x^3} + C$ 25. $4\sqrt{x} + C$
29. $r(x) = 4x - 0.01x^2 - 300$ 31. 14 gallons 33. $2x$
35. 15 37. A

Pages 948-951 Lesson 17-5

5. 12 sq units 7. $2\frac{1}{3}$ sq units 9. 4 sq units 11. 5 13. $\frac{9}{2}$
15. $\frac{16}{3}$ sq units 17. $16\frac{1}{2}$ sq units 19. $1\frac{1}{3}$ sq units
21. $4\frac{1}{3}$ sq units 23. $2\frac{2}{3}$ 25. $22\frac{1}{2}$ 27. $40\frac{1}{3}$ 29. $\frac{2}{3}$
31. $-20\frac{5}{6}$ 33. $4\frac{1}{4}$ sq units 35. 64 sq units 37. about 20.8 sq units 39a. 322,994 b. 211,961 41. $781{,}250{,}000\pi$ or 2,454,369,261 foot-pounds
43. $2x^4 - 11x^3 - 19x^2 + 84x - 36 = 0$
45. equation: $\frac{(x-4)^2}{2} - \frac{(y-2)^2}{4} = 1$; center: (4, 2); foci: $(4 \pm \sqrt{6}, 2)$; vertices: $(4 \pm \sqrt{2}, 2)$; asymptotes: $y = 2 \pm \sqrt{2}(x - 4)$



47. 31.7% 49. C

Pages 952-954 Chapter 17 Summary and Review

1. 2 3. $\frac{2}{3}$ 5. -1 7. 1 9. $6x^5$ 11. $3 + 8x$
13. $\frac{3x^2-3}{\sqrt{2x^3-6x}}$ 15. 4 unit² 17. $\frac{37}{3}$ unit² 19. $-\frac{4}{x} + C$
21. $x - \frac{x^2}{2} + C$ 23. $\frac{(x+3)^{10}}{2} + C$ 25. 36 27. 36
29. 0.0000125 31a. 10.48 ft/s² b. $v(t) = 10.48t + C_1$
c. $d(t) = 5.24t^2 + C_1t + C_2$

Pages 955 Chapter 17 Test

1. $\frac{2}{9}$ 2. -1 3. 1 4. 18 5. $-\frac{2}{3}$ 6. $\frac{1}{3}$ 7. 27
8. $12x^2$ 9. $2(x + 3)$ 10. $24x^3$ 11. $14x^6 + 36x^5$
12. $\frac{2-2x^2}{1+2x^2+x^4}$ 13. $\frac{4x}{\sqrt{4x^2-1}}$ 14. $\lim_{n\to\infty}\sum_{i=1}^{n}\left(\frac{2i}{n}\right)^3\left(\frac{2}{n}\right)$; 4 unit²
15. $\lim_{n\to\infty}\sum_{i=1}^{n}3\left(\frac{3i}{n}\right)^2\left(\frac{3}{n}\right) - \lim_{n\to\infty}\sum_{i=1}^{n}3\left(\frac{i}{n}\right)^2\left(\frac{1}{n}\right)$; 26 unit²
16. $x - x^2 + C$ 17. $x^3 + 2x^2 + 7x + C$ 18. $-\frac{1}{x} + C$
19. $\frac{3}{5}\sqrt[3]{x^5} + C$ 20. $-\frac{1}{4x^2} + C$ 21. 4 22. $-\frac{20}{3}$ 23. $22\frac{1}{2}$
24. $T'(\ell) = \frac{\pi}{\sqrt{32\ell}}$ 25. $\frac{32\pi}{3}$ BONUS 1