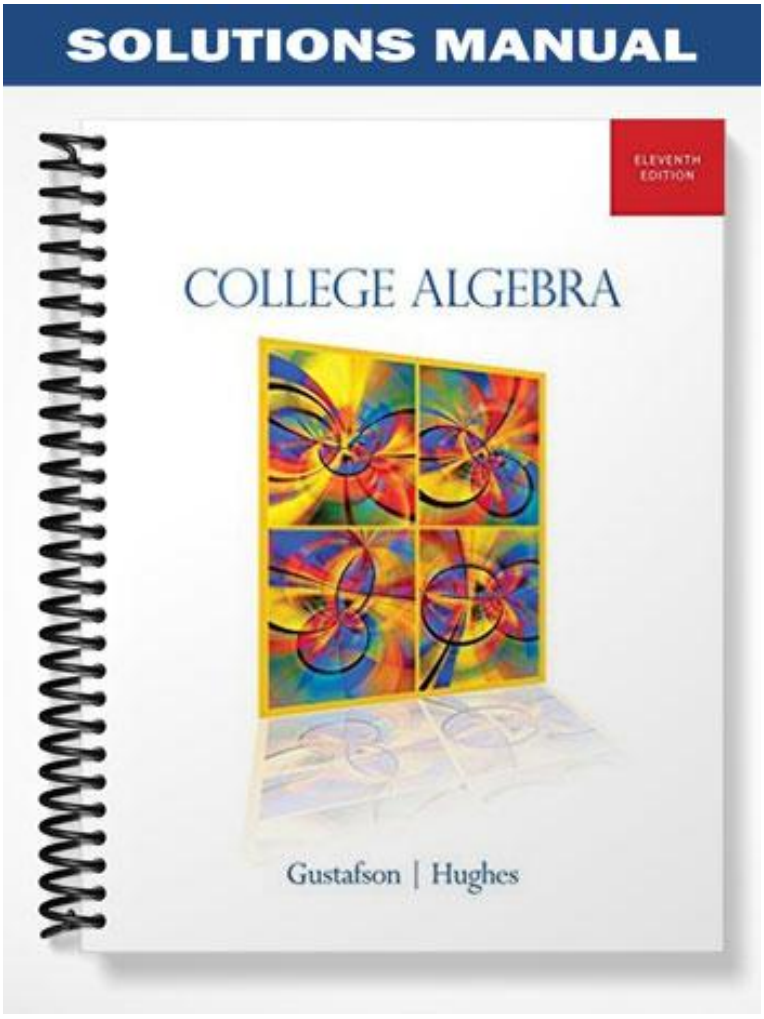
SOLUTIONS MANUAL



Preface

This manual contains detailed solutions to all of the exercises of the text *College Algebra*, eleventh edition, by R. David Gustafson and Jeff Hughes.

Many of the exercises in the text may be solved using more than one method, but it is not feasible to list all possible solutions in this manual. Also, some of the exercises may have been solved in this manual using a method that differs slightly from that presented in the text. There are a few exercises in the text whose solutions may vary from person to person. Some of these solutions may not have been included in this manual. For the solution to an exercise like this, the notation "answers may vary" has been included.

If you are a student using this manual, please remember that only reading a solution does not teach you how to solve a problem. To repeat a commonly used phrase, mathematics is not a spectator sport. You MUST make an honest attempt to solve each exercise in the text without using this manual first. This manual should be viewed more or less as a last resort. Above all, DO NOT simply copy the solution from this manual onto your own paper. Doing so will not help you learn how to do the exercise, nor will it help you to do better on quizzes or tests.

I would like to thank Paul McCombs from Rock Valley College and Cynthia Ashton of Brooks/Cole Publishing Company for their help and support. This solutions manual was prepared using EXP 5.1.

This book is dedicated to John, who helps me to realize that mathematics cannot describe everything in life.

May your study of this material be successful and rewarding.

Michael G. Welden

Contents

Exercises 0.1 (page 13)

1. set **2.** subset **3.** union **4.** intersection

5. decimal **6.** variable **7.** 2 **8.** even

9. composite **10.** rational **11.** decimals **12.** $\leq$

13. negative **14.** 0 **15.** $x + (y + z)$ **16.** yx

17. $5m + 5 \cdot 2$ **18.** commutative, multiplication **19.** interval **20.** no

21. two **22.** half-open **23.** positive **24.** distance

25. Every natural number is a whole number, so **N** $\subset$ **W**. **TRUE**

26. Every rational number is a real number, so **Q** $\subset$ **R**. **TRUE**

27. The rational number $\frac{1}{2}$ is **not** a natural number, so **Q** $\not\subset$ **N**. **FALSE**

28. Every integer is a rational number, so **Z** $\subset$ **Q**. **TRUE**

29. Every whole number is an integer, so **W** $\subset$ **Z**. **TRUE**

30. The real number $\sqrt{2}$ is **not** an integer, so **R** $\not\subset$ **Z**. **FALSE**

31. $A \cup B = \{\text{a, b, c, d, e, f, g}\}$

32. $A \cap B = \{\text{d, e}\}$

33. $A \cap C = \{\text{a, c, e}\}$

34. $B \cup C = \{\text{a, c, d, e, f, g}\}$

35. $\frac{9}{16} = 0.5625$; terminates

36. $\frac{3}{8} = 0.375$; terminates

37. $\frac{3}{11} = 0.272727...$; repeats

38. $\frac{5}{12} = 0.416666...$; repeats

39. natural: 1, 2, 6, 7

40. whole: 0, 1, 2, 6, 7

41. integers: $-5, -4$, 0, 1, 2, 6, 7

42. rational: $-5, -4, -\frac{2}{3}$, 0, 1, 2, 2.75, 6, 7

43. irrational: $\sqrt{2}$

44. prime: 2, 7

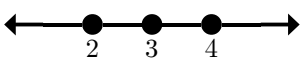
45. composite: 6

46. even: -4, 0, 2, 6

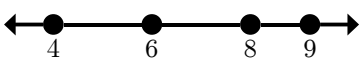
47. odd: -5, 1, 7

48. negative: $-5, -4, -\frac{2}{3}$

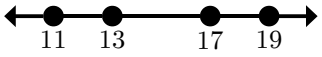
49.

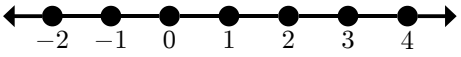


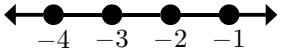
50.

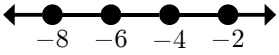


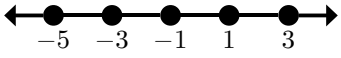
SECTION 0.1

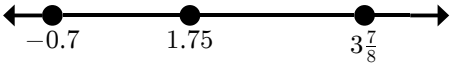
51. 

52. 

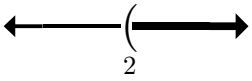
53. 

54. 

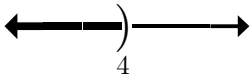
55. 

56. 

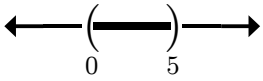
57. $x > 2 \rightarrow (2, \infty)$



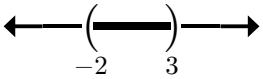
58. $x < 4 \rightarrow (-\infty, 4)$



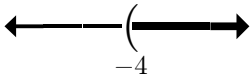
59. $0 < x < 5 \rightarrow (0, 5)$



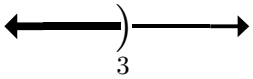
60. $-2 < x < 3 \rightarrow (-2, 3)$



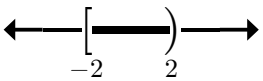
61. $x > -4 \rightarrow (-4, \infty)$



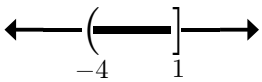
62. $x < 3 \rightarrow (-\infty, 3)$



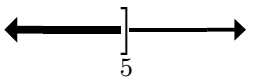
63. $-2 \leq x < 2 \rightarrow [-2, 2)$



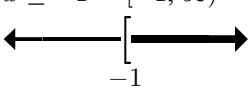
64. $-4 < x \leq 1 \rightarrow (-4, 1]$



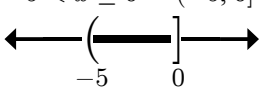
65. $x \leq 5 \rightarrow (-\infty, 5]$



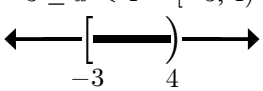
66. $x \geq -1 \rightarrow [-1, \infty)$



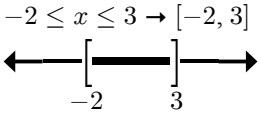
67. $-5 < x \leq 0 \rightarrow (-5, 0]$



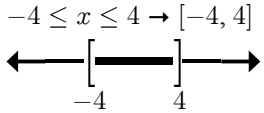
68. $-3 \leq x < 4 \rightarrow [-3, 4)$



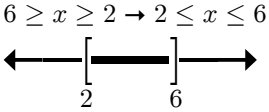
69. $-2 \leq x \leq 3 \rightarrow [-2, 3]$



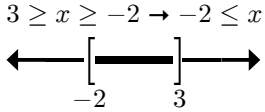
70. $-4 \leq x \leq 4 \rightarrow [-4, 4]$



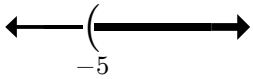
71. $6 \geq x \geq 2 \rightarrow 2 \leq x \leq 6 \rightarrow [2, 6]$

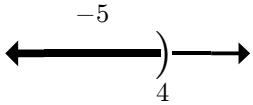


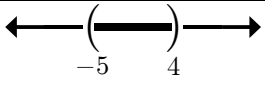
72. $3 \geq x \geq -2 \rightarrow -2 \leq x \leq 3 \rightarrow [-2, 3]$



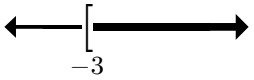
73. $x > -5$ and $x < 4 \rightarrow (-5, \infty) \cap (-\infty, 4)$

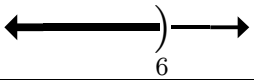
$(-5, \infty)$ 

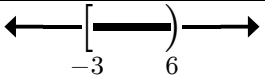
$(-\infty, 4)$ 

$(-5, \infty) \cap (-\infty, 4)$ 

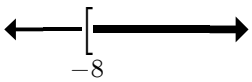
74. $x \geq -3$ and $x < 6 \rightarrow [-3, \infty) \cap (-\infty, 6)$

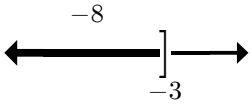
$[-3, \infty)$ 

$(-\infty, 6)$ 

$[-3, \infty) \cap (-\infty, 6)$ 

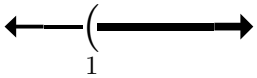
75. $x \geq -8$ and $x \leq -3 \rightarrow [-8, \infty) \cap (-\infty, -3]$

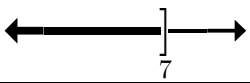
$[-8, \infty)$ 

$(-\infty, -3]$ 

$[-8, \infty) \cap (-\infty, -3]$ 

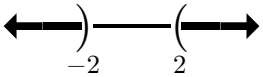
76. $x > 1$ and $x \leq 7 \rightarrow (1, \infty) \cap (-\infty, 7]$

$(1, \infty)$ 

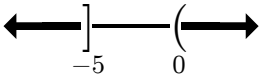
$(-\infty, 7]$ 

$(1, \infty) \cap (-\infty, 7]$ 

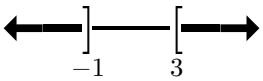
77. $x < -2$ or $x > 2 \rightarrow (-\infty, -2) \cup (2, \infty)$



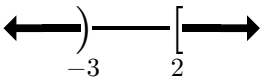
78. $x \leq -5$ or $x > 0 \rightarrow (-\infty, -5] \cup (0, \infty)$



79. $x \leq -1$ or $x \geq 3 \rightarrow (-\infty, -1] \cup [3, \infty)$



80. $x < -3$ or $x \geq 2 \rightarrow (-\infty, -3) \cup [2, \infty)$



81. Since $13 \geq 0$, $|13| = 13$.

82. Since $-17 < 0$, $|-17| = -(-17) = 17$.

83. Since $0 \geq 0$, $|0| = 0$.

84. Since $63 \geq 0$, $|63| = 63$.
$-|63| = -(63) = -63$

85. Since $-8 < 0$, $|-8| = -(-8) = 8$.
$-|-8| = -(8) = -8$

86. Since $-25 < 0$, $|-25| = -(-25) = 25$.

87. Since $32 \geq 0$, $|32| = 32$.
$-|32| = -(32) = -32$

88. Since $-6 < 0$, $|-6| = -(-6) = 6$.
$-|-6| = -(6) = -6$

89. Since $\pi - 5 < 0$,
$|\pi - 5| = -(\pi - 5) = -\pi + 5 = 5 - \pi$.

90. Since $8 - \pi \geq 0$, $|8 - \pi| = 8 - \pi$.

91. $|\pi - \pi| = |0| = 0$

92. Since $2\pi \geq 0$, $|2\pi| = 2\pi$.

93. If $x \geq 2$, then $x + 1 \geq 0$. Then
$|x + 1| = x + 1$.

94. If $x \leq -2$, then $x + 1 < 0$. Then
$|x + 1| = -(x + 1)$.

95. If $x < 0$, then $x - 4 < 0$. Then
$|x - 4| = -(x - 4)$.

96. If $x > 10$, then $x - 7 \geq 0$. Then
$|x - 7| = x - 7$.

97. distance $= |8 - 3| = |5| = 5$

98. distance $= |12 - (-5)| = |17| = 17$

99. distance $= |-3 - (-8)| = |5| = 5$

100. distance $= |-20 - 6| = |-26| = 26$

101. Since population must be positive and never has a fractional part, the set of **natural numbers** should be used.

102. Since the subdivisions on a ruler are measured in fractions of an inch, the set of **rational numbers** should be used.

103. Since temperatures are usually reported without fractional parts and may be either positive or negative (or zero), the set of **integers** should be used.

104. Since the financial condition of a business is usually described in terms of dollars and cents (fractional parts of a dollar), the set of **rational numbers** should be used.

105. $-x$ will represent a positive number if x itself is negative. For instance, if $x = -3$, then $-x = -(-3) = 3$, which is a positive number.

106. Every integer is a rational number because every integer is equal to itself over 1.

107. The statement is always true.

108. The statement is always true.

109. The statement is not always true. (For example, let $a = 5$ and $b = -2$.)

110. The statement will be true if $a \geq 0$ and $b \geq 0$, or if $a \leq 0$ and $b \leq 0$.

111. The statement $a < b > c$ could be interpreted to mean that $a > c$, when this is not necessarily true.

112. $|b - a| = |-1(a - b)| = |-1| \cdot |a - b|$
$= |a - b|$

Exercises 0.2 (page 24)

1. factor **2.** natural **3.** 3, $2x$ **4.** exponential

SECTION 0.2

5. scientific, integer **6.** **Answers may vary.** **7.** $x^m x^n = x^{m+n}$ **8.** $(x^m)^n = x^{mn}$

9. $(xy)^n = x^n y^n$ **10.** $\dfrac{x^m}{x^n} = x^{m-n}$ **11.** $x^0 = 1$ **12.** $x^{-n} = \dfrac{1}{x^n}$

13. $13^2 = 13 \cdot 13 = 169$

14. $10^3 = 10 \cdot 10 \cdot 10 = 1{,}000$

15. $-5^2 = -1 \cdot 5 \cdot 5 = -25$

16. $(-5)^2 = (-5)(-5) = 25$

17. $4x^3 = 4 \cdot x \cdot x \cdot x$

18. $(4x)^3 = (4x)(4x)(4x)$

19. $(-5x)^4 = (-5x)(-5x)(-5x)(-5x)$

20. $-6x^2 = -6 \cdot x \cdot x$

21. $-8x^4 = -8 \cdot x \cdot x \cdot x \cdot x$

22. $(-8x)^4 = (-8x)(-8x)(-8x)(-8x)$

23. $7xxx = 7x^3$

24. $-8yyyy = -8y^4$

25. $(-x)(-x) = (-1)(-1)x^2 = x^2$

26. $(2a)(2a)(2a) = 2 \cdot 2 \cdot 2 \cdot a^3 = 8a^3$

27. $(3t)(3t)(-3t) = (3)(3)(-3)t^3 = -27t^3$

28. $-(2b)(2b)(2b)(2b) = -1 \cdot 2 \cdot 2 \cdot 2 \cdot 2 \cdot b^4 = -16b^4$

29. $xxxyy = x^3y^2$

30. $aaabbbb = a^3b^4$

31. $2.2^3 = 10.648$

32. $7.1^4 = 2541.1681$

33. $-0.5^4 = -0.0625$

34. $(-0.2)^4 = 0.0016$

35. $x^2x^3 = x^{2+3} = x^5$

36. $y^3y^4 = y^{3+4} = y^7$

37. $(z^2)^3 = z^{2 \cdot 3} = z^6$

38. $(t^6)^7 = t^{6 \cdot 7} = t^{42}$

39. $(y^5y^2)^3 = (y^7)^3 = y^{21}$

40. $(a^3a^6)a^4 = a^9a^4 = a^{13}$

41. $(z^2)^3(z^4)^5 = z^6z^{20} = z^{26}$

42. $(t^3)^4(t^5)^2 = t^{12}t^{10} = t^{22}$

43. $(a^2)^3(a^4)^2 = a^6a^8 = a^{14}$

44. $(a^2)^4(a^3)^3 = a^8a^9 = a^{17}$

45. $(3x)^3 = 3^3x^3 = 27x^3$

46. $(-2y)^4 = (-2)^4y^4 = 16y^4$

47. $(x^2y)^3 = (x^2)^3y^3 = x^6y^3$

48. $(x^3z^4)^6 = (x^3)^6(z^4)^6 = x^{18}z^{24}$

49. $\left(\dfrac{a^2}{b}\right)^3 = \dfrac{(a^2)^3}{b^3} = \dfrac{a^6}{b^3}$

50. $\left(\dfrac{x}{y^3}\right)^4 = \dfrac{x^4}{(y^3)^4} = \dfrac{x^4}{y^{12}}$

51. $(-x)^0 = 1$

52. $4x^0 = 4 \cdot 1 = 4$

53. $(4x)^0 = 1$

SECTION 0.2

54. $-2x^0 = -2 \cdot 1 = -2$

55. $z^{-4} = \dfrac{1}{z^4}$

56. $\dfrac{1}{t^{-2}} = t^2$

57. $y^{-2}y^{-3} = y^{-5} = \dfrac{1}{y^5}$

58. $-m^{-2}m^3 = -m^1 = -m$

59. $(x^3x^{-4})^{-2} = (x^{-1})^{-2} = x^2$

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

61. $\dfrac{x^7}{x^3} = x^{7-3} = x^4$

62. $\dfrac{r^5}{r^2} = r^{5-2} = r^3$

63. $\dfrac{a^{21}}{a^{17}} = a^{21-17} = a^4$

64. $\dfrac{t^{13}}{t^4} = t^{13-4} = t^9$

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

66. $\dfrac{s^9s^3}{(s^2)^2} = \dfrac{s^{12}}{s^4} = s^{12-4} = s^8$

67. $\left(\dfrac{m^3}{n^2}\right)^3 = \dfrac{(m^3)^3}{(n^2)^3} = \dfrac{m^9}{n^6}$

68. $\left(\dfrac{t^4}{t^3}\right)^3 = \left(t^{4-3}\right)^3 = \left(t^1\right)^3 = t^3$

69. $\dfrac{(a^3)^{-2}}{aa^2} = \dfrac{a^{-6}}{a^3} = a^{-6-3} = a^{-9} = \dfrac{1}{a^9}$

70. $\dfrac{r^9r^{-3}}{(r^{-2})^3} = \dfrac{r^6}{r^{-6}} = r^{6-(-6)} = r^{12}$

71. $\left(\dfrac{a^{-3}}{b^{-1}}\right)^{-4} = \dfrac{(a^{-3})^{-4}}{(b^{-1})^{-4}} = \dfrac{a^{12}}{b^4}$

72. $\left(\dfrac{t^{-4}}{t^{-3}}\right)^{-2} = \dfrac{(t^{-4})^{-2}}{(t^{-3})^{-2}} = \dfrac{t^8}{t^6} = t^2$

73. $\left(\dfrac{r^4r^{-6}}{r^3r^{-3}}\right)^2 = \left(\dfrac{r^{-2}}{r^0}\right)^2 = \left(r^{-2}\right)^2 = r^{-4} = \dfrac{1}{r^4}$

74. $\dfrac{(x^{-3}x^2)^2}{(x^2x^{-5})^{-3}} = \dfrac{(x^{-1})^2}{(x^{-3})^{-3}} = \dfrac{x^{-2}}{x^9} = x^{-11} = \dfrac{1}{x^{11}}$

75. $\left(\dfrac{x^5y^{-2}}{x^{-3}y^2}\right)^4 = \left(\dfrac{x^5x^3}{y^2y^2}\right)^4 = \left(\dfrac{x^8}{y^4}\right)^4 = \dfrac{x^{32}}{y^{16}}$

76. $\left(\dfrac{x^{-7}y^5}{x^7y^{-4}}\right)^3 = \left(\dfrac{y^5y^4}{x^7x^7}\right)^3 = \left(\dfrac{y^9}{x^{14}}\right)^3 = \dfrac{y^{27}}{x^{42}}$

77. $\left(\dfrac{5x^{-3}y^{-2}}{3x^2y^{-3}}\right)^{-2} = \left(\dfrac{3x^2y^{-3}}{5x^{-3}y^{-2}}\right)^2 = \left(\dfrac{3x^2x^3y^2}{5y^3}\right)^2 = \left(\dfrac{3x^5}{5y}\right)^2 = \dfrac{9x^{10}}{25y^2}$

78. $\left(\dfrac{3x^2y^{-5}}{2x^{-2}y^{-6}}\right)^{-3} = \left(\dfrac{2x^{-2}y^{-6}}{3x^2y^{-5}}\right)^3 = \left(\dfrac{2y^5}{3x^2x^2y^6}\right)^3 = \left(\dfrac{2}{3x^4y}\right)^3 = \dfrac{8}{27x^{12}y^3}$

79. $\left(\dfrac{3x^5y^{-3}}{6x^{-5}y^3}\right)^{-2} = \left(\dfrac{6x^{-5}y^3}{3x^5y^{-3}}\right)^2 = \left(\dfrac{2y^3y^3}{1x^5x^5}\right)^2 = \left(\dfrac{2y^6}{x^{10}}\right)^2 = \dfrac{4y^{12}}{x^{20}}$

SECTION 0.2

80. $\left(\dfrac{12x^{-4}y^3z^{-5}}{4x^4y^{-3}z^5}\right)^3 = \left(\dfrac{3y^3y^3}{1x^4x^4z^5z^5}\right)^3 = \left(\dfrac{3y^6}{x^8z^{10}}\right)^3 = \dfrac{27y^{18}}{x^{24}z^{30}}$

81. $\dfrac{(8^{-2}z^{-3}y)^{-1}}{(5y^2z^{-2})^3(5yz^{-2})^{-1}} = \dfrac{8^2z^3y^{-1}}{5^3y^6z^{-6}\cdot 5^{-1}y^{-1}z^2} = \dfrac{64z^3y^{-1}}{5^2y^5z^{-4}} = \dfrac{64z^3z^4}{25y^5y^1} = \dfrac{64z^7}{25y^6}$

82. $\dfrac{(m^{-2}n^3p^4)^{-2}(mn^{-2}p^3)^4}{(mn^{-2}p^3)^{-4}(mn^2p)^{-1}} = \dfrac{m^4n^{-6}p^{-8}\cdot m^4n^{-8}p^{12}}{m^{-4}n^8p^{-12}\cdot m^{-1}n^{-2}p^{-1}} = \dfrac{m^8n^{-14}p^4}{m^{-5}n^6p^{-13}} = \dfrac{m^8m^5p^4p^{13}}{n^6n^{14}} = \dfrac{m^{13}p^{17}}{n^{20}}$

83. $-\dfrac{5[6^2+(9-5)]}{4(2-3)^2} = -\dfrac{5[36+4]}{4(-1)^2} = -\dfrac{5[40]}{4(1)} = -\dfrac{200}{4} = -50$

84. $\dfrac{6\left[3-(4-7)^2\right]}{-5(2-4^2)} = \dfrac{6\left[3-(-3)^2\right]}{-5(2-16)} = \dfrac{6[3-9]}{-5(-14)} = \dfrac{6[-6]}{70} = \dfrac{-36}{70} = -\dfrac{18}{35}$

85. $x^2 = (-2)^2 = 4$

86. $-x^2 = -(-2)^2 = -1\cdot 4 = -4$

87. $x^3 = (-2)^3 = -8$

88. $-x^3 = -(-2)^3 = -1\cdot(-8) = 8$

89. $(-xz)^3 = [-1\cdot(-2)\cdot 3]^3 = 6^3 = 216$

90. $-xz^3 = -1\cdot(-2)\cdot 3^3 = 2\cdot 27 = 54$

91. $\dfrac{-(x^2z^3)}{z^2-y^2} = \dfrac{-\left[(-2)^2\cdot 3^3\right]}{3^2-0^2} = \dfrac{-[4\cdot 27]}{9-0} = \dfrac{-108}{9} = -12$

92. $\dfrac{z^2(x^2-y^2)}{x^3z} = \dfrac{3^2\left[(-2)^2-0^2\right]}{(-2)^3(3)} = \dfrac{9(4-0)}{(-8)(3)} = \dfrac{9(4)}{-24} = \dfrac{36}{-24} = -\dfrac{3}{2}$

93. $5x^2-3y^3z = 5(-2)^2-3(0)^3(3) = 5(4)-3(0)(3) = 20-0 = 20$

94. $3(x-z)^2+2(y-z)^3 = 3(-2-3)^2+2(0-3)^3 = 3(-5)^2+2(-3)^3 = 3(25)+2(-27)$
$= 75+(-54) = 21$

95. $\dfrac{-3x^{-3}z^{-2}}{6x^2z^{-3}} = \dfrac{-1z^3}{2x^2x^3z^2} = \dfrac{-z}{2x^5} = \dfrac{-3}{2(-2)^5} = \dfrac{-3}{2(-32)} = \dfrac{-3}{-64} = \dfrac{3}{64}$

96. $\dfrac{(-5x^2z^{-3})^2}{5xz^{-2}} = \dfrac{25x^4z^{-6}}{5xz^{-2}} = \dfrac{5x^4}{xz^{-2}z^6} = \dfrac{5x^3}{z^4} = \dfrac{5(-2)^3}{3^4} = \dfrac{5(-8)}{81} = \dfrac{-40}{81} = -\dfrac{40}{81}$

97. $372{,}000 = 3.72\times 10^5$

98. $89{,}500 = 8.95\times 10^4$

99. $-177{,}000{,}000 = -1.77\times 10^8$

100. $-23{,}470{,}000{,}000 = -2.347\times 10^{10}$

101. $0.007 = 7\times 10^{-3}$

102. $0.00052 = 5.2\times 10^{-4}$

SECTION 0.2

103. $-0.000000693 = -6.93 \times 10^{-7}$

104. $-0.000000089 = -8.9 \times 10^{-8}$

105. $1{,}000{,}000{,}000{,}000 = 1 \times 10^{12}$

106. $0.000001 = 1 \times 10^{-6}$

107. $9.37 \times 10^{5} = 937{,}000$

108. $4.26 \times 10^{9} = 4{,}260{,}000{,}000$

109. $2.21 \times 10^{-5} = 0.0000221$

110. $2.774 \times 10^{-2} = 0.02774$

111. $0.00032 \times 10^{4} = 3.2$

112. $9{,}300.0 \times 10^{-4} = 0.93$

113. $-3.2 \times 10^{-3} = -0.0032$

114. $-7.25 \times 10^{3} = -7{,}250$

115. $$\frac{(65{,}000)(45{,}000)}{250{,}000} = \frac{(6.5 \times 10^{4})(4.5 \times 10^{4})}{2.5 \times 10^{5}} = \frac{(6.5)(4.5)}{2.5} \times 10^{4+4-5} = 11.7 \times 10^{3}$$
$$= 1.17 \times 10^{1} \times 10^{3}$$
$$= 1.17 \times 10^{4}$$

116. $$\frac{(0.000000045)(0.00000012)}{45{,}000{,}000} = \frac{(4.5 \times 10^{-8})(1.2 \times 10^{-7})}{4.5 \times 10^{7}} = \frac{(4.5)(1.2)}{4.5} \times 10^{(-8)+(-7)-7}$$
$$= 1.2 \times 10^{-22}$$

117. $$\frac{(0.00000035)(170{,}000)}{0.00000085} = \frac{(3.5 \times 10^{-7})(1.7 \times 10^{5})}{8.5 \times 10^{-7}} = \frac{(3.5)(1.7)}{8.5} \times 10^{(-7)+5-(-7)}$$
$$= 0.7 \times 10^{5}$$
$$= 7 \times 10^{-1} \times 10^{5} = 7 \times 10^{4}$$

118. $$\frac{(0.0000000144)(12{,}000)}{600{,}000} = \frac{(1.44 \times 10^{-8})(1.2 \times 10^{4})}{6 \times 10^{5}} = \frac{(1.44)(1.2)}{6} \times 10^{(-8)+4-5}$$
$$= 0.288 \times 10^{-9}$$
$$= 2.88 \times 10^{-1} \times 10^{-9} = 2.88 \times 10^{-10}$$

119. $$\frac{(45{,}000{,}000{,}000)(212{,}000)}{0.00018} = \frac{(4.5 \times 10^{10})(2.12 \times 10^{5})}{1.8 \times 10^{-4}} = \frac{(4.5)(2.12)}{1.8} \times 10^{10+5-(-4)}$$
$$= 5.3 \times 10^{19}$$

120. $$\frac{(0.00000000275)(4{,}750)}{500{,}000{,}000{,}000} = \frac{(2.75 \times 10^{-9})(4.75 \times 10^{3})}{5 \times 10^{11}} = \frac{(2.75)(4.75)}{5} \times 10^{(-9)+3-11}$$
$$= 2.6125 \times 10^{-17}$$

121. $$3.31 \times 10^{4} \text{ cm/sec} = \frac{3.31 \times 10^{4} \text{ cm}}{1 \text{ sec}} \cdot \frac{1 \text{ m}}{100 \text{ cm}} \cdot \frac{60 \text{ sec}}{1 \text{ min}} = \frac{(3.31 \times 10^{4})(6 \times 10^{1})}{1 \times 10^{2}} \text{ m/min}$$
$$= \frac{(3.31)(6)}{1} \times 10^{4+1-2} \text{ m/min}$$
$$= 19.86 \times 10^{3} \text{ m/min}$$
$$= 1.986 \times 10^{4} \text{ m/min}$$

SECTION 0.2

122. $V = lwh = (6{,}000 \text{ mm})(9{,}700 \text{ mm})(4{,}700 \text{ mm}) = \left(6 \times 10^3\right)\left(9.7 \times 10^3\right)\left(4.7 \times 10^3\right) \text{ mm}^3$
$= (6)(9.7)(4.7) \times 10^{3+3+3} \text{ mm}^3$
$= 273.54 \times 10^9 \text{ mm}^3$
$= 2.7354 \times 10^{11} \text{ mm}^3$

123. mass $= 1{,}000{,}000{,}000(0.000000000000000000000000167248 \text{ g})$
$= \left(1 \times 10^9\right)\left(1.67248 \times 10^{-24} \text{ g}\right) = 1.67248 \times 10^{-15} \text{ g}$

124. $30{,}000{,}000{,}000 \text{ cm/sec} = \dfrac{30{,}000{,}000{,}000 \text{ cm}}{1 \text{ sec}} \cdot \dfrac{1 \text{ mile}}{160{,}934.4 \text{ cm}} \cdot \dfrac{60 \text{ sec}}{1 \text{ min}} \cdot \dfrac{60 \text{ min}}{1 \text{ hr}}$
$= \dfrac{(3 \times 10^{10})(6 \times 10^1)(6 \times 10^1)}{1.609344 \times 10^5} \text{ mile/hr}$
$= \dfrac{(3)(6)(6)}{1.609344} \times 10^{10+1+1-5} \text{ mile/hr}$
$\approx 67.11 \times 10^7 \text{ mile/hr} = 6.711 \times 10^8 \text{ mile/hr}$

125.

Earth: $n = 3$	Mars: $n = 4$
$d = 9{,}275{,}200\left[3\left(2^{n-2}\right) + 4\right]$	$d = 9{,}275{,}200\left[3\left(2^{n-2}\right) + 4\right]$
$= 9{,}275{,}200\left[3\left(2^{3-2}\right) + 4\right]$	$= 9{,}275{,}200\left[3\left(2^{4-2}\right) + 4\right]$
$= 9{,}275{,}200\left[3\left(2^1\right) + 4\right]$	$= 9{,}275{,}200\left[3\left(2^2\right) + 4\right]$
$= 9{,}275{,}200[10]$	$= 9{,}275{,}200[16]$
$= 92{,}752{,}000 \approx 93{,}000{,}000$	$= 148{,}403{,}200 \approx 148{,}000{,}000$
9.3×10^7 mi	1.48×10^8 mi

126. $10 \cdot 10 \cdot 10 \cdot 26 \cdot 26 \cdot 26 = 10^3 \cdot 26^3$; $10^3 \cdot 26^3 = 17{,}576{,}000 = 1.7576 \times 10^7$

127. polar radius $= 6.3567505 \times 10^3$ km
equatorial radius $= 6.378135 \times 10^3$ km

128. polar radius $= 3.941185 \times 10^3$ mi
equatorial radius $= 3.9544437 \times 10^3$ mi

129. $x^n x^2 = x^{n+2}$

130. $\dfrac{x^m}{x^3} = x^{m-3}$

131. $\dfrac{x^m x^2}{x^3} = \dfrac{x^{m+2}}{x^3} = x^{m+2-3} = x^{m-1}$

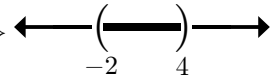
132. $\dfrac{x^{3m+5}}{x^2} = x^{3m+5-2} = x^{3m+3}$

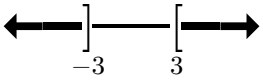
133. $x^{m+1}x^3 = x^{m+1+3} = x^{m+4}$

134. $a^{n-3}a^3 = a^{n-3+3} = a^n$

135. In the expression $-x^4$, the base of the exponent is x, while in the expression $(-x)^4$, the base of the exponent is $-x$.

136. 32×10^2 is not in scientific notation because 32 is not a number between 1 and 10.

137. $(-2, 4) \Rightarrow$ 

138. $(-\infty, -3] \cup [3, \infty) \Rightarrow$ 

139. Since $\pi - 5 < 0$,
$|\pi - 5| = -(\pi - 5) = -\pi + 5 = 5 - \pi$.

140. distance $= |-5 - (-7)| = |2| = 2$

Exercises 0.3 (page 38)

1. 0

2. positive

3. not

4. $(6^2)^{1/3}$, $\left(6^{1/3}\right)^2$

5. $a^{1/n}$

6. $|a|$

7. $\sqrt[n]{ab}$

8. $\dfrac{\sqrt[n]{a}}{\sqrt[n]{b}}$

9. $\neq$

10. $\sqrt[mn]{x}$

11. $9^{1/2} = (3^2)^{1/2} = 3$

12. $8^{1/3} = (2^3)^{1/3} = 2$

13. $\left(\dfrac{1}{25}\right)^{1/2} = \left[\left(\dfrac{1}{5}\right)^2\right]^{1/2} = \dfrac{1}{5}$

14. $\left(\dfrac{16}{625}\right)^{1/4} = \left[\left(\dfrac{2}{5}\right)^4\right]^{1/4} = \dfrac{2}{5}$

15. $-81^{1/4} = -(3^4)^{1/4} = -3$

16. $-\left(\dfrac{8}{27}\right)^{1/3} = -\left[\left(\dfrac{2}{3}\right)^3\right]^{1/3} = -\dfrac{2}{3}$

17. $(10{,}000)^{1/4} = (10^4)^{1/4} = 10$

18. $(1{,}024)^{1/5} = (4^5)^{1/5} = 4$

19. $\left(-\dfrac{27}{8}\right)^{1/3} = \left[\left(-\dfrac{3}{2}\right)^3\right]^{1/3} = -\dfrac{3}{2}$

20. $-64^{1/3} = -\left(4^3\right)^{1/3} = -4$

21. $(-64)^{1/2} \Rightarrow$ not a real number

22. $(-125)^{1/3} = \left[(-5)^3\right]^{1/3} = -5$

23. $(16a^2)^{1/2} = \left[(4a)^2\right]^{1/2} = 4|a|$

24. $(25a^4)^{1/2} = \left[(5a^2)^2\right]^{1/2} = 5|a^2| = 5a^2$

25. $(16a^4)^{1/4} = \left[(2a)^4\right]^{1/4} = 2|a|$

26. $(-64a^3)^{1/3} = \left[(-4a)^3\right]^{1/3} = -4a$

27. $(-32a^5)^{1/5} = \left[(-2a)^5\right]^{1/5} = -2a$

28. $(64a^6)^{1/6} = \left[(2a)^6\right]^{1/6} = 2|a|$

29. $(-216b^6)^{1/3} = \left[(-6b^2)^3\right]^{1/3} = -6b^2$

30. $(256t^8)^{1/4} = \left[(4t^2)^4\right]^{1/4} = 4|t^2| = 4t^2$

SECTION 0.3

31. $\left(\dfrac{16a^4}{25b^2}\right)^{1/2} = \left[\left(\dfrac{4a^2}{5b}\right)^2\right]^{1/2} = \left|\dfrac{4a^2}{5b}\right| = \dfrac{4a^2}{5|b|}$

32. $\left(-\dfrac{a^5}{32b^{10}}\right)^{1/5} = \left[\left(-\dfrac{a}{2b^2}\right)^5\right]^{1/5} = -\dfrac{a}{2b^2}$

33. $\left(-\dfrac{1{,}000x^6}{27y^3}\right)^{1/3} = \left[\left(-\dfrac{10x^2}{3y}\right)^3\right]^{1/3} = -\dfrac{10x^2}{3y}$

34. $\left(\dfrac{49t^2}{100z^4}\right)^{1/2} = \left[\left(\dfrac{7t}{10z^2}\right)^2\right]^{1/2} = \left|\dfrac{7t}{10z^2}\right| = \dfrac{7|t|}{10z^2}$

35. $4^{3/2} = \left(4^{1/2}\right)^3 = 2^3 = 8$

36. $8^{2/3} = \left(8^{1/3}\right)^2 = 2^2 = 4$

37. $-16^{3/2} = -\left(16^{1/2}\right)^3 = -(4)^3 = -64$

38. $(-8)^{2/3} = \left[(-8)^{1/3}\right]^2 = (-2)^2 = 4$

39. $-1{,}000^{2/3} = -\left(1{,}000^{1/3}\right)^2 = -(10)^2 = -100$

40. $100^{3/2} = \left(100^{1/2}\right)^3 = 10^3 = 1{,}000$

41. $64^{-1/2} = \dfrac{1}{64^{1/2}} = \dfrac{1}{8}$

42. $25^{-1/2} = \dfrac{1}{25^{1/2}} = \dfrac{1}{5}$

43. $64^{-3/2} = \dfrac{1}{64^{3/2}} = \dfrac{1}{\left(64^{1/2}\right)^3} = \dfrac{1}{8^3} = \dfrac{1}{512}$

44. $49^{-3/2} = \dfrac{1}{49^{3/2}} = \dfrac{1}{\left(49^{1/2}\right)^3} = \dfrac{1}{7^3} = \dfrac{1}{343}$

45. $-9^{-3/2} = -\dfrac{1}{9^{3/2}} = -\dfrac{1}{\left(9^{1/2}\right)^3} = -\dfrac{1}{3^3} = -\dfrac{1}{27}$

46. $(-27)^{-2/3} = \dfrac{1}{(-27)^{2/3}} = \dfrac{1}{\left[(-27)^{1/3}\right]^2} = \dfrac{1}{(-3)^2} = \dfrac{1}{9}$

47. $\left(\dfrac{4}{9}\right)^{5/2} = \left[\left(\dfrac{4}{9}\right)^{1/2}\right]^5 = \left(\dfrac{2}{3}\right)^5 = \dfrac{32}{243}$

48. $\left(\dfrac{25}{81}\right)^{3/2} = \left[\left(\dfrac{25}{81}\right)^{1/2}\right]^3 = \left(\dfrac{5}{9}\right)^3 = \dfrac{125}{729}$

49. $\left(-\dfrac{27}{64}\right)^{-2/3} = \left(-\dfrac{64}{27}\right)^{2/3} = \left[\left(-\dfrac{64}{27}\right)^{1/3}\right]^2 = \left(-\dfrac{4}{3}\right)^2 = \dfrac{16}{9}$

50. $\left(\dfrac{125}{8}\right)^{-4/3} = \left(\dfrac{8}{125}\right)^{4/3} = \left[\left(\dfrac{8}{125}\right)^{1/3}\right]^4 = \left(\dfrac{2}{5}\right)^4 = \dfrac{16}{625}$

51. $(100s^4)^{1/2} = 100^{1/2}(s^4)^{1/2} = 10s^2$

52. $(64u^6v^3)^{1/3} = 64^{1/3}(u^6)^{1/3}(v^3)^{1/3} = 4u^2v$

SECTION 0.3

53. $(32y^{10}z^5)^{-1/5} = \dfrac{1}{(32y^{10}z^5)^{1/5}} = \dfrac{1}{32^{1/5}(y^{10})^{1/5}(z^5)^{1/5}} = \dfrac{1}{2y^2z}$

54. $(625a^4b^8)^{-1/4} = \dfrac{1}{(625a^4b^8)^{1/4}} = \dfrac{1}{625^{1/4}(a^4)^{1/4}(b^8)^{1/4}} = \dfrac{1}{5ab^2}$

55. $(x^{10}y^5)^{3/5} = x^{30/5}y^{15/5} = x^6y^3$

56. $(64a^6b^{12})^{5/6} = 64^{5/6}a^{30/6}b^{60/6} = \left(64^{1/6}\right)^5 a^5b^{10} = 2^5a^5b^{10} = 32a^5b^{10}$

57. $\left(r^8s^{16}\right)^{-3/4} = r^{-24/4}s^{-48/4} = r^{-6}s^{-12} = \dfrac{1}{r^6s^{12}}$

58. $\left(-8x^9y^{12}\right)^{-2/3} = (-8)^{-2/3}x^{-18/3}y^{-24/3} = \dfrac{1}{(-8)^{2/3}}x^{-6}y^{-8} = \dfrac{1}{(-2)^2x^6y^8} = \dfrac{1}{4x^6y^8}$

59. $\left(-\dfrac{8a^6}{125b^9}\right)^{2/3} = \dfrac{(-8)^{2/3}a^{12/3}}{125^{2/3}b^{18/3}} = \dfrac{(-2)^2a^4}{5^2b^6} = \dfrac{4a^4}{25b^6}$

60. $\left(\dfrac{16x^4}{625y^8}\right)^{3/4} = \dfrac{16^{3/4}x^{12/4}}{625^{3/4}y^{24/4}} = \dfrac{2^3x^3}{5^3y^6} = \dfrac{8x^3}{125y^6}$

61. $\left(\dfrac{27r^6}{1{,}000s^{12}}\right)^{-2/3} = \left(\dfrac{1{,}000s^{12}}{27r^6}\right)^{2/3} = \dfrac{1{,}000^{2/3}s^{24/3}}{27^{2/3}r^{12/3}} = \dfrac{10^2s^8}{3^2r^4} = \dfrac{100s^8}{9r^4}$

62. $\left(-\dfrac{32m^{10}}{243n^{15}}\right)^{-2/5} = \left(\dfrac{-243n^{15}}{32m^{10}}\right)^{2/5} = \dfrac{(-243)^{2/5}n^{30/5}}{32^{2/5}m^{20/5}} = \dfrac{(-3)^2n^6}{2^2m^4} = \dfrac{9n^6}{4m^4}$

63. $\dfrac{a^{2/5}a^{4/5}}{a^{1/5}} = \dfrac{a^{6/5}}{a^{1/5}} = a^{5/5} = a$

64. $\dfrac{x^{6/7}x^{3/7}}{x^{2/7}x^{5/7}} = \dfrac{x^{9/7}}{x^{7/7}} = x^{2/7}$

65. $\sqrt{49} = \sqrt{7^2} = 7$

66. $\sqrt{81} = \sqrt{9^2} = 9$

67. $\sqrt[3]{125} = \sqrt[3]{5^3} = 5$

68. $\sqrt[3]{-64} = \sqrt[3]{(-4)^3} = -4$

69. $\sqrt[3]{-125} = \sqrt[3]{(-5)^3} = -5$

70. $\sqrt[5]{-243} = \sqrt[5]{(-3)^5} = -3$

71. $\sqrt[5]{-\dfrac{32}{100{,}000}} = \sqrt[5]{\left(-\dfrac{2}{10}\right)^5} = -\dfrac{2}{10} = -\dfrac{1}{5}$

72. $\sqrt[4]{\dfrac{256}{625}} = \sqrt[4]{\left(\dfrac{4}{5}\right)^4} = \dfrac{4}{5}$

73. $\sqrt{36x^2} = \sqrt{(6x)^2} = |6x| = 6|x|$

74. $-\sqrt{25y^2} = -\sqrt{(5y)^2} = -|5y| = -5|y|$

75. $\sqrt{9y^4} = \sqrt{(3y^2)^2} = |3y^2| = 3y^2$

76. $\sqrt{a^4b^8} = \sqrt{(a^2b^4)^2} = |a^2b^4| = a^2b^4$

77. $\sqrt[3]{8y^3} = \sqrt[3]{(2y)^3} = 2y$

78. $\sqrt[3]{-27z^9} = \sqrt[3]{(-3z^3)^3} = -3z^3$

79. $\sqrt[4]{\dfrac{x^4y^8}{z^{12}}} = \sqrt[4]{\left(\dfrac{xy^2}{z^3}\right)^4} = \left|\dfrac{xy^2}{z^3}\right| = \dfrac{|x|y^2}{|z^3|}$

80. $\sqrt[5]{\dfrac{a^{10}b^5}{c^{15}}} = \sqrt[5]{\left(\dfrac{a^2b}{c^3}\right)^5} = \dfrac{a^2b}{c^3}$

81. $\sqrt{8} - \sqrt{2} = \sqrt{4}\sqrt{2} - \sqrt{2} = 2\sqrt{2} - \sqrt{2} = \sqrt{2}$

82. $\sqrt{75} - 2\sqrt{27} = \sqrt{25}\sqrt{3} - 2\sqrt{9}\sqrt{3} = 5\sqrt{3} - 2(3)\sqrt{3} = 5\sqrt{3} - 6\sqrt{3} = -\sqrt{3}$

83. $\sqrt{200x^2} + \sqrt{98x^2} = \sqrt{100x^2}\sqrt{2} + \sqrt{49x^2}\sqrt{2} = 10x\sqrt{2} + 7x\sqrt{2} = 17x\sqrt{2}$

84. $\sqrt{128a^3} - a\sqrt{162a} = \sqrt{64a^2}\sqrt{2a} - a\sqrt{81}\sqrt{2a} = 8a\sqrt{2a} - 9a\sqrt{2a} = -a\sqrt{2a}$

85. $2\sqrt{48y^5} - 3y\sqrt{12y^3} = 2\sqrt{16y^4}\sqrt{3y} - 3y\sqrt{4y^2}\sqrt{3y} = 2\big(4y^2\big)\sqrt{3y} - 3y(2y)\sqrt{3y}$
$= 8y^2\sqrt{3y} - 6y^2\sqrt{3y} = 2y^2\sqrt{3y}$

86. $y\sqrt{112y} + 4\sqrt{175y^3} = y\sqrt{16}\sqrt{7y} + 4\sqrt{25y^2}\sqrt{7y} = y(4)\sqrt{7y} + 4(5y)\sqrt{7y}$
$= 4y\sqrt{7y} + 20y\sqrt{7y} = 24y\sqrt{7y}$

87. $2\sqrt[3]{81} + 3\sqrt[3]{24} = 2\sqrt[3]{27}\sqrt[3]{3} + 3\sqrt[3]{8}\sqrt[3]{3} = 2(3)\sqrt[3]{3} + 3(2)\sqrt[3]{3} = 6\sqrt[3]{3} + 6\sqrt[3]{3} = 12\sqrt[3]{3}$

88. $3\sqrt[4]{32} - 2\sqrt[4]{162} = 3\sqrt[4]{16}\sqrt[4]{2} - 2\sqrt[4]{81}\sqrt[4]{2} = 3(2)\sqrt[4]{2} - 2(3)\sqrt[4]{2} = 6\sqrt[4]{2} - 6\sqrt[4]{2} = 0$

89. $\sqrt[4]{768z^5} + \sqrt[4]{48z^5} = \sqrt[4]{256z^4}\sqrt[4]{3z} + \sqrt[4]{16z^4}\sqrt[4]{3z} = 4z\sqrt[4]{3z} + 2z\sqrt[4]{3z} = 6z\sqrt[4]{3z}$

90. $-2\sqrt[5]{64y^2} + 3\sqrt[5]{486y^2} = -2\sqrt[5]{32}\sqrt[5]{2y^2} + 3\sqrt[5]{243}\sqrt[5]{2y^2} = -2(2)\sqrt[5]{2y^2} + 3(3)\sqrt[5]{2y^2}$
$= -4\sqrt[5]{2y^2} + 9\sqrt[5]{2y^2} = 5\sqrt[5]{2y^2}$

91. $\sqrt{8x^2y} - x\sqrt{2y} + \sqrt{50x^2y} = \sqrt{4x^2}\sqrt{2y} - x\sqrt{2y} + \sqrt{25x^2}\sqrt{2y}$
$= 2x\sqrt{2y} - x\sqrt{2y} + 5x\sqrt{2y} = 6x\sqrt{2y}$

92. $3x\sqrt{18x} + 2\sqrt{2x^3} - \sqrt{72x^3} = 3x\sqrt{9}\sqrt{2x} + 2\sqrt{x^2}\sqrt{2x} - \sqrt{36x^2}\sqrt{2x}$
$= 3x(3)\sqrt{2x} + 2x\sqrt{2x} - 6x\sqrt{2x}$
$= 9x\sqrt{2x} + 2x\sqrt{2x} - 6x\sqrt{2x} = 5x\sqrt{2x}$

93. $\sqrt[3]{16xy^4} + y\sqrt[3]{2xy} - \sqrt[3]{54xy^4} = \sqrt[3]{8y^3}\sqrt[3]{2xy} + y\sqrt[3]{2xy} - \sqrt[3]{27y^3}\sqrt[3]{2xy}$
$= 2y\sqrt[3]{2xy} + y\sqrt[3]{2xy} - 3y\sqrt[3]{2xy} = 0$

SECTION 0.3

94. $\sqrt[4]{512x^5} - \sqrt[4]{32x^5} + \sqrt[4]{1{,}250x^5} = \sqrt[4]{256x^4}\sqrt[4]{2x} - \sqrt[4]{16x^4}\sqrt[4]{2x} + \sqrt[4]{625x^4}\sqrt[4]{2x}$
$= 4x\sqrt[4]{2x} - 2x\sqrt[4]{2x} + 5x\sqrt[4]{2x} = 7x\sqrt[4]{2x}$

95. $\dfrac{3}{\sqrt{3}} = \dfrac{3}{\sqrt{3}} \cdot \dfrac{\sqrt{3}}{\sqrt{3}} = \dfrac{3\sqrt{3}}{3} = \sqrt{3}$

96. $\dfrac{6}{\sqrt{5}} = \dfrac{6}{\sqrt{5}} \cdot \dfrac{\sqrt{5}}{\sqrt{5}} = \dfrac{6\sqrt{5}}{5}$

97. $\dfrac{2}{\sqrt{x}} = \dfrac{2}{\sqrt{x}} \cdot \dfrac{\sqrt{x}}{\sqrt{x}} = \dfrac{2\sqrt{x}}{x}$

98. $\dfrac{8}{\sqrt{y}} = \dfrac{8}{\sqrt{y}} \cdot \dfrac{\sqrt{y}}{\sqrt{y}} = \dfrac{8\sqrt{y}}{y}$

99. $\dfrac{2}{\sqrt[3]{2}} = \dfrac{2}{\sqrt[3]{2}} \cdot \dfrac{\sqrt[3]{4}}{\sqrt[3]{4}} = \dfrac{2\sqrt[3]{4}}{\sqrt[3]{8}} = \dfrac{2\sqrt[3]{4}}{2} = \sqrt[3]{4}$

100. $\dfrac{4d}{\sqrt[3]{9}} = \dfrac{4d}{\sqrt[3]{9}} \cdot \dfrac{\sqrt[3]{3}}{\sqrt[3]{3}} = \dfrac{4d\sqrt[3]{3}}{\sqrt[3]{27}} = \dfrac{4d\sqrt[3]{3}}{3}$

101. $\dfrac{5a}{\sqrt[3]{25a}} = \dfrac{5a}{\sqrt[3]{25a}} \cdot \dfrac{\sqrt[3]{5a^2}}{\sqrt[3]{5a^2}} = \dfrac{5a\sqrt[3]{5a^2}}{\sqrt[3]{125a^3}} = \dfrac{5a\sqrt[3]{5a^2}}{5a} = \sqrt[3]{5a^2}$

102. $\dfrac{7}{\sqrt[3]{36c}} = \dfrac{7}{\sqrt[3]{36c}} \cdot \dfrac{\sqrt[3]{6c^2}}{\sqrt[3]{6c^2}} = \dfrac{7\sqrt[3]{6c^2}}{\sqrt[3]{216c^3}} = \dfrac{7\sqrt[3]{6c^2}}{6c}$

103. $\dfrac{2b}{\sqrt[4]{3a^2}} = \dfrac{2b}{\sqrt[4]{3a^2}} \cdot \dfrac{\sqrt[4]{27a^2}}{\sqrt[4]{27a^2}} = \dfrac{2b\sqrt[4]{27a^2}}{\sqrt[4]{81a^4}} = \dfrac{2b\sqrt[4]{27a^2}}{3a}$

104. $\sqrt{\dfrac{x}{2y}} = \dfrac{\sqrt{x}}{\sqrt{2y}} = \dfrac{\sqrt{x}}{\sqrt{2y}} \cdot \dfrac{\sqrt{2y}}{\sqrt{2y}} = \dfrac{\sqrt{2xy}}{2y}$

105. $\sqrt[3]{\dfrac{2u^4}{9v}} = \dfrac{\sqrt[3]{2u^4}}{\sqrt[3]{9v}} = \dfrac{\sqrt[3]{u^3}\sqrt[3]{2u}}{\sqrt[3]{9v}} \cdot \dfrac{\sqrt[3]{3v^2}}{\sqrt[3]{3v^2}} = \dfrac{u\sqrt[3]{6uv^2}}{\sqrt[3]{27v^3}} = \dfrac{u\sqrt[3]{6uv^2}}{3v}$

106. $\sqrt[3]{-\dfrac{3s^5}{4r^2}} = \dfrac{\sqrt[3]{-3s^5}}{\sqrt[3]{4r^2}} = \dfrac{\sqrt[3]{-s^3}\sqrt[3]{3s^2}}{\sqrt[3]{4r^2}} \cdot \dfrac{\sqrt[3]{2r}}{\sqrt[3]{2r}} = \dfrac{-s\sqrt[3]{6rs^2}}{\sqrt[3]{8r^3}} = -\dfrac{s\sqrt[3]{6rs^2}}{2r}$

107. $\dfrac{\sqrt{5}}{10} = \dfrac{\sqrt{5}}{10} \cdot \dfrac{\sqrt{5}}{\sqrt{5}} = \dfrac{5}{10\sqrt{5}} = \dfrac{1}{2\sqrt{5}}$

108. $\dfrac{\sqrt{y}}{3} = \dfrac{\sqrt{y}}{3} \cdot \dfrac{\sqrt{y}}{\sqrt{y}} = \dfrac{y}{3\sqrt{y}}$

109. $\dfrac{\sqrt[3]{9}}{3} = \dfrac{\sqrt[3]{9}}{3} \cdot \dfrac{\sqrt[3]{3}}{\sqrt[3]{3}} = \dfrac{\sqrt[3]{27}}{3\sqrt[3]{3}} = \dfrac{3}{3\sqrt[3]{3}} = \dfrac{1}{\sqrt[3]{3}}$

110. $\dfrac{\sqrt[3]{16b^2}}{16} = \dfrac{\sqrt[3]{16b^2}}{16} \cdot \dfrac{\sqrt[3]{4b}}{\sqrt[3]{4b}} = \dfrac{\sqrt[3]{64b^3}}{16\sqrt[3]{4b}} = \dfrac{4b}{16\sqrt[3]{4b}} = \dfrac{b}{4\sqrt[3]{4b}}$

111. $\dfrac{\sqrt[5]{16b^3}}{64a} = \dfrac{\sqrt[5]{16b^3}}{64a} \cdot \dfrac{\sqrt[5]{2b^2}}{\sqrt[5]{2b^2}} = \dfrac{\sqrt[5]{32b^5}}{64a\sqrt[5]{2b^2}} = \dfrac{2b}{64a\sqrt[5]{2b^2}} = \dfrac{b}{32a\sqrt[5]{2b^2}}$

112. $\sqrt{\dfrac{3x}{57}} = \dfrac{\sqrt{3x}}{\sqrt{57}} = \dfrac{\sqrt{3x}}{\sqrt{57}} \cdot \dfrac{\sqrt{3x}}{\sqrt{3x}} = \dfrac{3x}{\sqrt{171x}} = \dfrac{3x}{\sqrt{9}\sqrt{19x}} = \dfrac{3x}{3\sqrt{19x}} = \dfrac{x}{\sqrt{19x}}$

113. $\sqrt{\dfrac{1}{3}} - \sqrt{\dfrac{1}{27}} = \dfrac{\sqrt{1}}{\sqrt{3}} - \dfrac{\sqrt{1}}{\sqrt{27}} = \dfrac{1}{\sqrt{3}} \cdot \dfrac{\sqrt{3}}{\sqrt{3}} - \dfrac{1}{\sqrt{27}} \cdot \dfrac{\sqrt{3}}{\sqrt{3}} = \dfrac{\sqrt{3}}{3} - \dfrac{\sqrt{3}}{\sqrt{81}} = \dfrac{\sqrt{3}}{3} - \dfrac{\sqrt{3}}{9}$

$$= \frac{3\sqrt{3}}{9} - \frac{\sqrt{3}}{9} = \frac{2\sqrt{3}}{9}$$

114. $\sqrt[3]{\dfrac{1}{2}} + \sqrt[3]{\dfrac{1}{16}} = \dfrac{\sqrt[3]{1}}{\sqrt[3]{2}} + \dfrac{\sqrt[3]{1}}{\sqrt[3]{16}} = \dfrac{1}{\sqrt[3]{2}} \cdot \dfrac{\sqrt[3]{4}}{\sqrt[3]{4}} + \dfrac{1}{\sqrt[3]{16}} \cdot \dfrac{\sqrt[3]{4}}{\sqrt[3]{4}} = \dfrac{\sqrt[3]{4}}{\sqrt[3]{8}} + \dfrac{\sqrt[3]{4}}{\sqrt[3]{64}} = \dfrac{\sqrt[3]{4}}{2} + \dfrac{\sqrt[3]{4}}{4}$

$$= \frac{2\sqrt[3]{4}}{4} + \frac{\sqrt[3]{4}}{4} = \frac{3\sqrt[3]{4}}{4}$$

115. $\sqrt{\dfrac{x}{8}} - \sqrt{\dfrac{x}{2}} + \sqrt{\dfrac{x}{32}} = \dfrac{\sqrt{x}}{\sqrt{8}} - \dfrac{\sqrt{x}}{\sqrt{2}} + \dfrac{\sqrt{x}}{\sqrt{32}} = \dfrac{\sqrt{x}}{\sqrt{8}} \cdot \dfrac{\sqrt{2}}{\sqrt{2}} - \dfrac{\sqrt{x}}{\sqrt{2}} \cdot \dfrac{\sqrt{2}}{\sqrt{2}} + \dfrac{\sqrt{x}}{\sqrt{32}} \cdot \dfrac{\sqrt{2}}{\sqrt{2}}$

$$= \frac{\sqrt{2x}}{\sqrt{16}} - \frac{\sqrt{2x}}{\sqrt{4}} + \frac{\sqrt{2x}}{\sqrt{64}}$$

$$= \frac{\sqrt{2x}}{4} - \frac{\sqrt{2x}}{2} + \frac{\sqrt{2x}}{8}$$

$$= \frac{2\sqrt{2x}}{8} - \frac{4\sqrt{2x}}{8} + \frac{\sqrt{2x}}{8} = -\frac{\sqrt{2x}}{8}$$

116. $\sqrt[3]{\dfrac{y}{4}} + \sqrt[3]{\dfrac{y}{32}} - \sqrt[3]{\dfrac{y}{500}} = \dfrac{\sqrt[3]{y}}{\sqrt[3]{4}} + \dfrac{\sqrt[3]{y}}{\sqrt[3]{32}} - \dfrac{\sqrt[3]{y}}{\sqrt[3]{500}} = \dfrac{\sqrt[3]{y}}{\sqrt[3]{4}} \cdot \dfrac{\sqrt[3]{2}}{\sqrt[3]{2}} + \dfrac{\sqrt[3]{y}}{\sqrt[3]{32}} \cdot \dfrac{\sqrt[3]{2}}{\sqrt[3]{2}} - \dfrac{\sqrt[3]{y}}{\sqrt[3]{500}} \cdot \dfrac{\sqrt[3]{2}}{\sqrt[3]{2}}$

$$= \frac{\sqrt[3]{2y}}{\sqrt[3]{8}} + \frac{\sqrt[3]{2y}}{\sqrt[3]{64}} - \frac{\sqrt[3]{2y}}{\sqrt[3]{1{,}000}}$$

$$= \frac{\sqrt[3]{2y}}{2} + \frac{\sqrt[3]{2y}}{4} - \frac{\sqrt[3]{2y}}{10}$$

$$= \frac{10\sqrt[3]{2y}}{20} + \frac{5\sqrt[3]{2y}}{20} - \frac{2\sqrt[3]{2y}}{20} = \frac{13\sqrt[3]{2y}}{20}$$

117. $\sqrt[4]{9} = 9^{1/4} = (3^2)^{1/4} = 3^{2/4} = 3^{1/2} = \sqrt{3}$

118. $\sqrt[6]{27} = 27^{1/6} = (3^3)^{1/6} = 3^{3/6} = 3^{1/2} = \sqrt{3}$

119. $\sqrt[10]{16x^6} = (16x^6)^{1/10} = (2^4x^6)^{1/10} = 2^{4/10}x^{6/10} = 2^{2/5}x^{3/5} = (2^2x^3)^{1/5} = \sqrt[5]{4x^3}$

120. $\sqrt[6]{27x^9} = (27x^9)^{1/6} = (3^3x^9)^{1/6} = 3^{3/6}x^{9/6} = 3^{1/2}x^{3/2} = (3x^3)^{1/2} = \sqrt{3x^3} = x\sqrt{3x}$

121. $\sqrt{2}\sqrt[3]{2} = 2^{1/2} \cdot 2^{1/3} = 2^{3/6} \cdot 2^{2/6} = \sqrt[6]{2^3}\sqrt[6]{2^2} = \sqrt[6]{8}\sqrt[6]{4} = \sqrt[6]{32}$

122. $\sqrt{3}\sqrt[3]{5} = 3^{1/2}5^{1/3} = 3^{3/6}5^{2/6} = \sqrt[6]{3^3}\sqrt[6]{5^2} = \sqrt[6]{27}\sqrt[6]{25} = \sqrt[6]{675}$

123. $\dfrac{\sqrt[4]{3}}{\sqrt{2}} = \dfrac{3^{1/4}}{2^{1/2}} = \dfrac{3^{1/4}}{2^{2/4}} = \dfrac{\sqrt[4]{3}}{\sqrt[4]{2^2}} = \dfrac{\sqrt[4]{3}}{\sqrt[4]{4}} = \dfrac{\sqrt[4]{3}}{\sqrt[4]{4}} \cdot \dfrac{\sqrt[4]{4}}{\sqrt[4]{4}} = \dfrac{\sqrt[4]{12}}{\sqrt[4]{16}} = \dfrac{\sqrt[4]{12}}{2}$

124. $\dfrac{\sqrt[3]{2}}{\sqrt{5}} = \dfrac{2^{1/3}}{5^{1/2}} = \dfrac{2^{2/6}}{5^{3/6}} = \dfrac{\sqrt[6]{2^2}}{\sqrt[6]{5^3}} = \dfrac{\sqrt[6]{4}}{\sqrt[6]{125}} = \dfrac{\sqrt[6]{4}}{\sqrt[6]{125}} \cdot \dfrac{\sqrt[6]{125}}{\sqrt[6]{125}} = \dfrac{\sqrt[6]{500}}{\sqrt[6]{15{,}625}} = \dfrac{\sqrt[6]{500}}{5}$

125. $\sqrt[4]{x^4} = |x|$. Since $|x| = x$ if $x \geq 0$, then $\sqrt[4]{x^4} = x$ if $x \geq 0$.

126. $\sqrt[n]{\dfrac{x}{y}} = \left(\dfrac{x}{y}\right)^{1/n} = \dfrac{x^{1/n}}{y^{1/n}} = \dfrac{\sqrt[n]{x}}{\sqrt[n]{y}}$

127. $\left(\dfrac{x}{y}\right)^{-m/n} = \dfrac{x^{-m/n}}{y^{-m/n}} = \dfrac{x^{-m/n}}{y^{-m/n}} \cdot \dfrac{x^{m/n}y^{m/n}}{x^{m/n}y^{m/n}} = \dfrac{y^{m/n}}{x^{m/n}} = \dfrac{(y^m)^{1/n}}{(x^m)^{1/n}} = \left(\dfrac{y^m}{x^m}\right)^{1/n} = \sqrt[n]{\dfrac{y^m}{x^m}}$

128. Consider the case when n is even, m is odd and x is negative. Then $x^{m/n} = \left(x^{1/n}\right)^m = \left(\sqrt[n]{x}\right)^m$. Thus, $\sqrt[n]{x}$ must be a real number for the expression to be defined.

129. $-2 < x \leq 5 \Rightarrow (-2, 5]$

130. If $x > 4$, then $3 - x < 0$. Then $|3 - x| = -(3 - x) = -3 + x = x - 3$.

131. $x^2 - y^2 = (-2)^2 - 3^2 = 4 - 9 = -5$

132. $\dfrac{xy + 4y}{x} = \dfrac{-2(3) + 4(3)}{-2} = \dfrac{-6 + 12}{-2} = \dfrac{6}{-2} = -3$

133. $617{,}000{,}000 = 6.17 \times 10^8$

134. $0.00235 \times 10^4 = 23.5$

Exercises 0.4 (page 50)

1. monomial, variables

2. degree, variables

3. trinomial

4. binomial

5. one

6. zero

7. like

8. degree

9. coefficients, variables

10. $3\sqrt{x} - 2$

11. yes, trinomial, 2nd degree

12. yes, binomial, 3rd degree

13. no

14. no

15. yes, binomial, 3rd degree

16. yes, monomial, 5th degree

17. yes, monomial, 0th degree

18. no

19. yes, monomial, no degree

20. yes, none, 3rd degree

21. $(x^3 - 3x^2) + (5x^3 - 8x) = x^3 - 3x^2 + 5x^3 - 8x = x^3 + 5x^3 - 3x^2 - 8x = 6x^3 - 3x^2 - 8x$

SECTION 0.4

22. $\big(2x^4 - 5x^3\big) + \big(7x^3 - x^4 + 2x\big) = 2x^4 - 5x^3 + 7x^3 - x^4 + 2x$
$= 2x^4 - x^4 - 5x^3 + 7x^3 + 2x = x^4 + 2x^3 + 2x$

23. $\big(y^5 + 2y^3 + 7\big) - \big(y^5 - 2y^3 - 7\big) = y^5 + 2y^3 + 7 - y^5 + 2y^3 + 7$
$= y^5 - y^5 + 2y^3 + 2y^3 + 7 + 7 = 4y^3 + 14$

24. $\big(3t^7 - 7t^3 + 3\big) - \big(7t^7 - 3t^3 + 7\big) = 3t^7 - 7t^3 + 3 - 7t^7 + 3t^3 - 7$
$= 3t^7 - 7t^7 - 7t^3 + 3t^3 + 3 - 7 = -4t^7 - 4t^3 - 4$

25. $2\big(x^2 + 3x - 1\big) - 3\big(x^2 + 2x - 4\big) + 4 = 2\big(x^2\big) + 2(3x) + 2(-1) - 3\big(x^2\big) - 3(2x) - 3(-4) + 4$
$= 2x^2 + 6x - 2 - 3x^2 - 6x + 12 + 4$
$= 2x^2 - 3x^2 + 6x - 6x - 2 + 12 + 4 = -x^2 + 14$

26. $5\big(x^3 - 8x + 3\big) + 2\big(3x^2 + 5x\big) - 7 = 5\big(x^3\big) + 5(-8x) + 5(3) + 2\big(3x^2\big) + 2(5x) - 7$
$= 5x^3 - 40x + 15 + 6x^2 + 10x - 7$
$= 5x^3 + 6x^2 - 40x + 10x + 15 - 7 = 5x^3 + 6x^2 - 30x + 8$

27. $8\big(t^2 - 2t + 5\big) + 4\big(t^2 - 3t + 2\big) - 6\big(2t^2 - 8\big)$
$= 8\big(t^2\big) + 8(-2t) + 8(5) + 4\big(t^2\big) + 4(-3t) + 4(2) - 6\big(2t^2\big) - 6(-8)$
$= 8t^2 - 16t + 40 + 4t^2 - 12t + 8 - 12t^2 + 48$
$= 8t^2 + 4t^2 - 12t^2 - 16t - 12t + 40 + 8 + 48 = -28t + 96$

28. $-3\big(x^3 - x\big) + 2\big(x^2 + x\big) + 3\big(x^3 - 2x\big) = -3\big(x^3\big) - 3(-x) + 2\big(x^2\big) + 2(x) + 3\big(x^3\big) + 3(-2x)$
$= -3x^3 + 3x + 2x^2 + 2x + 3x^3 - 6x$
$= -3x^3 + 3x^3 + 2x^2 + 3x + 2x - 6x = 2x^2 - x$

29. $y\big(y^2 - 1\big) - y^2(y + 2) - y(2y - 2) = y\big(y^2\big) + y(-1) - y^2(y) - y^2(2) - y(2y) - y(-2)$
$= y^3 - y - y^3 - 2y^2 - 2y^2 + 2y$
$= y^3 - y^3 - 2y^2 - 2y^2 - y + 2y = -4y^2 + y$

30. $-4a^2(a + 1) + 3a\big(a^2 - 4\big) - a^2(a + 2)$
$= -4a^2(a) - 4a^2(1) + 3a\big(a^2\big) + 3a(-4) - a^2(a) - a^2(2)$
$= -4a^3 - 4a^2 + 3a^3 - 12a - a^3 - 2a^2$
$= -4a^3 + 3a^3 - a^3 - 4a^2 - 2a^2 - 12a = -2a^3 - 6a^2 - 12a$

31. $xy(x - 4y) - y\big(x^2 + 3xy\big) + xy(2x + 3y)$
$= xy(x) + xy(-4y) - y\big(x^2\big) - y(3xy) + xy(2x) + xy(3y)$
$= x^2y - 4xy^2 - x^2y - 3xy^2 + 2x^2y + 3xy^2$
$= x^2y - x^2y + 2x^2y - 4xy^2 - 3xy^2 + 3xy^2 = 2x^2y - 4xy^2$

SECTION 0.4

32. $3mn(m+2n)-6m(3mn+1)-2n(4mn-1)$
$=3mn(m)+3mn(2n)-6m(3mn)-6m(1)-2n(4mn)-2n(-1)$
$=3m^2n+6mn^2-18m^2n-6m-8mn^2+2n$
$=3m^2n-18m^2n+6mn^2-8mn^2-6m+2n=-15m^2n-2mn^2-6m+2n$

33. $2x^2y^3(4xy^4)=2(4)x^2xy^3y^4=8x^3y^7$

34. $-15a^3b\big(-2a^2b^3\big)=-15(-2)a^3a^2bb^3$
$=30a^5b^4$

35. $-3m^2n\big(2mn^2\big)\Big(-\dfrac{mn}{12}\Big)=(-3)(2)\Big(-\dfrac{1}{12}\Big)m^2mmnn^2n=\dfrac{6}{12}m^4n^4=\dfrac{m^4n^4}{2}$

36. $-\dfrac{3r^2s^3}{5}\Big(\dfrac{2r^2s}{3}\Big)\Big(\dfrac{15rs^2}{2}\Big)=\Big(-\dfrac{3}{5}\Big)\Big(\dfrac{2}{3}\Big)\Big(\dfrac{15}{2}\Big)r^2r^2rs^3ss^2=-3r^5s^6$

37. $-4rs(r^2+s^2)=-4rs(r^2)-4rs(s^2)=-4r^3s-4rs^3$

38. $6u^2v(2uv^2-y)=6u^2v(2uv^2)+6u^2v(-y)=12u^3v^3-6u^2vy$

39. $6ab^2c\big(2ac+3bc^2-4ab^2c\big)=6ab^2c(2ac)+6ab^2c\big(3bc^2\big)+6ab^2c\big(-4ab^2c\big)$
$=12a^2b^2c^2+18ab^3c^3-24a^2b^4c^2$

40. $-\dfrac{mn^2}{2}\big(4mn-6m^2-8\big)=-\dfrac{mn^2}{2}(4mn)-\dfrac{mn^2}{2}\big(-6m^2\big)-\dfrac{mn^2}{2}(-8)$
$=-2m^2n^3+3m^3n^2+4mn^2$

41. $(a+2)(a+2)=a^2+2a+2a+4$
$=a^2+4a+4$

42. $(y-5)(y-5)=y^2-5y-5y+25$
$=y^2-10y+25$

43. $(a-6)^2=(a-6)(a-6)$
$=a^2-6a-6a+36$
$=a^2-12a+36$

44. $(t+9)^2=(t+9)(t+9)$
$=t^2+9t+9t+81$
$=t^2+18t+81$

45. $(x+4)(x-4)=x^2-4x+4x-16$
$=x^2-16$

46. $(z+7)(z-7)=z^2-7z+7z-49$
$=z^2-49$

47. $(x-3)(x+5)=x^2+5x-3x-15$
$=x^2+2x-15$

48. $(z+4)(z-6)=z^2-6z+4z-24$
$=z^2-2z-24$

49. $(u+2)(3u-2)=3u^2-2u+6u-4$
$=3u^2+4u-4$

50. $(4x+1)(2x-3)=8x^2-12x+2x-3$
$=8x^2-10x-3$

51. $(5x-1)(2x+3)=10x^2+15x-2x-3$
$=10x^2+13x-3$

52. $(4x-1)(2x-7)=8x^2-28x-2x+7$
$=8x^2-30x+7$

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53. $(3a-2b)^2 = (3a-2b)(3a-2b) = 9a^2 - 6ab - 6ab + 4b^2 = 9a^2 - 12ab + 4b^2$

54. $(4a+5b)(4a-5b) = 16a^2 - 20ab + 20ab - 25b^2 = 16a^2 - 25b^2$

55. $(3m+4n)(3m-4n) = 9m^2 - 12mn + 12mn - 16n^2 = 9m^2 - 16n^2$

56. $(4r+3s)^2 = (4r+3s)(4r+3s) = 16r^2 + 12rs + 12rs + 9s^2 = 16r^2 + 24rs + 9s^2$

57. $(2y-4x)(3y-2x) = 6y^2 - 4xy - 12xy + 8x^2 = 6y^2 - 16xy + 8x^2$

58. $(-2x+3y)(3x+y) = -6x^2 - 2xy + 9xy + 3y^2 = -6x^2 + 7xy + 3y^2$

59. $(9x-y)(x^2-3y) = 9x^3 - 27xy - x^2y + 3y^2 = 9x^3 - x^2y - 27xy + 3y^2$

60. $(8a^2+b)(a+2b) = 8a^3 + 16a^2b + ab + 2b^2$

61. $(5z+2t)(z^2-t) = 5z^3 - 5tz + 2tz^2 - 2t^2 = 5z^3 + 2tz^2 - 5tz - 2t^2$

62. $(y-2x^2)(x^2+3y) = x^2y + 3y^2 - 2x^4 - 6x^2y = -2x^4 - 5x^2y + 3y^2$

63. $\left(\sqrt{5}+3x\right)\left(2-\sqrt{5}x\right) = 2\sqrt{5} - 5x + 6x - 3\sqrt{5}x^2 = -3\sqrt{5}\,x^2 + x + 2\sqrt{5}$

64. $\left(\sqrt{2}+x\right)\left(3+\sqrt{2}x\right) = 3\sqrt{2} + 2x + 3x + \sqrt{2}x^2 = \sqrt{2}\,x^2 + 5x + 3\sqrt{2}$

65.
$$\begin{aligned}(3x-1)^3 &= (3x-1)(3x-1)(3x-1)\\ &= \big(9x^2 - 3x - 3x + 1\big)(3x-1)\\ &= \big(9x^2 - 6x + 1\big)(3x-1)\\ &= 9x^2(3x) + 9x^2(-1) - 6x(3x) - 6x(-1) + 1(3x) + 1(-1)\\ &= 27x^3 - 9x^2 - 18x^2 + 6x + 3x - 1 = 27x^3 - 27x^2 + 9x - 1\end{aligned}$$

66.
$$\begin{aligned}(2x-3)^3 &= (2x-3)(2x-3)(2x-3)\\ &= \big(4x^2 - 6x - 6x + 9\big)(2x-3)\\ &= \big(4x^2 - 12x + 9\big)(2x-3)\\ &= 4x^2(2x) + 4x^2(-3) - 12x(2x) - 12x(-3) + 9(2x) + 9(-3)\\ &= 8x^3 - 12x^2 - 24x^2 + 36x + 18x - 27 = 8x^3 - 36x^2 + 54x - 27\end{aligned}$$

67.
$$\begin{aligned}(3x+1)\big(2x^2+4x-3\big) &= 3x\big(2x^2\big) + 3x(4x) + 3x(-3) + 1\big(2x^2\big) + 1(4x) + 1(-3)\\ &= 6x^3 + 12x^2 - 9x + 2x^2 + 4x - 3 = 6x^3 + 14x^2 - 5x - 3\end{aligned}$$

68.
$$\begin{aligned}(2x-5)\big(x^2-3x+2\big) &= 2x\big(x^2\big) + 2x(-3x) + 2x(2) - 5\big(x^2\big) - 5(-3x) - 5(2)\\ &= 2x^3 - 6x^2 + 4x - 5x^2 + 15x - 10 = 2x^3 - 11x^2 + 19x - 10\end{aligned}$$

69. $(3x+2y)\left(2x^2-3xy+4y^2\right)$
$= 3x\left(2x^2\right)+3x(-3xy)+3x\left(4y^2\right)+2y\left(2x^2\right)+2y(-3xy)+2y\left(4y^2\right)$
$= 6x^3-9x^2y+12xy^2+4x^2y-6xy^2+8y^3 = 6x^3-5x^2y+6xy^2+8y^3$

70. $(4r-3s)\left(2r^2+4rs-2s^2\right)$
$= 4r\left(2r^2\right)+4r(4rs)+4r\left(-2s^2\right)-3s\left(2r^2\right)-3s(4rs)-3s\left(-2s^2\right)$
$= 8r^3+16r^2s-8rs^2-6r^2s-12rs^2+6s^3 = 8r^3+10r^2s-20rs^2+6s^3$

71. $2y^n(3y^n+y^{-n}) = 2y^n(3y^n)+2y^n(y^{-n}) = 6y^{n+n}+2y^{n+(-n)} = 6y^{2n}+2y^0 = 6y^{2n}+2$

72. $3a^{-n}\left(2a^n+3a^{n-1}\right) = 3a^{-n}(2a^n)+3a^{-n}\left(3a^{n-1}\right) = 6a^{-n+n}+9a^{-n+n-1} = 6a^0+9a^{-1}$
$= 6+\dfrac{9}{a}$

73. $-5x^{2n}y^n\left(2x^{2n}y^{-n}+3x^{-2n}y^n\right) = -5x^{2n}y^n\left(2x^{2n}y^{-n}\right)-5x^{2n}y^n\left(3x^{-2n}y^n\right)$
$= -10x^{2n+2n}y^{n+(-n)}-15x^{2n+(-2n)}y^{n+n}$
$= -10x^{4n}y^0-15x^0y^{2n} = -10x^{4n}-15y^{2n}$

74. $-2a^{3n}b^{2n}\left(5a^{-3n}b-ab^{-2n}\right) = -2a^{3n}b^{2n}\left(5a^{-3n}b\right)-2a^{3n}b^{2n}\left(-ab^{-2n}\right)$
$= -10a^{3n+(-3n)}b^{2n+1}+2a^{3n+1}b^{2n+(-2n)}$
$= -10a^0b^{2n+1}+2a^{3n+1}b^0 = -10b^{2n+1}+2a^{3n+1}$

75. $(x^n+3)(x^n-4) = x^nx^n-4x^n+3x^n-12 = x^{2n}-x^n-12$

76. $(a^n-5)(a^n-3) = a^na^n-3a^n-5a^n+15 = a^{2n}-8a^n+15$

77. $(2r^n-7)(3r^n-2) = 2r^n(3r^n)-2r^n(2)-7(3r^n)+14$
$= 6r^{2n}-4r^n-21r^n+14 = 6r^{2n}-25r^n+14$

78. $(4z^n+3)(3z^n+1) = 4z^n(3z^n)+4z^n(1)+3(3z^n)+3$
$= 12z^{2n}+4z^n+9z^n+3 = 12z^{2n}+13z^n+3$

79. $x^{1/2}\left(x^{1/2}y+xy^{1/2}\right) = x^{1/2}x^{1/2}y+x^{1/2}xy^{1/2} = x^{2/2}y+x^{3/2}y^{1/2} = xy+x^{3/2}y^{1/2}$

80. $ab^{1/2}\left(a^{1/2}b^{1/2}+b^{1/2}\right) = ab^{1/2}a^{1/2}b^{1/2}+ab^{1/2}b^{1/2} = a^{3/2}b^{2/2}+ab^{2/2} = a^{3/2}b+ab$

81. $\left(a^{1/2}+b^{1/2}\right)\left(a^{1/2}-b^{1/2}\right) = a^{1/2}a^{1/2}-a^{1/2}b^{1/2}+a^{1/2}b^{1/2}-b^{1/2}b^{1/2}$
$= a^{2/2}-b^{2/2} = a-b$

82. $\left(x^{3/2}+y^{1/2}\right)^2 = \left(x^{3/2}+y^{1/2}\right)\left(x^{3/2}+y^{1/2}\right) = x^{3/2}x^{3/2}+x^{3/2}y^{1/2}+x^{3/2}y^{1/2}+y^{1/2}y^{1/2}$
$= x^{6/2}+2x^{3/2}y^{1/2}+y^{2/2}$
$= x^3+2x^{3/2}y^{1/2}+y$

83. $\dfrac{2}{\sqrt{3}-1}=\dfrac{2}{\sqrt{3}-1}\cdot\dfrac{\sqrt{3}+1}{\sqrt{3}+1}=\dfrac{2\left(\sqrt{3}+1\right)}{\left(\sqrt{3}\right)^2-1^2}=\dfrac{2\left(\sqrt{3}+1\right)}{3-1}=\dfrac{2\left(\sqrt{3}+1\right)}{2}=\sqrt{3}+1$

84. $\dfrac{1}{\sqrt{5}+2}=\dfrac{1}{\sqrt{5}+2}\cdot\dfrac{\sqrt{5}-2}{\sqrt{5}-2}=\dfrac{1\left(\sqrt{5}-2\right)}{\left(\sqrt{5}\right)^2-2^2}=\dfrac{\sqrt{5}-2}{5-4}=\dfrac{\sqrt{5}-2}{1}=\sqrt{5}-2$

85. $\dfrac{3x}{\sqrt{7}+2}=\dfrac{3x}{\sqrt{7}+2}\cdot\dfrac{\sqrt{7}-2}{\sqrt{7}-2}=\dfrac{3x\left(\sqrt{7}-2\right)}{\left(\sqrt{7}\right)^2-2^2}=\dfrac{3x\left(\sqrt{7}-2\right)}{7-4}=\dfrac{3x\left(\sqrt{7}-2\right)}{3}=x\left(\sqrt{7}-2\right)$

86. $\dfrac{14y}{\sqrt{2}-3}=\dfrac{14y}{\sqrt{2}-3}\cdot\dfrac{\sqrt{2}+3}{\sqrt{2}+3}=\dfrac{14y\left(\sqrt{2}+3\right)}{\left(\sqrt{2}\right)^2-3^2}=\dfrac{14y\left(\sqrt{2}+3\right)}{2-9}=-2y\left(\sqrt{2}+3\right)$

87. $\dfrac{x}{x-\sqrt{3}}=\dfrac{x}{x-\sqrt{3}}\cdot\dfrac{x+\sqrt{3}}{x+\sqrt{3}}=\dfrac{x\left(x+\sqrt{3}\right)}{x^2-\left(\sqrt{3}\right)^2}=\dfrac{x\left(x+\sqrt{3}\right)}{x^2-3}$

88. $\dfrac{y}{2y+\sqrt{7}}=\dfrac{y}{2y+\sqrt{7}}\cdot\dfrac{2y-\sqrt{7}}{2y-\sqrt{7}}=\dfrac{y\left(2y-\sqrt{7}\right)}{(2y)^2-\left(\sqrt{7}\right)^2}=\dfrac{y\left(2y-\sqrt{7}\right)}{4y^2-7}$

89. $\dfrac{y+\sqrt{2}}{y-\sqrt{2}}=\dfrac{y+\sqrt{2}}{y-\sqrt{2}}\cdot\dfrac{y+\sqrt{2}}{y+\sqrt{2}}=\dfrac{\left(y+\sqrt{2}\right)\left(y+\sqrt{2}\right)}{y^2-\left(\sqrt{2}\right)^2}=\dfrac{y^2+2y\sqrt{2}+2}{y^2-2}$

90. $\dfrac{x-\sqrt{3}}{x+\sqrt{3}}=\dfrac{x-\sqrt{3}}{x+\sqrt{3}}\cdot\dfrac{x-\sqrt{3}}{x-\sqrt{3}}=\dfrac{\left(x-\sqrt{3}\right)\left(x-\sqrt{3}\right)}{x^2-\left(\sqrt{3}\right)^2}=\dfrac{x^2-2x\sqrt{3}+3}{x^2-3}$

91. $\dfrac{\sqrt{2}-\sqrt{3}}{1-\sqrt{3}}=\dfrac{\sqrt{2}-\sqrt{3}}{1-\sqrt{3}}\cdot\dfrac{1+\sqrt{3}}{1+\sqrt{3}}=\dfrac{\sqrt{2}+\sqrt{6}-\sqrt{3}-\left(\sqrt{3}\right)^2}{1^2-\left(\sqrt{3}\right)^2}=\dfrac{\sqrt{2}+\sqrt{6}-\sqrt{3}-3}{1-3}$

$$=\frac{\sqrt{2}+\sqrt{6}-\sqrt{3}-3}{-2}$$

$$=\frac{-\left(\sqrt{2}+\sqrt{6}-\sqrt{3}-3\right)}{2}$$

$$=\frac{\sqrt{3}+3-\sqrt{2}-\sqrt{6}}{2}$$

92. $\dfrac{\sqrt{3}-\sqrt{2}}{1+\sqrt{2}} = \dfrac{\sqrt{3}-\sqrt{2}}{1+\sqrt{2}} \cdot \dfrac{1-\sqrt{2}}{1-\sqrt{2}} = \dfrac{\sqrt{3}-\sqrt{6}-\sqrt{2}+\left(\sqrt{2}\right)^2}{1^2-\left(\sqrt{2}\right)^2} = \dfrac{\sqrt{3}-\sqrt{6}-\sqrt{2}+2}{1-2}$

$$= \frac{\sqrt{3}-\sqrt{6}-\sqrt{2}+2}{-1}$$
$$= -\left(\sqrt{3}-\sqrt{6}-\sqrt{2}+2\right)$$
$$= \sqrt{6}+\sqrt{2}-\sqrt{3}-2$$

93. $\dfrac{\sqrt{x}-\sqrt{y}}{\sqrt{x}+\sqrt{y}} = \dfrac{\sqrt{x}-\sqrt{y}}{\sqrt{x}+\sqrt{y}} \cdot \dfrac{\sqrt{x}-\sqrt{y}}{\sqrt{x}-\sqrt{y}} = \dfrac{\sqrt{x^2}-\sqrt{xy}-\sqrt{xy}+\sqrt{y^2}}{\left(\sqrt{x}\right)^2-\left(\sqrt{y}\right)^2} = \dfrac{x-2\sqrt{xy}+y}{x-y}$

94. $\dfrac{\sqrt{2x}+y}{\sqrt{2x}-y} = \dfrac{\sqrt{2x}+y}{\sqrt{2x}-y} \cdot \dfrac{\sqrt{2x}+y}{\sqrt{2x}+y} = \dfrac{\sqrt{4x^2}+y\sqrt{2x}+y\sqrt{2x}+y^2}{\left(\sqrt{2x}\right)^2-y^2} = \dfrac{2x+2y\sqrt{2x}+y^2}{2x-y^2}$

95. $\dfrac{\sqrt{2}+1}{2} = \dfrac{\sqrt{2}+1}{2} \cdot \dfrac{\sqrt{2}-1}{\sqrt{2}-1} = \dfrac{\left(\sqrt{2}\right)^2-1^2}{2\left(\sqrt{2}-1\right)} = \dfrac{2-1}{2\left(\sqrt{2}-1\right)} = \dfrac{1}{2\left(\sqrt{2}-1\right)}$

96. $\dfrac{\sqrt{x}-3}{3} = \dfrac{\sqrt{x}-3}{3} \cdot \dfrac{\sqrt{x}+3}{\sqrt{x}+3} = \dfrac{\left(\sqrt{x}\right)^2-3^2}{3\left(\sqrt{x}+3\right)} = \dfrac{x-9}{3\left(\sqrt{x}+3\right)}$

97. $\dfrac{y-\sqrt{3}}{y+\sqrt{3}} = \dfrac{y-\sqrt{3}}{y+\sqrt{3}} \cdot \dfrac{y+\sqrt{3}}{y+\sqrt{3}} = \dfrac{y^2-\left(\sqrt{3}\right)^2}{y^2+y\sqrt{3}+y\sqrt{3}+\sqrt{9}} = \dfrac{y^2-3}{y^2+2y\sqrt{3}+3}$

98. $\dfrac{\sqrt{a}-\sqrt{b}}{\sqrt{a}+\sqrt{b}} = \dfrac{\sqrt{a}-\sqrt{b}}{\sqrt{a}+\sqrt{b}} \cdot \dfrac{\sqrt{a}+\sqrt{b}}{\sqrt{a}+\sqrt{b}} = \dfrac{\left(\sqrt{a}\right)^2-\left(\sqrt{b}\right)^2}{\sqrt{a^2}+\sqrt{ab}+\sqrt{ab}+\sqrt{b^2}} = \dfrac{a-b}{a+2\sqrt{ab}+b}$

99. $\dfrac{\sqrt{x+3}-\sqrt{x}}{3} = \dfrac{\sqrt{x+3}-\sqrt{x}}{3} \cdot \dfrac{\sqrt{x+3}+\sqrt{x}}{\sqrt{x+3}+\sqrt{x}} = \dfrac{\left(\sqrt{x+3}\right)^2-\left(\sqrt{x}\right)^2}{3\left(\sqrt{x+3}+\sqrt{x}\right)}$

$$= \frac{x+3-x}{3\left(\sqrt{x+3}+\sqrt{x}\right)}$$
$$= \frac{3}{3\left(\sqrt{x+3}+\sqrt{x}\right)} = \frac{1}{\sqrt{x+3}+\sqrt{x}}$$

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100. $$\frac{\sqrt{2+h}-\sqrt{2}}{h} = \frac{\sqrt{2+h}-\sqrt{2}}{h}\cdot\frac{\sqrt{2+h}+\sqrt{2}}{\sqrt{2+h}+\sqrt{2}} = \frac{\left(\sqrt{2+h}\right)^2-\left(\sqrt{2}\right)^2}{h\left(\sqrt{2+h}+\sqrt{2}\right)}$$
$$= \frac{2+h-2}{h\left(\sqrt{2+h}+\sqrt{2}\right)}$$
$$= \frac{h}{h\left(\sqrt{2+h}+\sqrt{2}\right)} = \frac{1}{\sqrt{2+h}+\sqrt{2}}$$

101. $$\frac{36a^2b^3}{18ab^6} = 2a^{2-1}b^{3-6} = 2a^1b^{-3} = \frac{2a}{b^3}$$

102. $$\frac{-45r^2s^5t^3}{27r^6s^2t^8} = -\frac{5}{3}r^{2-6}s^{5-2}t^{3-8} = -\frac{5}{3}r^{-4}s^3t^{-5} = -\frac{5s^3}{3r^4t^5}$$

103. $$\frac{16x^6y^4z^9}{-24x^9y^6z^0} = -\frac{2}{3}x^{6-9}y^{4-6}z^{9-0} = -\frac{2}{3}x^{-3}y^{-2}z^9 = -\frac{2z^9}{3x^3y^2}$$

104. $$\frac{32m^6n^4p^2}{26m^6n^7p^2} = \frac{16}{13}m^{6-6}n^{4-7}p^{2-2} = \frac{16}{13}m^0n^{-3}p^0 = \frac{16}{13n^3}$$

105. $$\frac{5x^3y^2+15x^3y^4}{10x^2y^3} = \frac{5x^3y^2}{10x^2y^3}+\frac{15x^3y^4}{10x^2y^3}$$
$$= \frac{x}{2y}+\frac{3xy}{2}$$

106. $$\frac{9m^4n^9-6m^3n^4}{12m^3n^3} = \frac{9m^4n^9}{12m^3n^3}-\frac{6m^3n^4}{12m^3n^3}$$
$$= \frac{3mn^6}{4}-\frac{n}{2}$$

107. $$\frac{24x^5y^7-36x^2y^5+12xy}{60x^5y^4} = \frac{24x^5y^7}{60x^5y^4}-\frac{36x^2y^5}{60x^5y^4}+\frac{12xy}{60x^5y^4} = \frac{2y^3}{5}-\frac{3y}{5x^3}+\frac{1}{5x^4y^3}$$

108. $$\frac{9a^3b^4+27a^2b^4-18a^2b^3}{18a^2b^7} = \frac{9a^3b^4}{18a^2b^7}+\frac{27a^2b^4}{18a^2b^7}-\frac{18a^2b^3}{18a^2b^7} = \frac{a}{2b^3}+\frac{3}{2b^3}-\frac{1}{b^4}$$

109.
$$\begin{array}{r} 3x+\ \ 2 \\ x+3\ \overline{)\ 3x^2+11x+6} \\ \underline{3x^2+\ 9x} \\ 2x+6 \\ \underline{2x+6} \\ 0 \end{array}$$

110.
$$\begin{array}{r} x+\ \ 3 \\ 3x+2\ \overline{)\ 3x^2+11x+6} \\ \underline{3x^2+\ 2x} \\ 9x+6 \\ \underline{9x+6} \\ 0 \end{array}$$

111.
$$\begin{array}{r} x-\ \ 7+\frac{2}{2x-5} \\ 2x-5\ \overline{)\ 2x^2-19x+\ \ 37} \\ \underline{2x^2-\ 5x} \\ -14x+\ \ 37 \\ \underline{-14x+\ \ 35} \\ 2 \end{array}$$

112.
$$\begin{array}{r} 2x-\ \ 5 \\ x-7\ \overline{)\ 2x^2-19x+35} \\ \underline{2x^2-14x} \\ -\ \ 5x+35 \\ \underline{-\ \ 5x+35} \\ 0 \end{array}$$

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113.
$$\begin{array}{r|l} & 2x^2+\ 2x+\ 2+\frac{3}{x-1} \\ \hline x-1 & 2x^3+0x^2+0x+\ \ 1 \\ & \underline{2x^3-2x^2} \\ & \ 2x^2+0x+\ \ 1 \\ & \ \underline{2x^2-2x} \\ & \ 2x+\ \ 1 \\ & \ \underline{2x-\ \ 2} \\ & \ \ 3 \end{array}$$

114.
$$\begin{array}{r|l} & x^2-\ \ x+\ \ 3+\frac{1}{2x-7} \\ \hline 2x-7 & 2x^3-9x^2+13x-\ \ 20 \\ & \underline{2x^3-7x^2} \\ & -2x^2+13x-\ \ 20 \\ & \ \underline{-2x^2+\ 7x} \\ & \ 6x-\ \ 20 \\ & \ \underline{6x-\ \ 21} \\ & \ \ 1 \end{array}$$

115.
$$\begin{array}{r|l} & x-\ \ 3 \\ \hline x^2+x-1 & x^3-2x^2-4x+3 \\ & \underline{x^3+\ x^2-\ x} \\ & -3x^2-3x+3 \\ & \ \underline{-3x^2-3x+3} \\ & \ 0 \end{array}$$

116.
$$\begin{array}{r|l} & x-\ \ 2+\frac{-x-1}{x^2-3} \\ \hline x^2-3 & x^3-2x^2-4x+5 \\ & \underline{x^3-3x} \\ & -2x^2-\ x+5 \\ & \ \underline{-2x^2+6} \\ & -\ x-1 \end{array}$$

117.
$$\begin{array}{r|l} & x^2-\ \ 2+\frac{-x^2+5}{x^3-2} \\ \hline x^3-2 & x^5+0x^4-2x^3-3x^2+0x+9 \\ & \underline{x^5-2x^2} \\ & -2x^3-\ x^2+0x+9 \\ & \ \underline{-2x^3+4} \\ & -\ x^2+5 \end{array}$$

118.
$$\begin{array}{r|l} & x^2-\ \ 2+\frac{3}{x^3-3} \\ \hline x^3-3 & x^5+0x^4-2x^3-3x^2+0x+9 \\ & \underline{x^5-3x^2} \\ & -2x^3+0x+9 \\ & \ \underline{-2x^3+6} \\ & \ 3 \end{array}$$

119.
$$\begin{array}{r|l} & x^4+2x^3+4x^2+\ 8x+\ \ 16 \\ \hline x-2 & x^5+0x^4+0x^3+0x^2+\ \ 0x-32 \\ & \underline{x^5-2x^4} \\ & \ 2x^4+0x^3 \\ & \ \underline{2x^4-4x^3} \\ & \ 4x^3+0x^2 \\ & \ \underline{4x^3-8x^2} \\ & \ 8x^2+\ 0x \\ & \ \underline{8x^2-16x} \\ & \ 16x-32 \\ & \ \underline{16x-32} \\ & \ 0 \end{array}$$

120.
$$\begin{array}{r|l} & x^3-\ \ x^2+\ \ x-\ \ 1 \\ \hline x+1 & x^4+0x^3+0x^2+0x-1 \\ & \underline{x^4+\ x^3} \\ & -\ x^3+0x^2 \\ & \ \underline{-x^3-\ x^2} \\ & \ x^2+0x \\ & \ \underline{x^2+\ x} \\ & -\ x-1 \\ & \ \underline{-\ x-1} \\ & \ 0 \end{array}$$

121.
$$\begin{array}{r|l} & 6x^2+\ \ \ x-\ \ \ 12 \\ \hline 6x^2+11x-10 & 36x^4+72x^3-121x^2-142x+120 \\ & \underline{36x^4+66x^3-\ \ 60x^2} \\ & \ 6x^3-\ \ 61x^2-142x \\ & \ \underline{6x^3+\ \ 11x^2-\ \ 10x} \\ & -\ \ 72x^2-132x+120 \\ & \ \underline{-\ \ 72x^2-132x+120} \\ & \ 0 \end{array}$$

122.
$$\begin{array}{r} 6x^2+\ 11x-\ \ 10 \\ 6x^2+x-12\ \overline{\big|\ 36x^4+72x^3-121x^2-142x+120} \\ \underline{36x^4+\ 6x^3-\ 72x^2} \\ 66x^3-\ 49x^2-142x \\ \underline{66x^3+\ 11x^2-132x} \\ -\ 60x^2-\ 10x+120 \\ \underline{-\ 60x^2-\ 10x+120} \\ 0 \end{array}$$

123. Area = length $\cdot$ width $= (x+5)(x-2)$ ft^2 $= (x^2-2x+5x-10)$ ft^2 $= (x^2+3x-10)$ ft^2

124.
$$\begin{aligned} \text{Area} &= \frac{1}{2}\cdot \text{base}\cdot \text{height} \\ x^2+3x-40 &= \frac{1}{2}(x+8)\cdot \text{height} \\ 2\big(x^2+3x-40\big) &= (x+8)\cdot \text{height} \\ 2x^2+6x-80 &= (x+8)\cdot \text{height} \\ \frac{2x^2+6x-80}{x+8} &= \text{height} \end{aligned}$$

$$\begin{array}{r} 2x-\ \ 10 \\ x+8\ \overline{\big|\ 2x^2+\ 6x-80} \\ \underline{2x^2+16x} \\ -\ 10x-80 \\ \underline{-\ 10x-80} \\ 0 \end{array}$$

The height is $(2x-10)$ ft.

125.
$$\begin{aligned} \text{Volume} &= l\cdot w\cdot h \\ &= (12-2x)(12-2x)x \text{ in.}^3 \\ &= \big(144-48x+4x^2\big)x \text{ in.}^3 \\ &= \big(144x-48x^2+4x^3\big) \text{ in.}^3 \end{aligned}$$

126. $t = \dfrac{d}{r} = \dfrac{3x^2+19x+20}{3x+4}$

$$\begin{array}{r} x+\ \ 5 \\ 3x+4\ \overline{\big|\ 3x^2+19x+20} \\ \underline{3x^2+\ 4x} \\ 15x+20 \\ \underline{15x+20} \\ 0 \end{array}$$

$t = x+5$

127.
$$\begin{aligned} (a+b+c)^2 = (a+b+c)(a+b+c) &= a(a+b+c)+b(a+b+c)+c(a+b+c) \\ &= a^2+ab+ac+ab+b^2+bc+ac+bc+c^2 \\ &= a^2+b^2+c^2+2ab+2bc+2ac \end{aligned}$$

128.
$$\begin{aligned} (a+b+c+d)^2 &= (a+b+c+d)(a+b+c+d) \\ &= a(a+b+c+d)+b(a+b+c+d)+c(a+b+c+d)+d(a+b+c+d) \\ &= a^2+ab+ac+ad+ab+b^2+bc+bd+ac+bc+c^2+cd+ad+bd+cd+d^2 \\ &= a^2+b^2+c^2+d^2+2ab+2ac+2ad+2bc+2bd+2cd \end{aligned}$$

129. Answers may vary.

130. Multiply the numeratior and denominator by the conjugate of the numerator $\big(\sqrt{x}-2\big)$.

131. Check the formula with $a=1$ and $b=2$.

132. Check the formula with $a=3$ and $b=4$.

133. $9^{3/2} = \big(9^{1/2}\big)^3 = 3^3 = 27$

134. $\left(\frac{8}{125}\right)^{-2/3} = \left(\frac{125}{8}\right)^{2/3} = \left(\left(\frac{125}{8}\right)^{1/3}\right)^2 = \left(\frac{5}{2}\right)^2 = \frac{25}{4}$

135. $\left(\frac{625x^4}{16y^8}\right)^{3/4} = \frac{625^{3/4}(x^4)^{3/4}}{16^{3/4}(y^8)^{3/4}} = \frac{125x^3}{8y^6}$

136. $\sqrt{80x^4} = \sqrt{16x^4}\sqrt{5} = 4x^2\sqrt{5}$

137. $\sqrt[3]{16ab^4} - b\sqrt[3]{54ab} = \sqrt[3]{8b^3}\sqrt[3]{2ab} - b\sqrt[3]{27}\sqrt[3]{2ab} = 2b\sqrt[3]{2ab} - b(3)\sqrt[3]{2ab} = 2b\sqrt[3]{2ab} - 3b\sqrt[3]{2ab}$
$= -b\sqrt[3]{2ab}$

138. $x\sqrt[4]{1{,}280x} + \sqrt[4]{80x^5} = x\sqrt[4]{256}\sqrt[4]{5x} + \sqrt[4]{16x^4}\sqrt[4]{5x} = 4x\sqrt[4]{5x} + 2x\sqrt[4]{5x} = 6x\sqrt[4]{5x}$

Exercises 0.5 (page 61)

1. factor

2. integer, prime

3. $ax + bx = x(a + b)$

4. $x^2 - y^2 = (x + y)(x - y)$

5. $x^2 + 2xy + y^2 = (x + y)(x + y) = (x + y)^2$

6. $x^2 - 2xy + y^2 = (x - y)(x - y) = (x - y)^2$

7. $x^3 + y^3 = (x + y)(x^2 - xy + y^2)$

8. $x^3 - y^3 = (x - y)(x^2 + xy + y^2)$

9. $3x - 6 = 3(x - 2)$

10. $5y - 15 = 5(y - 3)$

11. $8x^2 + 4x^3 = 4x^2(2 + x)$

12. $9y^3 + 6y^2 = 3y^2(3y + 2)$

13. $7x^2y^2 + 14x^3y^2 = 7x^2y^2(1 + 2x)$

14. $25y^2z - 15yz^2 = 5yz(5y - 3z)$

15. $a(x + y) + b(x + y) = (x + y)(a + b)$

16. $b(x - y) + a(x - y) = (x - y)(b + a)$

17. $4a + b - 12a^2 - 3ab = 4a + b - 3a(4a + b) = 1(4a + b) - 3a(4a + b) = (4a + b)(1 - 3a)$

18. $x^2 + 4x + xy + 4y = x(x + 4) + y(x + 4) = (x + 4)(x + y)$

19. $4x^2 - 9 = (2x)^2 - 3^2 = (2x + 3)(2x - 3)$

20. $36z^2 - 49 = (6z)^2 - 7^2 = (6z + 7)(6z - 7)$

21. $4 - 9r^2 = 2^2 - (3r)^2 = (2 + 3r)(2 - 3r)$

22. $16 - 49x^2 = 4^2 - (7x)^2 = (4 + 7x)(4 - 7x)$

23. $81x^4 - 1 = (9x^2)^2 - 1^2 = (9x^2 + 1)(9x^2 - 1) = (9x^2 + 1)(3x + 1)(3x - 1)$

24. $81 - x^4 = 9^2 - (x^2)^2 = (9 + x^2)(9 - x^2) = (9 + x^2)(3 + x)(3 - x)$

25. $(x + z)^2 - 25 = (x + z)^2 - 5^2$
$= (x + z + 5)(x + z - 5)$

26. $(x - y)^2 - 9 = (x - y)^2 - 3^2$
$= (x - y + 3)(x - y - 3)$

SECTION 0.5

27. $x^2 + 8x + 16 = (x + 4)(x + 4) = (x + 4)^2$

28. $a^2 - 12a + 36 = (a - 6)(a - 6) = (a - 6)^2$

29. $b^2 - 10b + 25 = (b - 5)(b - 5) = (b - 5)^2$

30. $y^2 + 14y + 49 = (y + 7)(y + 7) = (y + 7)^2$

31. $m^2 + 4mn + 4n^2 = (m + 2n)(m + 2n) = (m + 2n)^2$

32. $r^2 - 8rs + 16s^2 = (r - 4s)(r - 4s) = (r - 4s)^2$

33. $12x^2 - xy - 6y^2 = (4x - 3y)(3x + 2y)$

34. $8x^2 - 10xy - 3y^2 = (4x + y)(2x - 3y)$

35. $x^2 + 10x + 21$: $a = 1$, $b = 10$, $c = 21$
key number $= ac = 1(21) = 21$
$x^2 + 10x + 21 = x^2 + 7x + 3x + 21$
$= x(x + 7) + 3(x + 7)$
$= (x + 7)(x + 3)$

36. $x^2 + 7x + 10$: $a = 1$, $b = 7$, $c = 10$
key number $= ac = 1(10) = 10$
$x^2 + 7x + 10 = x^2 + 5x + 2x + 10$
$= x(x + 5) + 2(x + 5)$
$= (x + 5)(x + 2)$

37. $x^2 - 4x - 12$: $a = 1$, $b = -4$, $c = -12$
key number $= ac = 1(-12) = -12$
$x^2 - 4x - 12 = x^2 - 6x + 2x - 12$
$= x(x - 6) + 2(x - 6)$
$= (x - 6)(x + 2)$

38. $x^2 - 2x - 63$: $a = 1$, $b = -2$, $c = -63$
key number $= ac = 1(-63) = -63$
$x^2 - 2x - 63 = x^2 - 9x + 7x - 63$
$= x(x - 9) + 7(x - 9)$
$= (x - 9)(x + 7)$

39. $6p^2 + 7p - 3$: $a = 6$, $b = 7$, $c = -3$
key number $= ac = 6(-3) = -18$
$6p^2 + 7p - 3 = 6p^2 + 9p - 2p - 3$
$= 3p(2p + 3) - (2p + 3)$
$= (2p + 3)(3p - 1)$

40. $4q^2 - 19q + 12$: $a = 4$, $b = -19$, $c = 12$
key number $= ac = 4(12) = 48$
$4q^2 - 19q + 12 = 4q^2 - 3q - 16q + 12$
$= q(4q - 3) - 4(4q - 3)$
$= (4q - 3)(q - 4)$

41. $t^3 + 343 = t^3 + 7^3 = (t + 7)[t^2 - (t)(7) + 7^2] = (t + 7)(t^2 - 7t + 49)$

42. $r^3 + 8s^3 = r^3 + (2s)^3 = (r + 2s)\left[r^2 - (r)(2s) + (2s)^2\right] = (r + 2s)(r^2 - 2rs + 4s^2)$

43. $8z^3 - 27 = (2z)^3 - 3^3 = (2z - 3)\left[(2z)^2 + (2z)(3) + 3^2\right] = (2z - 3)(4z^2 + 6z + 9)$

44. $125a^3 - 64 = (5a)^3 - 4^3 = (5a - 4)\left[(5a)^2 + (5a)(4) + 4^2\right] = (5a - 4)(25a^2 + 20a + 16)$

45. $3a^2bc + 6ab^2c + 9abc^2 = 3abc(a + 2b + 3c)$

46. $5x^3y^3z^3 + 25x^2y^2z^2 - 125xyz = 5xyz(x^2y^2z^2 + 5xyz - 25)$

47. $3x^3 + 3x^2 - x - 1 = 3x^2(x + 1) - 1(x + 1) = (x + 1)(3x^2 - 1)$

48. $4x + 6xy - 9y - 6 = 2x(2 + 3y) - 3(3y + 2) = (3y + 2)(2x - 3)$

49. $2txy + 2ctx - 3ty - 3ct = t(2xy + 2cx - 3y - 3c) = t[2x(y + c) - 3(y + c)] = t(y + c)(2x - 3)$

SECTION 0.5

50. $2ax + 4ay - bx - 2by = 2a(x + 2y) - b(x + 2y) = (x + 2y)(2a - b)$

51. $ax + bx + ay + by + az + bz = x(a + b) + y(a + b) + z(a + b) = (a + b)(x + y + z)$

52. $6x^2y^3 + 18xy + 3x^2y^2 + 9x = 3x\big(2xy^3 + 6y + xy^2 + 3\big) = 3x\big[2y\big(xy^2 + 3\big) + 1\big(xy^2 + 3\big)\big]$
$= 3x\big(xy^2 + 3\big)(2y + 1)$

53. $x^2 - (y - z)^2 = [x + (y - z)][x - (y - z)]$
$= (x + y - z)(x - y + z)$

54. $z^2 - (y + 3)^2 = [z + (y + 3)][z - (y + 3)]$
$= (z + y + 3)(z - y - 3)$

55. $(x - y)^2 - (x + y)^2 = [(x - y) + (x + y)][(x - y) - (x + y)] = (x - y + x + y)(x - y - x - y)$
$= (2x)(-2y) = -4xy$

56. $(2a + 3)^2 - (2a - 3)^2 = [(2a + 3) + (2a - 3)][(2a + 3) - (2a - 3)]$
$= (2a + 3 + 2a - 3)(2a + 3 - 2a + 3) = (4a)(6) = 24a$

57. $x^4 - y^4 = (x^2)^2 - (y^2)^2 = (x^2 + y^2)(x^2 - y^2) = (x^2 + y^2)(x + y)(x - y)$

58. $z^4 - 81 = (z^2)^2 - 9^2 = (z^2 + 9)(z^2 - 9) = (z^2 + 9)(z^2 - 3^2) = (z^2 + 9)(z + 3)(z - 3)$

59. $3x^2 - 12 = 3(x^2 - 4) = 3(x + 2)(x - 2)$

60. $3x^3y - 3xy = 3xy\big(x^2 - 1\big)$
$= 3xy(x + 1)(x - 1)$

61. $18xy^2 - 8x = 2x\big(9y^2 - 4\big)$
$= 2x(3y + 2)(3y - 2)$

62. $27x^2 - 12 = 3\big(9x^2 - 4\big)$
$= 3(3x + 2)(3x - 2)$

63. $x^2 - 2x + 15 \Rightarrow$ prime

64. $x^2 + x + 2 \Rightarrow$ prime

65. $-15 + 2a + 24a^2 = 24a^2 + 2a - 15$
$= (6a + 5)(4a - 3)$

66. $-32 - 68x + 9x^2 = 9x^2 - 68x - 32$
$= (9x + 4)(x - 8)$

67. $6x^2 + 29xy + 35y^2 = (3x + 7y)(2x + 5y)$

68. $10x^2 - 17xy + 6y^2 = (5x - 6y)(2x - y)$

69. $12p^2 - 58pq - 70q^2 = 2(6p^2 - 29pq - 35q^2) = 2(6p - 35q)(p + q)$

70. $3x^2 - 6xy - 9y^2 = 3(x^2 - 2xy - 3y^2) = 3(x - 3y)(x + y)$

71. $-6m^2 + 47mn - 35n^2 = -(6m^2 - 47mn + 35n^2) = -(6m - 5n)(m - 7n)$

72. $-14r^2 - 11rs + 15s^2 = -(14r^2 + 11rs - 15s^2) = -(7r - 5s)(2r + 3s)$

73. $-6x^3 + 23x^2 + 35x = -x(6x^2 - 23x - 35) = -x(6x + 7)(x - 5)$

74. $-y^3 - y^2 + 90y = -y(y^2 + y - 90) = -y(y + 10)(y - 9)$

75. $6x^4 - 11x^3 - 35x^2 = x^2(6x^2 - 11x - 35) = x^2(2x - 7)(3x + 5)$

76. $12x + 17x^2 - 7x^3 = -7x^3 + 17x^2 + 12x = -x(7x^2 - 17x - 12) = -x(x - 3)(7x + 4)$

77. $x^4 + 2x^2 - 15 = (x^2 + 5)(x^2 - 3)$

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

79. $a^{2n} - 2a^n - 3 = (a^n - 3)(a^n + 1)$

80. $a^{2n} + 6a^n + 8 = (a^n + 4)(a^n + 2)$

81. $6x^{2n} - 7x^n + 2 = (3x^n - 2)(2x^n - 1)$

82. $9x^{2n} + 9x^n + 2 = (3x^n + 2)(3x^n + 1)$

83. $4x^{2n} - 9y^{2n} = (2x^n)^2 - (3y^n)^2$
$= (2x^n + 3y^n)(2x^n - 3y^n)$

84. $8x^{2n} - 2x^n - 3 = (4x^n - 3)(2x^n + 1)$

85. $10y^{2n} - 11y^n - 6 = (5y^n + 2)(2y^n - 3)$

86. $16y^{4n} - 25y^{2n} = y^{2n}\big(16y^{2n} - 25\big)$
$= y^{2n}\big[(4y^n)^2 - 5^2\big]$
$= y^{2n}(4y^n + 5)(4y^n - 5)$

87. $2x^3 + 2{,}000 = 2(x^3 + 1{,}000) = 2(x^3 + 10^3) = 2(x + 10)(x^2 - 10x + 100)$

88. $3y^3 + 648 = 3(y^3 + 216) = 3(y^3 + 6^3) = 3(y + 6)(y^2 - 6y + 36)$

89. $(x + y)^3 - 64 = (x + y)^3 - 4^3 = [(x + y) - 4]\big[(x + y)^2 + 4(x + y) + 4^2\big]$
$= (x + y - 4)\big(x^2 + 2xy + y^2 + 4x + 4y + 16\big)$

90. $(x - y)^3 + 27 = (x - y)^3 + 3^3 = [(x - y) + 3]\big[(x - y)^2 - 3(x - y) + 3^2\big]$
$= (x - y + 3)\big(x^2 - 2xy + y^2 - 3x + 3y + 9\big)$

91. $64a^6 - y^6 = \big(8a^3\big)^2 - \big(y^3\big)^2 = \big(8a^3 + y^3\big)\big(8a^3 - y^3\big)$
$= (2a + y)\big(4a^2 - 2ay + y^2\big)(2a - y)\big(4a^2 + 2ay + y^2\big)$
$= (2a + y)(2a - y)\big(4a^2 - 2ay + y^2\big)\big(4a^2 + 2ay + y^2\big)$

92. $a^6 + b^6 = (a^2)^3 + (b^2)^3 = (a^2 + b^2)\Big((a^2)^2 - a^2b^2 + (b^2)^2\Big) = (a^2 + b^2)(a^4 - a^2b^2 + b^4)$

93. $a^3 - b^3 + a - b = (a - b)(a^2 + ab + b^2) + (a - b)1 = (a - b)(a^2 + ab + b^2 + 1)$

94. $(a^2 - y^2) - 5(a + y) = (a + y)(a - y) - 5(a + y) = (a + y)(a - y - 5)$

95. $64x^6 + y^6 = \big(4x^2\big)^3 + \big(y^2\big)^3 = \big(4x^2 + y^2\big)\Big(\big(4x^2\big)^2 - 4x^2y^2 + \big(y^2\big)^2\Big)$
$= \big(4x^2 + y^2\big)\big(16x^4 - 4x^2y^2 + y^4\big)$

96. $z^2 + 6z + 9 - 225y^2 = (z + 3)(z + 3) - 225y^2 = (z + 3)^2 - (15y)^2$
$= (z + 3 + 15y)(z + 3 - 15y)$

97. $x^2 - 6x + 9 - 144y^2 = (x-3)(x-3) - 144y^2 = (x-3)^2 - (12y)^2$
$= (x - 3 + 12y)(x - 3 - 12y)$

98. $x^2 + 2x - 9y^2 + 1 = x^2 + 2x + 1 - 9y^2 = (x+1)(x+1) - 9y^2$
$= (x+1)^2 - (3y)^2 = (x + 1 + 3y)(x + 1 - 3y)$

99. $(a+b)^2 - 3(a+b) - 10 = [(a+b) - 5][(a+b) + 2] = (a + b - 5)(a + b + 2)$

100. $2(a+b)^2 - 5(a+b) - 3 = [2(a+b) + 1][(a+b) - 3] = (2a + 2b + 1)(a + b - 3)$

101. $x^6 + 7x^3 - 8 = (x^3 + 8)(x^3 - 1) = (x + 2)(x^2 - 2x + 4)(x - 1)(x^2 + x + 1)$

102. $x^6 - 13x^4 + 36x^2 = x^2(x^4 - 13x^2 + 36) = x^2(x^2 - 9)(x^2 - 4) = x^2(x + 3)(x - 3)(x + 2)(x - 2)$

103. $x^4 + x^2 + 1 = x^4 + 2x^2 + 1 - x^2$
$= \big(x^2 + 1\big)\big(x^2 + 1\big) - x^2$
$= \big(x^2 + 1\big)^2 - x^2$
$= \big(x^2 + 1 + x\big)\big(x^2 + 1 - x\big)$

104. $x^4 + 3x^2 + 4 = x^4 + 4x^2 + 4 - x^2$
$= \big(x^2 + 2\big)\big(x^2 + 2\big) - x^2$
$= \big(x^2 + 2\big)^2 - x^2$
$= \big(x^2 + 2 + x\big)\big(x^2 + 2 - x\big)$

105. $x^4 + 7x^2 + 16 = x^4 + 8x^2 + 16 - x^2$
$= \big(x^2 + 4\big)\big(x^2 + 4\big) - x^2$
$= \big(x^2 + 4\big)^2 - x^2$
$= \big(x^2 + 4 + x\big)\big(x^2 + 4 - x\big)$

106. $y^4 + 2y^2 + 9 = y^4 + 6y^2 + 9 - 4y^2$
$= \big(y^2 + 3\big)\big(y^2 + 3\big) - 4y^2$
$= \big(y^2 + 3\big)^2 - (2y)^2$
$= \big(y^2 + 3 + 2y\big)\big(y^2 + 3 - 2y\big)$

107. $4a^4 + 1 + 3a^2 = 4a^4 + 4a^2 + 1 - a^2 = \big(2a^2 + 1\big)\big(2a^2 + 1\big) - a^2 = \big(2a^2 + 1\big)^2 - a^2$
$= \big(2a^2 + 1 + a\big)\big(2a^2 + 1 - a\big)$

108. $x^4 + 25 + 6x^2 = x^4 + 10x^2 + 25 - 4x^2 = \big(x^2 + 5\big)\big(x^2 + 5\big) - 4x^2$
$= \big(x^2 + 5\big)^2 - (2x)^2 = \big(x^2 + 5 + 2x\big)\big(x^2 + 5 - 2x\big)$

109. $V = \dfrac{4}{3}\pi r_1^3 - \dfrac{4}{3}\pi r_2^3$
$= \dfrac{4}{3}\pi\big(r_1^3 - r_2^3\big)$
$= \dfrac{4}{3}\pi(r_1 - r_2)\big(r_1^2 + r_1 r_2 + r_2^2\big)$

110. $f = 144 - 16t^2$
$= 16\big(9 - t^2\big)$
$= 16(3 + t)(3 - t)$

111-114. Answers may vary.

115. $3x + 2 = 2\big(\frac{3x}{2} + \frac{2}{2}\big) = 2\big(\frac{3}{2}x + 1\big)$

116. $5x - 3 = 5\big(\frac{5x}{5} - \frac{3}{5}\big) = 5\big(x - \frac{3}{5}\big)$

117. $x^2 + 2x + 4 = 2\Big(\frac{x^2}{2} + \frac{2x}{2} + \frac{4}{2}\Big)$
$= 2\big(\frac{1}{2}x^2 + x + 2\big)$

118. $3x^2 - 2x - 5 = 3\Big(\frac{3x^2}{3} - \frac{2x}{3} - \frac{5}{3}\Big)$
$= 3\big(x^2 - \frac{2}{3}x - \frac{5}{3}\big)$

119. $a+b=a\left(\frac{a}{a}+\frac{b}{a}\right)=a\left(1+\frac{b}{a}\right)$

120. $a-b=b\left(\frac{a}{b}-\frac{b}{b}\right)=b\left(\frac{a}{b}-1\right)$

121. $x+x^{1/2}=x^{1/2}\left(x^{1-1/2}+x^{1/2-1/2}\right)$
$=x^{1/2}\left(x^{1/2}+1\right)$

122. $x^{3/2}-x^{1/2}=x^{1/2}\left(x^{3/2-1/2}-x^{1/2-1/2}\right)$
$=x^{1/2}(x-1)$

123. $2x+\sqrt{2}y=\sqrt{2}\left(\dfrac{2x}{\sqrt{2}}+\dfrac{\sqrt{2}y}{\sqrt{2}}\right)$
$=\sqrt{2}\left(\sqrt{2}x+y\right)$

124. $\sqrt{3}a-3b=\sqrt{3}\left(\dfrac{\sqrt{3}a}{\sqrt{3}}-\dfrac{3b}{\sqrt{3}}\right)$
$=\sqrt{3}\left(a-\sqrt{3}b\right)$

125. $ab^{3/2}-a^{3/2}b=ab\left(\dfrac{ab^{3/2}}{ab}-\dfrac{a^{3/2}b}{ab}\right)$
$=ab\left(b^{1/2}-a^{1/2}\right)$

126. $ab^2+b=b^{-1}\left(\dfrac{ab^2}{b^{-1}}+\dfrac{b}{b^{-1}}\right)$
$=b^{-1}\left(ab^3+b^2\right)$

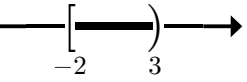
127. $x^2+x-6+xy-2y=(x+3)(x-2)+y(x-2)=(x-2)(x+3+y)$

128. $2x^2+5x+2-xy-2y=(2x+1)(x+2)-y(x+2)=(x+2)(2x+1-y)$

129. $a^4+2a^3+a^2+a+1=a^2\left(a^2+2a+1\right)+a+1=a^2(a+1)(a+1)+1(a+1)$
$=(a+1)\left[a^2(a+1)+1\right]$
$=(a+1)\left(a^3+a^2+1\right)$

130. $a^4+a^3-2a^2+a-1=a^2\left(a^2+a-2\right)+a-1=a^2(a+2)(a-1)+1(a-1)$
$=(a-1)\left[a^2(a+2)+1\right]$
$=(a-1)\left(a^3+2a^2+1\right)$

131. The number 1 is neither prime nor composite.

132. $[-2,3)\Rightarrow$ 

133. $(x^3x^2)^4=(x^5)^4=x^{20}$

134. $\dfrac{(a^3)^3(a^2)^4}{(a^2a^3)^3}=\dfrac{a^9a^8}{(a^5)^3}=\dfrac{a^{17}}{a^{15}}=a^2$

135. $\left(\dfrac{3x^4x^3}{6x^{-2}x^4}\right)^0=1$

136. $\sqrt{20x^5}=\sqrt{4x^4}\sqrt{5x}=2x^2\sqrt{5x}$

137. $\sqrt{20x}-\sqrt{125x}=\sqrt{4}\sqrt{5x}-\sqrt{25}\sqrt{5x}=2\sqrt{5x}-5\sqrt{5x}=-3\sqrt{5x}$

138. $\dfrac{3}{\sqrt[3]{3}}=\dfrac{3}{\sqrt[3]{3}}\cdot\dfrac{\sqrt[3]{9}}{\sqrt[3]{9}}=\dfrac{3\sqrt[3]{9}}{\sqrt[3]{27}}=\dfrac{3\sqrt[3]{9}}{3}=\sqrt[3]{9}$

Exercises 0.6 (page 71)

1. numerator **2.** denominator **3.** $ad = bc$ **4.** zero

5. $\dfrac{ac}{bd}$ **6.** $\dfrac{ad}{bc}$ **7.** $\dfrac{a+c}{b}$ **8.** $\dfrac{a-c}{b}$

9.
$$\frac{8x}{3y} \stackrel{?}{=} \frac{16x}{6y}$$
$$8x \cdot 6y \stackrel{?}{=} 3y \cdot 16x$$
$$48xy = 48xy$$
EQUAL

10.
$$\frac{3x^2}{4y^2} \stackrel{?}{=} \frac{12y^2}{16x^2}$$
$$3x^2 \cdot 16x^2 \stackrel{?}{=} 4y^2 \cdot 12y^2$$
$$48x^4 \neq 48y^4$$
NOT EQUAL

11.
$$\frac{25xyz}{12ab^2c} \stackrel{?}{=} \frac{50a^2bc}{24xyz}$$
$$25xyz \cdot 24xyz \stackrel{?}{=} 12ab^2c \cdot 50a^2bc$$
$$600x^2y^2z^2 \neq 600a^3b^3c^2$$
NOT EQUAL

12.
$$\frac{15rs^2}{4rs^2} \stackrel{?}{=} \frac{37.5a^3}{10a^3}$$
$$15rs^2 \cdot 10a^3 \stackrel{?}{=} 4rs^2 \cdot 37.5a^3$$
$$150rs^2a^3 = 150rs^2a^3$$
EQUAL

13. $\dfrac{7a^2b}{21ab^2} = \dfrac{a \cdot 7ab}{3b \cdot 7ab} = \dfrac{a}{3b} \cdot \dfrac{7ab}{7ab} = \dfrac{a}{3b}$

14. $\dfrac{35p^3q^2}{49p^4q} = \dfrac{5q \cdot 7p^3q}{7p \cdot 7p^3q} = \dfrac{5q}{7p} \cdot \dfrac{7p^3q}{7p^3q} = \dfrac{5q}{7p}$

15. $\dfrac{4x}{7} \cdot \dfrac{2}{5a} = \dfrac{4x \cdot 2}{7 \cdot 5a} = \dfrac{8x}{35a}$

16. $\dfrac{-5y}{2z} \cdot \dfrac{4}{y^2} = \dfrac{-5y \cdot 4}{2z \cdot y^2} = \dfrac{-20y}{2y^2z} = -\dfrac{10}{yz}$

17. $\dfrac{8m}{5n} \div \dfrac{3m}{10n} = \dfrac{8m}{5n} \cdot \dfrac{10n}{3m} = \dfrac{80mn}{15mn} = \dfrac{16}{3}$

18. $\dfrac{15p}{8q} \div \dfrac{-5p}{16q^2} = \dfrac{15p}{8q} \cdot \dfrac{16q^2}{-5p} = \dfrac{240pq^2}{-40pq} = -6q$

19. $\dfrac{3z}{5c} + \dfrac{2z}{5c} = \dfrac{3z + 2z}{5c} = \dfrac{5z}{5c} = \dfrac{z}{c}$

20. $\dfrac{7a}{4b} - \dfrac{3a}{4b} = \dfrac{7a - 3a}{4b} = \dfrac{4a}{4b} = \dfrac{a}{b}$

21. $\dfrac{15x^2y}{7a^2b^3} - \dfrac{x^2y}{7a^2b^3} = \dfrac{14x^2y}{7a^2b^3} = \dfrac{2x^2y}{a^2b^3}$

22. $\dfrac{8rst^2}{15m^4t^2} + \dfrac{7rst^2}{15m^4t^2} = \dfrac{15rst^2}{15m^4t^2} = \dfrac{rs}{m^4}$

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

24. $\dfrac{x^2-16}{x^2-8x+16} = \dfrac{(x+4)(x-4)}{(x-4)(x-4)} = \dfrac{x+4}{x-4}$

25. $\dfrac{4-x^2}{x^2-5x+6} = \dfrac{(2+x)(2-x)}{(x-3)(x-2)} = -\dfrac{x+2}{x-3}$

26. $\dfrac{25-x^2}{x^2+10x+25} = \dfrac{(5+x)(5-x)}{(x+5)(x+5)} = \dfrac{5-x}{x+5} = -\dfrac{x-5}{x+5}$

27. $\dfrac{6x^3+x^2-12x}{4x^3+4x^2-3x} = \dfrac{x(6x^2+x-12)}{x(4x^2+4x-3)} = \dfrac{x(2x+3)(3x-4)}{x(2x+3)(2x-1)} = \dfrac{3x-4}{2x-1}$

SECTION 0.6

28. $\dfrac{6x^4-5x^3-6x^2}{2x^3-7x^2-15x}=\dfrac{x^2(6x^2-5x-6)}{x(2x^2-7x-15)}=\dfrac{x^2(2x-3)(3x+2)}{x(2x+3)(x-5)}=\dfrac{x(2x-3)(3x+2)}{(2x+3)(x-5)}$

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

30. $\dfrac{xy+2x+3y+6}{x^3+27}=\dfrac{x(y+2)+3(y+2)}{x^3+3^3}=\dfrac{(y+2)(x+3)}{(x+3)(x^2-3x+9)}=\dfrac{y+2}{x^2-3x+9}$

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

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

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

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

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

36. $\dfrac{x^2+5x+6}{x^2+6x+9}\cdot\dfrac{x+2}{x^2-4}=\dfrac{(x+2)(x+3)}{(x+3)(x+3)}\cdot\dfrac{x+2}{(x+2)(x-2)}=\dfrac{x+2}{(x+3)(x-2)}$

37. $\dfrac{2x^2+32}{8}\div\dfrac{x^2+16}{2}=\dfrac{2x^2+32}{8}\cdot\dfrac{2}{x^2+16}=\dfrac{2(x^2+16)}{8}\cdot\dfrac{2}{x^2+16}=\dfrac{1}{2}$

38. $\dfrac{x^2+x-6}{x^2-6x+9}\div\dfrac{x^2-4}{x^2-9}=\dfrac{x^2+x-6}{x^2-6x+9}\cdot\dfrac{x^2-9}{x^2-4}=\dfrac{(x+3)(x-2)}{(x-3)(x-3)}\cdot\dfrac{(x+3)(x-3)}{(x+2)(x-2)}$

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

39. $\dfrac{z^2+z-20}{z^2-4}\div\dfrac{z^2-25}{z-5}=\dfrac{z^2+z-20}{z^2-4}\cdot\dfrac{z-5}{z^2-25}=\dfrac{(z+5)(z-4)}{(z+2)(z-2)}\cdot\dfrac{z-5}{(z+5)(z-5)}$

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

SECTION 0.6

40. $$\frac{ax+bx+a+b}{a^2+2ab+b^2} \div \frac{x^2-1}{x^2-2x+1} = \frac{ax+bx+a+b}{a^2+2ab+b^2} \cdot \frac{x^2-2x+1}{x^2-1}$$
$$= \frac{x(a+b)+1(a+b)}{(a+b)(a+b)} \cdot \frac{(x-1)(x-1)}{(x+1)(x-1)}$$
$$= \frac{(a+b)(x+1)}{(a+b)(a+b)} \cdot \frac{(x-1)(x-1)}{(x+1)(x-1)} = \frac{x-1}{a+b}$$

41. $$\frac{3x^2+5x-2}{x^3+2x^2} \div \frac{6x^2+13x-5}{2x^3+5x^2} = \frac{3x^2+5x-2}{x^3+2x^2} \cdot \frac{2x^3+5x^2}{6x^2+13x-5}$$
$$= \frac{(3x-1)(x+2)}{x^2(x+2)} \cdot \frac{x^2(2x+5)}{(3x-1)(2x+5)} = 1$$

42. $$\frac{x^2+13x+12}{8x^2-6x-5} \div \frac{2x^2-x-3}{8x^2-14x+5} = \frac{x^2+13x+12}{8x^2-6x-5} \cdot \frac{8x^2-14x+5}{2x^2-x-3}$$
$$= \frac{(x+12)(x+1)}{(4x-5)(2x+1)} \cdot \frac{(4x-5)(2x-1)}{(2x-3)(x+1)} = \frac{(x+12)(2x-1)}{(2x+1)(2x-3)}$$

43. $$\frac{x^2+7x+12}{x^3-x^2-6x} \cdot \frac{x^2-3x-10}{x^2+2x-3} \cdot \frac{x^3-4x^2+3x}{x^2-x-20}$$
$$= \frac{(x+3)(x+4)}{x(x-3)(x+2)} \cdot \frac{(x-5)(x+2)}{(x+3)(x-1)} \cdot \frac{x(x-3)(x-1)}{(x-5)(x+4)} = 1$$

44. $$\frac{x(x-2)-3}{x(x+7)-3(x-1)} \cdot \frac{x(x+1)-2}{x(x-7)+3(x+1)} = \frac{x^2-2x-3}{x^2+7x-3x+3} \cdot \frac{x^2+x-2}{x^2-7x+3x+3}$$
$$= \frac{x^2-2x-3}{x^2+4x+3} \cdot \frac{x^2+x-2}{x^2-4x+3}$$
$$= \frac{(x-3)(x+1)}{(x+3)(x+1)} \cdot \frac{(x+2)(x-1)}{(x-3)(x-1)} = \frac{x+2}{x+3}$$

45. $$\frac{x^2-2x-3}{21x^2-50x-16} \cdot \frac{3x-8}{x-3} \div \frac{x^2+6x+5}{7x^2-33x-10} = \frac{x^2-2x-3}{21x^2-50x-16} \cdot \frac{3x-8}{x-3} \cdot \frac{7x^2-33x-10}{x^2+6x+5}$$
$$= \frac{(x-3)(x+1)}{(7x+2)(3x-8)} \cdot \frac{3x-8}{x-3} \cdot \frac{(7x+2)(x-5)}{(x+5)(x+1)}$$
$$= \frac{x-5}{x+5}$$

SECTION 0.6

46. $\dfrac{x^3+27}{x^2-4} \div \left(\dfrac{x^2+4x+3}{x^2+2x} \div \dfrac{x^2+x-6}{x^2-3x+9}\right) = \dfrac{x^3+27}{x^2-4} \div \left(\dfrac{x^2+4x+3}{x^2+2x} \cdot \dfrac{x^2-3x+9}{x^2+x-6}\right)$

$= \dfrac{x^3+27}{x^2-4} \div \left(\dfrac{(x+3)(x+1)}{x(x+2)} \cdot \dfrac{x^2-3x+9}{(x+3)(x-2)}\right)$

$= \dfrac{x^3+27}{x^2-4} \div \dfrac{(x+1)(x^2-3x+9)}{x(x+2)(x-2)}$

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

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

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

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

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

50. $\dfrac{6x}{x-2} - \dfrac{3}{x-2} = \dfrac{6x-3}{x-2} = \dfrac{3(2x-1)}{x-2}$

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

52. $\dfrac{3}{x-6} - \dfrac{2}{6-x} = \dfrac{3}{x-6} - \dfrac{-2}{x-6} = \dfrac{5}{x-6}$

53. $\dfrac{3}{x+1} + \dfrac{2}{x-1} = \dfrac{3(x-1)}{(x+1)(x-1)} + \dfrac{2(x+1)}{(x-1)(x+1)} = \dfrac{3x-3}{(x+1)(x-1)} + \dfrac{2x+2}{(x-1)(x+1)}$

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

54. $\dfrac{3}{x+4} + \dfrac{x}{x-4} = \dfrac{3(x-4)}{(x+4)(x-4)} + \dfrac{x(x+4)}{(x-4)(x+4)} = \dfrac{3x-12}{(x+4)(x-4)} + \dfrac{x^2+4x}{(x-4)(x+4)}$

$= \dfrac{x^2+7x-12}{(x+4)(x-4)}$

55. $\dfrac{a+3}{a^2+7a+12} + \dfrac{a}{a^2-16} = \dfrac{a+3}{(a+3)(a+4)} + \dfrac{a}{(a+4)(a-4)}$

$= \dfrac{1}{a+4} + \dfrac{a}{(a+4)(a-4)}$

$= \dfrac{1(a-4)}{(a+4)(a-4)} + \dfrac{a}{(a+4)(a-4)}$

$= \dfrac{a-4}{(a+4)(a-4)} + \dfrac{a}{(a+4)(a-4)}$

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

SECTION 0.6

56. $$\frac{a}{a^2+a-2}+\frac{2}{a^2-5a+4}=\frac{a}{(a+2)(a-1)}+\frac{2}{(a-4)(a-1)}$$
$$=\frac{a(a-4)}{(a+2)(a-1)(a-4)}+\frac{2(a+2)}{(a-4)(a-1)(a+2)}$$
$$=\frac{a^2-4a}{(a+2)(a-1)(a-4)}+\frac{2a+4}{(a+2)(a-1)(a-4)}$$
$$=\frac{a^2-2a+4}{(a+2)(a-1)(a-4)}$$

57. $$\frac{x}{x^2-4}-\frac{1}{x+2}=\frac{x}{(x+2)(x-2)}-\frac{1}{x+2}=\frac{x}{(x+2)(x-2)}-\frac{1(x-2)}{(x+2)(x-2)}$$
$$=\frac{x}{(x+2)(x-2)}-\frac{x-2}{(x+2)(x-2)}$$
$$=\frac{2}{(x+2)(x-2)}$$

58. $$\frac{b^2}{b^2-4}-\frac{4}{b^2+2b}=\frac{b^2}{(b+2)(b-2)}-\frac{4}{b(b+2)}=\frac{b^2(b)}{b(b+2)(b-2)}-\frac{4(b-2)}{b(b+2)(b-2)}$$
$$=\frac{b^3}{b(b+2)(b-2)}-\frac{4b-8}{b(b+2)(b-2)}$$
$$=\frac{b^3-4b+8}{b(b+2)(b-2)}$$

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

60. $$\frac{2t}{t^2-25}-\frac{t+1}{t^2+5t}=\frac{2t}{(t+5)(t-5)}-\frac{t+1}{t(t+5)}=\frac{2t(t)}{t(t+5)(t-5)}-\frac{(t+1)(t-5)}{t(t+5)(t-5)}$$
$$=\frac{2t^2}{t(t+5)(t-5)}-\frac{t^2-4t-5}{t(t+5)(t-5)}$$
$$=\frac{t^2+4t+5}{t(t+5)(t-5)}$$

61. $$\frac{2}{y^2-1}+3+\frac{1}{y+1}=\frac{2}{(y+1)(y-1)}+\frac{3}{1}+\frac{1}{y+1}$$
$$=\frac{2}{(y+1)(y-1)}+\frac{3(y+1)(y-1)}{1(y+1)(y-1)}+\frac{1(y-1)}{(y+1)(y-1)}$$
$$=\frac{2}{(y+1)(y-1)}+\frac{3y^2-3}{(y+1)(y-1)}+\frac{y-1}{(y+1)(y-1)}$$
$$=\frac{3y^2+y-2}{(y+1)(y-1)}=\frac{(3y-2)(y+1)}{(y+1)(y-1)}=\frac{3y-2}{y-1}$$

62. $$2+\frac{4}{t^2-4}-\frac{1}{t-2}=\frac{2}{1}+\frac{4}{(t+2)(t-2)}-\frac{1}{t-2}$$
$$=\frac{2(t+2)(t-2)}{1(t+2)(t-2)}+\frac{4}{(t+2)(t-2)}-\frac{1(t+2)}{(t+2)(t-2)}$$
$$=\frac{2t^2-8}{(t+2)(t-2)}+\frac{4}{(t+2)(t-2)}-\frac{t+2}{(t+2)(t-2)}$$
$$=\frac{2t^2-t-6}{(t+2)(t-2)}=\frac{(2t+3)(t-2)}{(t+2)(t-2)}=\frac{2t+3}{t+2}$$

63. $$\frac{1}{x-2}+\frac{3}{x+2}-\frac{3x-2}{x^2-4}=\frac{1}{x-2}+\frac{3}{x+2}-\frac{3x-2}{(x+2)(x-2)}$$
$$=\frac{1(x+2)}{(x-2)(x+2)}+\frac{3(x-2)}{(x+2)(x-2)}-\frac{3x-2}{(x+2)(x-2)}$$
$$=\frac{x+2}{(x+2)(x-2)}+\frac{3x-6}{(x+2)(x-2)}-\frac{3x-2}{(x+2)(x-2)}$$
$$=\frac{x-2}{(x+2)(x-2)}=\frac{1}{x+2}$$

64. $$\frac{x}{x-3}-\frac{5}{x+3}+\frac{3(3x-1)}{x^2-9}=\frac{x}{x-3}-\frac{5}{x+3}+\frac{9x-3}{(x+3)(x-3)}$$
$$=\frac{x(x+3)}{(x-3)(x+3)}-\frac{5(x-3)}{(x+3)(x-3)}+\frac{9x-3}{(x+3)(x-3)}$$
$$=\frac{x^2+3x}{(x+3)(x-3)}-\frac{5x-15}{(x+3)(x-3)}+\frac{9x-3}{(x+3)(x-3)}$$
$$=\frac{x^2+7x+12}{(x+3)(x-3)}=\frac{(x+3)(x+4)}{(x+3)(x-3)}=\frac{x+4}{x-3}$$

65. $$\left(\frac{1}{x-2}+\frac{1}{x-3}\right)\cdot\frac{x-3}{2x}=\left(\frac{1(x-3)}{(x-2)(x-3)}+\frac{1(x-2)}{(x-3)(x-2)}\right)\cdot\frac{x-3}{2x}$$
$$=\left(\frac{x-3}{(x-2)(x-3)}+\frac{x-2}{(x-2)(x-3)}\right)\cdot\frac{x-3}{2x}$$
$$=\frac{2x-5}{(x-2)(x-3)}\cdot\frac{x-3}{2x}=\frac{2x-5}{2x(x-2)}$$

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66. $$\left(\frac{1}{x+1}-\frac{1}{x-2}\right)\div\frac{1}{x-2}=\left(\frac{1(x-2)}{(x+1)(x-2)}-\frac{1(x+1)}{(x-2)(x+1)}\right)\cdot\frac{x-2}{1}$$
$$=\left(\frac{x-2}{(x+1)(x-2)}-\frac{x+1}{(x+1)(x-2)}\right)\cdot\frac{x-2}{1}$$
$$=\frac{-3}{(x+1)(x-2)}\cdot\frac{x-2}{1}=\frac{-3}{x+1}$$

67. $$\frac{3x}{x-4}-\frac{x}{x+4}-\frac{3x+1}{16-x^2}=\frac{3x}{x-4}-\frac{x}{x+4}-\frac{3x+1}{(4+x)(4-x)}$$
$$=\frac{3x}{x-4}-\frac{x}{x+4}+\frac{3x+1}{(x+4)(x-4)}$$
$$=\frac{3x(x+4)}{(x-4)(x+4)}-\frac{x(x-4)}{(x+4)(x-4)}+\frac{3x+1}{(x+4)(x-4)}$$
$$=\frac{3x^2+12x}{(x+4)(x-4)}-\frac{x^2-4x}{(x+4)(x-4)}+\frac{3x+1}{(x+4)(x-4)}$$
$$=\frac{2x^2+19x+1}{(x+4)(x-4)}$$

68. $$\frac{7x}{x-5}+\frac{3x}{5-x}+\frac{3x-1}{x^2-25}=\frac{7x}{x-5}+\frac{-3x}{x-5}+\frac{3x-1}{(x+5)(x-5)}$$
$$=\frac{4x}{x-5}+\frac{3x-1}{(x+5)(x-5)}$$
$$=\frac{4x(x+5)}{(x-5)(x+5)}+\frac{3x-1}{(x+5)(x-5)}$$
$$=\frac{4x^2+20x}{(x+5)(x-5)}+\frac{3x-1}{(x+5)(x-5)}=\frac{4x^2+23x-1}{(x+5)(x-5)}$$

69. $$\frac{1}{x^2+3x+2}-\frac{2}{x^2+4x+3}+\frac{1}{x^2+5x+6}$$
$$=\frac{1}{(x+2)(x+1)}-\frac{2}{(x+3)(x+1)}+\frac{1}{(x+2)(x+3)}$$
$$=\frac{1(x+3)}{(x+2)(x+1)(x+3)}-\frac{2(x+2)}{(x+3)(x+1)(x+2)}+\frac{1(x+1)}{(x+2)(x+3)(x+1)}$$
$$=\frac{x+3}{(x+2)(x+1)(x+3)}-\frac{2x+4}{(x+2)(x+1)(x+3)}+\frac{x+1}{(x+2)(x+1)(x+3)}$$
$$=\frac{x+3-2x-4+x+1}{(x+2)(x+1)(x+3)}=\frac{0}{(x+2)(x+1)(x+3)}=0$$

70. $$\begin{aligned}\frac{-2}{x-y}+\frac{2}{x-z}-\frac{2z-2y}{(y-x)(z-x)} &= \frac{2}{y-x}+\frac{-2}{z-x}-\frac{2z-2y}{(y-x)(z-x)}\\ &= \frac{2(z-x)}{(y-x)(z-x)}+\frac{-2(y-x)}{(z-x)(y-x)}-\frac{2z-2y}{(y-x)(z-x)}\\ &= \frac{2z-2x}{(y-x)(z-x)}+\frac{-2y+2x}{(y-x)(z-x)}-\frac{2z-2y}{(y-x)(z-x)}\\ &= \frac{2z-2x-2y+2x-2z+2y}{(y-x)(z-x)}=\frac{0}{(y-x)(z-x)}=0\end{aligned}$$

71. $$\begin{aligned}&\frac{3x-2}{x^2+x-20}-\frac{4x^2+2}{x^2-25}+\frac{3x^2-25}{x^2-16}\\ &= \frac{3x-2}{(x+5)(x-4)}-\frac{4x^2+2}{(x+5)(x-5)}+\frac{3x^2-25}{(x+4)(x-4)}\\ &= \frac{(3x-2)(x-5)(x+4)}{(x+5)(x-4)(x-5)(x+4)}-\frac{(4x^2+2)(x-4)(x+4)}{(x+5)(x-5)(x-4)(x+4)}\ \cdots\\ &\qquad\qquad +\frac{(3x^2-25)(x+5)(x-5)}{(x+4)(x-4)(x+5)(x-5)}\\ &= \frac{3x^3-5x^2-58x+40}{(x+5)(x-4)(x-5)(x+4)}-\frac{4x^4-62x^2-32}{(x+5)(x-4)(x-5)(x+4)}\ \cdots\\ &\qquad\qquad +\frac{3x^4-100x^2+625}{(x+5)(x-4)(x-5)(x+4)}\\ &= \frac{3x^3-5x^2-58x+40-4x^4+62x^2+32+3x^4-100x^2+625}{(x+5)(x-4)(x-5)(x+4)}\\ &= \frac{-x^4+3x^3-43x^2-58x+697}{(x+5)(x-4)(x-5)(x+4)}\end{aligned}$$

72. $$\begin{aligned}&\frac{3x+2}{8x^2-10x-3}+\frac{x+4}{6x^2-11x+3}-\frac{1}{4x+1}\\ &= \frac{3x+2}{(4x+1)(2x-3)}+\frac{x+4}{(3x-1)(2x-3)}-\frac{1}{4x+1}\\ &= \frac{(3x+2)(3x-1)}{(4x+1)(2x-3)(3x-1)}+\frac{(x+4)(4x+1)}{(3x-1)(2x-3)(4x+1)}-\frac{1(2x-3)(3x-1)}{(4x+1)(2x-3)(3x-1)}\\ &= \frac{9x^2+3x-2}{(4x+1)(2x-3)(3x-1)}+\frac{4x^2+17x+4}{(4x+1)(2x-3)(3x-1)}-\frac{6x^2-11x+3}{(4x+1)(2x-3)(3x-1)}\\ &= \frac{9x^2+3x-2+4x^2+17x+4-6x^2+11x-3}{(4x+1)(2x-3)(3x-1)}=\frac{7x^2+31x-1}{(4x+1)(2x-3)(3x-1)}\end{aligned}$$

73. $$\frac{\frac{3a}{b}}{\frac{6ac}{b^2}}=\frac{3a}{b}\div\frac{6ac}{b^2}=\frac{3a}{b}\cdot\frac{b^2}{6ac}=\frac{b}{2c}$$

74. $$\frac{\frac{3t^2}{9x}}{\frac{t}{18x}}=\frac{3t^2}{9x}\div\frac{t}{18x}=\frac{3t^2}{9x}\cdot\frac{18x}{t}=6t$$

75. $$\frac{3a^2b}{\frac{ab}{27}}=\frac{3a^2b}{1}\div\frac{ab}{27}=\frac{3a^2b}{1}\cdot\frac{27}{ab}=81a$$

76. $$\frac{\frac{3u^2v}{4t}}{3uv}=\frac{3u^2v}{4t}\div\frac{3uv}{1}=\frac{3u^2v}{4t}\cdot\frac{1}{3uv}=\frac{u}{4t}$$

SECTION 0.6

77. $\dfrac{\frac{x-y}{ab}}{\frac{y-x}{ab}} = \dfrac{x-y}{ab} \div \dfrac{y-x}{ab} = \dfrac{x-y}{ab} \cdot \dfrac{ab}{y-x} = -1$

78. $\dfrac{\frac{x^2-5x+6}{2x^2y}}{\frac{x^2-9}{2x^2y}} = \dfrac{x^2-5x+6}{2x^2y} \div \dfrac{x^2-9}{2x^2y} = \dfrac{x^2-5x+6}{2x^2y} \cdot \dfrac{2x^2y}{x^2-9}$

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

79. $\dfrac{\frac{1}{x}+\frac{1}{y}}{xy} = \dfrac{xy\left(\frac{1}{x}+\frac{1}{y}\right)}{xy(xy)} = \dfrac{xy\left(\frac{1}{x}\right)+xy\left(\frac{1}{y}\right)}{x^2y^2} = \dfrac{y+x}{x^2y^2}$

80. $\dfrac{xy}{\frac{11}{x}+\frac{11}{y}} = \dfrac{xy(xy)}{xy\left(\frac{11}{x}+\frac{11}{y}\right)} = \dfrac{x^2y^2}{xy\left(\frac{11}{x}\right)+xy\left(\frac{11}{y}\right)} = \dfrac{x^2y^2}{11y+11x} = \dfrac{x^2y^2}{11(y+x)}$

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

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

83. $\dfrac{\frac{3a}{b}-\frac{4a^2}{x}}{\frac{1}{b}+\frac{1}{ax}} = \dfrac{abx\left(\frac{3a}{b}-\frac{4a^2}{x}\right)}{abx\left(\frac{1}{b}+\frac{1}{ax}\right)} = \dfrac{abx\left(\frac{3a}{b}\right)-abx\left(\frac{4a^2}{x}\right)}{abx\left(\frac{1}{b}\right)+abx\left(\frac{1}{ax}\right)} = \dfrac{3a^2x-4a^3b}{ax+b} = \dfrac{a^2(3x-4ab)}{ax+b}$

84. $\dfrac{1-\frac{x}{y}}{\frac{x^2}{y^2}-1} = \dfrac{y^2\left(1-\frac{x}{y}\right)}{y^2\left(\frac{x^2}{y^2}-1\right)} = \dfrac{y^2(1)-y^2\left(\frac{x}{y}\right)}{y^2\left(\frac{x^2}{y^2}\right)-y^2(1)} = \dfrac{y^2-xy}{x^2-y^2} = \dfrac{y(y-x)}{(x+y)(x-y)} = \dfrac{-y}{x+y}$

85. $\dfrac{x+1-\frac{6}{x}}{x+5+\frac{6}{x}} = \dfrac{x\left(x+1-\frac{6}{x}\right)}{x\left(x+5+\frac{6}{x}\right)} = \dfrac{x(x)+x(1)-x\left(\frac{6}{x}\right)}{x(x)+x(5)+x\left(\frac{6}{x}\right)} = \dfrac{x^2+x-6}{x^2+5x+6} = \dfrac{(x+3)(x-2)}{(x+2)(x+3)} = \dfrac{x-2}{x+2}$

86. $\dfrac{2z}{1-\frac{3}{z}} = \dfrac{z(2z)}{z\left(1-\frac{3}{z}\right)} = \dfrac{2z^2}{z(1)-z\left(\frac{3}{z}\right)} = \dfrac{2z^2}{z-3}$

87. $\dfrac{3xy}{1-\frac{1}{xy}} = \dfrac{xy(3xy)}{xy\left(1-\frac{1}{xy}\right)} = \dfrac{3x^2y^2}{xy(1)-xy\left(\frac{1}{xy}\right)} = \dfrac{3x^2y^2}{xy-1}$

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

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

SECTION 0.6

90. $\dfrac{2x^2+4}{2+\frac{4x}{5}} = \dfrac{5(2x^2+4)}{5\left(2+\frac{4x}{5}\right)} = \dfrac{10x^2+20}{10+4x} = \dfrac{2(5x^2+10)}{2(5+2x)} = \dfrac{5x^2+10}{5+2x}$

91. $\dfrac{\frac{x}{x+2}-\frac{2}{x-1}}{\frac{3}{x+2}+\frac{x}{x-1}} = \dfrac{(x+2)(x-1)\left(\frac{x}{x+2}-\frac{2}{x-1}\right)}{(x+2)(x-1)\left(\frac{3}{x+2}+\frac{x}{x-1}\right)} = \dfrac{(x+2)(x-1)\left(\frac{x}{x+2}\right)-(x+2)(x-1)\left(\frac{2}{x-1}\right)}{(x+2)(x-1)\left(\frac{3}{x+2}\right)+(x+2)(x-1)\left(\frac{x}{x-1}\right)}$

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

$= \dfrac{x^2-x-2x-4}{3x-3+x^2+2x} = \dfrac{x^2-3x-4}{x^2+5x-3}$

92. $\dfrac{\frac{2x}{x-3}+\frac{1}{x-2}}{\frac{3}{x-3}-\frac{x}{x-2}} = \dfrac{(x-3)(x-2)\left(\frac{2x}{x-3}+\frac{1}{x-2}\right)}{(x-3)(x-2)\left(\frac{3}{x-3}-\frac{x}{x-2}\right)} = \dfrac{(x-3)(x-2)\left(\frac{2x}{x-3}\right)+(x-3)(x-2)\left(\frac{1}{x-2}\right)}{(x-3)(x-2)\left(\frac{3}{x-3}\right)-(x-3)(x-2)\left(\frac{x}{x-2}\right)}$

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

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

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

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

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

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

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

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

$= \dfrac{3x-3+2x+4}{x-1} = \dfrac{5x+1}{x-1}$

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

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

$= 2x^2+4x-3x+9 = 2x^2+x+9$

97. $\dfrac{1}{\frac{1}{k_1}+\frac{1}{k_2}} = \dfrac{k_1k_2(1)}{k_1k_2\left(\frac{1}{k_1}+\frac{1}{k_2}\right)} = \dfrac{k_1k_2}{k_1k_2\left(\frac{1}{k_1}\right)+k_1k_2\left(\frac{1}{k_2}\right)} = \dfrac{k_1k_2}{k_2+k_1}$

98. $$\frac{1}{\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}} = \frac{R_1R_2R_3(1)}{R_1R_2R_3\left(\frac{1}{R_1}+\frac{1}{R_2}+\frac{1}{R_3}\right)} = \frac{R_1R_2R_3}{R_1R_2R_3\left(\frac{1}{R_1}\right)+R_1R_2R_3\left(\frac{1}{R_2}\right)+R_1R_2R_3\left(\frac{1}{R_3}\right)}$$
$$= \frac{R_1R_2R_3}{R_2R_3+R_1R_3+R_1R_2}$$

99. $$\frac{x}{1+\frac{1}{3x^{-1}}} = \frac{x}{1+\frac{1}{\frac{3}{x}}} = \frac{x}{1+\frac{x(1)}{x\left(\frac{3}{x}\right)}} = \frac{x}{1+\frac{x}{3}} = \frac{3x}{3\left(1+\frac{x}{3}\right)} = \frac{3x}{3+x}$$

100. $$\frac{ab}{2+\frac{3}{2a^{-1}}} = \frac{ab}{2+\frac{3}{\frac{2}{a}}} = \frac{ab}{2+\frac{a(3)}{a\left(\frac{2}{a}\right)}} = \frac{ab}{2+\frac{3a}{2}} = \frac{2ab}{2\left(2+\frac{3a}{2}\right)} = \frac{2ab}{4+3a}$$

101. $$\frac{1}{1+\frac{1}{1+\frac{1}{x}}} = \frac{1}{1+\frac{x(1)}{x\left(1+\frac{1}{x}\right)}} = \frac{1}{1+\frac{x}{x+1}} = \frac{(x+1)1}{(x+1)\left(1+\frac{x}{x+1}\right)} = \frac{x+1}{x+1+x} = \frac{x+1}{2x+1}$$

102. $$\frac{y}{2+\frac{2}{2+\frac{2}{y}}} = \frac{y}{2+\frac{y(2)}{y\left(2+\frac{2}{y}\right)}} = \frac{y}{2+\frac{2y}{2y+2}} = \frac{(2y+2)(y)}{(2y+2)\left(2+\frac{2y}{2y+2}\right)} = \frac{2y^2+2y}{(2y+2)(2)+2y}$$
$$= \frac{2y(y+1)}{4y+4+2y}$$
$$= \frac{2y(y+1)}{2(3y+2)} = \frac{y(y+1)}{3y+2}$$

103-106. Answers may vary.

107. Since $-6<0$, $|-6| = -(-6) = 6$.

108. If $x<0$, then $5-x\geq 0$. Then $|5-x| = 5-x$.

109. $$\left(\frac{x^3y^{-2}}{x^{-1}y}\right)^{-3} = \left(\frac{x^{-1}y}{x^3y^{-2}}\right)^{3} = \left(\frac{y^2y}{x^3x}\right)^{3} = \left(\frac{y^3}{x^4}\right)^{3} = \frac{y^9}{x^{12}}$$

110. $(27x^6)^{2/3} = 27^{2/3}(x^6)^{2/3} = \left(27^{1/3}\right)^2x^{12/3} = 3^2x^4 = 9x^4$

111. $\sqrt{20}-\sqrt{45} = \sqrt{4}\sqrt{5}-\sqrt{9}\sqrt{5} = 2\sqrt{5}-3\sqrt{5} = -\sqrt{5}$

112. $2(x^2+4)-3(2x^2+5) = 2(x^2)+2(4)-3(2x^2)-3(5) = 2x^2+8-6x^2-15 = -4x^2-7$

Chapter 0 Review (page 75)

1. natural: 3, 6, 8

2. whole: 0, 3, 6, 8

3. integers: -6, -3, 0, 3, 6, 8

4. rational: -6, -3, 0, $\frac{1}{2}$, 3, 6, 8

5. irrational: π, $\sqrt{5}$

6. real: -6, -3, 0, $\frac{1}{2}$, 3, π, $\sqrt{5}$, 6, 8

7. prime: 3

8. composite: 6, 8

9. even integers: -6, 0, 6, 8

10. odd integers: -3, 3

11. associative property of addition

12. commutative property of addition

13. associative property of multiplication

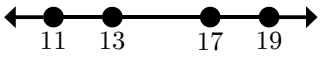
14. distributive property

15. commutative property of multiplication

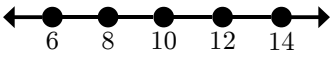
16. commutative property of addition

17. double negative rule

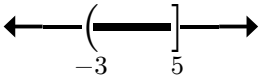
18.



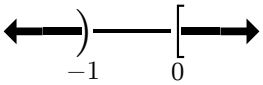
19.



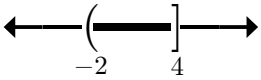
20. $-3 < x \leq 5$



21. $x \geq 0$ or $x < -1$

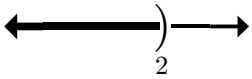


22. $(-2, 4]$

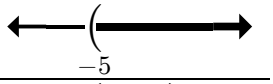


23. $(-\infty, 2) \cap (-5, \infty)$

$(-\infty, 2)$

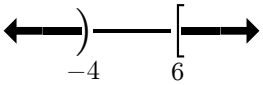


$(-5, \infty)$



$(-\infty, 2) \cap (-5, \infty)$

24. $(-\infty, -4) \cup [6, \infty)$



25. Since $6 \geq 0$, $|6| = 6$.

26. Since $-25 < 0$, $|-25| = -(-25) = 25$.

27. Since $1 - \sqrt{2} < 0$,
$\left|1 - \sqrt{2}\right| = -\left(1 - \sqrt{2}\right) = \sqrt{2} - 1$.

28. Since $\sqrt{3} - 1 \geq 0$,
$\left|\sqrt{3} - 1\right| = \sqrt{3} - 1$.

29. distance $= |7 - (-5)| = |12| = 12$

30. $-5a^3 = -5aaa$

31. $(-5a)^2 = (-5a)(-5a)$

32. $3ttt = 3t^3$

33. $(-2b)(3b) = (-2)(3)bb = -6b^2$

34. $n^2n^4 = n^{2+4} = n^6$

35. $(p^3)^2 = p^{3\cdot 2} = p^6$

36. $(x^3y^2)^4 = (x^3)^4(y^2)^4 = x^{12}y^8$

37. $\left(\dfrac{a^4}{b^2}\right)^3 = \dfrac{(a^4)^3}{(b^2)^3} = \dfrac{a^{12}}{b^6}$

38. $\left(m^{-3}n^0\right)^2 = \left(m^{-3}\cdot 1\right)^2 = m^{-6} = \dfrac{1}{m^6}$

39. $\left(\dfrac{p^{-2}q^2}{2}\right)^3 = \left(\dfrac{q^2}{2p^2}\right)^3 = \dfrac{(q^2)^3}{(2p^2)^3} = \dfrac{q^6}{8p^6}$

40. $\dfrac{a^5}{a^8} = a^{5-8} = a^{-3} = \dfrac{1}{a^3}$

41. $\left(\dfrac{a^2}{b^3}\right)^{-2} = \left(\dfrac{b^3}{a^2}\right)^2 = \dfrac{b^6}{a^4}$

42. $\left(\dfrac{3x^2y^{-2}}{x^2y^2}\right)^{-2} = \left(\dfrac{x^2y^2}{3x^2y^{-2}}\right)^2 = \left(\dfrac{x^2y^2y^2}{3x^2}\right)^2 = \left(\dfrac{y^4}{3}\right)^2 = \dfrac{y^8}{9}$

43. $\left(\dfrac{a^{-3}b^2}{ab^{-3}}\right)^{-2} = \left(\dfrac{ab^{-3}}{a^{-3}b^2}\right)^2 = \left(\dfrac{aa^3}{b^2b^3}\right)^2 = \left(\dfrac{a^4}{b^5}\right)^2 = \dfrac{a^8}{b^{10}}$

44. $\left(\dfrac{-3x^3y}{xy^3}\right)^{-2} = \left(\dfrac{xy^3}{-3x^3y}\right)^2 = \left(\dfrac{y^2}{-3x^2}\right)^2 = \dfrac{y^4}{9x^4}$

45. $\left(-\dfrac{2m^{-2}n^0}{4m^2n^{-1}}\right)^{-3} = \left(-\dfrac{4m^2n^{-1}}{2m^{-2}n^0}\right)^3 = \left(-\dfrac{2m^2m^2}{n^1n^0}\right)^3 = \left(-\dfrac{2m^4}{n}\right)^3 = -\dfrac{8m^{12}}{n^3}$

46. $-x^2 - xy^2 = -(-3)^2 - (-3)(3)^2 = -(+9) - (-3)(9) = -9 - (-27) = -9 + 27 = 18$

47. $6{,}750 = 6.750 \times 10^3$

48. $0.00023 = 2.3 \times 10^{-4}$

49. $4.8 \times 10^2 = 480$

50. $0.25 \times 10^{-3} = 0.00025$

51. $\dfrac{(45{,}000)(350{,}000)}{0.000105} = \dfrac{(4.5 \times 10^4)(3.5 \times 10^5)}{1.05 \times 10^{-4}} = \dfrac{4.5 \times 3.5 \times 10^4 \times 10^5}{1.05 \times 10^{-4}} = \dfrac{15.75 \times 10^9}{1.05 \times 10^{-4}}$
$= 15 \times 10^{13}$
$= 1.5 \times 10^{14}$

52. $121^{1/2} = (11^2)^{1/2} = 11$

53. $\left(\dfrac{27}{125}\right)^{1/3} = \left[\left(\dfrac{3}{5}\right)^3\right]^{1/3} = \dfrac{3}{5}$

54. $(32x^5)^{1/5} = 32^{1/5}(x^5)^{1/5} = 2x$

55. $(81a^4)^{1/4} = 81^{1/4}(a^4)^{1/4} = 3|a|$

56. $\left(-1{,}000x^6\right)^{1/3} = (-1{,}000)^{1/3}\left(x^6\right)^{1/3}$
$= -10x^2$

57. $\left(-25x^2\right)^{1/2} = (-25)^{1/2}\left(x^2\right)^{1/2}$
$\Rightarrow$ not a real number

58. $(x^{12}y^2)^{1/2} = (x^{12})^{1/2}(y^2)^{1/2} = x^6|y|$

59. $\left(\dfrac{x^{12}}{y^4}\right)^{-1/2} = \left(\dfrac{y^4}{x^{12}}\right)^{1/2} = \dfrac{y^2}{x^6}$

60. $\left(\dfrac{-c^{2/3}c^{5/3}}{c^{-2/3}}\right)^{1/3} = \left(\dfrac{-c^{7/3}}{c^{-2/3}}\right)^{1/3} = \left(-c^{9/3}\right)^{1/3} = \left(-c^3\right)^{1/3} = -c$

61. $\left(\dfrac{a^{-1/4}a^{3/4}}{a^{9/2}}\right)^{-1/2} = \left(\dfrac{a^{9/2}}{a^{-1/4}a^{3/4}}\right)^{1/2} = \left(\dfrac{a^{9/2}}{a^{2/4}}\right)^{1/2} = \left(\dfrac{a^{9/2}}{a^{1/2}}\right)^{1/2} = \left(a^{8/2}\right)^{1/2} = \left(a^4\right)^{1/2} = a^2$

62. $64^{2/3} = \left(64^{1/3}\right)^2 = 4^2 = 16$

63. $32^{-3/5} = \dfrac{1}{32^{3/5}} = \dfrac{1}{\left(32^{1/5}\right)^3} = \dfrac{1}{2^3} = \dfrac{1}{8}$

64. $\left(\dfrac{16}{81}\right)^{3/4} = \dfrac{16^{3/4}}{81^{3/4}} = \dfrac{\left(16^{1/4}\right)^3}{\left(81^{1/4}\right)^3} = \dfrac{2^3}{3^3} = \dfrac{8}{27}$

65. $\left(\dfrac{32}{243}\right)^{2/5} = \dfrac{32^{2/5}}{243^{2/5}} = \dfrac{\left(32^{1/5}\right)^2}{\left(243^{1/5}\right)^2} = \dfrac{2^2}{3^2} = \dfrac{4}{9}$

66. $\left(\dfrac{8}{27}\right)^{-2/3} = \left(\dfrac{27}{8}\right)^{2/3} = \dfrac{27^{2/3}}{8^{2/3}} = \dfrac{\left(27^{1/3}\right)^2}{\left(8^{1/3}\right)^2} = \dfrac{3^2}{2^2} = \dfrac{9}{4}$

67. $\left(\dfrac{16}{625}\right)^{-3/4} = \left(\dfrac{625}{16}\right)^{3/4} = \dfrac{625^{3/4}}{16^{3/4}} = \dfrac{\left(625^{1/4}\right)^3}{\left(16^{1/4}\right)^3} = \dfrac{5^3}{2^3} = \dfrac{125}{8}$

68. $(-216x^3)^{2/3} = (-216)^{2/3}(x^3)^{2/3} = 36x^2$

69. $\dfrac{p^{a/2}p^{a/3}}{p^{a/6}} = \dfrac{p^{3a/6}p^{2a/6}}{p^{a/6}} = \dfrac{p^{5a/6}}{p^{a/6}} = p^{4a/6} = p^{2a/3}$

70. $\sqrt{36} = 6$

71. $-\sqrt{49} = -7$

72. $\sqrt{\dfrac{9}{25}} = \dfrac{\sqrt{9}}{\sqrt{25}} = \dfrac{3}{5}$

73. $\sqrt[3]{\dfrac{27}{125}} = \dfrac{\sqrt[3]{27}}{\sqrt[3]{125}} = \dfrac{3}{5}$

74. $\sqrt{x^2y^4} = \sqrt{x^2}\sqrt{y^4}$
$= |x|y^2$

75. $\sqrt[3]{x^3} = x$

76. $\sqrt[4]{\dfrac{m^8n^4}{p^{16}}} = \dfrac{\sqrt[4]{m^8}\sqrt[4]{n^4}}{\sqrt[4]{p^{16}}} = \dfrac{m^2|n|}{p^4}$

77. $\sqrt[5]{\dfrac{a^{15}b^{10}}{c^5}} = \dfrac{\sqrt[5]{a^{15}}\sqrt[5]{b^{10}}}{\sqrt[5]{c^5}} = \dfrac{a^3b^2}{c}$

78. $\sqrt{50} + \sqrt{8} = \sqrt{25}\sqrt{2} + \sqrt{4}\sqrt{2} = 5\sqrt{2} + 2\sqrt{2} = 7\sqrt{2}$

79. $\sqrt{12} + \sqrt{3} - \sqrt{27} = \sqrt{4}\sqrt{3} + \sqrt{3} - \sqrt{9}\sqrt{3} = 2\sqrt{3} + \sqrt{3} - 3\sqrt{3} = 3\sqrt{3} - 3\sqrt{3} = 0$

80. $\sqrt[3]{24x^4} - \sqrt[3]{3x^4} = \sqrt[3]{8x^3}\sqrt[3]{3x} - \sqrt[3]{x^3}\sqrt[3]{3x} = 2x\sqrt[3]{3x} - x\sqrt[3]{3x} = x\sqrt[3]{3x}$

81. $\dfrac{\sqrt{7}}{\sqrt{5}} = \dfrac{\sqrt{7}}{\sqrt{5}} \cdot \dfrac{\sqrt{5}}{\sqrt{5}} = \dfrac{\sqrt{35}}{5}$

82. $\dfrac{8}{\sqrt{8}} = \dfrac{8}{\sqrt{8}} \cdot \dfrac{\sqrt{2}}{\sqrt{2}} = \dfrac{8\sqrt{2}}{\sqrt{16}} = \dfrac{8\sqrt{2}}{4} = 2\sqrt{2}$

83. $\dfrac{1}{\sqrt[3]{2}} = \dfrac{1}{\sqrt[3]{2}} \cdot \dfrac{\sqrt[3]{4}}{\sqrt[3]{4}} = \dfrac{\sqrt[3]{4}}{\sqrt[3]{8}} = \dfrac{\sqrt[3]{4}}{2}$

84. $\dfrac{2}{\sqrt[3]{25}} = \dfrac{2}{\sqrt[3]{25}} \cdot \dfrac{\sqrt[3]{5}}{\sqrt[3]{5}} = \dfrac{2\sqrt[3]{5}}{\sqrt[3]{125}} = \dfrac{2\sqrt[3]{5}}{5}$

85. $\dfrac{\sqrt{2}}{5} = \dfrac{\sqrt{2}}{5} \cdot \dfrac{\sqrt{2}}{\sqrt{2}} = \dfrac{2}{5\sqrt{2}}$

86. $\dfrac{\sqrt{5}}{5} = \dfrac{\sqrt{5}}{5} \cdot \dfrac{\sqrt{5}}{\sqrt{5}} = \dfrac{5}{5\sqrt{5}} = \dfrac{1}{\sqrt{5}}$

87. $\dfrac{\sqrt{2x}}{3} = \dfrac{\sqrt{2x}}{3} \cdot \dfrac{\sqrt{2x}}{\sqrt{2x}} = \dfrac{2x}{3\sqrt{2x}}$

88. $\dfrac{3\sqrt[3]{7x}}{2} = \dfrac{3\sqrt[3]{7x}}{2} \cdot \dfrac{\sqrt[3]{49x^2}}{\sqrt[3]{49x^2}} = \dfrac{3\sqrt[3]{343x^3}}{2\sqrt[3]{49x^2}} = \dfrac{21x}{2\sqrt[3]{49x^2}}$

89. 3rd degree, binomial

90. 2nd degree, trinomial

91. 2nd degree, monomial

92. 4th degree, trinomial

93. $2(x+3) + 3(x-4) = 2x + 6 + 3x - 12 = 5x - 6$

94. $3x^2(x-1) - 2x(x+3) - x^2(x+2) = 3x^3 - 3x^2 - 2x^2 - 6x - x^3 - 2x^2 = 2x^3 - 7x^2 - 6x$

95. $(3x+2)(3x+2) = 9x^2 + 6x + 6x + 4 = 9x^2 + 12x + 4$

96. $(3x+y)(2x-3y) = 6x^2 - 9xy + 2xy - 3y^2 = 6x^2 - 7xy - 3y^2$

97. $(4a+2b)(2a-3b) = 8a^2 - 12ab + 4ab - 6b^2 = 8a^2 - 8ab - 6b^2$

98. $(z+3)(3z^2+z-1) = 3z^3 + z^2 - z + 9z^2 + 3z - 3 = 3z^3 + 10z^2 + 2z - 3$

99. $(a^n+2)(a^n-1) = a^{2n} - a^n + 2a^n - 2 = a^{2n} + a^n - 2$

100. $\left(\sqrt{2}+x\right)^2 = \left(\sqrt{2}+x\right)\left(\sqrt{2}+x\right) = \left(\sqrt{2}\right)^2 + x\sqrt{2} + x\sqrt{2} + x^2 = 2 + 2x\sqrt{2} + x^2$

101. $\left(\sqrt{2}+1\right)\left(\sqrt{3}+1\right) = \sqrt{6} + \sqrt{2} + \sqrt{3} + 1$

102. $\left(\sqrt[3]{3}-2\right)\left(\sqrt[3]{9}+2\sqrt[3]{3}+4\right) = \sqrt[3]{27} + 2\sqrt[3]{9} + 4\sqrt[3]{3} - 2\sqrt[3]{9} - 4\sqrt[3]{3} - 8 = 3 - 8 = -5$

103. $\dfrac{2}{\sqrt{3}-1} = \dfrac{2}{\sqrt{3}-1}\cdot\dfrac{\sqrt{3}+1}{\sqrt{3}+1} = \dfrac{2\left(\sqrt{3}+1\right)}{\left(\sqrt{3}\right)^2-1^2} = \dfrac{2\left(\sqrt{3}+1\right)}{3-1} = \dfrac{2\left(\sqrt{3}+1\right)}{2} = \sqrt{3}+1$

104. $\dfrac{-2}{\sqrt{3}-\sqrt{2}} = \dfrac{-2}{\sqrt{3}-\sqrt{2}}\cdot\dfrac{\sqrt{3}+\sqrt{2}}{\sqrt{3}+\sqrt{2}} = \dfrac{-2\left(\sqrt{3}+\sqrt{2}\right)}{\left(\sqrt{3}\right)^2-\left(\sqrt{2}\right)^2} = \dfrac{-2\left(\sqrt{3}+\sqrt{2}\right)}{3-2}$

$= \dfrac{-2\left(\sqrt{3}+\sqrt{2}\right)}{1}$

$= -2\left(\sqrt{3}+\sqrt{2}\right)$

105. $\dfrac{2x}{\sqrt{x}-2} = \dfrac{2x}{\sqrt{x}-2}\cdot\dfrac{\sqrt{x}+2}{\sqrt{x}+2} = \dfrac{2x\left(\sqrt{x}+2\right)}{\left(\sqrt{x}\right)^2-2^2} = \dfrac{2x\left(\sqrt{x}+2\right)}{x-4}$

106. $\dfrac{\sqrt{x}-\sqrt{y}}{\sqrt{x}+\sqrt{y}} = \dfrac{\sqrt{x}-\sqrt{y}}{\sqrt{x}+\sqrt{y}}\cdot\dfrac{\sqrt{x}-\sqrt{y}}{\sqrt{x}-\sqrt{y}} = \dfrac{\sqrt{x^2}-\sqrt{xy}-\sqrt{xy}+y}{\left(\sqrt{x}\right)^2-\left(\sqrt{y}\right)^2} = \dfrac{x-2\sqrt{xy}+y}{x-y}$

107. $\dfrac{\sqrt{x}+2}{5} = \dfrac{\sqrt{x}+2}{5}\cdot\dfrac{\sqrt{x}-2}{\sqrt{x}-2} = \dfrac{\left(\sqrt{x}\right)^2-2^2}{5\left(\sqrt{x}-2\right)} = \dfrac{x-4}{5\left(\sqrt{x}-2\right)}$

108. $\dfrac{1-\sqrt{a}}{a} = \dfrac{1-\sqrt{a}}{a}\cdot\dfrac{1+\sqrt{a}}{1+\sqrt{a}} = \dfrac{1^2-\left(\sqrt{a}\right)^2}{a\left(1+\sqrt{a}\right)} = \dfrac{1-a}{a\left(1+\sqrt{a}\right)}$

109. $\dfrac{3x^2y^2}{6x^3y} = \dfrac{y}{2x}$

110. $\dfrac{4a^2b^3+6ab^4}{2b^2} = \dfrac{4a^2b^3}{2b^2}+\dfrac{6ab^4}{2b^2}$

$= 2a^2b+3ab^2$

111.

$$\begin{array}{r} x^2+\ 2x+\ 1 \\ 2x+3\ \overline{)\ 2x^3+7x^2+8x+3} \\ \underline{2x^3+3x^2} \\ 4x^2+8x \\ \underline{4x^2+6x} \\ 2x+3 \\ \underline{2x+3} \\ 0 \end{array}$$

112.

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

113. $3t^3-3t = 3t(t^2-1) = 3t(t+1)(t-1)$

114. $5r^3-5 = 5(r^3-1) = 5(r^3-1^3) = 5(r-1)(r^2+r+1)$

115. $6x^2+7x-24 = (3x+8)(2x-3)$

116. $3a^2+ax-3a-x = a(3a+x)-1(3a+x) = (3a+x)(a-1)$

117. $8x^3 - 125 = (2x)^3 - 5^3 = (2x-5)\left[(2x)^2 + (2x)(5) + 5^2\right] = (2x-5)(4x^2+10x+25)$

118. $6x^2 - 20x - 16 = 2(3x^2 - 10x - 8) = 2(3x+2)(x-4)$

119. $x^2 + 6x + 9 - t^2 = (x+3)(x+3) - t^2 = (x+3)^2 - t^2 = (x+3+t)(x+3-t)$

120. $3x^2 - 1 + 5x = 3x^2 + 5x - 1 \Rightarrow$ prime

121. $8z^3 + 343 = (2z)^3 + 7^3 = (2z+7)\left[(2z)^2 - (2z)(7) + 7^2\right] = (2z+7)(4z^2 - 14z + 49)$

122. $1 + 14b + 49b^2 = 49b^2 + 14b + 1 = (7b+1)(7b+1) = (7b+1)^2$

123. $121z^2 + 4 - 44z = 121z^2 - 44z + 4 = (11z-2)(11z-2) = (11z-2)^2$

124. $64y^3 - 1{,}000 = 8(8y^3 - 125) = 8\left[(2y)^3 - 5^3\right] = 8(2y-5)(4y^2+10y+25)$

125. $2xy - 4zx - wy + 2zw = 2x(y-2z) - w(y-2z) = (y-2z)(2x-w)$

126.
$$\begin{aligned} x^8 + x^4 + 1 = x^8 + 2x^4 + 1 - x^4 &= \left(x^4+1\right)\left(x^4+1\right) - x^4 \\ &= \left(x^4+1\right)^2 - \left(x^2\right)^2 \\ &= \left(x^4+1+x^2\right)\left(x^4+1-x^2\right) \\ &= \left(x^4+2x^2+1-x^2\right)\left(x^4-x^2+1\right) \\ &= \left[\left(x^2+1\right)\left(x^2+1\right) - x^2\right]\left(x^4-x^2+1\right) \\ &= \left(x^2+1+x\right)\left(x^2+1-x\right)\left(x^4-x^2+1\right) \end{aligned}$$

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

128. $\dfrac{a^2-9}{a^2-6a+9} = \dfrac{(a+3)(a-3)}{(a-3)(a-3)} = \dfrac{a+3}{a-3}$

129. $\dfrac{x^2-4x+4}{x+2} \cdot \dfrac{x^2+5x+6}{x-2} = \dfrac{(x-2)(x-2)}{x+2} \cdot \dfrac{(x+2)(x+3)}{x-2} = (x-2)(x+3)$

130. $\dfrac{2y^2-11y+15}{y^2-6y+8} \cdot \dfrac{y^2-2y-8}{y^2-y-6} = \dfrac{(2y-5)(y-3)}{(y-4)(y-2)} \cdot \dfrac{(y-4)(y+2)}{(y-3)(y+2)} = \dfrac{2y-5}{y-2}$

131.
$$\begin{aligned} \frac{2t^2+t-3}{3t^2-7t+4} \div \frac{10t+15}{3t^2-t-4} &= \frac{2t^2+t-3}{3t^2-7t+4} \cdot \frac{3t^2-t-4}{10t+15} \\ &= \frac{(2t+3)(t-1)}{(3t-4)(t-1)} \cdot \frac{(3t-4)(t+1)}{5(2t+3)} = \frac{t+1}{5} \end{aligned}$$

132.
$$\begin{aligned} \frac{p^2+7p+12}{p^3+8p^2+4p} \div \frac{p^2-9}{p^2} = \frac{p^2+7p+12}{p^3+8p^2+4p} \cdot \frac{p^2}{p^2-9} &= \frac{(p+3)(p+4)}{p(p^2+8p+4)} \cdot \frac{p^2}{(p+3)(p-3)} \\ &= \frac{p(p+4)}{(p^2+8p+4)(p-3)} \end{aligned}$$

133. $\dfrac{x^2+x-6}{x^2-x-6}\cdot\dfrac{x^2-x-6}{x^2+x-2}\div\dfrac{x^2-4}{x^2-5x+6}$

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

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

134. $\left(\dfrac{2x+6}{x+5}\div\dfrac{2x^2-2x-4}{x^2-25}\right)\dfrac{x^2-x-2}{x^2-2x-15}=\dfrac{2x+6}{x+5}\cdot\dfrac{x^2-25}{2(x^2-x-2)}\cdot\dfrac{x^2-x-2}{x^2-2x-15}$

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

135. $\dfrac{2}{x-4}+\dfrac{3x}{x+5}=\dfrac{2(x+5)}{(x-4)(x+5)}+\dfrac{3x(x-4)}{(x+5)(x-4)}=\dfrac{2x+10}{(x-4)(x+5)}+\dfrac{3x^2-12x}{(x-4)(x+5)}$

$$=\frac{3x^2-10x+10}{(x-4)(x+5)}$$

136. $\dfrac{5x}{x-2}-\dfrac{3x+7}{x+2}+\dfrac{2x+1}{x+2}=\dfrac{5x}{x-2}+\dfrac{-x-6}{x+2}=\dfrac{5x(x+2)}{(x-2)(x+2)}+\dfrac{(-x-6)(x-2)}{(x+2)(x-2)}$

$$=\frac{5x^2+10x}{(x-2)(x+2)}+\frac{-x^2-4x+12}{(x-2)(x+2)}$$

$$=\frac{4x^2+6x+12}{(x-2)(x+2)}=\frac{2(2x^2+3x+6)}{(x-2)(x+2)}$$

137. $\dfrac{x}{x-1}+\dfrac{x}{x-2}+\dfrac{x}{x-3}$

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

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

$$=\frac{3x^3-12x^2+11x}{(x-1)(x-2)(x-3)}=\frac{x(3x^2-12x+11)}{(x-1)(x-2)(x-3)}$$

138. $\dfrac{x}{x+1}-\dfrac{3x+7}{x+2}+\dfrac{2x+1}{x+2}=\dfrac{x}{x+1}+\dfrac{-3x-7}{x+2}+\dfrac{2x+1}{x+2}$

$$=\frac{x}{x+1}+\frac{-x-6}{x+2}$$

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

$$=\frac{x^2+2x}{(x+1)(x+2)}+\frac{-x^2-7x-6}{(x+1)(x+2)}=\frac{-5x-6}{(x+1)(x+2)}$$

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

$= \dfrac{3x^3+6x^2+3x}{x^2(x+1)} - \dfrac{5x^3+5x^2+15x+15}{x^2(x+1)} + \dfrac{x^3}{x^2(x+1)}$

$= \dfrac{-x^3+x^2-12x-15}{x^2(x+1)}$

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

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

141. $\dfrac{\frac{5x}{2}}{\frac{3x^2}{8}} = \dfrac{5x}{2} \div \dfrac{3x^2}{8} = \dfrac{5x}{2} \cdot \dfrac{8}{3x^2} = \dfrac{20}{3x}$

142. $\dfrac{\frac{3x}{y}}{\frac{6x}{y^2}} = \dfrac{3x}{y} \div \dfrac{6x}{y^2} = \dfrac{3x}{y} \cdot \dfrac{y^2}{6x} = \dfrac{y}{2}$

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

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

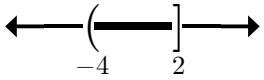
Chapter 0 Test (page 82)

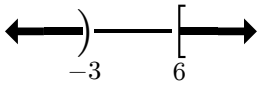
1. odd integers: $-7, 1, 3$

2. prime numbers: 3

3. commutative property of addition

4. distributive property

5. $-4 < x \leq 2 \Rightarrow$ 

6. $(-\infty, -3) \cup [6, \infty) \Rightarrow$ 

7. Since $-17 < 0$, $|-17| = -(-17) = 17$

8. If $x < 0$, then $x - 7 < 0$. Then $|x-7| = -(x-7)$.

9. distance $= |12-(-4)| = |16| = 16$

10. distance $= |-12-(-20)| = |8| = 8$

11. $x^4x^5x^2 = x^{4+5+2} = x^{11}$

12. $\dfrac{r^2r^3s}{r^4s^2} = \dfrac{r^5s}{r^4s^2} = \dfrac{r}{s}$

13. $\dfrac{(a^{-1}a^2)^{-2}}{a^{-3}} = \dfrac{(a^1)^{-2}}{a^{-3}} = \dfrac{a^{-2}}{a^{-3}} = a$

14. $\left(\dfrac{x^0x^2}{x^{-2}}\right)^6 = \left(\dfrac{x^2}{x^{-2}}\right)^6 = \left(x^4\right)^6 = x^{24}$

15. $450{,}000 = 4.5 \times 10^5$

16. $0.000345 = 3.45 \times 10^{-4}$

17. $3.7 \times 10^3 = 3{,}700$

18. $1.2 \times 10^{-3} = 0.0012$

19. $(25a^4)^{1/2} = 25^{1/2}(a^4)^{1/2} = 5a^2$

20. $\left(\dfrac{36}{81}\right)^{3/2} = \dfrac{36^{3/2}}{81^{3/2}} = \dfrac{\left(36^{1/2}\right)^3}{\left(81^{1/2}\right)^3} = \dfrac{216}{729}$

21. $\left(\dfrac{8t^6}{27s^9}\right)^{-2/3} = \left(\dfrac{27s^9}{8t^6}\right)^{2/3} = \dfrac{27^{2/3}(s^9)^{2/3}}{8^{2/3}(t^6)^{2/3}} = \dfrac{\left(27^{1/3}\right)^2 s^6}{\left(8^{1/3}\right)^2 t^4} = \dfrac{9s^6}{4t^4}$

22. $\sqrt[3]{27a^6} = \sqrt[3]{27}\sqrt[3]{a^6} = 3a^2$

23. $\sqrt{12} + \sqrt{27} = \sqrt{4}\sqrt{3} + \sqrt{9}\sqrt{3}$
$= 2\sqrt{3} + 3\sqrt{3} = 5\sqrt{3}$

24. $2\sqrt[3]{3x^4} - 3x\sqrt[3]{24x} = 2\sqrt[3]{x^3}\sqrt[3]{3x} - 3x\sqrt[3]{8}\sqrt[3]{3x} = 2x\sqrt[3]{3x} - 3x(2)\sqrt[3]{3x} = 2x\sqrt[3]{3x} - 6x\sqrt[3]{3x}$
$= -4x\sqrt[3]{3x}$

25. $\dfrac{x}{\sqrt{x}-2} = \dfrac{x}{\sqrt{x}-2} \cdot \dfrac{\sqrt{x}+2}{\sqrt{x}+2} = \dfrac{x\left(\sqrt{x}+2\right)}{\left(\sqrt{x}\right)^2 - 2^2} = \dfrac{x\left(\sqrt{x}+2\right)}{x-4}$

26. $\dfrac{\sqrt{x}-\sqrt{y}}{\sqrt{x}+\sqrt{y}} = \dfrac{\sqrt{x}-\sqrt{y}}{\sqrt{x}+\sqrt{y}} \cdot \dfrac{\sqrt{x}+\sqrt{y}}{\sqrt{x}+\sqrt{y}} = \dfrac{\left(\sqrt{x}\right)^2 - \left(\sqrt{y}\right)^2}{\sqrt{x^2}+\sqrt{xy}+\sqrt{xy}+\sqrt{y^2}} = \dfrac{x-y}{x+2\sqrt{xy}+y}$

27. $\left(a^2+3\right) - \left(2a^2-4\right) = a^2 + 3 - 2a^2 + 4$
$= -a^2 + 7$

28. $(3a^3b^2)(-2a^3b^4) = -6a^6b^6$

29. $(3x-4)(2x+7) = 6x^2 + 21x - 8x - 28$
$= 6x^2 + 13x - 28$

30. $(a^n+2)(a^n-3) = a^{2n} - 3a^n + 2a^n - 6$
$= a^{2n} - a^n - 6$

31. $(x^2+4)(x^2-4) = x^4 - 4x^2 + 4x^2 - 16 = x^4 - 16$

32. $(x^2 - x + 2)(2x-3) = 2x^3 - 3x^2 - 2x^2 + 3x + 4x - 6 = 2x^3 - 5x^2 + 7x - 6$

33.
$$\begin{array}{r} 6x + 19 + \frac{34}{x-3} \\ x-3 \overline{)\,6x^2 + x - 23} \\ \underline{6x^2 - 18x} \\ 19x - 23 \\ \underline{19x - 57} \\ 34 \end{array}$$

34.
$$\begin{array}{r} x^2 + 2x + 1 \\ 2x-1 \overline{)\,2x^3 + 3x^2 + 0x - 1} \\ \underline{2x^3 - x^2} \\ 4x^2 + 0x \\ \underline{4x^2 - 2x} \\ 2x - 1 \\ \underline{2x - 1} \\ 0 \end{array}$$

35. $3x + 6y = 3(x + 2y)$

36. $x^2 - 100 = x^2 - 10^2 = (x+10)(x-10)$

37. $10t^2 - 19tw + 6w^2 = (5t - 2w)(2t - 3w)$

38. $3a^3 - 648 = 3\left(a^3 - 216\right)$
$= 3(a-6)\left(a^2 + 6a + 36\right)$

39. $x^4 - x^2 - 12 = (x^2 - 4)(x^2 + 3)$
$= (x + 2)(x - 2)(x^2 + 3)$

40. $6x^4 + 11x^2 - 10 = (3x^2 - 2)(2x^2 + 5)$

41. $\dfrac{x}{x+2} + \dfrac{2}{x+2} = \dfrac{x+2}{x+2} = 1$

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

43. $\dfrac{x^2 + x - 20}{x^2 - 16} \cdot \dfrac{x^2 - 25}{x - 5} = \dfrac{(x+5)(x-4)}{(x+4)(x-4)} \cdot \dfrac{(x+5)(x-5)}{x-5} = \dfrac{(x+5)^2}{x+4}$

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

45. $\dfrac{\frac{1}{a} + \frac{1}{b}}{\frac{1}{b}} = \dfrac{ab\left(\frac{1}{a} + \frac{1}{b}\right)}{ab\left(\frac{1}{b}\right)} = \dfrac{ab\left(\frac{1}{a}\right) + ab\left(\frac{1}{b}\right)}{a} = \dfrac{b + a}{a}$

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

Exercises 1.1 (page 93)

1. root, solution

2. identity

3. no

4. conditional

5. linear

6. rational

7. one

8. denominator

9. $x + 3 = 1$
no restrictions

10. $\dfrac{1}{2}x - 7 = 14$
no restrictions

11. $\dfrac{1}{x} = 12$
$x \neq 0$

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

13. $\dfrac{8}{x-3} = \dfrac{5}{x+2}$
$x - 3 \neq 0 \quad x + 2 \neq 0$
$x \neq 3 \quad x \neq -2$
$x \neq 3, x \neq -2$

14. $\dfrac{x}{x-3} = -\dfrac{4}{x+4}$
$x - 3 \neq 0 \quad x + 4 \neq 0$
$x \neq 3 \quad x \neq -4$
$x \neq 3, x \neq -4$

15. $\dfrac{1}{x-3} = \dfrac{5x}{x^2 - 16}$
$\dfrac{1}{x-3} = \dfrac{5x}{(x+4)(x-4)}$
$x - 3 \neq 0 \quad x + 4 \neq 0 \quad x - 4 \neq 0$
$x \neq 3 \quad x \neq -4 \quad x \neq 4$
$x \neq 3, x \neq -4, x \neq 4$

16. $\dfrac{1}{x^2 - 3x - 4} = \dfrac{5}{x} + 2$
$\dfrac{1}{(x+1)(x-4)} = \dfrac{5}{x} + 2$
$x + 1 \neq 0 \quad x - 4 \neq 0 \quad x \neq 0$
$x \neq -1 \quad x \neq 4$
$x \neq -1, x \neq 4, x \neq 0$

SECTION 1.1

17.
$$2x + 5 = 15$$
$$2x + 5 - 5 = 15 - 5$$
$$2x = 10$$
$$\frac{2x}{2} = \frac{10}{2}$$
$$x = 5$$
conditional equation

18.
$$3x + 2 = x + 8$$
$$3x - x + 2 = x - x + 8$$
$$2x + 2 = 8$$
$$2x + 2 - 2 = 8 - 2$$
$$2x = 6$$
$$\frac{2x}{2} = \frac{6}{2}$$
$$x = 3$$
conditional equation

19.
$$2(n + 2) - 5 = 2n$$
$$2n + 4 - 5 = 2n$$
$$2n - 1 = 2n$$
$$2n - 2n - 1 = 2n - 2n$$
$$-1 \neq 0$$
contradiction

20.
$$3(m + 2) = 2(m + 3) + m$$
$$3m + 6 = 2m + 6 + m$$
$$3m + 6 = 3m + 6$$
identity

21.
$$\frac{x + 7}{2} = 7$$
$$2 \cdot \frac{x + 7}{2} = 2(7)$$
$$x + 7 = 14$$
$$x + 7 - 7 = 14 - 7$$
$$x = 7$$
conditional equation

22.
$$\frac{x}{2} - 7 = 14$$
$$\frac{x}{2} - 7 + 7 = 14 + 7$$
$$\frac{x}{2} = 21$$
$$2 \cdot \frac{x}{2} = 2(21)$$
$$x = 42$$
conditional equation

23.
$$2(a + 1) = 3(a - 2) - a$$
$$2a + 2 = 3a - 6 - a$$
$$2a + 2 = 2a - 6$$
$$2a - 2a + 2 = 2a - 2a - 6$$
$$2 \neq -6$$
contradiction

24.
$$x^2 = (x + 4)(x - 4) + 16$$
$$x^2 = x^2 - 16 + 16$$
$$x^2 = x^2$$
identity

25.
$$3(x - 3) = \frac{6x - 18}{2}$$
$$3x - 9 = \frac{6x - 18}{2}$$
$$2(3x - 9) = 2 \cdot \frac{6x - 18}{2}$$
$$6x - 18 = 6x - 18$$
identity

26.
$$x(x + 2) = (x + 1)^2$$
$$x^2 + 2x = (x + 1)(x + 1)$$
$$x^2 + 2x = x^2 + 2x + 1$$
$$x^2 - x^2 + 2x = x^2 - x^2 + 2x + 1$$
$$2x = 2x + 1$$
$$2x - 2x = 2x - 2x + 1$$
$$0 \neq 1$$
contradiction

27.
$$\frac{3}{b-3} = 1$$
$$(b-3)\cdot\frac{3}{b-3} = (b-3)(1)$$
$$3 = b-3$$
$$3+3 = b-3+3$$
$$6 = b$$
conditional equation

28.
$$x^2-8x+15 = (x-3)(x+5)$$
$$x^2-8x+15 = x^2+2x-15$$
$$x^2-x^2-8x+15 = x^2-x^2+2x-15$$
$$-8x+15 = 2x-15$$
$$-8x+8x+15 = 2x+8x-15$$
$$15 = 10x-15$$
$$15+15 = 10x-15+15$$
$$30 = 10x$$
$$\frac{30}{10} = \frac{10x}{10}$$
$$3 = x$$
conditional equation

29.
$$2x^2+5x-3 = (2x-1)(x+3)$$
$$2x^2+5x-3 = 2x^2+5x-3$$
identity

30.
$$2x^2+5x-3 = 2x\left(x+\frac{19}{2}\right)$$
$$2x^2+5x-3 = 2x^2+19x$$
$$2x^2-2x^2+5x-3 = 2x^2-2x^2+19x$$
$$5x-3 = 19x$$
$$5x-5x-3 = 19x-5x$$
$$-3 = 14x$$
$$\frac{-3}{14} = \frac{14x}{14}$$
$$-\frac{3}{14} = x$$
conditional equation

31.
$$2x+7 = 10-x$$
$$3x+7 = 10$$
$$3x = 3$$
$$x = 1$$

32.
$$9a-3 = 15+3a$$
$$6a-3 = 15$$
$$6a = 18$$
$$a = 3$$

33.
$$5(x-2) = 2(x+4)$$
$$5x-10 = 2x+8$$
$$3x-10 = 8$$
$$3x = 18$$
$$x = 6$$

34.
$$5(r-4) = -5(r-4)$$
$$5r-20 = -5r+20$$
$$10r-20 = 20$$
$$10r = 40$$
$$r = 4$$

35.
$$7(2x+5)-6(x+8) = 7$$
$$14x+35-6x-48 = 7$$
$$8x-13 = 7$$
$$8x = 20$$
$$x = \frac{20}{8} = \frac{5}{2}$$

36.
$$6(x-5)-4(x+2) = -1$$
$$6x-30-4x-8 = -1$$
$$2x-38 = -1$$
$$2x = 37$$
$$x = \frac{37}{2}$$

37.
$$\frac{5}{3}z - 8 = 7$$
$$\frac{5}{3}z = 15$$
$$3 \cdot \frac{5}{3}z = 3(15)$$
$$5z = 45$$
$$z = 9$$

38.
$$\frac{4}{3}y + 12 = -4$$
$$\frac{4}{3}y = -16$$
$$3 \cdot \frac{4}{3}y = 3(-16)$$
$$4y = -48$$
$$y = -12$$

39.
$$\frac{z}{5} + 2 = 4$$
$$\frac{z}{5} = 2$$
$$5 \cdot \frac{z}{5} = 5(2)$$
$$z = 10$$

40.
$$\frac{3p}{7} - p = -4$$
$$7\left(\frac{3p}{7} - p\right) = 7(-4)$$
$$3p - 7p = -28$$
$$-4p = -28$$
$$p = 7$$

41.
$$\frac{3x-2}{3} = 2x + \frac{7}{3}$$
$$3 \cdot \frac{3x-2}{3} = 3\left(2x + \frac{7}{3}\right)$$
$$3x - 2 = 6x + 7$$
$$-3x - 2 = 7$$
$$-3x = 9$$
$$x = -3$$

42.
$$\frac{7}{2}x + 5 = x + \frac{15}{2}$$
$$2\left(\frac{7}{2}x + 5\right) = 2\left(x + \frac{15}{2}\right)$$
$$7x + 10 = 2x + 15$$
$$5x + 10 = 15$$
$$5x = 5$$
$$x = 1$$

43.
$$\frac{3x+1}{20} = \frac{1}{2}$$
$$20 \cdot \frac{3x+1}{20} = 20 \cdot \frac{1}{2}$$
$$3x + 1 = 10$$
$$3x = 9$$
$$x = 3$$

44.
$$2x - \frac{7}{6} + \frac{x}{6} = \frac{4x+3}{6}$$
$$6\left(2x - \frac{7}{6} + \frac{x}{6}\right) = 6 \cdot \frac{4x+3}{6}$$
$$12x - 7 + x = 4x + 3$$
$$13x - 7 = 4x + 3$$
$$9x - 7 = 3$$
$$9x = 10$$
$$x = \frac{10}{9}$$

45.
$$\frac{3+x}{3} + \frac{x+7}{2} = 4x + 1$$
$$6\left(\frac{3+x}{3} + \frac{x+7}{2}\right) = 6(4x+1)$$
$$2(3+x) + 3(x+7) = 24x + 6$$
$$6 + 2x + 3x + 21 = 24x + 6$$
$$5x + 27 = 24x + 6$$
$$-19x + 27 = 6$$
$$-19x = -21$$
$$x = \frac{21}{19}$$

46.
$$2(2x+1) - \frac{3x}{2} = \frac{-3(4+x)}{2}$$
$$2\left[2(2x+1) - \frac{3x}{2}\right] = 2 \cdot \frac{-3(4+x)}{2}$$
$$4(2x+1) - 3x = -3(4+x)$$
$$8x + 4 - 3x = -12 - 3x$$
$$5x + 4 = -12 - 3x$$
$$8x + 4 = -12$$
$$8x = -16$$
$$x = -2$$

47.
$$\frac{3}{2}(3x-2)-10x-4=0$$
$$2\left[\frac{3}{2}(3x-2)-10x-4\right]=2(0)$$
$$3(3x-2)-20x-8=0$$
$$9x-6-20x-8=0$$
$$-11x-14=0$$
$$-11x=14$$
$$x=-\frac{14}{11}$$

48.
$$\frac{a(a-3)+5}{7}=\frac{(a-1)^2}{7}$$
$$7\left[\frac{a(a-3)+5}{7}\right]=7\left[\frac{(a-1)^2}{7}\right]$$
$$a(a-3)+5=(a-1)(a-1)$$
$$a^2-3a+5=a^2-2a+1$$
$$-3a+5=-2a+1$$
$$5=a+1$$
$$4=a$$

49.
$$\frac{(y+2)^2}{3}=y+2+\frac{y^2}{3}$$
$$3\left[\frac{(y+2)^2}{3}\right]=3\left(y+2+\frac{y^2}{3}\right)$$
$$(y+2)^2=3y+6+y^2$$
$$y^2+4y+4=y^2+3y+6$$
$$4y+4=3y+6$$
$$y+4=6$$
$$y=2$$

50.
$$(t+1)(t-1)=(t+2)(t-3)+4$$
$$t^2-1=t^2-t-6+4$$
$$-1=-t-2$$
$$t-1=-2$$
$$t=-1$$

51.
$$x(x+2)=(x+1)^2-1$$
$$x^2+2x=(x+1)(x+1)-1$$
$$x^2+2x=x^2+2x+1-1$$
$$x^2+2x=x^2+2x$$
$$0=0 \Rightarrow \text{identity}$$

52.
$$(x-2)(x-3)=(x+3)(x+4)$$
$$x^2-5x+6=x^2+7x+12$$
$$-5x+6=7x+12$$
$$-12x+6=12$$
$$-12x=6$$
$$x=-\frac{6}{12}=-\frac{1}{2}$$

53.
$$2(s+2)+(s+3)^2=s(s+5)+2\left(\frac{17}{2}+s\right)$$
$$2s+4+s^2+6s+9=s^2+5s+17+2s$$
$$s^2+8s+13=s^2+7s+17$$
$$8s+13=7s+17$$
$$s=4$$

54.
$$\frac{3}{x}+\frac{1}{2}=\frac{4}{x}$$
$$2x\left(\frac{3}{x}+\frac{1}{2}\right)=2x\cdot\frac{4}{x}$$
$$6+x=8$$
$$x=2$$

55.
$$\frac{2}{x+1}+\frac{1}{3}=\frac{1}{x+1}$$
$$3(x+1)\left(\frac{2}{x+1}+\frac{1}{3}\right)=3(x+1)\cdot\frac{1}{x+1}$$
$$6+1(x+1)=3(1)$$
$$6+x+1=3$$
$$x+7=3$$
$$x=-4$$

56.
$$\frac{3}{x-2}+\frac{1}{x}=\frac{3}{x-2}$$
$$x(x-2)\left(\frac{3}{x-2}+\frac{1}{x}\right)=x(x-2)\cdot\frac{3}{x-2}$$
$$3x+1(x-2)=3x$$
$$3x+x-2=3x$$
$$4x-2=3x$$
$$x=2$$
The answer does not check. $\Rightarrow$ no solution

57.
$$\frac{9t+6}{t(t+3)}=\frac{7}{t+3}$$
$$t(t+3)\left[\frac{9t+6}{t(t+3)}\right]=t(t+3)\cdot\frac{7}{t+3}$$
$$9t+6=7t$$
$$2t+6=0$$
$$2t=-6$$
$$t=-3$$
The answer does not check. $\Rightarrow$ no solution

58.
$$x+\frac{2(-2x+1)}{3x+5}=\frac{3x^2}{3x+5}$$
$$(3x+5)\left[x+\frac{2(-2x+1)}{3x+5}\right]=(3x+5)\cdot\frac{3x^2}{3x+5}$$
$$x(3x+5)+2(-2x+1)=3x^2$$
$$3x^2+5x-4x+2=3x^2$$
$$x+2=0$$
$$x=-2$$

59.
$$\frac{2}{(a-7)(a+2)}=\frac{4}{(a+3)(a+2)}$$
$$(a-7)(a+2)(a+3)\cdot\frac{2}{(a-7)(a+2)}=(a-7)(a+2)(a+3)\cdot\frac{4}{(a+3)(a+2)}$$
$$2(a+3)=4(a-7)$$
$$2a+6=4a-28$$
$$-2a=-34$$
$$a=17$$

60.
$$\frac{2}{n-2}+\frac{1}{n+1}=\frac{1}{n^2-n-2}$$
$$\frac{2}{n-2}+\frac{1}{n+1}=\frac{1}{(n-2)(n+1)}$$
$$(n-2)(n+1)\left(\frac{2}{n-2}+\frac{1}{n+1}\right)=(n-2)(n+1)\cdot\frac{1}{(n-2)(n+1)}$$
$$2(n+1)+1(n-2)=1$$
$$2n+2+n-2=1$$
$$3n=1$$
$$n=\frac{1}{3}$$

61.
$$\frac{2x+3}{x^2+5x+6}+\frac{3x-2}{x^2+x-6}=\frac{5x-2}{x^2-4}$$
$$\frac{2x+3}{(x+3)(x+2)}+\frac{3x-2}{(x+3)(x-2)}=\frac{5x-2}{(x+2)(x-2)}$$
$$(x-2)(2x+3)+(x+2)(3x-2)=(x+3)(5x-2)\qquad\{\text{multiply by common denominator}\}$$
$$2x^2-x-6+3x^2+4x-4=5x^2+13x-6$$
$$5x^2+3x-10=5x^2+13x-6$$
$$3x-10=13x-6$$
$$-10x=4$$
$$x=-\frac{4}{10}=-\frac{2}{5}$$

62.
$$\frac{3x}{x^2+x}-\frac{2x}{x^2+5x}=\frac{x+2}{x^2+6x+5}$$
$$\frac{3x}{x(x+1)}-\frac{2x}{x(x+5)}=\frac{x+2}{(x+5)(x+1)}$$
$$\frac{3}{x+1}-\frac{2}{x+5}=\frac{x+2}{(x+5)(x+1)}$$
$$3(x+5)-2(x+1)=x+2\qquad\{\text{multiply by common denominator}\}$$
$$3x+15-2x-2=x+2$$
$$x+13=x+2$$
$$13\neq 2\Rightarrow\text{no solution}$$

63.
$$\frac{3x+5}{x^3+8}+\frac{3}{x^2-4}=\frac{2(3x-2)}{(x-2)(x^2-2x+4)}$$
$$\frac{3x+5}{(x+2)(x^2-2x+4)}+\frac{3}{(x+2)(x-2)}=\frac{2(3x-2)}{(x-2)(x^2-2x+4)}$$
$$(x-2)(3x+5)+\left(x^2-2x+4\right)(3)=2(x+2)(3x-2) \quad \{\text{multiply by common denominator}\}$$
$$3x^2-x-10+3x^2-6x+12=6x^2+8x-8$$
$$6x^2-7x+2=6x^2+8x-8$$
$$-15x=-10$$
$$x=\frac{-10}{-15}=\frac{2}{3}$$

64.
$$\frac{1}{n+8}-\frac{3n-4}{5n^2+42n+16}=\frac{1}{5n+2}$$
$$\frac{1}{n+8}-\frac{3n-4}{(5n+2)(n+8)}=\frac{1}{5n+2}$$
$$(5n+2)(1)-(3n-4)=n+8 \quad \{\text{multiply by common denominator}\}$$
$$5n+2-3n+4=n+8$$
$$2n+6=n+8$$
$$n=2$$

65.
$$\frac{1}{11-n}-\frac{2(3n-1)}{-7n^2+74n+33}=\frac{1}{7n+3}$$
$$\frac{-1}{n-11}+\frac{2(3n-1)}{7n^2-74n-33}=\frac{1}{7n+3}$$
$$\frac{-1}{n-11}+\frac{6n-2}{(7n+3)(n-11)}=\frac{1}{7n+3}$$
$$-(7n+3)+6n-2=(n-11)1 \quad \{\text{multiply by common denominator}\}$$
$$-7n-3+6n-2=n-11$$
$$-n-5=n-11$$
$$-2n=-6$$
$$n=3$$

66.
$$\frac{4}{a^2-13a-48}-\frac{2}{a^2-18a+32}=\frac{1}{a^2+a-6}$$
$$\frac{4}{(a-16)(a+3)}-\frac{2}{(a-16)(a-2)}=\frac{1}{(a+3)(a-2)}$$
$$4(a-2)-2(a+3)=1(a-16) \quad \{\text{multiply by common denominator}\}$$
$$4a-8-2a-6=a-16$$
$$2a-14=a-16$$
$$a=-2$$

67. $\dfrac{5}{y+4}+\dfrac{2}{y+2}=\dfrac{6}{y+2}-\dfrac{1}{y^2+6y+8}$

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

$5(y+2)=4(y+4)-1$ {multiply by common denominator}

$5y+10=4y+16-1$

$5y+10=4y+15$

$y=5$

68. $\dfrac{6}{2a-6}-\dfrac{3}{3-3a}=\dfrac{1}{a^2-4a+3}$

$\dfrac{6}{2(a-3)}-\dfrac{3}{3(1-a)}=\dfrac{1}{(a-3)(a-1)}$

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

$3(a-1)+1(a-3)=1$ {multiply by common denominator}

$3a-3+a-3=1$

$4a-6=1$

$4a=7$

$a=\dfrac{7}{4}$

69. $\dfrac{3y}{6-3y}+\dfrac{2y}{2y+4}=\dfrac{8}{4-y^2}$

$\dfrac{3y}{3(2-y)}+\dfrac{2y}{2(y+2)}=\dfrac{8}{(2+y)(2-y)}$

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

$y(2+y)+y(2-y)=8$ {multiply by common denominator}

$2y+y^2+2y-y^2=8$

$4y=8$

$y=2 \Rightarrow$ The solution does not check, so the equation has no solution.

70. $\dfrac{3+2a}{a^2+6+5a}-\dfrac{2-3a}{a^2-6+a}=\dfrac{5a-2}{a^2-4}$

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

$(a-2)(2a+3)+(a+2)(3a-2)=(a+3)(5a-2)$ {multiply by common denominator}

$2a^2-a-6+3a^2+4a-4=5a^2+13a-6$

$5a^2+3a-10=5a^2+13a-6$

$-10a=4$

$a=\dfrac{4}{-10}=-\dfrac{2}{5}$

71.
$$\frac{a}{a+2}-1=-\frac{3a+2}{a^2+4a+4}$$
$$\frac{a}{a+2}-\frac{1}{1}=-\frac{3a+2}{(a+2)(a+2)}$$
$$(a+2)(a+2)\left[\frac{a}{a+2}-1\right]=(a+2)(a+2)\cdot\left[-\frac{3a+2}{(a+2)(a+2)}\right]$$
$$a(a+2)-(a+2)(a+2)=-(3a+2)$$
$$a^2+2a-\left(a^2+4a+4\right)=-3a-2$$
$$a^2+2a-a^2-4a-4=-3a-2$$
$$-2a-4=-3a-2$$
$$a=2$$

72.
$$\frac{x-1}{x+3}+\frac{x-2}{x-3}=\frac{1-2x}{3-x}$$
$$\frac{x-1}{x+3}+\frac{x-2}{x-3}=\frac{2x-1}{x-3}$$
$$(x-3)(x-1)+(x+3)(x-2)=(x+3)(2x-1)\quad\{\text{multiply by common denominator}\}$$
$$x^2-4x+3+x^2+x-6=2x^2+5x-3$$
$$2x^2-3x-3=2x^2+5x-3$$
$$-8x=0$$
$$x=\frac{0}{-8}=0$$

73.
$$k=2.2p$$
$$\frac{k}{2.2}=\frac{2.2p}{2.2}$$
$$\frac{k}{2.2}=p$$

74.
$$ax+b=0$$
$$ax=-b$$
$$x=-\frac{b}{a}$$

75.
$$p=2l+2w$$
$$p-2l=2w$$
$$\frac{p-2l}{2}=\frac{2w}{2}$$
$$\frac{p-2l}{2}=w$$

76.
$$V=\frac{1}{3}\pi r^2h$$
$$3V=3\cdot\frac{1}{3}\pi r^2h$$
$$3V=\pi r^2h$$
$$\frac{3V}{\pi r^2}=\frac{\pi r^2h}{\pi r^2}$$
$$\frac{3V}{\pi r^2}=h$$

77.
$$V=\frac{1}{3}\pi r^2h$$
$$3V=3\cdot\frac{1}{3}\pi r^2h$$
$$3V=\pi r^2h$$
$$\frac{3V}{\pi h}=\frac{\pi r^2h}{\pi h}$$
$$\frac{3V}{\pi h}=r^2$$

78.
$$z=\frac{x-\mu}{\sigma}$$
$$z\sigma=\frac{x-\mu}{\sigma}\cdot\sigma$$
$$z\sigma=x-\mu$$
$$\mu+z\sigma=x$$
$$\mu=x-z\sigma$$

79.
$$P_n = L + \frac{si}{f}$$
$$P_n - L = \frac{si}{f}$$
$$f(P_n - L) = f \cdot \frac{si}{f}$$
$$f(P_n - L) = si$$
$$\frac{f(P_n - L)}{i} = \frac{si}{i}$$
$$\frac{f(P_n - L)}{i} = s$$

80.
$$P_n = L + \frac{si}{f}$$
$$P_n - L = \frac{si}{f}$$
$$f(P_n - L) = f \cdot \frac{si}{f}$$
$$f(P_n - L) = si$$
$$\frac{f(P_n - L)}{P_n - L} = \frac{si}{P_n - L}$$
$$f = \frac{si}{P_n - L}$$

81.
$$F = \frac{mMg}{r^2}$$
$$Fr^2 = \frac{mMg}{r^2} \cdot r^2$$
$$Fr^2 = mMg$$
$$\frac{Fr^2}{Mg} = \frac{mMg}{Mg}$$
$$\frac{Fr^2}{Mg} = m$$

82.
$$\frac{1}{f} = \frac{1}{p} + \frac{1}{q}$$
$$fpq \cdot \frac{1}{f} = fpq\left(\frac{1}{p} + \frac{1}{q}\right)$$
$$pq = fq + fp$$
$$pq = f(q + p)$$
$$\frac{pq}{q+p} = \frac{f(q+p)}{q+p}$$
$$\frac{pq}{q+p} = f$$

83.
$$\frac{x}{a} + \frac{y}{b} = 1$$
$$\frac{y}{b} = 1 - \frac{x}{a}$$
$$b \cdot \frac{y}{b} = b\left(1 - \frac{x}{a}\right)$$
$$y = b\left(1 - \frac{x}{a}\right)$$

84.
$$\frac{x}{a} - \frac{y}{b} = 1$$
$$ab\left(\frac{x}{a} - \frac{y}{b}\right) = ab \cdot 1$$
$$bx - ay = ab$$
$$bx = ab + ay$$
$$bx = a(b + y)$$
$$\frac{bx}{b+y} = \frac{a(b+y)}{b+y}$$
$$\frac{bx}{b+y} = a$$

85.
$$\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$$
$$rr_1r_2 \cdot \frac{1}{r} = rr_1r_2\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$
$$r_1r_2 = rr_2 + rr_1$$
$$r_1r_2 = r(r_2 + r_1)$$
$$\frac{r_1r_2}{r_2 + r_1} = \frac{r(r_2 + r_1)}{r_2 + r_1}$$
$$\frac{r_1r_2}{r_2 + r_1} = r$$

86.
$$\frac{1}{r} = \frac{1}{r_1} + \frac{1}{r_2}$$
$$rr_1r_2 \cdot \frac{1}{r} = rr_1r_2\left(\frac{1}{r_1} + \frac{1}{r_2}\right)$$
$$r_1r_2 = rr_2 + rr_1$$
$$r_1r_2 - rr_1 = rr_2$$
$$r_1(r_2 - r) = rr_2$$
$$\frac{r_1(r_2 - r)}{r_2 - r} = \frac{rr_2}{r_2 - r}$$
$$r_1 = \frac{rr_2}{r_2 - r}$$

87.
$$l = a + (n-1)d$$
$$l = a + nd - d$$
$$l - a + d = nd$$
$$\frac{l - a + d}{d} = \frac{nd}{d}$$
$$\frac{l - a + d}{d} = n$$

88.
$$l = a + (n-1)d$$
$$l - a = (n-1)d$$
$$\frac{l - a}{n-1} = \frac{(n-1)d}{n-1}$$
$$\frac{l - a}{n-1} = d$$

89.
$$\begin{aligned} a &= (n-2)\frac{180}{n} \\ an &= (n-2)\frac{180}{n}\cdot n \\ an &= (n-2)180 \\ an &= 180n - 360 \\ 360 &= 180n - an \\ 360 &= n(180-a) \\ \frac{360}{180-a} &= n \end{aligned}$$

90.
$$\begin{aligned} S &= \frac{a-lr}{1-r} \\ S(1-r) &= \frac{a-lr}{1-r}(1-r) \\ S(1-r) &= a - lr \\ S - Sr + lr &= a \end{aligned}$$

91.
$$\begin{aligned} R &= \frac{1}{\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}} \\ R &= \frac{r_1r_2r_3(1)}{r_1r_2r_3\left(\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}\right)} \\ R &= \frac{r_1r_2r_3}{r_2r_3+r_1r_3+r_1r_2} \\ R(r_2r_3+r_1r_3+r_1r_2) &= r_1r_2r_3 \\ Rr_2r_3+Rr_1r_3+Rr_1r_2 &= r_1r_2r_3 \\ Rr_1r_3+Rr_1r_2-r_1r_2r_3 &= -Rr_2r_3 \\ r_1(Rr_3+Rr_2-r_2r_3) &= -Rr_2r_3 \\ r_1 &= \frac{-Rr_2r_3}{Rr_3+Rr_2-r_2r_3} \end{aligned}$$

92.
$$\begin{aligned} R &= \frac{1}{\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}} \\ R &= \frac{r_1r_2r_3(1)}{r_1r_2r_3\left(\frac{1}{r_1}+\frac{1}{r_2}+\frac{1}{r_3}\right)} \\ R &= \frac{r_1r_2r_3}{r_2r_3+r_1r_3+r_1r_2} \\ R(r_2r_3+r_1r_3+r_1r_2) &= r_1r_2r_3 \\ Rr_2r_3+Rr_1r_3+Rr_1r_2 &= r_1r_2r_3 \\ Rr_2r_3+Rr_1r_3-r_1r_2r_3 &= -Rr_1r_2 \\ r_3(Rr_2+Rr_1-r_1r_2) &= -Rr_1r_2 \\ r_3 &= \frac{-Rr_1r_2}{Rr_2+Rr_1-r_1r_2} \end{aligned}$$

93. Answers may vary.

94. Answers may vary.

95. $(25x^2)^{1/2} = \left[(5x)^2\right]^{1/2} = 5|x|$

96. $\left(\frac{25p^2}{16q^4}\right)^{1/2} = \left[\left(\frac{5p}{4q^2}\right)^2\right]^{1/2} = \frac{5|p|}{4q^2}$

97. $\left(\dfrac{125x^3}{8y^6}\right)^{-2/3} = \left(\dfrac{8y^6}{125x^3}\right)^{2/3}$
$= \dfrac{8^{2/3}(y^6)^{2/3}}{125^{2/3}(x^3)^{2/3}} = \dfrac{4y^4}{25x^2}$

98. $\left(-\dfrac{27y^3}{1{,}000x^6}\right)^{1/3} = \dfrac{(-27)^{1/3}(y^3)^{1/3}}{1{,}000^{1/3}(x^6)^{1/3}}$
$= \dfrac{-3y}{10x^2} = -\dfrac{3y}{10x^2}$

99. $\sqrt{25y^2} = \sqrt{(5y)^2} = 5|y|$

100. $\sqrt[3]{-125y^9} = \sqrt[3]{(-5y^3)^3} = -5y^3$

101. $\sqrt[4]{\dfrac{a^4b^{12}}{z^8}} = \sqrt[4]{\left(\dfrac{ab^3}{z^2}\right)^4} = \dfrac{|ab^3|}{z^2}$

102. $\sqrt[5]{\dfrac{x^{10}y^5}{z^{15}}} = \sqrt[5]{\left(\dfrac{x^2y}{z^3}\right)^5} = \dfrac{x^2y}{z^3}$

Exercises 1.2 (page 101)

1. add

2. perimeter

3. amount

4. break point

5. rate, time

6. $0.05(30) = 1.5$

7. Let $x =$ the score on the first exam.
Then $x + 5 =$ the score on the midterm,
and $x + 13 =$ the score on the final.

$$\frac{\boxed{\text{Sum of scores}}}{3} = 90$$
$$\frac{x + x + 5 + x + 13}{3} = 90$$
$$\frac{3x + 18}{3} = 90$$
$$3x + 18 = 270$$
$$3x = 252$$
$$x = 84$$

His score on the first exam was 84.

8. Let $x =$ the score on the first exam. Then her scores on the following tests were $x + 3$, $x + 6$ and $x + 9$.

$$\frac{\boxed{\text{Sum of scores}}}{4} = 69.5$$
$$\frac{x + x + 3 + x + 6 + x + 9}{4} = 69.5$$
$$\frac{4x + 18}{4} = 69.5$$
$$4x + 18 = 278$$
$$4x = 260$$
$$x = 65$$

Her score on the first exam was 65%.

9. Let $x =$ the program development score.

$$\frac{\boxed{\text{Sum of scores}}}{4} = 86$$
$$\frac{82 + 90 + x + 78}{4} = 86$$
$$\frac{x + 250}{4} = 86$$
$$x + 250 = 344$$
$$x = 94$$

The program development score was 94.

10. Let $x =$ the score on the final round.

$$\frac{\boxed{\text{Sum of scores}}}{4} = 72$$
$$\frac{76 + 68 + 70 + x}{4} = 72$$
$$\frac{x + 214}{4} = 72$$
$$x + 214 = 288$$
$$x = 74$$

She needs to shoot 74 on the final round.

11. Let $x =$ the number of locks replaced.

$$40 + 28 \cdot \boxed{\text{Number of locks}} = 236$$
$$40 + 28x = 236$$
$$28x = 196$$
$$x = 7$$

7 locks can be changed for \$236.

12. Let $x =$ the number of interviews.

$$20 + 0.75 \cdot \boxed{\text{Number of interviews}} = 56$$
$$20 + 0.75x = 56$$
$$0.75x = 36$$
$$x = 48$$

He interviewed 48 people.

13. Let $x =$ the width.
Then $x + 26 =$ the height.

$$\boxed{\text{Perimeter}} = 92$$
$$2x + 2(x + 26) = 92$$
$$2x + 2x + 52 = 92$$
$$4x = 40$$
$$x = 10$$

The dimensions are 10 ft by 36 ft.

14. Let $x =$ the width.
Then $x + 115 =$ the length.

$$\boxed{\text{Perimeter}} = 570$$
$$2x + 2(x + 115) = 570$$
$$2x + 2x + 230 = 570$$
$$4x = 340$$
$$x = 85$$

The dimensions are 85 ft by 200 ft.

15.

$$\boxed{\text{Perimeter}} = 14$$
$$x + (x + 2) + x + (x + 2) = 14$$
$$4x + 4 = 14$$
$$4x = 10$$
$$x = \frac{5}{2} = 2\frac{1}{2} \Rightarrow \text{The width is } 2\frac{1}{2} \text{ feet.}$$

16.

$$\boxed{\text{Total Fence Length}} = 2 \cdot \boxed{\text{Square Fence Length}}$$
$$x + (x + 24) + x + (x + 24) = 2 \cdot (x + x + x + x)$$
$$4x + 48 = 8x$$
$$48 = 4x$$
$$x = 12$$

The total fencing required is $4x + 48 = 4(12) + 48 = 96$ feet.

17.

$$\boxed{\text{Total Area}} = 2 \cdot \boxed{\text{Triangular Area}}$$
$$20x + \frac{1}{2}(16)(20) = 2 \cdot \frac{1}{2}(16)(20)$$
$$20x + 160 = 320$$
$$20x = 160$$
$$x = 8$$

The dimensions are 8 feet by 20 feet.

18.

$$\boxed{\text{Sum of angles}} = 180$$
$$x + x + 30 + x + 30 = 180$$
$$3x + 60 = 180$$
$$3x = 120$$
$$x = 40$$

The angles measure $40°$, $70°$ and $70°$.

19. $\boxed{\text{New Area}} = \boxed{\text{Old Area}} + 0.50 \cdot \boxed{\text{Old Area}}$

$$12(x+10) + 12x = 12(x+10) + 0.50 \cdot 12(x+10)$$
$$12x + 120 + 12x = 12x + 120 + 6x + 60$$
$$24x + 120 = 18x + 180$$
$$6x = 60$$
$$x = 10 \Rightarrow \text{The length of the living room is } x + 10 = 20 \text{ feet.}$$

20. $\boxed{\text{Area}} = 54$

$$\frac{1}{2}d(12+8) = 54$$
$$10d = 54$$
$$d = 5.4 \Rightarrow \text{The depth is 5.4 inches}$$

21. Let $x =$ the amount invested at 7%. Then $22000 - x =$ the amount invested at 6%.

$\boxed{\text{Interest at 7\%}} + \boxed{\text{Interest at 6\%}} = \boxed{\text{Total interest}}$

$$0.07x + 0.06(22000 - x) = 1420$$
$$0.07x + 1320 - 0.06x = 1420$$
$$0.01x = 100$$
$$x = 10000$$

\$10,000 was invested at 7% and \$12,000 was invested at 6%.

22. Let $x =$ the amount invested at 7%.

$\boxed{\text{Interest at 7\%}} + \boxed{\text{Interest at 9\%}} = \boxed{\text{Total interest}}$

$$0.07x + 0.09(20000) = 5000$$
$$0.07x + 1800 = 5000$$
$$0.07x = 3200$$
$$x \approx 45714.29$$

She needs to invest \$45,714.29 at 7% to reach her goal.

23. Let $x =$ the amount invested at each rate.

$\boxed{\text{Interest at 6\%}} + \boxed{\text{Interest at 7\%}} + \boxed{\text{Interest at 8\%}} = \boxed{\text{Total interest}}$

$$0.06x + 0.07x + 0.08x = 2037$$
$$0.21x = 2037$$
$$x = 9700$$

\$9,700 was invested at each rate, for a total investment of \$29,100.

24. Let $x =$ the amount invested at 8%. Then $37{,}000 - x =$ the amount invested at $9\frac{1}{2}\%$.

$$\boxed{\text{Interest at } 9\tfrac{1}{2}\%} = \boxed{\text{Interest at } 8\%} + 452.50$$
$$0.095(37{,}000 - x) = 0.08x + 452.50$$
$$3515 - 0.095x = 0.08x + 452.50$$
$$3062.50 = 0.175x$$
$$17500 = x$$

\$17,500 is invested at 8% and \$19,500 is invested at $9\frac{1}{2}\%$.

25. Let $x =$ the number of full-price tickets sold. Then $585 - x =$ the number of student tickets sold.

$$2.50 \cdot \boxed{\begin{matrix}\#\text{ of}\\ \text{full-price}\end{matrix}} + 1.75 \cdot \boxed{\begin{matrix}\#\text{ of}\\ \text{student}\end{matrix}} = 1217.25$$
$$2.50x + 1.75(585 - x) = 1217.25$$
$$2.50x + 1023.75 - 1.75x = 1217.25$$
$$0.75x = 193.50$$
$$x = 258 \Rightarrow \text{There were 327 student tickets sold.}$$

26. Let $x =$ the cost of a student ticket.

$$\boxed{\begin{matrix}\text{Cost of}\\ \text{full-price}\end{matrix}} \cdot \boxed{\begin{matrix}\#\text{ of}\\ \text{full-price}\end{matrix}} + \boxed{\begin{matrix}\text{Cost of}\\ \text{student}\end{matrix}} \cdot \boxed{\begin{matrix}\#\text{ of}\\ \text{student}\end{matrix}} = 4960$$
$$480(7) + x(800 - 480) = 4960$$
$$3360 + 320x = 4960$$
$$320x = 1600$$
$$x = 5 \Rightarrow \text{A student ticket cost \$5.}$$

27. Let $p =$ the original price.

$$\boxed{\begin{matrix}\text{Original}\\ \text{price}\end{matrix}} - \boxed{\text{Discount}} = \boxed{\begin{matrix}\text{New}\\ \text{price}\end{matrix}}$$
$$p - 0.20p = 63.96$$
$$0.80p = 63.96$$
$$p = 79.95$$

The original price was \$79.95.

28. Let $w =$ the wholesale cost.

$$\boxed{\begin{matrix}\text{Wholesale}\\ \text{cost}\end{matrix}} + \boxed{\text{Markup}} = \boxed{\begin{matrix}\text{Selling}\\ \text{price}\end{matrix}}$$
$$w + 0.30w = 588.90$$
$$1.30w = 588.90$$
$$w = 453$$

The wholesale cost is \$453.

29. Let $x =$ # of plates for equal costs.

$$\boxed{\begin{matrix}\text{Cost of 1st}\\ \text{machine}\end{matrix}} = \boxed{\begin{matrix}\text{Cost of 2nd}\\ \text{machine}\end{matrix}}$$
$$600 + 3x = 800 + 2x$$
$$x = 200$$

The break point is 200 plates.

30. Let $x =$ # of fasteners for equal costs.

$$\boxed{\begin{matrix}\text{Cost of 1st}\\ \text{machine}\end{matrix}} = \boxed{\begin{matrix}\text{Cost of 2nd}\\ \text{machine}\end{matrix}}$$
$$1200 + 0.005x = 1500 + 0.0015x$$
$$0.0035x = 300$$
$$x \approx 85714$$

The break point is about 85,714 fasteners.

31. Let $x = $ # of computers to break even.

$$\boxed{\text{Income}} = \boxed{\text{Expenses}}$$
$$1275x = 8925 + 850x$$
$$425x = 8925$$
$$x = 21$$

21 computers need to be sold to break even.

32. Let $x = $ # of meals to break even.

$$\boxed{\text{Income}} = \boxed{\text{Expenses}}$$
$$6x = 137.50 + 4.75x$$
$$1.25x = 137.50$$
$$x = 110$$

More than 110 meals need to be sold to make a profit.

33. Let $x = $ days for both working together.

$$\boxed{\begin{matrix}\text{Man in}\\ \text{1 day}\end{matrix}} + \boxed{\begin{matrix}\text{Roofer in}\\ \text{1 day}\end{matrix}} = \boxed{\begin{matrix}\text{Total in}\\ \text{1 day}\end{matrix}}$$
$$\frac{1}{7} + \frac{1}{4} = \frac{1}{x}$$
$$28x\left(\frac{1}{7} + \frac{1}{4}\right) = 28x\left(\frac{1}{x}\right)$$
$$4x + 7x = 28$$
$$11x = 28$$
$$x = \frac{28}{11} = 2\frac{6}{11}$$

They can roof the house in $2\frac{6}{11}$ days.

34. Let $x = $ hours for both working together.

$$\boxed{\begin{matrix}\text{Crew 1}\\ \text{in 1 hour}\end{matrix}} + \boxed{\begin{matrix}\text{Crew 2}\\ \text{in 1 hour}\end{matrix}} = \boxed{\begin{matrix}\text{Total in}\\ \text{1 hour}\end{matrix}}$$
$$\frac{1}{8} + \frac{1}{10} = \frac{1}{x}$$
$$40x\left(\frac{1}{8} + \frac{1}{10}\right) = 40x\left(\frac{1}{x}\right)$$
$$5x + 4x = 40$$
$$9x = 40$$
$$x = \frac{40}{9} = 4\frac{4}{9}$$

They can seal the parking lot in $4\frac{4}{9}$ hours.

35. Let $x = $ hours for both working together.

$$\boxed{\begin{matrix}\text{Woman}\\ \text{in 1 hour}\end{matrix}} + \boxed{\begin{matrix}\text{Man in}\\ \text{1 hour}\end{matrix}} = \boxed{\begin{matrix}\text{Total in}\\ \text{1 hour}\end{matrix}}$$
$$\frac{1}{2} + \frac{1}{4} = \frac{1}{x}$$
$$4x\left(\frac{1}{2} + \frac{1}{4}\right) = 4x\left(\frac{1}{x}\right)$$
$$2x + x = 4$$
$$3x = 4$$
$$x = \frac{4}{3} = 1\frac{1}{3}$$

They can mow the lawn in $1\frac{1}{3}$ hours.

36. Let $x = $ days for both hoses to fill the pool.

$$\boxed{\begin{matrix}\text{1st hose}\\ \text{in 1 day}\end{matrix}} + \boxed{\begin{matrix}\text{2nd hose}\\ \text{in 1 day}\end{matrix}} = \boxed{\begin{matrix}\text{Total in}\\ \text{1 day}\end{matrix}}$$
$$\frac{1}{3} + \frac{1}{2} = \frac{1}{x}$$
$$6x\left(\frac{1}{3} + \frac{1}{2}\right) = 6x\left(\frac{1}{x}\right)$$
$$2x + 3x = 6$$
$$5x = 6$$
$$x = \frac{6}{5} = 1\frac{1}{5}$$

The pool can be filled in $1\frac{1}{5}$ days.