Quick Check 4 Add.

a. $\frac{5}{t+4} + \frac{3}{t-1}$ **b.** $\frac{m}{2m+1} + \frac{3}{m-1}$ **c.** $\frac{-2}{a+2} + \frac{3a}{2a-1}$

You can combine rational expressions to investigate real-world situations.

5 EXAMPLE **Real-World Problem Solving**

Air Travel The ground speed for jet traffic from Los Angeles to New York City can be about 15% faster than the ground speed from New York City to Los Angeles. This difference is due to a strong westerly wind at high altitudes. If r is a jet's ground speed from New York City to Los Angeles, write and simplify an expression for the round-trip air time. The two cities are about 2500 miles apart.

NYC to LA time: $\frac{2500}{r}$ time $= \frac{\text{distance}}{\text{rate}}$

LA to NYC time: $\frac{2500}{1.15r}$ time $= \frac{\text{distance}}{\text{rate}}$ **15% more than a number is 115% of the number.**

An expression for the total time is $\frac{2500}{r} + \frac{2500}{1.15r}$.

$\frac{2500}{r} + \frac{2500}{1.15r} = \frac{2875}{1.15r} + \frac{2500}{1.15r}$ **Rewrite using the LCD, 1.15r.**

$= \frac{5375}{1.15r}$ **Add the numerators.**

$\approx \frac{4674}{r}$ **Simplify.**

Quick Check 5 **Air Travel** The distance between Atlanta, Georgia, and Albuquerque, New Mexico, is about 1270 miles. The ground speed for jet traffic from Atlanta to Albuquerque can be about 12% faster than the ground speed from Albuquerque to Atlanta. Use r for a jet's ground speed. Write and simplify an expression for the round-trip air time.

EXERCISES

For more exercises, see *Extra Skill and Word Problem Practice.*

Practice and Problem Solving

A Practice by Example

Example 1 (page 687)

Example 2 (page 687)

Example 3 (page 688)

GO for Help

Add or subtract.

1. $\frac{5}{2m} + \frac{4}{2m}$
2. $\frac{4}{6t-1} + \frac{3}{6t-1}$
3. $\frac{n}{n+3} + \frac{2}{n+3}$
4. $\frac{5}{c-5} + \frac{9}{c-5}$
5. $\frac{s^2+3}{4s^2+2} + \frac{s^2-2}{4s^2+2}$
6. $\frac{5c}{2c+7} + \frac{c-28}{2c+7}$
7. $\frac{1}{2-b} - \frac{4}{2-b}$
8. $\frac{5}{t^2+1} - \frac{6}{t^2+1}$
9. $\frac{3t}{2t-3} - \frac{5t}{2t-3}$
10. $\frac{2y+1}{y-1} - \frac{y+2}{y-1}$
11. $\frac{3n+2}{n+4} - \frac{n-6}{n+4}$
12. $\frac{3}{b-3} - \frac{b}{b-3}$

Find the LCD of each pair of expressions.

13. $\frac{1}{2}; \frac{4}{x^2}$
14. $\frac{b}{6}; \frac{2b}{9}$
15. $\frac{1}{z}; \frac{3}{7z}$
16. $\frac{8}{5b}; \frac{12}{7b^3c}$

Add or subtract.

17. $\frac{7}{3a} + \frac{2}{5}$
18. $\frac{4}{x} - \frac{2}{3}$
19. $\frac{6}{5x^8} + \frac{4}{3x^6}$
20. $\frac{3}{8m^3} + \frac{1}{12m^2}$
21. $\frac{27}{n^3} - \frac{9}{7n^2}$
22. $\frac{9}{4x^2} + \frac{9}{5}$

Example 4 (page 688)

Add.

23. $\frac{9}{m+2} + \frac{8}{m-7}$
24. $\frac{a}{a+3} + \frac{4}{a+5}$
25. $\frac{a}{a+3} + \frac{a+5}{4}$
26. $\frac{c}{c+5} + \frac{4}{c+3}$
27. $\frac{5}{t^2} + \frac{4}{t+1}$
28. $\frac{3}{2a+1} + \frac{6}{2a-1}$

Example 5 (page 689)

29. **Exercise** Jane walks one mile from her house to her grandparents' house. Then she returns home, walking with her grandfather. Her return rate is 70% of her normal walking rate. Let r represent her normal walking rate.
   a. Write an expression for the amount of time Jane spends walking.
   b. Simplify your expression.
   c. Suppose Jane's normal walking rate is 3 mi/h. About how much time does she spend walking?

B Apply Your Skills

Add or subtract.

30. $\frac{y^2+2y-1}{3y+1} - \frac{2y^2-3}{3y+1}$
31. $\frac{h^2+1}{2t^2-7} + \frac{h}{2t^2-7}$
32. $\frac{r-5}{9+p^3} - \frac{2k+1}{9+p^3}$
33. $\frac{2-x}{xy^2z} - \frac{5+z}{xy^2z}$
34. $\frac{k}{2m^2} + \frac{3k}{2m}$
35. $\frac{12}{ab} - \frac{15}{bc}$
36. $\frac{c^2}{ab} - \frac{a^2}{bc}$
37. $9 + \frac{x-3}{x+2}$
38. $\frac{t}{2t-3} - 11$
39. $\frac{x}{x^2-9} - \frac{x}{x^2+6x+9}$
40. $\frac{k-24}{k^2-3k-18} - \frac{3}{k+3} + \frac{k+1}{k-6}$

41. **Error Analysis** A student wrote that $\frac{2}{x+3} + \frac{3}{x+1} = \frac{5}{2x+4}$. What error did the student make?

Real-World Connection

Dragon boat racing has become popular in North American cities in recent years.

42. **Rowing** A rowing team practices rowing 2 mi upstream and 2 mi downstream. The team can row downstream 25% faster than they can row upstream.
   a. Let r represent their rate upstream. Write and simplify an expression for the amount of time they spend rowing.
   b. Let d represent their rate downstream. Write and simplify an expression for the amount of time they spend rowing.
   c. Critical Thinking Do the expressions you wrote in parts (a) and (b) represent the same time? Explain.

43. **Writing** When adding or subtracting rational expressions, will the answer be in simplest form if you use the LCD? Explain.

44. **Open-Ended** Write two rational expressions with different denominators. Find the LCD and add the two expressions.

For $f(x) = 8x$, $g(x) = \frac{1}{x}$, and $h(x) = \frac{4}{x-5}$, perform the indicated operation.

Samples

$$f(x) + g(x) = 8x + \frac{1}{x} = \frac{8x}{1}\left(\frac{x}{x}\right) + \frac{1}{x} = \frac{8x^2}{x} + \frac{1}{x} = \frac{8x^2+1}{x}$$

$$f(x) \div g(x) = 8x \div \frac{1}{x} = 8x\left(\frac{x}{1}\right) = 8x^2$$

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45. $f(x) - g(x)$
46. $f(x) \cdot g(x)$
47. $g(x) - h(x)$
48. $f(x) \cdot h(x)$
49. $g(x) \div h(x)$
50. $h(x) \div f(x)$

C Challenge

Simplify each expression.

51. $\frac{7d-2}{d^2+2d-8} - \frac{4}{d+4} - \frac{d}{d-2}$
52. $\frac{7x-10}{x^3+x^2-10x} - \frac{1}{x+5}$
53. $\frac{x^2}{x^2+x-12} - \frac{x}{x+4} \cdot \frac{3}{x-3}$
54. $\frac{2}{a-5} \cdot \frac{a-1}{a+2} - \frac{a-2}{2+a} \cdot \frac{3}{5-a}$

Test Prep

Multiple Choice

55. Subtract $\frac{2x}{3x-2}$ from $\frac{5x}{3x-2}$.

A. -2 B. $\frac{-3x}{3x-2}$ C. $\frac{7x}{3x-2}$ D. $\frac{3x}{3x-2}$

56. What is the least common denominator of $\frac{x}{x^2-1}$ and $\frac{-2}{x-1}$?

F. $x+1$ G. $x-1$ H. x^2-1 J. $(x^2-1)(x-1)$

57. A band director found that he could line up the musicians in the brass section in rows of 4, 5, or 8. What is the least number of brass players in the band?

A. 16 players B. 24 players C. 32 players D. 40 players

Short Response

58. The members of a bicycle club rode a 20-mile round-trip route. On the way back, they had a tail wind and averaged 3 mi/h faster than on the first 10 miles of the trip.

a. Use r for the rate. Write an expression for the total ride time. Simplify the expression.

b. Suppose the bicyclists averaged a rate of 12 mi/h for the first half of the ride. How long did the round trip take? Show your work.

Mixed Review

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Lesson 12-4 **Divide.**

59. $(2x^4 + 8x^3 - 4x^2) \div 4x^2$ 60. $(10b + 5b^3) \div (b + 2)$

Lesson 11-3 **Solve each radical equation. Check your answers. If there is no solution, write *no solution.***

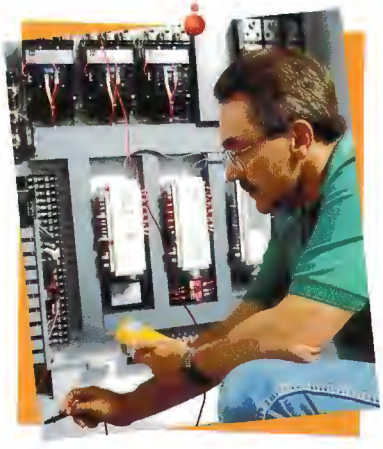
61. $x = \sqrt{5x + 6}$ 62. $n = \sqrt{24 - 5n}$ 63. $\sqrt{16y} = -8$

Lesson 10-3 **Solve each equation by finding square roots. Round to the nearest tenth. If the equation has no solution, write *no solution.***

64. $a^2 - 48 = 0$ 65. $2n^2 = 30$ 66. $3p^2 + 60 = 0$

Algebra at Work

Electrician



More than half a million men and women work as electricians. All are highly skilled technicians licensed by the states in which they work. Electricians use formulas containing rational expressions. For example, when a circuit connected in parallel contains two resistors with resistances R_1 and R_2 ohms, the total resistance R_T (in ohms) of the circuit can be found using the formula $\frac{1}{R_T} = \frac{1}{R_1} + \frac{1}{R_2}$.

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