Complete Solutions Manual

Finite Mathematics

SIXTH EDITION

Stefan Waner
Hofstra University

Steven R. Costenoble
Hofstra University

Prepared by

Stefan Waner
Hofstra University

Steven R. Costenoble
Hofstra University

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Solutions Section 0.1

Section 0.1

1. $2(4 + (-1))(2 \cdot -4)$
$= 2(3)(-8) = (6)(-8) = -48$

2. $3 + ([4 - 2] \cdot 9)$
$= 3 + (2 \times 9) = 3 + 18 = 21$

3. `20/(3*4)-1`
$= \frac{20}{12} - 1 = \frac{5}{3} - 1 = \frac{2}{3}$

4. `2-(3*4)/10`
$= 2 - \frac{12}{10} = 2 - \frac{6}{5} = \frac{4}{5}$

5. $\frac{3 + ([3 + (-5)])}{3 - 2 \times 2} = \frac{3 + (-2)}{3 - 4}$
$= \frac{1}{-1} = -1$

6. $\frac{12 - (1 - 4)}{2(5 - 1) \cdot 2 - 1} = \frac{12 - (-3)}{16 - 1}$
$= \frac{15}{15} = 1$

7. `(2-5*(-1))/1-2*(-1)`
$= \frac{2 - 5 \cdot (-1)}{1} - 2 \cdot (-1)$
$= \frac{2+5}{1} + 2 = 7 + 2 = 9$

8. `2-5*(-1)/(1-2*(-1))`
$= 2 - \frac{5 \cdot (-1)}{1 - 2 \cdot (-1)}$
$= 2 - \frac{-5}{1 + 2} = 2 + \frac{5}{3} = \frac{11}{3}$

9. $2 \cdot (-1)^2 / 2 = \frac{2 \times (-1)^2}{2} = \frac{2 \times 1}{2} = \frac{2}{2} = 1$

10. $2 + 4 \cdot 3^2 = 2 + 4 \times 9 = 2 + 36 = 38$

11. $2 \cdot 4^2 + 1 = 2 \times 16 + 1 = 32 + 1 = 33$

12. $1 - 3 \cdot (-2)^2 \times 2 = 1 - 3 \times 4 \times 2$
$= 1 - 24 = -23$

13. `3^2+2^2+1`
$= 3^2 + 2^2 + 1 = 9 + 4 + 1 = 14$

14. `2^(2^2-2)` $= 2^{\left(2^2 - 2\right)} = 2^{4-2} = 2^2 = 4$

15. $\frac{3 - 2(-3)^2}{-6(4 - 1)^2} = \frac{3 - 2 \times 9}{-6(3)^2} = \frac{3 - 18}{6 \times 9}$
$= \frac{-15}{54} = \frac{5}{18}$

16. $\frac{1 - 2(1 - 4)^2}{2(5 - 1)^2 \cdot 2} = \frac{1 - 2(-3)^2}{2(4)^2 \cdot 2} = \frac{1 - 2 \times 9}{2 \times 16 \times 2}$
$= \frac{1-18}{64} = -\frac{17}{64}$

17. `10*(1+1/10)^3`
$= 10\left(1 + \frac{1}{10}\right)^3 = 10(1.1)^3$
$= 10 \times 1.331 = 13.31$

18. `121/(1+1/10)^2`
$= \frac{121}{\left(1 + \frac{1}{10}\right)^2} = \frac{121}{1.1^2} = \frac{121}{1.21} = 100$

19. $3\left[\frac{-2 \cdot 3^2}{-(4 - 1)^2}\right] = 3\left[\frac{-2 \times 9}{-3^2}\right] = 3\left[\frac{-18}{-9}\right]$
$= 3 \times 2 = 6$

20. $-\left[\frac{8(1 - 4)^2}{-9(5 - 1)^2}\right] = -\left[\frac{8(-3)^2}{-9(4)^2}\right]$
$= -\left[\frac{8 \times 9}{-9 \times 16}\right] = -\left(\frac{72}{-144}\right) = -\left(-\frac{1}{2}\right) = \frac{1}{2}$

21. $3\left[1 - \left(-\frac{1}{2}\right)^2\right]^2 + 1 = 3\left[1 - \frac{1}{4}\right]^2 + 1$
$= 3\left[\frac{3}{4}\right]^2 = 3\left[\frac{9}{16}\right] + 1 = \frac{27}{16} + 1 = \frac{43}{16}$

22. $3\left[\frac{1}{9} - \left(\frac{2}{3}\right)^2\right]^2 + 1 = 3\left[\frac{1}{9} - \frac{4}{9}\right]^2 + 1$
$= 3\left[\frac{-3}{9}\right]^2 + 1 = 3\left[\frac{-1}{3}\right]^2 + 1$
$= 3\left[\frac{1}{9}\right] + 1 = \frac{3}{9} + 1 = \frac{4}{3}$

23. `(1/2)^2-1/2^2`

Solutions Section 0.1

$$= \left[\frac{1}{2}\right]^2 - \frac{1}{2^2} = \frac{1}{4} - \frac{1}{4} = 0$$

24. `2/(1^2)-(2/1)^2`

$$= \frac{2}{1^2} - \left[\frac{2}{1}\right]^2 = \frac{2}{1} - \frac{4}{1} = -2$$

25. $3\times(2-5)$ = `3*(2-5)`

26. $4 + \dfrac{5}{9}$ = `4+5/9` or `4+(5/9)`

27. $\dfrac{3}{2-5}$ = `3/(2-5)`

Note $3/2-5$ is wrong, since it corresponds to $\dfrac{3}{2} - 5$.

28. $\dfrac{4-1}{3}$ = `(4-1)/3`

29. $\dfrac{3-1}{8+6}$ = `(3-1)/(8+6)`

Note $3-1/8-6$ is wrong, since it corresponds to $3 - \dfrac{1}{8} - 6$.

30. $3 + \dfrac{3}{2-9}$ = `3+3/(2-9)`

31. $3 - \dfrac{4+7}{8}$ = `3-(4+7)/8`

32. $\dfrac{4\times2}{\left[\frac{2}{3}\right]}$ = `4*2/(2/3)` or `(4*2)/(2/3)`

33. $\dfrac{2}{3+x} - xy^2$ = `2/(3+x)-x*y^2`

34. $3+\dfrac{3+x}{xy}$ = `3+(3+x)/(x*y)`

35. $3.1x^3 - 4x^{-2} - \dfrac{60}{x^2-1}$

$\quad$ = `3.1x^3-4x^(-2)-60/(x^2-1)`

36. $2.1x^{-3} - x^{-1} + \dfrac{x^2-3}{2}$

$\quad$ = `2.1x^(-3)-x^(-1)+(x^2-3)/2`

37. $\dfrac{\left[\frac{2}{3}\right]}{5}$ = `(2/3)/5`

Note that we use only (round) parentheses in technology formulas, and not brackets.

38. $\dfrac{2}{\left[\frac{3}{5}\right]}$ = `2/(3/5)`

39. $3^{4-5}\times6$ = `3^(4-5)*6`

Note that the entire exponent is in parentheses.

40. $\dfrac{2}{3+5^{7-9}}$ = `2/(3+5^(7-9))`

41. $3\left[1 + \dfrac{4}{100}\right]^{-3}$ = `3*(1+4/100)^(-3)`

Note that we use only (round) parentheses in technology formulas, and not brackets.

42. $3\left[\dfrac{1 + 4}{100}\right]^{-3}$ = `3((1+4)/100)^(-3)`

43. $3^{2x-1} + 4^x - 1$ = `3^(2*x-1)+4^x-1`

Note that the entire exponent of 3 is in parentheses.

44. $2^{x^2} - (2^{2x})^2$ = `2^(x^2)-(2^(2*x))^2`

45. 2^{2x^2-x+1} = `2^(2x^2-x+1)`

Note that the entire exponent is in parentheses.

46. $2^{2x^2-x} + 1$ = `2^(2x^2-x)+1`

47. $\dfrac{4e^{-2x}}{2-3e^{-2x}}$ = `4*e^(-2*x)/(2-3e^(-2*x))`

or `4(*e^(-2*x))/(2-3e^(-2*x))`

or `(4*e^(-2*x))/(2-3e^(-2*x))`

48. $\dfrac{e^{2x} + e^{-2x}}{e^{2x} - e^{-2x}}$

= `(e^(2*x)+e^(-2*x))/e^(2*x)-e^(-2*x))`

49. $3\left[1 - \left(-\dfrac{1}{2}\right)^2\right]^2 + 1$ = `3(1-(-1/2)^2)^2+1`

Note that we use only (round) parentheses in technology formulas, and not brackets.

Section 0.2

1. $3^3 = 27$

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

3. $-(2 \cdot 3)^2 = -(2^2 \cdot 3^2) = -(4 \cdot 9) = -36$ or
$-(2 \cdot 3)^2 = -(6^2) = -36$

4. $(4 \cdot 2)^2 = 4^2 \cdot 2^2 = 16 \cdot 4 = 64$ or
$(4 \cdot 2)^2 = 8^2 = 64$

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

6. $\left(\dfrac{3}{2}\right)^3 = \dfrac{3^3}{2^3} = \dfrac{27}{8}$

7. $(-2)^{-3} = \dfrac{1}{(-2)^3} = \dfrac{1}{-8} = -\dfrac{1}{8}$

8. $-2^{-3} = -\dfrac{1}{2^3} = -\dfrac{1}{8}$

9. $\left(\dfrac{1}{4}\right)^{-2} = \dfrac{1}{(1/4)^2} = \dfrac{1}{1/4^2} = \dfrac{1}{1/16} = 16$

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

11. $2 \cdot 3^0 = 2 \cdot 1 = 2$

12. $3 \cdot (-2)^0 = 3 \cdot 1 = 3$

13. $2^3\, 2^2 = 2^{3+2} = 2^5 = 32$ or $2^3\, 2^2 = 8 \cdot 4 = 32$

14. $3^2\, 3 = 3^{2+1} = 3^3 = 27$ or $3^2\, 3 = 9 \cdot 3 = 27$

15. $2^2\, 2^{-1}\, 2^4\, 2^{-4} = 2^{2-1+4-4} = 2^1 = 2$

16. $5^2\, 5^{-3}\, 5^2\, 5^{-2} = 5^{2-3+2-2} = 5^{-1} = \dfrac{1}{5}$

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

18. $x^4 x^{-1} = x^{4-1} = x^3$

19. $-x^2 x^{-3} y = -x^{2-3} y = -x^{-1} y = -\dfrac{y}{x}$

20. $-xy^{-1}x^{-1} = -x^{1-1}y^{-1} = -x^0 y^{-1} = -\dfrac{1}{y}$

21. $\dfrac{x^3}{x^4} = x^{3-4} = x^{-1} = \dfrac{1}{x}$

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

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

24. $\dfrac{x^{-1} y}{x^2 y^2} = x^{-1-2} y^{1-2} = x^{-3} y^{-1} = \dfrac{1}{x^3 y}$

25. $\dfrac{(xy^{-1}z^3)^2}{x^2 y z^2} = \dfrac{x^2(y^{-1})^2(z^3)^2}{x^2 y z^2} = x^{2-2} y^{-2-1} z^{6-2} =$
$y^{-3} z^4 = \dfrac{z^4}{y^3}$

26. $\dfrac{x^2 y z^2}{(xyz^{-1})^{-1}} = \dfrac{x^2 y z^2}{x^{-1} y^{-1} z} = x^{2-(-1)} y^{1-(-1)} z^{2-1} = x^3 y^2 z$

27. $\left(\dfrac{xy^{-2}z}{x^{-1}z}\right)^3 = \dfrac{(xy^{-2}z)^3}{(x^{-1}z)^3} = \dfrac{x^3 y^{-6} z^3}{x^{-3} z^3} = x^{3-(-3)} y^{-6} z^{3-3} =$
$x^6 y^{-6} = \dfrac{x^6}{y^6}$

28. $\left(\dfrac{x^2 y^{-1} z^0}{xyz}\right)^2 = \dfrac{x^4 y^{-2}}{x^2 y^2 z^2} = x^{4-2} y^{-2-2} z^{-2} = x^2 y^{-4} z^{-2} =$
$\dfrac{x^2}{y^4 z^2}$

29. $\left(\dfrac{x^{-1}y^{-2}z^2}{xy}\right)^{-2} = (x^{-1-1} y^{-2-1} z^2)^{-2} = (x^{-2} y^{-3} z^2)^{-2} =$
$x^4 y^6 z^{-4} = \dfrac{x^4 y^6}{z^4}$

30. $\left(\dfrac{xy^{-2}}{x^2 y^{-1} z}\right)^{-3} = (x^{1-2} y^{-2+1} z^{-1})^{-3} = (x^{-1} y^{-1} z^{-1})^{-3} =$
$x^3 y^3 z^3$

31. $3x^{-4} = \dfrac{3}{x^4}$

Solutions Section 0.2

32. $\dfrac{1}{2}x^{-4} = \dfrac{1}{2x^4}$

33. $\dfrac{3}{4}x^{-2/3} = \dfrac{3}{4x^{2/3}}$

34. $\dfrac{4}{5}y^{-3/4} = \dfrac{4}{5y^{3/4}}$

35. $1 - \dfrac{0.3}{x^{-2}} - \dfrac{6}{5}x^{-1} = 1 - 0.3x^2 - \dfrac{6}{5x}$

36. $\dfrac{1}{3x^{-4}} + \dfrac{0.1x^{-2}}{3} = \dfrac{x^4}{3} + \dfrac{0.1}{3x^2}$

37. $\sqrt{4} = 2$

38. $\sqrt{5} \approx 2.236$

39. $\sqrt{\dfrac{1}{4}} = \dfrac{\sqrt{1}}{\sqrt{4}} = \dfrac{1}{2}$

40. $\sqrt{\dfrac{1}{9}} = \dfrac{\sqrt{1}}{\sqrt{9}} = \dfrac{1}{3}$

41. $\sqrt{\dfrac{16}{9}} = \dfrac{\sqrt{16}}{\sqrt{9}} = \dfrac{4}{3}$

42. $\sqrt{\dfrac{9}{4}} = \dfrac{\sqrt{9}}{\sqrt{4}} = \dfrac{3}{2}$

43. $\dfrac{\sqrt{4}}{5} = \dfrac{2}{5}$

44. $\dfrac{6}{\sqrt{25}} = \dfrac{6}{5}$

45. $\sqrt{9} + \sqrt{16} = 3 + 4 = 7$

46. $\sqrt{25} - \sqrt{16} = 5 - 4 = 1$

47. $\sqrt{9 + 16} = \sqrt{25} = 5$

48. $\sqrt{25 - 16} = \sqrt{9} = 3$

49. $\sqrt[3]{8 - 27} = \sqrt[3]{-19} \approx -2.668$

50. $\sqrt[4]{81 - 16} = \sqrt[4]{65} \approx 2.839$

51. $\sqrt[3]{\dfrac{27}{8}} = \dfrac{\sqrt[3]{27}}{\sqrt[3]{8}} = \dfrac{3}{2}$

52. $\sqrt[3]{8 \cdot 64} = \sqrt[3]{8} \cdot \sqrt[3]{64} = 2 \cdot 4 = 8$

53. $\sqrt{(-2)^2} = \sqrt{4} = 2$

54. $\sqrt{(-1)^2} = \sqrt{1} = 1$

55. $\sqrt{\dfrac{1}{4}(1 + 15)} = \sqrt{\dfrac{16}{4}} = \dfrac{\sqrt{16}}{\sqrt{4}} = \dfrac{4}{2} = 2$

56. $\sqrt{\dfrac{1}{9}(3 + 33)} = \sqrt{\dfrac{36}{9}} = \dfrac{\sqrt{36}}{\sqrt{9}} = \dfrac{6}{3} = 2$

57. $\sqrt{a^2b^2} = \sqrt{a}\,\sqrt{b} = ab$

58. $\sqrt{\dfrac{a^2}{b^2}} = \dfrac{\sqrt{a^2}}{\sqrt{b^2}} = \dfrac{a}{b}$

59. $\sqrt{(x + 9)^2} = x + 9$ ($x + 9 > 0$ because x is positive)

60. $\left(\sqrt{x + 9}\right)^2 = x + 9$

61. $\sqrt[3]{x^3(a^3 + b^3)} = \sqrt[3]{x^3}\,\sqrt[3]{a^3 + b^3} = x\sqrt[3]{a^3 + b^3}$ (Notice: *Not* $x(a + b)$.)

62. $\sqrt[4]{\dfrac{x^4}{a^4b^4}} = \dfrac{\sqrt[4]{x^4}}{\sqrt[4]{a^4}\,\sqrt[4]{b^4}} = \dfrac{x}{ab}$

63. $\sqrt{\dfrac{4xy^3}{x^2y}} = \sqrt{\dfrac{4y^2}{x}} = \dfrac{\sqrt{4}\,\sqrt{y^2}}{\sqrt{x}} = \dfrac{2y}{\sqrt{x}}$

64. $\sqrt{\dfrac{4(x^2 + y^2)}{c^2}} = \dfrac{\sqrt{4}\,\sqrt{x^2 + y^2}}{\sqrt{c^2}} = \dfrac{2\sqrt{x^2 + y^2}}{c}$

(Notice: *Not* $2(x + y)/c$.)

65. $\sqrt{3} = 3^{1/2}$

66. $\sqrt{8} = 8^{1/2}$

67. $\sqrt{x^3} = x^{3/2}$

68. $\sqrt[3]{x^2} = x^{2/3}$

69. $\sqrt[3]{xy^2} = (xy^2)^{1/3}$

70. $\sqrt{x^2y} = (x^2y)^{1/2}$

71. $\dfrac{x^2}{\sqrt{x}} = \dfrac{x^2}{x^{1/2}} = x^{2-1/2} = x^{3/2}$

72. $\dfrac{x}{\sqrt{x}} = \dfrac{x}{x^{1/2}} = x^{1-1/2} = x^{1/2}$

73. $\dfrac{3}{5x^2} = \dfrac{3}{5}\,x^{-2}$

74. $\dfrac{2}{5x^{-3}} = \dfrac{2}{5}\,x^3$

75. $\dfrac{3x^{-1.2}}{2} - \dfrac{1}{3x^{2.1}} = \dfrac{3}{2}\,x^{-1.2} - \dfrac{1}{3}\,x^{-2.1}$

76. $\dfrac{2}{3x^{-1.2}} - \dfrac{x^{2.1}}{3} = \dfrac{2}{3}\,x^{1.2} - \dfrac{1}{3}\,x^{2.1}$

77. $\dfrac{2x}{3} - \dfrac{x^{0.1}}{2} + \dfrac{4}{3x^{1.1}} = \dfrac{2}{3}\,x - \dfrac{1}{2}\,x^{0.1} + \dfrac{4}{3}\,x^{-1.1}$

78. $\dfrac{4x^2}{3} + \dfrac{x^{3/2}}{6} - \dfrac{2}{3x^2} = \dfrac{4}{3}\,x^2 + \dfrac{1}{6}\,x^{3/2} - \dfrac{2}{3}\,x^{-2}$

79. $\dfrac{3\sqrt{x}}{4} - \dfrac{5}{3\sqrt{x}} + \dfrac{4}{3x\sqrt{x}} = \dfrac{3x^{1/2}}{4} - \dfrac{5}{3x^{1/2}} + \dfrac{4}{3xx^{1/2}} =$

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

80. $\dfrac{3}{5\sqrt{x}} - \dfrac{5\sqrt{x}}{8} + \dfrac{7}{2\sqrt[3]{x}} = \dfrac{3}{5x^{1/2}} - \dfrac{5x^{1/2}}{8} + \dfrac{7}{2x^{1/3}} = \dfrac{3}{5}$

$x^{-1/2} - \dfrac{5}{8}x^{1/2} + \dfrac{7}{2}x^{-1/3}$

81. $\dfrac{3\sqrt[5]{x^2}}{4} - \dfrac{7}{2\sqrt{x^3}}$

$= \dfrac{3x^{2/5}}{4} - \dfrac{7}{2x^{3/2}} = \dfrac{3}{4}x^{2/5} - \dfrac{7}{2}x^{-3/2}$

82. $\dfrac{1}{8x\sqrt{x}} - \dfrac{2}{3\sqrt[5]{x^3}} = \dfrac{1}{8x^{3/2}} - \dfrac{2}{3x^{3/5}}$

$= \dfrac{1}{8}x^{-3/2} - \dfrac{2}{3}x^{-3/5}$

83. $\dfrac{1}{(x^2 + 1)^3} - \dfrac{3}{4\sqrt[3]{(x^2 + 1)}} =$

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

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

84. $\dfrac{2}{3(x^2 + 1)^{-3}} - \dfrac{3\sqrt[3]{(x^2 + 1)^7}}{4} =$

$\dfrac{2}{3}\,(x^2 + 1)^3 - \dfrac{3}{4}\,(x^2 + 1)^{7/3}$

85. $2^{2/3} = \sqrt[3]{2^2}$

86. $3^{4/5} = \sqrt[5]{3^4}$

87. $x^{4/3} = \sqrt[3]{x^4}$

88. $y^{7/4} = \sqrt[4]{y^7}$

89. $(x^{1/2}y^{1/3})^{1/5} = \sqrt[5]{\sqrt{x}\,\sqrt[3]{y}}$

90. $x^{-1/3}y^{3/2} = \dfrac{y^{3/2}}{x^{1/3}} = \dfrac{\sqrt{y^3}}{\sqrt[3]{x}}$

91. $-\dfrac{3}{2}x^{-1/4} = -\dfrac{3}{2x^{1/4}} = -\dfrac{3}{2\sqrt[4]{x}}$

92. $\dfrac{4}{5}x^{3/2} = \dfrac{4\sqrt{x^3}}{5}$

93. $0.2x^{-2/3} + \dfrac{3}{7x^{-1/2}} = \dfrac{0.2}{x^{2/3}} + \dfrac{3x^{1/2}}{7} = \dfrac{0.2}{\sqrt[3]{x^2}} + \dfrac{3\sqrt{x}}{7}$

94. $\dfrac{3.1}{x^{-4/3}} - \dfrac{11}{7}x^{-1/7} = 3.1x^{4/3} - \dfrac{11}{7x^{1/7}} =$
$3.1\sqrt[3]{x^4} - \dfrac{11}{7\sqrt[7]{x}}$

95. $\dfrac{3}{4(1-x)^{5/2}} = \dfrac{3}{4\sqrt{(1-x)^5}}$

96. $\dfrac{9}{4(1-x)^{-7/3}} = \dfrac{9(1-x)^{7/3}}{4} = \dfrac{9\sqrt[3]{(1-x)^7}}{4}$

97. $4^{-1/2}4^{7/2} = 4^{-1/2+7/2} = 4^3 = 64$

98. $\dfrac{2^{1/a}}{2^{2/a}} = 2^{1/a-2/a} = 2^{-1/a} = \dfrac{1}{2^{1/a}}$

99. $3^{2/3}3^{-1/6} = 3^{2/3-1/6} = 3^{1/2} = \sqrt{3}$

100. $2^{1/3}2^{-1}2^{2/3}2^{-1/3} = 2^{1/3-1+2/3-1/3} = 2^{-1/3} = \dfrac{1}{2^{1/3}}$

101. $\dfrac{x^{3/2}}{x^{5/2}} = x^{3/2-5/2} = x^{-1} = \dfrac{1}{x}$

102. $\dfrac{y^{5/4}}{y^{3/4}} = y^{5/4-3/4} = y^{1/2} = \sqrt{y}$

103. $\dfrac{x^{1/2}y^2}{x^{-1/2}y} = x^{1/2+1/2}y^{2-1} = xy$

104. $\dfrac{x^{-1/2}y}{x^2y^{3/2}} = x^{-1/2-2}y^{1-3/2} = x^{-5/2}y^{-1/2}$

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

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

107. $x^2 - 16 = 0$, $x^2 = 16$, $x = \pm\sqrt{16} = \pm 4$

108. $x^2 - 1 = 0$, $x^2 = 1$, $x = \pm\sqrt{1} = \pm 1$

109. $x^2 - \dfrac{4}{9} = 0$, $x^2 = \dfrac{4}{9}$, $x = \pm\sqrt{\dfrac{4}{9}} = \pm\dfrac{2}{3}$

110. $x^2 - \dfrac{1}{10} = 0$, $x^2 = \dfrac{1}{10}$, $x = \pm\sqrt{\dfrac{1}{10}} =$
$\pm\dfrac{1}{\sqrt{10}} \approx \pm 0.3162$

111. $x^2 - (1 + 2x)^2 = 0$, $x^2 = (1 + 2x)^2$, $x =$
$\pm(1 + 2x)$; if $x = 1 + 2x$ then $-x = 1$, $x = -1$; if $x = -(1 + 2x)$ then $3x = -1$, $x = -1/3$. So, $x = -1$ or $-1/3$.

112. $x^2 - (2 - 3x)^2 = 0$, $x^2 = (2 - 3x)^2$, $x =$
$\pm(2 - 3x)$; if $x = 2 - 3x$ then $4x = 2$, $x = 1/2$; if $x = -(2 - 3x)$ then $-2x = -2$, $x = 1$. So, $x = 1$ or $1/2$.

113. $x^5 + 32 = 0$, $x^5 = -32$, $x = \sqrt[5]{-32} = -2$

114. $x^4 - 81 = 0$, $x^4 = 81$, $x = \pm\sqrt[4]{81} = \pm 3$

115. $x^{1/2} - 4 = 0$, $x^{1/2} = 4$, $x = 4^2 = 16$

116. $x^{1/3} - 2 = 0$, $x^{1/3} = 2$, $x = 2^3 = 8$

117. $1 - \dfrac{1}{x^2} = 0$, $1 = \dfrac{1}{x^2}$, $x^2 = 1$, $x = \pm\sqrt{1} = \pm 1$

118. $\dfrac{2}{x^3} - \dfrac{6}{x^4} = 0$, $\dfrac{2}{x^3} = \dfrac{6}{x^4}$, $2x^4 = 6x^3$, $2x = 6$,
$x = 3$

119. $(x - 4)^{-1/3} = 2$, $x - 4 = 2^{-3} = \dfrac{1}{8}$,
$x = 4 + \dfrac{1}{8} = \dfrac{33}{8}$

120. $(x - 4)^{2/3} + 1 = 5$, $(x - 4)^{2/3} = 4$, $x - 4 = \pm 4^{3/2}$
$= \pm 8$, $x = 4 \pm 8 = -4$ or 12

Section 0.3

1. $x(4x + 6) = 4x^2 + 6x$

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

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

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

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

6. $(y + 3)(y + 4) = y^2 + 3y + 4y + 12 = y^2 + 7y + 12$

7. $(2y + 3)(y + 5) = 2y^2 + 3y + 10y + 15 = 2y^2 + 13y + 15$

8. $(2x - 2)(3x - 4) = 6x^2 - 6x - 8x + 8 = 6x^2 - 14x + 8$

9. $(2x - 3)^2 = 4x^2 - 12x + 9$

10. $(3x + 1)^2 = 9x^2 + 6x + 1$

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

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

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

14. $(4 + 2x)(4 - 2x) = 4^2 - (2x)^2 = 16 - 4x^2$

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

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

17. $(x^2 + x - 1)(2x + 4) = (x^2 + x - 1)2x + (x^2 + x - 1)4 = 2x^3 + 2x^2 - 2x + 4x^2 + 4x - 4 = 2x^3 + 6x^2 + 2x - 4$

18. $(3x + 1)(2x^2 - x + 1) = 3x(2x^2 - x + 1) + 1(2x^2 - x + 1) = 6x^3 - 3x^2 + 3x + 2x^2 - x +$

$1 = 6x^3 - x^2 + 2x + 1$

19. $(x^2 - 2x + 1)^2 = (x^2 - 2x + 1)(x^2 - 2x + 1) = x^2(x^2 - 2x + 1) - 2x(x^2 - 2x + 1) + (x^2 - 2x + 1) = x^4 - 2x^3 + x^2 - 2x^3 + 4x^2 - 2x + x^2 - 2x + 1 = x^4 - 4x^3 + 6x^2 - 4x + 1$

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

21. $(y^3 + 2y^2 + y)(y^2 + 2y - 1) = y^3(y^2 + 2y - 1) + 2y^2(y^2 + 2y - 1) + y(y^2 + 2y - 1) = y^5 + 2y^4 - y^3 + 2y^4 + 4y^3 - 2y^2 + y^3 + 2y^2 - y = y^5 + 4y^4 + 4y^3 - y$

22. $(x^3 - 2x^2 + 4)(3x^2 - x + 2) = x^3(3x^2 - x + 2) - 2x^2(3x^2 - x + 2) + 4(3x^2 - x + 2) = 3x^5 - x^4 + 2x^3 - 6x^4 + 2x^3 - 4x^2 + 12x^2 - 4x + 8 = 3x^5 - 7x^4 + 4x^3 + 8x^2 - 4x + 8$

23. $(x + 1)(x + 2) + (x + 1)(x + 3) = (x + 1)(x + 2 + x + 3) = (x + 1)(2x + 5)$

24. $(x + 1)(x + 2)^2 + (x + 1)^2(x + 2) = (x + 1)(x + 2)(x + 2 + x + 1) = (x + 1)(x + 2)(2x + 3)$

25. $(x^2 + 1)^5(x + 3)^4 + (x^2 + 1)^6(x + 3)^3 = (x^2 + 1)^5(x + 3)^3(x + 3 + x^2 + 1) = (x^2 + 1)^5(x + 3)^3(x^2 + x + 4)$

26. $10x(x^2 + 1)^4(x^3 + 1)^5 + 15x^2(x^2 + 1)^5 \cdot (x^3 + 1)^4 = 5x(x^2 + 1)^4(x^3 + 1)^4[2(x^3 + 1) + 3x(x^2 + 1)] = 5x(x^2 + 1)^4(x^3 + 1)^4(5x^3 + 3x + 2)$

27. $(x^3 + 1)\sqrt{x + 1} - (x^3 + 1)^2\sqrt{x + 1} = (x^3 + 1)\sqrt{x + 1}\,[1 - (x^3 + 1)] = -x^3(x^3 + 1)\sqrt{x + 1}$

28. $(x^2 + 1)\sqrt{x + 1} - \sqrt{(x + 1)^3} = \sqrt{x + 1} \cdot [x^2 + 1 - \sqrt{(x + 1)^2}\,] = \sqrt{x + 1}\,[x^2 + 1 - (x + 1)] = (x^2 - x)\sqrt{x + 1} = x(x - 1)\sqrt{x + 1}$

29. $\sqrt{(x + 1)^3} + \sqrt{(x + 1)^5} = \sqrt{(x + 1)^3} \cdot [1 + \sqrt{(x + 1)^2}\,] = \sqrt{(x + 1)^3}\,(1 + x + 1) =$

$(x + 2)\sqrt{(x + 1)^3}$

30. $(x^2 + 1)\sqrt[3]{(x + 1)^4} - \sqrt[3]{(x + 1)^7} =$

$\sqrt[3]{(x + 1)^4}\ [x^2 + 1 - \sqrt[3]{(x + 1)^3}\ ] =$

$\sqrt[3]{(x + 1)^4}\ [x^2 + 1 - (x + 1)] =$

$(x^2 - x)\sqrt[3]{(x + 1)^4} = x(x - 1)\sqrt[3]{(x + 1)^4}$

31. (a) $2x + 3x^2 = x(2 + 3x)$ **(b)** $x(2 + 3x) = 0$; $x = 0$ or $2 + 3x = 0$; $x = 0$ or $-2/3$

32. (a) $y^2 - 4y = y(y - 4)$ **(b)** $y(y - 4) = 0$; $y = 0$ or $y - 4 = 0$; $y = 0$ or 4

33. (a) $6x^3 - 2x^2 = 2x^2(3x - 1)$
(b) $2x^2(3x - 1) = 0$; $x = 0$ or $3x - 1 = 0$; $x = 0$ or $1/3$

34. (a) $3y^3 - 9y^2 = 3y^2(y - 3)$ **(b)** $3y^2(y - 3) = 0$; $y = 0$ or $y - 3 = 0$; $y = 0$ or 3

35. (a) $x^2 - 8x + 7 = (x - 1)(x - 7)$
(b) $(x - 1)(x - 7) = 0$; $x - 1 = 0$ or $x - 7 = 0$; $x = 1$ or 7

36. (a) $y^2 + 6y + 8 = (y + 2)(y + 4)$
(b) $(y + 2)(y + 4) = 0$; $y + 2 = 0$ or $y + 4 = 0$; $y = -2$ or -4

37. (a) $x^2 + x - 12 = (x - 3)(x + 4)$
(b) $(x - 3)(x + 4) = 0$; $x - 3 = 0$ or $x + 4 = 0$; $x = 3$ or -4
38. (a) $y^2 + y - 6 = (y - 2)(y + 3)$
(b) $(y - 2)(y + 3) = 0$; $y - 2 = 0$ or $y + 3 = 0$; $y = 2$ or -3

39. (a) $2x^2 - 3x - 2 = (2x + 1)(x - 2)$
(b) $(2x + 1)(x - 2) = 0$; $2x + 1 = 0$ or $x - 2 = 0$; $x = -1/2$ or 2

40. (a) $3y^2 - 8y - 3 = (3y + 1)(y - 3)$
(b) $(3y + 1)(y - 3) = 0$; $3y + 1 = 0$ or $y - 3 = 0$; $y = -1/3$ or 3

41. (a) $6x^2 + 13x + 6 = (2x + 3)(3x + 2)$

(b) $(2x + 3)(3x + 2) = 0$; $2x + 3 = 0$ or $3x + 2 = 0$; $x = -3/2$ or $-2/3$

42. (a) $6y^2 + 17y + 12 = (3y + 4)(2y + 3)$
(b) $(3y + 4)(2y + 3) = 0$; $3y + 4 = 0$ or $2y + 3 = 0$; $y = -4/3$ or $-3/2$

43. (a) $12x^2 + x - 6 = (3x - 2)(4x + 3)$
(b) $(3x - 2)(4x + 3) = 0$; $3x - 2 = 0$ or $4x + 3 = 0$; $x = 2/3$ or $-3/4$

44. (a) $20y^2 + 7y - 3 = (4y - 1)(5y + 3)$
(b) $(4y - 1)(5y + 3) = 0$; $4y - 1 = 0$ or $5y + 3 = 0$; $y = 1/4$ or $-3/5$

45. (a) $x^2 + 4xy + 4y^2 = (x + 2y)^2$
(b) $(x + 2y)^2 = 0$; $x + 2y = 0$; $x = -2y$

46. (a) $4y^2 - 4xy + x^2 = (2y - x)^2$
(b) $(2y - x)^2 = 0$; $2y - x = 0$; $y = x/2$

47. (a) $x^4 - 5x^2 + 4 = (x^2 - 1)(x^2 - 4) =$
$(x - 1)(x + 1)(x - 2)(x + 2)$
(b) $(x - 1)(x + 1)(x - 2)(x + 2) = 0$; $x - 1 = 0$ or $x + 1 = 0$ or $x - 2 = 0$ or $x + 2 = 0$; $x = \pm1$ or ±2

48. (a) $y^4 + 2y^2 - 3 = (y^2 - 1)(y^2 + 3) =$
$(y - 1)(y + 1)(y^2 + 3)$
(b) $(y - 1)(y + 1)(y^2 + 3) = 0$; $y - 1 = 0$ or $y + 1 = 0$ or $y^2 + 3 = 0$; $y = \pm1$ (Notice that $y^2 + 3 = 0$ has no real solutions.)

Section 0.4

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

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

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

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

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

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

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

8. $\dfrac{2}{\left(\dfrac{x-2}{x^2}\right)} - \dfrac{1}{x-2} = \dfrac{2x^2}{x-2} - \dfrac{1}{x-2} = \dfrac{2x^2-1}{x-2}$

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

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

11. $\dfrac{(x+1)^2(x+2)^3-(x+1)^3(x+2)^2}{(x+2)^6} =$
$\dfrac{(x+1)^2(x+2)^2[(x+2)-(x+1)]}{(x+2)^6} = \dfrac{(x+1)^2}{(x+2)^4}$

12. $\dfrac{6x(x^2+1)^2(x^3+2)^3-9x^2(x^2+1)^3(x^3+2)^2}{(x^3+2)^6} =$
$\dfrac{3x(x^2+1)^2(x^3+2)^2[2(x^3+2)-3x(x^2+1)]}{(x^3+2)^6} =$
$\dfrac{3x(x^2+1)^2(-x^3-3x+4)}{(x^3+2)^4} =$
$\dfrac{-3x(x^2+1)^2(x^3+3x-4)}{(x^3+2)^4}$

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

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

15. $\dfrac{\dfrac{1}{(x+y)^2} - \dfrac{1}{x^2}}{y} = \dfrac{x^2-(x+y)^2}{yx^2(x+y)^2} = \dfrac{x^2-x^2-2xy-y^2}{yx^2(x+y)^2}$
$= \dfrac{-y(2x+y)}{yx^2(x+y)^2} = \dfrac{-(2x+y)}{x^2(x+y)^2}$

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

Solutions Section 0.5

Section 0.5

1. $x + 1 = 0$, $x = -1$

2. $x - 3 = 1$, $x = 4$

3. $-x + 5 = 0$, $x = 5$

4. $2x + 4 = 1$, $2x = -3$, $x = -3/2$

5. $4x - 5 = 8$, $4x = 13$, $x = 13/4$

6. $\frac{3}{4}x + 1 = 0$, $\frac{3}{4}x = -1$, $x = -4/3$

7. $7x + 55 = 98$, $7x = 43$, $x = 43/7$

8. $3x + 1 = x$, $2x = -1$, $x = -1/2$

9. $x + 1 = 2x + 2$, $-x = 1$, $x = -1$

10. $x + 1 = 3x + 1$, $-2x = 0$, $x = 0$

11. $ax + b = c$, $ax = c - b$, $x = (c - b)/a$

12. $x - 1 = cx + d$, $(1 - c)x = d + 1$, $x = \frac{d + 1}{1 - c}$

13. $2x^2 + 7x - 4 = 0$, $(2x - 1)(x + 4) = 0$, $x = -4$, $\frac{1}{2}$

14. $x^2 + x + 1 = 0$, $\Delta = -3 < 0$, so this equation has no real solutions

15. $x^2 - x + 1 = 0$, $\Delta = -3 < 0$, so this equation has no real solutions

16. $2x^2 - 4x + 3 = 0$, $\Delta = -8 < 0$, so this equation has no real solutions

17. $2x^2 - 5 = 0$, $x^2 = \frac{5}{2}$, $x = \pm\sqrt{\frac{5}{2}}$

18. $3x^2 - 1 = 0$, $x^2 = \frac{1}{3}$, $x = \pm\frac{1}{\sqrt{3}}$

19. $-x^2 - 2x - 1 = 0$, $-(x + 1)^2 = 0$, $x = -1$

20. $2x^2 - x - 3 = 0$, $(2x - 3)(x + 1) = 0$, $x = 3/2$, -1

21. $\frac{1}{2}x^2 - x - \frac{3}{2} = 0$, $x^2 - 2x - 3 = 0$, $(x + 1)(x - 3) = 0$, $x = -1$, 3

22. $-\frac{1}{2}x^2 - \frac{1}{2}x + 1 = 0$, $x^2 + x - 2 = 0$, $(x + 2)(x - 1) = 0$, $x = -2$, 1

23. $x^2 - x = 1$, $x^2 - x - 1 = 0$, $x = \frac{1 \pm \sqrt{5}}{2}$ by the quadratic formula

24. $16x^2 = -24x - 9$, $16x^2 + 24x + 9 = 0$, $(4x + 3)^2 = 0$, $x = -3/4$

25. $x = 2 - \frac{1}{x}$, $x^2 = 2x - 1$, $x^2 - 2x + 1 = 0$, $(x - 1)^2 = 0$, $x = 1$

26. $x + 4 = \frac{1}{x - 2}$, $(x + 4)(x - 2) = 1$, $x^2 + 2x - 8 = 1$, $x^2 + 2x - 9 = 0$, $x = \frac{-2 \pm \sqrt{40}}{2} = -1 \pm \sqrt{10}$ by the quadratic formula

27. $x^4 - 10x^2 + 9 = 0$, $(x^2 - 1)(x^2 - 9) = 0$, $x^2 = 1$ or $x^2 = 0$, $x = \pm 1$, ± 3

28. $x^4 - 2x^2 + 1 = 0$, $(x^2 - 1)^2 = 0$, $x = \pm 1$

29. $x^4 + x^2 - 1 = 0$, $x^2 = \frac{-1 \pm \sqrt{5}}{2}$ by the quadratic formula, $x = \pm\sqrt{\frac{-1 \pm \sqrt{5}}{2}}$

30. $x^3 + 2x^2 + x = 0$, $x(x^2 + 2x + 1) = 0$, $x(x + 1)^2 = 0$, $x = 0$, -1

31. $x^3 + 6x^2 + 11x + 6 = 0$, $(x + 1)(x + 2)(x + 3) = 0$, $x = -1$, -2, -3

32. $x^3 - 6x^2 + 12x - 8 = 0$, $(x - 2)^3 = 0$, $x = 2$

33. $x^3 + 4x^2 + 4x + 3 = 0$,

$(x + 3)(x^2 + x + 1) = 0$, $x = -3$ (For $x^2 + x + 1 = 0$, $\Delta = -3 < 0$, so there are no real solutions to this quadratic equation.)

34. $y^3 + 64 = 0$, $y^3 = -64$, $y = \sqrt[3]{-64} = -4$

35. $x^3 - 1 = 0$, $x^3 = 1$, $x = \sqrt[3]{1} = 1$

36. $x^3 - 27 = 0$, $x^3 = 27$, $x = \sqrt[3]{27} = 3$

37. $y^3 + 3y^2 + 3y + 2 = 0$,
$(y + 2)(y^2 + y + 1) = 0$, $y = -2$ (For $y^2 + y + 1 = 0$, $\Delta = -3 < 0$, so there are no real solutions to this quadratic equation.)

38. $y^3 - 2y^2 - 2y - 3 = 0$,
$(y - 3)(y^2 + y + 1) = 0$, $y = 3$ (For $y^2 + y + 1 = 0$, $\Delta = -3 < 0$, so there are no real solutions to this quadratic equation.)

39. $x^3 - x^2 - 5x + 5 = 0$, $(x - 1)(x^2 - 5) = 0$,
$x = 1$, $\pm\sqrt{5}$

40. $x^3 - x^2 - 3x + 3 = 0$, $(x - 1)(x^2 - 3) = 0$,
$x = 1$, $\pm\sqrt{3}$

41. $2x^6 - x^4 - 2x^2 + 1 = 0$, $(2x^2 - 1)(x^4 - 1) = 0$,
[or $(2x^2 - 1)(x^2 - 1)(x^2 + 1) = 0$; in any case, think of the cubic you get by substituting y for x^2], $x = \pm 1$, $\pm \dfrac{1}{\sqrt{2}}$

42. $3x^6 - x^4 - 12x^2 + 4 = 0$,
$(3x^2 - 1)(x^4 - 4) = 0$, [or $(3x^2 - 1)(x^2 - 2)(x^2 + 2)$
$= 0$], $x = \pm\sqrt{2}$, $\pm \dfrac{1}{\sqrt{3}}$

43. $(x^2 + 3x + 2)(x^2 - 5x + 6) = 0$,
$(x + 2)(x + 1)(x - 2)(x - 3) = 0$, $x = -2, -1, 2, 3$

44. $(x^2 - 4x + 4)^2(x^2 + 6x + 5)^3 = 0$,
$(x - 2)^4(x + 1)^3(x + 5)^3 = 0$, $x = -5, -1, 2$

Section 0.6

1. $x^4 - 3x^3 = 0$, $x^3(x - 3) = 0$, $x = 0, 3$

2. $x^6 - 9x^4 = 0$, $x^4(x^2 - 9) = 0$, $x = 0, \pm3$

3. $x^4 - 4x^2 = -4$, $x^4 - 4x^2 + 4 = 0$, $(x^2 - 2)^2 = 0$, $x = \pm\sqrt{2}$

4. $x^4 - x^2 = 6$, $x^4 - x^2 - 6 = 0$,
$(x^2 - 3)(x^2 + 2) = 0$, $x = \pm\sqrt{3}$

5. $(x + 1)(x + 2) + (x + 1)(x + 3) = 0$,
$(x + 1)(x + 2 + x + 3) = 0$, $(x + 1)(2x + 5) = 0$, $x = -1, -5/2$

6. $(x + 1)(x + 2)^2 + (x + 1)^2(x + 2) = 0$,
$(x + 1)(x + 2)(x + 2 + x + 1) = 0$,
$(x + 1)(x + 2)(2x + 3) = 0$, $x = -1, -2, -3/2$

7. $(x^2 + 1)^5(x + 3)^4 + (x^2 + 1)^6(x + 3)^3 = 0$,
$(x^2 + 1)^5(x + 3)^3(x + 3 + x^2 + 1) = 0$,
$(x^2 + 1)^5(x + 3)^3(x^2 + x + 4) = 0$, $x = -3$ (Neither $x^2 + 1 = 0$ nor $x^2 + x + 4 = 0$ has a real solution.)

8. $10x(x^2 + 1)^4(x^3 + 1)^5 - 10x^2(x^2 + 1)^5(x^3 + 1)^4 = 0$, $10x(x^2 + 1)^4(x^3 + 1)^4[x^3 + 1 - x(x^2 + 1)] = 0$,
$10x(x^2 + 1)^4(x^3 + 1)^4(1 - x) = 0$, $x = -1, 0, 1$

9. $(x^3 + 1)\sqrt{x + 1} - (x^3 + 1)^2\sqrt{x + 1} = 0$,
$(x^3 + 1)\sqrt{x + 1}\,[1 - (x^3 + 1)] = 0$,
$-x^3(x^3 + 1)\sqrt{x + 1} = 0$, $x = 0, -1$

10. $(x^2 + 1)\sqrt{x + 1} - \sqrt{(x + 1)^3} = 0$,
$\sqrt{x + 1}\,[x^2 + 1 - (x + 1)] = 0$, $(x^2 - x)\sqrt{x + 1} = 0$,
$x(x - 1)\sqrt{x + 1} = 0$, $x = -1, 0, 1$

11. $\sqrt{(x + 1)^3} + \sqrt{(x + 1)^5} = 0$, $\sqrt{(x + 1)^3}\,(1 + x + 1) = 0$, $(x + 2)\sqrt{(x + 1)^3} = 0$, $x = -1$ ($x = -2$ is not a solution because $\sqrt{(x + 1)^3}$ is not defined for $x = -2$.)

12. $(x^2 + 1)\sqrt[3]{(x + 1)^4} - \sqrt[3]{(x + 1)^7} = 0$,
$\sqrt[3]{(x + 1)^4}\,[x^2 + 1 - (x + 1)] = 0$,

$(x^2 - x)\sqrt[3]{(x + 1)^4} = 0$, $x(x - 1)\sqrt[3]{(x + 1)^4} = 0$,
$x = -1, 0, 1$

13. $(x + 1)^2(2x + 3) - (x + 1)(2x + 3)^2 = 0$,
$(x + 1)(2x + 3)(x + 1 - 2x - 3) = 0$,
$(x + 1)(2x + 3)(-x - 2) = 0$, $x = -2, -3/2, -1$

14. $(x^2 - 1)^2(x + 2)^3 - (x^2 - 1)^3(x + 2)^2 = 0$,
$(x^2 - 1)^2(x + 2)^2(x + 2 - x^2 + 1) = 0$,
$-(x^2 - 1)^2(x + 2)^2(x^2 - x - 3) = 0$, $x = -2, -1, 1$,
$(1 \pm \sqrt{13})/2$

15. $\dfrac{(x + 1)^2(x + 2)^3 - (x + 1)^3(x + 2)^2}{(x + 2)^6} = 0$,

$\dfrac{(x + 1)^2(x + 2)^2[(x + 2) - (x + 1)]}{(x + 2)^6} = 0$, $\dfrac{(x + 1)^2}{(x + 2)^4} = 0$, $(x + 1)^2 = 0$, $x = -1$

16.

$\dfrac{6x(x^2 + 1)^2(x^2 + 2)^4 - 8x(x^2 + 1)^3(x^2 + 2)^3}{(x^2 + 2)^8} = 0$,

$\dfrac{2x(x^2 + 1)^2(x^2 + 2)^3[3(x^2 + 2) - 4(x^2 + 1)]}{(x^2 + 2)^8} = 0$,

$\dfrac{-2x(x^2 + 1)^2(x^2 - 2)}{(x^2 + 2)^5} = 0$,

$-2x(x^2 + 1)^2(x^2 - 2) = 0$, $x = 0, \pm\sqrt{2}$

17. $\dfrac{2(x^2 - 1)\sqrt{x^2 + 1} - \dfrac{x^4}{\sqrt{x^2 + 1}}}{x^2 + 1} = 0$,

$\dfrac{2(x^2 - 1)(x^2 + 1) - x^4}{(x^2 + 1)\sqrt{x^2 + 1}} = 0$, $\dfrac{x^4 - 2}{(x^2 + 1)\sqrt{x^2 + 1}} = 0$, $x^4 - 2 = 0$, $x = \pm\sqrt[4]{2}$

18. $\dfrac{4x\sqrt{x^3 - 1} - \dfrac{3x^4}{\sqrt{x^3 - 1}}}{x^3 - 1} = 0$,

$\dfrac{4x(x^3 - 1) - 3x^4}{(x^3 - 1)\sqrt{x^3 - 1}} = 0$, $\dfrac{x^4 - 4x}{(x^3 - 1)\sqrt{x^3 - 1}} = 0$,

$x^4 - 4x = 0$, $x(x^3 - 4) = 0$, $x = 0, \pm\sqrt[3]{4}$

19. $x - \dfrac{1}{x} = 0$, $x^2 - 1 = 0$, $x = \pm1$

20. $1 - \dfrac{4}{x^2} = 0, \; x^2 - 4 = 0, \; x = \pm 2$

21. $\dfrac{1}{x} - \dfrac{9}{x^3} = 0, \; x^2 - 9 = 0, \; x = \pm 3$

22. $\dfrac{1}{x^2} - \dfrac{1}{x+1} = 0, \; x + 1 - x^2 = 0,$

$x^2 - x - 1 = 0, \; x = (1 \pm \sqrt{5})/2$

23. $\dfrac{x-4}{x+1} - \dfrac{x}{x-1} = 0, \; \dfrac{(x-4)(x-1) - x(x+1)}{(x+1)(x-1)} =$

$0,$

$\dfrac{-6x+4}{(x+1)(x-1)} = 0, \; -6x + 4 = 0, \; x = 2/3$

24. $\dfrac{2x-3}{x-1} - \dfrac{2x+3}{x+1} = 0,$

$\dfrac{(2x-3)(x+1) - (2x+3)(x-1)}{(x-1)(x+1)} = 0,$

$\dfrac{-2x}{(x-1)(x+1)} = 0, \; -2x = 0, \; x = 0$

25. $\dfrac{x+4}{x+1} + \dfrac{x+4}{3x} = 0, \; \dfrac{3x(x+4) + (x+1)(x+4)}{3x(x+1)} =$

$0, \; \dfrac{(x+4)(3x+x+1)}{3x(x+1)} = 0, \; \dfrac{(x+4)(4x+1)}{3x(x+1)} = 0, \; (x$

$+ 4)(4x + 1) = 0, \; x = -4, \; -1/4$

26. $\dfrac{2x-3}{x} - \dfrac{2x-3}{x+1} = 0,$

$\dfrac{(2x-3)(x+1) - x(2x-3)}{x(x+1)} = 0,$

$\dfrac{(2x-3)(x+1-x)}{x(x+1)} = 0, \; \dfrac{2x-3}{x(x+1)} = 0,$
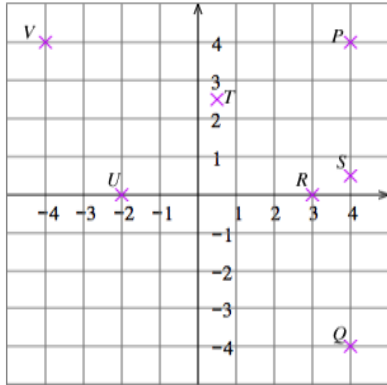
$2x - 3 = 0, \; x = 3/2$

Solutions Section 0.7
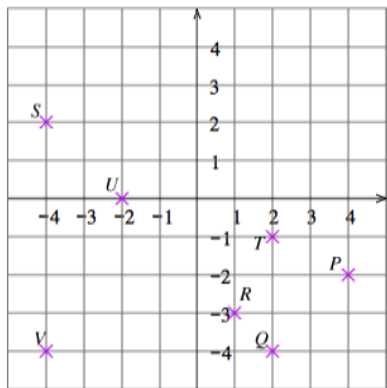
Section 0.7

1. $P(0, 2)$, $Q(4, -2)$, $R(-2, 3)$, $S(-3.5, -1.5)$, $T(-2.5, 0)$, $U(2, 2.5)$

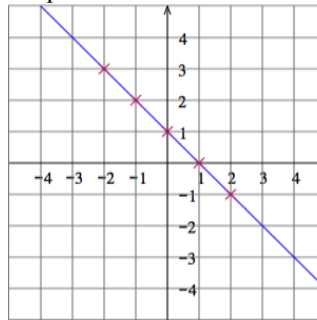**2.** $P(-2, 2)$, Q $(3.5, 2)$, $R(0,-3)$, $S(-3.5, -1.5)$, $T(2.5, 0)$, $U(-2, 2.5)$

3.

4.

5. Solve the equation $x + y = 1$ for y to get $y = 1-x$. Then plot some points:

x	$y = 1-x$
-2	3
-1	2
0	1
1	0
2	-1

Graph:

6. Solve the equation $y - x = -1$ for y to get $y = -1+x$. Then plot some points:

x	$y = 4+x$
-2	-3
-1	-2
0	-1
1	0
2	1

Graph:

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