ns

ages 651–657

sh to preteach some of the key in this chapter. Particularly for guage Learners (ELL), the vocabulary before the esson begins gives students a nto understanding the new riting new words on poster ting to the words as you say displaying the poster for a ne is a useful technique.

tional expression (p. 469)
eorem (p. 472)
solution (p. 452)
rem (p. 468)
ion multiple (LCM)

uation (p. 451)
ression (p. 432)
Theorem (p. 472)
rm of a rational expression

CHAPTER 10

What You'll Learn in Chapter 10

- How to simplify, multiply, divide, add, and subtract rational expressions
- How to solve rational equations
- How to solve work problems and mixture problems
- How to divide polynomials
- How to simplify complex rational expressions
- How to prove multiplication and division theorems

Skills & Concepts You Need for Chapter 10

2-6 Find the reciprocal.

1. $\frac{3}{5}$ **2.** $\frac{3x}{y}$

3-3 and 3-5 Solve.

3. $9 = 6(5x - 1)$ **4.** $11 - 2(y + 1) = 21$

5. $5(d + 4) = 7(d - 1)$ **6.** $5(t + 3) + 4 = 3(t - 2) + 1$

5-7, 5-8 Add or subtract.

7. $(2x^2 + 3x - 7) + (x^2 + x - 8)$

8. $(x^2 + 6x + 8) - (x^2 - 3x - 4)$

5-9 to 5-11 Multiply.

9. $2x(3x + 2)$ **10.** $(x + 1)(x^2 - 2x - 1)$

11. $(x - 2)(x + 2)$ **12.** $(x + 3)(x + 3)$

6-1 to 6-5 Factor.

13. $x^2 - 9$ **14.** $x^2 - 6x + 9$ **15.** $x^2 + 3x + 2$

16. $16x^6 - 32x^5$ **17.** $6a^2 + 5a - 6$

6-8 Solve.

18. $x^2 - 5x + 6 = 0$ **19.** $9x^2 - 4 = 0$

6-9

20. One more than a number times one less than a number is 24. Find the number.

Skills & Concepts You Need for Chapter 10

1. $\frac{5}{3}$
2. $\frac{y}{3x}$
3. $\frac{1}{2}$
4. -6
5. $\frac{27}{2}$
6. -12
7. $3x^2 + 4x - 15$
8. $9x + 12$
9. $6x^2 + 4x$
10. $x^3 - x^2 - 3x - 1$
11. $x^2 - 4$
12. $x^2 + 6x + 9$
13. $(x - 3)(x + 3)$
14. $(x - 3)(x - 3)$ or $(x - 3)^2$
15. $(x + 2)(x + 1)$
16. $16x^5(x - 2)$
17. $(3a - 2)(2a + 3)$
18. 2, 3
19. $\frac{2}{3}, -\frac{2}{3}$
20. 5, -5

ACTICE/ASSESS

QUIZ

15

3

$\frac{2}{1}$

$\frac{9t + 14}{+ 2}$

7

$\frac{y}{2}$

gnment Guide
ore 1–38
tension 39–46

Mixed Review to maintain skills.

4 $\frac{3x - 6}{2 - x} = \frac{3(x - 2)}{2 - x}$ Factoring the numerator

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

$= -3$ Simplifying

5 $\frac{1 - y^2}{y^2 - 4y + 3} = \frac{(1 - y)(1 + y)}{(y - 1)(y - 3)}$ Factoring the numerator and denominator

$= \frac{-1(y - 1)(1 + y)}{(y - 1)(y - 3)}$

$= \frac{-1(1 + y)}{(y - 3)}$

$= \frac{-1 - y}{y - 3}$

Try This Simplify.

d. $\frac{b - 7}{7 - b}$ **e.** $\frac{5 - 2a}{3(2a - 5)}$ **f.** $\frac{4x - 12}{6 - 2x}$

Internet Connection *Extra Help On the Web*

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

10-1 Exercises

A

Simplify.

1. $\frac{4x^2y}{2xy^3}$ **2.** $\frac{a^3b^2}{-2a^5b}$ **3.** $\frac{4x - 12}{4x}$

4. $\frac{-2y + 6}{-4y}$ **5.** $\frac{3m^2 + 3m}{6m^2 + 9m}$ **6.** $\frac{4y^2 - 2y}{5y^2 - 5y}$

7. $\frac{6x^5 - x^4}{x^2 - x}$ **8.** $\frac{a^6 - a^5}{a^8 - a^7}$ **9.** $\frac{d + 7}{d^2 - 49}$

10. $\frac{a^2 - 9}{a^2 + 5a + 6}$ **11.** $\frac{t^2 - 25}{t^2 + t - 20}$ **12.** $\frac{2t^2 + 6t + 4}{4t^2 - 12t - 16}$

13. $\frac{a^2 - 1}{a - 1}$ **14.** $\frac{t^2 - 1}{t + 1}$ **15.** $\frac{x^2 + 1}{x + 1}$

16. $\frac{y^2 + 4}{y + 2}$ **17.** $\frac{6x^2 - 54}{4x^2 - 36}$ **18.** $\frac{8y^2 - 32}{4y^2 - 16}$

19. $\frac{6x + 12}{x^2 - x - 6}$ **20.** $\frac{5a + 5}{a^2 + 7a + 6}$ **21.** $\frac{b^2 - 10b + 21}{b^2 - 11b + 28}$

Try This

d. -1
e. $-\frac{1}{3}$
f. -2

Exercises

1. $\frac{2x}{y^2}$
2. $\frac{b}{-2a^2}$
3. $\frac{x - 3}{x}$
4. $\frac{y - 3}{2y}$
5. $\frac{m + 1}{2m + 3}$
6. $\frac{2(2y - 1)}{5(y - 1)}$
7. $\frac{x^3(6x - 1)}{x - 1}$
8. $\frac{1}{a^2}$
9. $\frac{1}{d - 7}$
10. $\frac{a - 3}{a + 2}$
11. $\frac{t - 5}{t - 4}$
12. $\frac{t + 2}{2(t - 4)}$
13. $a + 1$
14. $t - 1$
15. Already simplified
16. Already simplified
17. $\frac{3}{2}$
18. 2
19. $\frac{6}{x - 3}$
20. $\frac{5}{a + 6}$
21. $\frac{b - 3}{b - 4}$

22. $\frac{2t - 8}{12 - 3t}$

23. $\frac{y^2 - 3y - 18}{y^2 - 2y - 15}$

24. $\frac{t^2 - 4}{(t + 2)^2}$

25. $\frac{(a - 3)^2}{a^2 - 9}$

26. $\frac{5x - 15}{3 - x}$

27. $\frac{6 - y}{y^2 - 2y - 24}$

28. $\frac{4 - 2y}{2y^2 + 10y - 28}$

29. $\frac{-12}{4x^2 - 1}$

30. $\frac{(a - b)^2}{b^2 - a^2}$

B

Simplify.

31. $\frac{a^4 - b^4}{b^2 - a^2}$

32. $\frac{x^4 - 16y^4}{(x^2 + 4y^2)(x - 2y)}$

33. $\frac{m^4 - n^4}{4m^2 + 4n^2}$

34. $\frac{2y^4 - 2z^4}{2y^2 - 2z^2}$

35. $\frac{(t - 3)^3(t^2 - 2t + 1)}{(t - 1)^3(t^2 - 4t + 4)}$

36. $\frac{(x^2 - y^2)(x^2 - 2xy + y^2)}{(x - y)^2(x^2 - 4xy - 5y^2)}$

Evaluate each expression before simplifying and after simplifying.

37. $\frac{(x + 3)^2}{x^2 - 9}$ for $x = 4$

38. $\frac{3a - 6}{2 - a}$ for $a = 2$

39. ***Critical Thinking*** If a is a rational number, is it *sometimes*, *always*, or *never* true that $\frac{a^2 - 3a}{a - 3} = a$? Explain.

Error Analysis Tell which of the rational expressions below were simplified correctly. For those that were not done correctly, tell what error was made.

40. $\frac{8x^4y^2}{2x^3y^2} = 4x$

41. $\frac{2y - 7}{2y} = -7$

42. $\frac{(m - 2)^2}{m^2 - 4} = m + 2$

43. $\frac{8y^2 - 32}{4y^2 - 16} = 2y^2 - 2$

Challenge

Determine which replacements of x are not acceptable.

44. $\frac{x + 1}{x^2 + 4x + 4}$

45. $\frac{x^2 - 16}{x^2 + 2x - 3}$

46. $\frac{x - 7}{x^3 - 9x^2 + 14x}$

Mixed Review

Solve.

47. $x^2 - 12x + 35 = 0$

48. $25x^2 - 9 = 0$

49. $6x^2 - x - 1 = 0$

50. $3x^2 + 2x - 8 = 0$

51. $3x - 4y = 6$
$x + 4y = -14$

52. $x - y = -6$
$3x + 4y = -4$

53. $2y + 7x = -4$
$x = y - 7$ *6-8, 8-1, 8-2, 8-3*

Exercises

22. $-\frac{2}{3}$
23. $\frac{y - 6}{y - 5}$
24. $\frac{t - 2}{t + 2}$
25. $\frac{a - 3}{a + 3}$
26. -5
27. $\frac{-1}{y + 4}$
28. $\frac{-1}{y + 7}$
29. Already simplified
30. $\frac{b - a}{b + a}$
31. $-a^2 - b^2$
32. $x + 2y$
33. $\frac{m^2 - n^2}{4}$
34. $y^2 + z^2$
35. $\frac{(t - 3)^3}{(t - 1)(t - 2)^2}$
36. $\frac{x - y}{x - 5y}$
37. 7; 7
38. Not defined: -3
39. Sometimes; It is true for all values of a except $a = 3$.
40. Correct
41. Incorrect; only factors can be simplified, not individual terms.
42. Incorrect; the expression was factored incorrectly. The correct answer is $\frac{m - 2}{m + 2}$.
43. Incorrect; the expression was factored incorrectly. The correct answer is 2.
44. -2
45. $-3, 1$
46. $0, 2, 7$

Mixed Review

47. 5, 7
48. $\frac{3}{5}, -\frac{3}{5}$
49. $\frac{1}{2}, -\frac{1}{3}$
50. $-2, \frac{4}{3}$
51. $(-2, -3)$
52. $(-4, 2)$
53. $(-2, 5)$

10-2 Exercises

Extra Help On the Web
Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

A
Multiply. Simplify the product.

1. $\frac{4x^3}{3x} \cdot \frac{14}{x}$
2. $\frac{32}{b^4} \cdot \frac{3b^2}{8}$
3. $\frac{3c}{d^2} \cdot \frac{4d}{6c^3}$
4. $\frac{8}{3x} \cdot \frac{x+7}{6x^2}$
5. $\frac{y+6}{2y} \cdot \frac{4y^2}{y+6}$
6. $\frac{-5}{m} \cdot \frac{m^6}{m+2}$
7. $\frac{-2n}{7(n+2)} \cdot \frac{7n+7}{n+1}$
8. $\frac{-3y}{6(y-1)} \cdot \frac{2y-2}{y^2}$
9. $\frac{a-6}{a^2} \cdot \frac{a+2}{a+1}$
10. $\frac{3x}{2} \cdot \frac{x+4}{x-1}$
11. $\frac{4y}{5} \cdot \frac{y-3}{2y}$
12. $\frac{a-1}{a+2} \cdot \frac{a+1}{a-1}$
13. $\frac{m-2}{m-5} \cdot \frac{m+5}{m-2}$
14. $\frac{2x+3}{4} \cdot \frac{4}{x-5}$
15. $\frac{-5}{6y-4} \cdot \frac{-6}{5y+6}$
16. $\frac{a-5}{a^2+1} \cdot \frac{a+1}{a^2-1}$
17. $\frac{t+3}{t^2-2} \cdot \frac{t+3}{t^2-9}$
18. $\frac{x+1}{2+x} \cdot \frac{x-1}{x+1}$
19. $\frac{2x}{2x} \cdot \frac{x-1}{x+4}$
20. $\frac{3y-1}{2y+1} \cdot \frac{y}{y}$
21. $\frac{-1}{-1} \cdot \frac{3-x}{4-x}$
22. $\frac{-1}{-1} \cdot \frac{4-a}{5-a}$
23. $\frac{4(x+2)}{5x} \cdot \frac{6x^2}{2x}$
24. $\frac{6(m-3)}{5m} \cdot \frac{4m^2}{2(m-3)}$
25. $\frac{(y-4)^2}{3y} \cdot \frac{(y-2)}{(y+4)(y-4)}$
26. $\frac{(x+1)^2}{x+3} \cdot \frac{(x+3)^3}{x+1}$
27. $\frac{5(m-1)}{(m+3)^2} \cdot \frac{m+3}{(m-1)^2}$
28. $\frac{6a+12}{5} \cdot \frac{15a}{7a+14}$
29. $\frac{25-x^2}{12} \cdot \frac{6}{5-x}$
30. $\frac{3}{x^2-1} \cdot \frac{x+1}{3}$
31. $\frac{4-3a}{6} \cdot \frac{3}{3a-4}$
32. $\frac{1-x}{7} \cdot \frac{14}{x-1}$
33. $\frac{7x}{4x+3} \cdot (8x+6)$
34. $\frac{4c}{2c-1} \cdot (8c-4)$

3. PRACTICE/ASSESS

LESSON QUIZ
Multiply and simplify.
1. $\frac{8x^4}{3} \cdot \frac{6}{4x^3}$ $4x$
2. $\frac{12x-6}{5} \cdot \frac{25}{4x-2}$ 15
3. $\frac{1-x}{1+x} \cdot \frac{1+x}{x-1}$ -1

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Extension 48–52

Use Mixed Review to maintai

Exercises
1. $\frac{56x}{3}$
2. $\frac{12}{b^2}$
3. $\frac{2}{c^2d}$
4. $\frac{4(x+7)}{9x^3}$
5. $2y$
6. $\frac{-5m^5}{m+2}$
7. $\frac{-2n}{n+2}$
8. $\frac{-1}{y}$
9. $\frac{(a-6)(a+2)}{a^2(a+1)}$
10. $\frac{3x(x+4)}{2(x-1)}$
11. $\frac{2(y-3)}{5}$
12. $\frac{a+1}{a+2}$
13. $\frac{m+5}{m-5}$
14. $\frac{2x+3}{x-5}$
15. $\frac{15}{(3y-2)(5y+6)}$
16. $\frac{a-5}{(a^2+1)(a-1)}$
17. $\frac{t+3}{(t^2-2)(t-3)}$
18. $\frac{x-1}{2+x}$
19. $\frac{x-1}{x+4}$
20. $\frac{3y-1}{2y+1}$
21. $\frac{x-3}{x-4}$
22. $\frac{a-4}{a-5}$
23. $\frac{12(x+2)}{5}$
24. $\frac{12m}{5}$
25. $\frac{(y-4)(y-2)}{3y(y+4)}$
26. $(x+1)(x+3)^2$
27. $\frac{5}{(m+3)(m-1)}$
28. $\frac{18a}{7}$
29. $\frac{5+x}{2}$
30. $\frac{1}{x-1}$
31. $-\frac{1}{2}$
32. -2
33. $14x$
34. $16c$

B

Multiply. Simplify the product.

35. $\frac{x^2 - 3x - 10}{(x-2)^2} \cdot \frac{x-2}{x-5}$

36. $\frac{t^2}{t^2-4} \cdot \frac{t^2 - 5t + 6}{t^2 - 3t}$

37. $\frac{a^2 - 9}{a^2} \cdot \frac{a^2 - 3a}{a^2 + a - 12}$

38. $\frac{m^2 + 10m - 11}{m^2 - 1} \cdot \frac{m+1}{m+11}$

39. $\frac{4a^2}{3a^2 - 12a + 12} \cdot \frac{3a-6}{2a}$

40. $\frac{5v+5}{v-2} \cdot \frac{v^2 - 4v + 4}{v^2 - 1}$

41. $\frac{x^4 - 16}{x^4 - 1} \cdot \frac{x^2+1}{x^2+4}$

42. $\frac{t^4 - 1}{t^4 - 81} \cdot \frac{t^2+9}{t^2+1}$

43. $\frac{(t-2)^3}{(t-1)^3} \cdot \frac{t^2 - 2t + 1}{t^2 - 4t + 4}$

44. $\frac{(y+4)^3}{(y+2)^3} \cdot \frac{y^2 + 4y + 4}{y^2 + 8y + 16}$

45. $\frac{m^2 - n^2}{2m+1} \cdot \frac{2m^2 - 5m - 3}{m+n}$

46. $\frac{a^4 - b^4}{2ab} \cdot \frac{2a^2 - ab - 3b^2}{a^2 + b^2}$

47. $\frac{-4x^2 - 9xy - 2y^2}{x + 2y} \cdot \frac{-1}{4x^2 - 3xy - y^2}$

48. ***Critical Thinking*** Find two different pairs of rational expressions whose product is $\frac{8a^2 + 16a - 24}{a^2 + 13a + 40}$.

A cord of firewood is a stack that is 8 ft long, 4 ft high, and 4 ft wide. How many cords fill a woodbin that is 12 ft long, 4 ft high, and 2 ft deep? How much would it cost to fill the bin with Warne's firewood? (See Exercise 65.)

Challenge

Determine which replacements of x are not acceptable.

49. $\frac{x+1}{x^2 + 4x + 4}$

50. $\frac{x^2 - 16}{x^2 + 2x - 3}$

51. $\frac{x-7}{x^3 - 9x^2 + 14x}$

52. $\frac{x^2 - 4}{x^3 + x^2 - 6x}$

Mixed Review

Let $A = \{-2, 0, 3, 5\}$, $B = \{0, 1, 2, 3, 4\}$, and $C = \{-3, -2, 0, 1\}$. Find the following. **53.** $A \cup B$ **54.** $A \cap C$ **55.** $B \cap C$ **56.** $A \cup \emptyset$ *9-1*

Solve. **57.** $x^2 - 4 = 3x$ **58.** $2y^2 - 6y = -4$ **59.** $3a^2 - 5 = 2a$ *6-8*

Solve each system. **60.** $x - \frac{2}{5}y = -2$, $3x + 2y = 10$ **61.** $2x - y = 4$, $\frac{3}{4}x + y = 7$ *8-2, 8-3*

Solve. **62.** $|y + 2| = 5$ **63.** $|2y - 6| = 16$ **64.** $|3x + 4| = 13$ *9-3*

65. Warne's Firewood Sales delivers and stacks seasoned firewood. A half cord costs \$65. One cord costs \$110. Assume a linear relationship fits these data using the ordered pairs (cords, price).

a. Find the linear equation for the data points.

b. Use this linear equation to find the cost of 5 cords of firewood. *7-7*

43. $\frac{t-2}{t-1}$

44. $\frac{y+4}{y+2}$

45. $(m - n)(m - 3)$

46. $\frac{(a+b)^2(a-b)(2a-3b)}{2ab}$

47. $\frac{1}{x-y}$

48. Answers may vary. Possible answers are $\frac{2(a+3)}{a+5} \cdot \frac{4(a-1)}{a+8}$ or $\frac{8a+24}{a+5} \cdot \frac{a-1}{a+8}$.

49. -2

50. $1, -3$

51. $0, 2, 7$

52. $0, -3, 2$

Mixed Review

53. $\{-2, 0, 1, 2, 3, 4, 5\}$

54. $\{-2, 0\}$

55. $\{0, 1\}$

56. $\{-2, 0, 3, 5\}$

57. $4, -1$

58. $1, 2$

59. $\frac{5}{2}, -1$

60. $(0, 5)$

61. $(4, 4)$

62. $3, -7$

63. $11, -5$

64. $3, -\frac{17}{3}$

65. a. $y = 90x + 20$

b. \$470

Photo caption: $\frac{3}{4}$ cord, \$87.50

TICE/ASSESS

IIZ

simplify.

$\frac{x^2}{3}$

$\frac{x-4}{6x}$ 4

$+2 \div \frac{x+1}{2x}$ $\frac{x+2}{3}$

ent Guide
1–40
sion 41–45

ed Review to maintain skills.

Exercises

1. $2x^2$
2. $\frac{-5x^5}{14}$
3. $\frac{1}{a^3}$
4. $\frac{1}{4t^3}$
5. $\frac{3m^3}{5}$
6. $\frac{4a^5}{15}$
7. $\frac{15}{8}$
8. $\frac{1}{2}$

Extra Help On the Web

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

Practice Multiple Choice

Choose the best answer.

1. Simplify.

$$\frac{4x^2-1}{9x^2-1} \cdot \frac{12x^2+1x-1}{10x^2-9x+2}$$

A $\frac{8x^2+6x+1}{15x^2-11x+2}$

B $\frac{8x^2+2x-1}{15x^2-11x+2}$

C $\frac{8x^2+2x-1}{15x^2+11x+2}$

D $\frac{8x^2+2x-1}{15x^2-1x-2}$

2. Simplify.

$$\frac{25x^2-1}{15x^2+22x+8} \div \frac{20x^2-11x-3}{12x^2-x-6}$$

F $\frac{-1}{4}$

G $\frac{5x-1}{5x+4}$

H $\frac{x^2-1}{x^2+22x+4} \cdot \frac{x^2-1x+1}{x^2-11x-1}$

J $\frac{5x+1}{5x+4}$

1. B; Algebra 12.0, 13.0
2. G; Algebra 12.0; 13.0

10-3 Exercises

A

Divide and simplify.

1. $\frac{5x^4}{3} \div \frac{5x^2}{6}$
2. $\frac{-2x^6}{7} \div \frac{4x}{5}$
3. $\frac{3}{a^5} \div \frac{3}{a^2}$
4. $\frac{2}{t^5} \div \frac{8}{t^2}$
5. $\frac{6m^4}{5} \div 2m$
6. $\frac{4a^7}{3} \div 5a^2$
7. $\frac{5x-5}{16} \div \frac{x-1}{6}$
8. $\frac{-4+2x}{8} \div \frac{x-2}{2}$
9. $\frac{-6+3x}{5} \div \frac{4x-8}{25}$
10. $\frac{-12+4x}{4} \div \frac{-6+2x}{6}$
11. $\frac{a+2}{a-1} \div \frac{3a+6}{a-5}$
12. $\frac{t-3}{t+2} \div \frac{4t-12}{t+1}$
13. $\frac{x^2-4}{x} \div \frac{x-2}{x+2}$
14. $\frac{x^2-1}{x} \div \frac{x+1}{x-1}$
15. $\frac{x^2-9}{4x+12} \div \frac{x-3}{6}$
16. $\frac{4y-8}{y+2} \div \frac{y-2}{y^2-4}$
17. $\frac{c^2+3c}{c^2+2c-3} \div \frac{c}{c+1}$
18. $\frac{x-5}{2x} \div \frac{x^2-25}{4x^2}$
19. $\frac{8a-32}{a+1} \div \frac{16}{3a+3}$
20. $\frac{17}{5x-10} \div \frac{34x+51}{3x-6}$
21. $\frac{2y^2-7y+3}{2y^2+3y-2} \div \frac{6y^2-5y+1}{3y^2+5y-2}$
22. $\frac{x^2-x-20}{x^2+7x+12} \div \frac{x^2-10x+25}{x^2+6x+9}$
23. $\frac{x^2+13x+12}{x+2} \div (x+1)$
24. $\frac{a^2-5a+6}{a-3} \div (a-2)$
25. $\frac{c^2+10c+21}{c^2-2c-15} \div (c^2+2c-35)$
26. $\frac{1-z}{1+2z-z^2} \div (1-z)$
27. $(c+3) \div \frac{c^2+c-6}{c+2}$
28. $(2-x) \div \frac{x^2-4}{x-7}$
29. $\frac{(t+5)^3}{(t-5)^3} \div \frac{(t+5)^2}{(t-5)^2}$
30. $\frac{(y-3)^3}{(y+3)^3} \div \frac{(y-3)^2}{(y+3)^2}$
31. $\left(\frac{a+7}{3}\right)^3 \div \left(\frac{a+7}{2}\right)^2$
32. $\left(\frac{2x-3}{2}\right)^4 \div \left(\frac{2x-3}{2}\right)^3$
33. $\left(\frac{4}{b-3}\right)^4 \div \left(\frac{3}{b-3}\right)^5$
34. $\left(\frac{5}{y+9}\right) \div \left(\frac{5}{y+9}\right)^5$

9. $\frac{15}{4}$
10. 3
11. $\frac{a-5}{3(a-1)}$
12. $\frac{t+1}{4(t+2)}$
13. $\frac{(x+2)^2}{x}$
14. $\frac{(x-1)^2}{x}$
15. $\frac{3}{2}$
16. $4y-8$
17. $\frac{c+1}{c-1}$
18. $\frac{2x}{x+5}$
19. $\frac{3(a-4)}{2}$
20. $\frac{3}{5(2x+3)}$
21. $\frac{y-3}{2y-1}$
22. $\frac{x+3}{x-5}$
23. $\frac{x+12}{x+2}$
24. 1
25. $\frac{1}{(c-5)^2}$
26. $\frac{1}{1+2z-z^2}$
27. $\frac{c+2}{c-2}$
28. $-\frac{x-7}{x+2}$ or $\frac{7-x}{x+2}$
29. $\frac{t+5}{t-5}$
30. $\frac{y-3}{y+3}$
31. $\frac{4(a+7)}{27}$
32. $\frac{2x-3}{2}$
33. $\frac{4^4(b-3)}{3^5}$
34. $\frac{(y+9)^4}{5^4}$

B

Divide and simplify.

35. $\frac{2a^2 - 5ab}{c - 3d} \div (4a^2 - 25b^2)$

36. $\frac{3a^2 - 5ab - 12b^2}{3ab + 4b^2} \div (3b^2 - ab)$

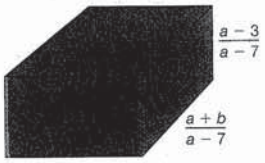
37. $(x - 2a) \div \frac{a^2x^2 - 4a^4}{a^2x + 2a^3}$

38. $\frac{3x^2 - 2xy - y^2}{x^2 - y^2} \div (3x^2 + 4xy + y^2)$

39. $\frac{z^2 - 8z + 16}{z^2 + 8z + 16} \div \frac{(z - 4)^5}{(z + 4)^5}$

40. $xy \cdot \frac{y^2 - 4xy}{y - x} \div \frac{16x^2y^2 - y^4}{4x^2 - 3xy - y^2}$

41. ***Critical Thinking*** The volume of this figure is $a - 3$. What is its width?



Challenge

Divide and simplify.

42. $\frac{x^2 - x + xy - y}{x^2 + 6x - 7} \div \frac{x^2 + 2xy + y^2}{4x + 4y}$

43. $\frac{3x + 3y + 3}{9x} \div \frac{x^2 + 2xy + y^2 - 1}{x^4 + x^2}$

44. $\left(\frac{y^2 + 5y + 6}{y^2} \cdot \frac{3y^3 + 6y^2}{y^2 - y - 12}\right) \div \frac{y^2 - y}{y^2 - 2y - 8}$

45. $\frac{a^4 - 81b^4}{a^2c - 6abc + 9b^2c} \cdot \frac{a + 3b}{a^2 + 9b^2} \div \frac{a^2 + 6ab + 9b^2}{(a - 3b)^2}$

Mixed Review

Determine whether the graphs of the equations are parallel.

46. $2x - 3y = 9$
$8x + 4 = -6y$

47. $4y + 9 = x$
$5 + 2y = 8x$

48. $6y - 21x = 5$
$8y - 5 = 28x$ *7-8*

Determine whether the graphs of the equations are perpendicular.

49. $5y = 2x - 10$
$2y + 5x = 2$

50. $4y + 1 = 3x$
$3y - 4x = 3$

51. $y = x + 3$
$y + x = -3$ *7-8*

Solve for the indicated letter. **52.** $Q = \frac{5mv}{s}$, for v **53.** $\frac{a}{b} = \frac{c}{d}$ for c *3-7*

Solve. **54.** $2x + y = -1$
$5 - y = 4x$

55. $2x + 3y = 8$
$5y - x = 22$

56. $9y - 16 = 11x$
$5x + 1 = 2y$ *8-2, 8-3*

Solve. **57.** $9a^2 - 81 = 0$ **58.** $c^2 - 2c = 35$ **59.** $|2x + 3| > 5$ *6-8, 9-4*

60. Steve is half as old as Stacey. The sum of their ages five years ago was 8. How old are Steve and Stacey now?

Exercises

35. $\frac{a}{(c - 3d)(2a + 5b)}$
36. $\frac{-1}{b^2}$
37. 1
38. $\frac{1}{(x + y)^2}$
39. $\frac{(z + 4)^3}{(z - 4)^3}$
40. x
41. $\frac{(a - 7)^2}{a + b}$
42. $\frac{4}{x + 7}$
43. $\frac{x(x^2 + 1)}{3(x + y - 1)}$
44. $\frac{3(y + 2)^3}{y(y - 1)}$
45. $\frac{a - 3b}{c}$

Mixed Review

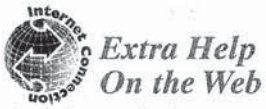
46. No
47. No
48. Yes
49. Yes
50. No
51. Yes
52. $v = \frac{Qs}{5m}$
53. $c = \frac{ad}{b}$
54. (3, −7)
55. (−2, 4)
56. (1, 3)
57. ± 3
58. 7, −5
59. $x > 1$ or $x < -4$
60. Steve is 6 years old.
Stacey is 12 years old.

Try This Subtract and simplify.

d. $\frac{4m+5}{m-1} - \frac{2m-1}{m-1}$ **e.** $\frac{2y^2+4y-3}{y+3} - \frac{y^2-2y-12}{y+3}$

Any number of expressions with common denominators can be added or subtracted by adding or subtracting the numerators and placing the result over the common denominator.

10-4 Exercises



Extra Help On the Web

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

A

Add or subtract. Simplify.

1. $\frac{3a}{5} + \frac{2a}{5}$
2. $\frac{6m}{11} + \frac{8m}{11}$
3. $\frac{7s}{10} - \frac{2s}{10}$
4. $\frac{18xy}{7} - \frac{11xy}{7}$
5. $\frac{6b^2}{c} + \frac{7b^2}{c}$
6. $\frac{10x}{y} - \frac{7x}{y}$
7. $\frac{4x+3}{x+2} + \frac{3x+4}{x+2}$
8. $\frac{-6m}{m-5} + \frac{m-10}{m-5}$
9. $\frac{a-6}{a+1} - \frac{3a-4}{a+1}$
10. $\frac{b+4}{b+2} - \frac{3b-8}{b+2}$
11. $\frac{y^2+5}{y+2} - \frac{4y+17}{y+2}$
12. $\frac{x^2+3}{x-2} - \frac{10x-7}{x-2}$
13. $\frac{3a+5}{a-1} + \frac{2a-6}{a-1}$
14. $\frac{4p-3}{p+2} + \frac{5-3p}{p+2}$
15. $\frac{z-6}{2z+3} - \frac{5z}{2z+3}$
16. $\frac{x-9}{3x+2} - \frac{7x-5}{3x+2}$
17. $\frac{y-3}{y+5} - \frac{2y-7}{y+5}$
18. $\frac{m+9}{m+3} - \frac{-4m-6}{m+3}$
19. $\frac{n^2+3n}{n+4} + \frac{2n^2-13n-8}{n+4}$
20. $\frac{z+6}{z+5} + \frac{3z^2+19z+19}{z+5}$
21. $\frac{5x^2-3x+2}{2x-1} - \frac{3x^2+3x-2}{2x-1}$
22. $\frac{4y^2+2y-3}{5y+1} - \frac{3y^2-2y-4}{5y+1}$
23. $\frac{a-1}{a^2-2a+1} + \frac{5-3a}{a^2-2a+1}$
24. $\frac{3m-3}{m^2+3m-4} + \frac{m-7}{m^2+3m-4}$

3. PRACTICE/ASSESS

LESSON QUIZ

Add or subtract and simplify.

1. $\frac{3x}{5} + \frac{x}{5}$
   $\frac{4x}{5}$
2. $\frac{7}{2z+7} - \frac{3}{2z+7}$
   $\frac{4}{2z+7}$
3. $\frac{2x^2+5x+3}{x+1} + \frac{x^2+x+1}{x+1}$
   $\frac{3x^2+6x+4}{x+1}$

Assignment Guide

▼ Core 1–34
Extension 35–37

Use Mixed Review to maintain

Try This

d. $\frac{2(m+3)}{m-1}$

e. $y+3$

Exercises

1. a
2. $\frac{14m}{11}$
3. $\frac{s}{2}$
4. xy
5. $\frac{13b^2}{c}$
6. $\frac{3x}{y}$
7. $\frac{7(x+1)}{x+2}$
8. $\frac{-5(m+2)}{m-5}$
9. -2
10. $\frac{-2(b-6)}{b+2}$
11. $y-6$
12. $\frac{x^2-10x+10}{x-2}$
13. $\frac{5a-1}{a-1}$
14. 1
15. -2
16. -2
17. $\frac{-y+4}{y+5}$
18. 5
19. $\frac{(3n+2)(n-4)}{n+4}$
20. $3z+5$
21. $\frac{2(x-2)(x-1)}{2x-1}$
22. $\frac{y^2+4y+1}{5y+1}$
23. $\frac{-2(a-2)}{(a-1)(a-1)}$
24. $\frac{2(2m-5)}{(m+4)(m-1)}$

B

Add or subtract. Simplify.

25. $\frac{4a+5}{a-2} + \frac{6a-4}{a-2} + \frac{5}{a-2}$

26. $\frac{5x-3}{x+1} + \frac{2x}{x+1} + \frac{4}{x+1}$

27. $\frac{3a+3}{a+2} + \frac{a^2-2a}{a+2} + \frac{6}{a+2}$

28. $\frac{2b}{b+4} - \frac{4b}{b+4} - \frac{-2b^2-3b+5}{b+4}$

29. $\frac{x^2+3x-2}{x-1} + \frac{2x+4}{x-1} + \frac{x^2-x+1}{x-1}$

30. $\frac{4a^2+2a-3}{3a+4} + \frac{a^2+2a-15}{3a+4} + \frac{a^2+6a-6}{3a+4}$

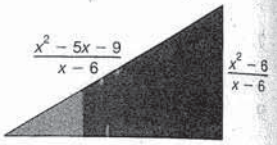
31. $\frac{y^2-3y}{2y+1} - \frac{3y^2+4y}{2y+1} - \frac{y^2+3y}{2y+1}$

32. $\frac{p^2-6}{3p+8} + \frac{2p^2+5p-3}{3p+8} - \frac{3p^2+p-4}{3p+8}$

33. $\frac{3x^2+4x-12}{(3x+4)(x-1)} - \frac{5x^2-2x-6}{(3x+4)(x-1)} - \frac{-14x^2-4x+2}{(3x+4)(x-1)}$

34. $\frac{10b^2+b-2}{(5b+2)(2b+1)} + \frac{12b^2-5b}{(5b+2)(2b+1)} - \frac{-8b^2-7b+4}{(5b+2)(2b+1)}$

35. ***Critical Thinking*** The perimeter of the figure at the right is $2x + 5$. Find the length of the missing side.



Challenge

Simplify.

36. $\frac{x^2}{3x^2-5x-2} - \frac{2x}{3x+1} \cdot \frac{1}{x-2}$

37. $\frac{3}{x+4} \cdot \frac{2x+11}{x-3} - \frac{-1}{4+x} \cdot \frac{6x+3}{3-x}$

Self-Test On the Web

Check your progress. Look for a self-test at the Prentice Hall Web site.
www.phschool.com

Mixed Review

Simplify. 38. $\frac{6x^2y}{3y^2}$ 39. $\frac{m^2-36}{4m+24}$ 40. $\frac{4-a}{a^2-16}$ 41. $(-3t^2)^4$

42. $\left(\frac{y^4}{6}\right)^2$ 43. $\left(\frac{m^4n^2}{2}\right)^6$

44. $(-3ab)^2$ 45. $\left(\frac{-2x}{y}\right)^2$ *5-1, 5-2, 10-1*

Solve. **46.** Find two numbers whose sum is -2 and whose product is -24. **47.** The difference of two positive numbers is 2. The difference of the squares of the two numbers is 40. Find the numbers. *8-6*

Exercises

25. $\frac{2(5a+3)}{a-2}$
26. $\frac{7x+1}{x+1}$
27. $\frac{a^2+a+9}{a+2}$
28. $\frac{2b^2+b-5}{b+4}$
29. $\frac{2x^2+4x+3}{x-1}$
30. $\frac{2(3a-4)(a+3)}{3a+4}$
31. $\frac{-y(3y+10)}{2y+1}$
32. $\frac{4p-5}{3p+8}$
33. $\frac{2(2x-1)}{x-1}$
34. $\frac{3(5b-2)}{5b+2}$
35. $\frac{-2x-15}{x-6}$
36. $\frac{x}{3x+1}$
37. $\frac{30}{(x+4)(x-3)}$

Mixed Review

38. $\frac{2x^2}{y}$
39. $\frac{m-6}{4}$
40. $\frac{-1}{a+4}$
41. $81t^8$
42. $\frac{y^8}{36}$
43. $\frac{m^{24}n^{12}}{64}$
44. $9a^2b^2$
45. $\frac{4x^2}{y^2}$
46. $-6, 4$
47. $11, 9$

10

$$\frac{k^2}{k-5} - \frac{2}{5-k} = \frac{k^2}{k-5} - \frac{2}{-1(k-5)}$$

Factoring out -1 because the denominators are additive inverses

$$= \frac{k^2}{k-5} - \frac{2}{-1(k-5)} \cdot \frac{-1}{-1}$$

Multiplying by a form of 1 to get the LCD $k-5$

$$= \frac{k^2}{k-5} - \frac{-2}{k-5}$$

$$= \frac{k^2+2}{k-5}$$

Try This Add or subtract and simplify.

j. $\frac{3x}{25} + \frac{x^2}{10}$ **k.** $\frac{3}{xy^2} - \frac{x+y}{x^2y}$ **l.** $\frac{4}{3-b} + \frac{b}{2b-6}$

Internet Connection ***Extra Help On the Web***

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

10-5 Exercises

A

Add and simplify.

1. $\frac{a^2}{2} + \frac{3a^2}{8}$ **2.** $\frac{8y}{10} + \frac{2y}{5}$ **3.** $\frac{4c}{15} + \frac{8c}{25}$

4. $\frac{2}{x} + \frac{5}{x^2}$ **5.** $\frac{4}{x} + \frac{8}{x^2}$ **6.** $\frac{5}{6r} + \frac{7}{8r}$

7. $\frac{3}{x-2} + \frac{3}{x+2}$ **8.** $\frac{2}{x-1} + \frac{2}{x+1}$ **9.** $\frac{3}{x+1} + \frac{2}{3x}$

Subtract and simplify.

10. $\frac{x-2}{6} - \frac{x+1}{3}$ **11.** $\frac{a+2}{2} - \frac{a-4}{4}$ **12.** $\frac{y-5}{y} - \frac{3y-1}{4y}$

13. $\frac{x-1}{4x} - \frac{2x+3}{x}$ **14.** $2 - \frac{2x+1}{5}$ **15.** $3x - \frac{x}{x-2}$

16. $\frac{2}{x+5} - \frac{3}{4x}$ **17.** $\frac{x+4}{x} - \frac{x}{x+4}$ **18.** $\frac{x}{x-5} - \frac{x-5}{x}$

Find the LCM.

19. c^2d, cd^2

20. $2x^2, 6xy$

21. $x - y, x + y$

22. $a - 5, a + 5$

23. $2(y - 3), 6(3 - y)$

24. $4(x - 1), 8(1 - x)$

25. $t + 2, t - 2$

26. $x + 3, x - 3$

27. $x^2 - 4, x^2 + 5x + 6$

28. $x^2 + 3x + 2, x^2 - 4$

29. $t^3 + 4t^2 + 4t, t^2 - 4t$

30. $y^3 - y^2, y^4 - y^2$

31. $a + 1, a^2 - 1$

32. $x^2 - y^2, x^2 + 2xy + y^2$

33. $m^2 - 5m + 6, m^2 - 4m + 4$

34. $2x^2 + 5x + 2, 2x^2 - x - 1$

5. $\frac{4(x+2)}{x^2}$
6. $\frac{41}{24r}$
7. $\frac{6x}{(x-2)(x+2)}$
8. $\frac{4x}{(x-1)(x+1)}$
9. $\frac{11x+2}{3x(x+1)}$
10. $\frac{-x-4}{6}$
11. $\frac{a+8}{4}$
12. $\frac{y-19}{4y}$
13. $\frac{-7x-13}{4x}$
14. $\frac{9-2x}{5}$
15. $\frac{x(3x-7)}{x-2}$
16. $\frac{5(x-3)}{4x(x+5)}$
17. $\frac{8(x+2)}{x(x+4)}$
18. $\frac{5(2x-5)}{x(x-5)}$
19. c^2d^2
20. $6x^2y$
21. $(x-y)(x+y)$
22. $(a-5)(a+5)$
23. $6(y-3)$ or $6(3-y)$
24. $8(x-1)$ or $8(1-x)$
25. $(t+2)(t-2)$
26. $(x+3)(x-3)$
27. $(x+2)(x-2)(x+3)$
28. $(x+1)(x-2)(x+2)$
29. $t(t+2)^2(t-4)$
30. $y^2(y+1)(y-1)$
31. $(a-1)(a+1)$
32. $(x+y)^2(x-y)$
33. $(m-2)^2(m-3)$
34. $(x+2)(x-1)(2x+1)$

Add or subtract and simplify.

35. $\frac{2}{9t} + \frac{11}{6t}$

36. $\frac{x + y}{xy^2} + \frac{3x + y}{x^2y}$

37. $\frac{2c - d}{c^2d} + \frac{c + d}{cd^2}$

38. $\frac{t}{t - 3} + \frac{5}{4t - 12}$

39. $\frac{3}{x - 1} + \frac{2}{(x - 1)^2}$

40. $\frac{2}{x + 3} + \frac{4}{(x + 3)^2}$

41. $\frac{4a}{5a - 10} + \frac{3a}{10a - 20}$

42. $\frac{3a}{4a - 20} + \frac{9a}{6a - 30}$

43. $\frac{x}{x^2 + 2x + 1} + \frac{1}{x^2 + 5x + 4}$

44. $\frac{7}{a^2 + a - 2} + \frac{5}{a^2 - 4a + 3}$

45. $\frac{3 - b}{b - 7} + \frac{2b - 5}{7 - b}$

46. $\frac{x}{x - 1} + \frac{1}{1 - x}$

47. $\frac{t^2}{t - 2} - \frac{4}{2 - t}$

48. $\frac{y^2}{y - 3} - \frac{9}{3 - y}$

49. $\frac{2z}{z - 1} - \frac{3z}{z + 1}$

50. $\frac{5x}{x^2 - 9} - \frac{4}{x + 3}$

51. $\frac{8x}{x^2 - 16} - \frac{5}{x + 4}$

52. $\frac{3}{2t^2 - 2t} - \frac{5}{2t - 2}$

53. $\frac{4}{5b^2 - 5b} - \frac{3}{5b - 5}$

54. $\frac{2s}{t^2 - s^2} - \frac{s}{t - s}$

55. $\frac{2x}{x^2 - 16} + \frac{x}{x - 4}$

56. $\frac{4x}{x^2 - 25} + \frac{x}{x + 5}$

B

Add or subtract and simplify.

57. $\frac{5}{z + 4} + \frac{3}{3z + 12}$

58. $\frac{5x + 3y}{2x^2y} - \frac{3x - 4y}{xy^2}$

59. $\frac{4x + 2t}{3xt^2} - \frac{5x - 3t}{x^2t}$

60. $\frac{5}{x + 5} - \frac{3}{x - 5}$

61. $\frac{y - 8}{y^2 - 16} + \frac{y - 8}{16 - y^2}$

62. $\frac{a + 3}{a - 5} - \frac{2a - 1}{5 - a}$

63. $\frac{3(x - 2)}{2x - 3} - \frac{3(x - 1)}{3 - 2x}$

64. $\frac{m - 2}{m^2 - 25} + \frac{m - 2}{25 - m^2}$

65. $\frac{x}{x^2 + 5x + 6} - \frac{2}{x^2 + 3x + 2}$

66. $\frac{x}{x^2 + 11x + 30} - \frac{5}{x^2 + 9x + 20}$

Find the LCM.

67. $8x^2 - 8, 6x^2 - 12x + 6$, and $10 - 10x$

68. $9x^3 - 9x^2 - 18x, 6x^5 - 24x^4 + 24x^3$

69. $x^5 + 2x^4 + x^3, 2x^3 - 2x, 5x - 5$

70. $x^5 + 4x^4 + 4x^3, 3x^2 - 12, 2x + 4$

Exercises

35. $\frac{37}{18t}$

36. $\frac{x^2 + 4xy + y^2}{x^2y^2}$

37. $\frac{c^2 + 3cd - d^2}{c^2d^2}$

38. $\frac{4t + 5}{4(t - 3)}$

39. $\frac{3x - 1}{(x - 1)^2}$

40. $\frac{2(x + 5)}{(x + 3)^2}$

41. $\frac{11a}{10(a - 2)}$

42. $\frac{9a}{4(a - 5)}$

43. $\frac{x^2 + 5x + 1}{(x + 1)^2(x + 4)}$

44. $\frac{12a - 11}{(a + 2)(a - 1)(a - 3)}$

45. $\frac{8 - 3b}{b - 7}$ or $\frac{3b - 8}{7 - b}$

46. 1

47. $\frac{t^2 + 4}{t - 2}$

48. $\frac{y^2 + 9}{y - 3}$

49. $\frac{z(5 - z)}{(z - 1)(z + 1)}$

50. $\frac{x + 12}{(x - 3)(x + 3)}$

51. $\frac{3x + 20}{(x - 4)(x + 4)}$

52. $\frac{3 - 5t}{2t(t - 1)}$

53. $\frac{4 - 3b}{5b(b - 1)}$

54. $\frac{s(2 - t - s)}{(t + s)(t - s)}$

55. $\frac{x(x + 6)}{(x - 4)(x + 4)}$

56. $\frac{x(x - 1)}{(x + 5)(x - 5)}$

57. $\frac{6}{z + 4}$

58. $\frac{-6x^2 + 13xy + 3y^2}{2x^2y^2}$

59. $\frac{4x^2 - 13xt + 9t^2}{3x^2t^2}$

60. $\frac{2(x - 20)}{(x + 5)(x - 5)}$

61. 0

62. $\frac{3a + 2}{a - 5}$

63. 3

64. 0

65. $\frac{x - 3}{(x + 1)(x + 3)}$

66. $\frac{x - 6}{(x + 4)(x + 6)}$

67. $120(x + 1)(x - 1)^2$

68. $18x^3(x - 2)^2(x + 1)$

69. $10x^3(x + 1)^2(x - 1)$

70. $6x^3(x + 2)^2(x - 2)$

Add and simplify.

71. $\frac{5}{z+2} + \frac{4z}{z^2-4} + 2$

72. $\frac{-2}{y^2-9} + \frac{4y}{(y-3)^2} + \frac{6}{3-y}$

73. $\frac{3z^2}{z^4-4} + \frac{5z^2-3}{2z^4+z^2-6}$

74. Write $\frac{a+b}{a-b}$ as the sum of two rational expressions.

75. ***Critical Thinking*** Write $\frac{5x^2-2xy}{x^2+y^2}$ as the difference of two rational expressions, such that y occurs in the numerator of each expression.

Challenge

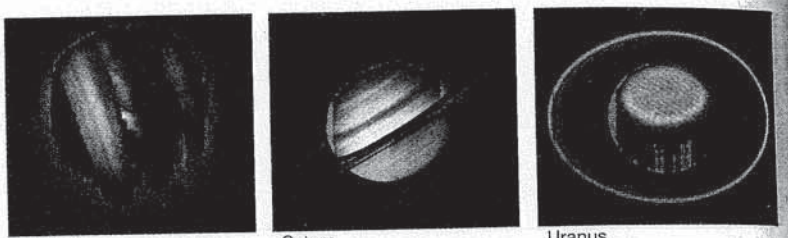
76. Two joggers leave the starting point of a circular course at the same time. One jogger completes one round in 6 minutes, and the second jogger finishes in 8 minutes. After how many minutes will they meet again at the starting place, assuming that they continue to run at the same pace?

The planets Earth, Jupiter, Saturn, and Uranus revolve around the sun about once each 1, 12, 30, and 84 years, respectively.

77. How often will Jupiter and Saturn appear in the same position in the night sky as seen from Earth?

78. How often will Jupiter, Saturn, and Uranus all appear in the same position in the night sky as seen from Earth?

Jupiter and Uranus revolve once around the sun about every 12 and 84 years, respectively. How often will Jupiter and Uranus appear in the same position in the night sky as seen from Earth?



Jupiter Saturn Uranus

Mixed Review

Determine whether the graphs of the equations are perpendicular.

79. $4y = 5x + 2$, $8x = 3 - 10y$ **80.** $y + 3x = 4$, $2x = 5 - 6y$ **81.** $6y + 4x = 11$, $21 - 15y = 10x$ *7-8*

Solve and graph.

82. $|11x| > 121$ **83.** $|3x - 5| \geq 4$

84. $|9x| \leq 108$ **85.** $|2x - x| > 0$ **86.** $|x - 1| \leq 5$ *9-4*

Simplify.

87. $\frac{a^2+7a+12}{a^2-9}$ **88.** $\frac{9x^2-25}{3x+5}$ **89.** $\frac{3x-6}{2-x}$ *10-1*

Exercises

71. $\frac{(z+6)(2z-3)}{z^2-4}$

72. $\frac{-2(y^2-5y-30)}{(y-3)^2(y+3)}$

73. $\frac{11z^4-22z^2+6}{(2z^2-3)(z^2+2)(z^2-2)}$

74. $\frac{a}{a-b} + \frac{b}{a-b}$

75. Answers may vary. Example: $\frac{5x^2+y}{x^2+y^2} - \frac{2xy+y}{x^2+y^2}$

76. 24 min

77. Every 60 years

78. Every 420 years

Photo caption: 84 yr

Mixed Review

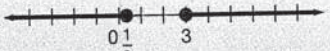
79. Yes

80. No

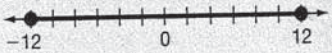
81. No

82. $\{x|x > 11 \text{ or } x < -11\}$

83. $\left\{x|x \geq 3 \text{ or } x \leq \frac{1}{3}\right\}$

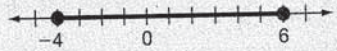


84. $\{x|-12 \leq x \leq 12\}$



85. $\{x|x \neq 0\}$

86. $\{x|-4 \leq x \leq 6\}$



87. $\frac{a+4}{a-3}$

88. $3x - 5$

89. -3

10-6 Exercises

A

Solve.

1. $\frac{3}{8} + \frac{4}{5} = \frac{x}{20}$
2. $\frac{3}{5} + \frac{2}{3} = \frac{x}{9}$
3. $\frac{2}{3} - \frac{5}{6} = \frac{1}{x}$
4. $\frac{1}{8} - \frac{3}{5} = \frac{1}{x}$
5. $\frac{1}{6} + \frac{1}{8} = \frac{1}{t}$
6. $\frac{1}{8} + \frac{1}{10} = \frac{1}{t}$
7. $x + \frac{4}{x} = -5$
8. $x + \frac{3}{x} = -4$
9. $\frac{x}{4} - \frac{4}{x} = 0$
10. $\frac{x}{5} - \frac{5}{x} = 0$
11. $\frac{5}{x} = \frac{6}{x} - \frac{1}{3}$
12. $\frac{4}{x} = \frac{5}{x} - \frac{1}{2}$
13. $\frac{5}{3x} + \frac{3}{x} = 1$
14. $\frac{3}{4x} + \frac{5}{x} = 1$
15. $\frac{x-7}{x+2} = \frac{1}{4}$
16. $\frac{a-2}{a+3} = \frac{3}{8}$
17. $\frac{2}{x+1} = \frac{1}{x-2}$
18. $\frac{5}{x-1} = \frac{3}{x+2}$
19. $\frac{x}{6} - \frac{x}{10} = \frac{1}{6}$
20. $\frac{x}{8} - \frac{x}{12} = \frac{1}{8}$
21. $\frac{x+1}{3} - \frac{x-1}{2} = 1$
22. $\frac{x+2}{5} - \frac{x-2}{4} = 1$
23. $\frac{a-3}{3a+2} = \frac{1}{5}$
24. $\frac{x-1}{2x+5} = \frac{1}{4}$
25. $\frac{x-1}{x-5} = \frac{4}{x-5}$
26. $\frac{x-7}{x-9} = \frac{2}{x-9}$
27. $\frac{2}{x+3} = \frac{5}{x}$
28. $\frac{3}{x+4} = \frac{4}{x}$
29. $\frac{x-2}{x-3} = \frac{x-1}{x+1}$
30. $\frac{2b-3}{3b+2} = \frac{2b+1}{3b-2}$
31. $\frac{1}{x+3} + \frac{1}{x-3} = \frac{1}{x^2-9}$
32. $\frac{4}{x-3} + \frac{2x}{x^2-9} = \frac{1}{x+3}$
33. $\frac{x}{x+4} - \frac{4}{x-4} = \frac{x^2+16}{x^2-16}$
34. $\frac{5}{y-3} - \frac{30}{y^2-9} = 1$

Extra Help On the Web

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

Practice Multiple Choice

Choose the best answer.

1. Simplify.

$\frac{3x}{x+1} + \frac{5x+4}{x} + \frac{7x+4}{x(x+1)}$

A 16
B 9
C $\frac{8x+8}{x}$
D $\frac{15x+8}{x(3x+2)}$

2. Solve for x.

$\frac{5}{x+2} - \frac{8}{x-2} = \frac{6}{x^2-4}$

F $x = 0$
G $x = -\frac{32}{3}$ or $-10\frac{2}{3}$
H $x = -\frac{32}{13}$ or $-2\frac{6}{13}$
J $x = \frac{20}{3}$ or $6\frac{2}{3}$

1. C; Algebra 13.0
2. G; Algebra 13.0; 4.0

3. PRACTICE/ASSESS

LESSON QUIZ

Solve and check.

1. $\frac{x}{3} + \frac{3}{2} = 1$
   $x = -\frac{3}{2}$
2. $x + \frac{5}{x} = 6$
   $x = 1$ or $x = 5$
3. $\frac{x-8}{x-5} = x$
   $x = 2$ or $x = 4$

Assignment Guide

Core 1–42
Extension 43–46

Use Mixed Review to maintain

Exercises

1. $\frac{47}{2}$
2. $\frac{57}{5}$
3. -6
4. $-\frac{40}{19}$
5. $\frac{24}{7}$
6. $\frac{40}{9}$
7. $-4; -1$
8. $-3; -1$
9. $4; -4$
10. $5; -5$
11. 3
12. 2
13. $\frac{14}{3}$
14. $\frac{23}{4}$
15. 10
16. 5
17. 5
18. $-\frac{13}{2}$
19. $\frac{5}{2}$
20. 3
21. -1
22. -2
23. $\frac{17}{2}$
24. $\frac{9}{2}$
25. No solution
26. No solution
27. -5
28. -16
29. $\frac{5}{3}$
30. $\frac{1}{5}$
31. $\frac{1}{2}$
32. No solution
33. No solution
34. 2

B

Solve.

35. $\frac{4}{y-2} - \frac{2y-3}{y^2-4} = \frac{5}{y+2}$

36. $\frac{x}{x^2+3x-4} + \frac{x+1}{x^2+6x+8} = \frac{2x}{x^2+x-2}$

37. $\frac{2a+7}{8a^2-2a-1} + \frac{a-4}{2a^2+5a-3} = \frac{4a-1}{4a^2+13a+3}$

38. $\frac{y}{y+0.2} - 1.2 = \frac{y-0.2}{y+0.2}$

39. $\frac{x^2}{x^2-4} = \frac{x}{x+2} - \frac{2x}{2-x}$

40. $4a - 3 = \frac{a+13}{a+1}$

41. $\frac{14x-2}{x-3} = \frac{9x+8}{-2}$

42. $\frac{y^2-4}{y+3} = 2 - \frac{y-2}{y+3}$

43. ***Critical Thinking*** Solve the equation $\frac{8}{x} - 4 = \frac{2}{x}$ using any problem-solving strategy.

Challenge

44. Solve. $\frac{n}{n-\frac{4}{9}} - \frac{n}{n+\frac{4}{9}} = \frac{1}{n}$

45. Suppose $t = \frac{x}{y}$ and $r = \frac{w}{z}$. Show that $\frac{xz+yw}{yz-xw} = \frac{t+r}{1-tr}$.

46. Suppose $x = \frac{ab}{a+b}$ and $y = \frac{ab}{a-b}$. Show that $\frac{y^2-x^2}{y^2+x^2} = \frac{2ab}{a^2+b^2}$.

Mixed Review

Multiply or divide and simplify. **47.** $\frac{(x+1)^2}{(x-5)} \cdot \frac{(x-3)}{(x+1)}$

48. $\frac{3x+3}{2} \div \frac{4}{9x+9}$ **49.** $\frac{4a}{3a-3} \cdot \frac{3(a-1)}{16a}$ **50.** $\frac{x+2}{x-1} \div \frac{5x+10}{x-2}$ *10-2, 10-3*

Solve. **51.** $|2x-1| = 5$ **52.** $|x-3| \leq 8$ *9-3, 9-4*

53. $x - 3 < -7$ or $x + 1 > 1$ **54.** $x - 2 < 3$ or $x + 4 > 11$

55. $11 - 8y < 6y + 39$ **56.** $3 - 7x < 9x + 67$ *4-4, 9-2*

57. The difference of two numbers is 4. Five times the larger number is fifteen times the smaller. Find the numbers. *8-6*

Exercises

5. 7
6. $-\frac{1}{6}$
7. 4, −2
8. $\frac{-1}{30}$
9. 0, −1
10. 2, −2
11. $\frac{4}{3}, -\frac{7}{3}$
12. 4
13. $\frac{3}{2}$
14. $\frac{4}{3}, -\frac{4}{3}$
15. $\frac{\frac{x}{4}+\frac{n}{2}}{1-\frac{x}{4}\cdot\frac{n}{2}} \cdot \frac{y2}{y2} = \frac{x2+yn}{y2-xn}$

46. LCM is $(a-b)^2(a+b)^2$.

$$\frac{\left(\frac{ab}{a-b}\right)^2 - \left(\frac{ab}{a+b}\right)^2}{\left(\frac{ab}{a-b}\right)^2 + \left(\frac{ab}{a+b}\right)^2} = \frac{a^2b^2(a+b)^2 - a^2b^2(a-b)^2}{a^2b^2(a+b)^2 + a^2b^2(a-b)^2} = \frac{(a+b)^2-(a-b)^2}{(a+b)^2+(a-b)^2} = \frac{4ab}{2a^2+2b^2} = \frac{2ab}{a^2+b^2}$$

Mixed Review

47. $\frac{(x+1)(x-3)}{x-5}$
48. $\frac{27(x+1)^2}{8}$
49. $\frac{1}{4}$
50. $\frac{x-2}{5(x-1)}$
51. −2, 3
52. $-5 \leq x \leq 11$
53. $x < -4$ or $x > 0$
54. $x < 5$ or $x > 7$
55. $y > -2$
56. $x > -4$
57. 2, 6

TICE/ASSESS

UIZ

can be emptied through either pipes. The first pipe empties k in 4 hours. The second pipe the tank in 3 hours. How long ake to empty the tank using pes?

s

nent Guide

1–16
nsion 17–20
ed Review to maintain skills.

Extra Help On the Web

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

10-7 Exercises

A

Solve.

1. It takes painter A 3 hours to paint a certain area of a house. It takes painter B 5 hours to do the same job. How long would it take them, working together, to do the painting job?
2. By checking work records, a plumber finds that worker A can do a certain job in 12 hours. Worker B can do the same job in 9 hours. How long would it take if they worked together?
3. A tank can be filled in 18 hours by pipe A or in 24 hours by pipe B. How long would it take both pipes to fill the tank?
4. Team A can set up chairs in the gym in 15 minutes and team B can set up the chairs in 20 minutes. How long would it take them, working together, to set up the same chairs?
5. One car travels 40 km/h faster than another. While one travels 150 km, the other goes 350 km. Find their speeds.
6. A person traveled 120 miles in one direction. The return trip was accomplished at double the speed and took 3 hours less time. Find the speed going.
7. The speed of a freight train is 14 km/h slower than the speed of a passenger train. The freight train travels 330 km in the same time that it takes the passenger train to travel 400 km. Find the speed of each train.
8. The reciprocal of 4 plus the reciprocal of 5 is the reciprocal of what number?
9. The sum of half a number and its reciprocal is the same as 51 divided by the number. Find the number.
10. The additive inverse of a number divided by twelve is the same as one less than three times its reciprocal. Find the number.

B

11. Kirsten can type a 50-page paper in 8 hours. Last month Kirsten and Courtney, together, typed a 50-page paper in 6 hours. How long would it take Courtney to type a 50-page paper on her own?
12. Two road crews, working together, repaired 1 mile of a road in 4 hours. Working separately, one of the crews takes about 6 hours to repair a similar road. How long would it take the other crew, working alone, to repair a similar road?
13. One machine in a print shop can produce a certain number of pages twice as fast as another machine. Operating together, these machines can produce this number of pages in 8 minutes. How long would it take each machine, working alone, to produce this number of pages?

Exercises

1. $1\frac{7}{8}$ h
2. $5\frac{1}{7}$ h
3. $10\frac{2}{7}$ h
4. $8\frac{4}{7}$ min
5. 30 km/h, 70 km/h
6. 20 mi/h
7. p: 80 km/h, f: 66 km/h
8. $\frac{20}{9}$, or $2\frac{2}{9}$
9. $\frac{1}{2}x + \frac{1}{x} = \frac{51}{x}$, $x = 10$ or -10
10. $\frac{-x}{12} = \frac{3}{x} - 1$, $x = 6$
11. 24 h
12. 12 h
13. 12 min, 24 min

14. One watering system needs about 3 times as long to complete a job as another watering system. When both systems operate at the same time, the job can be completed in 9 minutes. How long does it take each system to do the job alone?

15. It takes 10 hours to fill a pool with water, and 20 hours to drain it. If the pool is empty and the drain is open, how long will it take to fill the pool?

16. It takes 8 hours to fill a tank with a particular chemical. Without treatment, all of the chemical in the tank would evaporate in 12 hours. If the tank is empty to start, and the chemical is not being treated as it enters the tank, how long will it take to have a full tank?

17. ***Critical Thinking*** In Exercise 16, suppose it takes 9 hours to fill the tank. Without treatment, how long will it take to fill the tank?

Challenge

18. A carpenter can complete a certain job in 5 hours. After working on the job for 2 hours, an assistant helped finish the job. Together they completed the job in 1 hour. How long might it take the assistant, working alone, to complete a job similar to this one?

19. Dr. Wright allowed one hour to reach an appointment 50 miles away. After driving 30 miles she realized that her speed would have to be increased 15 mi/h for the remainder of the trip. What was her speed for the first 30 miles?

20. Together, Michelle, Bernie, and Kurt can do a job in 1 hour and 20 minutes. To do the job alone, Michelle needs twice the time that Bernie needs and two hours more than Kurt. How long would it take each to complete the job working alone?

Mixed Review

Add or subtract. Simplify. **21.** $\frac{5x-2}{x-1}+\frac{3x-1}{x-1}$ **22.** $\frac{x^2+7}{x-3}+\frac{7x+3}{x-3}$

23. $\frac{x^2+6x}{x+4}-\frac{3x+5}{x+4}+\frac{1}{x+4}$ **24.** $\frac{3}{x+1}+\frac{3}{x-1}$ *10-4, 10-5*

Solve. **25.** $m^2-5m=14$ **26.** $9n^2=16$

27. $x^3+3x^2+2x=0$ *6-7*

Solve.

28. On a test of 88 items, a student got 82 correct. What percent of the items were correct?

29. On a test of 88 items, a student got 87.5% of them correct. How many items were correct?

30. On a test, a student got 72 items correct, which was 80% of the total number of items. How many items were on the test? *3-10*

Exercises

14. 12 min, 36 min
15. 20 h
16. 24 h
17. 36 h
18. $2\frac{1}{2}$ h
19. $\frac{30}{r}+\frac{20}{r+15}=1$; 45 mi/h
20. Michelle 6 h, Bernie 3 h, Kurt 4 h

Mixed Review

21. $\frac{(8x-3)}{(x-1)}$
22. $\frac{(x+5)(x+2)}{(x-3)}$
23. $x-1$
24. $\frac{6x}{(x+1)(x-1)}$
25. 7, −2
26. $\frac{4}{3}$, $-\frac{4}{3}$
27. 0, −1, −2
28. about 93%
29. 77
30. 90

ICE/ASSESS

has 5 liters of a certain
iat is 70% salt. How much
uld be added to this solution
new solution that is only

nt Guide
11
on 12, Connection

Review to maintain skills.

Try This

a. A 280 mL solution is 20% salt. How much water should be added to make the solution 14% salt?

b. A grocer wishes to mix some nuts worth 90¢ per pound with some nuts worth \$1.60 per pound to make 175 pounds of a mixture that is worth \$1.30 per pound. How much of each should she use?

Extra Help On the Web

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

10-8 Exercises

A

1. A lab technician has one solution that is 60% chlorinated and another that is 40% chlorinated. How much of each solution is needed to make a 100 L solution that is 50% chlorine?

	Amount of solution	Percent chlorine	Amount of chlorine
1st solution	x	60%	$0.60x$
2nd solution			
Final solution	100		

2. A 50-gallon barrel of milk is 6% butterfat. How much skim milk (no butterfat) should be mixed to make milk that is 3% butterfat?

	Amount (gallons)	Percent butterfat	Amount butterfat (gallons)
Original solution	50		
Skim milk	x		
Final solution			

3. ***Multi-Step Problem*** Solution A is 50% acid and solution B is 80% acid. How much of each should be used to make 100 milliliters of a solution that is 68% acid?

a. Copy the table below. Write labels for the table.

Try This

a. 120 mL
b. 75 lb, 100 lb

Exercises

1.

$100 - x$	40%	$0.40(100 - x)$
	50%	$0.50(100)$

50 L of 60%, 50 L of 40%

2.

	6%	0.06(50)
	0%	0
$50 + x$	3%	$0.03(50 + x)$

50 gal of skim milk

3. a, b, d.

	Amt. of solution	% Acid	Amount of acid
Soln. A	x	50%	$0.50x$
Soln. B	$100 - x$	80%	$0.80(100 - x)$
Final soln.	100	68%	0.68(100)

c. (Percent acid)(Amount solution)

e. $0.50x + 0.80(100 - x) = 0.68(100)$; 40 mL of A, 60 mL of B

b. Let x be the amount of the first solution. Complete the columns that show the amount of solution and the percent of acid.

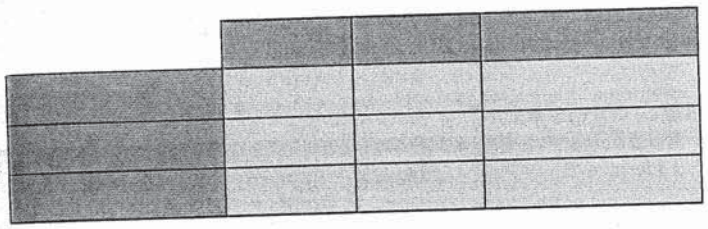
c. To find the *amount* of acid in a solution, what two quantities must be multiplied?

d. Write expressions that show the amount of acid in each solution.

e. Write and solve an equation to answer the problem.

4. ***Multi-Step Problem*** Seminole Dairy Farm has 100 gal of milk that is 4.6% butterfat. How much skim milk (no butterfat) should be mixed with it to make milk that is 3.2% fat?

a. Copy the table below. Write labels for the table.



b. Let x be the amount of skim milk. Complete the columns that show the amount and the percent of butterfat.

c. To find the *amount* of butterfat in a solution, what two quantities must be multiplied?

d. Write expressions that show the amount of butterfat in each solution.

e. Write and solve an equation to answer the problem.

5. A solution containing 30% insecticide is to be mixed with a solution containing 50% insecticide to make 200 L of a solution containing 42% insecticide. How much of each solution should be used?

6. A solution containing 28% fungicide is to be mixed with a solution containing 40% fungicide to make 300 L of a solution containing 36% fungicide. How much of each solution should be used?

7. The Nut Shoppe has 10 kg of mixed cashews and pecans, which sell for \$8.40 per kilogram. Cashews alone sell for \$8 per kilogram, and pecans sell for \$9 per kilogram. How many kilograms of each are in the mix?

8. A coffee shop mixed Brazilian coffee worth \$5 per kilogram with Turkish coffee worth \$8 per kilogram. The mixture is to sell for \$7 per kilogram. How much of each type of coffee should be used to make 300 kg of the mixture?

B

9. Northern Maywood voted 60% to 40% in favor of a water project. Southern Maywood voted 90% to 10% against the project. The project passed 55% to 45%. If 5900 people voted, how many were from Southern Maywood?

Exercises

4. a, b, d.

	Amount (gallons)	Percent butterfat	Amount butterfat (gallons)
Original solution	100	4.6%	0.046(100)
Skim milk	x	0%	0
Final solution	$100 + x$	3.2%	$0.032(100 + x)$

c. (Percent butterfat)(Amount)

e. $0.046(100) = 0.032(100 + x)$; 43.75 gal

5. 80 L of 30%, 120 L of 50%

6. 100 L of 28%, 200 L of 40%

7. 6 kg of cashews, 4 kg of pecans

8. 100 kg of Brazilian coffee
200 kg of Turkish coffee

9. 590 from Southern Maywood

10. An employer has a daily payroll of \$1950 when employing some workers at \$120 per day and others at \$150 per day. When the number of \$120 workers is increased by 50% and the number of \$150 workers is decreased $\frac{1}{5}$, the new daily payroll is \$2400. Find how many workers were originally employed at each rate.

11. ***Critical Thinking*** In Exercise 9, suppose that the project failed 45% to 55%. How many voters were from Southern Maywood?

Challenge

12. Bottle A, containing 12 L of 15% acid, is combined with bottle B, containing 3 L of 25% acid. Bottle C is 26% acid. How much of each solution is needed to have 24 L of a 20% acid solution?

Mixed Review

Solve. **13.** $|x + 3| = 7$ **14.** $|2x - 4| = 16$ **15.** $|4x| - 5 = 19$

16. $8 - |x| > 4$ **17.** $|3x - 4| \leq 13$ **18.** $|5x - 4| + 3 < -19$ *9-3, 9-4*

19. A collection of dimes and quarters is worth \$13.85. There are 83 coins in all. How many are dimes and how many are quarters? *8-6*

Connections: Reasoning

Problem: Aretha needs an antifreeze solution that is 50% alcohol. She has antifreeze that is 40% alcohol and antifreeze that is 60% alcohol. How much of each solution does she need to get 10 liters of the antifreeze that is 50% alcohol?

Solution A	Amount of solution	Percent alcohol	Amount of alcohol
1st antifreeze	x	0.60	
2nd antifreeze	$10 - x$	0.40	
Final solution	10	0.50	

Solution B	Amount of solution	Percent alcohol	Amount of alcohol
1st antifreeze	x	0.60	
2nd antifreeze	y	0.40	
Final solution	10	0.50	

Complete both tables and use the information in them to solve the problem. What mathematical concept is involved in Solution B?

Exercises

10. 10 people at \$120
    5 people at \$150
11. 1770
12. 16 liters of the combined A and B solution and 8 liters of the C solution are needed, but there are only 15 liters of the A-B solution, so it can't be done.

Mixed Review

13. 4, −10
14. 10, −6
15. 6, −6
16. $-4 < x < 4$
17. $-3 \leq x \leq \frac{17}{3}$
18. No solution
19. 46 dimes, 37 quarters

Connections: Reasoning

5 L of each

Solution A:	
	0.60x
	0.40(10 − x)
	0.50(10)

Solution B:	
	0.60x
	0.40y
	0.50(10)

Systems of equations

10-9 Exercises

Extra Help On the Web

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

A

Divide.

1. $\frac{24x^4 - 4x^3 + x^2 - 16}{8}$
2. $\frac{12a^4 - 3a^2 + a - 6}{6}$
3. $\frac{u - 2u^2 - u^5}{u}$
4. $\frac{50x^5 - 7x^4 + x^2}{x}$
5. $\frac{15t^3 + 24t^2 - 6t}{3t}$
6. $\frac{25t^3 + 15t^2 - 30t}{5t}$
7. $\frac{20x^6 - 20x^4 - 5x^2}{-5x^2}$
8. $\frac{24x^6 + 32x^5 - 8x^2}{-8x^2}$
9. $\frac{9r^2s^2 + 3r^2s - 6rs^2}{-3rs}$
10. $\frac{4x^4y - 8x^6y^2 + 12x^8y^6}{4x^4y}$

Divide.

11. $(x^2 + 4x + 4) \div (x + 2)$
12. $(x^2 - 6x + 9) \div (x - 3)$
13. $(x^2 - 10x - 25) \div (x - 5)$
14. $(x^2 + 8x - 16) \div (x + 4)$
15. $(x^2 - 9) \div (x + 3)$
16. $(x^2 - 25) \div (x + 5)$
17. $(x^5 + 1) \div (x + 1)$
18. $(x^5 - 1) \div (x - 1)$
19. $\frac{a^3 + 6a^2 + 12a + 8}{a + 2}$
20. $\frac{x^3 - 4x^2 + x + 6}{x - 2}$
21. $\frac{8x^3 - 22x^2 - 5x + 12}{4x + 3}$
22. $\frac{2x^3 - 9x^2 + 11x - 3}{2x - 3}$
23. $(x^6 - 13x^3 + 42) \div (x^3 - 7)$
24. $(x^6 + 5x^3 - 24) \div (x^3 - 3)$
25. $(x^4 - 16) \div (x - 2)$
26. $(x^4 - 81) \div (x - 3)$
27. $(t^3 - t^2 + t - 1) \div (t - 1)$
28. $(t^3 - t^2 + t - 1) \div (t + 1)$

B

Divide.

29. $(x^4 + 9x^2 + 20) \div (x^2 + 4)$
30. $(y^4 + a^2) \div (y + a)$
31. $(5a^3 + 8a^2 - 23a - 1) \div (5a^2 - 7a - 2)$
32. $(15y^3 - 30y + 7 - 19y^2) \div (3y^2 - 2 - 5y)$
33. $(6x^5 - 13x^3 + 5x + 3 - 4x^2 + 3x^4) \div (3x^3 - 2x - 1)$
34. $(5x^7 - 3x^4 + 2x^2 - 10x + 2) \div (x^2 - x + 1)$
35. $(a^6 - b^6) \div (a - b)$
36. $(x^5 + y^5) \div (x + y)$
37. ***Critical Thinking*** What polynomial has a quotient of $3a^2 + ab - b$ with a remainder of a when divided by $2a^2 - b$?

3. PRACTICE/ASSESS

LESSON QUIZ

1. Divide $\frac{9x^2 + 3x + 12}{3}$.
   $3x^2 + x + 4$
2. Divide $5x^4 + 20x^2 + 15x$ by $x^3 + 4x + 3$
   $5x$
3. Divide $5x^2 - 2x - 3$ by $x - 1$
   $5x + 3$

Assignment Guide

- Core 1–10
- Core 11–38
- Extension 39–42
- The Factor Theorem 1–5

Use Mixed Review to maintai

Exercises

1. $3x^4 - \frac{x^3}{2} + \frac{x^2}{8} - 2$
2. $2a^4 - \frac{a^2}{2} + \frac{a}{6} - 1$
3. $1 - 2u - u^4$
4. $50x^4 - 7x^3 + x$
5. $5t^2 + 8t - 2$
6. $5t^2 + 3t - 6$
7. $-4x^4 + 4x^2 + 1$
8. $-3x^4 - 4x^3 + 1$
9. $-3rs - r + 2s$
10. $1 - 2x^2y + 3x^4y^5$
11. $x + 2$
12. $x - 3$
13. $x - 5 + \frac{-50}{x - 5}$
14. $x + 4 + \frac{-32}{x + 4}$
15. $x - 3$
16. $x - 5$
17. $x^4 - x^3 + x^2 - x + 1$
18. $x^4 + x^3 + x^2 + x + 1$
19. $a^2 + 4a + 4$
20. $x^2 - 2x - 3$
21. $2x^2 - 7x + 4$
22. $x^2 - 3x + 1$
23. $x^3 - 6$
24. $x^3 + 8$
25. $x^3 + 2x^2 + 4x + 8$
26. $x^3 + 3x^2 + 9x + 27$
27. $t^2 + 1$
28. $t^2 - 2t + 3 + \frac{-4}{t + 1}$
29. $x^2 + 5$
30. $y^3 - ay^2 + a^2y - a^3 + \frac{a^2(a^2 + 1)}{y + a}$
31. $a + 3 + \frac{5}{5a^2 - 7a - 2}$
32. $5y + 2 + \frac{-10y + 11}{3y^2 - 5y - 2}$
33. $2x^2 + x - 3$
34. $5x^5 + 5x^4 - 8x^2 - 8x + 2$
35. $a^5 + a^4b + a^3b^2 + a^2b^3 +$
36. $x^4 - x^3y + x^2y^2 - xy^3 +$
37. $6a^4 + 2a^3b - 5a^2b - ab^2 +$

Challenge

38. Divide $6a^{3h} + 13a^{2h} - 4a^h - 15$ by $2a^h + 3$.

If the remainder is 0 when one polynomial is divided by another, then the divisor is a factor of the dividend. Find the value(s) of c for which $x - 1$ is a factor of each polynomial.

39. $x^2 + 4x + c$ **40.** $2x^2 + 3cx - 8$ **41.** $c^2x^2 - 2cx + 1$

42. One factor of $x^3 + 2x^2 - x - 2$ is $x + 2$. Find two other factors of this polynomial.

Mixed Review

Find the least common multiple (LCM). **43.** $6(y - 1), 9 - 9y$ *10-5*

Add or subtract. Simplify. **44.** $\frac{(x + y)}{x^2y} + \frac{(x + y)}{xy^2}$ **45.** $\frac{4}{7m} + \frac{1}{14m}$

46. $\frac{2}{x + 2} - \frac{3}{x - 2}$ **47.** $\frac{7}{x^2 - 9} - \frac{4}{2x - 6}$ **48.** $\frac{(x - 3)}{2x - 1} - \frac{4(x + 1)}{1 - 2x}$ *10-5*

Solve. **49.** $x - \frac{3}{x} = 2$ **50.** $\frac{x - 3}{x + 2} = \frac{1}{2}$ **51.** $\frac{x + 2}{4} - \frac{x - 3}{3} = 1$ *10-6*

California Topic

CA 24.0: Use and know simple aspects of a logical argument.

The Factor Theorem

If a polynomial such as $ax^2 + bx + c$ is divided by $x - d$ to get a quotient Q and a remainder R, then $ax^2 + bx + c = (x - d)Q + R$. When x has the value d, $(x - d)Q + R = (d - d)Q + R = (0)Q + R = R$. So when x has the value d, $ax^2 + bx + c = R$.

When x has the value d and the remainder is 0, $ax^2 + bx + c = 0$. This means that d is a root of the polynomial.

When x has the value d and the remainder is 0, $x - d$ divides $ax^2 + bx + c$ evenly. This means that $x - d$ is a factor of $ax^2 + bx + c$.

Therefore, $x - d$ is a factor of a polynomial whenever d is a root of the polynomial.

The statement we have just proved is known as the **factor theorem.**

Exercises

Factor the polynomial and use the factors to find its roots.

1. $x^2 - 9x + 8$ **2.** $x^2 + 11x + 28$ **3.** $x^2 - 2x - 15$

Evaluate the polynomial for each given value of x to find which values are roots. Use the roots to find the factors of the polynomial.

4. $2, -1, -2; x^2 - x - 2$ **5.** $\frac{7}{2}, \frac{5}{2}, \frac{3}{2}; 4x^2 - 20x + 21$

Exercises

38. $3a^{2h} + 2a^h - 5$
39. -5
40. 2
41. 1
42. $(x + 1)(x - 1)$

Mixed Review

43. $-18(y - 1)$ or $18(y - 1)$
44. $\frac{(x + y)^2}{x^2y^2}$
45. $\frac{9}{14m}$
46. $\frac{-1(x + 10)}{(x + 2)(x - 2)}$
47. $\frac{-1(2x - 1)}{(x + 3)(x - 3)}$
48. $\frac{(5x + 1)}{(2x - 1)}$
49. $-1, 3$
50. 8
51. 6

The Factor Theorem

1. $(x - 8)(x - 1)$; 8, 1
2. $(x + 4)(x + 7)$; $-4, -7$
3. $(x - 5)(x + 3)$; 5, -3
4. 0, 0, 4; roots: 2, -1; factors: $(x - 2)$, $(x + 1)$
5. 0, -4, 0; roots: $\frac{7}{2}, \frac{3}{2}$; factors: $(x - \frac{7}{2})$, $(x - \frac{3}{2})$

ment Guide
1–27
nsion 28–30

xed Review to maintain skills.

You can also simplify complex rational expressions by replacing a division by a product of the reciprocal. This method is particularly useful when the numerator and denominator are quotients.

EXAMPLE 3

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

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

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

$$= \frac{2 \cdot 2(x - y)}{(x + y)(x - y)2}$$

$$= \frac{2}{x + y}$$

Try This Simplify.

a. $\dfrac{\frac{x}{2} + \frac{x}{3}}{\frac{1}{2}}$ **b.** $\dfrac{1 + \frac{1}{x}}{1 - \frac{1}{x^2}}$ **c.** $\dfrac{\frac{3}{(t + 2)(2t - 1)}}{\frac{t}{t + 2}}$

Extra Help On the Web

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

10-10 Exercises

A

Simplify.

1. $\dfrac{\frac{2}{7} + \frac{3}{7}}{\frac{3}{4}}$ **2.** $\dfrac{3 + \frac{5}{2}}{\frac{5}{4}}$ **3.** $\dfrac{1 + \frac{2}{x}}{\frac{3}{4}}$

4. $\dfrac{3 + \frac{x}{2}}{\frac{5}{4}}$ **5.** $\dfrac{1 + \frac{9}{16}}{1 - \frac{3}{4}}$ **6.** $\dfrac{\frac{5}{27} - 5}{\frac{1}{3} + 1}$

7. $\dfrac{\frac{1}{x} + 3}{\frac{1}{x} - 5}$ **8.** $\dfrac{\frac{3}{a}}{\frac{1}{a} - \frac{1}{3a}}$ **9.** $\dfrac{\frac{7}{y}}{\frac{1}{4} + \frac{2}{y}}$

10. $\dfrac{\frac{c}{d} + 3}{4 + \frac{c}{d}}$ **11.** $\dfrac{\frac{3}{s} + s}{\frac{s}{3} + s}$ **12.** $\dfrac{\frac{2}{y} + \frac{1}{2y}}{y + \frac{y}{2}}$

Try This

a. $\frac{5x}{3}$
b. $\frac{x}{x - 1}$
c. $\frac{3}{t(2t - 1)}$

Exercises

1. $\frac{20}{21}$
2. $\frac{22}{5}$
3. $\frac{4(x + 2)}{3x}$
4. $\frac{12 + 2x}{5}$
5. $\frac{25}{4}$
6. $\frac{-65}{18}$
7. $\frac{1 + 3x}{1 - 5x}$
8. $\frac{9}{2}$
9. $\frac{28}{y + 8}$
10. $\frac{c + 3d}{4d + c}$
11. $\frac{9 + 3s^2}{4s^2}$
12. $\frac{5}{3y^2}$

13. $\dfrac{4 - \frac{1}{x^2}}{2 - \frac{1}{x}}$

14. $\dfrac{\frac{1}{xy}}{\frac{1}{x} + \frac{1}{y}}$

15. $\dfrac{\frac{2}{a+b}}{\frac{4}{a^2 - b^2}}$

16. $\dfrac{\frac{p}{q} + \frac{q}{r}}{\frac{r}{s} + \frac{s}{t}}$

17. $\dfrac{\frac{x}{y} - \frac{y}{x}}{\frac{1}{y} + \frac{1}{x}}$

18. $\dfrac{\frac{1}{a} - \frac{1}{2}}{a - 2}$

19. $\dfrac{\frac{a}{(a+b)(2a+1)}}{\frac{b}{(a+b)}}$

20. $\dfrac{\frac{m}{(m-n)(m+n)}}{\frac{n+1}{(m+n)^2}}$

21. $\dfrac{\frac{x}{x-y}}{\frac{x^2}{x^2 - y^2}}$

22. $\dfrac{\frac{a}{b} + \frac{b}{c}}{\frac{c}{d} + \frac{d}{e}}$

23. $\dfrac{\frac{g}{2f} + \frac{g+2}{f+1}}{\frac{g^2}{f+1} + \frac{2g+3}{f}}$

24. $\dfrac{\frac{x+1}{x+2} + \frac{1}{x}}{\frac{x}{x+2} + \frac{1}{x^2}}$

B

Simplify.

25. $\dfrac{1 + \frac{a}{b-a}}{\frac{a}{a+b} - 1}$

26. $\dfrac{\frac{a}{b} + \frac{c}{d}}{\frac{b}{a} + \frac{d}{c}}$

27. $\dfrac{\frac{a}{b} - \frac{c}{d}}{\frac{b}{a} - \frac{d}{c}}$

28. ***Critical Thinking*** What values of a are unacceptable because they would make a denominator 0 in this fraction?

$$\dfrac{\frac{2a-4}{a+1}}{\frac{a+2}{a-2}}$$

Challenge

Solve.

29. $\dfrac{\frac{2a+3}{a+1}}{\frac{a-2}{a+1}} = 12$

30. $\dfrac{\frac{x+1}{x-1} + 1}{\frac{x+1}{x-1} - 1} = 10$

Mixed Review

Calculate and simplify. 31. $\dfrac{4x+5}{x+5} - \dfrac{x+11}{x+5}$ 32. $\dfrac{5}{y+2} + \dfrac{5}{y-2}$

33. $\dfrac{m^2}{m-5} + \dfrac{25}{5-m}$ 34. $\dfrac{2}{x+1} + \dfrac{5}{2x}$ 35. $\dfrac{x-1}{x} - \dfrac{3x+5}{2x}$ *10-4, 10-5*

Solve. 36. $\dfrac{5}{x+1} = \dfrac{4}{x-1}$ 37. $\dfrac{x}{4} - \dfrac{x}{6} = \dfrac{1}{4}$ 38. $\dfrac{x-2}{3x} = \dfrac{1}{4}$ *10-6*

39. Find two numbers whose sum is -13 and whose difference is 21. *8-6*

Exercises

13. $\dfrac{2x+1}{x}$

14. $\dfrac{1}{y+x}$

15. $\dfrac{a-b}{2}$

16. $\dfrac{st(pr+q^2)}{qr(rt+s^2)}$

17. $x - y$

18. $-\dfrac{1}{2a}$

19. $\dfrac{a}{b(2a+1)}$

20. $\dfrac{m(m+n)}{(n+1)(m-n)}$

21. $\dfrac{x+y}{x}$

22. $\dfrac{de(ac+b^2)}{bc(ce+d^2)}$

23. $\dfrac{4f+3fg+g}{2(fg^2+2fg+3f+2g+3)}$

24. $\dfrac{x(x^2+2x+2)}{x^3+x+2}$

25. $\dfrac{a+b}{a-b}$

26. $\dfrac{ac}{bd}$

27. $\dfrac{-ac}{bd}$

28. $-1, \pm 2$

29. $\dfrac{27}{10}$

30. 10

Mixed Review

31. $\dfrac{3(x-2)}{(x+5)}$

32. $\dfrac{10y}{(y+2)(y-2)}$

33. $(m+5)$

34. $\dfrac{(9x+5)}{2x(x+1)}$

35. $\dfrac{-1(x+7)}{2x}$

36. 9

37. 3

38. 8

39. $-17, 4$

CTICE/ASSESS

UIZ

roperty guarantees that
$+ c = a + (b + c)$?
tive property
roperty guarantees that
$+ c = c + (a + b)$?
utative property of addition

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stributive property
vision theorem
ansitive property of equality

$\cdot \frac{1}{c}$ and $\frac{b}{c} = b \cdot \frac{1}{c}$	Div. thm.
$= a \cdot \frac{1}{c} - b \cdot \frac{1}{c}$	Subst.
$= (a - b)\frac{1}{c}$	Distrib.
$= \frac{a-b}{c}$	Div. thm.
$= \frac{a-b}{c}$	Trans. prop.

$\frac{1}{\frac{a}{b}} = \frac{b}{a}$.

$\frac{1 \cdot b}{\frac{a}{b} \cdot b}$	Mult. identity; $\frac{b}{b} = 1$
$\frac{b}{\cdot b}$	Mult. identity
$\frac{b}{a \cdot \frac{1}{b}) \cdot b}$	Division theorem
$\frac{b}{\left(\frac{1}{b} \cdot b\right)}$	Associative property
$\frac{b}{(1)}$	Definition of reciprocal
	Mult. identity
$\frac{b}{a}$	Transitive property of equality

Extra Help On the Web

Look for worked-out examples at the Prentice Hall Web site.
www.phschool.com

Practice Multiple Choice

Choose the best answer.

1. One groundskeeper mows the athletic fields in 7 hours. Another groundskeeper on a smaller mower takes 12 hours. If they both mow, how many hours does it take to mow the fields?

A 19 h
B $4\frac{8}{19}$ h
C 9.5 h
D $5\frac{3}{19}$ h

2. Water is added to 5 L of a 60% solution to make a 25% solution. How much water must be added?

F 3 L
G 37%
H 3.7 L
J 7 L

1. B; Algebra 15.0
2. J; Algebra 15.0

10-11 Exercises

A

1. Complete the proof of the following theorem by supplying the reasons. For any numbers a, b, and any nonzero number c,

$$\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}.$$

(a) $\frac{a}{c} = a \cdot \frac{1}{c}$ and $\frac{b}{c} = b \cdot \frac{1}{c}$	(a) Division theorem
(b) $\frac{a}{c} + \frac{b}{c} = a \cdot \frac{1}{c} + b \cdot \frac{1}{c}$	(b) Substituting $a \cdot \frac{1}{c}$ for $\frac{a}{c}$ and $b \cdot \frac{1}{c}$ for $\frac{b}{c}$
(c) $= (a + b)\frac{1}{c}$	(c)
(d) $= \frac{a+b}{c}$	(d)
(e) $\frac{a}{c} + \frac{b}{c} = \frac{a+b}{c}$	(e)

2. Write a proof of the following theorem. For any numbers a, b, and any nonzero number c,

$$\frac{a}{c} - \frac{b}{c} = \frac{a-b}{c}$$

(Hint: Use Exercise 1 as a model for your proof.)

3. Prove that if $\frac{a}{b}$ is any nonzero rational number, then its reciprocal is $\frac{b}{a}$. (Hint: Show that $\frac{b}{a}$ satisfies the definition of reciprocal.)

4. Prove the property of proportion:

if $\frac{a}{b} = \frac{c}{d}$, then $ad = bc$.

Mixed Review

Simplify. **5.** $(2w)^5$ **6.** $\frac{a^2b^3}{ab^2c}$ **7.** $(y^9)^9$ **8.** $(-3m^5)^4$ *5-3*

Factor. **9.** $81c^2 - 16$ **10.** $5x^2 + 5x - 30$ **11.** $2x^2 + 3x - 5$ *6-2, 6-5*

12. $6x^2 + 25x + 4$ **13.** $6x^2 + 11x + 3$ **14.** $10x^2 + 23x + 12$

Solve. **15.** $\frac{x}{7} - \frac{7}{x} = 0$ **16.** $x - \frac{4}{x} = 0$ **17.** $\frac{a+3}{2a+2} = \frac{2}{3}$ *10-6*

18. $3x + y = 8$, $5x - y = 8$ **19.** $2x + 5y = 3$, $5x - 2y = -7$ *8-1, 8-2, 8-3*

4. If $\frac{a}{b} = \frac{c}{d}$, show $ad = bc$.

1. $\frac{a}{b}(bd) = \frac{c}{d}(bd)$	1. Multiplication property of equality
2. $\left(a \cdot \frac{1}{b}\right)(bd) = \left(c \cdot \frac{1}{d}\right)(bd)$	2. Division Theorem
3. $\left(a \cdot \frac{1}{b}\right)(bd) = \left(c \cdot \frac{1}{d}\right)(db)$	3. Commutative property
4. $a\left(\frac{1}{b} \cdot b\right)d = c\left(\frac{1}{d} \cdot d\right)b$	4. Associative property
5. $a \cdot 1 \cdot d = c \cdot 1 \cdot b$	5. Definition of Reciprocal
6. $ad = cb$	6. Mult. identity

Mixed Review

5. $32w^5$
6. $\frac{ab}{c}$
7. y^{81}
8. $81m^{20}$
9. $(9c + 4)(9c - 4)$
10. $5(x + 3)(x - 2)$
11. $(2x + 5)(x - 1)$
12. $(x + 4)(6x + 1)$
13. $(3x + 1)(2x + 3)$
14. $(2x + 3)(5x + 4)$
15. 7, −7
16. 2, −2
17. 5
18. (2, 2)
19. (−1, 1)

10 Chapter Wrap Up

10-1

A **rational expression** is in **simplest form** when the only common factor of the numerator and denominator is 1 or -1. To simplify a rational expression, factor the numerator and the denominator, and find common factors that simplify to 1.

Simplify.

1. $\frac{3x + 9}{3x}$
2. $\frac{6y^2 + 3y}{3y^2 + 6y}$
3. $\frac{3x - 3}{3x + 6}$
4. $\frac{3c + 5d}{25d^2 - 9c^2}$

10-2

To multiply two rational expressions, multiply the numerators and multiply the denominators.

Multiply. Simplify the product.

5. $\frac{9y^2}{5y^2} \cdot \frac{(y - 3)}{3}$
6. $\frac{2x}{x + 1} \cdot \frac{x + 1}{4x}$
7. $\frac{7(m - 2)}{5m} \cdot \frac{4m^2}{m - 2}$

10-3

To divide rational expressions, multiply the first expression by the reciprocal of the divisor.

Divide and simplify.

8. $\frac{3x + 3}{3} \div \frac{x + 1}{6}$
9. $\frac{y + 2}{y - 3} \div \frac{y + 2}{y + 1}$
10. $\frac{y + 3}{y^2 - 9} \div \frac{y - 3}{y^2 - 5y + 6}$
11. $\frac{b - 2}{b^2 + b} \div \frac{b^2 - 4}{b + 1}$
12. $\frac{4x - 6}{5} \div \frac{6x - 9}{25}$
13. $\frac{x^2 - y^2}{xy^2} \div \frac{xy + y^2}{x}$

10-4, 10-5

To add or subtract rational expressions, first determine the least common denominator and if necessary rewrite each expression as an equivalent expression with the LCD. Add or subtract the numerators, and write the sum or difference over the denominator.

Add or subtract. Simplify.

14. $\frac{3x^2 + 2x - 5}{5x + 1} + \frac{2x^2 - x + 6}{5x + 1}$
15. $\frac{5b}{2 + b} - \frac{b - 3}{2 + b}$
16. $\frac{3a}{3a} + \frac{-1}{a}$
17. $\frac{2a}{a + 1} + \frac{4a}{a^2 - 1}$
18. $\frac{3}{3x - 9} + \frac{x - 2}{3 - x}$
19. $\frac{3x - 1}{2x} - \frac{x - 1}{x}$
20. $\frac{15}{b^2 - 4} - \frac{7}{b - 2}$
21. $\frac{1}{x^2 - 25} - \frac{x - 5}{x^2 - 4x - 5}$

Key Terms

complex rational expression (p. 469)
Division Theorem (p. 472)
extraneous solution (p. 452)
Factor Theorem (p. 468)
least common multiple (LCM) (p. 446)
rational equation (p. 451)
rational expression (p. 432)
Reciprocal Theorem (p. 472)
simplest form of a rational expression (p. 433)

Chapter 10 Wrap Up

1. $\frac{x + 3}{x}$
2. $\frac{2y + 1}{y + 2}$
3. $\frac{x - 1}{x + 2}$
4. $\frac{1}{5d - 3c}$
5. $\frac{3(y - 3)}{5}$
6. $\frac{1}{2}$
7. $\frac{28m}{5}$
8. 6
9. $\frac{y + 1}{y - 3}$
10. $\frac{y - 2}{y - 3}$
11. $\frac{1}{b(b + 2)}$
12. $\frac{10}{3}$
13. $\frac{x - y}{y^3}$
14. $\frac{5x^2 + x + 1}{5x + 1}$
15. $\frac{4b + 3}{2 + b}$
16. $\frac{a - 1}{a}$
17. $\frac{2a}{a - 1}$
18. -1
19. $\frac{x + 1}{2x}$
20. $\frac{-7b + 1}{(b + 2)(b - 2)}$
21. $\frac{-x^2 + x + 26}{(x - 5)(x + 5)(x + 1)}$

Internet Activity On the Web

Look for extension problems for this chapter at the Prentice Hall Web site.
www.phschool.com

10-6

To solve an equation with rational expressions, first multiply both sides of the equation by the **LCM** of all the denominators.

Solve.

22. $\frac{3}{y} - \frac{1}{4} = \frac{1}{y}$

23. $\frac{15}{x} - \frac{15}{x+2} = 2$

24. $\frac{4x}{3} - \frac{2x-1}{5} = \frac{x+3}{2}$

25. $\frac{5}{x} + x = -6$

26. $\frac{x}{x-1} - \frac{2}{1-x^2} = \frac{8}{x+1}$

10-7

If a job requires n hours, then $\frac{1}{n}$ of the job can be done in 1 hour. You can use this principle to write an equation to solve work problems.

27. In checking records a contractor finds that crew A can pave a certain length of highway in 9 hours. Crew B can do the same job in 12 hours. How long would it take if both crews worked together?

The formula $d = r \cdot t$ or $t = \frac{d}{r}$ can be used to make a table and write an equation for solving motion problems.

28. A lab is testing two high-speed trains. One train travels 40 km/h faster than the other train. While one train travels 70 km, the other travels 60 km. Find their speeds.

10-8

29. Solution A is 30% alcohol and solution B is 60% alcohol. How much of each is needed to make 80 liters of a solution that is 45% alcohol?

10-9

To divide a polynomial by a monomial, divide each term by that monomial. To divide a polynomial by another polynomial, use the long division method.

Divide.

30. $\frac{12y^3 + 8y - 3}{3}$

31. $(2x^2 + 3x - 20) \div (x + 4)$

10-10

To simplify a complex rational expression, multiply both the numerator and the denominator by the LCM of all denominators in the complex expression.

Simplify.

32. $\dfrac{\frac{1}{x} + 1}{\frac{1}{x^2} - 1}$

33. $\dfrac{x + \frac{3}{y}}{x - \frac{2}{y^2}}$

Chapter 10 Wrap Up

22. 8
23. (−5, 3)
24. 3
25. (−1, −5)
26. (5, 2)
27. $5\frac{1}{7}$ hours
28. 240 km/h, 280 km/h
29. 40 liters of each
30. $4y^3 + \frac{8}{3}y - 1$
31. $2x - 5$
32. $\frac{x}{1-x}$
33. $\frac{y(xy+3)}{xy^2-2}$

10 Chapter Assessment

Simplify.

1. $\frac{5y + 15}{10}$
2. $\frac{14y^2 + 7y}{49y^2 + 14y}$
3. $\frac{4x^2 - 8xy + 4y^2}{3x - 3y}$

Multiply. Simplify the product.

4. $\frac{2x + 3y}{5} \cdot \frac{10}{4x + 6y}$
5. $\frac{25 - x^2}{12} \cdot \frac{6}{5 - x}$
6. $\frac{x^2 + x}{x^2} \cdot \frac{3x - 3}{x^2 - 1}$

Divide and simplify.

7. $\frac{4x - 6}{5} \div \frac{6x - 9}{25}$
8. $\frac{2x + x^2}{4x - 5} \div \frac{4x^2 + 2x^3}{16x - 20}$

Add or subtract. Simplify.

9. $\frac{16 + x}{x^3} + \frac{7 - 4x}{x^3}$
10. $\frac{5 - t}{t^2 + 1} - \frac{t - 3}{t^2 + 1}$
11. $\frac{x - 5}{x^2 - 1} + \frac{5}{x^2 - 1}$

Add or subtract. Simplify.

12. $\frac{x - 4}{x - 3} + \frac{x - 1}{3 - x}$
13. $\frac{5}{t - 1} + \frac{3}{t}$
14. $\frac{1}{x^2 - 16} - \frac{x + 4}{x^2 - 3x - 4}$
15. $\frac{6}{9 - a^2} - \frac{3}{12 + 4a}$
16. $\frac{4}{x^2 - 1} - \frac{2}{x^2 - 2x + 1}$
17. $\frac{3}{2a + 18} + \frac{27}{a^2 - 81}$

Solve.

18. $\frac{7}{y} - \frac{1}{3} = \frac{1}{4}$
19. $\frac{15}{x} - \frac{15}{x - 2} = -2$

20. Solution A is 25% acid and Solution B is 40% acid. How much of each is needed to make 60 liters of a solution that is 30% acid?

21. Mrs. Crowley has a stack of letters to be typed. If she can type all of the letters in 6 hours and Mr. Crowley can type all of the letters in 9 hours, how long will it take them if they work together?

Divide.

22. $(12x^4 + 9x^3 - 15x^2) \div 3x^2$
23. $\frac{6x^3 - 8x^2 - 14x + 13}{3x + 2}$

Simplify.

24. $\frac{\frac{1}{14y} - \frac{1}{2y^2}}{\frac{1}{7} - \frac{6}{7y} - \frac{1}{y^2}}$
25. $\frac{25 - \frac{9}{x^2}}{5 + \frac{3}{x}}$

Assessment Item Analysis

Item	Lesson
1–3	10-1
4–6	10-2
7, 8	10-3
9–11	10-4
12–17	10-5
18, 19	10-6
20	10-8
21	10-7
22, 23	10-9
24, 25	10-10

Chapter 10 Assessment

1. $\frac{y + 3}{2}$
2. $\frac{2y + 1}{7y + 2}$
3. $\frac{4(x - y)}{3}$
4. 1
5. $\frac{5 + x}{2}$
6. $\frac{3}{x}$
7. $\frac{10}{3}$
8. $\frac{2}{x}$
9. $\frac{23 - 3x}{x^3}$
10. $\frac{8 - 2t}{t^2 + 1}$
11. $\frac{x}{x^2 - 1}$
12. $\frac{-3}{x - 3}$
13. $\frac{8t - 3}{t(t - 1)}$
14. $\frac{-x^2 - 7x - 15}{(x - 4)(x + 4)(x + 1)}$
15. $\frac{3(5 + a)}{4(3 - a)(3 + a)}$
16. $\frac{2(x - 3)}{(x + 1)(x - 1)^2}$
17. $\frac{3}{2(a - 9)}$
18. 12
19. 5, −3
20. 40 liters of A; 20 liters of B
21. $3\frac{3}{5}$ hours
22. $4x^2 + 3x - 5$
23. $2x^2 - 4x - 2 + \frac{17}{3x + 2}$
24. $\frac{1}{2(y + 1)}$
25. $\frac{5x - 3}{x}$