

95. (d)  $t(x) = \frac{10}{5-x} + \frac{10}{5+x}$

$$6\frac{1}{4} = \frac{10}{5-x} + \frac{10}{5+x}$$

$$4(5-x)(5+x)\left(\frac{25}{4}\right) = \left(\frac{10}{5-x} + \frac{10}{5+x}\right)4(5-x)(5+x)$$

$$25(25-x^2) = 40(5+x) + 40(5-x)$$

$$625 - 25x^2 = 200 + 40x + 200 - 40x$$

$$0 = 25x^2 - 225$$

$$0 = x^2 - 9$$

$$x = 3 \text{ miles per hour}$$

(e)  $t(x) = \frac{10}{5-4} + \frac{10}{5+4}$

$$t(x) = 10 + \frac{10}{9} = \frac{90}{9} + \frac{10}{9} = \frac{100}{9}$$

$$t(x) = 11\frac{1}{9} \text{ or } 11.1 \text{ hours}$$

Yes

97. Solve a rational equation by multiplying both sides of the equation by the lowest common denominator. Then solve the resulting equation, checking for any extraneous solutions.

99. (a) Simplify each side by removing symbols of grouping, combining like terms, and reducing fractions on one or both sides.

(b) Add (or subtract) the same quantity to (from) both sides of the equation.

(c) Multiply (or divide) both sides of the equation by the same nonzero real number.

(d) Interchange the two sides of the equation.

101. When the equation involves only two fractions, one on each side of the equation, the equation can be solved by cross-multiplication.

## Review Exercises for Chapter 4

1.  $(2^3 \cdot 3^2)^{-1} = (8 \cdot 9)^{-1}$

$$= 72^{-1}$$

$$= \frac{1}{72}$$

3.  $\left(\frac{2}{5}\right)^{-3} = \left(\frac{5}{2}\right)^3$

$$= \frac{125}{8}$$

5.  $(6 \times 10^3)^2 = 6^2 \times 10^6$

$$= 36 \times 10^6$$

$$= 36,000,000$$

7.  $\frac{3.5 \times 10^7}{7 \times 10^4} = \frac{3.5}{7} \times 10^{7-4}$

$$= 0.5 \times 10^3$$

$$= 5 \times 10^2$$

$$= 500$$

9.  $0.0000538 = 5.38 \times 10^{-5}$

11.  $4.833 \times 10^8 = 483,300,000$

13.  $(6y^4)(2y^{-3}) = 12y^{4+(-3)}$

$$= 12y^1$$

$$= 12y$$

15.  $\frac{4x^{-2}}{2x} = 2x^{-2-1}$

$$= 2x^{-3}$$

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

17.  $(x^3y^{-4})^2 = x^6y^{-8}$

$$= \frac{x^6}{y^8}$$

$$\begin{aligned}
 19. \frac{t^{-5}}{t^{-2}} &= t^{(-5)-(-2)} \\
 &= t^{-5+2} \\
 &= t^{-3} \\
 &= \frac{1}{t^3}
 \end{aligned}$$

$$\begin{aligned}
 21. \left(\frac{y}{3}\right)^{-3} &= \left(\frac{3}{y}\right)^3 \\
 &= \frac{27}{y^3}
 \end{aligned}$$

$$\begin{aligned}
 23. y - 8 &\neq 0 \\
 y &\neq 8 \\
 D &= (-\infty, 8) \cup (8, \infty)
 \end{aligned}$$

$$\begin{aligned}
 25. u^2 - 7u + 6 &\neq 0 \\
 (u - 6)(u - 1) &\neq 0 \\
 u &\neq 6, \quad u \neq 1 \\
 D &= (-\infty, 1) \cup (1, 6) \cup (6, \infty)
 \end{aligned}$$

$$\begin{aligned}
 27. \frac{6x^4y^2}{15xy^2} &= \frac{2 \cdot 3x \cdot x^3 \cdot y^2}{5 \cdot 3x \cdot y^2} \\
 &= \frac{2x^3}{5}, \quad x \neq 0, y \neq 0
 \end{aligned}$$

$$\begin{aligned}
 29. \frac{5b - 15}{30b - 120} &= \frac{5(b - 3)}{30(b - 4)} \\
 &= \frac{5(b - 3)}{5 \cdot 6(b - 4)} \\
 &= \frac{b - 3}{6(b - 4)}
 \end{aligned}$$

$$\begin{aligned}
 31. \frac{9x - 9y}{y - x} &= \frac{9(x - y)}{-1(x - y)} \\
 &= -9, \quad x \neq y
 \end{aligned}$$

$$\begin{aligned}
 33. \frac{x^2 - 5x}{2x^2 - 50} &= \frac{x(x - 5)}{2(x^2 - 25)} \\
 &= \frac{x(x - 5)}{2(x - 5)(x + 5)} \\
 &= \frac{x}{2(x + 5)}, \quad x \neq 5
 \end{aligned}$$

$$\begin{aligned}
 35. 3x(x^2y)^2 &= 3x(x^4y^2) \\
 &= 3x^5y^2
 \end{aligned}$$

$$37. \frac{24x^4}{15x} = \frac{8x^3}{5}$$

$$\begin{aligned}
 39. \frac{7}{8} \cdot \frac{2x}{y} \cdot \frac{y^2}{14x^2} &= \frac{7 \cdot 2 \cdot x \cdot y \cdot y}{2 \cdot 2 \cdot 2 \cdot y \cdot 7 \cdot 2 \cdot x \cdot x} \\
 &= \frac{y}{8x}, \quad y \neq 0
 \end{aligned}$$

$$\begin{aligned}
 41. \frac{60z}{z + 6} \cdot \frac{z^2 - 36}{5} &= \frac{5 \cdot 12z(z - 6)(z + 6)}{(z + 6)5} \\
 &= 12z(z - 6), \quad z \neq -6
 \end{aligned}$$

$$\begin{aligned}
 43. \frac{u}{u - 3} \cdot \frac{3u - u^2}{4u^2} &= \frac{u}{u - 3} \cdot \frac{-u(u - 3)}{4u^2} \\
 &= -\frac{1}{4}, \quad u \neq 0, u \neq 3
 \end{aligned}$$

$$\begin{aligned}
 45. \frac{6/x}{2/x^3} &= \frac{6}{x} \div \frac{2}{x^3} \\
 &= \frac{3 \cdot 2}{x} \cdot \frac{x \cdot x^2}{2} \\
 &= 3x^2, \quad x \neq 0
 \end{aligned}$$

$$\begin{aligned}
 47. 25y^2 \div \frac{xy}{5} &= 25y \cdot y \cdot \frac{5}{xy} \\
 &= \frac{125y}{x}, \quad y \neq 0
 \end{aligned}$$

$$\begin{aligned}
 49. \frac{x^2 - 7x}{x + 1} \div \frac{x^2 - 14x + 49}{x^2 - 1} &= \frac{x(x - 7)}{x + 1} \cdot \frac{(x - 1)(x + 1)}{(x - 7)(x - 7)} \\
 &= \frac{x(x - 1)}{x - 7}, \quad x \neq -1, x \neq 1
 \end{aligned}$$

$$\begin{aligned}
 51. \frac{\left(\frac{6x^2}{x^2+2x-35}\right)}{\left(\frac{x^3}{x^2-25}\right)} &= \frac{6x^2}{(x+7)(x-5)} \cdot \frac{(x+7)(x-5)(x+5)}{x^3} \\
 &= \frac{6x^2(x+5)}{x^3(x+7)} \\
 &= \frac{6(x+5)}{x(x+7)}, \quad x \neq 5, x \neq -5
 \end{aligned}$$

$$53. \frac{4}{9} - \frac{11}{9} = \frac{4-11}{9} = -\frac{7}{9}$$

$$\begin{aligned}
 55. \frac{15}{16} - \frac{5}{24} - 1 &= \frac{15(3)}{16(3)} - \frac{5(2)}{24(2)} - \frac{1(48)}{1(48)} \\
 &= \frac{45-10-48}{48} \\
 &= -\frac{13}{48}
 \end{aligned}$$

$$\begin{aligned}
 57. \frac{1}{x+5} + \frac{3}{x-12} &= \frac{1}{x+5} \left(\frac{x-12}{x-12}\right) + \frac{3}{x-12} \left(\frac{x+5}{x+5}\right) \\
 &= \frac{x-12}{(x+5)(x-12)} + \frac{3(x+5)}{(x-12)(x+5)} \\
 &= \frac{x-12+3x+15}{(x+5)(x-12)} \\
 &= \frac{4x+3}{(x+5)(x-12)}
 \end{aligned}$$

$$\begin{aligned}
 59. 5x + \frac{2}{x-3} - \frac{3}{x+2} &= \frac{5x(x-3)(x+2)}{(x-3)(x+2)} + \frac{2}{(x-3)(x+2)} \left(\frac{x+2}{x+2}\right) - \frac{3}{(x+2)(x-3)} \left(\frac{x-3}{x-3}\right) \\
 &= \frac{5x^3 - 5x^2 - 30x + 2x + 4 - 3x + 9}{(x-3)(x+2)} \\
 &= \frac{5x^3 - 5x^2 - 31x + 13}{(x-3)(x+2)}
 \end{aligned}$$

$$\begin{aligned}
 61. \frac{6}{x} - \frac{6x+1}{x^2+4} &= \frac{6(x^2+4)}{x(x^2+4)} - \frac{6x-1(x)}{x^2+4(x)} \\
 &= \frac{6x^2+24-6x^2+x}{x(x^2+4)} \\
 &= \frac{24+x}{x(x^2+4)}
 \end{aligned}$$

$$\begin{aligned}
 63. \frac{5}{x+3} - \frac{4x}{(x+3)^2} - \frac{1}{x-3} &= \frac{5}{x+3} \left(\frac{(x+3)(x-3)}{(x+3)(x-3)}\right) - \frac{4x}{(x+3)^2} \left(\frac{x-3}{x-3}\right) - \frac{1}{x-3} \left(\frac{(x+3)^2}{(x+3)^2}\right) \\
 &= \frac{5x^2 - 45 - 4x^2 + 12x - x^2 - 6x - 9}{(x+3)^2(x-3)} \\
 &= \frac{6x-54}{(x+3)^2(x-3)}
 \end{aligned}$$



$$\begin{array}{r}
 x^2 - x - 3 + \frac{-3x^2 + 2x + 3}{x^3 - 2x^2 + x - 1} \\
 79. \quad x^3 - 2x^2 + x - 1 \overline{)x^5 - 3x^4 + 0x^3 + x^2 + 0x + 6} \\
 \underline{x^5 - 2x^4 + x^3 - x^2} \phantom{+ 0x + 6} \\
 -x^4 - x^3 + 2x^2 + 0x \phantom{+ 6} \\
 \underline{-x^4 + 2x^3 - x^2 + x} \phantom{+ 6} \\
 -3x^3 + 3x^2 - x + 6 \\
 \underline{-3x^3 + 6x^2 - 3x + 3} \\
 -3x^2 + 2x + 3
 \end{array}$$

$$81. \frac{x^3 + 7x^2 + 3x - 14}{x + 2} = x^2 + 5x - 7, x \neq -2$$

$$\begin{array}{r}
 -2 \overline{) \begin{array}{cccc} 1 & 7 & 3 & -14 \\ & -2 & -10 & 14 \\ \hline 1 & 5 & -7 & 0 \end{array}}
 \end{array}$$

$$85. \frac{3x}{8} = -15 + \frac{x}{4}$$

$$8\left(\frac{3x}{8}\right) = (-15)8 + \left(\frac{x}{4}\right)8$$

$$3x = -120 + 2x$$

$$x = -120$$

**Check:**

$$\frac{3(-120)}{8} \stackrel{?}{=} -15 + \frac{-120}{4}$$

$$\frac{-360}{8} \stackrel{?}{=} -15 + -30$$

$$-45 = -45$$

$$83. (x^4 - 3x^2 - 25) \div (x - 3)$$

$$= x^3 + 3x^2 + 6x + 18 + \frac{29}{x - 3}$$

$$\begin{array}{r}
 3 \overline{) \begin{array}{cccccc} 1 & 0 & -3 & 0 & -25 \\ & 3 & 9 & 18 & 54 \\ \hline 1 & 3 & 6 & 18 & 29 \end{array}}
 \end{array}$$

$$87. (3t)\left(8 - \frac{12}{t}\right) = \frac{1}{3}(3t)$$

$$24t - 36 = t$$

$$23t = 36$$

$$t = \frac{36}{23}$$

**Check:**

$$8 - \frac{12}{\left(\frac{36}{23}\right)} \stackrel{?}{=} \frac{1}{3}$$

$$8 - \frac{23}{3} \stackrel{?}{=} \frac{1}{3}$$

$$\frac{24}{3} - \frac{23}{3} \stackrel{?}{=} \frac{1}{3}$$

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

$$89. \frac{2}{y} - \frac{1}{3y} = \frac{1}{3}$$

$$3y\left(\frac{2}{y} - \frac{1}{3y}\right) = \left(\frac{1}{3}\right)3y$$

$$6 - 1 = y$$

$$5 = y$$

**Check:**

$$\frac{2}{5} - \frac{1}{3(5)} \stackrel{?}{=} \frac{1}{3}$$

$$\frac{2}{5} - \frac{1}{15} \stackrel{?}{=} \frac{1}{3}$$

$$\frac{6}{15} - \frac{1}{15} \stackrel{?}{=} \frac{1}{3}$$

$$\frac{5}{15} \stackrel{?}{=} \frac{1}{3}$$

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

**91.**

$$r = 2 + \frac{24}{r}$$

$$r(r) = \left(2 + \frac{24}{r}\right)r$$

$$r^2 = 2r + 24$$

$$r^2 - 2r - 24 = 0$$

$$(r - 6)(r + 4) = 0$$

$$r = 6, r = -4$$

**Check:**

$$6 \stackrel{?}{=} 2 + \frac{24}{6}$$

$$6 \stackrel{?}{=} 2 + 4$$

$$6 = 6$$

**Check:**

$$-4 \stackrel{?}{=} 2 + \frac{24}{-4}$$

$$-4 \stackrel{?}{=} 2 - 6$$

$$-4 = -4$$

$$93. \quad 8\left(\frac{6}{x} - \frac{1}{x+5}\right) = 15$$

$$\left(\frac{6}{x} - \frac{1}{x+5}\right) = \frac{15}{8}$$

$$8x(x+5)\left(\frac{6}{x} - \frac{1}{x+5}\right) = \left(\frac{15}{8}\right)8x(x+5)$$

$$48(x+5) - 8x = 15x(x+5)$$

$$48x + 240 - 8x = 15x^2 + 75x$$

$$240 + 40x = 15x^2 + 75x$$

$$0 = 15x^2 + 35x - 240$$

$$0 = 5(3x^2 + 7x - 48)$$

$$0 = 5(3x + 16)(x - 3)$$

$$3x + 16 = 0 \quad x - 3 = 0$$

$$3x = -16 \quad x = 3$$

$$x = -\frac{16}{3}$$

**Check:**

$$8\left(\frac{6}{-\frac{16}{3}} - \frac{1}{-\frac{16}{3} + 5}\right) \stackrel{?}{=} 15$$

$$8\left(-\frac{18}{16} - \frac{1}{-\frac{16}{3} + \frac{15}{3}}\right) \stackrel{?}{=} 15$$

$$8\left(-\frac{9}{8} - \frac{1}{-\frac{1}{3}}\right) \stackrel{?}{=} 15$$

$$8\left(-\frac{9}{8} + 3\right) \stackrel{?}{=} 15$$

$$8\left(-\frac{9}{8} + \frac{24}{8}\right) \stackrel{?}{=} 15$$

$$8\left(\frac{15}{8}\right) \stackrel{?}{=} 15$$

$$15 = 15$$

**Check:**

$$8\left(\frac{6}{3} - \frac{1}{3+5}\right) \stackrel{?}{=} 15$$

$$8\left(2 - \frac{1}{8}\right) \stackrel{?}{=} 15$$

$$8\left(\frac{16}{8} - \frac{1}{8}\right) \stackrel{?}{=} 15$$

$$8\left(\frac{15}{8}\right) \stackrel{?}{=} 15$$

$$15 = 15$$

$$95. \quad \frac{4x}{x-5} + \frac{2}{x} = -\frac{4}{x-5}$$

$$(x-5)\left(\frac{4x}{x-5} + \frac{2}{x}\right) = \left(-\frac{4}{x-5}\right)x(x-5)$$

$$4x^2 + 2(x-5) = -4x$$

$$4x^2 + 2x - 10 + 4x = 0$$

$$4x^2 + 6x - 10 = 0$$

$$2x^2 + 3x - 5 = 0$$

$$(2x+5)(x-1) = 0$$

$$x = -\frac{5}{2}, x = 1$$

**Check:**

$$\frac{4\left(-\frac{5}{2}\right)}{\left(-\frac{5}{2}\right) - 5} + \frac{2}{\left(-\frac{5}{2}\right)} \stackrel{?}{=} -\frac{4}{\left(-\frac{5}{2}\right) - 5}$$

$$\frac{-10}{-\frac{15}{2}} - \frac{4}{5} \stackrel{?}{=} -\frac{4}{-\frac{15}{2}}$$

$$\frac{20}{15} - \frac{12}{15} \stackrel{?}{=} \frac{8}{15}$$

$$\frac{8}{15} = \frac{8}{15}$$

**Check:**

$$\frac{4(1)}{1-5} + \frac{2}{1} \stackrel{?}{=} -\frac{4}{1-5}$$

$$\frac{4}{-4} + 2 \stackrel{?}{=} -\frac{4}{-4}$$

$$1 = 1$$

$$97. \quad \frac{12}{x^2+x-12} - \frac{1}{x-3} = -1$$

$$(x-3)(x+4)\left(\frac{12}{x^2+x-12} - \frac{1}{x-3}\right) = (-1)(x-3)(x+4)$$

$$12 - (x+4) = -1(x^2+x-12)$$

$$12 - x - 4 = -x^2 - x + 12$$

$$(x^2 - 4) = 0$$

$$(x-2)(x+2) = 0$$

$$x-2 = 0$$

$$x = 2$$

$$x+2 = 0$$

$$x = -2$$

$$99. \quad \frac{5}{x^2 - 4} - \frac{6}{x - 2} = -5$$

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

$$5 - 6(x + 2) = -5(x^2 - 4)$$

$$5 - 6x - 12 = -5x^2 + 20$$

$$5x^2 - 6x - 27 = 0$$

$$(5x + 9)(x - 3) = 0$$

$$5x + 9 = 0 \qquad x - 3 = 0$$

$$x = -\frac{9}{5} \qquad x = 3$$

101. Keystrokes:

 $\boxed{Y=}$   $\boxed{1}$   $\boxed{\div}$   $\boxed{X,T,\theta}$   $\boxed{-}$   $\boxed{1}$   $\boxed{\div}$   $\boxed{C}$   $\boxed{2}$   $\boxed{X,T,\theta}$   $\boxed{+}$   $\boxed{3}$   $\boxed{)}$   $\boxed{\text{GRAPH}}$ 

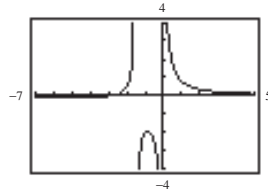
 x-intercepts:  $x = -3$ 

$$0 = \frac{1}{x} - \frac{1}{2x - 3}$$

$$0 = 2x + 3 - x$$

$$0 = x + 3$$

$$-3 = x$$


 103. Domain:  $(0, 6]$ 

$$P = 2 \left( w + \frac{36}{w} \right), \quad w \neq 0$$

105. Verbal Model:

$$\boxed{\text{Distance}} = \boxed{\text{Rate}} \cdot \boxed{\text{Time}}$$

$$\frac{\boxed{\text{Original trip distance}}}{\boxed{\text{Rate}}} = \frac{\boxed{\text{Return trip distance}}}{\boxed{\text{Rate}}} + \frac{1}{6}$$

 Labels: Rate of original trip =  $x$ 

 Rate of return trip =  $x + 8$ 

Equation: 
$$\frac{56}{x} = \frac{56}{x + 8} + \frac{1}{6}$$

$$6x(x + 8) \left( \frac{56}{x} \right) = \left( \frac{56}{x + 8} + \frac{1}{6} \right) 6x(x + 8)$$

$$336(x + 8) = 336x + x(x + 8)$$

$$336x + 2688 = 336x + x^2 + 8x$$

$$0 = x^2 + 8x - 2688$$

$$0 = (x - 48)(x + 56)$$

$$x = 48, \quad x = -56$$

$$x + 8 = 56 \text{ miles per hour}$$

107. Verbal Model:  $\frac{\text{Hits}}{\text{At bats}} = 0.400$

Label: Consecutive times =  $x$

Equation:  $\frac{45 + x}{150 + x} = 0.4$

$$(150 + x)\left(\frac{45 + x}{150 + x}\right) = 0.4(150 + x)$$

$$45 + x = 0.4(150 + x)$$

$$45 + x = 60 + 0.4x$$

$$45 + 0.6x = 60$$

$$0.6x = 15$$

$$x = \frac{15}{0.6}$$

$$x = 25$$

Thus, the player must hit safely 25 consecutive times to obtain a batting average of .400.

109. Verbal Model:  $\frac{\text{Share per person now}}{\text{Share per person later}} = \frac{\text{Share per person later}}{\text{Share per person later}} + 5000$

Labels: People presently in group =  $x$

People in new group =  $x + 2$

Equation:  $\frac{60,000}{x} = \frac{60,000}{x + 2} + 5000$

$$x(x + 2)\left(\frac{60,000}{x}\right) = \left(\frac{60,000}{x + 2} + 5000\right)x(x + 2)$$

$$60,000(x + 2) = 60,000x + 5000x(x + 2)$$

$$60,000x + 120,000 = 60,000x + 5000x^2 + 10,000x$$

$$0 = 5000x^2 + 10,000x - 120,000$$

$$0 = x^2 + 2x - 24$$

$$0 = (x + 6)(x - 4)$$

$$x = -6, \quad x = 4 \text{ people}$$