Section 5.1 Practice Exercises

1. **a.** rational

b. denominator

c. $\frac{p}{q}$

d. 1; –1

2.
$$f(x)=\frac{5}{x+1}$$
$$f(0)=\frac{5}{0+1}=\frac{5}{1}=5$$
$$f(2)=\frac{5}{2+1}=\frac{5}{3}$$
$$f(-1)=\frac{5}{-1+1}=\frac{5}{0} \text{ is undefined}$$
$$f(-6)=\frac{5}{-6+1}=\frac{5}{-5}=-1$$

3.
$$k(x)=\frac{-3}{x+4}$$
$$k(0)=\frac{-3}{0+4}=-\frac{3}{4}$$
$$k(-1)=\frac{-3}{-1+4}=-\frac{3}{3}=-1$$
$$k(2)=\frac{-3}{2+4}=-\frac{3}{6}=-\frac{1}{2}$$
$$k(-4)=\frac{-3}{-4+4}$$
$$=-\frac{3}{0} \text{ is undefined}$$

4.
$$m(x)=\frac{x-4}{x+6}$$
$$m(-6)=\frac{-6-4}{-6+6}=\frac{-10}{0} \text{ is undefined}$$
$$m(-4)=\frac{-4-4}{-4+6}=\frac{-8}{2}=-4$$
$$m(0)=\frac{0-4}{0+6}=\frac{-4}{6}=-\frac{2}{3}$$
$$m(4)=\frac{4-4}{4+6}=\frac{0}{10}=0$$

5.
$$n(a)=\frac{3a+1}{a^2+1}$$
$$n(1)=\frac{3(1)+1}{(1)^2+1}=\frac{3+1}{1+1}=\frac{4}{2}=2$$
$$n(0)=\frac{3(0)+1}{(0)^2+1}=\frac{0+1}{0+1}=\frac{1}{1}=1$$
$$n\left(-\frac{1}{3}\right)=\frac{3\left(-\frac{1}{3}\right)+1}{\left(-\frac{1}{3}\right)^2+1}=\frac{-1+1}{\frac{1}{9}+1}=\frac{0}{\frac{10}{9}}=0$$

6.
$$f(t)=\frac{2t-8}{t^2+9}$$
$$f(4)=\frac{2(4)-8}{(4)^2+9}=\frac{8-8}{16+9}=\frac{0}{25}=0$$
$$f(-4)=\frac{2(-4)-8}{(-4)^2+9}=\frac{-8-8}{16+9}=\frac{-16}{25}=-\frac{16}{25}$$
$$f(3)=\frac{2(3)-8}{(3)^2+9}=\frac{6-8}{9+9}=\frac{-2}{18}=-\frac{1}{9}$$

$$n(-1)=\frac{3(-1)+1}{(-1)^2+1}=\frac{-3+1}{1+1}=\frac{-2}{2}=-1 \qquad f(-3)=\frac{2(-3)-8}{(-3)^2+9}=\frac{-6-8}{9+9}=\frac{-14}{18}=-\frac{7}{9}$$

7. $f(x)=\dfrac{9}{x}$

$x\neq 0$

a. $\{x \mid x \text{ is a real number and } x\neq 0\}$

b. $(-\infty,0)\cup(0,\infty)$

8. $g(a)=-\dfrac{10}{a}$

$a\neq 0$

a. $\{a \mid a \text{ is a real number and } a\neq 0\}$

b. $(-\infty,0)\cup(0,\infty)$

9. $h(v)=\dfrac{v+1}{v-7}$

$v-7\neq 0$

$v\neq 7$

a. $\{v \mid v \text{ is a real number and } v\neq 7\}$

b. $(-\infty,7)\cup(7,\infty)$

10. $p(t)=\dfrac{t+9}{t+3}$

$t+3\neq 0$

$t\neq -3$

a. $\{t \mid t \text{ is a real number and } t\neq -3\}$

b. $(-\infty,-3)\cup(-3,\infty)$

11. $k(x)=\dfrac{3x-1}{2x-5}$

$2x-5\neq 0$

$2x\neq 5$

$x\neq \dfrac{5}{2}$

a. $\left\{x \mid x \text{ is a real number and } x\neq \dfrac{5}{2}\right\}$

b. $\left(-\infty,\dfrac{5}{2}\right)\cup\left(\dfrac{5}{2},\infty\right)$

12. $n(t)=\dfrac{6t+5}{3t+8}$

$3t+8\neq 0$

$3t\neq -8$

$t\neq -\dfrac{8}{3}$

a. $\left\{t \mid t \text{ is a real number and } t\neq -\dfrac{8}{3}\right\}$

b. $\left(-\infty,-\dfrac{8}{3}\right)\cup\left(-\dfrac{8}{3},\infty\right)$

13. $f(q)=\dfrac{q+1}{q^2+6q-27}$

$q^2+6q-27\neq 0$

$(q+9)(q-3)\neq 0$

$q+9\neq 0 \quad \text{or} \quad q-3\neq 0$

$q\neq -9 \quad \text{or} \quad q\neq 3$

14. $k(a)=\dfrac{a^2}{2a^2+3a-5}$

$2a^2+3a-5\neq 0$

$(2a+5)(a-1)\neq 0$

$2a+5\neq 0 \quad \text{or} \quad a-1\neq 0$

$2a\neq -5 \quad \text{or} \quad a\neq 1$

$a\neq -\dfrac{5}{2} \quad \text{or} \quad a\neq 1$

a. $\left\{q \mid q \text{ is a real number and } q \neq -9, q \neq 3\right\}$

b. $(-\infty,-9)\cup(-9,3)\cup(3,\infty)$

15. $h(c)=\dfrac{c}{c^2+25}$

Because c^2 is nonnegative for any real number c, the denominator c^2+25 cannot equal zero; therefore, no real numbers are excluded from the domain.

a. $\left\{c \mid c \text{ is a real number}\right\}$

b. $(-\infty,\infty)$

16. $m(x)=\dfrac{x}{x^2+16}$

Because x^2 is nonnegative for any real number x, the denominator x^2+16 cannot equal zero; therefore, no real numbers are excluded from the domain.

a. $\left\{x \mid x \text{ is a real number}\right\}$

b. $(-\infty,\infty)$

17. $f(x)=\dfrac{x+5}{x^2-25}$

$x^2-25\neq 0$

$(x+5)(x-5)\neq 0$

$x+5\neq 0$ or $x-5\neq 0$

$x\neq -5$ or $x\neq 5$

a. $\left\{x \mid x \text{ is a real number and } x \neq -5, x \neq 5\right\}$

b. $(-\infty,-5)\cup(-5,5)\cup(5,\infty)$

18. $g(t)=\dfrac{t+4}{t^2-16}$

$t^2-16\neq 0$

$(t+4)(t-4)\neq 0$

$t+4\neq 0$ or $t-4\neq 0$

$t\neq -4$ or $t\neq 4$

a. $\left\{t \mid t \text{ is a real number and } t \neq -4, t \neq 4\right\}$

b. $(-\infty,-4)\cup(-4,4)\cup(4,\infty)$

19. $p(x)=\dfrac{x-5}{3}$

a. $\left\{x \mid x \text{ is a real number}\right\}$

b. $(-\infty,\infty)$

20. $r(x)=\dfrac{x+2}{8}$

a. $\left\{x \mid x \text{ is a real number}\right\}$

b. $(-\infty,\infty)$

21. $m(x)=\dfrac{1}{x+4}$

$x+4=0$

$x=-4$

$D:(-\infty,-4)\cup(-4,\infty)$

Graph: b

22. $n(x)=\dfrac{1}{x+1}$

$x+1=0$

$x=-1$

$D:(-\infty,-1)\cup(-1,\infty)$

Graph: c

23. $q(x)=\dfrac{1}{x-4}$

$x-4=0$

$x=4$

$D:(-\infty,4)\cup(4,\infty)$

Graph: d

24. $p(x)=\dfrac{1}{x-1}$

$x-1=0$

$x=1$

$D:(-\infty,1)\cup(1,\infty)$

Graph: a

25. **a.** $\dfrac{8x}{4y}=\dfrac{2x}{y}$

b. $\dfrac{8+x}{4+y}$ cannot be simplified

26. **a.** $\dfrac{a-21}{14+b}$ cannot be simplified

b. $\dfrac{-21a}{14b}=\dfrac{-3a}{2b}$

27. $\dfrac{x^2+6x+8}{x^2+3x-4}$

a. $\dfrac{(x+4)(x+2)}{(x+4)(x-1)}$

b. $(x+4)(x-1)\neq 0$

$x+4\neq 0$ or $x-1\neq 0$

$x\neq -4$ or $x\neq 1$

c. $\dfrac{\cancel{(x+4)}(x+2)}{\cancel{(x+4)}(x-1)}=\dfrac{x+2}{x-1}$

provided $x\neq -4, x\neq$

28. $\dfrac{x^2-6x}{2x^2-11x-6}$

a. $\dfrac{x(x-6)}{(2x+1)(x-6)}$

b. $(2x+1)(x-6)\neq 0$

$2x+1\neq 0$ or $x-6\neq 0$

$2x\neq -1$ or $x\neq 6$

$x\neq -\dfrac{1}{2}$ or $x\neq 6$

c. $\dfrac{x\cancel{(x-6)}}{(2x+1)\cancel{(x-6)}}=\dfrac{x}{2x+1}$

provided $x\neq -\dfrac{1}{2}, x\neq 6$

29. $\dfrac{x^2-18x+81}{x^2-81}$

a. $\dfrac{(x-9)(x-9)}{(x+9)(x-9)}$

b. $(x+9)(x-9)\neq 0$

$x+9\neq 0$ or $x-9\neq 0$

$x\neq -9$ or $x\neq 9$

c. $\dfrac{(x-9)\cancel{(x-9)}}{(x+9)\cancel{(x-9)}}=\dfrac{x-9}{x+9}$ provided $x\neq -9, x\neq 9$

30. $\dfrac{x^2+14x+49}{x^2-49}$

a. $\dfrac{(x+7)(x+7)}{(x+7)(x-7)}$

b. $(x+7)(x-7)\neq 0$

$x+7\neq 0$ or $x-7\neq 0$

$x\neq -7$ or $x\neq 7$

c. $\dfrac{\cancel{(x+7)}(x+7)}{\cancel{(x+7)}(x-7)}=\dfrac{x+7}{x-7}$ provided $x\neq -7, x\neq 7$

31. $\dfrac{100x^3y^5}{36xy^8}=\dfrac{25}{9}x^{3-1}y^{5-8}=\dfrac{25}{9}x^2y^{-3}$

$=\dfrac{25x^2}{9y^3}$ provided $x\neq 0, y\neq 0$

32. $\dfrac{48ab^3c^2}{6a^7bc^0}=8a^{1-7}b^{3-1}c^{2-0}=8a^{-6}b^2c^2$

$=\dfrac{8b^2c^2}{a^6}$ provided $a\neq 0, b\neq 0, c\neq 0$

33. $\dfrac{7w^{11}z^6}{14w^3z^3}=\dfrac{1}{2}w^{11-3}z^{6-3}=\dfrac{1}{2}w^8z^3$

$=\dfrac{w^8z^3}{2}$ provided $w\neq 0, z\neq 0$

34. $\dfrac{12r^9s^3}{24r^8s^4}=\dfrac{1}{2}r^{9-8}s^{3-4}=\dfrac{1}{2}rs^{-1}$

$=\dfrac{r}{2s}$ provided $r\neq 0, s\neq 0$

35. $\dfrac{-3m^4n}{12m^6n^4}=-\dfrac{1}{4}m^{4-6}n^{1-4}=-\dfrac{1}{4}m^{-2}n^{-3}$

$=-\dfrac{1}{4m^2n^3}$ provided $m\neq 0, n\neq 0$

36. $\dfrac{-5x^3y^2}{20x^4y^2}=-\dfrac{1}{4}x^{3-4}y^{2-2}=-\dfrac{1}{4}x^{-1}y^0$

$=-\dfrac{1}{4x}$ provided $x\neq 0, y\neq 0$

37. $\dfrac{6a+18}{9a+27}=\dfrac{6\cancel{(a+3)}}{9\cancel{(a+3)}}=\dfrac{2}{3}$ provided $a\neq -3$

38. $\dfrac{5y-15}{3y-9}=\dfrac{5\cancel{(y-3)}}{3\cancel{(y-3)}}=\dfrac{5}{3}$ provided $y\neq 3$

39. $\dfrac{x-5}{x^2-25}=\dfrac{\cancel{x-5}}{(x+5)\cancel{(x-5)}}=\dfrac{1}{x+5}$ provided $x\neq -5, x\neq 5$

40. $\dfrac{3z-6}{3z^2-12}=\dfrac{3(z-2)}{3(z^2-4)}=\dfrac{\cancel{3}\cancel{(z-2)}}{\cancel{3}(z+2)\cancel{(z-2)}}$

$=\dfrac{1}{z+2}$ provided $z\neq -2, z\neq 2$

41. $\dfrac{-7c}{21c^2-35c} = \dfrac{-1\cdot \cancel{7c}}{\cancel{7c}\left(3c-5\right)} = -\dfrac{1}{3c-5}$

provided $c \neq 0, c \neq \dfrac{5}{3}$

42. $\dfrac{2p+3}{2p^2+7p+6} = \dfrac{\cancel{2p+3}}{\left(\cancel{2p+3}\right)\left(p+2\right)}$

$= \dfrac{1}{p+2}$ provided $p \neq -2, p \neq -\dfrac{3}{2}$

43. $\dfrac{2t^2+7t-4}{-2t^2-5t+3} = \dfrac{\left(2t-1\right)\left(t+4\right)}{-\left(2t^2+5t-3\right)}$

$= \dfrac{\cancel{\left(2t-1\right)}\left(t+4\right)}{-\cancel{\left(2t-1\right)}\left(t+3\right)}$

$= -\dfrac{t+4}{t+3}$ provided $t \neq \dfrac{1}{2}, t \neq -3$

44. $\dfrac{y^2+8y-9}{y^2-5y+4} = \dfrac{\left(y+9\right)\cancel{\left(y-1\right)}}{\left(y-4\right)\cancel{\left(y-1\right)}}$

$= \dfrac{y+9}{y-4}$ provided $y \neq 4, y \neq 1$

45. $\dfrac{\left(p+1\right)\left(2p-1\right)^4}{\left(p+1\right)^2\left(2p-1\right)^2} = \left(p+1\right)^{1-2}\left(2p-1\right)^{4-2}$

$= \left(p+1\right)^{-1}\left(2p-1\right)^2$

$= \dfrac{\left(2p-1\right)^2}{p+1}$ provided $p \neq \dfrac{1}{2}, p \neq -1$

46. $\dfrac{r\left(r-3\right)^5}{r^3\left(r-3\right)^2} = r^{1-3}\left(r-3\right)^{5-2} = r^{-2}\left(r-3\right)^3$

$= \dfrac{\left(r-3\right)^3}{r^2}$ provided $r \neq 0, r \neq 3$

47. $\dfrac{9-z^2}{2z^2+z-15} = \dfrac{\cancel{\left(3+z\right)}\left(3-z\right)}{\left(2z-5\right)\cancel{\left(z+3\right)}} = \dfrac{3-z}{2z-5}$

provided $z \neq \dfrac{5}{2}, z \neq -3$

48. $\dfrac{2c^2+2c-12}{-8+2c+c^2} = \dfrac{2\left(c^2+c-6\right)}{c^2+2c-8}$

$= \dfrac{2\left(c+3\right)\cancel{\left(c-2\right)}}{\left(c+4\right)\cancel{\left(c-2\right)}} = \dfrac{2\left(c+3\right)}{c+4}$

provided $c \neq -4, c \neq 2$

49. $\dfrac{2z^3+128}{16+8z+z^2} = \dfrac{2\left(z^3+64\right)}{z^2+8z+16}$

$= \dfrac{2\cancel{\left(z+4\right)}\left(z^2-4z+16\right)}{\left(z+4\right)\cancel{\left(z+4\right)}}$

$= \dfrac{2\left(z^2-4z+16\right)}{z+4}$

provided $z \neq -4$

50. $\dfrac{p^3-1}{5-10p+5p^2} = \dfrac{\left(p-1\right)\left(p^2+p+1\right)}{5\left(p^2-2p+1\right)}$

$= \dfrac{\cancel{\left(p-1\right)}\left(p^2+p+1\right)}{5\cancel{\left(p-1\right)}\left(p-1\right)}$

$= \dfrac{p^2+p+1}{5\left(p-1\right)}$

provided $p \neq 1$

51. $\dfrac{10x^3-25x^2+4x-10}{-4-10x^2}$

$$=\frac{5x^2(2x-5)+2(2x-5)}{-2(5x^2+2)}$$

$$=\frac{(2x-5)\cancel{(5x^2+2)}}{-2\cancel{(5x^2+2)}}$$

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

52. $\dfrac{8x^3-12x^2+6x-9}{16x^4-9}$

$$=\frac{4x^2(2x-3)+3(2x-3)}{(4x^2+3)(4x^2-3)}$$

$$=\frac{(2x-3)\cancel{(4x^2+3)}}{\cancel{(4x^2+3)}(4x^2-3)}$$

$$=\frac{2x-3}{4x^2-3}$$

provided $x\neq\dfrac{\sqrt{3}}{2}, x\neq-\dfrac{\sqrt{3}}{2}$

53. $\dfrac{r+6}{6+r}=\dfrac{r+6}{r+6}=1$

provided $r\neq -6$

54. $\dfrac{a+2}{2+a}=\dfrac{a+2}{a+2}=1$

provided $a\neq -2$

55. $\dfrac{b+8}{-b-8}=\dfrac{\cancel{b+8}}{-\cancel{(b+8)}}$

$$=-1$$

provided $b\neq -8$

56. $\dfrac{7+w}{-7-w}=\dfrac{\cancel{7+w}}{-\cancel{(7+w)}}$

$$=-1$$

provided $w\neq -7$

57. $\dfrac{10-x}{x-10}=\dfrac{-\cancel{(x-10)}}{\cancel{x-10}}$

$$=-1$$

provided $x\neq 10$

58. $\dfrac{y-14}{14-y}=\dfrac{\cancel{y-14}}{-\cancel{(y-14)}}$

$$=-1$$

provided $y\neq 14$

59. $\dfrac{2t-2}{1-t}=\dfrac{2\cancel{(t-1)}}{-\cancel{(t-1)}}$

$$=-2$$

provided $t\neq 1$

60. $\dfrac{5p-10}{2-p}=\dfrac{5\cancel{(p-2)}}{-\cancel{(p-2)}}$

$$=-5$$

provided $p\neq 2$

61. $\dfrac{c+4}{c-4}$ cannot be simplified

62. $\dfrac{b+2}{b-2}$ cannot be simplified

63. $$\frac{y-x}{12x^2-12y^2}=\frac{-(x-y)}{12(x^2-y^2)}$$
$$=\frac{-(x-y)}{12(x+y)(x-y)}$$
$$=-\frac{1}{12(x+y)}$$
provided $x\neq y, x\neq -y$

64. $$\frac{4w^2-49z^2}{14z-4w}=\frac{(2w+7z)(2w-7z)}{-2(2w-7z)}$$
$$=-\frac{2w+7z}{2}$$
provided $w\neq\frac{7}{2}z$

65. $$\frac{t^2-1}{t^2+7t+6}=\frac{(t-1)(t+1)}{(t+6)(t+1)}$$
$$=\frac{t-1}{t+6}$$ provided $t\neq -6, t\neq -1$

66. $$\frac{x^2+4x+4}{x^2-4}=\frac{(x+2)(x+2)}{(x+2)(x-2)}$$
$$=\frac{x+2}{x-2}$$ provided $x\neq -2, x\neq 2$

67. $$\frac{8p+8}{2p^2-4p-6}=\frac{8(p+1)}{2(p^2-2p-3)}$$
$$=\frac{2\cdot 4(p+1)}{2(p-3)(p+1)}$$
$$=\frac{4}{p-3}$$
provided $p\neq 3, p\neq -1$

68. $$\frac{15y-15}{3y^2+9y-12}=\frac{15(y-1)}{3(y^2+3y-4)}$$
$$=\frac{3\cdot 5(y-1)}{3(y-1)(y+4)}$$
$$=\frac{5}{y+4}$$
provided $y\neq -4, y\neq 1$

69. $$\frac{-16a^2bc^4}{8ab^2c^4}=-\frac{16}{8}a^{2-1}b^{1-2}c^{4-4}$$
$$=-2a^1b^{-1}c^0$$
$$=-\frac{2a}{b}$$
provided $a\neq 0, b\neq 0, c\neq 0$

70. $$\frac{-9x^3yz^2}{27x^4yz}=-\frac{9}{27}x^{3-4}y^{1-1}z^{2-1}$$
$$=-\frac{1}{3}x^{-1}y^0z^1$$
$$=-\frac{z}{3x}$$
provided $x\neq 0, y\neq 0, z\neq 0$

71. $$\frac{x^2-y^2}{8y-8x}=\frac{(x-y)(x+y)}{-8(x-y)}$$
$$=-\frac{x+y}{8}$$ provided $x\neq y$

72. $$\frac{p^2-49}{14-2p}=\frac{(p-7)(p+7)}{-2(p-7)}$$
$$=-\frac{p+7}{2}$$ provided $p\neq 7$

73. $$\frac{b+4}{2b^2+5b-12}=\frac{\cancel{b+4}}{(2b-3)\cancel{(b+4)}}$$
$$=\frac{1}{2b-3}$$
provided $b\neq\frac{3}{2},b\neq -4$

74. $$\frac{c-6}{3c^2-17c-6}=\frac{\cancel{c-6}}{(3c+1)\cancel{(c-6)}}$$
$$=\frac{1}{3c+1}$$
provided $c\neq -\frac{1}{3},c\neq 6$

75. $$\frac{-2x+34}{-4x+6}=\frac{\cancel{-2}(x-17)}{\cancel{-2}(2x-3)}=\frac{x-17}{2x-3}$$
provided $x\neq\frac{3}{2}$

76. $$\frac{-9w-3}{3w+12}=\frac{-\cancel{3}(3w+1)}{\cancel{3}(w+4)}=-\frac{3w+1}{w+4}$$
provided $w\neq -4$

77. $$\frac{(a-2)^2(a-5)^3}{(a-2)^3(a-5)}=(a-2)^{2-3}(a-5)^{3-1}$$
$$=(a-2)^{-1}(a-5)^2$$
$$=\frac{(a-5)^2}{a-2}$$
provided $a\neq 2,a\neq 5$

78. $$\frac{t^2(t-11)^4}{t^5(t-11)^2}=t^{2-5}(t-11)^{4-2}$$
$$=t^{-3}(t-11)^2$$
$$=\frac{(t-11)^2}{t^3}$$
provided $t\neq 0,t\neq 11$

79. $$\frac{4x-2x^2}{5x-10}=\frac{-2x\cancel{(x-2)}}{5\cancel{(x-2)}}$$
$$=-\frac{2x}{5}\text{ provided } x\neq 2$$

80. $$\frac{2y-6}{3y^2-y^3}=\frac{2\cancel{(y-3)}}{-y^2\cancel{(y-3)}}$$
$$=-\frac{2}{y^2}\text{ provided } y\neq 0,y\neq 3$$

81. $$\frac{x^3-2x^2-25x+50}{x^3+5x^2-4x-20}$$
$$=\frac{x^2(x-2)-25(x-2)}{x^2(x+5)-4(x+5)}$$
$$=\frac{(x-2)(x^2-25)}{(x+5)(x^2-4)}$$
$$=\frac{\cancel{(x-2)}\cancel{(x+5)}(x-5)}{\cancel{(x+5)}(x+2)\cancel{(x-2)}}$$

82. $$\frac{4y^3+12y^2-y-3}{2y^3+y^2-18y-9}$$
$$=\frac{4y^2(y+3)-(y+3)}{y^2(2y+1)-9(2y+1)}$$
$$=\frac{(y+3)(4y^2-1)}{(2y+1)(y^2-9)}$$
$$=\frac{\cancel{(y+3)}\cancel{(2y+1)}(2y-1)}{\cancel{(2y+1)}\cancel{(y+3)}(y-3)}$$

$$= \frac{x-5}{x+2}$$

provided $x \neq -5, x \neq -2, x \neq 2$

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

provided $y \neq -\frac{1}{2}, y \neq -3, y \neq 3$

83. $$\frac{t^3+8}{3t^2+t-10} = \frac{\cancel{(t+2)}\left(t^2-2t+4\right)}{(3t-5)\cancel{(t+2)}}$$

$$= \frac{t^2-2t+4}{3t-5}$$

provided $t \neq \frac{5}{3}, t \neq -2$

84. $$\frac{w^3-27}{4w^2-5w-21} = \frac{\cancel{(w-3)}\left(w^2+3w+9\right)}{(4w+7)\cancel{(w-3)}}$$

$$= \frac{w^2+3w+9}{4w+7}$$

provided $w \neq -\frac{7}{4}, w \neq 3$

85. For example: $\frac{1}{x-2}$

86. For example: $\frac{1}{x-3}$

87. For example: $f(x) = \frac{1}{x+5}$

88. For example: $f(x) = \frac{1}{x+6}$

Section 5.2 Practice Exercises

1. **a.** $\frac{pr}{qs}$

b. $\frac{ps}{qr}$

2. $$\frac{3w^2-12}{w^2+5w+6} = \frac{3\left(w^2-4\right)}{(w+3)(w+2)}$$

$$= \frac{3(w-2)\cancel{(w+2)}}{(w+3)\cancel{(w+2)}}$$

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

3. $$\frac{t^2-5t-6}{t^2-7t+6} = \frac{\cancel{(t-6)}(t+1)}{\cancel{(t-6)}(t-1)}$$

$$= \frac{t+1}{t-1}$$

4. $$\frac{5y+15}{5y^2+16y+3} = \frac{5\cancel{(y+3)}}{(5y+1)\cancel{(y+3)}}$$

$$= \frac{5}{5y+1}$$

5. $$\frac{2-p}{p^2-p-2} = \frac{-1\cancel{(p-2)}}{\cancel{(p-2)}(p+1)}$$

$$= -\frac{1}{p+1}$$

6. $\dfrac{5x^2yz^3}{20xyz} = \dfrac{1}{4}x^{2-1}y^{1-1}z^{3-1}$

$= \dfrac{1}{4}xy^0z^2$

$= \dfrac{xz^2}{4}$

7. $\dfrac{7x+14}{7x^2-7x-42} = \dfrac{7(x+2)}{7(x^2-x-6)}$

$= \dfrac{\cancel{7}(x+2)}{\cancel{7}(x-3)\cancel{(x+2)}}$

$= \dfrac{1}{x-3}$

8. $\dfrac{25-x^2}{x^2-10x+25} = \dfrac{-(x^2-25)}{x^2-10x+25}$

$= \dfrac{-(x+5)\cancel{(x-5)}}{(x-5)\cancel{(x-5)}}$

$= -\dfrac{x+5}{x-5}$

9. $\dfrac{a^3b^2c^5}{2a^3bc^2} = \dfrac{1}{2}a^{3-3}b^{2-1}c^{5-2}$

$= \dfrac{1}{2}a^0bc^3$

$= \dfrac{bc^3}{2}$

10. $\dfrac{8w^2}{9}\cdot\dfrac{3}{2w^4} = \dfrac{24w^2}{18w^4} = \dfrac{4}{3}w^{2-4}$

$= \dfrac{4}{3}w^{-2}$

$= \dfrac{4}{3w^2}$

11. $\dfrac{16}{z^7}\cdot\dfrac{z^4}{8} = \dfrac{16z^4}{8z^7} = 2z^{4-7}$

$= 2z^{-3}$

$= \dfrac{2}{z^3}$

12. $\dfrac{5p^2q^4}{12pq^3}\cdot\dfrac{6p^2}{20q^2} = \dfrac{\cancel{5}p\cdot\cancel{p}\cdot\cancel{q^3}\cdot\cancel{q}}{\cancel{6}\cdot 2\cancel{p}\cdot\cancel{q^3}}\cdot\dfrac{\cancel{6}p^2}{\cancel{5}\cdot 4\cancel{q}\cdot q}$

$= \dfrac{p^{1+2}}{2\cdot 4\cdot q}$

$= \dfrac{p^3}{8q}$

13. $\dfrac{27r^5}{7s}\cdot\dfrac{28rs^3}{9r^3s^2} = \dfrac{\cancel{9}\cdot 3\cancel{r^3}\cdot r^2}{\cancel{7}\,\cancel{s}}\cdot\dfrac{\cancel{7}\cdot 4r\cancel{s^2}\cdot\cancel{s}}{\cancel{9}\,\cancel{r^3}\,\cancel{s^2}}$

$= 3\cdot 4\cdot r^2\cdot r$

$= 12r^{2+1}$

$= 12r^3$

14. $\dfrac{3z+12}{8z^3}\cdot\dfrac{16z^3}{9z+36}$

$= \dfrac{\cancel{3}(z+4)}{\cancel{8}\,\cancel{z^3}}\cdot\dfrac{\cancel{8}\cdot 2\cancel{z^3}}{3\cdot\cancel{3}(z+4)}$

$= \dfrac{2}{3}$

15. $\dfrac{x^2y}{x^2-4x-5}\cdot\dfrac{2x^2-13x+15}{xy^3}$

$= \dfrac{\cancel{x}\cdot x\cdot\cancel{y}}{\cancel{(x-5)}(x+1)}\cdot\dfrac{(2x-3)\cancel{(x-5)}}{\cancel{x}\cdot\cancel{y}\cdot y^2}$

$= \dfrac{x(2x-3)}{y^2(x+1)}$

16. $\dfrac{3y^2+18y+15}{6y+6}\cdot\dfrac{y-5}{y^2-25}$

$=\dfrac{3\left(y^2+6y+5\right)}{6\left(y+1\right)}\cdot\dfrac{y-5}{\left(y+5\right)\left(y-5\right)}$

$=\dfrac{\cancel{3}\left(y+5\right)\left(y+1\right)}{2\cdot\cancel{3}\left(y+1\right)}\cdot\dfrac{\cancel{y-5}}{\cancel{\left(y+5\right)}\cancel{\left(y-5\right)}}$

$=\dfrac{1}{2}$

17. $\dfrac{10w-8}{w+2}\cdot\dfrac{3w^2-w-14}{25w^2-16}$

$=\dfrac{2\cancel{\left(5w-4\right)}}{\cancel{w+2}}\cdot\dfrac{\left(3w-7\right)\cancel{\left(w+2\right)}}{\left(5w+4\right)\cancel{\left(5w-4\right)}}$

$=\dfrac{2\left(3w-7\right)}{5w+4}$

18. $\dfrac{x-5y}{x^2+xy}\cdot\dfrac{y^2-x^2}{10y-2x}$

$=\dfrac{\cancel{x-5y}}{x\left(x+y\right)}\cdot\dfrac{\not-\left(x^2-y^2\right)}{\not-2\cancel{\left(x-5y\right)}}$

$=\dfrac{\cancel{\left(x+y\right)}\left(x-y\right)}{2x\cancel{\left(x+y\right)}}$

$=\dfrac{x-y}{2x}$

19. $\dfrac{3x-15}{4x^2-2x}\cdot\dfrac{10x-20x^2}{5-x}$

$=\dfrac{3\cancel{\left(x-5\right)}}{\cancel{2x}\left(2x-1\right)}\cdot\dfrac{\not-5\cdot\cancel{2x}\left(2x-1\right)}{\not-\cancel{\left(x-5\right)}}$

$=15$

20. $x\left(x+5\right)^2\cdot\dfrac{2}{x^2-25}=\dfrac{2x\cancel{\left(x+5\right)}\left(x+5\right)}{\cancel{\left(x+5\right)}\left(x-5\right)}$

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

21. $y\left(y^2-4\right)\cdot\dfrac{y}{y+2}=\dfrac{y^2\cancel{\left(y+2\right)}\left(y-2\right)}{\cancel{y+2}}$

$=y^2\left(y-2\right)$

22. $\dfrac{5x}{7}\div\dfrac{10x^2}{21}=\dfrac{5x}{7}\cdot\dfrac{21}{10x^2}$

$=\dfrac{\cancel{5x}}{\cancel{7}}\cdot\dfrac{3\cdot\cancel{7}}{\cancel{5x}\cdot 2x}$

$=\dfrac{3}{2x}$

23. $\dfrac{2a}{7b^3}\div\dfrac{10a^5}{77}=\dfrac{2a}{7b^3}\cdot\dfrac{77}{10a^5}$

$=\dfrac{\cancel{2a}}{\cancel{7}b^3}\cdot\dfrac{\cancel{7}\cdot 11}{\cancel{2a}\cdot 5a^4}$

$=\dfrac{11}{5a^4b^3}$

24. $\dfrac{6x^2y^2}{x-2}\div\dfrac{3xy^2}{\left(x-2\right)^2}$

$=\dfrac{6x^2y^2}{x-2}\cdot\dfrac{\left(x-2\right)^2}{3xy^2}$

25. $\dfrac{\left(r+3\right)^2}{4r^3s}\div\dfrac{r+3}{rs}$

$=\dfrac{\left(r+3\right)^2}{4r^3s}\cdot\dfrac{rs}{r+3}$

$$= \frac{\cancel{3}\cdot 2\cdot \cancel{x}\cdot x\cdot \cancel{y^2}}{\cancel{x-2}}\cdot\frac{\cancel{(x-2)}(x-2)}{\cancel{3}\cdot\cancel{x}\cdot\cancel{y^2}}$$
$$= 2x(x-2)$$

$$= \frac{(r+3)\cancel{(r+3)}}{4r^2\cdot\cancel{r}\cdot\cancel{s}}\cdot\frac{\cancel{r}\cdot\cancel{s}}{\cancel{r+3}}$$
$$= \frac{r+3}{4r^2}$$

26. $\dfrac{t^2+5t}{t+1}\div(t+5)$

$$= \frac{t^2+5t}{t+1}\cdot\frac{1}{t+5}$$
$$= \frac{t\cancel{(t+5)}}{t+1}\cdot\frac{1}{\cancel{t+5}}$$
$$= \frac{t}{t+1}$$

27. $\dfrac{6p+7}{p+2}\div(36p^2-49)$

$$= \frac{6p+7}{p+2}\cdot\frac{1}{36p^2-49}$$
$$= \frac{\cancel{6p+7}}{p+2}\cdot\frac{1}{\cancel{(6p+7)}(6p-7)}$$
$$= \frac{1}{(p+2)(6p-7)}$$

28. $\dfrac{a}{a-10}\div\dfrac{a^3+6a^2-40a}{a^2-100}$

$$= \frac{a}{a-10}\cdot\frac{a^2-100}{a(a^2+6a-40)}$$
$$= \frac{\cancel{a}}{\cancel{a-10}}\cdot\frac{\cancel{(a+10)}\cancel{(a-10)}}{\cancel{a}\cancel{(a+10)}(a-4)}$$
$$= \frac{1}{a-4}$$

29. $\dfrac{b^2-6b+9}{b^2-b-6}\div\dfrac{b^2-9}{4}$

$$= \frac{b^2-6b+9}{b^2-b-6}\cdot\frac{4}{b^2-9}$$
$$= \frac{\cancel{(b-3)}\cancel{(b-3)}}{\cancel{(b-3)}(b+2)}\cdot\frac{4}{(b+3)\cancel{(b-3)}}$$
$$= \frac{4}{(b+2)(b+3)}$$

30. $\dfrac{2x^2+5xy+2y^2}{4x^2-y^2}\div\dfrac{x^2+xy-2y^2}{2x^2+xy-y^2}$

$$= \frac{2x^2+5xy+2y^2}{4x^2-y^2}\cdot\frac{2x^2+xy-y^2}{x^2+xy-2y^2}$$
$$= \frac{\cancel{(2x+y)}\cancel{(x+2y)}}{\cancel{(2x+y)}\cancel{(2x-y)}}\cdot\frac{\cancel{(2x-y)}(x+y)}{\cancel{(x+2y)}(x-y)}$$
$$= \frac{x+y}{x-y}$$

31. $\dfrac{6s^2+st-2t^2}{6s^2-5st+t^2}\div\dfrac{3s^2+17st+10t^2}{6s^2+13st-5t^2}$

$$= \frac{6s^2+st-2t^2}{6s^2-5st+t^2}\cdot\frac{6s^2+13st-5t^2}{3s^2+17st+10t^2}$$
$$= \frac{\cancel{(3s+2t)}\cancel{(2s-t)}}{\cancel{(3s-t)}\cancel{(2s-t)}}\cdot\frac{\cancel{(3s-t)}(2s+5t)}{\cancel{(3s+2t)}(s+5t)}$$
$$= \frac{2s+5t}{s+5t}$$

32. $$\frac{x^4-x^3+x^2-x}{2x^3+2x^2+x+1}\div\frac{x^3-4x^2+x-4}{2x^3-8x^2+x-4}=\frac{x\left(x^3-x^2+x-1\right)}{2x^3+2x^2+x+1}\cdot\frac{2x^3-8x^2+x-4}{x^3-4x^2+x-4}$$
$$=\frac{x\left[x^2(x-1)+(x-1)\right]}{2x^2(x+1)+(x+1)}\cdot\frac{2x^2(x-4)+(x-4)}{x^2(x-4)+(x-4)}=\frac{x(x-1)\cancel{\left(x^2+1\right)}}{(x+1)\cancel{\left(2x^2+1\right)}}\cdot\frac{\cancel{(x-4)}\cancel{\left(2x^2+1\right)}}{\cancel{(x-4)}\cancel{\left(x^2+1\right)}}$$
$$=\frac{x(x-1)}{x+1}$$

33. $$\frac{a^3+a+a^2+1}{a^3+a^2+ab^2+b^2}\div\frac{a^3+a+a^2b+b}{2a^2+2ab+ab^2+b^3}=\frac{a^3+a+a^2+1}{a^3+a^2+ab^2+b^2}\cdot\frac{2a^2+2ab+ab^2+b^3}{a^3+a+a^2b+b}$$
$$=\frac{a\left(a^2+1\right)+\left(a^2+1\right)}{a^2(a+1)+b^2(a+1)}\cdot\frac{2a(a+b)+b^2(a+b)}{a\left(a^2+1\right)+b\left(a^2+1\right)}=\frac{\cancel{\left(a^2+1\right)}\cancel{(a+1)}}{\cancel{(a+1)}\left(a^2+b^2\right)}\cdot\frac{\cancel{(a+b)}\left(2a+b^2\right)}{\cancel{\left(a^2+1\right)}\cancel{(a+b)}}$$
$$=\frac{2a+b^2}{a^2+b^2}$$

34. $$\frac{3y-y^2}{y^3-27}\div\frac{y}{y^2+3y+9}$$
$$=\frac{3y-y^2}{y^3-27}\cdot\frac{y^2+3y+9}{y}$$
$$=\frac{-\cancel{y}\cancel{(y-3)}}{\cancel{(y-3)}\cancel{\left(y^2+3y+9\right)}}\cdot\frac{\cancel{y^2+3y+9}}{\cancel{y}}$$
$$=-1$$

35. $$\frac{8x-4x^2}{xy-2y+3x-6}\div\frac{3x+6}{y+3}$$
$$=\frac{8x-4x^2}{y(x-2)+3(x-2)}\cdot\frac{y+3}{3x+6}$$
$$=\frac{-4x\cancel{(x-2)}}{\cancel{(x-2)}\cancel{(y+3)}}\cdot\frac{\cancel{y+3}}{3(x+2)}$$
$$=\frac{-4x}{3(x+2)}$$

36. $$\frac{8a^4b^3}{3c}\div\frac{a^7b^2}{9c}=\frac{8a^4b^3}{3c}\cdot\frac{9c}{a^7b^2}$$
$$=\frac{8\cancel{a^4}\cancel{b^2}\cdot b}{\cancel{3c}}\cdot\frac{3\cdot\cancel{3c}}{\cancel{a^4}a^3\cancel{b^2}}$$
$$=\frac{24b}{a^3}$$

37. $$\frac{3x^5}{2x^2y^7}\div\frac{4x^3y}{6y^6}=\frac{3x^5}{2x^2y^7}\cdot\frac{6y^6}{4x^3y}$$
$$=\frac{3\cancel{x^2}\cancel{x^3}}{\cancel{2}\cancel{x^2}\cancel{y^6}y}\cdot\frac{\cancel{2}\cdot3\cancel{y^6}}{4\cancel{x^3}y}$$
$$=\frac{9}{4y^2}$$

38. $$\frac{2}{25x^2}\cdot\frac{5x}{12}\div\frac{2}{15x}=\frac{2}{25x^2}\cdot\frac{5x}{12}\cdot\frac{15x}{2}$$
$$=\frac{\cancel{2}}{\cancel{5}\cdot\cancel{5x}\cdot\cancel{x}}\cdot\frac{\cancel{5x}}{4\cdot\cancel{3}}\cdot\frac{\cancel{3}\cdot\cancel{5}\cancel{x}}{\cancel{2}}=\frac{1}{4}$$

39. $$\frac{4y}{7}\div\frac{y^2}{14}\cdot\frac{3}{y}=\frac{4y}{7}\cdot\frac{14}{y^2}\cdot\frac{3}{y}$$
$$=\frac{4\cancel{y}}{\cancel{7}}\cdot\frac{\cancel{7}\cdot2}{y^2}\cdot\frac{3}{\cancel{y}}=\frac{24}{y^2}$$

40. $\dfrac{10x^2-13xy-3y^2}{8x^2-10xy-3y^2}\cdot\dfrac{2y+8x}{2x^2+2y^2}$

$$=\frac{(5x+y)\cancel{(2x-3y)}}{\cancel{(4x+y)}\cancel{(2x-3y)}}\cdot\frac{\cancel{2}(4x+y)}{\cancel{2}(x^2+y^2)}$$

$$=\frac{5x+y}{x^2+y^2}$$

41. $\dfrac{6a^2+ab-b^2}{10a^2+5ab}\cdot\dfrac{2a^3+4a^2b}{3a^2+5ab-2b^2}$

$$=\frac{\cancel{(3a-b)}\cancel{(2a+b)}}{5a\cancel{(2a+b)}}\cdot\frac{2a^2\cancel{(a+2b)}}{\cancel{(3a-b)}\cancel{(a+2b)}}$$

$$=\frac{2a}{5}$$

42. $\left(3m^2-12m\right)\div\dfrac{m^2-4m}{m^2-6m+8}$

$$=\frac{3m^2-12m}{1}\cdot\frac{m^2-6m+8}{m^2-4m}$$

$$=\frac{3\cancel{m}(m-4)}{1}\cdot\frac{\cancel{(m-4)}(m-2)}{\cancel{m}\cancel{(m-4)}}$$

$$=3(m-4)(m-2)$$

43. $\left(2x^2+8\right)\div\dfrac{x^4-16}{x^2+x-6}$

$$=\frac{2x^2+8}{1}\cdot\frac{x^2+x-6}{x^4-16}$$

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

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

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

44. $\dfrac{(a+b)^2}{a-b}\cdot\dfrac{a^3-b^3}{a^2-b^2}\div\dfrac{a^2+ab+b^2}{(a-b)^2}=\dfrac{(a+b)^2}{a-b}\cdot\dfrac{a^3-b^3}{a^2-b^2}\cdot\dfrac{(a-b)^2}{a^2+ab+b^2}$

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

$$=(a+b)(a-b)$$

45. $\dfrac{m^2-n^2}{(m-n)^2}\div\dfrac{m^2-2mn+n^2}{m^2-mn+n^2}\cdot\dfrac{(m-n)^4}{m^3+n^3}$

$$=\frac{m^2-n^2}{(m-n)^2}\cdot\frac{m^2-mn+n^2}{m^2-2mn+n^2}\cdot\frac{(m-n)^4}{m^3+n^3}$$

$$=\frac{\cancel{(m+n)}(m-n)}{\cancel{(m-n)^2}}\cdot\frac{\cancel{m^2-mn+n^2}}{\cancel{(m-n)^2}}\cdot\frac{\cancel{(m-n)^2}\cancel{(m-n)^2}}{\cancel{(m+n)}\cancel{\left(m^2-mn+n^2\right)}}$$

$$=m-n$$

46. $\dfrac{x^2-4y^2}{x+2y}\div(x+2y)\cdot\dfrac{2y}{x-2y}=\dfrac{x^2-4y^2}{x+2y}\cdot\dfrac{1}{x+2y}\cdot\dfrac{2y}{x-2y}$

$$=\frac{\cancel{(x+2y)}\cancel{(x-2y)}}{\cancel{x+2y}}\cdot\frac{1}{x+2y}\cdot\frac{2y}{\cancel{x-2y}}=\frac{2y}{x+2y}$$

47. $\dfrac{x^2-6xy+9y^2}{x^2-4y^2}\cdot\dfrac{x^2-5xy+6y^2}{3y-x}\div\dfrac{x^2-9y^2}{x+2y}$

$$=\frac{x^2-6xy+9y^2}{x^2-4y^2}\cdot\frac{x^2-5xy+6y^2}{3y-x}\cdot\frac{x+2y}{x^2-9y^2}$$

$$=\frac{(x-3y)\cancel{(x-3y)}}{\cancel{(x+2y)}\cancel{(x-2y)}}\cdot\frac{\cancel{(x-3y)}\cancel{(x-2y)}}{-\cancel{(x-3y)}}\cdot\frac{\cancel{x+2y}}{(x+3y)\cancel{(x-3y)}}$$

$$=-\frac{x-3y}{x+3y}\text{ or }\frac{3y-x}{x+3y}$$

48. $\dfrac{8x^3-27y^3}{4x^2-9y^2}\div\dfrac{8x^2+12xy+18y^2}{2x+3y}=\dfrac{8x^3-27y^3}{4x^2-9y^2}\cdot\dfrac{2x+3y}{8x^2+12xy+18y^2}$

$$=\frac{\cancel{(2x-3y)}\cancel{\left(4x^2+6xy+9y^2\right)}}{\cancel{(2x+3y)}\cancel{(2x-3y)}}\cdot\frac{\cancel{2x+3y}}{2\cancel{\left(4x^2+6xy+9y^2\right)}}=\frac{1}{2}$$

49. $\dfrac{25m^2-1}{125m^3-1}\div\dfrac{5m+1}{25m^2+5m+1}=\dfrac{25m^2-1}{125m^3-1}\cdot\dfrac{25m^2+5m+1}{5m+1}$

$$=\frac{\cancel{(5m+1)}\cancel{(5m-1)}}{\cancel{(5m-1)}\cancel{(25m^2+5m+1)}}\cdot\frac{\cancel{25m^2+5m+1}}{\cancel{5m+1}}=1$$

50. $\dfrac{m^3+2m^2-mn^2-2n^2}{m^3-m^2-20m}\cdot\dfrac{m^3-25m}{m^3+m^2n-4m-4n}$

$$=\frac{m^2(m+2)-n^2(m+2)}{m(m^2-m-20)}\cdot\frac{m(m^2-25)}{m^2(m+n)-4(m+n)}$$

$$=\frac{(m+2)(m^2-n^2)}{m(m-5)(m+4)}\cdot\frac{m(m+5)(m-5)}{(m+n)(m^2-4)}$$

$$=\frac{\cancel{(m+2)}\cancel{(m+n)}(m-n)}{\cancel{m}\cancel{(m-5)}(m+4)}\cdot\frac{\cancel{m}(m+5)\cancel{(m-5)}}{\cancel{(m+n)}\cancel{(m+2)}(m-2)}=\frac{(m-n)(m+5)}{(m+4)(m-2)}$$

51. $\dfrac{2a^2+ab-8a-4b}{2a^2-6a+ab-3b}\cdot\dfrac{a^2-6a+9}{a^2-16}=\dfrac{a(2a+b)-4(2a+b)}{2a(a-3)+b(a-3)}\cdot\dfrac{(a-3)(a-3)}{(a+4)(a-4)}$

$=\dfrac{\cancel{(2a+b)}\,\cancel{(a-4)}}{\cancel{(a-3)}\,\cancel{(2a+b)}}\cdot\dfrac{(a-3)\,\cancel{(a-3)}}{(a+4)\,\cancel{(a-4)}}=\dfrac{a-3}{a+4}$

52. $\dfrac{7}{3x+15}\cdot(x+5)\div\dfrac{14}{9x-27}=\dfrac{\cancel{7}}{\cancel{3(x+5)}}\cdot\dfrac{\cancel{x+5}}{1}\cdot\dfrac{\cancel{3}\cdot 3(x-3)}{\cancel{7}\cdot 2}=\dfrac{3(x-3)}{2}$

53. $\dfrac{45}{2x+1}\cdot(8x+4)\div\dfrac{27}{4x+2}=\dfrac{5\cdot\cancel{9}}{\cancel{2x+1}}\cdot\dfrac{\cancel{4(2x+1)}}{1}\cdot\dfrac{2(2x+1)}{\cancel{9}\cdot 3}=\dfrac{40(2x+1)}{3}$

54. $\dfrac{12y+3}{6y^2-y-12}\div\dfrac{4y^2-19y-5}{2y^2-y-3}=\dfrac{12y+3}{6y^2-y-12}\cdot\dfrac{2y^2-y-3}{4y^2-19y-5}$

$=\dfrac{3\cancel{(4y+1)}}{(3y+4)\,\cancel{(2y-3)}}\cdot\dfrac{\cancel{(2y-3)}\,(y+1)}{\cancel{(4y+1)}\,(y-5)}$

$=\dfrac{3(y+1)}{(3y+4)(y-5)}$

55. $\dfrac{2x^2-11x-6}{3x-2}\div\dfrac{2x^2-5x-3}{3x^2-7x-6}=\dfrac{2x^2-11x-6}{3x-2}\cdot\dfrac{3x^2-7x-6}{2x^2-5x-3}$

$=\dfrac{\cancel{(2x+1)}\,(x-6)}{3x-2}\cdot\dfrac{(3x+2)\,\cancel{(x-3)}}{\cancel{(2x+1)}\,\cancel{(x-3)}}$

$=\dfrac{(x-6)(3x+2)}{3x-2}$

56. $A=\dfrac{1}{2}\left(\dfrac{4a^2}{b}\right)\left(\dfrac{b^2}{5a}\right)$

$=\dfrac{1}{\cancel{2}}\left(\dfrac{\cancel{2}\cdot 2a\cdot\cancel{a}}{\cancel{b}}\right)\left(\dfrac{b\cdot\cancel{b}}{5\cancel{a}}\right)$

$=\dfrac{2ab}{5}\ \text{in}^2$

57. $A=\dfrac{1}{2}\left(\dfrac{k^2}{2h^2}\right)\left(\dfrac{8}{hk}\right)$

$=\dfrac{1}{\cancel{2}}\left(\dfrac{k\cdot\cancel{k}}{\cancel{2}h^2}\right)\left(\dfrac{\cancel{2}\cdot\cancel{2}\cdot 2}{h\cancel{k}}\right)$

$=\dfrac{2k}{h^3}\ \text{cm}^2$

58. $A = \dfrac{x+2}{6} \cdot \dfrac{12x}{x^2-4}$

$= \dfrac{\cancel{x+2}}{\cancel{6}} \cdot \dfrac{\cancel{6} \cdot 2x}{\cancel{(x+2)}(x-2)} = \dfrac{2x}{x-2}$ m^2

59. $A = \dfrac{x^2}{x-3} \cdot \dfrac{5x-15}{4x}$

$= \dfrac{x \cdot \cancel{x}}{\cancel{x-3}} \cdot \dfrac{5\cancel{(x-3)}}{4\cancel{x}}$

$= \dfrac{5x}{4}$ ft^2

Section 5.3 Practice Exercises

1. **a.** $\dfrac{p+r}{q}$; $\dfrac{p-r}{q}$.

b. least common denominator

2. $\dfrac{x}{x-y} \div \dfrac{x^2}{y-x} = \dfrac{x}{x-y} \cdot \dfrac{y-x}{x^2} = \dfrac{\cancel{x}}{\cancel{x-y}} \cdot \dfrac{-\cancel{(x-y)}}{\cancel{x} \cdot x} = -\dfrac{1}{x}$

3. $\dfrac{9b+9}{4b+8} \cdot \dfrac{2b+4}{3b-3} = \dfrac{\cancel{3} \cdot 3(b+1)}{\cancel{2} \cdot 2\cancel{(b+2)}} \cdot \dfrac{\cancel{2}\,\cancel{(b+2)}}{\cancel{3}\,(b-1)} = \dfrac{3(b+1)}{2(b-1)}$

4. $\dfrac{8a^2}{7b^3} \div \dfrac{4a}{21b} = \dfrac{8a^2}{7b^3} \cdot \dfrac{21b}{4a} = \dfrac{2 \cdot \cancel{4} \cdot 3 \cdot \cancel{7}}{\cancel{7} \cdot \cancel{4}} a^{2-1}b^{1-3} = 6a^1b^{-2} = \dfrac{6a}{b^2}$

5. $\dfrac{(5-a)^2}{10a-2} \cdot \dfrac{25a^2-1}{a^2-10a+25} = \dfrac{(-1)^2\,\cancel{(a-5)^2}}{2\cancel{(5a-1)}} \cdot \dfrac{(5a+1)\cancel{(5a-1)}}{\cancel{(a-5)^2}} = \dfrac{5a+1}{2}$

6. $\dfrac{x^2-z^2}{14x^2z^4} \div \dfrac{x^2+2xz+z^2}{3xz^3} = \dfrac{x^2-z^2}{14x^2z^4} \cdot \dfrac{3xz^3}{x^2+2xz+z^2} = \dfrac{\cancel{(x+z)}(x-z)}{14x \cdot \cancel{x} \cdot z^{\cancel{3}} \cdot z} \cdot \dfrac{3\cancel{x}\,z^{\cancel{3}}}{\cancel{(x+z)}(x+z)}$

$= \dfrac{3(x-z)}{14xz(x+z)}$

7. $\dfrac{3}{5x} + \dfrac{7}{5x} = \dfrac{10}{5x} = \dfrac{\cancel{5} \cdot 2}{\cancel{5}x} = \dfrac{2}{x}$

8. $\dfrac{1}{2x^2} - \dfrac{5}{2x^2} = -\dfrac{4}{2x^2} = -\dfrac{\cancel{2} \cdot 2}{\cancel{2}x^2} = -\dfrac{2}{x^2}$

9. $\dfrac{x}{x^2-2x-3}-\dfrac{3}{x^2-2x-3}=\dfrac{x-3}{x^2-2x-3}$

$=\dfrac{\cancel{x-3}}{\cancel{(x-3)}(x+1)}=\dfrac{1}{x+1}$

10. $\dfrac{x}{x^2+4x-12}+\dfrac{6}{x^2+4x-12}=\dfrac{x+6}{x^2+4x-12}$

$=\dfrac{\cancel{x+6}}{\cancel{(x+6)}(x-2)}=\dfrac{1}{x-2}$

11. $\dfrac{5x-1}{(2x+9)(x-6)}-\dfrac{3x-6}{(2x+9)(x-6)}$

$=\dfrac{5x-1-(3x-6)}{(2x+9)(x-6)}$

$=\dfrac{5x-1-3x+6}{(2x+9)(x-6)}$

$=\dfrac{2x+5}{(2x+9)(x-6)}$

12. $\dfrac{4-x}{8x+1}-\dfrac{5x-6}{8x+1}=\dfrac{4-x-(5x-6)}{8x+1}$

$=\dfrac{4-x-5x+6}{8x+1}$

$=\dfrac{10-6x}{8x+1}$

$=\dfrac{-2(3x-5)}{8x+1}$

13. $\dfrac{x+2}{x-5}+\dfrac{x-12}{x-5}=\dfrac{2x-10}{x-5}=\dfrac{2\cancel{(x-5)}}{\cancel{x-5}}=2$

14. $\dfrac{2x-1}{x-2}+\dfrac{x-5}{x-2}=\dfrac{3x-6}{x-2}=\dfrac{3\cancel{(x-2)}}{\cancel{x-2}}=3$

15. $\dfrac{5}{8}=\dfrac{5}{2^3}, \qquad \dfrac{3}{20x}=\dfrac{3}{5\cdot 2^2 x}$

$\text{LCD}=2^3\cdot 5\cdot x=40x$

16. $\dfrac{y}{15a}=\dfrac{y}{3\cdot 5\cdot a}, \qquad \dfrac{y^2}{35}=\dfrac{y^2}{7\cdot 5}$

$\text{LCD}=3\cdot 5\cdot 7\cdot a=105a$

17. $\dfrac{-5}{6m^4}=\dfrac{-5}{2\cdot 3\cdot m^4}, \qquad \dfrac{1}{15mn^7}=\dfrac{1}{3\cdot 5\cdot mn^7}$

$\text{LCD}=2\cdot 3\cdot 5\cdot m^4n^7=30m^4n^7$

18. $\dfrac{13}{12cd^5}=\dfrac{13}{2^2\cdot 3\cdot cd^5}, \qquad \dfrac{9}{8c^3}=\dfrac{9}{2^3c^3}$

$\text{LCD}=2^3\cdot 3\cdot c^3d^5=24c^3d^5$

19. $\dfrac{6}{(x-4)(x+2)}, \qquad \dfrac{-8}{(x-4)(x-6)}$

$\text{LCD}=(x-4)(x+2)(x-6)$

20. $\dfrac{x}{(2x-1)(x-7)}, \qquad \dfrac{2}{(2x-1)(x+1)}$

$\text{LCD}=(2x-1)(x-7)(x+1)$

21. $\dfrac{3}{x(x-1)(x+7)^2}, \qquad \dfrac{-1}{x^2(x+7)}$

$\text{LCD}=x^2(x-1)(x+7)^2$

22. $\dfrac{14}{(x-2)^2(x+9)}, \qquad \dfrac{41}{x(x-2)(x+9)}$

$\text{LCD}=x(x-2)^2(x+9)$

23. $\dfrac{5}{x-6}, \quad \dfrac{x-5}{x^2-8x+12}=\dfrac{x-5}{(x-6)(x-2)}$

$\text{LCD}=(x-6)(x-2)$

24. $\dfrac{7a}{a+4}, \quad \dfrac{a+12}{a^2-16}=\dfrac{a+12}{(a+4)(a-4)}$

$\text{LCD}=(a+4)(a-4)$

25. $\dfrac{3a}{a-4}, \quad \dfrac{5}{4-a}=\dfrac{5(-1)}{(4-a)(-1)}=\dfrac{-5}{a-4}$

$\text{LCD}=a-4 \text{ or } 4-a$

26. $\dfrac{10}{x-6}, \quad \dfrac{x+1}{6-x}=\dfrac{(x+1)(-1)}{(6-x)(-1)}=\dfrac{-x-1}{x-6}$

$\text{LCD}=x-6 \text{ or } 6-x$

27. $\dfrac{5}{3x}=\dfrac{}{9x^2y}$

$\dfrac{5}{3x}\cdot\dfrac{3xy}{3xy}=\dfrac{15xy}{9x^2y}$

28. $\dfrac{-5}{xy}=\dfrac{}{4x^2y^3}$

$\dfrac{-5}{xy}\cdot\dfrac{4xy^2}{4xy^2}=\dfrac{-20xy^2}{4x^2y^3}$

29. $\dfrac{2x}{x-1}=\dfrac{}{x(x-1)(x+2)}$

$\dfrac{2x}{x-1}\cdot\dfrac{x(x+2)}{x(x+2)}=\dfrac{2x^2(x+2)}{x(x-1)(x+2)}$

$=\dfrac{2x^3+4x^2}{x(x-1)(x+2)}$

30. $\dfrac{5x}{2x-5}=\dfrac{}{(2x-5)(x+8)}$

$\dfrac{5x}{2x-5}\cdot\dfrac{x+8}{x+8}=\dfrac{5x^2+40x}{(2x-5)(x+8)}$

31. $\dfrac{y}{y+6}=\dfrac{}{y^2+5y-6}$

$\dfrac{y}{y+6}=\dfrac{}{(y+6)(y-1)}$

$\dfrac{y}{y+6}\cdot\dfrac{y-1}{y-1}=\dfrac{y^2-y}{(y+6)(y-1)}$

32. $\dfrac{t^2}{t-8}=\dfrac{}{t^2-6t-16}$

$\dfrac{t^2}{t-8}=\dfrac{}{(t-8)(t+2)}$

$\dfrac{t^2}{t-8}\cdot\dfrac{t+2}{t+2}=\dfrac{t^3+2t^2}{(t-8)(t+2)}$

33. $\dfrac{4}{3p}-\dfrac{5}{2p^2} \qquad \text{LCD}=2\cdot3\cdot p^2=6p^2$

$=\dfrac{4}{3p}\cdot\dfrac{2p}{2p}-\dfrac{5}{2p^2}\cdot\dfrac{3}{3}=\dfrac{8p}{6p^2}-\dfrac{15}{6p^2}$

$=\dfrac{8p-15}{6p^2}$

34. $\dfrac{6}{5a^2b}-\dfrac{1}{10ab} \qquad \text{LCD}=2\cdot5\cdot a^2b=10a^2b$

$=\dfrac{6}{5a^2b}\cdot\dfrac{2}{2}-\dfrac{1}{10ab}\cdot\dfrac{a}{a}=\dfrac{12}{10a^2b}-\dfrac{a}{10a^2b}$

$=\dfrac{12-a}{10a^2b}$

35. $\dfrac{s-1}{s}-\dfrac{t+1}{t}$ $\quad \text{LCD}=st$

$$=\frac{s-1}{s}\cdot\frac{t}{t}-\frac{t+1}{t}\cdot\frac{s}{s}=\frac{st-t}{st}-\frac{st+s}{st}$$
$$=\frac{st-t-st-s}{st}=\frac{-t-s}{st}$$

36. $\dfrac{x+2}{x}-\dfrac{y-2}{y}$ $\quad \text{LCD}=xy$

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

37. $\dfrac{4a-2}{3a+12}-\dfrac{a-2}{a+4}=\dfrac{4a-2}{3(a+4)}-\dfrac{a-2}{a+4}$

$\text{LCD}=3(a+4)$

$$=\frac{4a-2}{3(a+4)}-\frac{a-2}{a+4}\cdot\frac{3}{3}$$
$$=\frac{4a-2-3(a-2)}{3(a+4)}$$
$$=\frac{4a-2-3a+6}{3(a+4)}=\frac{\cancel{a+4}}{3\cancel{(a+4)}}=\frac{1}{3}$$

38. $\dfrac{6y+5}{5y-25}-\dfrac{y+2}{y-5}=\dfrac{6y+5}{5(y-5)}-\dfrac{y+2}{y-5}$

$\text{LCD}=5(y-5)$

$$=\frac{6y+5}{5(y-5)}-\frac{y+2}{y-5}\cdot\frac{5}{5}$$
$$=\frac{6y+5-5(y+2)}{5(y-5)}$$
$$=\frac{6y+5-5y-10}{5(y-5)}=\frac{\cancel{y-5}}{5\cancel{(y-5)}}=\frac{1}{5}$$

39. $\dfrac{10}{b(b+5)}+\dfrac{2}{b}$ $\quad \text{LCD}=b(b+5)$

$$=\frac{10}{b(b+5)}+\frac{2}{b}\cdot\frac{b+5}{b+5}=\frac{10+2(b+5)}{b(b+5)}$$
$$=\frac{10+2b+10}{b(b+5)}=\frac{2b+20}{b(b+5)}$$

40. $\dfrac{6}{w(w-2)}+\dfrac{3}{w}$ $\quad \text{LCD}=w(w-2)$

$$=\frac{6}{w(w-2)}+\frac{3}{w}\cdot\frac{w-2}{w-2}=\frac{6+3(w-2)}{w(w-2)}$$
$$=\frac{6+3w-6}{w(w-2)}=\frac{3\cancel{w}}{\cancel{w}(w-2)}=\frac{3}{w-2}$$

41. $\dfrac{x-2}{x-6}-\dfrac{x+2}{6-x}=\dfrac{x-2}{x-6}-\dfrac{x+2}{6-x}\cdot\dfrac{(-1)}{(-1)}$

$$=\frac{x-2}{x-6}-\frac{-(x+2)}{x-6}$$
$$=\frac{x-2+x+2}{x-6}$$
$$=\frac{2x}{x-6}$$

42. $\dfrac{x-10}{x-8}-\dfrac{x+10}{8-x}=\dfrac{x-10}{x-8}-\dfrac{x+10}{8-x}\cdot\dfrac{(-1)}{(-1)}$

$$=\frac{x-10}{x-8}-\frac{-(x+10)}{x-8}$$
$$=\frac{x-10+x+10}{x-8}$$
$$=\frac{2x}{x-8}$$

43. $\dfrac{6b}{b-4}-\dfrac{1}{b+1}$ $\quad \text{LCD}=(b-4)(b+1)$

$$=\frac{6b}{b-4}\cdot\frac{b+1}{b+1}-\frac{1}{b+1}\cdot\frac{b-4}{b-4}$$
$$=\frac{6b(b+1)-1(b-4)}{(b-4)(b+1)}$$
$$=\frac{6b^2+6b-b+4}{(b-4)(b+1)}=\frac{6b^2+5b+4}{(b-4)(b+1)}$$

44. $\dfrac{a}{a-3}-\dfrac{5}{a+6}$ $\quad \text{LCD}=(a-3)(a+6)$

$$=\frac{a}{a-3}\cdot\frac{a+6}{a+6}-\frac{5}{a+6}\cdot\frac{a-3}{a-3}$$
$$=\frac{a(a+6)-5(a-3)}{(a-3)(a+6)}=\frac{a^2+6a-5a+15}{(a-3)(a+6)}$$
$$=\frac{a^2+a+15}{(a-3)(a+6)}$$

45. $\dfrac{2}{2x+1}+\dfrac{4}{x-2}$

$\text{LCD}=(2x+1)(x-2)$

$$=\frac{2}{2x+1}\cdot\frac{x-2}{x-2}+\frac{4}{x-2}\cdot\frac{2x+1}{2x+1}$$
$$=\frac{2x-4+8x+4}{(2x+1)(x-2)}=\frac{10x}{(2x+1)(x-2)}$$

46. $\dfrac{3}{y+6}+\dfrac{1}{3y+1}$

$\text{LCD}=(y+6)(3y+1)$

$$=\frac{3}{y+6}\cdot\frac{3y+1}{3y+1}+\frac{1}{3y+1}\cdot\frac{y+6}{y+6}$$
$$=\frac{9y+3+y+6}{(y+6)(3y+1)}=\frac{10y+9}{(y+6)(3y+1)}$$

47. $\dfrac{y-2}{y-4}+\dfrac{2y^2-15y+12}{y^2-16}=\dfrac{y-2}{y-4}+\dfrac{2y^2-15y+12}{(y+4)(y-4)}$ $\quad \text{LCD}=(y+4)(y-4)$

$$=\frac{y-2}{y-4}\cdot\frac{y+4}{y+4}+\frac{2y^2-15y+12}{(y+4)(y-4)}=\frac{y^2+2y-8+2y^2-15y+12}{(y+4)(y-4)}=\frac{3y^2-13y+4}{(y+4)(y-4)}$$
$$=\frac{(3y-1)\cancel{(y-4)}}{(y+4)\cancel{(y-4)}}=\frac{3y-1}{y+4}$$

48. $\dfrac{x^2+13x+18}{x^2-9}+\dfrac{x+1}{x+3}=\dfrac{x^2+13x+18}{(x+3)(x-3)}+\dfrac{x+1}{x+3}$ $\quad \text{LCD}=(x+3)(x-3)$

$$=\frac{x^2+13x+18}{(x+3)(x-3)}+\frac{x+1}{x+3}\cdot\frac{x-3}{x-3}=\frac{x^2+13x+18+x^2-2x-3}{(x+3)(x-3)}=\frac{2x^2+11x+15}{(x+3)(x-3)}$$
$$=\frac{(2x+5)\cancel{(x+3)}}{\cancel{(x+3)}(x-3)}$$
$$=\frac{2x+5}{x-3}$$

49. $\dfrac{x+2}{x^2-36}-\dfrac{x}{x^2+9x+18}=\dfrac{x+2}{(x+6)(x-6)}-\dfrac{x}{(x+6)(x+3)}$ LCD $=(x+6)(x-6)(x+3)$

$=\dfrac{x+2}{(x+6)(x-6)}\cdot\dfrac{x+3}{x+3}-\dfrac{x}{(x+6)(x+3)}\cdot\dfrac{x-6}{x-6}=\dfrac{(x+2)(x+3)-x(x-6)}{(x+6)(x-6)(x+3)}$

$=\dfrac{x^2+5x+6-x^2+6x}{(x+6)(x-6)(x+3)}=\dfrac{11x+6}{(x+6)(x-6)(x+3)}$

50. $\dfrac{7}{x^2-x-2}+\dfrac{x}{x^2+4x+3}=\dfrac{7}{(x-2)(x+1)}+\dfrac{x}{(x+1)(x+3)}$ LCD $=(x-2)(x+1)(x+3)$

$=\dfrac{7}{(x-2)(x+1)}\cdot\dfrac{x+3}{x+3}+\dfrac{x}{(x+1)(x+3)}\cdot\dfrac{x-2}{x-2}$

$=\dfrac{7x+21+x^2-2x}{(x-2)(x+1)(x+3)}=\dfrac{x^2+5x+21}{(x-2)(x+1)(x+3)}$

51. $\dfrac{5}{w}+\dfrac{8}{-w}=\dfrac{5}{w}+\dfrac{8}{-w}\cdot\dfrac{(-1)}{(-1)}=\dfrac{5}{w}+\dfrac{-8}{w}=-\dfrac{3}{w}$

52. $\dfrac{4}{y}+\dfrac{5}{-y}=\dfrac{4}{y}+\dfrac{5}{-y}\cdot\dfrac{(-1)}{(-1)}=\dfrac{4}{y}+\dfrac{-5}{y}=-\dfrac{1}{y}$

53. $\dfrac{n}{5-n}+\dfrac{2n-5}{n-5}=\dfrac{n}{5-n}\cdot\dfrac{(-1)}{(-1)}+\dfrac{2n-5}{n-5}$

$=\dfrac{-n}{n-5}+\dfrac{2n-5}{n-5}=\dfrac{n-5}{n-5}=1$

54. $\dfrac{c}{7-c}+\dfrac{2c-7}{c-7}=\dfrac{c}{7-c}\cdot\dfrac{(-1)}{(-1)}+\dfrac{2c-7}{c-7}$

$=\dfrac{-c}{c-7}+\dfrac{2c-7}{c-7}=\dfrac{c-7}{c-7}=1$

55. $\dfrac{2}{3x-15}+\dfrac{x}{25-x^2}=\dfrac{2}{3x-15}+\dfrac{x}{25-x^2}\cdot\dfrac{(-1)}{(-1)}$

$=\dfrac{2}{3(x-5)}+\dfrac{-x}{(x+5)(x-5)}$ LCD $=3(x+5)(x-5)$

$=\dfrac{2}{3(x-5)}\cdot\dfrac{x+5}{x+5}+\dfrac{-x}{(x+5)(x-5)}\cdot\dfrac{3}{3}$

$=\dfrac{2x+10-3x}{3(x+5)(x-5)}$

$=\dfrac{10-x}{3(x+5)(x-5)}$

56. $\dfrac{5}{9-x^2}-\dfrac{4}{x^2+4x+3}=\dfrac{5}{9-x^2}\cdot\dfrac{(-1)}{(-1)}-\dfrac{4}{x^2+4x+3}=\dfrac{-5}{(x+3)(x-3)}-\dfrac{4}{(x+3)(x+1)}$

$\text{LCD}=(x+3)(x-3)(x+1)$

$=\dfrac{-5}{(x+3)(x-3)}\cdot\dfrac{x+1}{x+1}-\dfrac{4}{(x+3)(x+1)}\cdot\dfrac{x-3}{x-3}=\dfrac{-5(x+1)-4(x-3)}{(x+3)(x-3)(x+1)}$

$=\dfrac{-5x-5-4x+12}{(x+3)(x-3)(x+1)}=\dfrac{-9x+7}{(x+3)(x-3)(x+1)}$

57. $\dfrac{m}{20+9m+m^2}-\dfrac{4}{12+7m+m^2}=\dfrac{m}{(m+5)(m+4)}-\dfrac{4}{(m+4)(m+3)}$

$\text{LCD}=(m+5)(m+4)(m+3)$

$=\dfrac{m}{(m+5)(m+4)}\cdot\dfrac{m+3}{m+3}-\dfrac{4}{(m+4)(m+3)}\cdot\dfrac{m+5}{m+5}$

$=\dfrac{m^2+3m}{(m+5)(m+4)(m+3)}-\dfrac{4m+20}{(m+5)(m+4)(m+3)}$

$=\dfrac{m^2+3m-4m-20}{(m+5)(m+4)(m+3)}=\dfrac{m^2-m-20}{(m+5)(m+4)(m+3)}$

$=\dfrac{(m-5)\cancel{(m+4)}}{(m+5)\cancel{(m+4)}(m+3)}=\dfrac{m-5}{(m+5)(m+3)}$

58. $\dfrac{t}{6+5t+t^2}-\dfrac{2}{2+3t+t^2}=\dfrac{t}{(t+3)(t+2)}-\dfrac{2}{(t+2)(t+1)}$

$\text{LCD}=(t+3)(t+2)(t+1)$

$=\dfrac{t}{(t+3)(t+2)}\cdot\dfrac{t+1}{t+1}-\dfrac{2}{(t+2)(t+1)}\cdot\dfrac{t+3}{t+3}=\dfrac{t^2+t}{(t+3)(t+2)(t+1)}-\dfrac{2t+6}{(t+3)(t+2)(t+1)}$

$=\dfrac{t^2+t-2t-6}{(t+3)(t+2)(t+1)}=\dfrac{t^2-t-6}{(t+3)(t+2)(t+1)}$

$=\dfrac{(t-3)\cancel{(t+2)}}{(t+3)\cancel{(t+2)}(t+1)}$

$=\dfrac{t-3}{(t+3)(t+1)}$

59. $\dfrac{x+3}{x^2}+\dfrac{x+5}{2x}$ $\quad \text{LCD}=2x^2$

$$=\frac{x+3}{x^2}\cdot\frac{2}{2}+\frac{x+5}{2x}\cdot\frac{x}{x}$$
$$=\frac{2x+6}{2x^2}+\frac{x^2+5x}{2x^2}$$
$$=\frac{x^2+7x+6}{2x^2}$$

60. $\dfrac{x+2}{5x^2}+\dfrac{x+4}{15x}$ $\quad \text{LCD}=3\cdot 5\cdot x^2=15x^2$

$$=\frac{x+2}{5x^2}\cdot\frac{3}{3}+\frac{x+4}{15x}\cdot\frac{x}{x}$$
$$=\frac{3x+6}{15x^2}+\frac{x^2+4x}{15x^2}$$
$$=\frac{x^2+7x+6}{15x^2}$$

61. $w+2+\dfrac{1}{w-2}$ $\quad \text{LCD}=w-2$

$$=(w+2)\cdot\frac{w-2}{w-2}+\frac{1}{w-2}$$
$$=\frac{w^2-4+1}{w-2}$$
$$=\frac{w^2-3}{w-2}$$

62. $h-3+\dfrac{1}{h+3}$ $\quad \text{LCD}=h+3$

$$=(h-3)\cdot\frac{h+3}{h+3}+\frac{1}{h+3}$$
$$=\frac{h^2-9+1}{h+3}$$
$$=\frac{h^2-8}{h+3}$$

63. $\dfrac{9}{x^2-2x+1}-\dfrac{x-3}{x^2-x}=\dfrac{9}{(x-1)^2}-\dfrac{x-3}{x(x-1)}$ $\quad \text{LCD}=x(x-1)^2$

$$=\frac{9}{(x-1)^2}\cdot\frac{x}{x}-\frac{x-3}{x(x-1)}\cdot\frac{x-1}{x-1}=\frac{9x-(x^2-4x+3)}{x(x-1)^2}$$
$$=\frac{9x-x^2+4x-3}{x(x-1)^2}=\frac{-x^2+13x-3}{x(x-1)^2}$$

64. $\dfrac{2}{4z^2-12z+9}-\dfrac{z+1}{2z^2-3z}=\dfrac{2}{(2z-3)^2}-\dfrac{z+1}{z(2z-3)}$ $\quad \text{LCD}=z(2z-3)^2$

$$=\frac{2}{(2z-3)^2}\cdot\frac{z}{z}-\frac{z+1}{z(2z-3)}\cdot\frac{2z-3}{2z-3}$$
$$=\frac{2z-(2z^2-z-3)}{z(2z-3)^2}$$
$$=\frac{2z-2z^2+z+3}{z(2z-3)^2}$$
$$=\frac{-2z^2+3z+3}{z(2z-3)^2}$$

65. $\dfrac{t+1}{t+3}-\dfrac{t-2}{t-3}+\dfrac{6}{t^2-9}=\dfrac{t+1}{t+3}-\dfrac{t-2}{t-3}+\dfrac{6}{(t+3)(t-3)}$ LCD $=(t+3)(t-3)$

$=\dfrac{t+1}{t+3}\cdot\dfrac{t-3}{t-3}-\dfrac{t-2}{t-3}\cdot\dfrac{t+3}{t+3}+\dfrac{6}{(t+3)(t-3)}=\dfrac{t^2-2t-3-(t^2+t-6)+6}{(t+3)(t-3)}$

$=\dfrac{t^2-2t-3-t^2-t+6+6}{(t+3)(t-3)}=\dfrac{-3t+9}{(t+3)(t-3)}=\dfrac{-3\cancel{(t-3)}}{(t+3)\cancel{(t-3)}}=-\dfrac{3}{t+3}$

66. $\dfrac{y-3}{y-2}-\dfrac{y+1}{2y-5}+\dfrac{-4y+7}{2y^2-9y+10}$

$=\dfrac{y-3}{y-2}-\dfrac{y+1}{2y-5}+\dfrac{-4y+7}{(2y-5)(y-2)}$ LCD $=(2y-5)(y-2)$

$=\dfrac{y-3}{y-2}\cdot\dfrac{2y-5}{2y-5}-\dfrac{y+1}{2y-5}\cdot\dfrac{y-2}{y-2}+\dfrac{-4y+7}{(2y-5)(y-2)}$

$=\dfrac{2y^2-11y+15-(y^2-y-2)-4y+7}{(2y-5)(y-2)}$

$=\dfrac{2y^2-11y+15-y^2+y+2-4y+7}{(2y-5)(y-2)}$

$=\dfrac{y^2-14y+24}{(2y-5)(y-2)}=\dfrac{(y-12)\cancel{(y-2)}}{(2y-5)\cancel{(y-2)}}=\dfrac{y-12}{2y-5}$

67. $(x-1)\cdot\left[\dfrac{3}{x^2-1}+\dfrac{x}{2x-2}\right]=\dfrac{3\cancel{(x-1)}}{(x+1)\cancel{(x-1)}}+\dfrac{x\cancel{(x-1)}}{2\cancel{(x-1)}}=\dfrac{3}{x+1}+\dfrac{x}{2}$ LCD $=2(x+1)$

$=\dfrac{3}{x+1}\cdot\dfrac{2}{2}+\dfrac{x}{2}\cdot\dfrac{x+1}{x+1}=\dfrac{6+x^2+x}{2(x+1)}=\dfrac{x^2+x+6}{2(x+1)}$

68. $(3x-2)\cdot\left[\dfrac{x}{3x^2+x-2}+\dfrac{2}{x+1}\right]=\dfrac{x\cancel{(3x-2)}}{\cancel{(3x-2)}(x+1)}+\dfrac{2(3x-2)}{x+1}=\dfrac{x}{x+1}+\dfrac{6x-4}{x+1}$

$=\dfrac{x}{x+1}+\dfrac{6x-4}{x+1}=\dfrac{7x-4}{x+1}$

69. $\dfrac{3z}{z-3}-\dfrac{z}{z+4}$ LCD $=(z-3)(z+4)$

$=\dfrac{3z}{z-3}\cdot\dfrac{z+4}{z+4}-\dfrac{z}{z+4}\cdot\dfrac{z-3}{z-3}=\dfrac{3z^2+12z-(z^2-3z)}{(z-3)(z+4)}=\dfrac{3z^2+12z-z^2+3z}{(z-3)(z+4)}=\dfrac{2z^2+15z}{(z-3)(z+4)}$

70. $\dfrac{2p}{p-5}-\dfrac{p}{p+6}$ $\quad \text{LCD}=(p-5)(p+6)$

$$=\frac{2p}{p-5}\cdot\frac{p+6}{p+6}-\frac{p}{p+6}\cdot\frac{p-5}{p-5}=\frac{2p^2+12p-(p^2-5p)}{(p-5)(p+6)}$$
$$=\frac{2p^2+12p-p^2+5p}{(p-5)(p+6)}=\frac{p^2+17p}{(p-5)(p+6)}$$

71. $\dfrac{2x}{x^2-y^2}-\dfrac{1}{x-y}+\dfrac{1}{y-x}=\dfrac{2x}{(x+y)(x-y)}-\dfrac{1}{x-y}+\dfrac{1}{y-x}$ $\quad \text{LCD}=(x+y)(x-y)$

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

72. $\dfrac{3w-1}{2w^2+w-3}-\dfrac{2-w}{w-1}-\dfrac{w}{1-w}=\dfrac{3w-1}{(2w+3)(w-1)}-\dfrac{2-w}{w-1}-\dfrac{w}{1-w}$ $\quad \text{LCD}=(2w+3)(w-1)$

$$=\frac{3w-1}{(2w+3)(w-1)}-\frac{2-w}{w-1}\cdot\frac{2w+3}{2w+3}-\frac{w}{1-w}\cdot\frac{(-1)}{(-1)}\cdot\frac{2w+3}{2w+3}$$
$$=\frac{3w-1-(-2w^2+w+6)-(-2w^2-3w)}{(2w+3)(w-1)}$$
$$=\frac{3w-1+2w^2-w-6+2w^2+3w}{(2w+3)(w-1)}=\frac{4w^2+5w-7}{(2w+3)(w-1)}$$

73. $(2p+1)\cdot\left[\dfrac{2p}{6p+3}-\dfrac{1}{p+4}\right]=\dfrac{2p\cancel{(2p+1)}}{3\cancel{(2p+1)}}-\dfrac{2p+1}{p+4}=\dfrac{2p}{3}-\dfrac{2p+1}{p+4}$ $\quad \text{LCD}=3(p+4)$

$$=\frac{2p}{3}\cdot\frac{p+4}{p+4}-\frac{2p+1}{p+4}\cdot\frac{3}{3}=\frac{2p^2+8p-(6p+3)}{3(p+4)}=\frac{2p^2+8p-6p-3}{3(p+4)}$$
$$=\frac{2p^2+2p-3}{3(p+4)}$$

74. $(y+8)\cdot\left[\dfrac{4}{2y+1}-\dfrac{y}{2y^2+17y+8}\right]=\dfrac{4(y+8)}{2y+1}-\dfrac{y\cancel{(y+8)}}{(2y+1)\cancel{(y+8)}}$ LCD $=(2y+1)$

$=\dfrac{4y+32}{2y+1}-\dfrac{y}{2y+1}=\dfrac{4y+32-y}{2y+1}=\dfrac{3y+32}{2y+1}$

75. $\dfrac{1}{x+5}+\dfrac{3}{(x+5)^2}-\dfrac{2}{(x+5)^3}$ LCD $=(x+5)^3$

$=\dfrac{1}{x+5}\cdot\dfrac{(x+5)^2}{(x+5)^2}+\dfrac{3}{(x+5)^2}\cdot\dfrac{x+5}{x+5}-\dfrac{2}{(x+5)^3}=\dfrac{(x+5)^2}{(x+5)^3}+\dfrac{3x+15}{(x+5)^3}-\dfrac{2}{(x+5)^3}$

$=\dfrac{x^2+10x+25+3x+15-2}{(x+5)^3}=\dfrac{x^2+13x+38}{(x+5)^3}$

76. $\dfrac{1}{x-2}+\dfrac{4}{(x-2)^2}-\dfrac{3}{(x-2)^3}$ LCD $=(x-2)^3$

$=\dfrac{1}{x-2}\cdot\dfrac{(x-2)^2}{(x-2)^2}+\dfrac{4}{(x-2)^2}\cdot\dfrac{x-2}{x-2}-\dfrac{3}{(x-2)^3}$

$=\dfrac{(x-2)^2}{(x-2)^3}+\dfrac{4x-8}{(x-2)^3}-\dfrac{3}{(x-2)^3}$

$=\dfrac{x^2-4x+4+4x-8-3}{(x-2)^3}=\dfrac{x^2-7}{(x-2)^3}$

77. $\dfrac{-10}{z^2-6z+5}+\dfrac{15}{z^2-4z-5}=\dfrac{-10}{(z-5)(z-1)}+\dfrac{15}{(z-5)(z+1)}$ LCD $=(z-5)(z-1)(z+1)$

$=\dfrac{-10}{(z-5)(z-1)}\cdot\dfrac{z+1}{z+1}+\dfrac{15}{(z-5)(z+1)}\cdot\dfrac{z-1}{z-1}=\dfrac{-10z-10}{(z-5)(z-1)(z+1)}+\dfrac{15z-15}{(z-5)(z-1)(z+1)}$

$=\dfrac{5z-25}{(z-5)(z-1)(z+1)}$

$=\dfrac{5\cancel{(z-5)}}{\cancel{(z-5)}(z-1)(z+1)}$

$=\dfrac{5}{(z-1)(z+1)}$

78. $\dfrac{-4}{n^2+6n+5}+\dfrac{3}{n^2+7n+10}=\dfrac{-4}{(n+5)(n+1)}+\dfrac{3}{(n+5)(n+2)}$ $\quad \text{LCD}=(n+5)(n+1)(n+2)$

$$=\frac{-4}{(n+5)(n+1)}\cdot\frac{n+2}{n+2}+\frac{3}{(n+5)(n+2)}\cdot\frac{n+1}{n+1}$$

$$=\frac{-4n-8}{(n+5)(n+1)(n+2)}+\frac{3n+3}{(n+5)(n+1)(n+2)}=\frac{-n-5}{(n+5)(n+1)(n+2)}$$

$$=\frac{-\cancel{(n+5)}}{\cancel{(n+5)}(n+1)(n+2)}=-\frac{1}{(n+1)(n+2)}$$

79. $\dfrac{5}{x^2-4}+\dfrac{2}{x^3-8}$

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

$\text{LCD}=(x-2)(x+2)(x^2+2x+4)$

$$=\frac{5}{(x-2)(x+2)}\cdot\frac{x^2+2x+4}{x^2+2x+4}+\frac{2}{(x-2)(x^2+2x+4)}\cdot\frac{x+2}{x+2}$$

$$=\frac{5x^2+10x+20+2x+4}{(x-2)(x+2)(x^2+2x+4)}$$

$$=\frac{5x^2+12x+24}{(x-2)(x+2)(x^2+2x+4)}$$

80. $\dfrac{-2}{x^2-9}+\dfrac{3}{x^3-27}$

$$=\frac{-2}{(x-3)(x+3)}+\frac{3}{(x-3)(x^2+3x+9)}$$

$\text{LCD}=(x-3)(x+3)(x^2+3x+9)$

$$=\frac{-2}{(x-3)(x+3)}\cdot\frac{x^2+3x+9}{x^2+3x+9}+\frac{3}{(x-3)(x^2+3x+9)}\cdot\frac{x+3}{x+3}$$

$$=\frac{-2x^2-6x-18+3x+9}{(x-3)(x+3)(x^2+3x+9)}$$

$$=\frac{-2x^2-3x-9}{(x-3)(x+3)(x^2+3x+9)}$$

81. $\dfrac{2}{3x}+\dfrac{x+1}{x}+\dfrac{6}{x^2}$ LCD $=3x^2$

$$=\frac{2}{3x}\cdot\frac{x}{x}+\frac{x+1}{x}\cdot\frac{3x}{3x}+\frac{6}{x^2}\cdot\frac{3}{3}$$
$$=\frac{2x+3x^2+3x+18}{3x^2}$$
$$=\frac{3x^2+5x+18}{3x^2}\text{ cm}$$

82. $\dfrac{x+1}{x}+\dfrac{2}{x^2}+\dfrac{x-4}{3}$ LCD $=3x^2$

$$=\frac{x+1}{x}\cdot\frac{3x}{3x}+\frac{2}{x^2}\cdot\frac{3}{3}+\frac{x-4}{3}\cdot\frac{x^2}{x^2}$$
$$=\frac{3x^2+3x+6+x^3-4x^2}{3x^2}$$
$$=\frac{x^3-x^2+3x+6}{3x^2}\text{ yd}$$

83 $2\left(\dfrac{5}{x-3}\right)+2\left(\dfrac{2x}{x+5}\right)$

LCD $=(x-3)(x+5)$

$$=\frac{10}{x-3}\cdot\frac{x+5}{x+5}+\frac{4x}{x+5}\cdot\frac{x-3}{x-3}$$
$$=\frac{10x+50+4x^2-12x}{(x-3)(x+5)}$$
$$=\frac{4x^2-2x+50}{(x-3)(x+5)}\text{ m}$$

84. $2\left(\dfrac{3}{x+2}\right)+2\left(\dfrac{x}{x+1}\right)$

LCD $=(x+2)(x+1)$

$$=\frac{6}{x+2}\cdot\frac{x+1}{x+1}+\frac{2x}{x+1}\cdot\frac{x+2}{x+2}$$
$$=\frac{6x+6+2x^2+4x}{(x+2)(x+1)}$$
$$=\frac{2x^2+10x+6}{(x+2)(x+1)}\text{ ft}$$

Section 5.4 Practice Exercises

1. complex

2. $\dfrac{x^3+y^3}{5x+5y}=\dfrac{\cancel{(x+y)}\left(x^2-xy+y^2\right)}{5\cancel{(x+y)}}$

$$=\frac{x^2-xy+y^2}{5}$$

3. $\dfrac{25a^3b^3c}{15a^4bc}=\dfrac{25}{15}a^{3-4}b^{3-1}c^{1-1}=\dfrac{5}{3}a^{-1}b^2c^0=\dfrac{5b^2}{3a}$

4. $f(t)=\dfrac{6t^2-27t+30}{12t-30}$

$$=\frac{3\left(2t^2-9t+10\right)}{6(2t-5)}$$
$$=\frac{\cancel{3}\cancel{(2t-5)}(t-2)}{\cancel{3}\cdot 2\cancel{(2t-5)}}=\frac{t-2}{2}$$

5. $\dfrac{5}{x^2}+\dfrac{3}{2x}$ LCD $=2x^2$

$$=\frac{5}{x^2}\cdot\frac{2}{2}+\frac{3}{2x}\cdot\frac{x}{x}$$
$$=\frac{10+3x}{2x^2}$$

6. $\dfrac{2y-4}{y+1}\cdot\dfrac{y^2+3y+2}{y^2-4}$

$$=\frac{2\cancel{(y-2)}}{\cancel{y+1}}\cdot\frac{\cancel{(y+2)}\cancel{(y+1)}}{\cancel{(y+2)}\cancel{(y-2)}}=2$$

7. $\dfrac{3}{a-5}-\dfrac{1}{a+1}$ LCD $=(a-5)(a+1)$

$$=\frac{3}{a-5}\cdot\frac{a+1}{a+1}-\frac{1}{a+1}\cdot\frac{a-5}{a-5}$$

$$=\frac{3a+3-a+5}{(a-5)(a+1)}=\frac{2a+8}{(a-5)(a+1)}$$

8. $\dfrac{7}{12-6b}\div\dfrac{14b}{b^2+b-6}=\dfrac{7}{12-6b}\cdot\dfrac{b^2+b-6}{14b}$

$$=\frac{\cancel{7}}{-6\cancel{(b-2)}}\cdot\frac{(b+3)\cancel{(b-2)}}{\cancel{7}\cdot 2b}=-\frac{b+3}{12b}$$

9. $\dfrac{\dfrac{5x^2}{9y^2}}{\dfrac{3x}{y^2x}}=\dfrac{5x^2}{9\cancel{y^2}}\cdot\dfrac{\cancel{y^2}\,\cancel{x}}{3\cancel{x}}=\dfrac{5x^2}{27}$

10. $\dfrac{\dfrac{3w^2}{4rs}}{\dfrac{15wr}{s^2}}=\dfrac{3w^2}{4rs}\cdot\dfrac{s^2}{15wr}=\dfrac{\cancel{3}\cdot\cancel{w}\cdot w\cdot\cancel{s}\cdot s}{4\cdot\cancel{3}\cdot 5\cdot r^2\cdot\cancel{s}\cdot\cancel{w}}$

$$=\frac{ws}{20r^2}$$

11. $\dfrac{\dfrac{x-6}{3x}}{\dfrac{3x-18}{9}}=\dfrac{x-6}{3x}\cdot\dfrac{9}{3x-18}$

$$=\frac{\cancel{x-6}}{\cancel{3}x}\cdot\frac{\cancel{3}\cdot\cancel{3}}{\cancel{3}\cancel{(x-6)}}=\frac{1}{x}$$

12. $\dfrac{\dfrac{a+4}{6}}{\dfrac{16-a^2}{3}}=\dfrac{a+4}{6}\cdot\dfrac{3}{16-a^2}$

$$=\frac{\cancel{a+4}}{\cancel{3}\cdot 2}\cdot\frac{\cancel{3}}{\cancel{(4+a)}(4-a)}$$

$$=\frac{1}{2(4-a)}$$

13. $\dfrac{\frac{2}{3}+\frac{1}{6}}{\frac{1}{2}-\frac{1}{4}}=\dfrac{\frac{4}{6}+\frac{1}{6}}{\frac{2}{4}-\frac{1}{4}}=\dfrac{\frac{5}{6}}{\frac{1}{4}}=\dfrac{5}{6}\cdot\dfrac{4}{1}$

$$=\frac{5}{\cancel{2}\cdot 3}\cdot\frac{\cancel{2}\cdot 2}{1}=\frac{10}{3}$$

14. $\dfrac{\frac{7}{8}+\frac{3}{4}}{\frac{1}{3}-\frac{5}{6}}=\dfrac{\frac{7}{8}+\frac{6}{8}}{\frac{2}{6}-\frac{5}{6}}=\dfrac{\frac{13}{8}}{\frac{-3}{6}}=\dfrac{13}{8}\cdot\dfrac{6}{-3}$

$$=-\frac{13}{4\cdot\cancel{2}}\cdot\frac{\cancel{2}\cdot\cancel{3}}{\cancel{3}}=-\frac{13}{4}$$

15. $\dfrac{8-\frac{5}{2x}}{\frac{5}{8x}-2}=\dfrac{8\cdot\frac{2x}{2x}-\frac{5}{2x}}{\frac{5}{8x}-2\cdot\frac{8x}{8x}}=\dfrac{\frac{16x-5}{2x}}{\frac{5-16x}{8x}}$

$$=\frac{\cancel{16x-5}}{\cancel{2}x}\cdot\frac{\cancel{2}\cdot 4\cancel{x}}{-\cancel{(16x-5)}}=\frac{4}{-1}=-4$$

16.
$$\frac{10-\frac{3}{5x}}{\frac{3}{10x}-5}=\frac{10\cdot\frac{5x}{5x}-\frac{3}{5x}}{\frac{3}{10x}-5\cdot\frac{10x}{10x}}$$
$$=\frac{\frac{50x-3}{5x}}{\frac{3-50x}{10x}}$$
$$=\frac{\cancel{50x-3}}{\cancel{5x}}\cdot\frac{2\cdot\cancel{5x}}{-\cancel{(50x-3)}}$$
$$=\frac{2}{-1}=-2$$

17.
$$\frac{\frac{7y}{y+3}}{\frac{1}{4y+12}}=\frac{\frac{7y}{y+3}}{\frac{1}{4(y+3)}}\qquad \text{LCD}=4(y+3)$$
$$\frac{4\cancel{(y+3)}\left(\frac{7y}{\cancel{y+3}}\right)}{\cancel{4}\cancel{(y+3)}\left(\frac{1}{\cancel{4}\cancel{(y+3)}}\right)}=\frac{4(7y)}{1}=28y$$

18.
$$\frac{\frac{6x}{x-5}}{\frac{1}{4x-20}}=\frac{\frac{6x}{x-5}}{\frac{1}{4(x-5)}}\qquad \text{LCD}=4(x-5)$$
$$\frac{4\cancel{(x-5)}\left(\frac{6x}{\cancel{x-5}}\right)}{\cancel{4}\cancel{(x-5)}\left(\frac{1}{\cancel{4}\cancel{(x-5)}}\right)}=\frac{4(6x)}{1}=24x$$

19.
$$\frac{1+\frac{1}{3}}{\frac{5}{6}-1}\qquad \text{LCD}=6$$
$$\frac{6\left(1+\frac{1}{3}\right)}{6\left(\frac{5}{6}-1\right)}=\frac{6\cdot1+6\left(\frac{1}{3}\right)}{6\left(\frac{5}{6}\right)-6\cdot1}=\frac{6+2}{5-6}=\frac{8}{-1}=-8$$

20.
$$\frac{2+\frac{4}{5}}{-1+\frac{3}{10}}\qquad \text{LCD}=10$$
$$\frac{10\left(2+\frac{4}{5}\right)}{10\left(-1+\frac{3}{10}\right)}=\frac{10\cdot2+10\left(\frac{4}{5}\right)}{10(-1)+10\left(\frac{3}{10}\right)}$$
$$=\frac{20+8}{-10+3}$$
$$=\frac{28}{-7}=-4$$

21.
$$\frac{\frac{3q}{p}-q}{q-\frac{q}{p}}\qquad \text{LCD}=p$$
$$\frac{p\left(\frac{3q}{p}-q\right)}{p\left(q-\frac{q}{p}\right)}=\frac{\cancel{p}\left(\frac{3q}{\cancel{p}}\right)-pq}{pq-\cancel{p}\left(\frac{q}{\cancel{p}}\right)}$$
$$=\frac{3q-pq}{pq-q}$$
$$=\frac{\cancel{q}(3-p)}{\cancel{q}(p-1)}=\frac{3-p}{p-1}$$

22. $\dfrac{\frac{b}{a}+3b}{b+\frac{2b}{a}}$ LCD $= a$

$$\frac{a\left(\frac{b}{a}+3b\right)}{a\left(b+\frac{2b}{a}\right)}=\frac{\cancel{a}\left(\frac{b}{\cancel{a}}\right)+a(3b)}{a(b)+\cancel{a}\left(\frac{2b}{\cancel{a}}\right)}=\frac{b+3ab}{ab+2b}$$

$$=\frac{\cancel{b}(1+3a)}{\cancel{b}(a+2)}=\frac{1+3a}{a+2}$$

23. $\dfrac{\frac{2}{a}+\frac{3}{a^2}}{\frac{4}{a^2}-\frac{9}{a}}$ LCD $= a^2$

$$\frac{a^2\left(\frac{2}{a}+\frac{3}{a^2}\right)}{a^2\left(\frac{4}{a^2}-\frac{9}{a}\right)}=\frac{a^2\left(\frac{2}{a}\right)+a^2\left(\frac{3}{a^2}\right)}{a^2\left(\frac{4}{a^2}\right)-a^2\left(\frac{9}{a}\right)}$$

$$=\frac{2a+3}{4-9a}$$

24. $\dfrac{\frac{2}{y^2}+\frac{1}{y}}{\frac{4}{y^2}-\frac{1}{y}}$ LCD $= y^2$

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

25. $\dfrac{t^{-1}-1}{1-t^{-2}}=\dfrac{\frac{1}{t}-1}{1-\frac{1}{t^2}}$ LCD $= t^2$

$$\frac{t^2\left(\frac{1}{t}-1\right)}{t^2\left(1-\frac{1}{t^2}\right)}=\frac{t^2\left(\frac{1}{t}\right)-t^2(1)}{t^2(1)-t^2\left(\frac{1}{t^2}\right)}=\frac{t-t^2}{t^2-1}$$

$$=\frac{-t\cancel{(t-1)}}{(t+1)\cancel{(t-1)}}=-\frac{t}{t+1}$$

26. $\dfrac{d^{-2}-c^{-2}}{c^{-1}-d^{-1}}=\dfrac{\frac{1}{d^2}-\frac{1}{c^2}}{\frac{1}{c}-\frac{1}{d}}$ LCD $= c^2d^2$

$$\frac{c^2d^2\left(\frac{1}{d^2}-\frac{1}{c^2}\right)}{c^2d^2\left(\frac{1}{c}-\frac{1}{d}\right)}=\frac{c^2d^2\left(\frac{1}{d^2}\right)-c^2d^2\left(\frac{1}{c^2}\right)}{c^2d^2\left(\frac{1}{c}\right)-c^2d^2\left(\frac{1}{d}\right)}$$

$$=\frac{c^2-d^2}{cd^2-c^2d}=\frac{(c+d)\cancel{(c-d)}}{-cd\cancel{(c-d)}}$$

$$=-\frac{c+d}{cd}$$

27. $\dfrac{-8}{\frac{6w}{w-1}-4}$ LCD $= w-1$

$$\frac{(w-1)(-8)}{(w-1)\left(\frac{6w}{w-1}-4\right)}$$

$$=\frac{(w-1)(-8)}{\cancel{(w-1)}\left(\frac{6w}{\cancel{w-1}}\right)-(w-1)4}$$

$$=\frac{-8w+8}{6w-4w+4}=\frac{-8w+8}{2w+4}$$

$$=\frac{-4\cdot\cancel{2}(w-1)}{\cancel{2}(w+2)}=-\frac{4(w-1)}{w+2}$$

28. $\dfrac{6}{2z-\dfrac{10}{z-4}}$ LCD $= z-4$

$$\frac{(z-4)(6)}{(z-4)\left(2z-\dfrac{10}{z-4}\right)}$$

$$= \frac{(z-4)(6)}{(z-4)(2z)-\cancel{(z-4)}\left(\dfrac{10}{\cancel{z-4}}\right)}$$

$$= \frac{6z-24}{2z^2-8z-10} = \frac{6(z-4)}{2(z^2-4z-5)}$$

$$= \frac{\cancel{2}\cdot 3(z-4)}{\cancel{2}(z-5)(z+1)}$$

$$= \frac{3(z-4)}{(z-5)(z+1)}$$

29. $\dfrac{\dfrac{y}{y+3}}{\dfrac{y}{y+3}+y}$ LCD $= y+3$

$$\frac{(y+3)\left(\dfrac{y}{y+3}\right)}{(y+3)\left(\dfrac{y}{y+3}+y\right)}$$

$$= \frac{\cancel{(y+3)}\left(\dfrac{y}{\cancel{y+3}}\right)}{\cancel{(y+3)}\left(\dfrac{y}{\cancel{y+3}}\right)+(y+3)y}$$

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

$$= \frac{y}{y(y+4)} = \frac{1}{y+4}$$

30. $\dfrac{\dfrac{4}{w-4}}{\dfrac{4}{w-4}-1}$ LCD $= w-4$

$$\frac{(w-4)\left(\dfrac{4}{w-4}\right)}{(w-4)\left(\dfrac{4}{w-4}-1\right)}$$

$$= \frac{\cancel{(w-4)}\left(\dfrac{4}{\cancel{w-4}}\right)}{\cancel{(w-4)}\left(\dfrac{4}{\cancel{w-4}}\right)-(w-4)1}$$

$$= \frac{4}{4-w+4}$$

$$= \frac{4}{8-w}$$

31. $\dfrac{1-\dfrac{1}{x}-\dfrac{6}{x^2}}{1-\dfrac{4}{x}+\dfrac{3}{x^2}}$ LCD $= x^2$

$$\frac{x^2\left(1-\dfrac{1}{x}-\dfrac{6}{x^2}\right)}{x^2\left(1-\dfrac{4}{x}+\dfrac{3}{x^2}\right)}$$

$$= \frac{x^2(1)-x^2\left(\dfrac{1}{x}\right)-x^2\left(\dfrac{6}{x^2}\right)}{x^2(1)-x^2\left(\dfrac{4}{x}\right)+x^2\left(\dfrac{3}{x^2}\right)}$$

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

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

32. $\dfrac{1+\dfrac{1}{x}-\dfrac{12}{x^2}}{\dfrac{9}{x^2}+\dfrac{3}{x}-2}$ $\quad \text{LCD} = x^2$

$$\frac{x^2\left(1+\frac{1}{x}-\frac{12}{x^2}\right)}{x^2\left(\frac{9}{x^2}+\frac{3}{x}-2\right)} = \frac{x^2(1)+x^2\left(\frac{1}{x}\right)-x^2\left(\frac{12}{x^2}\right)}{x^2\left(\frac{9}{x^2}\right)+x^2\left(\frac{3}{x}\right)-x^2(2)} = \frac{x^2+x-12}{9+3x-2x^2} = \frac{x^2+x-12}{-\left(2x^2-3x-9\right)}$$

$$= -\frac{(x+4)\cancel{(x-3)}}{(2x+3)\cancel{(x-3)}} = -\frac{x+4}{2x+3}$$

33. $\dfrac{2-\dfrac{2}{t+1}}{2+\dfrac{2}{t}}$ $\quad \text{LCD} = t(t+1)$

$$\frac{t(t+1)\left(2-\frac{2}{t+1}\right)}{t(t+1)\left(2+\frac{2}{t}\right)} = \frac{t(t+1)(2)-t\cancel{(t+1)}\left(\frac{2}{\cancel{t+1}}\right)}{t(t+1)(2)+\cancel{t}(t+1)\left(\frac{2}{\cancel{t}}\right)} = \frac{2t^2+2t-2t}{2t^2+2t+2t+2}$$

$$= \frac{\cancel{2}t^2}{\cancel{2}\left(t^2+2t+1\right)} = \frac{t^2}{(t+1)^2}$$

34. $\dfrac{3+\dfrac{3}{p-1}}{3-\dfrac{3}{p}}$ $\quad \text{LCD} = p(p-1)$

$$\frac{p(p-1)\left(3+\frac{3}{p-1}\right)}{p(p-1)\left(3-\frac{3}{p}\right)} = \frac{p(p-1)(3)+p\cancel{(p-1)}\left(\frac{3}{\cancel{p-1}}\right)}{p(p-1)(3)-\cancel{p}(p-1)\left(\frac{3}{\cancel{p}}\right)}$$

$$= \frac{3p^2-3p+3p}{3p^2-3p-3p+3}$$

$$= \frac{\cancel{3}p^2}{\cancel{3}\left(p^2-2p+1\right)} = \frac{p^2}{(p-1)^2}$$

35. $\dfrac{\dfrac{2}{a}-\dfrac{3}{a+1}}{\dfrac{2}{a+1}-\dfrac{3}{a}}$ $\quad \text{LCD} = a(a+1)$

$$\frac{a(a+1)\left(\frac{2}{a}-\frac{3}{a+1}\right)}{a(a+1)\left(\frac{2}{a+1}-\frac{3}{a}\right)} = \frac{\cancel{a}(a+1)\left(\frac{2}{\cancel{a}}\right)-a\cancel{(a+1)}\left(\frac{3}{\cancel{a+1}}\right)}{a\cancel{(a+1)}\left(\frac{2}{\cancel{a+1}}\right)-\cancel{a}(a+1)\left(\frac{3}{\cancel{a}}\right)} = \frac{2a+2-3a}{2a-3a-3} = \frac{-a+2}{-a-3}$$

36. $\dfrac{\dfrac{5}{b}+\dfrac{4}{b+1}}{\dfrac{4}{b}-\dfrac{5}{b+1}}$ $\quad \text{LCD} = b(b+1)$

$$\frac{b(b+1)\left(\frac{5}{b}+\frac{4}{b+1}\right)}{b(b+1)\left(\frac{4}{b}-\frac{5}{b+1}\right)} = \frac{\cancel{b}(b+1)\left(\frac{5}{\cancel{b}}\right)+b\cancel{(b+1)}\left(\frac{4}{\cancel{b+1}}\right)}{\cancel{b}(b+1)\left(\frac{4}{\cancel{b}}\right)-b\cancel{(b+1)}\left(\frac{5}{\cancel{b+1}}\right)} = \frac{5b+5+4b}{4b+4-5b} = \frac{9b+5}{-b+4}$$

37. $\dfrac{\dfrac{1}{y+2}+\dfrac{4}{y-3}}{\dfrac{2}{y-3}-\dfrac{7}{y+2}}$ $\quad \text{LCD} = (y+2)(y-3)$

$$\frac{(y+2)(y-3)\left(\frac{1}{y+2}+\frac{4}{y-3}\right)}{(y+2)(y-3)\left(\frac{2}{y-3}-\frac{7}{y+2}\right)} = \frac{\cancel{(y+2)}(y-3)\left(\frac{1}{\cancel{y+2}}\right)+(y+2)\cancel{(y-3)}\left(\frac{4}{\cancel{y-3}}\right)}{(y+2)\cancel{(y-3)}\left(\frac{2}{\cancel{y-3}}\right)-\cancel{(y+2)}(y-3)\left(\frac{7}{\cancel{y+2}}\right)}$$

$$= \frac{y-3+4y+8}{2y+4-7y+21} = \frac{5y+5}{-5y+25} = \frac{\cancel{5}(y+1)}{-\cancel{5}(y-5)} = -\frac{y+1}{y-5}$$

38. $\dfrac{\dfrac{1}{t-4}+\dfrac{1}{t+5}}{\dfrac{6}{t+5}+\dfrac{2}{t-4}}$ $\quad \text{LCD} = (t-4)(t+5)$

$$\frac{(t-4)(t+5)\left(\frac{1}{t-4}+\frac{1}{t+5}\right)}{(t-4)(t+5)\left(\frac{6}{t+5}+\frac{2}{t-4}\right)} = \frac{\cancel{(t-4)}(t+5)\left(\frac{1}{\cancel{t-4}}\right)+(t-4)\cancel{(t+5)}\left(\frac{1}{\cancel{t+5}}\right)}{(t-4)\cancel{(t+5)}\left(\frac{6}{\cancel{t+5}}\right)+\cancel{(t-4)}(t+5)\left(\frac{2}{\cancel{t-4}}\right)}$$

$$= \frac{t+5+t-4}{6t-24+2t+10}$$
$$= \frac{2t+1}{8t-14} = \frac{2t+1}{2(4t-7)}$$

39. $\dfrac{\frac{2}{x+h}-\frac{2}{x}}{h}$ $\quad \text{LCD} = x(x+h)$

$$\frac{x(x+h)\left(\frac{2}{x+h}-\frac{2}{x}\right)}{x(x+h)(h)} = \frac{x\cancel{(x+h)}\left(\frac{2}{\cancel{x+h}}\right)-\cancel{x}(x+h)\left(\frac{2}{\cancel{x}}\right)}{x(x+h)(h)} = \frac{2x-2x-2h}{x(x+h)(h)}$$
$$= \frac{-2\cancel{h}}{x(x+h)(\cancel{h})} = -\frac{2}{x(x+h)}$$

40. $\dfrac{\frac{1}{2x+2h}-\frac{1}{2x}}{h} = \dfrac{\frac{1}{2(x+h)}-\frac{1}{2x}}{h}$ $\quad \text{LCD} = 2x(x+h)$

$$\frac{2x(x+h)\left(\frac{1}{2(x+h)}-\frac{1}{2x}\right)}{2x(x+h)(h)} = \frac{\cancel{2}x\cancel{(x+h)}\left(\frac{1}{\cancel{2}\cancel{(x+h)}}\right)-\cancel{2}\cancel{x}(x+h)\left(\frac{1}{\cancel{2}\cancel{x}}\right)}{2x(x+h)(h)}$$
$$= \frac{x-x-h}{2x(x+h)(h)} = \frac{-\cancel{h}}{2x(x+h)(\cancel{h})} = -\frac{1}{2x(x+h)}$$

41. $\dfrac{x^{-2}}{x+3x^{-1}} = \dfrac{\frac{1}{x^2}}{x+\frac{3}{x}}$ $\quad \text{LCD} = x^2$

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

42. $\dfrac{x^{-1}+x^{-2}}{5x^{-2}} = \dfrac{\frac{1}{x}+\frac{1}{x^2}}{\frac{5}{x^2}}$ $\quad \text{LCD} = x^2$

$$\frac{x^2\left(\frac{1}{x}+\frac{1}{x^2}\right)}{x^2\left(\frac{5}{x^2}\right)} = \frac{x^2\left(\frac{1}{x}\right)+x^2\left(\frac{1}{x^2}\right)}{x^2\left(\frac{5}{x^2}\right)}$$
$$= \frac{x+1}{5}$$

43. $\dfrac{2a^{-1}+3b^{-2}}{a^{-1}-b^{-1}} = \dfrac{\dfrac{2}{a}+\dfrac{3}{b^2}}{\dfrac{1}{a}-\dfrac{1}{b}}$ LCD $= ab^2$

$$\frac{ab^2\left(\frac{2}{a}+\frac{3}{b^2}\right)}{ab^2\left(\frac{1}{a}-\frac{1}{b}\right)} = \frac{ab^2\left(\frac{2}{a}\right)+ab^2\left(\frac{3}{b^2}\right)}{ab^2\left(\frac{1}{a}\right)-ab^2\left(\frac{1}{b}\right)} = \frac{2b^2+3a}{b^2-ab} = \frac{2b^2+3a}{b(b-a)}$$

44. $\dfrac{2m^{-1}+n^{-1}}{m^{-2}-4n^{-1}} = \dfrac{\dfrac{2}{m}+\dfrac{1}{n}}{\dfrac{1}{m^2}-\dfrac{4}{n}}$ LCD $= m^2n$

$$\frac{m^2n\left(\frac{2}{m}+\frac{1}{n}\right)}{m^2n\left(\frac{1}{m^2}-\frac{4}{n}\right)} = \frac{m^2n\left(\frac{2}{m}\right)+m^2n\left(\frac{1}{n}\right)}{m^2n\left(\frac{1}{m^2}\right)-m^2n\left(\frac{4}{n}\right)} = \frac{2mn+m^2}{n-4m^2} = \frac{m(2n+m)}{n-4m^2}$$

45. $\dfrac{\dfrac{1}{4+h}-\dfrac{1}{4}}{h}$ LCD $= 4(4+h)$

$$\frac{4(4+h)\left(\frac{1}{4+h}-\frac{1}{4}\right)}{4(4+h)h} = \frac{4-(4+h)}{4h(4+h)} = \frac{-\cancel{h}}{4\cancel{h}(4+h)} = \frac{-1}{4(4+h)}$$

46. $\dfrac{\dfrac{1}{3+3h}-\dfrac{1}{3}}{h} = \dfrac{\dfrac{1}{3(1+h)}-\dfrac{1}{3}}{h}$ LCD $= 3(1+h)$

$$\frac{3(1+h)\left(\frac{1}{3(1+h)}-\frac{1}{3}\right)}{3(1+h)h} = \frac{1-(1+h)}{3h(1+h)} = \frac{-\cancel{h}}{3\cancel{h}(1+h)} = \frac{-1}{3(1+h)}$$

47. $\dfrac{\dfrac{6}{x+h}-\dfrac{6}{x}}{h}$ LCD $= x(x+h)$

$$\frac{x(x+h)\left(\frac{6}{x+h}-\frac{6}{x}\right)}{x(x+h)h} = \frac{6x-6(x+h)}{xh(x+h)} = \frac{6x-6x-6h}{xh(x+h)} = \frac{-6\cancel{h}}{x\cancel{h}(x+h)} = \frac{-6}{x(x+h)}$$

48. $\dfrac{\dfrac{-3}{x+h}+\dfrac{3}{x}}{h}$ LCD $= x(x+h)$

$$\frac{x(x+h)\left(\frac{-3}{x+h}+\frac{3}{x}\right)}{x(x+h)h} = \frac{-3x+3(x+h)}{xh(x+h)} = \frac{-3x+3x+3h}{xh(x+h)} = \frac{3\cancel{h}}{x\cancel{h}(x+h)} = \frac{3}{x(x+h)}$$

49. $m = \dfrac{y_2 - y_1}{x_2 - x_1}$

50. $m = \dfrac{-2-\frac{2}{5}}{\frac{1}{4}-1\frac{1}{2}} = \dfrac{-2-\frac{2}{5}}{\frac{1}{4}-\frac{3}{2}}$ LCD = 20

$= \dfrac{20\left(-2-\frac{2}{5}\right)}{20\left(\frac{1}{4}-\frac{3}{2}\right)} = \dfrac{-40-8}{5-30} = \dfrac{-48}{-25} = \dfrac{48}{25}$

51. $m = \dfrac{-3-\frac{3}{5}}{-1-\left(-\frac{3}{7}\right)} = \dfrac{-3-\frac{3}{5}}{-1+\frac{3}{7}}$ LCD = 35

$= \dfrac{35\left(-3-\frac{3}{5}\right)}{35\left(-1+\frac{3}{7}\right)} = \dfrac{-105-21}{-35+15}$

$= \dfrac{-126}{-20} = \dfrac{63}{10}$

52. $m = \dfrac{-\frac{1}{5}-\frac{9}{10}}{-\frac{1}{16}-\frac{5}{8}}$ LCD = 80

$= \dfrac{80\left(-\frac{1}{5}-\frac{9}{10}\right)}{80\left(-\frac{1}{16}-\frac{5}{8}\right)} = \dfrac{-16-72}{-5-50}$

$= \dfrac{-88}{-55} = \dfrac{8}{5}$

53. $m = \dfrac{\frac{1}{6}-\frac{1}{3}}{\frac{1}{8}-\frac{1}{4}}$ LCD = 24

$= \dfrac{24\left(\frac{1}{6}-\frac{1}{3}\right)}{24\left(\frac{1}{8}-\frac{1}{4}\right)} = \dfrac{4-8}{3-6} = \dfrac{-4}{-3} = \dfrac{4}{3}$

54. $\left(x+x^{-1}\right)^{-1} = \dfrac{1}{x+x^{-1}} = \dfrac{1}{x+\frac{1}{x}}$ LCD = x

$= \dfrac{x(1)}{x\left(x+\frac{1}{x}\right)}$

$= \dfrac{x}{x^2+1}$

55. $\left(x^{-1}+y^{-1}\right)^{-1} = \dfrac{1}{x^{-1}+y^{-1}} = \dfrac{1}{\frac{1}{x}+\frac{1}{y}}$ LCD = xy

$= \dfrac{xy(1)}{xy\left(\frac{1}{x}+\frac{1}{y}\right)} = \dfrac{xy}{y+x} = \dfrac{xy}{x+y}$

56. $$\frac{x}{1-\left(1+\frac{1}{x}\right)^{-1}}=\frac{x}{1-\frac{1}{1+\frac{1}{x}}}=\frac{x}{1-\frac{1}{\frac{x}{x}+\frac{1}{x}}}=\frac{x}{1-\frac{1}{\frac{x+1}{x}}}=\frac{x}{1-1\cdot\frac{x}{x+1}}=\frac{x}{\frac{x+1}{x+1}-\frac{x}{x+1}}=\frac{x}{\frac{1}{x+1}}$$
$$=x\cdot\frac{x+1}{1}=x(x+1)$$

57. $$\frac{x}{1-\left(1-\frac{1}{x}\right)^{-1}}=\frac{x}{1-\frac{1}{1-\frac{1}{x}}}=\frac{x}{1-\frac{1}{\frac{x}{x}-\frac{1}{x}}}=\frac{x}{1-\frac{1}{\frac{x-1}{x}}}=\frac{x}{1-1\cdot\frac{x}{x-1}}=\frac{x}{\frac{x-1}{x-1}-\frac{x}{x-1}}=\frac{x}{\frac{-1}{x-1}}$$
$$=x\cdot\frac{x-1}{-1}=-x(x-1)$$

Problem Recognition Exercises

1. $\dfrac{2}{2y-3}-\dfrac{3}{2y}+1 \qquad \text{LCD}=2y(2y-3)$

$$=\frac{2}{2y-3}\cdot\frac{2y}{2y}-\frac{3}{2y}\cdot\frac{2y-3}{2y-3}+1\cdot\frac{2y(2y-3)}{2y(2y-3)}$$
$$=\frac{4y-3(2y-3)+2y(2y-3)}{2y(2y-3)}$$
$$=\frac{4y-6y+9+4y^2-6y}{2y(2y-3)}$$
$$=\frac{4y^2-8y+9}{2y(2y-3)}$$

2. $(x+5)+\left(\dfrac{7}{x-4}\right) \qquad \text{LCD}=x-4$

$$=(x+5)\cdot\frac{x-4}{x-4}+\left(\frac{7}{x-4}\right)$$
$$=\frac{x^2+x-20+7}{x-4}$$
$$=\frac{x^2+x-13}{x-4}$$

3. $$\frac{5x^2-6x+1}{x^2-1}\div\frac{16x^2-9}{4x^2+7x+3}-\frac{x}{4x-3}$$
$$=\frac{5x^2-6x+1}{x^2-1}\cdot\frac{4x^2+7x+3}{16x^2-9}-\frac{x}{4x-3}$$
$$=\frac{(5x-1)\cancel{(x-1)}}{\cancel{(x+1)}\cancel{(x-1)}}\cdot\frac{\cancel{(4x+3)}\cancel{(x+1)}}{\cancel{(4x+3)}(4x-3)}-\frac{x}{4x-3}$$
$$=\frac{5x-1}{4x-3}-\frac{x}{4x-3}$$
$$=\frac{4x-1}{4x-3}$$

4. $\dfrac{a^2-25}{3a^2+3ab}\cdot\dfrac{a^2+4a+ab+4b}{a^2+9a+20}$

$$=\frac{(a+5)(a-5)}{3a(a+b)}\cdot\frac{a(a+4)+b(a+4)}{(a+4)(a+5)}$$

$$=\frac{\cancel{(a+5)}(a-5)}{3a\cancel{(a+b)}}\cdot\frac{\cancel{(a+4)}\cancel{(a+b)}}{\cancel{(a+4)}\cancel{(a+5)}}=\frac{a-5}{3a}$$

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

$$=\frac{4}{y+1}\cdot\frac{y-1}{y-1}+\frac{y+2}{(y+1)(y-1)}-\frac{3}{y-1}\cdot\frac{y+1}{y+1}$$

$$=\frac{4(y-1)+y+2-3(y+1)}{(y+1)(y-1)}$$

$$=\frac{4y-4+y+2-3y-3}{(y+1)(y-1)}$$

$$=\frac{2y-5}{(y+1)(y-1)}$$

6. $\dfrac{8w^2}{w^3-16w}-\dfrac{4w}{w^2-4w}=\dfrac{8w^2}{w(w^2-16)}-\dfrac{4w}{w(w-4)}$

$$=\frac{8w^2}{w(w+4)(w-4)}-\frac{4w}{w(w-4)}$$ LCD $=w(w+4)(w-4)$

$$=\frac{8w^2}{w(w+4)(w-4)}-\frac{4w}{w(w-4)}\cdot\frac{w+4}{w+4}=\frac{8w^2-4w(w+4)}{w(w+4)(w-4)}$$

$$=\frac{8w^2-4w^2-16w}{w(w+4)(w-4)}=\frac{4w^2-16w}{w(w+4)(w-4)}$$

$$=\frac{4\cancel{w}\cancel{(w-4)}}{\cancel{w}(w+4)\cancel{(w-4)}}=\frac{4}{w+4}$$

7. $\dfrac{a^2-16}{2x+6}\cdot\dfrac{x+3}{a-4}=\dfrac{(a+4)\cancel{(a-4)}}{2\cancel{(x+3)}}\cdot\dfrac{\cancel{x+3}}{\cancel{a-4}}$

$$=\frac{a+4}{2}$$

8. $\dfrac{t^2-9}{t}\div\dfrac{t+3}{t+2}=\dfrac{\cancel{(t+3)}(t-3)}{t}\cdot\dfrac{t+2}{\cancel{t+3}}$

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

9. $\dfrac{2+\dfrac{1}{a}}{4-\dfrac{1}{a^2}}$ $\quad \text{LCD} = a^2$

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

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

$$= \frac{a}{2a-1}$$

10. $\dfrac{\dfrac{6x^2y}{5}}{\dfrac{3x}{y}}$ $\quad \text{LCD} = 5y$

$$\frac{5y\left(\frac{6x^2y}{5}\right)}{5y\left(\frac{3x}{y}\right)} = \frac{6x^2y^2}{15x} = \frac{2xy^2}{5}$$

11. $\dfrac{6xy}{x^2-y^2}+\dfrac{x+y}{y-x} = \dfrac{6xy}{(x+y)(x-y)}+\dfrac{x+y}{y-x}$

$\text{LCD} = (x+y)(x-y)$

$$= \frac{6xy}{(x+y)(x-y)}+\frac{x+y}{y-x}\cdot\frac{(-1)}{(-1)}\cdot\frac{x+y}{x+y}$$

$$= \frac{6xy-(x^2+2xy+y^2)}{(x+y)(x-y)}$$

$$= \frac{6xy-x^2-2xy-y^2}{(x+y)(x-y)}$$

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

12. $(x^2-6x+8)\left(\dfrac{3}{x-2}\right)$

$$= \frac{(x-4)\cancel{(x-2)}}{1}\cdot\frac{3}{\cancel{x-2}}$$

$$= 3(x-4)$$

13. $\dfrac{3}{x-2}-\dfrac{x-2}{6}$ $\quad \text{LCD} = 6(x-2)$

$$= \frac{3}{x-2}\cdot\frac{6}{6}-\frac{x-2}{6}\cdot\frac{x-2}{x-2}$$

$$= \frac{18-(x^2-4x+4)}{6(x-2)}$$

$$= \frac{18-x^2+4x-4}{6(x-2)}$$

$$= \frac{-x^2+4x+14}{6(x-2)}$$

14. $\dfrac{5}{x+7}+\dfrac{x+7}{10}$ $\quad \text{LCD} = 10(x+7)$

$$= \frac{5}{x+7}\cdot\frac{10}{10}+\frac{x+7}{10}\cdot\frac{x+7}{x+7}$$

$$= \frac{50+x^2+14x+49}{10(x+7)}$$

$$= \frac{x^2+14x+99}{10(x+7)}$$

15. $\dfrac{1}{w-1}-\dfrac{w+2}{3w-3}=\dfrac{1}{w-1}-\dfrac{w+2}{3(w-1)}$

$\text{LCD}=3(w-1)$

$=\dfrac{3}{3}\cdot\dfrac{1}{w-1}-\dfrac{w+2}{3(w-1)}=\dfrac{3-w-2}{3(w-1)}$

$=\dfrac{1-w}{3(w-1)}=\dfrac{-1\cancel{(w-1)}}{3\cancel{(w-1)}}=-\dfrac{1}{3}$

16. $\dfrac{3y+6}{y^2-3y-10}\div\dfrac{27}{y-5}$

$=\dfrac{\cancel{3}(y+2)}{\cancel{(y+2)}(y-5)}\cdot\dfrac{y-5}{\cancel{3}\cdot 9}=\dfrac{1}{9}$

17. $\dfrac{y+\dfrac{2}{y}-3}{1-\dfrac{2}{y}}$ $\quad\text{LCD}=y$

$\dfrac{y\left(y+\dfrac{2}{y}-3\right)}{y\left(1-\dfrac{2}{y}\right)}=\dfrac{y(y)+y\left(\dfrac{2}{y}\right)-y(3)}{y(1)-y\left(\dfrac{2}{y}\right)}=\dfrac{y^2+2-3y}{y-2}=\dfrac{\cancel{(y-2)}(y-1)}{\cancel{y-2}}=y-1$

18. $\dfrac{2}{t-3}-\dfrac{3}{t+2}+5$ $\quad\text{LCD}=(t-3)(t+2)$

$\left(\dfrac{t+2}{t+2}\right)\left(\dfrac{2}{t-3}\right)-\left(\dfrac{t-3}{t-3}\right)\left(\dfrac{3}{t+2}\right)+5\dfrac{(t-3)(t+2)}{(t-3)(t+2)}=\dfrac{2t+4-3t+9+5(t^2-t-6)}{(t-3)(t+2)}$

$=\dfrac{2t+4-3t+9+5t^2-5t-30}{(t-3)(t+2)}=\dfrac{5t^2-6t-17}{(t-3)(t+2)}$

19. $\dfrac{4x^2+22x+24}{4x+4}\cdot\dfrac{6x+6}{4x^2-9}=\dfrac{2(2x^2+11x+12)}{4(x+1)}\cdot\dfrac{6(x+1)}{(2x-3)(2x+3)}$

$=\dfrac{\cancel{2}\cancel{(2x+3)}(x+4)}{\cancel{2}\cdot\cancel{2}\cancel{(x+1)}}\cdot\dfrac{\cancel{2}\cdot 3\cancel{(x+1)}}{(2x-3)\cancel{(2x+3)}}=\dfrac{3(x+4)}{2x-3}$

20. $\dfrac{12x^3y^5z}{5x^4}\div\dfrac{16xy^7}{10z^2}=\dfrac{12x^3y^5z}{5x^4}\cdot\dfrac{10z^2}{16xy^7}=\dfrac{120x^3y^5z^3}{80x^5y^7}$

$=\dfrac{3}{2}x^{3-5}y^{5-7}z^3=\dfrac{3}{2}x^{-2}y^{-2}z^3=\dfrac{3z^3}{2x^2y^2}$

21. $\dfrac{3x-1}{4}+\dfrac{7}{6x-2}=\dfrac{3x-1}{4}+\dfrac{7}{2(3x-1)}$

$\text{LCD}=4(3x-1)$

$=\dfrac{3x-1}{4}\cdot\dfrac{3x-1}{3x-1}+\dfrac{7}{2(3x-1)}\cdot\dfrac{2}{2}$

$=\dfrac{9x^2-6x+1+14}{4(3x-1)}=\dfrac{9x^2-6x+15}{4(3x-1)}$

22. $\dfrac{2x^{-1}+3x^{-2}}{x^{-2}-5x^{-1}}=\dfrac{\dfrac{2}{x}+\dfrac{3}{x^2}}{\dfrac{1}{x^2}-\dfrac{5}{x}}=\dfrac{x^2\left(\dfrac{2}{x}+\dfrac{3}{x^2}\right)}{x^2\left(\dfrac{1}{x^2}-\dfrac{5}{x}\right)}$

$=\dfrac{2x+3}{1-5x}$

23. $(y+2)\cdot\dfrac{2y+1}{y^2-4}-\dfrac{y-2}{y+3}=\dfrac{\cancel{(y+2)}(2y+1)}{\cancel{(y+2)}(y-2)}-\dfrac{y-2}{y+3}=\dfrac{2y+1}{y-2}-\dfrac{y-2}{y+3}$

$\text{LCD}=(y-2)(y+3)$

$\left(\dfrac{y+3}{y+3}\right)\left(\dfrac{2y+1}{y-2}\right)-\left(\dfrac{y-2}{y-2}\right)\left(\dfrac{y-2}{y+3}\right)=\dfrac{2y^2+7y+3-(y^2-4y+4)}{(y-2)(y+3)}$

$=\dfrac{2y^2+7y+3-y^2+4y-4}{(y-2)(y+3)}=\dfrac{y^2+11y-1}{(y-2)(y+3)}$

24. $\dfrac{a^2}{a-10}-\dfrac{100-20a}{10-a}=\dfrac{a^2}{a-10}+\dfrac{100-20a}{a-10}=\dfrac{a^2-20a+100}{a-10}=\dfrac{\cancel{(a-10)}(a-10)}{\cancel{a-10}}=a-10$

Section 5.5 Practice Exercises

1. **a.** rational.

b. denominator

c. No.

2. $\dfrac{1}{x^2-16}+\dfrac{1}{x^2+8x+16}=\dfrac{1}{(x+4)(x-4)}+\dfrac{1}{(x+4)^2}$ $\quad\text{LCD}=(x+4)^2(x-4)$

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

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

3. $\dfrac{3}{y^2-1}-\dfrac{2}{y^2-2y+1}=\dfrac{3}{(y+1)(y-1)}-\dfrac{2}{(y-1)^2}$ LCD $=(y-1)^2(y+1)$

$$=\frac{3}{(y+1)(y-1)}\cdot\frac{y-1}{y-1}-\frac{2}{(y-1)^2}\cdot\frac{y+1}{y+1}=\frac{3y-3-2y-2}{(y-1)^2(y+1)}=\frac{y-5}{(y-1)^2(y+1)}$$

4. $\dfrac{m^2-9}{m^2-3m}\div(m^2-m-12)=\dfrac{m^2-9}{m^2-3m}\cdot\dfrac{1}{m^2-m-12}$

$$=\frac{\cancel{(m+3)}\cancel{(m-3)}}{m\cancel{(m-3)}}\cdot\frac{1}{(m-4)\cancel{(m+3)}}=\frac{1}{m(m-4)}$$

5. $\dfrac{2t^2+7t+3}{4t^2-1}\div(t+3)=\dfrac{2t^2+7t+3}{4t^2-1}\cdot\dfrac{1}{t+3}=\dfrac{\cancel{(2t+1)}\cancel{(t+3)}}{\cancel{(2t+1)}(2t-1)}\cdot\dfrac{1}{\cancel{t+3}}=\dfrac{1}{2t-1}$

6. $\dfrac{1+x^{-1}}{1-x^{-2}}=\dfrac{1+\frac{1}{x}}{1-\frac{1}{x^2}}$ LCD $=x^2$

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

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

7. $\dfrac{x+y}{x^{-1}+y^{-1}}=\dfrac{x+y}{\frac{1}{x}+\frac{1}{y}}$ LCD $=xy$

$$\frac{xy(x+y)}{xy\left(\frac{1}{x}+\frac{1}{y}\right)}=\frac{xy(x)+xy(y)}{xy\left(\frac{1}{x}\right)+xy\left(\frac{1}{y}\right)}$$

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

$$=\frac{xy\cancel{(x+y)}}{\cancel{x+y}}=xy$$

8. A possible solution may make a denominator equal to zero in the original equation, and therefore cannot be a solution.

9. $\dfrac{x+2}{3}-\dfrac{x-4}{4}=\dfrac{1}{2}$ LCD $=12$

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

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

10. $\dfrac{x+6}{3}-\dfrac{x+8}{5}=0$ LCD $=15$

$$15\left(\frac{x+6}{3}-\frac{x+8}{5}\right)=15(0)$$

$$15\left(\frac{x+6}{3}\right)-15\left(\frac{x+8}{5}\right)=0$$

$$4(x+2)-3(x-4)=6$$
$$4x+8-3x+12=6$$
$$x+20=6$$
$$x=-14 \quad \{-14\}$$

$$5(x+6)-3(x+8)=0$$
$$5x+30-3x-24=0$$
$$2x+6=0$$
$$2x=-6$$
$$x=-3 \quad \{-3\}$$

11. $\dfrac{3y}{4}-2=\dfrac{5y}{6}$ LCD $=12$

$$12\left(\frac{3y}{4}-2\right)=12\left(\frac{5y}{6}\right)$$
$$12\left(\frac{3y}{4}\right)-12(2)=12\left(\frac{5y}{6}\right)$$
$$9y-24=10y$$
$$-24=y \quad \{-24\}$$

12. $\dfrac{2w}{5}-8=\dfrac{4w}{2}$ LCD $=10$

$$10\left(\frac{2w}{5}-8\right)=10\left(\frac{4w}{2}\right)$$
$$10\left(\frac{2w}{5}\right)-10(8)=10\left(\frac{4w}{2}\right)$$
$$4w-80=20w$$
$$-80=16w$$
$$-5=w \quad \{-5\}$$

13. $\dfrac{5}{4p}-\dfrac{7}{6}+3=0$

LCD $=12p$ so $p\neq 0$

$$12p\left(\frac{5}{4p}-\frac{7}{6}+3\right)=12p(0)$$
$$12p\left(\frac{5}{4p}\right)-12p\left(\frac{7}{6}\right)+12p(3)=0$$
$$15-14p+36p=0$$
$$15+22p=0$$
$$22p=-15$$
$$p=-\frac{15}{22} \quad \left\{-\frac{15}{22}\right\}$$

14. $\dfrac{7}{15w}-\dfrac{3}{10}-2=0$

LCD $=30w$ so $w\neq 0$

$$30w\left(\frac{7}{15w}-\frac{3}{10}-2\right)=30w(0)$$
$$30w\left(\frac{7}{15w}\right)-30w\left(\frac{3}{10}\right)-30w(2)=0$$
$$14-9w-60w=0$$
$$14-69w=0$$
$$-69w=-14$$
$$w=\frac{14}{69} \quad \left\{\frac{14}{69}\right\}$$

15. $\dfrac{1}{2}-\dfrac{3}{2x}=\dfrac{4}{x}-\dfrac{5}{12}$

LCD $=12x$ so $x\neq 0$

$$12x\left(\frac{1}{2}-\frac{3}{2x}\right)=12x\left(\frac{4}{x}-\frac{5}{12}\right)$$

16. $\dfrac{2}{3x}+\dfrac{1}{4}=\dfrac{11}{6x}-\dfrac{1}{3}$

LCD $=12x$ so $x\neq 0$

$$12x\left(\frac{2}{3x}+\frac{1}{4}\right)=12x\left(\frac{11}{6x}-\frac{1}{3}\right)$$

$$12x\left(\frac{1}{2}\right)-12x\left(\frac{3}{2x}\right)=12x\left(\frac{4}{x}\right)-12x\left(\frac{5}{12}\right)$$
$$6x-18=48-5x$$
$$11x=66$$
$$x=6 \quad \{6\}$$

$$12x\left(\frac{2}{3x}\right)+12x\left(\frac{1}{4}\right)=12x\left(\frac{11}{6x}\right)-12x\left(\frac{1}{3}\right)$$
$$8+3x=22-4x$$
$$7x=14$$
$$x=2 \quad \{2\}$$

17. $$\frac{3}{x-4}+2=\frac{5}{x-4}$$
$\text{LCD}=x-4 \quad$ so $x\neq 4$
$$(x-4)\left(\frac{3}{x-4}+2\right)=\cancel{(x-4)}\left(\frac{5}{\cancel{x-4}}\right)$$
$$\cancel{(x-4)}\left(\frac{3}{\cancel{x-4}}\right)+(x-4)(2)=5$$
$$3+2x-8=5$$
$$2x-5=5$$
$$2x=10$$
$$x=5 \quad \{5\}$$

18. $$\frac{5}{x+3}-2=\frac{7}{x+3}$$
$\text{LCD}=x+3 \quad$ so $x\neq -3$
$$(x+3)\left(\frac{5}{x+3}-2\right)=\cancel{(x+3)}\left(\frac{7}{\cancel{x+3}}\right)$$
$$\cancel{(x+3)}\left(\frac{5}{\cancel{x+3}}\right)-(x+3)(2)=7$$
$$5-2x-6=7$$
$$-2x-1=7$$
$$-2x=8$$
$$x=-4 \quad \{-4\}$$

19. $$\frac{1}{3}+\frac{2}{w-3}=1$$
$\text{LCD}=3(w-3) \quad$ so $w\neq 3$
$$3(w-3)\left(\frac{1}{3}+\frac{2}{w-3}\right)=3(w-3)(1)$$
$$\cancel{3}(w-3)\left(\frac{1}{\cancel{3}}\right)+3\cancel{(w-3)}\left(\frac{2}{\cancel{w-3}}\right)=3w-9$$
$$w-3+6=3w-9$$
$$w+3=3w-9$$
$$-2w=-12$$
$$w=6 \quad \{6\}$$

20. $$\frac{3}{5}+\frac{7}{p+2}=2$$
$\text{LCD}=5(p+2) \quad$ so $p\neq -2$

$$5(p+2)\left(\frac{3}{5}+\frac{7}{p+2}\right)=5(p+2)(2)$$

$$\cancel{5}(p+2)\left(\frac{3}{\cancel{5}}\right)+5\cancel{(p+2)}\left(\frac{7}{\cancel{p+2}}\right)=10p+20$$

$$3p+6+35=10p+20$$

$$3p+41=10p+20$$

$$3p-10p=20-41$$

$$-7p=-21$$

$$p=3 \quad \{3\}$$

21.

$$\frac{12}{x}-\frac{12}{x-5}=\frac{2}{x}$$

LCD $=x(x-5)$ so $x\neq 0$ or $x\neq 5$

$$x(x-5)\left(\frac{12}{x}-\frac{12}{x-5}\right)=\cancel{x}(x-5)\left(\frac{2}{\cancel{x}}\right)$$

$$\cancel{x}(x-5)\left(\frac{12}{\cancel{x}}\right)-x\cancel{(x-5)}\left(\frac{12}{\cancel{x-5}}\right)=2x-10$$

$$12x-60-12x=2x-10$$

$$-60=2x-10$$

$$-50=2x$$

$$x=-25 \quad \{-25\}$$

22.

$$\frac{25}{y}-\frac{25}{y-2}=\frac{2}{y}$$

LCD $=y(y-2)$ so $y\neq 0$ or $y\neq 2$

$$y(y-2)\left(\frac{25}{y}-\frac{25}{y-2}\right)=\cancel{y}(y-2)\left(\frac{2}{\cancel{y}}\right)$$

$$\cancel{y}(y-2)\left(\frac{25}{\cancel{y}}\right)-y\cancel{(y-2)}\left(\frac{25}{\cancel{y-2}}\right)=2y-4$$

$$25y-50-25y=2y-4$$

$$-50=2y-4$$

$$-46=2y$$

$$y=-23 \quad \{-23\}$$

23.

$$\frac{3}{a^2}-\frac{4}{a}=-1$$

$\text{LCD}=a^2 \quad \text{so } a\neq 0$

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

$$\cancel{a^2}\left(\frac{3}{\cancel{a^2}}\right)-a\cdot\cancel{a}\left(\frac{4}{\cancel{a}}\right)=-a^2$$

$$3-4a=-a^2$$

$$a^2-4a+3=0$$

$$(a-3)(a-1)=0$$

$$a-3=0 \text{ or } a-1=0$$

$$a=3 \text{ or } a=1$$

$$\{3,1\}$$

24.

$$\frac{3}{w^2}=2+\frac{1}{w}$$

$\text{LCD}=w^2 \quad \text{so } w\neq 0$

$$w^2\left(\frac{3}{w^2}\right)=w^2\left(2+\frac{1}{w}\right)$$

$$\cancel{w^2}\left(\frac{3}{\cancel{w^2}}\right)=w^2(2)+\cancel{w}\cdot w\left(\frac{1}{\cancel{w}}\right)$$

$$3=2w^2+w$$

$$0=2w^2+w-3$$

$$0=(2w+3)(w-1)$$

$$2w+3=0 \text{ or } w-1=0$$

$$2w=-3 \text{ or } w=1$$

$$w=-\frac{3}{2} \text{ or } w=1 \quad \left\{-\frac{3}{2},1\right\}$$

25.

$$\frac{1}{4}a-4a^{-1}=0$$

$$\frac{a}{4}-\frac{4}{a}=0$$

$\text{LCD}=4a \quad \text{so } a\neq 0$

$$4a\left(\frac{a}{4}-\frac{4}{a}\right)=4a(0)$$

$$\cancel{4}a\left(\frac{a}{\cancel{4}}\right)-4\cancel{a}\left(\frac{4}{\cancel{a}}\right)=0$$

$$a^2-16=0$$

$$(a+4)(a-4)=0$$

$$a+4=0 \text{ or } a-4=0$$

$$a=-4 \text{ or } a=4 \quad \{-4,4\}$$

26.

$$\frac{1}{3}t-12t^{-1}=0$$

$$\frac{t}{3}-\frac{12}{t}=0$$

$\text{LCD}=3t \quad \text{so } t\neq 0$

$$3t\left(\frac{t}{3}-\frac{12}{t}\right)=3t(0)$$

$$\cancel{3}t\left(\frac{t}{\cancel{3}}\right)-3\cancel{t}\left(\frac{12}{\cancel{t}}\right)=0$$

$$t^2-36=0$$

$$(t+6)(t-6)=0$$

$$t+6=0 \text{ or } t-6=0$$

$$t=-6 \text{ or } t=6 \quad \{-6,6\}$$

27.

$$\frac{y}{y+3}+\frac{2}{y^2+3y}=\frac{6}{y}$$

$$\frac{y}{y+3}+\frac{2}{y(y+3)}=\frac{6}{y}$$

$\text{LCD}=y(y+3) \text{ so } y\neq 0, y\neq -3$

$$y(y+3)\left(\frac{y}{y+3}+\frac{2}{y(y+3)}\right)=y(y+3)\frac{6}{y}$$

$$\cancel{y(y+3)}\left(\frac{y}{\cancel{y+3}}\right)+\cancel{y}\cancel{(y+3)}\left(\frac{2}{\cancel{y}\cancel{(y+3)}}\right)=\cancel{y}(y+3)\frac{6}{\cancel{y}}$$

$$y^2+2=(y+3)6$$

$$y^2+2=6y+18$$

$$y^2-6y-16=0$$

$$(y-8)(y+2)=0$$

$$y-8=0 \text{ or } y+2=0$$

$$y=8 \text{ or } y=-2 \quad \{8,-2\}$$

28.

$$\frac{-8}{t^2-6t}+\frac{t}{t-6}=\frac{1}{t}$$

$$\frac{-8}{t(t-6)}+\frac{t}{t-6}=\frac{1}{t}$$

$\text{LCD}=t(t-6)$ so $t\neq 0, t\neq 6$

$$t(t-6)\left(\frac{-8}{t(t-6)}+\frac{t}{t-6}\right)=t(t-6)\left(\frac{1}{t}\right)$$

$$\cancel{t(t-6)}\frac{-8}{\cancel{t(t-6)}}+t\cancel{(t-6)}\frac{t}{\cancel{t-6}}=\cancel{t}(t-6)\frac{1}{\cancel{t}}$$

$$-8+t^2=t-6$$

$$t^2-t-2=0$$

$$(t-2)(t+1)=0$$

$$t-2=0 \text{ or } t+1=0$$

$$t=2 \text{ or } t=-1$$

$$\{2,-1\}$$

29.

$$\frac{4}{t-2}-\frac{8}{t^2-2t}=-2$$

$$\frac{4}{t-2}-\frac{8}{t(t-2)}=-2 \qquad \text{LCD}=t(t-2) \qquad \text{so } t\neq 0 \text{ or } t\neq 2$$

$$t(t-2)\left(\frac{4}{t-2}-\frac{8}{t(t-2)}\right)=t(t-2)(-2)$$

$$t\cancel{(t-2)}\left(\frac{4}{\cancel{t-2}}\right)-\cancel{t}\cancel{(t-2)}\left(\frac{8}{\cancel{t}\cancel{(t-2)}}\right)=-2t(t-2)$$

$$4t-8=-2t^2+4t$$

$$2t^2-8=0$$

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

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

$$2\neq 0 \text{ or } t+2=0 \text{ or } t-2=0$$

$$t=-2 \text{ or } t=2$$

$\{-2\}$ is the solution. ($t=2$ does not check because the denominator is zero.)

30.

$$\frac{x}{x+6}=\frac{72}{x^2-36}+4$$

$$\frac{x}{x+6}=\frac{72}{(x+6)(x-6)}+4 \qquad \text{LCD}=(x+6)(x-6) \qquad \text{so } x\neq -6 \text{ or } x\neq 6$$

$$(x+6)(x-6)\left(\frac{x}{x+6}\right)=(x+6)(x-6)\left(\frac{72}{(x+6)(x-6)}+4\right)$$

$$\cancel{(x+6)}(x-6)\left(\frac{x}{\cancel{x+6}}\right)=\cancel{(x+6)}\cancel{(x-6)}\left(\frac{72}{\cancel{(x+6)}\cancel{(x-6)}}\right)+(x+6)(x-6)(4)$$

$$x^2-6x=72+4(x^2-36)$$

$$x^2-6x=72+4x^2-144$$

$$0=3x^2+6x-72$$

$$3(x^2+2x-24)=0$$

$$3(x+6)(x-4)=0$$

$$3\neq 0 \text{ or } x+6=0 \text{ or } x-4=0$$

$$x=-6 \text{ or } x=4$$

$\{4\}$ is the solution. ($x=-6$ does not check because the denominator is zero.)

31.

$$\frac{6}{5y+10}-\frac{1}{y-5}=\frac{4}{y^2-3y-10}$$

$$\frac{6}{5(y+2)}-\frac{1}{y-5}=\frac{4}{(y-5)(y+2)} \qquad \text{LCD}=5(y-5)(y+2) \qquad \text{so } y\neq 5 \text{ or } y\neq -2$$

$$5(y-5)(y+2)\left(\frac{6}{5(y+2)}-\frac{1}{y-5}\right)=5(y-5)(y+2)\left(\frac{4}{(y-5)(y+2)}\right)$$

$$\cancel{5}(y-5)\cancel{(y+2)}\left(\frac{6}{\cancel{5}\cancel{(y+2)}}\right)-5\cancel{(y-5)}(y+2)\left(\frac{1}{\cancel{y-5}}\right)$$

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

$$6y-30-5y-10=20$$

$$y-40=20$$

$$y=60$$

$\{60\}$ is the solution.

32. $$\frac{-3}{x^2-7x+12}-\frac{2}{x^2+x-12}=\frac{10}{x^2-16}$$

$$\frac{-3}{(x-3)(x-4)}-\frac{2}{(x+4)(x-3)}=\frac{10}{(x+4)(x-4)}$$

LCD $=(x-3)(x-4)(x+4)$ so $x\neq 3$ or $x\neq 4$ or $x\neq -4$

$$(x-3)(x-4)(x+4)\left(\frac{-3}{(x-3)(x-4)}-\frac{2}{(x+4)(x-3)}\right)$$

$$=(x-3)\cancel{(x-4)}\cancel{(x+4)}\left(\frac{10}{\cancel{(x+4)}\cancel{(x-4)}}\right)$$

$$\cancel{(x-3)}\cancel{(x-4)}(x+4)\left(\frac{-3}{\cancel{(x-3)}\cancel{(x-4)}}\right)-\cancel{(x-3)}(x-4)\cancel{(x+4)}\left(\frac{2}{\cancel{(x+4)}\cancel{(x-3)}}\right)$$

$$=10(x-3)$$

$$-3x-12-2x+8=10x-30$$

$$-5x-4=10x-30$$

$$-15x=-26$$

$$x=\frac{26}{15}$$

$\left\{\frac{26}{15}\right\}$ is the solution.

33. $\frac{x}{x-5}+\frac{1}{5}=\frac{5}{x-5}$ LCD $=5(x-5)$ so $x\neq 5$

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

$$5\cancel{(x-5)}\left(\frac{x}{\cancel{x-5}}\right)+\cancel{5}(x-5)\left(\frac{1}{\cancel{5}}\right)=5\cancel{(x-5)}\left(\frac{5}{\cancel{x-5}}\right)$$

$$5x+x-5=25$$
$$6x-5=25$$
$$6x=30$$
$$x=5$$

{ } No solution. ($x=5$ does not check because it makes the denominator zero.)

34. $\dfrac{x}{x-2}+\dfrac{2}{3}=\dfrac{2}{x-2}$ LCD $=3(x-2)$ so $x\neq 2$

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

$$3\cancel{(x-2)}\left(\frac{x}{\cancel{x-2}}\right)+\cancel{3}(x-2)\left(\frac{2}{\cancel{3}}\right)=3\cancel{(x-2)}\left(\frac{2}{\cancel{x-2}}\right)$$

$$3x+2x-4=6$$
$$5x-4=6$$
$$5x=10$$
$$x=2$$

{ } No solution. ($x=2$ does not check because it makes the denominator zero.)

35. $\dfrac{6}{x^2-4x+3}-\dfrac{1}{x-3}=\dfrac{1}{4x-4}$

$\dfrac{6}{(x-3)(x-1)}-\dfrac{1}{x-3}=\dfrac{1}{4(x-1)}$ LCD $=4(x-3)(x-1)$ so $x\neq 3$ or $x\neq 1$

$$4(x-3)(x-1)\left(\frac{6}{(x-3)(x-1)}-\frac{1}{x-3}\right)=\cancel{4}(x-3)\cancel{(x-1)}\left(\frac{1}{\cancel{4}\cancel{(x-1)}}\right)$$

$$4\cancel{(x-3)}\cancel{(x-1)}\left(\frac{6}{\cancel{(x-3)}\cancel{(x-1)}}\right)-4\cancel{(x-3)}(x-1)\left(\frac{1}{\cancel{x-3}}\right)=x-3$$

$$24-4x+4=x-3$$
$$-4x+28=x-3$$
$$-5x=-31$$
$$x=\frac{31}{5}$$

$\left\{\dfrac{31}{5}\right\}$ is the solution.

36. $\dfrac{1}{4x^2-36}-\dfrac{5}{x+3}+\dfrac{2}{x-3}=0$

$\dfrac{1}{4(x+3)(x-3)}-\dfrac{5}{x+3}+\dfrac{2}{x-3}=0 \quad \text{LCD}=4(x+3)(x-3) \quad \text{so } x\neq -3 \text{ or } x\neq 3$

$4(x+3)(x-3)\left(\dfrac{1}{4(x+3)(x-3)}-\dfrac{5}{x+3}+\dfrac{2}{x-3}\right)=4(x+3)(x-3)(0)$

$\cancel{4}(\cancel{x+3})(\cancel{x-3})\left(\dfrac{1}{\cancel{4}(\cancel{x+3})(\cancel{x-3})}\right)-4(\cancel{x+3})(x-3)\left(\dfrac{5}{\cancel{x+3}}\right)$

$+4(x+3)(\cancel{x-3})\left(\dfrac{2}{\cancel{x-3}}\right)=0$

$1-20(x-3)+8(x+3)=0$

$1-20x+60+8x+24=0$

$-12x+85=0$

$-12x=-85$

$x=\dfrac{85}{12}$

$\left\{\dfrac{85}{12}\right\}$ is the solution.

37. $\dfrac{1}{k+2}-\dfrac{4}{k-2}-\dfrac{k^2}{4-k^2}=0$

$\dfrac{1}{k+2}-\dfrac{4}{k-2}+\dfrac{k^2}{(k+2)(k-2)}=0$

$\text{LCD}=(k+2)(k-2) \quad \text{so } k\neq -2 \text{ or } k\neq 2$

$(k+2)(k-2)\left(\dfrac{1}{k+2}-\dfrac{4}{k-2}+\dfrac{k^2}{(k+2)(k-2)}\right)=(k+2)(k-2)(0)$

$(\cancel{k+2})(k-2)\left(\dfrac{1}{\cancel{k+2}}\right)-(k+2)(\cancel{k-2})\left(\dfrac{4}{\cancel{k-2}}\right)+(\cancel{k+2})(\cancel{k-2})\left(\dfrac{k^2}{(\cancel{k+2})(\cancel{k-2})}\right)=0$

$k-2-4k-8+k^2=0$

$k^2-3k-10=0$

$(k-5)(k+2)=0$

$k-5=0 \text{ or } k+2=0$

$k=5 \text{ or } k=-2$

$\{5\}$ is the solution. ($k=-2$ does not check because the denominator is zero.)

38.

$$\frac{h}{2}-\frac{h}{h-4}=\frac{4}{4-h}$$
$$\frac{h}{2}-\frac{h}{h-4}=\frac{4}{(-1)(h-4)}$$
$$\frac{h}{2}-\frac{h}{h-4}=\frac{-4}{h-4}$$

$\text{LCD}=2(h-4)$ so $h\neq 4$

$$2(h-4)\left(\frac{h}{2}-\frac{h}{h-4}\right)=2(h-4)\left(\frac{-4}{h-4}\right)$$
$$\cancel{2}(h-4)\left(\frac{h}{\cancel{2}}\right)-2\cancel{(h-4)}\left(\frac{h}{\cancel{h-4}}\right)=2\cancel{(h-4)}\left(\frac{-4}{\cancel{h-4}}\right)$$
$$h^2-4h-2h=-8$$
$$h^2-6h+8=0$$
$$(h-4)(h-2)=0$$
$$h-4=0 \text{ or } h-2=0$$
$$h=4 \text{ or } h=2$$

$\{2\}$ is the solution. ($h=4$ does not check because the denominator is zero.)

39.

$$\frac{5}{x^2-7x+12}=\frac{2}{x-3}+\frac{5}{x-4}$$
$$\frac{5}{(x-4)(x-3)}=\frac{2}{x-3}+\frac{5}{x-4}$$

$\text{LCD}=(x-4)(x-3)$ so $x\neq 4$ or $x\neq 3$

$$(x-4)(x-3)\left(\frac{5}{(x-4)(x-3)}\right)=(x-4)(x-3)\left(\frac{2}{x-3}+\frac{5}{x-4}\right)$$
$$\cancel{(x-4)}\cancel{(x-3)}\left(\frac{5}{\cancel{(x-4)}\cancel{(x-3)}}\right)=(x-4)\cancel{(x-3)}\left(\frac{2}{\cancel{x-3}}\right)+\cancel{(x-4)}(x-3)\left(\frac{5}{\cancel{x-4}}\right)$$
$$5=2x-8+5x-15$$
$$5=7x-23$$
$$28=7x$$
$$x=4$$

{ } no solution. ($x=4$ does not check because the denominator is zero.)

40.
$$\frac{9}{x^2+7x+10}=\frac{5}{x+2}-\frac{3}{x+5}$$
$$\frac{9}{(x+5)(x+2)}=\frac{5}{x+2}-\frac{3}{x+5}$$
$$\text{LCD}=(x+5)(x+2) \quad \text{so } x\neq -5 \text{ or } x\neq -2$$
$$(x+5)(x+2)\left(\frac{9}{(x+5)(x+2)}\right)=(x+5)(x+2)\left(\frac{5}{x+2}-\frac{3}{x+5}\right)$$
$$\cancel{(x+5)}\cancel{(x+2)}\left(\frac{9}{\cancel{(x+5)}\cancel{(x+2)}}\right)=(x+5)\cancel{(x+2)}\left(\frac{5}{\cancel{x+2}}\right)-\cancel{(x+5)}(x+2)\left(\frac{3}{\cancel{x+5}}\right)$$
$$9=5x+25-3x-6$$
$$9=2x+19$$
$$-10=2x$$
$$x=-5$$
{ } no solution. ($x=-5$ does not check because the denominator is zero.)

41.
$$\frac{4}{x^2+7x+12}-\frac{7}{x^2+8x+15}=\frac{1}{x^2+9x+20}$$
$$\frac{4}{(x+4)(x+3)}-\frac{7}{(x+5)(x+3)}=\frac{1}{(x+5)(x+4)}$$
$$\text{LCD}=(x+4)(x+3)(x+5) \quad \text{so } x\neq -4, x\neq -3, x\neq -5$$
$$(x+4)(x+3)(x+5)\left(\frac{4}{(x+4)(x+3)}-\frac{7}{(x+5)(x+3)}\right)$$
$$=(x+4)(x+3)(x+5)\left(\frac{1}{(x+5)(x+4)}\right)$$
$$\cancel{(x+4)}\cancel{(x+3)}(x+5)\frac{4}{\cancel{(x+4)}\cancel{(x+3)}}-(x+4)\cancel{(x+3)}\cancel{(x+5)}\frac{7}{\cancel{(x+5)}\cancel{(x+3)}}$$
$$=\cancel{(x+4)}(x+3)\cancel{(x+5)}\frac{1}{\cancel{(x+5)}\cancel{(x+4)}}$$
$$4x+20-7x-28=x+3$$
$$-3x-8=x+3$$
$$-4x=11$$
$$x=-\frac{11}{4} \qquad \left\{-\frac{11}{4}\right\} \text{ is the solution.}$$

42. $\dfrac{5}{x^2-6x+8}-\dfrac{2}{x^2+3x-10}=\dfrac{8}{x^2+x-20}$

$\dfrac{5}{(x-4)(x-2)}-\dfrac{2}{(x+5)(x-2)}=\dfrac{8}{(x+5)(x-4)}$

$\text{LCD}=(x-4)(x-2)(x+5)$ so $x\neq 4, x\neq 2, x\neq -5$

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

$=(x-4)(x-2)(x+5)\left(\dfrac{8}{(x+5)(x-4)}\right)$

$\cancel{(x-4)}\cancel{(x-2)}(x+5)\dfrac{5}{\cancel{(x-4)}\cancel{(x-2)}}-(x-4)\cancel{(x-2)}\cancel{(x+5)}\dfrac{2}{\cancel{(x+5)}\cancel{(x-2)}}$

$=\cancel{(x-4)}(x-2)\cancel{(x+5)}\dfrac{8}{\cancel{(x+5)}\cancel{(x-4)}}$

$5x+25-2x+8=8x-16$

$3x+33=8x-16$

$-5x=-49$

$x=\dfrac{49}{5}$ $\left\{\dfrac{49}{5}\right\}$ is the solution.

43. $K=\dfrac{ma}{F}$ for m

$KF=ma$

$\dfrac{KF}{a}=m$

44. $K=\dfrac{ma}{F}$ for a

$KF=ma$

$\dfrac{KF}{m}=a$

45. $K=\dfrac{IR}{E}$ for E

$KE=IR$

$E=\dfrac{IR}{K}$

46. $K=\dfrac{IR}{E}$ for R

$KE=IR$

$\dfrac{KE}{I}=R$

47. $I=\dfrac{E}{R+r}$ for R

$I(R+r)=E$

48. $I=\dfrac{E}{R+r}$ for r

$I(R+r)=E$

$$IR + Ir = E$$
$$IR = E - Ir$$
$$R = \frac{E - Ir}{I} \quad \text{or} \quad R = \frac{E}{I} - r$$

$$IR + Ir = E$$
$$Ir = E - IR$$
$$r = \frac{E - IR}{I} \quad \text{or} \quad r = \frac{E}{I} - R$$

49.
$$h = \frac{2A}{B+b} \quad \text{for } B$$
$$h(B+b) = 2A$$
$$hB + hb = 2A$$
$$hB = 2A - hb$$
$$B = \frac{2A - hb}{h} \quad \text{or} \quad B = \frac{2A}{h} - b$$

50.
$$\frac{V}{\pi h} = r^2 \quad \text{for } h$$
$$V = \pi h r^2$$
$$\frac{V}{\pi r^2} = h$$

51.
$$x = \frac{at+b}{t} \quad \text{for } t$$
$$xt = at + b$$
$$xt - at = b$$
$$t(x-a) = b$$
$$t = \frac{b}{x-a}$$

52.
$$\frac{T+mf}{m} = g \quad \text{for } m$$
$$T + mf = mg$$
$$T = mg - mf$$
$$T = m(g-f)$$
$$\frac{T}{g-f} = m$$

53.
$$\frac{x-y}{xy} = z \quad \text{for } x$$
$$x - y = xyz$$
$$x - xyz = y$$
$$x(1-yz) = y$$
$$x = \frac{y}{1-yz}$$

54.
$$\frac{w-n}{wn} = P \quad \text{for } w$$
$$w - n = Pwn$$
$$w - Pwn = n$$
$$w(1-Pn) = n$$
$$w = \frac{n}{1-Pn}$$

55.
$$a + b = \frac{2A}{h} \quad \text{for } h$$
$$h(a+b) = 2A$$
$$h = \frac{2A}{a+b}$$

56.
$$1 + rt = \frac{A}{P} \quad \text{for } P$$
$$P(1+rt) = A$$
$$P = \frac{A}{1+rt}$$

57.
$$\frac{1}{R}=\frac{1}{R_1}+\frac{1}{R_2} \quad \text{for } R$$
$$RR_1R_2\left(\frac{1}{R}\right)=RR_1R_2\left(\frac{1}{R_1}+\frac{1}{R_2}\right)$$
$$\cancel{R}R_1R_2\left(\frac{1}{\cancel{R}}\right)=R\cancel{R_1}R_2\left(\frac{1}{\cancel{R_1}}\right)+RR_1\cancel{R_2}\left(\frac{1}{\cancel{R_2}}\right)$$
$$R_1R_2=RR_2+RR_1$$
$$R_1R_2=R\left(R_2+R_1\right)$$
$$\frac{R_1R_2}{R_2+R_1}=R$$

58.
$$\frac{b+a}{ab}=\frac{1}{f} \quad \text{for } b$$
$$\cancel{ab}f\left(\frac{b+a}{\cancel{ab}}\right)=ab\cancel{f}\left(\frac{1}{\cancel{f}}\right)$$
$$f\left(b+a\right)=ab$$
$$fb+fa=ab$$
$$fa=ab-fb$$
$$fa=b\left(a-f\right)$$
$$\frac{fa}{a-f}=b$$

59.
$$v=\frac{s_2-s_1}{t_2-t_1} \quad \text{for } t_2$$
$$v\left(t_2-t_1\right)=s_2-s_1$$
$$vt_2-vt_1=s_2-s_1$$
$$vt_2=s_2-s_1+vt_1$$
$$t_2=\frac{s_2-s_1+vt_1}{v}$$

60.
$$a=\frac{v_2-v_1}{t_2-t_1} \quad \text{for } v_1$$
$$a\left(t_2-t_1\right)=v_2-v_1$$
$$v_1=v_2-a\left(t_2-t_1\right)$$

61.
$$\frac{3}{x+2}+\frac{2}{x}=\frac{-4}{x^2+2x}$$
$$\frac{3}{x+2}+\frac{2}{x}=\frac{-4}{x\left(x+2\right)}$$
$\text{LCD}=x\left(x+2\right)$ so $x\neq 0, x\neq -2$
$$x\left(x+2\right)\left(\frac{3}{x+2}+\frac{2}{x}\right)=x\left(x+2\right)\frac{-4}{x\left(x+2\right)}$$
$$x\cancel{\left(x+2\right)}\frac{3}{\cancel{x+2}}+\cancel{x}\left(x+2\right)\frac{2}{\cancel{x}}=\cancel{x}\cancel{\left(x+2\right)}\frac{-4}{\cancel{x}\cancel{\left(x+2\right)}}$$

62.
$$\frac{1}{y^2-3y}+\frac{8}{y}=\frac{2}{y-3}$$
$$\frac{1}{y\left(y-3\right)}+\frac{8}{y}=\frac{2}{y-3}$$
$\text{LCD}=y\left(y-3\right)$ so $y\neq 0, y\neq 3$
$$y\left(y-3\right)\left(\frac{1}{y\left(y-3\right)}+\frac{8}{y}\right)=y\left(y-3\right)\left(\frac{2}{y-3}\right)$$
$$\cancel{y}\cancel{\left(y-3\right)}\frac{1}{\cancel{y}\cancel{\left(y-3\right)}}+\cancel{y}\left(y-3\right)\frac{8}{\cancel{y}}=y\cancel{\left(y-3\right)}\frac{2}{\cancel{y-3}}$$

$$\begin{aligned} 3x+2x+4&=-4\\ 5x+4&=-4\\ 5x&=-8\\ x&=-\frac{8}{5} \end{aligned} \qquad \left\{-\frac{8}{5}\right\}$$

$$\begin{aligned} 1+8y-24&=2y\\ 8y-23&=2y\\ -23&=-6y\\ y&=\frac{23}{6} \end{aligned} \qquad \left\{\frac{23}{6}\right\}$$

63.
$$\begin{aligned} 4c(c+1)&=3(c^2+4)\\ 4c^2+4c&=3c^2+12\\ c^2+4c-12&=0\\ (c+6)(c-2)&=0\\ c+6=0 &\text{ or } c-2=0\\ c=-6 &\text{ or } c=2 \end{aligned} \qquad \{-6,2\}$$

64.
$$\begin{aligned} 3t(2t-2)&=5(t^2-1)\\ 6t^2-6t&=5t^2-5\\ t^2-6t+5&=0\\ (t-5)(t-1)&=0\\ t-5=0 &\text{ or } t-1=0\\ t=5 &\text{ or } t=1 \end{aligned} \qquad \{1,5\}$$

65.
$$\frac{2}{v-1}-\frac{4}{v+5}=\frac{3}{v^2+4v-5}$$
$$\frac{2}{v-1}-\frac{4}{v+5}=\frac{3}{(v+5)(v-1)}$$

$\text{LCD}=(v+5)(v-1)$ so $v\neq -5$ or $v\neq 1$

$$(v+5)(v-1)\left(\frac{2}{v-1}-\frac{4}{v+5}\right)=(v+5)(v-1)\left(\frac{3}{(v+5)(v-1)}\right)$$

$$(v+5)\cancel{(v-1)}\left(\frac{2}{\cancel{v-1}}\right)-\cancel{(v+5)}(v-1)\left(\frac{4}{\cancel{v+5}}\right)=\cancel{(v+5)}\cancel{(v-1)}\left(\frac{3}{\cancel{(v+5)}\cancel{(v-1)}}\right)$$

$$\begin{aligned} 2v+10-4v+4&=3\\ -2v+14&=3\\ -2v&=-11\\ v&=\frac{11}{2} \end{aligned} \qquad \left\{\frac{11}{2}\right\}$$

66.
$$\frac{-2}{a+4}-\frac{3}{a-5}=\frac{6}{a^2-a-20}$$
$$\frac{-2}{a+4}-\frac{3}{a-5}=\frac{6}{(a-5)(a+4)}$$

$\text{LCD}=(a-5)(a+4)$ so $a\neq 5$ or $a\neq -4$

$$(a-5)(a+4)\left(\frac{-2}{a+4}-\frac{3}{a-5}\right)=(a-5)(a+4)\left(\frac{6}{(a-5)(a+4)}\right)$$

$$(a-5)\cancel{(a+4)}\left(\frac{-2}{\cancel{a+4}}\right)-\cancel{(a-5)}(a+4)\left(\frac{3}{\cancel{a-5}}\right)=\cancel{(a-5)}\cancel{(a+4)}\left(\frac{6}{\cancel{(a-5)}\cancel{(a+4)}}\right)$$

$$-2a+10-3a-12=6$$
$$-5a-2=6$$
$$-5a=8$$
$$a=-\frac{8}{5} \qquad \left\{-\frac{8}{5}\right\}$$

67. $5(x-9)=3(x+4)-2(4x+1)$

$5x-45=3x+12-8x-2$

$5x-45=-5x+10$

$10x-45=10$

$10x=55$

$x=\frac{55}{10}=\frac{11}{2} \quad \left\{\frac{11}{2}\right\}$

68. $4z-3(5z-3)=z-12$

$4z-15z+9=z-12$

$-11z+9=z-12$

$-12z+9=-12$

$-12z=-21$

$z=\frac{21}{12}=\frac{7}{4} \quad \left\{\frac{7}{4}\right\}$

69. $\frac{3y}{10}-\frac{5}{2y}=\frac{y}{5}$

LCD $=10y$ so $y\neq 0$

$$10y\left(\frac{3y}{10}-\frac{5}{2y}\right)=10y\left(\frac{y}{5}\right)$$

$$\cancel{10}y\left(\frac{3y}{\cancel{10}}\right)-5\cdot\cancel{2y}\left(\frac{5}{\cancel{2y}}\right)=\cancel{5}\cdot 2y\left(\frac{y}{\cancel{5}}\right)$$

$$3y^2-25=2y^2$$
$$y^2-25=0$$
$$(y-5)(y+5)=0$$
$$y-5=0$$
$$\text{or } y+5=0$$
$$y=5$$
$$\text{or } y=-5 \quad \{-5,5\}$$

70. $\frac{2h}{3}-\frac{8}{3h}=\frac{h}{2}$

LCD $=6h$ so $h\neq 0$

$$6h\left(\frac{2h}{3}-\frac{8}{3h}\right)=6h\left(\frac{h}{2}\right)$$

$$2\cdot\cancel{3}h\left(\frac{2h}{\cancel{3}}\right)-2\cdot\cancel{3h}\left(\frac{8}{\cancel{3h}}\right)=\cancel{2}\cdot 3h\left(\frac{h}{\cancel{2}}\right)$$

$$4h^2-16=3h^2$$
$$h^2-16=0$$
$$(h-4)(h+4)=0$$
$$h-4=0$$
$$\text{or } h+4=0$$
$$h=4$$
$$\text{or } h=-4 \quad \{-4,4\}$$

71. $\frac{1}{2}(4d-1)+\frac{2}{3}(2d+2)=\frac{5}{6}(4d+1)$

$\text{LCD}=6$

$6\left[\frac{1}{2}(4d-1)+\frac{2}{3}(2d+2)\right]=6\left[\frac{5}{6}(4d+1)\right]$

$3(4d-1)+4(2d+2)=5(4d+1)$

$12d-3+8d+8=20d+5$

$20d+5=20d+5$

$5=5$

$\{d \mid d \text{ is a real number}\}$

72. $\frac{2}{5}(2b+5)+\frac{1}{10}(7b-10)=\frac{1}{2}(3b+2)$

$\text{LCD}=10$

$10\left[\frac{2}{5}(2b+5)+\frac{1}{10}(7b-10)\right]=10\left[\frac{1}{2}(3b+2)\right]$

$4(2b+5)+7b-10=5(3b+2)$

$8b+20+7b-10=15b+10$

$15b+10=15b+10$

$10=10$

$\{b \mid b \text{ is a real number}\}$

73. $8t^{-1}+2=3t^{-1}$

$\frac{8}{t}+2=\frac{3}{t}$ $\quad \text{LCD}=t$ so $t\neq 0$

$t\left(\frac{8}{t}+2\right)=t\left(\frac{3}{t}\right)$

$\cancel{t}\left(\frac{8}{\cancel{t}}\right)+t(2)=\cancel{t}\left(\frac{3}{\cancel{t}}\right)$

$8+2t=3$

$2t=-5$

$t=-\frac{5}{2}$ $\quad \left\{-\frac{5}{2}\right\}$

74. $6z^{-2}-5z^{-1}=0$

$\frac{6}{z^2}-\frac{5}{z}=0$

$\text{LCD}=z^2$ so $z\neq 0$

$z^2\left(\frac{6}{z^2}-\frac{5}{z}\right)=z^2(0)$

$\cancel{z^2}\left(\frac{6}{\cancel{z^2}}\right)-\cancel{z}\cdot z\left(\frac{5}{\cancel{z}}\right)=0$

$6-5z=0$

$-5z=-6$

$z=\frac{6}{5}$ $\quad \left\{\frac{6}{5}\right\}$

75. $\frac{y-1}{11-3}=\frac{1}{2}$

$\frac{y-1}{8}=\frac{1}{2}$ $\quad \text{LCD}=8$

$\cancel{8}\left(\frac{y-1}{\cancel{8}}\right)=4\cdot\cancel{2}\left(\frac{1}{\cancel{2}}\right)$

$y-1=4$

$y=5$

76. $\frac{10-(-5)}{x-(-2)}=3$

$\frac{15}{x+2}=3$ $\quad \text{LCD}=x+2$

$\left(\cancel{x+2}\right)\left(\frac{15}{\cancel{x+2}}\right)=(x+2)(3)$

$15=3x+6$

$9=3x \Rightarrow x=3$

77.
$$\frac{2-(-2)}{x-4}=4$$
$$\frac{4}{x-4}=4 \qquad \text{LCD}=x-4$$
$$(x-4)\left(\frac{4}{x-4}\right)=(x-4)(4)$$
$$4=4x-16$$
$$20=4x$$
$$x=5$$

78.
$$\frac{y-2}{-1-3}=-\frac{3}{4}$$
$$\frac{y-2}{-4}=-\frac{3}{4} \qquad \text{LCD}=4$$
$$4\left(\frac{y-2}{-4}\right)=4\left(-\frac{3}{4}\right)$$
$$-(y-2)=-3$$
$$-y+2=-3$$
$$-y=-5$$
$$y=5$$

Problem Recognition Exercises

1. a.
$$\frac{3}{w-5}+\frac{10}{w^2-25}-\frac{1}{w+5}=\frac{3}{w-5}+\frac{10}{(w+5)(w-5)}-\frac{1}{w+5} \qquad \text{LCD}=(w+5)(w-5)$$
$$=\frac{3}{w-5}\cdot\frac{w+5}{w+5}+\frac{10}{(w+5)(w-5)}-\frac{1}{w+5}\cdot\frac{w-5}{w-5}=\frac{3w+15+10-w+5}{(w+5)(w-5)}=\frac{2w+30}{(w+5)(w-5)}$$

b.
$$\frac{3}{w-5}+\frac{10}{w^2-25}-\frac{1}{w+5}=0$$
$$\frac{2w+30}{(w+5)(w-5)}=0$$
$$(w+5)(w-5)\left(\frac{2w+30}{(w+5)(w-5)}\right)=(w+5)(w-5)(0)$$
$$2w+30=0$$
$$2w=-30$$
$$w=-15 \quad \{-15\}$$

c. The problem in part (a) is an expression, and the problem in part (b) is an equation.

2. a.
$$\frac{x}{2x+4}+\frac{2}{3x+6}-1=\frac{x}{2(x+2)}+\frac{2}{3(x+2)}-1 \qquad \text{LCD}=2\cdot 3(x+2)$$
$$=\frac{x}{2(x+2)}\cdot\frac{3}{3}+\frac{2}{3(x+2)}\cdot\frac{2}{2}-1\cdot\frac{2\cdot 3(x+2)}{2\cdot 3(x+2)}=\frac{3x+4-6x-12}{6(x+2)}=\frac{-3x-8}{6(x+2)}$$

b.

$$\frac{x}{2x+4}+\frac{2}{3x+6}=1$$

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

$$6(x+2)\left(\frac{x}{2(x+2)}+\frac{2}{3(x+2)}\right)=6(x+2)(1)$$

$$\cancel{2}\cdot 3\cancel{(x+2)}\left(\frac{x}{\cancel{2}\cancel{(x+2)}}\right)+2\cdot\cancel{3}\cancel{(x+2)}\left(\frac{2}{\cancel{3}\cancel{(x+2)}}\right)=6(x+2)$$

$$3x+4=6x+12$$

$$-3x=8$$

$$x=-\frac{8}{3}\quad\left\{-\frac{8}{3}\right\}$$

c. The problem in part (a) is an expression, and the problem in part (b) is an equation.

3. $\dfrac{2}{a^2+4a+3}+\dfrac{1}{a+3}=\dfrac{2}{(a+3)(a+1)}+\dfrac{1}{a+3}$ LCD $=(a+3)(a+1)$

$$=\frac{2}{(a+3)(a+1)}+\frac{1}{a+3}\cdot\frac{a+1}{a+1}=\frac{2+a+1}{(a+3)(a+1)}=\frac{\cancel{a+3}}{\cancel{(a+3)}(a+1)}=\frac{1}{a+1}$$

4. $\dfrac{1}{c+6}+\dfrac{4}{c^2+8c+12}=\dfrac{1}{c+6}+\dfrac{4}{(c+6)(c+2)}$ LCD $=(c+6)(c+2)$

$$=\frac{1}{c+6}\cdot\frac{c+2}{c+2}+\frac{4}{(c+6)(c+2)}=\frac{c+2+4}{(c+6)(c+2)}=\frac{\cancel{c+6}}{\cancel{(c+6)}(c+2)}=\frac{1}{c+2}$$

5. $\dfrac{7}{y^2-y-2}+\dfrac{1}{y+1}-\dfrac{3}{y-2}=0$

$\dfrac{7}{(y-2)(y+1)}+\dfrac{1}{y+1}-\dfrac{3}{y-2}=0$ LCD $=(y-2)(y+1)$ so $y\neq 2$ or $y\neq -1$

$$(y-2)(y+1)\left(\frac{7}{(y-2)(y+1)}+\frac{1}{y+1}-\frac{3}{y-2}\right)=(y-2)(y+1)(0)$$

$$\cancel{(y-2)}\cancel{(y+1)}\left(\frac{7}{\cancel{(y-2)}\cancel{(y+1)}}\right)+(y-2)\cancel{(y+1)}\left(\frac{1}{\cancel{y+1}}\right)-\cancel{(y-2)}(y+1)\left(\frac{3}{\cancel{y-2}}\right)=0$$

$$7+y-2-3y-3=0$$
$$-2y+2=0$$
$$-2y=-2$$
$$y=1$$

$\{1\}$ is the solution.

6. $\dfrac{3}{b+2}-\dfrac{1}{b-1}-\dfrac{5}{b^2+b-2}=0$

$\dfrac{3}{b+2}-\dfrac{1}{b-1}-\dfrac{5}{(b+2)(b-1)}=0$ LCD $=(b+2)(b-1)$ so $b\neq -2$ or $b\neq 1$

$$(b+2)(b-1)\left(\frac{3}{b+2}-\frac{1}{b-1}-\frac{5}{(b+2)(b-1)}\right)=(b+2)(b-1)(0)$$

$$\cancel{(b+2)}(b-1)\left(\frac{3}{\cancel{b+2}}\right)-(b+2)\cancel{(b-1)}\left(\frac{1}{\cancel{b-1}}\right)-\cancel{(b+2)}\cancel{(b-1)}\left(\frac{5}{\cancel{(b+2)}\cancel{(b-1)}}\right)=0$$
$$3b-3-b-2-5=0$$
$$2b-10=0$$
$$2b=10$$
$$b=5$$

$\{5\}$ is the solution.

7. $\dfrac{x}{x-1}-\dfrac{12}{x^2-x}=\dfrac{x}{x-1}-\dfrac{12}{x(x-1)}$

LCD $=x(x-1)$

$$=\frac{x}{x-1}\cdot\frac{x}{x}-\frac{12}{x(x-1)}=\frac{x^2-12}{x(x-1)}$$

8. $\dfrac{3}{5t-20}+\dfrac{4}{t-4}=\dfrac{3}{5(t-4)}+\dfrac{4}{t-4}$

LCD $=5(t-4)$

$$=\frac{3}{5(t-4)}+\frac{4}{t-4}\cdot\frac{5}{5}=\frac{3+20}{5(t-4)}=\frac{23}{5(t-4)}$$

9. $\dfrac{3}{w}-5=\dfrac{7}{w}-1$

LCD $=w$ so $w\neq 0$

$$w\left(\frac{3}{w}-5\right)=w\left(\frac{7}{w}-1\right)$$
$$\cancel{w}\left(\frac{3}{\cancel{w}}\right)-w(5)=\cancel{w}\left(\frac{7}{\cancel{w}}\right)-w(1)$$
$$3-5w=7-w$$

10. $\dfrac{-3}{y^2}-\dfrac{1}{y}=-2$

LCD $=y^2$ so $y\neq 0$

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

$$-4w = 4$$
$$w = -1 \quad \{-1\}$$

$$2y^2 - y - 3 = 0$$
$$(2y-3)(y+1) = 0$$
$$2y-3 = 0 \text{ or } y+1 = 0$$
$$2y = 3 \text{ or } y = -1$$
$$y = \frac{3}{2} \text{ or } y = -1 \quad \left\{\frac{3}{2}, -1\right\}$$

11. $\dfrac{4p+1}{8p-12} + \dfrac{p-3}{2p-3} = \dfrac{4p+1}{4(2p-3)} + \dfrac{p-3}{2p-3}$

$\text{LCD} = 4(2p-3)$

$$= \frac{4p+1}{4(2p-3)} + \frac{p-3}{2p-3} \cdot \frac{4}{4}$$
$$= \frac{4p+1+4p-12}{4(2p-3)} = \frac{8p-11}{4(2p-3)}$$

12. $\dfrac{x+1}{2x+4} - \dfrac{x^2}{x+2} = \dfrac{x+1}{2(x+2)} - \dfrac{x^2}{x+2}$

$\text{LCD} = 2(x+2)$

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

13. $\dfrac{1}{2x^2} + \dfrac{1}{6x} \quad \text{LCD} = 6x^2$

$$= \frac{1}{2x^2} \cdot \frac{3}{3} + \frac{1}{6x} \cdot \frac{x}{x} = \frac{3+x}{6x^2}$$

14. $\dfrac{5}{4a} + \dfrac{1}{6a^2} \quad \text{LCD} = 12a^2$

$$= \frac{5}{4a} \cdot \frac{3a}{3a} + \frac{1}{6a^2} \cdot \frac{2}{2} = \frac{15a+2}{12a^2}$$

15. $\dfrac{3}{2t} + \dfrac{2}{3t^2} = \dfrac{-1}{t}$

$\text{LCD} = 6t^2 \quad$ so $t \neq 0$

$$6t^2\left(\frac{3}{2t} + \frac{2}{3t^2}\right) = 6t^2\left(\frac{-1}{t}\right)$$
$$\cancel{2t} \cdot 3t\left(\frac{3}{\cancel{2t}}\right) + 2 \cdot \cancel{3t^2}\left(\frac{2}{\cancel{3t^2}}\right) = 6t \cdot \cancel{t}\left(\frac{-1}{\cancel{t}}\right)$$
$$9t + 4 = -6t$$
$$4 = -15t$$
$$-\frac{4}{15} = t \quad \left\{-\frac{4}{15}\right\}$$

16. $\dfrac{-3}{b^2} + \dfrac{1}{5b} = \dfrac{1}{2b}$

$\text{LCD} = 10b^2 \quad$ so $b \neq 0$

$$10b^2\left(\frac{-3}{b^2} + \frac{1}{5b}\right) = 10b^2\left(\frac{1}{2b}\right)$$
$$10\cancel{b^2}\left(\frac{-3}{\cancel{b^2}}\right) + 2b \cdot \cancel{5b}\left(\frac{1}{\cancel{5b}}\right) = \cancel{2b} \cdot 5b\left(\frac{1}{\cancel{2b}}\right)$$
$$-30 + 2b = 5b$$
$$-30 = 3b$$
$$-10 = b \quad \{-10\}$$

17. $\dfrac{3}{c^2+4c+3}-\dfrac{2}{c^2+6c+9}$

$=\dfrac{3}{(c+3)(c+1)}-\dfrac{2}{(c+3)^2}$

$\text{LCD}=(c+3)^2(c+1)$

$=\dfrac{3}{(c+3)(c+1)}\cdot\dfrac{c+3}{c+3}-\dfrac{2}{(c+3)^2}\cdot\dfrac{c+1}{c+1}$

$=\dfrac{3c+9-2c-2}{(c+3)^2(c+1)}$

$=\dfrac{c+7}{(c+3)^2(c+1)}$

18. $\dfrac{1}{y^2-10y+25}-\dfrac{3}{y^2-7y+10}$

$=\dfrac{1}{(y-5)^2}-\dfrac{3}{(y-5)(y-2)}$

$\text{LCD}=(y-5)^2(y-2)$

$=\dfrac{1}{(y-5)^2}\cdot\dfrac{y-2}{y-2}-\dfrac{3}{(y-5)(y-2)}\cdot\dfrac{y-5}{y-5}$

$=\dfrac{y-2-3y+15}{(y-5)^2(y-2)}$

$=\dfrac{-2y+13}{(y-5)^2(y-2)}$

19. $\dfrac{4}{w-4}-\dfrac{36}{2w^2-7w-4}=\dfrac{3}{2w+1}$

$\dfrac{4}{w-4}-\dfrac{36}{(2w+1)(w-4)}=\dfrac{3}{2w+1}$ $\quad \text{LCD}=(2w+1)(w-4)$ $\quad$ so $w\neq-\dfrac{1}{2}$ or $w\neq 4$

$(2w+1)(w-4)\left(\dfrac{4}{w-4}-\dfrac{36}{(2w+1)(w-4)}\right)=(2w+1)(w-4)\left(\dfrac{3}{2w+1}\right)$

$(2w+1)\cancel{(w-4)}\left(\dfrac{4}{\cancel{w-4}}\right)-\cancel{(2w+1)}\cancel{(w-4)}\left(\dfrac{36}{\cancel{(2w+1)}\cancel{(w-4)}}\right)=\cancel{(2w+1)}(w-4)\left(\dfrac{3}{\cancel{2w+1}}\right)$

$8w+4-36=3w-12$

$8w-32=3w-12$

$5w-32=-12$

$5w=20$

$w=4$

{ } no solution. ($w=4$ does not check because the denominator is zero.)

20. $\dfrac{2}{x-3}-\dfrac{5}{x+2}=\dfrac{25}{x^2-x-6}$

$\dfrac{2}{x-3}-\dfrac{5}{x+2}=\dfrac{25}{(x-3)(x+2)}$

$\text{LCD}=(x-3)(x+2)$ $\quad$ so $x\neq 3$ or $x\neq -2$

$(x-3)(x+2)\left(\dfrac{2}{x-3}-\dfrac{5}{x+2}\right)=(x-3)(x+2)\left(\dfrac{25}{(x-3)(x+2)}\right)$

$$\cancel{(x-3)}(x+2)\left(\frac{2}{\cancel{x-3}}\right)-(x-3)\cancel{(x+2)}\left(\frac{5}{\cancel{x+2}}\right)=\cancel{(x-3)}\cancel{(x+2)}\left(\frac{25}{\cancel{(x-3)}\cancel{(x+2)}}\right)$$

$$2x+4-5x+15=25$$
$$-3x+19=25$$
$$-3x=6$$
$$x=-2$$

{ } no solution. ($x=-2$ does not check because the denominator is zero.)

Section 5.6 Practice Exercises

1. **a.** proportion **b.** proportional

2.
$$3-\frac{6}{x}=x+8$$
LCD $=x$ so $x\neq 0$
$$x\left(3-\frac{6}{x}\right)=x(x+8)$$
$$x(3)-\cancel{x}\left(\frac{6}{\cancel{x}}\right)=x^2+8x$$
$$3x-6=x^2+8x$$
$$0=x^2+5x+6$$
$$(x+3)(x+2)=0$$
$$x+3=0 \text{ or } x+2=0$$
$$x=-3 \text{ or } x=-2 \quad \{-3,-2\}$$

3.
$$2+\frac{6}{x}=x+7$$
LCD $=x$ so $x\neq 0$
$$x\left(2+\frac{6}{x}\right)=x(x+7)$$
$$x(2)+\cancel{x}\left(\frac{6}{\cancel{x}}\right)=x^2+7x$$
$$2x+6=x^2+7x$$
$$0=x^2+5x-6$$
$$(x+6)(x-1)=0$$
$$x+6=0 \text{ or } x-1=0$$
$$x=-6 \text{ or } x=1 \quad \{-6,1\}$$

4.
$$\frac{5}{3x-6}-\frac{3}{4x-8}=\frac{5}{3(x-2)}-\frac{3}{4(x-2)}$$
$$\text{LCD}=12(x-2)$$
$$=\frac{5}{3(x-2)}\cdot\frac{4}{4}-\frac{3}{4(x-2)}\cdot\frac{3}{3}$$
$$=\frac{20-9}{12(x-2)}$$
$$=\frac{11}{12(x-2)}$$

5.
$$\frac{4}{5t-1}+\frac{1}{10t-2}=\frac{4}{5t-1}+\frac{1}{2(5t-1)}$$
$$\text{LCD}=2(5t-1)$$
$$=\frac{4}{5t-1}\cdot\frac{2}{2}+\frac{1}{2(5t-1)}$$
$$=\frac{8+1}{2(5t-1)}$$
$$=\frac{9}{2(5t-1)}$$

6. $$\frac{2}{y-1}-\frac{5}{4}=\frac{-1}{y+1}$$

$\text{LCD}=4(y+1)(y-1)$ so $y\neq -1$ or $y\neq 1$

$$4(y+1)(y-1)\left(\frac{2}{y-1}-\frac{5}{4}\right)=4\cancel{(y+1)}(y-1)\left(\frac{-1}{\cancel{y+1}}\right)$$

$$4(y+1)\cancel{(y-1)}\left(\frac{2}{\cancel{y-1}}\right)-\cancel{4}(y+1)(y-1)\left(\frac{5}{\cancel{4}}\right)=-4(y-1)$$

$$8(y+1)-5(y^2-1)=-4y+4$$

$$8y+8-5y^2+5=-4y+4$$

$$-5y^2+12y+9=0$$

$$-(5y^2-12y-9)=0$$

$$-(5y+3)(y-3)=0$$

$$-1\neq 0 \text{ or } 5y+3=0 \text{ or } y-3=0$$

$$5y=-3 \text{ or } y=3$$

$$y=-\frac{3}{5} \text{ or } y=3 \quad \left\{-\frac{3}{5},3\right\}$$

7. $$\frac{5}{w-2}=7-\frac{10}{w+2}$$

$\text{LCD}=(w+2)(w-2)$ so $w\neq -2$ or $w\neq 2$

$$(w+2)(w-2)\left(\frac{5}{w-2}\right)=(w+2)(w-2)\left(7-\frac{10}{w+2}\right)$$

$$(w+2)\cancel{(w-2)}\left(\frac{5}{\cancel{w-2}}\right)=(w+2)(w-2)(7)-\cancel{(w+2)}(w-2)\left(\frac{10}{\cancel{w+2}}\right)$$

$$5w+10=7(w^2-4)-10w+20$$

$$5w+10=7w^2-28-10w+20$$

$$0=7w^2-15w-18$$

$$(7w+6)(w-3)=0$$

$$7w+6=0 \text{ or } w-3=0$$

$$7w=-6 \text{ or } w=3$$

$$w=-\frac{6}{7} \text{ or } w=3 \quad \left\{-\frac{6}{7},3\right\}$$

8. $$\frac{ab}{6}\div\frac{a^2}{12}\cdot\frac{a+1}{ab+b}=\frac{ab}{6}\cdot\frac{12}{a^2}\cdot\frac{a+1}{b(a+1)}=\frac{\cancel{a}\,\cancel{b}}{\cancel{6}}\cdot\frac{\cancel{6}\cdot 2}{\cancel{a}\cdot a}\cdot\frac{\cancel{a+1}}{\cancel{b}\,\cancel{(a+1)}}=\frac{2}{a}$$

9. $$\frac{8p^2-32}{p^2-4p+4}\cdot\frac{3p^2-3p-6}{2p^2+20p+32}=\frac{8\left(p^2-4\right)}{p^2-4p+4}\cdot\frac{3\left(p^2-p-2\right)}{2\left(p^2+10p+16\right)}$$
$$=\frac{4\cdot\cancel{2}\cancel{\left(p+2\right)}\cancel{\left(p-2\right)}}{\cancel{\left(p-2\right)}\cancel{\left(p-2\right)}}\cdot\frac{3\cancel{\left(p-2\right)}\left(p+1\right)}{\cancel{2}\left(p+8\right)\cancel{\left(p+2\right)}}$$
$$=\frac{12\left(p+1\right)}{p+8}$$

10. $$\frac{3t}{t+6}=t+\frac{2t}{t+6}\qquad \text{LCD}=t+6\quad \text{so } t\neq -6$$
$$\left(t+6\right)\left(\frac{3t}{t+6}\right)=\left(t+6\right)\left(t+\frac{2t}{t+6}\right)$$
$$3t=t\left(t+6\right)+2t$$
$$3t=t^2+6t+2t$$
$$3t=t^2+8t$$
$$0=t^2+5t$$
$$t\left(t+5\right)=0$$
$$t=0 \text{ or } t+5=0$$
$$t=0 \text{ or } t=-5 \quad \{0,-5\}$$

11. $$\frac{y}{6}=\frac{20}{15}\qquad \text{LCD}=30$$
$$30\left(\frac{y}{6}\right)=30\left(\frac{20}{15}\right)$$
$$5y=40$$
$$y=8 \quad \{8\}$$

12. $$\frac{12}{18}=\frac{14}{x}\qquad \text{LCD}=18x$$
$$18x\left(\frac{12}{18}\right)=18x\left(\frac{14}{x}\right)$$
$$12x=252$$
$$x=21 \quad \{21\}$$

13. $$\frac{9}{75}=\frac{m}{50}\qquad \text{LCD}=150$$
$$150\left(\frac{9}{75}\right)=150\left(\frac{m}{50}\right)$$
$$18=3m$$
$$m=6 \quad \{6\}$$

14. $$\frac{n}{15}=\frac{12}{45}\qquad \text{LCD}=45$$
$$45\left(\frac{n}{15}\right)=45\left(\frac{12}{45}\right)$$
$$3n=12$$
$$n=4 \quad \{4\}$$

15. $\dfrac{p-1}{4}=\dfrac{p+3}{3}$ LCD $=12$

$$12\left(\frac{p-1}{4}\right)=12\left(\frac{p+3}{3}\right)$$
$$3(p-1)=4(p+3)$$
$$3p-3=4p+12$$
$$-15=p \quad \{-15\}$$

16. $\dfrac{q-5}{2}=\dfrac{q+2}{3}$ LCD $=6$

$$6\left(\frac{q-5}{2}\right)=6\left(\frac{q+2}{3}\right)$$
$$3(q-5)=2(q+2)$$
$$3q-15=2q+4$$
$$q=19 \quad \{19\}$$

17. $\dfrac{x+1}{5}=\dfrac{4}{15}$ LCD $=15$

$$15\left(\frac{x+1}{5}\right)=15\left(\frac{4}{15}\right)$$
$$3(x+1)=4$$
$$3x+3=4$$
$$3x=1$$
$$x=\frac{1}{3} \quad \left\{\frac{1}{3}\right\}$$

18. $\dfrac{t-1}{7}=\dfrac{2}{21}$ LCD $=21$

$$21\left(\frac{t-1}{7}\right)=21\left(\frac{2}{21}\right)$$
$$3(t-1)=2$$
$$3t-3=2$$
$$3t=5$$
$$t=\frac{5}{3} \quad \left\{\frac{5}{3}\right\}$$

19. $\dfrac{5-2x}{x}=\dfrac{1}{4}$ LCD $=4x$

$$4x\left(\frac{5-2x}{x}\right)=4x\left(\frac{1}{4}\right)$$
$$4(5-2x)=x$$
$$20-8x=x$$
$$20=9x$$
$$x=\frac{20}{9} \quad \left\{\frac{20}{9}\right\}$$

20. $\dfrac{2y+3}{y}=\dfrac{3}{2}$ LCD $=2y$

$$2y\left(\frac{2y+3}{y}\right)=2y\left(\frac{3}{2}\right)$$
$$2(2y+3)=3y$$
$$4y+6=3y$$
$$y=-6 \quad \{-6\}$$

21. $\dfrac{2}{y-1}=\dfrac{y-3}{4}$

LCD $=4(y-1)$

$$4\cancel{(y-1)}\left(\frac{2}{\cancel{y-1}}\right)=\cancel{4}(y-1)\left(\frac{y-3}{\cancel{4}}\right)$$
$$8=y^2-4y+3$$
$$0=y^2-4y-5$$

22. $\dfrac{1}{x-5}=\dfrac{x-3}{3}$

LCD $=3(x-5)$

$$3\cancel{(x-5)}\left(\frac{1}{\cancel{x-5}}\right)=\cancel{3}(x-5)\left(\frac{x-3}{\cancel{3}}\right)$$
$$3=x^2-8x+15$$
$$0=x^2-8x+12$$

$$(y-5)(y+1)=0$$
$$y-5=0 \text{ or } y+1=0$$
$$y=5 \text{ or } y=-1 \quad \{5,-1\}$$

$$(x-6)(x-2)=0$$
$$x-6=0 \text{ or } x-2=0$$
$$x=6 \text{ or } x=2 \quad \{6,2\}$$

23. $\dfrac{1}{49w}=\dfrac{w}{9}$

$$\text{LCD}=9\cdot 49w$$
$$9\cdot \cancel{49w}\left(\frac{1}{\cancel{49w}}\right)=\cancel{9}\cdot 49w\left(\frac{w}{\cancel{9}}\right)$$
$$9=49w^2$$
$$0=49w^2-9$$
$$(7w+3)(7w-3)=0$$
$$7w+3=0 \text{ or } 7w-3=0$$
$$7w=-3 \text{ or } 7w=3$$
$$w=-\frac{3}{7} \text{ or } w=\frac{3}{7} \quad \left\{-\frac{3}{7},\frac{3}{7}\right\}$$

24. $\dfrac{1}{4z}=\dfrac{z}{25}$

$$\text{LCD}=25\cdot 4z$$
$$25\cdot \cancel{4z}\left(\frac{1}{\cancel{4z}}\right)=\cancel{25}\cdot 4z\left(\frac{z}{\cancel{25}}\right)$$
$$25=4z^2$$
$$0=4z^2-25$$
$$(2z+5)(2z-5)=0$$
$$2z+5=0 \text{ or } 2z-5=0$$
$$2z=-5 \text{ or } 2z=5$$
$$z=-\frac{5}{2} \text{ or } z=\frac{5}{2} \quad \left\{-\frac{5}{2},\frac{5}{2}\right\}$$

25. $\dfrac{x+3}{5x+26}=\dfrac{2}{x+4}$

$$\text{LCD}=(5x+26)(x+4)$$
$$\cancel{(5x+26)}(x+4)\left(\frac{x+3}{\cancel{5x+26}}\right)$$
$$=(5x+26)\cancel{(x+4)}\left(\frac{2}{\cancel{x+4}}\right)$$
$$x^2+7x+12=10x+52$$
$$x^2-3x-40=0$$
$$(x-8)(x+5)=0$$
$$x-8=0 \text{ or } x+5=0$$
$$x=8 \text{ or } x=-5 \quad \{8,-5\}$$

26. $\dfrac{-2}{x-2}=\dfrac{x-3}{8x+11}$

$$\text{LCD}=(x-2)(8x+11)$$
$$\cancel{(x-2)}(8x+11)\left(\frac{-2}{\cancel{x-2}}\right)$$
$$=(x-2)\cancel{(8x+11)}\left(\frac{x-3}{\cancel{8x+11}}\right)$$
$$-16x-22=x^2-5x+6$$
$$0=x^2+11x+28$$
$$0=(x+7)(x+4)$$
$$x+7=0 \text{ or } x+4=0$$
$$x=-7 \text{ or } x=-4 \quad \{-7,-4\}$$

27. Let a = the number of adults

$$\frac{3}{1}=\frac{18}{a} \qquad \text{LCD}=a$$
$$a\left(\frac{3}{1}\right)=a\left(\frac{18}{a}\right)$$

28. Let c = the number of children

$$\frac{4}{1}=\frac{c}{5} \qquad \text{LCD}=5$$
$$5\left(\frac{4}{1}\right)=5\left(\frac{c}{5}\right)$$
$$20=c$$

$3a = 18$

$a = 6$

6 adults must be on the staff.

The maximum number of children that can enroll is 20 children.

29. Let x = the number of grams of fat

$$\frac{3.5}{21.0} = \frac{14}{x} \qquad \text{LCD} = 21x$$

$$21x\left(\frac{3.5}{21.0}\right) = 21x\left(\frac{14}{x}\right)$$

$$3.5x = 294$$

$$x = 84$$

The 14-oz box of candy contains 84 g of fat.

30. Let c = the number of calories

$$\frac{6}{350} = \frac{10}{c} \qquad \text{LCD} = 350c$$

$$350c\left(\frac{6}{350}\right) = 350c\left(\frac{10}{c}\right)$$

$$6c = 3500$$

$$c = 583.\overline{3}$$

The 10-oz box of candy contains approximately 583 calories.

31. Let x = the number of fish

$$\frac{8}{1840} = \frac{x}{230{,}000}$$

$$\text{LCD} = 230{,}000$$

$$230{,}000\left(\frac{8}{1840}\right) = 230{,}000\left(\frac{x}{230{,}000}\right)$$

$$1000 = x$$

1000 swordfish were caught.

32. Let c = the cost of 80-oz bottle

$$\frac{64}{12.00} = \frac{80}{c} \qquad \text{LCD} = 12.00c$$

$$12.00c\left(\frac{64}{12.00}\right) = 12.00c\left(\frac{80}{c}\right)$$

$$64c = 960$$

$$c = 15.00$$

The 80-oz bottle costs \$15.00.

33. Let x = the number of gallons of gas

$$\frac{243}{4.5} = \frac{621}{x} \qquad \text{LCD} = 4.5x$$

$$4.5x\left(\frac{243}{4.5}\right) = 4.5x\left(\frac{621}{x}\right)$$

$$243x = 2794.5$$

$$x = 11.5$$

Pam needs 11.5 gallons of gas.

34. Let x = the actual distance

$$\frac{8}{96} = \frac{7}{x} \qquad \text{LCD} = 96x$$

$$96x\left(\frac{8}{96}\right) = 96x\left(\frac{7}{x}\right)$$

$$8x = 672$$

$$x = 84$$

The actual distance is 84 mi.

35. Let x = the total number of bison

$$\frac{x}{200} = \frac{120}{6}$$

$$\text{LCD} = 600$$

$$600\left(\frac{x}{200}\right) = 600\left(\frac{120}{6}\right)$$

36. Let x = the total number of manatees

$$\frac{x}{150} = \frac{40}{3}$$

$$\text{LCD} = 150$$

$$150\left(\frac{x}{150}\right) = 150\left(\frac{40}{3}\right)$$

$$3x = 12000$$
$$x = 4000$$

There are approximately 4000 bison in the park.

37. Let x = the number of men

$186 - x$ = the number of women

$$\frac{1}{5} = \frac{x}{186 - x}$$
$$\text{LCD} = 186 - x$$
$$5(186 - x)\left(\frac{1}{5}\right) = 5(186 - x)\left(\frac{x}{186 - x}\right)$$
$$186 - x = 5x$$
$$186 = 6x$$
$$x = 31$$

There are 31 men enrolled.

$$x = 2000$$

There are approximately 2000 manatees in Florida.

38. Let x = the amount spent on rent

$1640 - x$ = amount spent on car payments

$$\frac{3}{1} = \frac{x}{1640 - x}$$
$$\text{LCD} = 1640 - x$$
$$(1640 - x)\left(\frac{3}{1}\right) = (1640 - x)\left(\frac{x}{1640 - x}\right)$$
$$4920 - 3x = x$$
$$4920 = 4x$$
$$x = 1230$$
$$1640 - x = 1640 - 1230 = 410$$

Rent was \$1230 and car payment was \$410.

39. Let x = the number of women

$1095 - x$ = the number of men

$$\frac{119}{100} = \frac{1095 - x}{x}$$
$$\text{LCD} = 100x$$
$$100x\left(\frac{119}{100}\right) = 100x\left(\frac{1095 - x}{x}\right)$$
$$119x = 109{,}500 - 100x$$
$$219x = 109{,}500$$
$$x = 500$$
$$1095 - x = 1095 - 500$$
$$= 595$$

There are 595 men and 500 women in the group.

40. Let x = the amount alcohol

$450 - x$ = amount of water

$$\frac{7}{8} = \frac{450 - x}{x}$$
$$\text{LCD} = 8x$$
$$8x\left(\frac{7}{8}\right) = 8x\left(\frac{450 - x}{x}\right)$$
$$7x = 3600 - 8x$$
$$15x = 3600$$
$$x = 240$$
$$450 - x = 450 - 240$$
$$= 210$$

There are 240 L of alcohol and 210 L of water in the mixture.

41.
$$\frac{11.2}{a}=\frac{14}{10}$$
$$10a\left(\frac{11.2}{a}\right)=10a\left(\frac{14}{10}\right)$$
$$112=14a$$
$$a=8 \text{ ft}$$
$$\frac{b}{6}=\frac{14}{10}$$
$$30\left(\frac{b}{6}\right)=30\left(\frac{14}{10}\right)$$
$$5b=42$$
$$b=8.4 \text{ ft}$$

42.
$$\frac{18}{x}=\frac{12}{8}$$
$$8x\left(\frac{18}{x}\right)=8x\left(\frac{12}{8}\right)$$
$$144=12x$$
$$x=12 \text{ cm}$$
$$\frac{y}{13}=\frac{12}{8}$$
$$104\left(\frac{y}{13}\right)=104\left(\frac{12}{8}\right)$$
$$8y=156$$
$$y=19.5 \text{ cm}$$

43.
$$\frac{1.75}{5}=\frac{4.55}{y}$$
$$5y\left(\frac{1.75}{5}\right)=5y\left(\frac{4.55}{y}\right)$$
$$1.75y=22.75$$
$$y=13 \text{ in}$$

$$(1.75)^2+z^2=(4.55)^2$$
$$3.0625+z^2=20.7025$$
$$z^2=17.64$$
$$z=4.2 \text{ in}$$

$$\frac{1.75}{5}=\frac{4.2}{x}$$
$$5x\left(\frac{1.75}{5}\right)=5x\left(\frac{4.2}{x}\right)$$
$$1.75x=21$$
$$x=12 \text{ in}$$

44.
$$\frac{3.75}{5}=\frac{a}{12}$$
$$60\left(\frac{3.75}{5}\right)=60\left(\frac{a}{12}\right)$$
$$45=5a$$
$$a=9 \text{ m}$$

$$(3.75)^2+(9)^2=b^2$$
$$14.0625+81=b^2$$
$$b^2=95.0625$$
$$b=9.75 \text{ m}$$

$$\frac{3.75}{5}=\frac{9.75}{c}$$
$$5c\left(\frac{3.75}{5}\right)=5c\left(\frac{9.75}{c}\right)$$
$$3.75c=48.75$$
$$c=13 \text{ m}$$

45. Let x = the number
$$\frac{1}{x}+5=\frac{16}{3} \quad \text{LCD}=3x \text{ so } x\neq 0$$
$$3x\left(\frac{1}{x}+5\right)=3x\left(\frac{16}{3}\right)$$
$$3\cancel{x}\left(\frac{1}{\cancel{x}}\right)+3x(5)=\cancel{3}x\left(\frac{16}{\cancel{3}}\right)$$
$$3+15x=16x$$
$$3=x$$

46. Let x = the number
$$\frac{1}{x}+\frac{2}{3}=\frac{17}{3} \quad \text{LCD}=3x \quad \text{so } x\neq 0$$
$$3x\left(\frac{1}{x}+\frac{2}{3}\right)=3x\left(\frac{17}{3}\right)$$
$$3\cancel{x}\left(\frac{1}{\cancel{x}}\right)+\cancel{3}x\left(\frac{2}{\cancel{3}}\right)=\cancel{3}x\left(\frac{17}{\cancel{3}}\right)$$
$$3+2x=17x$$
$$3=15x$$
$$x=\frac{1}{5}$$

47. Let x = the number

$$7-\frac{1}{x}=\frac{9}{2}$$

$\text{LCD}=2x \quad \text{so } x\neq 0$

$$2x\left(7-\frac{1}{x}\right)=2x\left(\frac{9}{2}\right)$$

$$2x(7)-2\cancel{x}\left(\frac{1}{\cancel{x}}\right)=\cancel{2}x\left(\frac{9}{\cancel{2}}\right)$$

$$14x-2=9x$$

$$5x=2$$

$$x=\frac{2}{5}$$

48. Let x = the number

$$x+\frac{1}{x}=\frac{13}{6}$$

$\text{LCD}=6x \quad \text{so } x\neq 0$

$$6x\left(x+\frac{1}{x}\right)=6x\left(\frac{13}{6}\right)$$

$$6x(x)+6\cancel{x}\left(\frac{1}{\cancel{x}}\right)=\cancel{6}x\left(\frac{13}{\cancel{6}}\right)$$

$$6x^2+6=13x$$

$$6x^2-13x+6=0$$

$$(3x-2)(2x-3)=0$$

$$3x-2=0 \text{ or } 2x-3=0$$

$$3x=2 \text{ or } 2x=3$$

$$x=\frac{2}{3} \text{ or } x=\frac{3}{2}$$

49. **a.** $x+7$

b. $\dfrac{48}{x}$

c. $\dfrac{83}{x+7}$

50. **a.** $x-4$

b. $\dfrac{50}{x}$

c. $\dfrac{145}{x-4}$

51. Let x = the speed in rainstorm

$x + 20$ = the speed in sunny weather

	Distance	Rate	Time
Rain	80	x	$80/x$
Sunny	120	$x + 20$	$120/(x + 20)$

(Time rain) = (Time sunny)

$$\frac{80}{x}=\frac{120}{x+20} \quad \text{LCD} = x(x+20)$$

$$x(x+20)\left(\frac{80}{x}\right)=x(x+20)\left(\frac{120}{x+20}\right)$$

$$80x+1600=120x$$

$$1600=40x$$

$$x=40$$

$$x+20=40+20=60$$

The motorist drives 40 mph in the rainstorm and 60 mph in sunny weather.

52. Let x = Adrianna's speed

$x - 2$ = Brooke's speed

	Distance	Rate	Time
Adrianna	18	x	$18/x$
Brooke	12	$x - 2$	$12/(x - 2)$

(Time Adrianna) = (Time Brooke)

$$\frac{12}{x-2} = \frac{18}{x} \qquad \text{LCD} = x(x-2)$$

$$x(x-2)\left(\frac{12}{x-2}\right) = x(x-2)\left(\frac{18}{x}\right)$$

$$12x = 18x - 36$$

$$-6x = -36$$

$$x = 6$$

$$x - 2 = 6 - 2$$

$$= 4$$

Adrianna walks at 6 km/hr and Brooke walks at 4 km/hr.

53. Let x = the speed of the Broadmoor truck

$x + 6.4$ = the speed of the Wescott truck

	Distance	Rate	Time
Broadmoor	88	x	$88/x$
Wescott	96	$x + 6.4$	$96/(x + 6.4)$

(Time Broadmoor) = (Time Wescott)

$$\frac{88}{x} = \frac{96}{x+6.4}$$

$$\text{LCD} = x(x+6.4)$$

$$x(x+6.4)\left(\frac{88}{x}\right) = x(x+6.4)\left(\frac{96}{x+6.4}\right)$$

$$88x + 563.2 = 96x$$

$$563.2 = 8x$$

$$x = 70.4$$

$$x + 6.4 = 70.4 + 6.4$$

$$= 76.8$$

The Broadmoor truck travels 70.4 mph and the Wescott truck travels 76.8 mph.

54. Let x = Dennis's speed on the bike

$x - 8$ = Kathy's speed

	Distance	Rate	Time
Dennis	7	x	$7/x$
Kathy	3	$x-8$	$3/(x-8)$

(Time Dennis) = (Time Kathy)

$$\frac{7}{x} = \frac{3}{x-8} \qquad \text{LCD} = x(x-8)$$

$$x(x-8)\left(\frac{7}{x}\right) = x(x-8)\left(\frac{3}{x-8}\right)$$

$$7x - 56 = 3x$$

$$-56 = -4x$$

$$x = 14$$

$$x - 8 = 14 - 8 = 6$$

Kathy runs at 6 mi/hr and Dennis bikes at 14 mi/hr.

55. Let x = the speed against the wind

$x + 5$ = the speed with the wind

$$\frac{30}{x} + \frac{30}{x+5} = 5$$

$$\text{LCD} = x(x+5)$$

$$x(x+5)\left(\frac{30}{x} + \frac{30}{x+5}\right) = x(x+5)(5)$$

$$30(x+5) + 30x = 5x(x+5)$$

$$30x + 150 + 30x = 5x^2 + 25x$$

$$5x^2 - 35x - 150 = 0$$

$$5(x^2 - 7x - 30) = 0$$

$$5(x-10)(x+3) = 0$$

$$x - 10 = 0 \text{ or } x + 3 = 0$$

$$x = 10 \text{ or } x = -3$$

The cyclist rides at a speed of 10 mph against the wind.

56. Let x = the speed going

$x - 3$ = the speed returning

$$\frac{60}{x} + \frac{60}{x-3} = 9$$

$$\text{LCD} = x(x-3)$$

$$x(x-3)\left(\frac{60}{x} + \frac{60}{x-3}\right) = x(x-3)(9)$$

$$60(x-3) + 60x = 9x(x-3)$$

$$60x - 180 + 60x = 9x^2 - 27x$$

$$9x^2 - 147x + 180 = 0$$

$$3(3x^2 - 49x + 60) = 0$$

$$3(3x-4)(x-15) = 0$$

$$3x - 4 = 0 \text{ or } x - 15 = 0$$

$$3x = 4 \text{ or } x = 15$$

$$x \neq \frac{4}{3} \text{ or } x = 15$$

$$x - 3 = 15 - 3 = 12$$

The speed to the island is 15 mph and the speed on the return trip is 12 mph.

57. Let x = Celeste's walking speed

$x + 2$ = speed on moving walkway

	Distance	Rate	Time
Off walkway	100	x	$100/x$
On walkway	140	$x + 2$	$140/(x + 2)$

(Time off walkway)+(Time on walkway) = 40

$$\frac{100}{x}+\frac{140}{x+2}=40 \quad \text{LCD} = x(x+2)$$

$$x(x+2)\left(\frac{100}{x}+\frac{140}{x+2}\right)=x(x+2)(40)$$

$$100(x+2)+140x=40x(x+2)$$

$$100x+200+140x=40x^2+80x$$

$$240x+200=40x^2+80x$$

$$0=40x^2-160x-200$$

$$0=40(x^2-4x-5)$$

$$0=40(x-5)(x+1)$$

$$x-5=0 \text{ or } x+1=0$$

$$x=5 \text{ or } x\neq -1$$

$$x+2=5+2=7$$

Celeste walks 5 ft/sec on the ground and travels 7 ft/sec while on the moving walkway.

58. Let x = riding speed

$x - 6$ = walking speed

	Distance	Rate	Time
Riding	6	x	$6/x$
Walking	1	$x - 6$	$1/(x - 6)$

(Time riding) + (Time walking) = 1

$$\frac{6}{x}+\frac{1}{x-6}=1 \quad \text{LCD} = x(x-6)$$

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

$$6(x-6)+1x=x(x-6)$$

$$6x-36+x=x^2-6x$$

$$7x-36=x^2-6x$$

$$0=x^2-13x+36$$

$$0=(x-9)(x-4)$$
$$x-9=0 \text{ or } x-4=0$$
$$x=9 \text{ or } x\neq 4$$
$$x-6=9-6=3$$

Julio rides his bike at 9 mph and walks at 3 mph.

59. Let x = Joe's speed

$x+2$ = Beatrice's speed

	Distance	Rate	Time
Joe	12	x	$12/x$
Beatrice	12	$x+2$	$12/(x+2)$

(Joe's time) – (Beatrice's time) = 0.5

$$\frac{12}{x}-\frac{12}{x+2}=\frac{1}{2} \quad \text{LCD} = 2x(x+2)$$
$$2x(x+2)\left(\frac{12}{x}-\frac{12}{x+2}\right)=2x(x+2)\left(\frac{1}{2}\right)$$
$$24(x+2)-24x=x(x+2)$$
$$24x+48-24x=x^2+2x$$
$$48=x^2+2x$$
$$0=x^2+2x-48$$
$$0=(x-6)(x+8)$$
$$x-6=0 \text{ or } x+8=0$$
$$x=6 \text{ or } x\neq -8$$
$$x+2=6+2=8$$

Joe runs at 6 mph and Beatrice runs at 8 mph.

60. Let x = the speed of the bus

$x+10$ = the speed of the car

	Distance	Rate	Time
Bus	200	x	$200/x$
Car	200	$x+10$	$200/(x+10)$

(Time bus) = (Time car) + 1

$$\frac{200}{x}=\frac{200}{x+10}+1$$
$$\text{LCD} = x(x+10)$$

$$x(x+10)\left(\frac{200}{x}\right) = x(x+10)\left(\frac{200}{x+10}+1\right)$$
$$200(x+10) = 200x + x(x+10)$$
$$200x + 2000 = 200x + x^2 + 10x$$
$$0 = x^2 + 10x - 2000$$
$$0 = (x+50)(x-40)$$
$$x+50 = 0 \text{ or } x-40 = 0$$
$$x \neq -50 \text{ or } x = 40$$
$$x+10 = 40+10$$
$$= 50$$

The speed of the bus is 40 mph and the speed of the car is 50 mph.

61.

	Work Rate	Time	Portion of Job Comp
Paint#1	1/6	x	$(1/6)x$
Paint#2	1/8	x	$(1/8)x$

(Paint#1 Part) + (Paint#2 Part) = (1 Job)

$$\frac{1}{6}x + \frac{1}{8}x = 1 \quad \text{LCD} = 24$$
$$24\left(\frac{1}{6}x + \frac{1}{8}x\right) = 24(1)$$
$$4x + 3x = 24$$
$$7x = 24$$
$$x = \frac{24}{7} \text{ hr or } 3\frac{3}{7} \text{ hr}$$

Together, the painters can paint the room in $3\frac{3}{7}$ hr.

62.

	Work Rate	Time	Portion of Job Comp
Karen	1/2	x	$(1/2)x$
Clarann	1/3	x	$(1/3)x$

(Karen Part) + (Clarann Part) = (1 Job)

$$\frac{1}{2}x + \frac{1}{3}x = 1 \quad \text{LCD} = 6$$
$$6\left(\frac{1}{2}x + \frac{1}{3}x\right) = 6(1)$$
$$3x + 2x = 6$$
$$5x = 6$$

$x = \frac{6}{5}$ hr or $1\frac{1}{5}$ hr

Together, they can wax the SUV in $1\frac{1}{5}$ hr.

63.

	Work Rate	Time	Portion of Job Comp
Joel	1/12	x	$(1/12)x$
Michael	1/15	x	$(1/15)x$

(Joel's Part) + (Michael's Part) = (1 Job)

$$\frac{1}{12}x + \frac{1}{15}x = 1 \quad \text{LCD} = 60$$

$$60\left(\frac{1}{12}x + \frac{1}{15}x\right) = 60(1)$$

$$5x + 4x = 60$$

$$9x = 60$$

$$x = \frac{60}{9} = \frac{20}{3} \text{ hr or } 6\frac{2}{3} \text{ hr}$$

Together, they can fence the yard in $6\frac{2}{3}$ hr.

64.

	Work Rate	Time	Portion of Job Comp
Ted	1/4	x	$(1/4)x$
Marie	1/5	x	$(1/5)x$

(Ted's Part) + (Marie's Part) = (1 Job)

$$\frac{1}{4}x + \frac{1}{5}x = 1 \quad \text{LCD} = 20$$

$$20\left(\frac{1}{4}x + \frac{1}{5}x\right) = 20(1)$$

$$5x + 4x = 20$$

$$9x = 20$$

$$x = \frac{20}{9} \text{ hr or } 2\frac{2}{9} \text{ hr}$$

Together, they can change the billboard in $2\frac{2}{9}$ hr.

65. a.

	Work Rate	Time	Part of Job Comp
Old	1/30	12	(1/30) 12
New	$1/x$	12	$(1/x)$ 12

(Old Part) + (New Part) = (1 Job)

$$\frac{1}{30}\cdot 12+\frac{1}{x}\cdot 12=1 \quad \text{LCD}=30x$$

$$30x\left(\frac{1}{30}\cdot 12+\frac{1}{x}\cdot 12\right)=30x(1)$$

$$12x+360=30x$$

$$360=18x$$

$$x=20 \text{ hr}$$

The new pump will take 20 hr.

b. The technician should return at noon on Friday.

66.

	Work Rate	Time	Part of Job Comp
Carp#1	1/8	4	(1/8) 4
Carp#2	1/x	4	(1/x) 4

(Carp#1 Part) + (Carp#2 Part) = (1 Job)

$$\frac{1}{8}\cdot 4+\frac{1}{x}\cdot 4=1 \quad \text{LCD}=8x$$

$$8x\left(\frac{1}{8}\cdot 4+\frac{1}{x}\cdot 4\right)=8x(1)$$

$$4x+32=8x$$

$$32=4x$$

$$x=8 \text{ days}$$

The second carpenter completes the job in 8 days working alone.

67.

	Work Rate	Time	Part of Job Comp
Gus	1/x	4	(1/x) 4
Sid	1/(2x)	4	(1/(2x)) 4

(Gus's Part) + (Sid's Part) = (1 Job)

$$\frac{1}{x}\cdot 4+\frac{1}{2x}\cdot 4=1 \quad \text{LCD}=2x$$

$$2x\left(\frac{1}{x}\cdot 4+\frac{1}{2x}\cdot 4\right)=2x(1)$$

$$8+4=2x$$

$$12=2x$$

$$x=6 \text{ hr}$$

$$2x=2(6)=12 \text{ hr}$$

Gus would take 6 hr and Sid would take 12 hr to dig the garden.

68.

	Work Rate	Time	Part of Job Comp
Adult	$1/x$	1	$(1/x)\,1$
Child	$1/(3x)$	1	$(1/(3x))\,1$

(Adult's Part) + (Child's Part) = (1 Job)

$$\frac{1}{x}\cdot 1+\frac{1}{3x}\cdot 1=1 \qquad \text{LCD}=3x$$

$$3x\left(\frac{1}{x}\cdot 1+\frac{1}{3x}\cdot 1\right)=3x(1)$$

$$3+1=3x$$

$$4=3x$$

$$x=\frac{4}{3}$$

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

$$3x=3\left(\frac{4}{3}\right)$$

$$=4\text{ hr}$$

The adult would take $1\frac{1}{3}$ hr and the child would take 4 hr to vacuum the house.

Section 5.7 Practice Exercises

1. **a.** kx

b. $\dfrac{k}{x}$

c. kxw

2.

$$\frac{x}{4}=\frac{13}{10}$$

$$20\left(\frac{x}{4}\right)=20\left(\frac{13}{10}\right)$$

$$5x=26$$

$$x=\frac{26}{5}$$

3.

$$\frac{8}{y}=\frac{6}{11}$$

$$11y\left(\frac{8}{y}\right)=11y\left(\frac{6}{11}\right)$$

$$88=6y$$

$$y=\frac{88}{6}=\frac{44}{3}$$

4.

$$\frac{3}{8}=\frac{w+2}{6}$$

$$24\left(\frac{3}{8}\right)=24\left(\frac{w+2}{6}\right)$$

$$9=4w+8$$

$$1=4w$$

$$w=\frac{1}{4}$$

5.
$$\frac{2}{3}=\frac{x-4}{2}$$
$$6\left(\frac{2}{3}\right)=6\left(\frac{x-4}{2}\right)$$
$$4=3x-12$$
$$16=3x$$
$$x=\frac{16}{3}$$

6.
$$\frac{p-5}{p}=\frac{2}{7}$$
$$7p\left(\frac{p-5}{p}\right)=7p\left(\frac{2}{7}\right)$$
$$7p-35=2p$$
$$-35=-5p$$
$$p=7$$

7.
$$\frac{k}{k+1}=\frac{1}{9}$$
$$9(k+1)\left(\frac{k}{k+1}\right)=9(k+1)\left(\frac{1}{9}\right)$$
$$9k=k+1$$
$$8k=1$$
$$k=\frac{1}{8}$$

8. Directly

9. Inversely

10. **a.** increase
b. decrease

11. $T=kq$

12. $W=kz$

13. $b=\frac{k}{c}$

14. $m=\frac{k}{t}$

15. $Q=\frac{kx}{y}$

16. $d=\frac{kp}{n}$

17. $c=kst$

18. $w=kpf$

19. $L=kw\sqrt{v}$

20. $q=kv\sqrt{w}$

21. $x=\frac{ky^2}{z}$

22. $a=\frac{kn}{d^2}$

23. $y = kx$

$18 = k(4)$

$k = \frac{18}{4} = \frac{9}{2}$

24. $m = kx$

$22 = k(8)$

$k = \frac{22}{8} = \frac{11}{4}$

25. $p = \frac{k}{q}$

$32 = \frac{k}{16}$

$k = 32(16) = 512$

26. $T = \frac{k}{x}$

$200 = \frac{k}{40}$

$k = 200(40) = 8000$

27. $y = kwv$

$8.75 = k(50)(0.1)$

$8.75 = 5k$

$k = \frac{8.75}{5} = 1.75$

28. $N = ktp$

$330 = k(1)(7.5)$

$330 = 7.5k$

$k = \frac{330}{7.5} = 44$

29. $x = kp$

$50 = k(10)$

$k = \frac{50}{10} = 5$

$x = 5(14) = 70$

30. $y = kz$

$12 = k(36)$

$k = \frac{12}{36} = \frac{1}{3}$

$y = \frac{1}{3}(21) = 7$

31. $b = \frac{k}{c}$

$4 = \frac{k}{3}$

$k = 4 \cdot 3 = 12$

$b = \frac{12}{2} = 6$

32. $q = \frac{k}{w}$

$8 = \frac{k}{50}$

$k = 8 \cdot 50 = 400$

$q = \frac{400}{125} = 3.2$

33. $Z = kw^2$

$14 = k(4)^2$

$14 = 16k$

$k = \frac{14}{16} = \frac{7}{8}$

$Z = \frac{7}{8}(8)^2 = \frac{7}{8}(64) = 56$

34. $m = kx^2$

$200 = k(20)^2$

$200 = 400k$

$k = \frac{200}{400} = \frac{1}{2}$

$m = \frac{1}{2}(32)^2 = \frac{1}{2}(1024) = 512$

35. $Q = \dfrac{k}{p^2}$

$4 = \dfrac{k}{3^2}$

$k = 4 \cdot 3^2 = 4 \cdot 9 = 36$

$Q = \dfrac{36}{2^2} = \dfrac{36}{4} = 9$

36. $z = \dfrac{k}{t^2}$

$15 = \dfrac{k}{4^2}$

$k = 15 \cdot 4^2 = 15 \cdot 16 = 240$

$z = \dfrac{240}{10^2} = \dfrac{240}{100} = 2.4$

37. $L = ka\sqrt{b}$

$72 = k(8)\sqrt{9}$

$72 = k \cdot 8 \cdot 3$

$72 = 24k$

$k = 3$

$L = 3\left(\dfrac{1}{2}\right)\sqrt{36} = 3\left(\dfrac{1}{2}\right)(6) = 9$

38. $Y = kx^3\sqrt{w}$

$128 = k\left(2^3\right)\sqrt{16}$

$k = \dfrac{128}{2^3\sqrt{16}} = \dfrac{128}{8 \cdot 4} = \dfrac{128}{32} = 4$

$Y = 4\left(\dfrac{1}{2}\right)^3 \sqrt{64} = 4 \cdot \dfrac{1}{8} \cdot 8 = 4$

39. $B = \dfrac{km}{n}$

$20 = \dfrac{k \cdot 10}{3}$

$k = \dfrac{20 \cdot 3}{10} = \dfrac{60}{10} = 6$

$B = \dfrac{6 \cdot 15}{12} = \dfrac{90}{12} = \dfrac{15}{2}$

40. $R = \dfrac{ks}{t}$

$14 = \dfrac{k \cdot 2}{9}$

$k = \dfrac{14 \cdot 9}{2} = \dfrac{126}{2} = 63$

$R = \dfrac{63 \cdot 4}{3} = \dfrac{252}{3} = 84$

41. $m = kw$

$3 = k(150)$

$k = \dfrac{3}{150} = \dfrac{1}{50}$

a. $m = \dfrac{1}{50} \cdot 180 = 3.6$ g should be prescribed.

b. $m = \dfrac{1}{50} \cdot 225 = 4.5$ g should be prescribed.

c. $m = \dfrac{1}{50} \cdot 120 = 2.4$ g should be prescribed.

42. $p = kw$

$10 = k(15)$

$k = \dfrac{10}{15} = \dfrac{2}{3}$

a. $p = \dfrac{2}{3} \cdot 12 = 8$ It serves 8 people.

b. $p = \dfrac{2}{3} \cdot 18 = 12$ It serves 12 people.

c. $p = \dfrac{2}{3} \cdot 21 = 14$ It serves 14 people.

43.
$$c = \frac{k}{n}$$
$$0.48 = \frac{k}{5000}$$
$$k = 0.48(5000) = 2400$$

a. $c = \frac{2400}{6000} = 0.40$ Unit cost is \$0.40

b. $c = \frac{2400}{8000} = 0.30$ Unit cost is \$0.30

c. $c = \frac{2400}{2400} = 1.00$ Unit cost is \$1.00

44.
$$n = \frac{k}{p}$$
$$1500 = \frac{k}{8}$$
$$k = 8(1500) = 12{,}000$$

a. $n = \frac{12{,}000}{12} = 1000$ She sells 1000 books.

b. $n = \frac{12{,}000}{15} = 800$ She sells 800 books.

c. $n = \frac{12{,}000}{6} = 2000$ She sells 2000 books.

45. Let A = the amount of pollution
P = the number of people
$$A = kP$$
$$56{,}800 = k(80{,}000)$$
$$k = \frac{56{,}800}{80{,}000} = 0.71$$
$$A = 0.71(500{,}000)$$
$$= 355{,}000 \text{ tons}$$
355,000 tons enter the atmosphere.

46. Let A = the area of the picture
d = the distance from the projector to wall
$$A = kd^2$$
$$16 = k(10)^2$$
$$k = \frac{16}{10^2} = \frac{16}{100} = 0.16$$
$$A = 0.16(20)^2 = 0.16(400) = 64 \text{ ft}^2$$
The area is 64 ft^2.

47. Let I = the intensity of the light source
d = the distance from the source
$$I = \frac{k}{d^2}$$
$$400 = \frac{k}{5^2}$$
$$k = 400 \cdot 5^2 = 400 \cdot 25$$
$$= 10{,}000$$
$$I = \frac{10{,}000}{8^2} = \frac{10{,}000}{64}$$
$$= 156.25 \text{ lumens/m}^2$$

The intensity is 156.25 lumens/m^2.

48. Let f = the frequency
L = the length of the string
$$f = \frac{k}{L}$$
$$252 = \frac{k}{24}$$
$$k = 252 \cdot 24$$
$$= 6048$$
$$f = \frac{6048}{18}$$
$$= 336 \text{ cycles/sec}$$

The frequency is 336 cycles/sec.

49. Let I = the current
V = the voltage
R = the resistance

$$I = \frac{kV}{R}$$
$$9 = \frac{k(90)}{10}$$
$$k = \frac{9 \cdot 10}{90} = \frac{90}{90} = 1$$
$$I = \frac{1 \cdot 185}{10} = \frac{185}{10} = 18.5 \text{ A}$$

The current is 18.5 A.

50. Let R = the resistance
L = the length of the wire
d = the diameter of the wire

$$R = \frac{kL}{d^2}$$
$$4 = \frac{k(40)}{(0.1)^2}$$
$$k = \frac{4(0.1)^2}{40} = \frac{4(0.01)}{40} = \frac{0.04}{40} = 0.001$$
$$R = \frac{0.001(50)}{(0.2)^2} = \frac{0.05}{0.04} = 1.25\,\Omega$$

The resistance is 1.25 Ω.

51. Let I = the interest
P = the principal
T = the time

$$I = kPt$$
$$500 = k(2500)(4)$$
$$500 = 10{,}000k$$
$$k = \frac{500}{10{,}000}$$
$$= 0.05$$
$$I = 0.05(7000)(10)$$
$$= \$3500$$

$3500 in interest will be earned.

52. Let I = the interest
P = the principal
T = the time

$$I = kPt$$
$$840 = k(6000)(2)$$
$$840 = 12{,}000k$$
$$k = \frac{840}{12{,}000}$$
$$= 0.07$$
$$I = 0.07(4500)(8)$$
$$= \$2520$$

$2520 in interest will be earned.

53. Let d = the stopping distance
s = the speed of the car

$$d = ks^2$$
$$109 = k(40)^2$$
$$k = \frac{109}{40^2}$$
$$= \frac{109}{1600}$$

54. Let w = the weight
r = the radius

$$w = kr^3$$
$$4.32 = k(3)^3$$
$$k = \frac{4.32}{3^3}$$
$$= \frac{4.32}{27}$$
$$= 0.16$$

$$d = \frac{109}{1600}(25)^2$$
$$= \frac{109}{1600}(625) \approx 42.6 \text{ ft}$$

The stopping distance will be 42.6 ft.

$$w = 0.16(5^3)$$
$$= 0.16(125) = 20 \text{ lb}$$

The ball will weigh 20 lb.

55. Let S = the surface area
L = the length of an edge

$$S = kL^2$$
$$24 = k(2)^2$$
$$k = \frac{24}{2^2} = \frac{24}{4} = 6$$
$$S = 6(5)^2 = 6(25) = 150 \text{ ft}^2$$

The surface area is 150 ft^2.

56. Let P = the period of the pendulum
L = the length of the pendulum

$$P = k\sqrt{L}$$
$$1.8 = k\sqrt{0.81}$$
$$k = \frac{1.8}{\sqrt{0.81}} = \frac{1.8}{0.9} = 2$$
$$P = 2\sqrt{1} = 2 \cdot 1 = 2 \text{ sec}$$

The period is 2 sec.

57. Let P = the power
I = the current
R = the resistance

$$P = kIR^2$$
$$144 = k(4)(6)^2$$
$$k = \frac{144}{4(6)^2} = \frac{144}{144} = 1$$
$$P = 1(3)(10)^2 = 3 \cdot 100 = 300 \text{ W}$$

The power is 300 W.

58. Let S = the strength of the beam
w = the width
t = the thickness
L = the length of the beam

$$S = \frac{kwt^2}{L}$$
$$417 = \frac{k(6)(2^2)}{48}$$
$$k = \frac{417 \cdot 48}{6 \cdot 2^2} = 834$$
$$S = \frac{834(12)(4^2)}{72} = 2224 \text{ lb}$$

The maximum load is 2224 lb.

59. **a.** $A = kl^2$

b. $A = k(2l)^2 = k(4l^2) = 4kl^2$

The area is 4 times the original.

c. $A = k(3l)^2 = k(9l^2) = 9kl^2$

The area is 9 times the original.

60. **a.** Direct relationship

b. $d = 1.25F$ or $F = 0.8d$

Chapter 5 Group Activity

1.

$$R = \$150$$
$$I = \frac{0.06}{12}$$
$$= 0.005$$
$$n = 30(12)$$
$$= 360$$
$$S = 150\left[\frac{(1+0.005)^{360}-1}{0.005}\right]$$
$$= 150\left[\frac{(1.005)^{360}-1}{0.005}\right]$$
$$= 150\left[\frac{6.0223-1}{0.005}\right]$$
$$= 150\left[\frac{5.023}{0.005}\right]$$
$$= 150[1004.515]$$
$$= \$150,677.25$$

2.

$$S = 100\left[\frac{(1+0.06/12)^{240}-1}{0.06/12}\right] = \$46,204.09$$
$$S = 150\left[\frac{(1+0.06/12)^{240}-1}{0.06/12}\right] = \$69,306.13$$
$$S = 200\left[\frac{(1+0.06/12)^{240}-1}{0.06/12}\right] = \$92,408.18$$
$$S = 200\left[\frac{(1+0.024/12)^{240}-1}{0.024/12}\right] = \$61,529.99$$
$$S = 200\left[\frac{(1+0.036/12)^{240}-1}{0.036/12}\right] = \$70,148.00$$
$$S = 200\left[\frac{(1+0.048/12)^{240}-1}{0.048/12}\right] = \$80,335.01$$
$$S = 200\left[\frac{(1+0.06/12)^{300}-1}{0.06/12}\right] = \$138,598.79$$
$$S = 200\left[\frac{(1+0.06/12)^{360}-1}{0.06/12}\right]$$
$$= \$200,903.01$$
$$S = 200\left[\frac{(1+0.06/12)^{420}-1}{0.06/12}\right]$$
$$= \$284,942.06$$

3.

$$A = 50,000 \div \left[\frac{(1+0.09/12)^{180}-1}{0.09/12}\right]$$
$$= \$132.13$$

Approximately \$133 must be saved each month.

4.

$$R = \$5000$$
$$I = 0.08$$
$$n = 20$$
$$S = 5000\left[\frac{(1+0.08)^{20}-1}{0.08}\right]$$
$$= \$228,809.82$$

Chapter 5 Review Exercises

Section 5.1

1. $k(y)=\dfrac{y}{y^2-1}$

a. $k(2)=\dfrac{2}{2^2-1}=\dfrac{2}{4-1}=\dfrac{2}{3}$

$k(0)=\dfrac{0}{0^2-1}=\dfrac{0}{0-1}=\dfrac{0}{-1}=0$

$k(1)=\dfrac{1}{1^2-1}=\dfrac{1}{1-1}=\dfrac{1}{0}$ is undefined

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

$=\dfrac{-1}{0}$ undefined

$k\left(\dfrac{1}{2}\right)=\dfrac{\frac{1}{2}}{\left(\frac{1}{2}\right)^2-1}=\dfrac{\frac{1}{2}}{\frac{1}{4}-\frac{4}{4}}=\dfrac{\frac{1}{2}}{-\frac{3}{4}}$

$=\dfrac{1}{2}\cdot\left(-\dfrac{4}{3}\right)=-\dfrac{2}{3}$

b. $(-\infty,-1)\cup(-1,1)\cup(1,\infty)$

2. $h(x)=\dfrac{x}{x^2+1}$

a. $h(1)=\dfrac{1}{1^2+1}=\dfrac{1}{1+1}=\dfrac{1}{2}$

$h(0)=\dfrac{0}{0^2+1}=\dfrac{0}{0+1}=\dfrac{0}{1}=0$

$h(-1)=\dfrac{-1}{(-1)^2+1}=\dfrac{-1}{1+1}=-\dfrac{1}{2}$

$h(-3)=\dfrac{-3}{(-3)^2+1}=\dfrac{-3}{9+1}=-\dfrac{3}{10}$

$h\left(\dfrac{1}{2}\right)=\dfrac{\frac{1}{2}}{\left(\frac{1}{2}\right)^2+1}=\dfrac{\frac{1}{2}}{\frac{1}{4}+\frac{4}{4}}=\dfrac{\frac{1}{2}}{\frac{5}{4}}$

$=\dfrac{1}{2}\cdot\dfrac{4}{5}=\dfrac{2}{5}$

b. $(-\infty,\infty)$

3. $\dfrac{28a^3b^3}{14a^2b^3}=2a^{3-2}b^{3-3}$

$=2a^1b^0$

$=2a$

4. $\dfrac{25x^2yz^3}{125xyz}=\dfrac{1}{5}x^{2-1}y^{1-1}z^{3-1}$

$=\dfrac{1}{5}xy^0z^2$

$=\dfrac{xz^2}{5}$

5. $\dfrac{x^2-4x+3}{x-3}=\dfrac{\cancel{(x-3)}(x-1)}{\cancel{x-3}}$

$=x-1$

6. $\dfrac{k^2+3k-10}{k^2-5k+6}=\dfrac{(k+5)\cancel{(k-2)}}{(k-3)\cancel{(k-2)}}$

$=\dfrac{k+5}{k-3}$

7. $\dfrac{x^3-27}{9-x^2}=\dfrac{x^3-3^3}{-\left(x^2-9\right)}$

$=\dfrac{\left(\cancel{x-3}\right)\left(x^2+3x+9\right)}{-\left(x+3\right)\left(\cancel{x-3}\right)}=-\dfrac{x^2+3x+9}{x+3}$

8. $\dfrac{a^4-81}{3-a}=\dfrac{\left(a^2+9\right)\left(a^2-9\right)}{-\left(a-3\right)}$

$=\dfrac{\left(a^2+9\right)\left(a+3\right)\left(\cancel{a-3}\right)}{-\left(\cancel{a-3}\right)}$

$=-\left(a^2+9\right)\left(a+3\right)$

9. $\dfrac{2t^2+3t-5}{7-6t-t^2}=\dfrac{\left(2t+5\right)\left(t-1\right)}{-\left(t^2+6t-7\right)}$

$=\dfrac{\left(2t+5\right)\left(\cancel{t-1}\right)}{-\left(t+7\right)\left(\cancel{t-1}\right)}=-\dfrac{2t+5}{t+7}$

10. $\dfrac{y^3-4y}{y^2-5y+6}=\dfrac{y\left(y^2-4\right)}{\left(y-3\right)\left(y-2\right)}$

$=\dfrac{y\left(y+2\right)\left(\cancel{y-2}\right)}{\left(y-3\right)\left(\cancel{y-2}\right)}=\dfrac{y\left(y+2\right)}{y-3}$

11. $f\left(x\right)=\dfrac{1}{x-3}$

$x-3=0$

$x=3$

$\left(-\infty,3\right)\cup\left(3,\infty\right)$

Graph: c

12. $m\left(x\right)=\dfrac{1}{x+2}$

$x+2=0$

$x=-2$

$\left(-\infty,-2\right)\cup\left(-2,\infty\right)$

Graph: a

13. $k\left(x\right)=\dfrac{6}{x^2-3x}=\dfrac{6}{x\left(x-3\right)}$

$x\left(x-3\right)=0$

$x=0$ or $x-3=0$

$x=0$ or $x=3$

$\left(-\infty,0\right)\cup\left(0,3\right)\cup\left(3,\infty\right)$

Graph: b

14. $p\left(x\right)=\dfrac{-2}{x^2+4}$

x^2+4 is never zero because x^2 is nonnegative

$\left(-\infty,\infty\right)$

Graph: d

Section 5.2

15. $\dfrac{3a+9}{a^2}\cdot\dfrac{a^3}{6a+18}=\dfrac{\cancel{3}\left(\cancel{a+3}\right)}{\cancel{a^2}}\cdot\dfrac{\cancel{a^2}\cdot a}{2\cdot\cancel{3}\left(\cancel{a+3}\right)}$

$=\dfrac{a}{2}$

16. $\dfrac{4-y}{5}\div\dfrac{2y-8}{15}=\dfrac{4-y}{5}\cdot\dfrac{15}{2y-8}$

$=\dfrac{-\left(\cancel{y-4}\right)}{\cancel{5}}\cdot\dfrac{\cancel{5}\cdot 3}{2\left(\cancel{y-4}\right)}=-\dfrac{3}{2}$

17. $\dfrac{x-4y}{x^2+xy} \div \dfrac{20y-5x}{x^2-y^2} = \dfrac{x-4y}{x^2+xy} \cdot \dfrac{x^2-y^2}{20y-5x}$

$= \dfrac{\cancel{x-4y}}{x\left(\cancel{x+y}\right)} \cdot \dfrac{\left(\cancel{x+y}\right)(x-y)}{-5\left(\cancel{x-4y}\right)}$

$= -\dfrac{x-y}{5x}$

18. $\left(x^2+5x-24\right)\left(\dfrac{x+8}{x-3}\right)$

$= \dfrac{(x+8)\left(\cancel{x-3}\right)}{1}\left(\dfrac{x+8}{\cancel{x-3}}\right)$

$= (x+8)^2$

19. $\dfrac{7k+28}{2k+4} \cdot \dfrac{k^2-2k-8}{k^2+2k-8}$

$= \dfrac{7\left(\cancel{k+4}\right)}{2\left(\cancel{k+2}\right)} \cdot \dfrac{(k-4)\left(\cancel{k+2}\right)}{\left(\cancel{k+4}\right)(k-2)}$

$= \dfrac{7(k-4)}{2(k-2)}$

20. $\dfrac{ab+2a+b+2}{ab-3b+2a-6} \cdot \dfrac{ab-3b+4a-12}{ab-b+4a-4}$

$= \dfrac{a(b+2)+(b+2)}{b(a-3)+2(a-3)} \cdot \dfrac{b(a-3)+4(a-3)}{b(a-1)+4(a-1)}$

$= \dfrac{\left(\cancel{b+2}\right)(a+1)}{\left(\cancel{a-3}\right)\left(\cancel{b+2}\right)} \cdot \dfrac{\left(\cancel{a-3}\right)\left(\cancel{b+4}\right)}{(a-1)\left(\cancel{b+4}\right)}$

$= \dfrac{a+1}{a-1}$

21. $\dfrac{x^2+8x-20}{x^2+6x-16} \div \dfrac{x^2+6x-40}{x^2+3x-40} = \dfrac{x^2+8x-20}{x^2+6x-16} \cdot \dfrac{x^2+3x-40}{x^2+6x-40}$

$= \dfrac{\left(\cancel{x+10}\right)\left(\cancel{x-2}\right)}{\left(\cancel{x+8}\right)\left(\cancel{x-2}\right)} \cdot \dfrac{\left(\cancel{x+8}\right)(x-5)}{\left(\cancel{x+10}\right)(x-4)}$

$= \dfrac{x-5}{x-4}$

22. $\dfrac{2b-b^2}{b^3-8} \cdot \dfrac{b^2+2b+4}{b^2} = \dfrac{-\cancel{b}\left(\cancel{b-2}\right)}{\left(\cancel{b-2}\right)\left(\cancel{b^2+2b+4}\right)} \cdot \dfrac{\cancel{b^2+2b+4}}{\cancel{b} \cdot b}$

$= -\dfrac{1}{b}$

23. $\dfrac{2w}{21} \div \dfrac{3w^2}{7} \cdot \dfrac{4}{w} = \dfrac{2w}{21} \cdot \dfrac{7}{3w^2} \cdot \dfrac{4}{w}$

$= \dfrac{2\cancel{w}}{\cancel{7} \cdot 3} \cdot \dfrac{\cancel{7}}{3w^2} \cdot \dfrac{4}{\cancel{w}} = \dfrac{8}{9w^2}$

24. $$\frac{5y^2-20}{y^3+8}\div\frac{7y^2-14y}{y^3+y}=\frac{5\left(y^2-4\right)}{y^3+2^3}\cdot\frac{y^3+y}{7y^2-14y}$$
$$=\frac{5\cancel{\left(y+2\right)}\cancel{\left(y-2\right)}}{\cancel{\left(y+2\right)}\left(y^2-2y+4\right)}\cdot\frac{\cancel{y}\left(y^2+1\right)}{7\cancel{y}\cancel{\left(y-2\right)}}=\frac{5\left(y^2+1\right)}{7\left(y^2-2y+4\right)}$$

25. $$\frac{x^2+x-20}{x^2-4x+4}\cdot\frac{x^2+x-6}{12+x-x^2}\div\frac{2x+10}{10-5x}=\frac{x^2+x-20}{x^2-4x+4}\cdot\frac{x^2+x-6}{-\left(x^2-x-12\right)}\cdot\frac{10-5x}{2x+10}$$
$$=\frac{\cancel{\left(x+5\right)}\cancel{\left(x-4\right)}}{\cancel{\left(x-2\right)}\cancel{\left(x-2\right)}}\cdot\frac{\cancel{\left(x+3\right)}\cancel{\left(x-2\right)}}{-\cancel{\left(x-4\right)}\cancel{\left(x+3\right)}}\cdot\frac{-5\cancel{\left(x-2\right)}}{2\cancel{\left(x+5\right)}}=\frac{-5}{-2}=\frac{5}{2}$$

26. $$\left(9k^2-25\right)\cdot\left(\frac{k+5}{3k-5}\right)=\frac{\left(3k+5\right)\cancel{\left(3k-5\right)}}{1}\cdot\left(\frac{k+5}{\cancel{3k-5}}\right)=\left(3k+5\right)\left(k+5\right)$$

Section 5.3

27. $$\frac{1}{x}+\frac{1}{x^2}-\frac{1}{x^3}\qquad \text{LCD}=x^3$$
$$=\frac{1}{x}\cdot\frac{x^2}{x^2}+\frac{1}{x^2}\cdot\frac{x}{x}-\frac{1}{x^3}=\frac{x^2+x-1}{x^3}$$

28. $$\frac{1}{x+2}+\frac{5}{x-2}\qquad \text{LCD}=\left(x+2\right)\left(x-2\right)$$
$$=\frac{1}{x+2}\cdot\frac{x-2}{x-2}+\frac{5}{x-2}\cdot\frac{x+2}{x+2}$$
$$=\frac{x-2+5x+10}{\left(x+2\right)\left(x-2\right)}=\frac{6x+8}{\left(x+2\right)\left(x-2\right)}$$
$$=\frac{2\left(3x+4\right)}{\left(x+2\right)\left(x-2\right)}$$

29. $$\frac{y}{2y-1}+\frac{3}{1-2y}$$
$$=\frac{y}{2y-1}+\frac{3}{1-2y}\cdot\frac{\left(-1\right)}{\left(-1\right)}$$
$$=\frac{y}{2y-1}+\frac{-3}{2y-1}$$
$$=\frac{y-3}{2y-1}$$

30. $$\frac{a+2}{2a+6}-\frac{3}{a+3}=\frac{a+2}{2\left(a+3\right)}-\frac{3}{a+3}$$
$$\text{LCD}=2\left(a+3\right)$$
$$=\frac{a+2}{2\left(a+3\right)}-\frac{3}{a+3}\cdot\frac{2}{2}$$
$$=\frac{a+2-6}{2\left(a+3\right)}$$
$$=\frac{a-4}{2\left(a+3\right)}$$

31. $\dfrac{4k}{k^2+2k+1}+\dfrac{3}{k^2-1}=\dfrac{4k}{(k+1)^2}+\dfrac{3}{(k+1)(k-1)}$ LCD $=(k+1)^2(k-1)$

$=\dfrac{4k}{(k+1)^2}\cdot\dfrac{k-1}{k-1}+\dfrac{3}{(k+1)(k-1)}\cdot\dfrac{k+1}{k+1}$

$=\dfrac{4k^2-4k+3k+3}{(k+1)^2(k-1)}=\dfrac{4k^2-k+3}{(k+1)^2(k-1)}$

32. $4x+3-\dfrac{2x+1}{x+4}=(4x+3)\dfrac{x+4}{x+4}-\dfrac{2x+1}{x+4}=\dfrac{4x^2+19x+12-2x-1}{x+4}=\dfrac{4x^2+17x+11}{x+4}$

33. $\dfrac{2}{a+3}+\dfrac{2a^2-2a}{a^2-2a-15}=\dfrac{2}{a+3}+\dfrac{2a^2-2a}{(a-5)(a+3)}=\dfrac{2}{a+3}\cdot\dfrac{a-5}{a-5}+\dfrac{2a^2-2a}{(a-5)(a+3)}$

$=\dfrac{2a-10+2a^2-2a}{(a-5)(a+3)}=\dfrac{2a^2-10}{(a-5)(a+3)}=\dfrac{2(a^2-5)}{(a-5)(a+3)}$

34. $\dfrac{6}{x^2+4x+3}+\dfrac{7}{x^2+5x+6}=\dfrac{6}{(x+3)(x+1)}+\dfrac{7}{(x+3)(x+2)}$ LCD $=(x+3)(x+1)(x+2)$

$=\dfrac{6}{(x+3)(x+1)}\cdot\dfrac{x+2}{x+2}+\dfrac{7}{(x+3)(x+2)}\cdot\dfrac{x+1}{x+1}$

$=\dfrac{6x+12+7x+7}{(x+3)(x+1)(x+2)}$

$=\dfrac{13x+19}{(x+3)(x+1)(x+2)}$

35. $\dfrac{2}{3x-5}-8=\dfrac{2}{3x-5}-8\cdot\dfrac{3x-5}{3x-5}=\dfrac{2-24x+40}{3x-5}=\dfrac{-24x+42}{3x-5}=\dfrac{-6(4x-7)}{3x-5}$

36. $\dfrac{7}{4k^2-k-3}+\dfrac{1}{4k^2-7k+3}=\dfrac{7}{(4k+3)(k-1)}+\dfrac{1}{(4k-3)(k-1)}$ LCD $=(4k+3)(4k-3)(k-1)$

$=\dfrac{7}{(4k+3)(k-1)}\cdot\dfrac{4k-3}{4k-3}+\dfrac{1}{(4k-3)(k-1)}\cdot\dfrac{4k+3}{4k+3}$

$=\dfrac{28k-21+4k+3}{(4k+3)(4k-3)(k-1)}$

$=\dfrac{32k-18}{(4k+3)(4k-3)(k-1)}=\dfrac{2(16k-9)}{(4k+3)(4k-3)(k-1)}$

37. $\dfrac{6a}{3a^2-7a+2}+\dfrac{2}{1-3a}+\dfrac{3a}{a-2}$

$$=\frac{6a}{(3a-1)(a-2)}+\frac{-2}{3a-1}+\frac{3a}{a-2}$$

$\text{LCD}=(3a-1)(a-2)$

$$=\frac{6a}{(3a-1)(a-2)}+\frac{-2}{3a-1}\cdot\frac{a-2}{a-2}+\frac{3a}{a-2}\cdot\frac{3a-1}{3a-1}$$

$$=\frac{6a}{(3a-1)(a-2)}+\frac{-2a+4}{(3a-1)(a-2)}+\frac{9a^2-3a}{(3a-1)(a-2)}$$

$$=\frac{6a-2a+4+9a^2-3a}{(3a-1)(a-2)}$$

$$=\frac{9a^2+a+4}{(3a-1)(a-2)}$$

38. $4+\dfrac{2y-5}{y+2}+\dfrac{y}{3-y}=4+\dfrac{2y-5}{y+2}+\dfrac{-y}{y-3}$

$\text{LCD}=(y-3)(y+2)$

$$=4\cdot\frac{(y-3)(y+2)}{(y-3)(y+2)}+\frac{2y-5}{y+2}\cdot\frac{y-3}{y-3}+\frac{-y}{y-3}\cdot\frac{y+2}{y+2}$$

$$=\frac{4y^2-4y-24}{(y-3)(y+2)}+\frac{2y^2-11y+15}{(y-3)(y+2)}+\frac{-y^2-2y}{(y-3)(y+2)}$$

$$=\frac{5y^2-17y-9}{(y-3)(y+2)}$$

Section 5.4

39. $\dfrac{\dfrac{2x}{3x^2-3}}{\dfrac{4x}{6x-6}}=\dfrac{2x}{3(x^2-1)}\cdot\dfrac{6x-6}{4x}$

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

$$=\frac{1}{x+1}$$

40. $\dfrac{\dfrac{k+2}{3}}{\dfrac{5}{k-2}}=\dfrac{k+2}{3}\cdot\dfrac{k-2}{5}$

$$=\frac{(k+2)(k-2)}{15}$$

41. $\dfrac{\dfrac{2}{x}+\dfrac{1}{xy}}{\dfrac{4}{x^2}}$ $\quad \text{LCD} = x^2y$

$$= \frac{x^2y\left(\frac{2}{x}+\frac{1}{xy}\right)}{x^2y\left(\frac{4}{x^2}\right)} = \frac{x^2y\left(\frac{2}{x}\right)+x^2y\left(\frac{1}{xy}\right)}{x^2y\left(\frac{4}{x^2}\right)}$$

$$= \frac{2xy+x}{4y} = \frac{x(2y+1)}{4y}$$

42. $\dfrac{\dfrac{4}{y}-1}{\dfrac{1}{y}-\dfrac{4}{y^2}}$ $\quad \text{LCD} = y^2$

$$= \frac{y^2\left(\frac{4}{y}-1\right)}{y^2\left(\frac{1}{y}-\frac{4}{y^2}\right)} = \frac{y^2\left(\frac{4}{y}\right)-y^2(1)}{y^2\left(\frac{1}{y}\right)-y^2\left(\frac{4}{y^2}\right)}$$

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

43. $\dfrac{\dfrac{1}{a-1}+1}{\dfrac{1}{a+1}-1}$ $\quad \text{LCD} = (a+1)(a-1)$

$$= \frac{(a+1)(a-1)\left(\frac{1}{a-1}+1\right)}{(a+1)(a-1)\left(\frac{1}{a+1}-1\right)} = \frac{(a+1)\cancel{(a-1)}\left(\frac{1}{\cancel{a-1}}\right)+(a+1)(a-1)(1)}{\cancel{(a+1)}(a-1)\left(\frac{1}{\cancel{a+1}}\right)-(a+1)(a-1)(1)}$$

$$= \frac{a+1+a^2-1}{a-1-(a^2-1)} = \frac{a^2+a}{a-1-a^2+1} = \frac{a^2+a}{-a^2+a} = \frac{\cancel{a}(a+1)}{-\cancel{a}(a-1)} = -\frac{a+1}{a-1}$$

44. $\dfrac{\dfrac{3}{x-1}-\dfrac{1}{1-x}}{\dfrac{2}{x-1}-\dfrac{2}{x}} = \dfrac{\dfrac{3}{x-1}+\dfrac{1}{x-1}}{\dfrac{2}{x-1}-\dfrac{2}{x}}$ $\quad \text{LCD} = x(x-1)$

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

$$= \frac{3x+x}{2x-2x+2} = \frac{4x}{2} = 2x$$

45. $\dfrac{1+xy^{-1}}{x^2y^{-2}-1} = \dfrac{1+\dfrac{x}{y}}{\dfrac{x^2}{y^2}-1}$ $\quad \text{LCD} = y^2$

$$= \frac{y^2\left(1+\frac{x}{y}\right)}{y^2\left(\frac{x^2}{y^2}-1\right)} = \frac{y^2(1)+y\cdot\cancel{y}\left(\frac{x}{\cancel{y}}\right)}{\cancel{y^2}\left(\frac{x^2}{\cancel{y^2}}\right)-y^2(1)} = \frac{y^2+xy}{x^2-y^2} = \frac{y\cancel{(y+x)}}{\cancel{(x+y)}(x-y)} = \frac{y}{x-y}$$

46.

$$\frac{5a^{-1}+(ab)^{-1}}{3a^{-2}} = \frac{\frac{5}{a}+\frac{1}{ab}}{\frac{3}{a^2}} \qquad \text{LCD} = a^2b$$

$$= \frac{a^2b\left(\frac{5}{a}+\frac{1}{ab}\right)}{a^2b\left(\frac{3}{a^2}\right)} = \frac{\cancel{a}\cdot a\cdot b\left(\frac{5}{\cancel{a}}\right)+a\cdot\cancel{ab}\left(\frac{1}{\cancel{ab}}\right)}{\cancel{a^2}\,b\left(\frac{3}{\cancel{a^2}}\right)} = \frac{5ab+a}{3b} = \frac{a(5b+1)}{3b}$$

47.

$$m = \frac{-\frac{5}{3}-\left(-\frac{7}{4}\right)}{\frac{13}{6}-\frac{2}{3}} \qquad \text{LCD} = 12$$

$$= \frac{12\left(-\frac{5}{3}+\frac{7}{4}\right)}{12\left(\frac{13}{6}-\frac{2}{3}\right)} = \frac{-20+21}{26-8} = \frac{1}{18}$$

48.

$$m = \frac{\frac{9}{5}-\left(-\frac{1}{3}\right)}{\frac{13}{10}-\frac{8}{15}} \qquad \text{LCD} = 30$$

$$= \frac{30\left(\frac{9}{5}+\frac{1}{3}\right)}{30\left(\frac{13}{10}-\frac{8}{15}\right)} = \frac{54+10}{39-16} = \frac{64}{23}$$

Section 5.5

49.

$$\frac{x+3}{x^2-x}-\frac{8}{x^2-1}=0$$

$$\frac{x+3}{x(x-1)}-\frac{8}{(x+1)(x-1)}=0$$

$\text{LCD} = x(x-1)(x+1)$ so $x \neq 0$ or $x \neq 1$ or $x \neq -1$

$$x(x-1)(x+1)\left(\frac{x+3}{x(x-1)}-\frac{8}{(x+1)(x-1)}\right) = x(x-1)(x+1)(0)$$

$$\cancel{x}\,\cancel{(x-1)}(x+1)\left(\frac{x+3}{\cancel{x}\,\cancel{(x-1)}}\right)-x\cancel{(x-1)}\cancel{(x+1)}\left(\frac{8}{\cancel{(x+1)}\cancel{(x-1)}}\right)=0$$

$$x^2+4x+3-8x=0$$

$$x^2-4x+3=0$$

$$(x-3)(x-1)=0$$
$$x-3=0 \text{ or } x-1=0$$
$$x=3 \text{ or } x=1$$

$\{3\}$ is the solution. ($x=1$ does not check because the denominator is zero.)

50.
$$\frac{y}{y+3}-\frac{3}{3-y}=\frac{18}{y^2-9}$$
$$\frac{y}{y+3}+\frac{3}{y-3}=\frac{18}{y^2-9}$$
$$\frac{y}{y+3}+\frac{3}{y-3}=\frac{18}{(y+3)(y-3)}$$
$$\text{LCD}=(y+3)(y-3) \quad \text{so } y\neq -3 \text{ or } y\neq 3$$
$$(y+3)(y-3)\left(\frac{y}{y+3}+\frac{3}{y-3}\right)=\cancel{(y+3)}\cancel{(y-3)}\left(\frac{18}{\cancel{(y+3)}\cancel{(y-3)}}\right)$$
$$\cancel{(y+3)}(y-3)\left(\frac{y}{\cancel{y+3}}\right)+(y+3)\cancel{(y-3)}\left(\frac{3}{\cancel{y-3}}\right)=18$$
$$y^2-3y+3y+9=18$$
$$y^2-9=0$$
$$(y-3)(y+3)=0$$
$$y-3=0 \text{ or } y+3=0$$
$$y=3 \text{ or } y=-3$$

{ }, no solution. (The values 3 and –3 do not check because each makes the denominator zero.)

51.
$$x-9=\frac{72}{x-8}$$
$$\text{LCD}=(x-8) \quad \text{so } x\neq 8$$
$$(x-8)(x-9)=\cancel{(x-8)}\left(\frac{72}{\cancel{x-8}}\right)$$
$$x^2-17x+72=72$$
$$x^2-17x=0$$
$$x(x-17)=0$$
$$x=0$$
$$\text{or } x-17=0$$
$$x=0$$
$$\text{or } x=17 \quad \{0,17\}$$

52.
$$\frac{3x+1}{x+5}=\frac{x-1}{x+1}+2 \qquad \text{LCD}=(x+5)(x+1) \qquad \text{so } x\neq -5 \text{ or } x\neq -1$$
$$(x+5)(x+1)\left(\frac{3x+1}{x+5}\right)=(x+5)(x+1)\left(\frac{x-1}{x+1}+2\right)$$
$$\cancel{(x+5)}(x+1)\left(\frac{3x+1}{\cancel{x+5}}\right)=(x+5)\cancel{(x+1)}\left(\frac{x-1}{\cancel{x+1}}\right)+(x+5)(x+1)(2)$$
$$3x^2+4x+1=x^2+4x-5+2(x^2+6x+5)$$
$$3x^2+4x+1=x^2+4x-5+2x^2+12x+10$$
$$3x^2+4x+1=3x^2+16x+5$$
$$-12x=4$$
$$x=-\frac{1}{3} \quad \left\{-\frac{1}{3}\right\}$$

53.
$$5y^{-2}+1=6y^{-1}$$
$$\frac{5}{y^2}+1=\frac{6}{y}$$
$$\text{LCD}=y^2 \quad \text{so } y\neq 0$$
$$y^2\left(\frac{5}{y^2}+1\right)=y^2\left(\frac{6}{y}\right)$$
$$\cancel{y^2}\left(\frac{5}{\cancel{y^2}}\right)+y^2(1)=y\cdot\cancel{y}\left(\frac{6}{\cancel{y}}\right)$$
$$5+y^2=6y$$
$$y^2-6y+5=0$$
$$(y-5)(y-1)=0$$
$$y-5=0 \text{ or } y-1=0$$
$$y=5 \text{ or } y=1 \quad \{5,1\}$$

54.
$$1+\frac{7}{6}m^{-1}=\frac{13}{6}m^{-1}$$
$$1+\frac{7}{6m}=\frac{13}{6m}$$
$$\text{LCD}=6m \quad \text{so } m\neq 0$$
$$6m\left(1+\frac{7}{6m}\right)=6m\left(\frac{13}{6m}\right)$$
$$6m(1)+\cancel{6m}\left(\frac{7}{\cancel{6m}}\right)=\cancel{6m}\left(\frac{13}{\cancel{6m}}\right)$$
$$6m+7=13$$
$$6m=6$$
$$m=1 \quad \{1\}$$

55.
$$c=\frac{ax+b}{x} \quad \text{for } x$$
$$cx=ax+b$$
$$cx-ax=b$$
$$x(c-a)=b$$
$$x=\frac{b}{c-a}$$

56.
$$\frac{A}{rt}=P+\frac{P}{rt} \quad \text{for } P$$
$$rt\left(\frac{A}{rt}\right)=rt\left(P+\frac{P}{rt}\right)$$
$$A=rtP+P$$
$$A=P(rt+1)$$
$$\frac{A}{rt+1}=P$$

Section 5.6

57. $\dfrac{5}{4}=\dfrac{x}{6}$ LCD $=12$

$12\left(\dfrac{5}{4}\right)=12\left(\dfrac{x}{6}\right)$

$15=2x$

$x=\dfrac{15}{2}$ $\left\{\dfrac{15}{2}\right\}$

58. $\dfrac{x}{36}=\dfrac{6}{7}$ LCD $=252$

$252\left(\dfrac{x}{36}\right)=252\left(\dfrac{6}{7}\right)$

$7x=216$

$x=\dfrac{216}{7}$ $\left\{\dfrac{216}{7}\right\}$

59. $\dfrac{x+2}{3}=\dfrac{5(x+1)}{4}$ LCD $=12$

$12\left(\dfrac{x+2}{3}\right)=12\left(\dfrac{5(x+1)}{4}\right)$

$4(x+2)=15(x+1)$

$4x+8=15x+15$

$-11x=7$

$x=-\dfrac{7}{11}$ $\left\{-\dfrac{7}{11}\right\}$

60. $\dfrac{x}{x+2}=\dfrac{-3}{5}$ LCD $=5(x+2)$

$5\cancel{(x+2)}\left(\dfrac{x}{\cancel{x+2}}\right)=\cancel{5}(x+2)\left(\dfrac{-3}{\cancel{5}}\right)$

$5x=-3x-6$

$8x=-6$

$x=-\dfrac{3}{4}$ $\left\{-\dfrac{3}{4}\right\}$

61. Let y = the number of yards gained

$\dfrac{34}{357}=\dfrac{22}{y}$ LCD $=357y$

$\cancel{357}y\left(\dfrac{34}{\cancel{357}}\right)=357\cancel{y}\left(\dfrac{22}{\cancel{y}}\right)$

$34y=7854$

$y=231$

He would gain 231 yd

62. Let c = the number of Canadian dollars

$\dfrac{108}{100}=\dfrac{c}{235}$ LCD $=4700$

$4700\left(\dfrac{108}{100}\right)=4700\left(\dfrac{c}{235}\right)$

$5076=20c$

$c=253.80$

Erik can buy \$253.80 Canadian.

63. Let x = the speed on first day

$x-5$ = the speed on second day

	Distance	Rate	Time
First Day	100	x	$100/x$
Second Day	75	$x-5$	$75/(x-5)$

(Time first) + (Time second) = 10

$$\frac{100}{x}+\frac{75}{x-5}=10 \quad \text{LCD } = x(x-5)$$

$$x(x-5)\left(\frac{100}{x}+\frac{75}{x-5}\right)=x(x-5)(10)$$

$$100x-500+75x=10x^2-50x$$

$$0=10x^2-225x+500$$

$$0=2x^2-45x+100$$

$$0=(2x-5)(x-20)$$

$$2x-5=0 \text{ or } x-20=0$$

$$2x=5 \text{ or } x=20$$

$$x\neq\frac{5}{2} \text{ or } x=20$$

$$x-5=20-5=15$$

Tony averaged 20 mph the first day and 15 mph the second day.

64. Let x = the walking speed

$15x$ = the driving speed

	Distance	Rate	Time
Walking	3	x	$3/x$
Driving	45	$15x$	$45/(15x)$

(Time walk) + (Time drive) = 1.5

$$\frac{3}{x}+\frac{45}{15x}=\frac{3}{2} \quad \text{LCD } = 30x$$

$$30x\left(\frac{3}{x}+\frac{45}{15x}\right)=30x\left(\frac{3}{2}\right)$$

$$90+90=45x$$

$$180=45x$$

$$x=4$$

$$15x=15(4)=60$$

The driving speed was 60 mph.

65.

	Work Rate	Time	Part of Job Comp
Doug	1/8	x	$(1/8)\,x$
Jean	1/10	x	$(1/10)\,x$

(Doug's Part) + (Jean's Part) = (1 Job)

$$\frac{1}{8}\cdot x+\frac{1}{10}\cdot x=1 \quad \text{LCD}=40$$
$$40\left(\frac{1}{8}\cdot x+\frac{1}{10}\cdot x\right)=40(1)$$
$$5x+4x=40$$
$$9x=40$$
$$x=\frac{40}{9}\text{ hr}\approx 4.4\text{ hr}$$

Together it would take about 4.4 hours to complete the job.

66.

	Work Rate	Time	Part of Job Comp
Lg pipe	$1/x$	6	$(1/x)\,6$
Sm pipe	$1/(2x)$	6	$(1/(2x))\,6$

(Lg Pipe Part) + (Sm Pipe Part) = (1 Job)

$$\frac{1}{x}\cdot 6+\frac{1}{2x}\cdot 6=1 \quad \text{LCD}=2x$$
$$2x\left(\frac{1}{x}\cdot 6+\frac{1}{2x}\cdot 6\right)=2x(1)$$
$$12+6=2x$$
$$18=2x$$
$$x=9\text{ hr}$$
$$2x=2(9)$$
$$=18\text{ hr}$$

The larger pipe takes 9 hr to fill the tank; the smaller pipe takes 18 hr to fill the tank.

Section 5.7

67. **a.** $F=kd$

b. $6=k(2)$

$k=3$

c. $F=3(4.2)=12.6$ lb

It requires 12.6 lb.

68.
$$y=\frac{k}{x}$$
$$32=\frac{k}{2}$$
$$k=32\cdot 2$$
$$=64$$
$$y=\frac{64}{4}$$
$$=16$$

69. $y = kx\sqrt{z}$

$3 = k(3)\sqrt{4}$

$3 = k(3)(2)$

$k = \frac{3}{3\cdot 2} = \frac{3}{6} = \frac{1}{2}$

$y = \frac{1}{2}(8)\sqrt{9} = 4\cdot 3 = 12$

70. Let d = the distance one can see

h = the height above sea level

$d = k\sqrt{h}$

$30 = k\sqrt{25}$

$30 = k\cdot 5$

$k = 6$

$d = 6\sqrt{64} = 6\cdot 8 = 48$ km

She can see 48 km.

Chapter 5 Test

1. $h(x) = \frac{2x-14}{x^2-49}$

a. $h(0) = \frac{2(0)-14}{(0)^2-49} = \frac{0-14}{0-49} = \frac{-14}{-49} = \frac{2}{7}$

$h(5) = \frac{2(5)-14}{(5)^2-49} = \frac{10-14}{25-49} = \frac{-4}{-24} = \frac{1}{6}$

$h(7) = \frac{2(7)-14}{(7)^2-49} = \frac{14-14}{49-49} = \frac{0}{0}$

is undefined

$h(-7) = \frac{2(-7)-14}{(-7)^2-49} = \frac{-14-14}{49-49} = \frac{-28}{0}$

is undefined

b. $(-\infty,-7)\cup(-7,7)\cup(7,\infty)$

2. $k(x) = \frac{5x-3}{7}$

$(-\infty,\infty)$

3. $f(x) = \frac{2x+6}{x^2-x-12}$

$= \frac{2(x+3)}{(x-4)(x+3)}$

a. $\{x \mid x \text{ is a real number and } x \neq 4, x \neq -3\}$

4. $\frac{12m^3n^7}{18mn^8} = \frac{2}{3}m^{3-1}n^{7-8} = \frac{2}{3}m^2n^{-1} = \frac{2m^2}{3n}$

b. $f(x)=\dfrac{2x+6}{x^2-x-12}=\dfrac{2\cancel{(x+3)}}{(x-4)\cancel{(x+3)}}$

$=\dfrac{2}{x-4}$

5. $\dfrac{9x^2-9}{3x^2+2x-5}=\dfrac{9(x^2-1)}{(3x+5)(x-1)}$

$=\dfrac{9(x+1)\cancel{(x-1)}}{(3x+5)\cancel{(x-1)}}=\dfrac{9(x+1)}{3x+5}$

6. $m=\dfrac{-\frac{8}{3}-\left(-\frac{3}{4}\right)}{\frac{5}{6}-\frac{1}{12}}$ LCD $=12$

$=\dfrac{12\left(-\frac{8}{3}+\frac{3}{4}\right)}{12\left(\frac{5}{6}-\frac{1}{12}\right)}=\dfrac{-32+9}{10-1}=\dfrac{-23}{9}=-\dfrac{23}{9}$

7. $\dfrac{2x-5}{25-4x^2}\cdot(2x^2-x-15)$

$=\dfrac{2x-5}{-(4x^2-25)}\cdot\dfrac{(2x+5)(x-3)}{1}$

$=\dfrac{\cancel{2x-5}}{-\cancel{(2x+5)}\cancel{(2x-5)}}\cdot\dfrac{\cancel{(2x+5)}(x-3)}{1}$

$=-(x-3)$

8. $\dfrac{x^2}{x-4}-\dfrac{8x-16}{x-4}=\dfrac{x^2-8x+16}{x-4}$

$=\dfrac{\cancel{(x-4)}(x-4)}{\cancel{x-4}}=x-4$

9. $\dfrac{4x}{x+1}+x+\dfrac{2}{x+1}=\dfrac{4x}{x+1}+x\cdot\dfrac{x+1}{x+1}+\dfrac{2}{x+1}$

$=\dfrac{4x+x^2+x+2}{x+1}=\dfrac{x^2+5x+2}{x+1}$

10. $\dfrac{3+\frac{3}{k}}{4+\frac{4}{k}}$ LCD $=k$

$=\dfrac{k\left(3+\frac{3}{k}\right)}{k\left(4+\frac{4}{k}\right)}=\dfrac{3k+3}{4k+4}=\dfrac{3\cancel{(k+1)}}{4\cancel{(k+1)}}=\dfrac{3}{4}$

11. $\dfrac{2u^{-1}+2v^{-1}}{4u^{-3}+4v^{-3}}=\dfrac{\frac{2}{u}+\frac{2}{v}}{\frac{4}{u^3}+\frac{4}{v^3}}$ LCD $=u^3v^3$

$$= \frac{u^3v^3\left(\frac{2}{u}+\frac{2}{v}\right)}{u^3v^3\left(\frac{4}{u^3}+\frac{4}{v^3}\right)} = \frac{2u^2v^3+2u^3v^2}{4v^3+4u^3} = \frac{2u^2v^2\left(v+u\right)}{4\left(v^3+u^3\right)}$$

$$= \frac{\cancel{2}u^2v^2\left(\cancel{v+u}\right)}{\cancel{2}\cdot 2\left(\cancel{v+u}\right)\left(v^2-vu+u^2\right)} = \frac{u^2v^2}{2\left(v^2-vu+u^2\right)}$$

12. $\dfrac{ax+bx+2a+2b}{ax-3a+bx-3b}\cdot\dfrac{x-3}{5-x}\div\dfrac{x+2}{ax-5a}$

$$= \frac{x\left(a+b\right)+2\left(a+b\right)}{a\left(x-3\right)+b\left(x-3\right)}\cdot\frac{x-3}{-(x-5)}\cdot\frac{ax-5a}{x+2}$$

$$= \frac{\left(\cancel{a+b}\right)\left(\cancel{x+2}\right)}{\left(\cancel{x-3}\right)\left(\cancel{a+b}\right)}\cdot\frac{\cancel{x-3}}{-\left(\cancel{x-5}\right)}\cdot\frac{a\left(\cancel{x-5}\right)}{\cancel{x+2}}$$

$$= -a$$

13. $\dfrac{3}{x^2+8x+15}-\dfrac{1}{x^2+7x+12}-\dfrac{1}{x^2+9x+20} = \dfrac{3}{\left(x+5\right)\left(x+3\right)}-\dfrac{1}{\left(x+4\right)\left(x+3\right)}-\dfrac{1}{\left(x+5\right)\left(x+4\right)}$

LCD $= \left(x+5\right)\left(x+3\right)\left(x+4\right)$

$$= \frac{3}{\left(x+5\right)\left(x+3\right)}\cdot\frac{x+4}{x+4}-\frac{1}{\left(x+4\right)\left(x+3\right)}\cdot\frac{x+5}{x+5}-\frac{1}{\left(x+5\right)\left(x+4\right)}\cdot\frac{x+3}{x+3}$$

$$= \frac{3x+12-x-5-x-3}{\left(x+5\right)\left(x+3\right)\left(x+4\right)}$$

$$= \frac{\cancel{x+4}}{\left(x+5\right)\left(x+3\right)\left(\cancel{x+4}\right)} = \frac{1}{\left(x+5\right)\left(x+3\right)}$$

14.

$$\frac{7}{z+1}-\frac{z-5}{z^2-1} = \frac{6}{z}$$

$$\frac{7}{z+1}-\frac{z-5}{\left(z+1\right)\left(z-1\right)} = \frac{6}{z}$$

LCD $= z\left(z+1\right)\left(z-1\right)$ so $z \neq 0$ or $z \neq -1$ or $z \neq 1$

$$z\left(z+1\right)\left(z-1\right)\left(\frac{7}{z+1}-\frac{z-5}{\left(z+1\right)\left(z-1\right)}\right) = z\left(z+1\right)\left(z-1\right)\left(\frac{6}{z}\right)$$

$$z\left(\cancel{z+1}\right)\left(z-1\right)\left(\frac{7}{\cancel{z+1}}\right)-z\left(\cancel{z+1}\right)\left(\cancel{z-1}\right)\left(\frac{z-5}{\left(\cancel{z+1}\right)\left(\cancel{z-1}\right)}\right) = \cancel{z}\left(z+1\right)\left(z-1\right)\left(\frac{6}{\cancel{z}}\right)$$

$$7z(z-1)-z(z-5)=6(z^2-1)$$
$$7z^2-7z-z^2+5z=6z^2-6$$
$$6z^2-2z=6z^2-6$$
$$-2z=-6$$
$$z=3 \quad \{3\}$$

15.
$$\frac{3}{y^2-9}+\frac{4}{y+3}=1$$
$$\frac{3}{(y+3)(y-3)}+\frac{4}{y+3}=1$$

LCD $=(y+3)(y-3)$ so $y\neq -3$ or $y\neq 3$

$$(y+3)(y-3)\left(\frac{3}{(y+3)(y-3)}+\frac{4}{y+3}\right)=(y+3)(y-3)(1)$$
$$\cancel{(y+3)}\cancel{(y-3)}\left(\frac{3}{\cancel{(y+3)}\cancel{(y-3)}}\right)+\cancel{(y+3)}(y-3)\left(\frac{4}{\cancel{y+3}}\right)=(y+3)(y-3)$$
$$3+4y-12=y^2-9$$
$$0=y^2-4y$$
$$y(y-4)=0$$
$$y=0 \quad \text{or} \quad y-4=0$$
$$y=0 \quad \text{or} \quad y=4 \quad \{0,4\}$$

16.
$$\frac{4x}{x-4}=3+\frac{16}{x-4}$$

LCD $=x-4$ so $x\neq 4$

$$\cancel{(x-4)}\left(\frac{4x}{\cancel{x-4}}\right)=(x-4)\left(3+\frac{16}{x-4}\right)$$
$$4x=(x-4)(3)+\cancel{(x-4)}\left(\frac{16}{\cancel{x-4}}\right)$$
$$4x=3x-12+16$$
$$x=4$$

{ } no solution. ($x=4$ does not check because the denominator is zero.)

17.
$$\frac{1+Tv}{T}=p \quad \text{for } T$$
$$1+Tv=pT$$
$$1=pT-Tv$$
$$1=T(p-v)$$
$$\frac{1}{p-v}=T$$

18. $F = \dfrac{Gm_1m_2}{r^2}$ for m_1

$$Fr^2 = Gm_1m_2$$

$$\frac{Fr^2}{Gm_2} = m_1$$

19. Let x = the number

$$\frac{1}{x} + 3x = \frac{13}{2}$$

$\text{LCD} = 2x$ so $x \neq 0$

$$2x\left(\frac{1}{x} + 3x\right) = 2x\left(\frac{13}{2}\right)$$

$$2\cancel{x}\left(\frac{1}{\cancel{x}}\right) + 2x(3x) = \cancel{2}x\left(\frac{13}{\cancel{2}}\right)$$

$$2 + 6x^2 = 13x$$

$$6x^2 - 13x + 2 = 0$$

$$(6x - 1)(x - 2) = 0$$

$$6x - 1 = 0 \text{ or } x - 2 = 0$$

$$6x = 1 \text{ or } x = 2$$

$$x = \frac{1}{6} \text{ or } x = 2$$

20.

$$\frac{21}{a} = \frac{18}{12}$$

$$12a\left(\frac{21}{a}\right) = 12a\left(\frac{18}{12}\right)$$

$$252 = 18a$$

$$a = 14 \text{ m}$$

$$\frac{b}{10} = \frac{18}{12}$$

$$60\left(\frac{b}{10}\right) = 60\left(\frac{18}{12}\right)$$

$$6b = 90$$

$$b = 15 \text{ m}$$

21. Let x = the actual distance

$$\frac{8.2}{2820} = \frac{5.7}{x} \qquad \text{LCD} = 2820x$$

$$2820x\left(\frac{8.2}{2820}\right) = 2820x\left(\frac{5.7}{x}\right)$$

$$8.2x = 16074$$

$$x \approx 1960 \text{ mi}$$

The cities are 1960 mi apart.

22. Let x = the speed against the wind

	Distance	Rate	Time
Against	48	x	$48/x$
With wind	60	$x + 4$	$60/(x + 4)$

(Time against wind) = (Time with wind)

$$\frac{48}{x} = \frac{60}{x+4} \qquad \text{LCD} = x(x+4)$$

$$\cancel{x}(x+4)\left(\frac{48}{\cancel{x}}\right) = x\left(\cancel{x+4}\right)\left(\frac{60}{\cancel{x+4}}\right)$$

$$\begin{aligned} 48x+192 &= 60x \\ 192 &= 12x \\ x &= 16 \\ x+4 &= 16+4 \\ &= 20 \end{aligned}$$

Lance rides 16 mph against the wind and 20 mph with the wind.

23.

	Work Rate	Time	Portion of Job Comp
Barbara	1/4	x	$(1/4)x$
Jack	1/10	x	$(1/10)x$

(Barbara's Part) + (Jack's Part) = (1 Job)

$$\frac{1}{4}x+\frac{1}{10}x=1 \quad \text{LCD}=20$$

$$20\left(\frac{1}{4}x+\frac{1}{10}x\right)=20(1)$$

$$5x+2x=20$$

$$7x=20$$

$$x=\frac{20}{7} \text{ hr}$$

$$\text{or } 2\frac{6}{7} \text{ hr}$$

Together, they can type the chapter in $2\frac{6}{7}$ hr.

24.

$$x=\frac{ky}{t^2}$$

25. Let P = the period of the pendulum

L = the length of the pendulum

$$P=k\sqrt{L}$$

$$2.2=k\sqrt{4}$$

$$k=\frac{2.2}{\sqrt{4}}$$

$$=\frac{2.2}{2}$$

$$=1.1$$

$$P=1.1\sqrt{9}$$

$$=1.1(3)$$

$$=3.3 \text{ sec}$$

The period is 3.3 sec.

Chapters 1 – 5 Cumulative Review Exercises

1.

		-22	π	6	$-\sqrt{2}$
	Real numbers	–	–	–	–
	Irrational numbers		–		–
	Rational numbers	–		–	
	Integers	–		–	
	Whole numbers			–	
	Natural numbers			–	

2. Multiply the first equation by 2, add to the second equation, and solve for x:

$$3x+4y=-4 \xrightarrow{\times 2} 6x+8y=-8$$
$$2x-8y=-8 \longrightarrow \underline{2x-8y=-8}$$
$$8x \quad =-16$$
$$x=-2$$

Substitute and solve for y:

$$3(-2)+4y=-4$$
$$-6+4y=-4$$
$$4y=2$$
$$y=\frac{2}{4}=\frac{1}{2}$$

The solution is: $\left\{\left(-2,\tfrac{1}{2}\right)\right\}$.

3.

$$\begin{aligned}&(2x-3)(x-4)-(x-5)^2\\ &=2x^2-8x-3x+12-\left(x^2-10x+25\right)\\ &=2x^2-11x+12-x^2+10x-25\\ &=x^2-x-13\end{aligned}$$

4. a.

$$A=\frac{1}{2}h(b_1+b_2) \quad \text{for } b_1$$
$$2A=h(b_1+b_2)$$
$$2A=hb_1+hb_2$$
$$2A-hb_2=hb_1$$
$$\frac{2A-hb_2}{h}=b_1$$

b.

$$b_1=\frac{2(32)-4(6)}{4}=\frac{64-24}{4}$$
$$=\frac{40}{4}=10 \text{ cm}$$

5. Let w = the width of the pool

$2w - 10$ = the length of the pool

$$2w+2(2w-10)=160$$
$$2w+4w-20=160$$
$$6w=180$$
$$w=30$$
$$2w-10=2(30)-10$$
$$=60-10=50$$

The length is 50 m and the width is 30 m.

6. $3x-3y+z=-13$
$2x-y-2z=4$
$x+2y-3z=15$

Multiply the first equation by 2 and add to the second equation to eliminate z:

$$\begin{array}{r} 6x-6y+2z=-26 \\ 2x-y-2z=4 \\ \hline 8x-7y=-22 \end{array}$$

Multiply the first equation by 3 and add to the third equation to eliminate z:

$$\begin{array}{r} 9x-9y+3z=-39 \\ x+2y-3z=15 \\ \hline 10x-7y=-24 \end{array}$$

Multiply the first result by –1 and add to the second result to eliminate y:

$$\begin{array}{r} -8x+7y=22 \\ 10x-7y=-24 \\ \hline 2x=-2 \end{array}$$

$$x=-1$$

Substitute and solve:

$$8(-1)-7y=-22$$
$$-8-7y=-22$$
$$-7y=-14$$
$$y=2$$

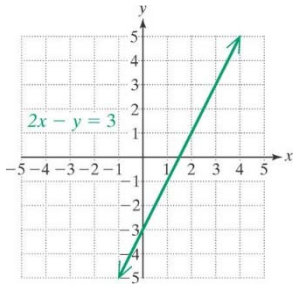
$$3(-1)-3(2)+z=-13$$
$$-3-6+z=-13$$
$$-9+z=-13$$
$$z=-4$$

The solution is $\{(-1, 2, -4)\}$.

7. The slope of the line is 3 and the slope of the perpendicular line is $-\frac{1}{3}$.

$$y-5=-\frac{1}{3}\left(x-(-3)\right)$$
$$y-5=-\frac{1}{3}x-1$$
$$y=-\frac{1}{3}x+4$$

8. $2x-y=3$



9.
$$s=\frac{k}{t}$$
$$60=\frac{k}{10}$$
$$600=k$$
$$s=\frac{600}{8}=75$$

10.
$$f(x)=-12x^3+17x^2-6x$$
$$=-x(12x^2-17x+6)$$
$$=-x(4x-3)(3x-2)$$
$$-x=0 \text{ or } 4x-3=0 \text{ or } 3x-2=0$$
$$x=0 \text{ or } 4x=3 \text{ or } 3x=2$$

The speed of the car is 75 mph.

$x = 0$ or $x = \frac{3}{4}$ or $x = \frac{2}{3}$

x-intercepts: $(0,0), \left(\frac{3}{4},0\right), \left(\frac{2}{3},0\right)$

11. $64y^3 - 8z^6 = 8\left(8y^3 - z^6\right)$

$= 8\left[\left(2y\right)^3 - \left(z^2\right)^3\right]$

$= 8\left(2y - z^2\right)\left(4y^2 + 2yz^2 + z^4\right)$

12. $10x^2 - x - 2 = \left(5x + 2\right)\left(2x - 1\right)$

13. $\frac{2x^2 + 11x - 21}{4x^2 - 10x + 6} \div \frac{2x^2 - 98}{x^2 - x + xa - a} = \frac{2x^2 + 11x - 21}{2\left(2x^2 - 5x + 3\right)} \cdot \frac{x^2 - x + xa - a}{2x^2 - 98}$

$= \frac{\left(2x - 3\right)\left(x + 7\right)}{2\left(2x - 3\right)\left(x - 1\right)} \cdot \frac{x\left(x - 1\right) + a\left(x - 1\right)}{2\left(x^2 - 49\right)}$

$= \frac{\cancel{\left(2x - 3\right)}\left(\cancel{x + 7}\right)}{2\cancel{\left(2x - 3\right)}\left(\cancel{x - 1}\right)} \cdot \frac{\cancel{\left(x - 1\right)}\left(x + a\right)}{2\cancel{\left(x + 7\right)}\left(x - 7\right)}$

$= \frac{x + a}{4\left(x - 7\right)}$

14. $\frac{x}{x^2 + 5x - 50} - \frac{1}{x^2 - 7x + 10} + \frac{1}{x^2 + 8x - 20} = \frac{x}{\left(x + 10\right)\left(x - 5\right)} - \frac{1}{\left(x - 5\right)\left(x - 2\right)} + \frac{1}{\left(x + 10\right)\left(x - 2\right)}$

LCD $= \left(x + 10\right)\left(x - 5\right)\left(x - 2\right)$

$= \frac{x}{\left(x + 10\right)\left(x - 5\right)} \cdot \frac{x - 2}{x - 2} - \frac{1}{\left(x - 5\right)\left(x - 2\right)} \cdot \frac{x + 10}{x + 10} + \frac{1}{\left(x + 10\right)\left(x - 2\right)} \cdot \frac{x - 5}{x - 5}$

$= \frac{x^2 - 2x - x - 10 + x - 5}{\left(x + 10\right)\left(x - 5\right)\left(x - 2\right)}$

$= \frac{x^2 - 2x - 15}{\left(x + 10\right)\left(x - 5\right)\left(x - 2\right)}$

$= \frac{\cancel{\left(x - 5\right)}\left(x + 3\right)}{\left(x + 10\right)\cancel{\left(x - 5\right)}\left(x - 2\right)}$

$= \frac{x + 3}{\left(x + 10\right)\left(x - 2\right)}$

15. $\dfrac{1-\dfrac{49}{c^2}}{\dfrac{7}{c}+1}$ $\quad \text{LCD} = c^2$

$$= \frac{c^2\left(1-\frac{49}{c^2}\right)}{c^2\left(\frac{7}{c}+1\right)} = \frac{c^2(1)-\cancel{c^2}\left(\frac{49}{\cancel{c^2}}\right)}{c\cdot\cancel{c}\left(\frac{7}{\cancel{c}}\right)+c^2(1)} = \frac{c^2-49}{7c+c^2}$$

$$= \frac{\cancel{(c+7)}(c-7)}{c\cancel{(c+7)}} = \frac{c-7}{c}$$

16. $y^3-5y^2-y=-5$

$$y^3-5y^2-y+5=0$$
$$y^2(y-5)-1(y-5)=0$$
$$(y-5)(y^2-1)=0$$
$$(y-5)(y+1)(y-1)=0$$
$$y-5=0 \text{ or } y+1=0 \text{ or } y-1=0$$
$$y=5 \text{ or } y=-1 \text{ or } y=1 \quad \{5,-1,1\}$$

17. $\dfrac{4y}{y+2}-\dfrac{y}{y-1}=\dfrac{9}{y^2+y-2}$

$$\frac{4y}{y+2}-\frac{y}{y-1}=\frac{9}{(y+2)(y-1)} \quad \text{LCD}=(y+2)(y-1) \quad \text{so } y\neq -2 \text{ or } y\neq 1$$

$$(y+2)(y-1)\left(\frac{4y}{y+2}-\frac{y}{y-1}\right)=(y+2)(y-1)\left(\frac{9}{(y+2)(y-1)}\right)$$

$$\cancel{(y+2)}(y-1)\left(\frac{4y}{\cancel{y+2}}\right)-(y+2)\cancel{(y-1)}\left(\frac{y}{\cancel{y-1}}\right)=\cancel{(y+2)}\cancel{(y-1)}\left(\frac{9}{\cancel{(y+2)}\cancel{(y-1)}}\right)$$

$$4y^2-4y-y^2-2y=9$$
$$3y^2-6y-9=0$$
$$3(y^2-2y-3)=0$$
$$3(y-3)(y+1)=0$$
$$y-3=0 \text{ or } y+1=0$$
$$y=3 \text{ or } y=-1 \quad \{3,-1\}$$

18. Let $x =$ the actual distance

$$\frac{6.5}{195} = \frac{9.25}{x} \qquad \text{LCD} = 195x$$

$$195x\left(\frac{6.5}{195}\right) = 195x\left(\frac{9.25}{x}\right)$$

$$6.5x = 1803.75$$

$$x \approx 278 \text{ mi}$$

The actual distance is about 278 mi.

20. Let $I =$ the amount of interest

$r =$ the interest rate

$t =$ the time in years

$I = krt$

$$1120 = k(0.08)(2)$$

$$1120 = k(0.16)$$

$$k = 7000$$

$$I = 7000(0.10)(5) = \$3500$$

The investment will yield \$3500 in interest.

19. a. $x = -5$ is a vertical line. The slope is undefined.

b. $2y = 8$ is a horizontal line. The slope of the line is 0.