6.2 Exercise Set

FOR EXTRA HELP

Concept Reinforcement *Classify each of the following statements as either true or false.*

1. A common denominator is required in order to add or subtract rational expressions. True
2. To find the least common denominator, we find the least common multiple of the denominators. True
3. It is rarely necessary to factor in order to find a common denominator. False
4. The sum of two rational expressions is the sum of the numerators over the sum of the denominators. False
5. The least common multiple of two expressions is always the product of those two expressions. False
6. To add two rational expressions, it is often necessary to multiply at least one of those expressions by a form of 1. True
7. After two rational expressions are added, it is unnecessary to simplify the result. False
8. Parentheses are particularly important when we are subtracting rational expressions. True

Perform the indicated operations. Simplify when possible.

9. $\frac{4}{3a} + \frac{11}{3a}$ $\frac{5}{a}$
10. $\frac{2}{5n} + \frac{8}{5n}$ $\frac{2}{n}$
11. $\frac{5}{3m^2n^2} - \frac{4}{3m^2n^2}$ $\frac{1}{3m^2n^2}$
12. $\frac{1}{4a^2b} - \frac{5}{4a^2b}$ $-\frac{1}{a^2b}$
13. $\frac{x-3y}{x+y} + \frac{x+5y}{x+y}$ 2
14. $\frac{a-5b}{a+b} + \frac{a+7b}{a+b}$ 2
15. $\frac{3t+2}{t-4} - \frac{t-2}{t-4}$ $\frac{2t+4}{t-4}$
16. $\frac{4y+2}{y-2} - \frac{y-3}{y-2}$ $\frac{3y+5}{y-2}$
17. $\frac{5-7x}{x^2-3x-10} + \frac{8x-3}{x^2-3x-10}$ $\frac{1}{x-5}$
18. $\frac{4-2x}{x^2-9} + \frac{3x-1}{x^2-9}$ $\frac{1}{x-3}$
19. $\frac{a-2}{a^2-25} - \frac{2a-7}{a^2-25}$ $\frac{-1}{a+5}$
20. $\frac{5a-4}{a^2-6a-7} - \frac{6a-11}{a^2-6a-7}$ $\frac{-1}{a+1}$

⊡ Answers to Exercises 21–24, 35, and 36 are on p. IA-14.

Find simplified form for $f(x)$ and list all restrictions on the domain.

21. $f(x) = \frac{2x+1}{x^2+6x+5} + \frac{x-2}{x^2+6x+5}$ ⊡
22. $f(x) = \frac{x-6}{x^2-4x+3} + \frac{5x-1}{x^2-4x+3}$ ⊡
23. $f(x) = \frac{x-4}{x^2-1} - \frac{2x+1}{x^2-1}$ ⊡
24. $f(x) = \frac{3x+11}{x^2-4} - \frac{2x-8}{x^2-4}$ ⊡

Find the least common multiple of each pair of polynomials.

25. $8x^2$, $12x^5$ $24x^5$
26. $15y$, $18y^3$ $90y^3$
27. x^2-9, x^2-6x+9 $(x+3)(x-3)^2$
28. x^2-x-12, x^2-16 $(x+3)(x-4)(x+4)$

Perform the indicated operations. Simplify when possible.

29. $\frac{2}{15x^2} + \frac{3}{5x}$ $\frac{9x+2}{15x^2}$
30. $\frac{8}{9y} - \frac{5}{18y^2}$ $\frac{16y-5}{18y^2}$
31. $\frac{y+1}{y-2} - \frac{y-1}{2y-4}$ $\frac{y+3}{2(y-2)}$
32. $\frac{x-3}{2x+6} + \frac{x+2}{x+3}$ $\frac{3x+1}{2(x+3)}$
33. $\frac{4xy}{x^2-y^2} + \frac{x-y}{x+y}$ $\frac{x+y}{x-y}$
34. $\frac{5ab}{a^2-b^2} + \frac{a+b}{a-b}$ $\frac{a^2+7ab+b^2}{(a+b)(a-b)}$
35. $\frac{8}{2x^2-7x+5} + \frac{3x+2}{2x^2-x-10}$ ⊡
36. $\frac{3y+2}{y^2+5y-24} + \frac{7}{y^2+4y-32}$ ⊡
37. $\frac{5ab}{a^2-b^2} - \frac{a-b}{a+b}$ $\frac{-a^2+7ab-b^2}{(a-b)(a+b)}$
38. $\frac{6xy}{x^2-y^2} - \frac{x+y}{x-y}$ $\frac{-x^2+4xy-y^2}{(x+y)(x-y)}$
39. $\frac{x}{x^2+9x+20} - \frac{4}{x^2+7x+12}$ $\frac{x-5}{(x+5)(x+3)}$
40. $\frac{x}{x^2+11x+30} - \frac{5}{x^2+9x+20}$ $\frac{x-6}{(x+6)(x+4)}$

41. $\frac{3}{t} - \frac{6}{-t}$ $\frac{9}{t}$

42. $\frac{8}{p} - \frac{7}{-p}$ $\frac{15}{p}$

43. $\frac{s^2}{r-s} + \frac{r^2}{s-r}$ $-(s+r)$

44. $\frac{a^2}{a-b} + \frac{b^2}{b-a}$ $a+b$

45. $\frac{a+2}{a-4} + \frac{a-2}{a+3}$ $\frac{2a^2-a+14}{(a-4)(a+3)}$

46. $\frac{a+3}{a-5} + \frac{a-2}{a+4}$ $\frac{2a^2+22}{(a-5)(a+4)}$

47. $4 + \frac{x-3}{x+1}$ $\frac{5x+1}{x+1}$

48. $3 + \frac{y+2}{y-5}$ $\frac{4y-13}{y-5}$

49. $\frac{x+6}{5x+10} - \frac{x-2}{4x+8}$ $\frac{-x+34}{20(x+2)}$

50. $\frac{a+3}{5a+25} - \frac{a-1}{3a+15}$ $\frac{-2a+14}{15(a+5)}$

51. $\frac{4}{x+1} + \frac{x+2}{x^2-1} + \frac{3}{x-1}$ $\frac{8x+1}{(x+1)(x-1)}$

52. $\frac{-2}{y+2} + \frac{5}{y-2} + \frac{y+3}{y^2-4}$ $\frac{4y+17}{(y+2)(y-2)}$

53. $\frac{y-4}{y^2-25} - \frac{9-2y}{25-y^2}$ $-\frac{1}{y+5}$

54. $\frac{x-7}{x^2-16} - \frac{x-1}{16-x^2}$ $\frac{2}{x+4}$

55. $\frac{y^2-5}{y^4-81} + \frac{4}{81-y^4}$ $\frac{1}{y^2+9}$

56. $\frac{t^2+3}{t^4-16} + \frac{7}{16-t^4}$ $\frac{1}{t^2+4}$

57. $\frac{r-6s}{r^3-s^3} - \frac{5s}{s^3-r^3}$ $\frac{1}{r^2+rs+s^2}$

58. $\frac{m-3n}{m^3-n^3} - \frac{2n}{n^3-m^3}$ $\frac{1}{m^2+mn+n^2}$

59. $\frac{3y}{y^2-7y+10} - \frac{2y}{y^2-8y+15}$ $\frac{y}{(y-2)(y-3)}$

60. $\frac{5x}{x^2-6x+8} - \frac{3x}{x^2-x-12}$ $\frac{2x^2+21x}{(x-4)(x-2)(x+3)}$

61. $\frac{2x+1}{x-y} + \frac{5x^2-5xy}{x^2-2xy+y^2}$ $\frac{7x+1}{x-y}$

62. $\frac{2-3a}{a-b} + \frac{3a^2+3ab}{a^2-b^2}$ $\frac{2}{a-b}$

63. $\frac{2y-6}{y^2-9} - \frac{y}{y-1} + \frac{y^2+2}{y^2+2y-3}$ $\frac{-y}{(y+3)(y-1)}$

64. $\frac{x-1}{x^2-1} - \frac{x}{x-2} + \frac{x^2+2}{x^2-x-2}$ 0

⊡ Answers to Exercises 69–72 are on p. IA-14.

Aha!

65. $\frac{5y}{1-4y^2} - \frac{2y}{2y+1} + \frac{5y}{4y^2-1}$ $-\frac{2y}{2y+1}$

66. $\frac{4x}{x^2-1} + \frac{3x}{1-x} - \frac{4}{x-1}$ $\frac{-3x^2-3x-4}{(x+1)(x-1)}$

Find simplified form for $f(x)$ and list all restrictions on the domain.

67. $f(x) = 2 + \frac{x}{x-3} - \frac{18}{x^2-9}$ $f(x) = \frac{3(x+4)}{x+3}$, $x \neq -3, 3$

68. $f(x) = 5 + \frac{x}{x+2} - \frac{8}{x^2-4}$ $f(x) = \frac{2(3x-7)}{x-2}$, $x \neq -2, 2$

69. $f(x) = \frac{3x-1}{x^2+2x-3} - \frac{x+4}{x^2-16}$ ⊡

70. $f(x) = \frac{3x-2}{x^2+2x-24} - \frac{x-3}{x^2-9}$ ⊡

71. $f(x) = \frac{1}{x^2+5x+6} - \frac{2}{x^2+3x+2} - \frac{1}{x^2+5x+6}$ ⊡

72. $f(x) = \frac{2}{x^2-5x+6} - \frac{4}{x^2-2x-3} + \frac{2}{x^2+4x+3}$ ⊡

TW **73.** Badar found that the sum of two rational expressions was $(3-x)/(x-5)$. The answer given at the back of the book is $(x-3)/(5-x)$. Is Badar's answer incorrect? Why or why not?

TW **74.** When two rational expressions are added or subtracted, should the numerator of the result be factored? Why or why not?

SKILL REVIEW

To prepare for Section 6.3, review negative exponents and multiplying using the distributive law (Sections 1.3 and 1.4).

Simplify. Use only positive exponents in your answer. [1.4]

75. $2x^{-1}$ $\frac{2}{x}$

76. $4x^{-2}$ $\frac{4}{x^2}$

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

78. $3p^2(3-p)^{-1}$ $\frac{3p^2}{3-p}$

Multiply and simplify. [1.3], [1.4]

79. $9x^3\left(\frac{1}{x^2} - \frac{2}{3x^3}\right)$ $9x-6$

80. $8a^2b^5\left(\frac{3}{8ab^2} + \frac{a}{4b^5}\right)$ $3ab^3+2a^3$

SYNTHESIS

TW **81.** Many students make the mistake of always multiplying denominators when looking for a common denominator. Use Example 7 to explain why this approach can yield results that are more difficult to simplify.

TW **82.** Is the sum of two rational expressions always a rational expression? Why or why not?

83. *Prescription Drugs.* After visiting her doctor, Jinney went to the pharmacy for a two-week supply of Zyrtec®, a 20-day supply of Albuterol, and a 30-day supply of Pepcid®. Jinney refills each prescription as soon as her supply runs out. How long will it be until she can refill all three prescriptions on the same day? 420 days

84. *Astronomy.* Earth, Jupiter, Saturn, and Uranus all revolve around the sun. Earth takes 1 year, Jupiter 12 years, Saturn 30 years, and Uranus 84 years. How frequently do these four planets line up with each other? Every 420 yr

85. *Music.* To duplicate a common African polyrhythm, a drummer needs to play sextuplets (6 beats per measure) on a tom-tom while simultaneously playing quarter notes (4 beats per measure) on a bass drum. Into how many equally sized parts must a measure be divided, in order to precisely execute this rhythm? 12 parts

86. *Appliances.* Dishwashers last an average of 9 years, garbage disposals an average of 12 years, and gas ranges an average of 15 years. If an apartment house is equipped with new dishwashers, garbage disposals, and gas ranges in 2012, in what year will all three appliances need to be replaced at once? 2192
Source: National Association of Home Builders/Bank of America Home Equity Study of Life Expectancy of Home Components

Find the LCM.

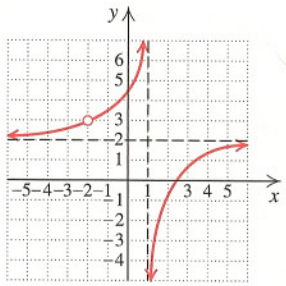
87. $x^8 - x^4,\ x^5 - x^2,\ x^5 - x^3,\ x^5 + x^2$
$x^4(x^2 + 1)(x + 1)(x - 1)(x^2 + x + 1)(x^2 - x + 1)$

88. $2a^3 + 2a^2b + 2ab^2,\ a^6 - b^6,$
$2b^2 + ab - 3a^2,\ 2a^2b + 4ab^2 + 2b^3$ ⊡

89. The LCM of two expressions is $8a^4b^7$. One of the expressions is $2a^3b^7$. List all the possibilities for the other expression.
$8a^4, 8a^4b, 8a^4b^2, 8a^4b^3, 8a^4b^4, 8a^4b^5, 8a^4b^6, 8a^4b^7$

⊡ Answers to Exercises 88, 90–96, 98, 99, and 104–107 are on p. IA-14.

90. Determine the domain and the range of the function graphed here. ⊡



If $f(x) = \dfrac{x^3}{x^2 - 4}$ *and* $g(x) = \dfrac{x^2}{x^2 + 3x - 10}$,

find each of the following.

91. $(f + g)(x)$ ⊡ **92.** $(f - g)(x)$ ⊡

93. $(f \cdot g)(x)$ ⊡ **94.** $(f/g)(x)$ ⊡

95. The domain of $f + g$ ⊡ **96.** The domain of f/g ⊡

Perform the indicated operations and simplify.

97. $x^{-2} + 2x^{-1}$ $\dfrac{2x + 1}{x^2}$ **98.** $a^{-3}b - ab^{-3}$ ⊡

99. $5(x - 3)^{-1} + 4(x + 3)^{-1} - 2(x + 3)^{-2}$ ⊡

100. $4(y - 1)(2y - 5)^{-1} + 5(2y + 3)(5 - 2y)^{-1} + (y - 4)(2y - 5)^{-1}$ $\dfrac{5y + 23}{5 - 2y}$

101. $\dfrac{x + 4}{6x^2 - 20x} \cdot \left(\dfrac{x}{x^2 - x - 20} + \dfrac{2}{x + 4}\right)$ $\dfrac{1}{2x(x - 5)}$

102. $\dfrac{x^2 - 7x + 12}{x^2 - x - 29/3} \cdot \left(\dfrac{3x + 2}{x^2 + 5x - 24} + \dfrac{7}{x^2 + 4x - 32}\right)$
3

103. $\dfrac{x + 8}{2t^2 - 10t + 12} \div \left(\dfrac{2t}{t^2 - 8t + 15} - \dfrac{3t}{t^2 - 7t + 10}\right)$ $8t^5$

104. $\dfrac{9t^3}{3t^3 - 12t^2 + 9t} \div \left(\dfrac{t + 4}{t^2 - 9} - \dfrac{3t - 1}{t^2 + 2t - 3}\right)$ ⊡ $-4t^4$

Use algebra and a graphing calculator to determine the domain and estimate the range of each function.

105. $f(x) = 2 + \dfrac{x - 3}{x + 1}$ ⊡

106. $g(x) = \dfrac{2}{(x + 1)^2} + 5$ ⊡

107. $r(x) = \dfrac{1}{x^2} + \dfrac{1}{(x - 1)^2}$ ⊡

Try Exercise Answers: Section 6.2

9. $\dfrac{5}{a}$ **17.** $\dfrac{1}{x - 5}$ **23.** $f(x) = \dfrac{-x - 5}{x^2 - 1}, x \neq -1, 1$
25. $24x^5$ **29.** $\dfrac{9x + 2}{15x^2}$ **33.** $\dfrac{x + y}{x - y}$ **39.** $\dfrac{x - 5}{(x + 5)(x + 3)}$
41. $\dfrac{9}{t}$ **43.** $-(s + r)$ **67.** $f(x) = \dfrac{3(x + 4)}{x + 3}, x \neq -3, 3$