2 ALGEBRAIC CONCEPTS AND OPERATIONS

2.1 ADDITION AND SUBTRACTION

1. 4 is a constant; x and y are variables.
2. 5 and 3 are constants; x, t, and w are variables.
3. 8 and π are constants; r is a variable.
4. $\sqrt{7}$ is a constant; a and b are usually constants; x and y are variables.

5. $3x^3$ and $4x$
6. $47x^4$ and $-9y^5$
7. $(2x^3)(5y)$, $\sqrt{3}ab$, and $-\frac{7a}{b}$
8. $-3x^5n$, $-(4a)\left(\frac{b}{5}\right)$, and $9\sqrt{y}$
9. -1, 5, x, and $\frac{1}{y}$

10. 3, 5, $x - y$, and $\frac{1}{x^2 + 3y}$
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12. $2\sqrt{3}$
13. $\frac{\pi a}{4}$, if a is a constant
14. $\frac{\sqrt{17b}}{\sqrt{5a}}$, if a and b are constants

15. $3x^2y$ and $17x^2y$
16. $\sqrt{5}xy$ and $\frac{2}{3}bxy$, if b is a constant
17. $(x + y)^2$ and $5(x + y)^2$
18. $-9xy^2$ and $5(xy^2)$

19. $a + b - c$ and $-2(a + b - c)$
20. There are two pairs of like terms. One pair is ax^2 and $5x^2$, and the other pair is a^2x and $5a^5x$, if a is a constant.
21. $4x + 7x = (4 + 7)x = 11x$
22. $5y - 2y = (5 - 2)y = 3y$
23. $3z - z = 3z - 1z = (3 - 1)z = 2z$
24. $7w + 4w - w = (7 + 4 - 1)w = 10w$
25. $8x + 9x^2 - 2x = 8x - 2x + 9x^2 = (8 - 2)x + 9x^2 = 6x + 9x^2$ or $9x^2 + 6x$
26. $11y - 7y + 6y^2 = (11 - 7)y + 6y^2 = 4y + 6y^2$ or $6y^2 + 4y$
27. $10w + w^2 - 8w^2 = 10w + (1 - 8)w^2 = 10w - 7w^2$ or $-7w^2 + 10w$
28. $y^2 - 6y^2 + 4y = (1 - 6)y^2 + 4y = -5y^2 + 4y$
29. $ax^2 + a^2x + ax^2 = ax^2 + ax^2 + a^2x = 2ax^2 + a^2x$
30. $by - by^2 + by = by + by - by^2 = 2by - by^2$
31. $7xy^2 - 5x^2y + 4xy^2 = 7xy^2 + 4xy^2 - 5x^2y = 11\,xy^2 - 5x^2y$
32. $12wz - 8w^2z + 6w^2z = 12wz + (-8 + 6)w^2z = 12wz - 2w^2z$

33. $(a + 6b) - (a - 6b) = a + 6b - a + 6b = a - a + 6b + 6b = (1 - 1)a + (6 + 6)b = 0a + 12b = 12b$
34. $(x - 7y) - (7y - x) = x - 7y - 7y + x = x + x - 7y - 7y = 2x - 14y$
35. $(2a^2 + 3b) + (2b + 4a) = 2a^2 + 3b + 2b + 4a = 2a^2 + (3 + 2)b + 4a = 2a^2 + 5b + 4a$
36. $(7c^2 - 8d) + (6d - 8c) = 7c^2 - 8d + 6d - 8c = 7c^2 + (-8 + 6)d - 8c = 7c^2 - 2d - 8c$
37. $(4x^2 + 3x) - (2x^2 - 3x) = 4x^2 + 3x - 2x^2 + 3x = (4 - 2)x^2 + (3 + 3)x = 2x^2 + 6x$
38. $(3y^2 - 4x) - (4y + 2x) = 3y^2 - 4x - 4y - 2x = 3y^2 + (-4 - 2)x - 4y = 3y^2 - 6x - 4y$ or $3y^2 - 4y - 6x$
39. $2(6y^2 + 7x) = 2 \cdot 6y^2 + 2 \cdot 7x = 12y^2 + 14x$
40. $5(3a + 4b) = 5 \cdot 3a + 5 \cdot 4b = 15a + 20b$
41. $-3(4b - 2c) = -3 \cdot 4b + (-3)(-2c) = -12b + 6c$
42. $-2(-6b + 3a) = (-2)(-6b) + (-2)(3a) = 12b - 6a$
43. $4(a + b) + 3(b + a) = 4a + 4b + 3b + 3a = 7a + 7b$
44. $2(c + d) + 8(d + c) = 2c + 2d + 8d + 8c = 10c + 10d$
45. $3(x + y) - 2(x + y) = 3x + 3y - 2x - 2y = (3 - 2)x + (3 - 2)y = x + y$

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46. $3(x^2 - y) - 2(y + x^2) = 3x^2 - 3y - 2y - 2x^2 = x^2 - 5y$

47. $2(a + b + c) + 3(a + b - c) = 2a + 2b + 2c + 3a + 3b - 3c = 5a + 5b - c$

48. $4(x - y + z) + 2(x + y - z) = 4x - 4y + 4z + 2x + 2y - 2z = 6x - 2y + 2z$

49. $3[2(x + y)] = 3[2x + 2y] = 6x + 6y$

50. $4[3(x - y)] = 4[3x - 3y] = 12x - 12y$

51. $3(a + b) + 4(a + b) - 2(a + b) = 3a + 3b + 4a + 4b - 2a - 2b = 5a + 5b$ or $(3 + 4 - 2)(a + b) = 5(a + b) = 5a + 5b$

52. $2(x + y) - 3(x + y) - 4(x + y) = (2 - 3 - 4)(x + y) = -5(x + y) = -5x - 5y$ or $2x + 2y - 3x - 3y - 4x - 4y = -5x - 5y$

53. $2(a + b + c) + 3(a - b + c) + (a - b - c) = 2a + 2b + 2c + 3a - 3b + 3c + a - b - c = 6a - 2b + 4c$

54. $3(x - y + z) - 2(x + y - z) + 4(-x - y + z) = 3x - 3y + 3z - 2x - 2y + 2z - 4x - 4y + 4z = -3x - 9y + 9z$

55. $2(x + 3y) - 3(x - 2y) + 5(2x - y) = 2x + 6y - 3x + 6y + 10x - 5y = 9x + 7y$

56. $3(y - 2a) - (a + 3y) + 4(a - 3y) = 3y - 6a - a - 3y + 4a - 12y = -12y - 3a$

57. $3(x + y - z) - 2(3x + 2y - z) - 3(x - y + 4z) = 3x + 3y - 3z - 6x - 4y + 2z - 3x + 3y - 12z = -6x + 2y - 13z$

58. $5(x - y + z) - (y - x + z) + 2(x - 2y + z) = 5x - 5y + 5z - y + x - z + 2x - 4y + 2z = 8x - 10y + 6z$

59. $(x + y) - 3(x - z) + 4(y + 4z) - 2(x + y - 3z) = x + y - 3x + 3z + 4y + 16z - 2x - 2y + 6z = -4x + 3y + 25z$

60. $(a + b) - 2(b - c) + 4(c + 2d) - 5(d + 2c - 3b - a) = a + b - 2b + 2c + 4c + 8d - 5d - 10c + 15b + 5a = 6a + 14b - 4c + 3d$

61. $x + [3x + 2(x + y)] = x + [3x + 2x + 2y] = x + [5x + 2y] = x + 5x + 2y = 6x + 2y$

62. $x + [5y + 3(y - x)] = x + [5y + 3y - 3x] = x + [8y - 3x] = -2x + 8y$

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

64. $2w - [4z - 5(z + w) + 2w] = 2w - [4z - 5z - 5w + 2w] = 2w - [-z - 3w] = 2w + z + 3w = 5w + z$

65. $[2x + 3(x + y) - 2(x - y) + y] - 2x = [2x + 3x + 3y - 2x + 2y + y] - 2x = [3x + 6y] - 2x = x + 6y$

66. $[4a - 8(a + b) + 2(a - b) + 3a] - 3b = [4a - 8a - 8b + 2a - 2b + 3a] - 3b = [a - 10b] - 3b = a - 13b$

67. $-\{-[2a - (3b + a)]\} = -\{-[2a - 3b - a]\} = -\{-[a - 3b]\} = -\{-a + 3b\} = a - 3b$

68. $-\{-3[4x - (5x - 4y)]\} = -\{-3[4x - 5x + 4y]\} = -\{-3[-x + 4y]\} = -\{3x - 12y\} = -3x + 12y$

69. $5a - 2\{4[a + 2(4a + b) - b] + a\} - a = 5a - 2\{4[a + 8a + 2b - b] + a\} - a = 5a - 2\{4[9a + b] + a\} - a = 5a - 2\{36a + 4b + a\} - a = 5a - 2\{37a + 4b\} - a = 5a - 74a - 8b - a = -70a - 8b$

70. $7x - 3\{-[x + 2(x - y) - y] + 2x\} - 3y = 7x - 3\{-[x + 2x - 2y - y] + 2x\} - 3y = 7x - 3\{-[3x - 3y] + 2x\} - 3y = 7x - 3\{-3x + 3y + 2x\} - 3y = 7x - 3\{-x + 3y\} - 3y = 7x + 3x - 9y - 3y = 10x - 12y$

71. $p + \frac{1}{2}p + \frac{2}{3}p = \frac{6}{6}p + \frac{3}{6}p + \frac{4}{6}p = \frac{6 + 3 + 4}{6}p = \frac{13}{6}p$

72. $x + 2x + 3x + 3x = (1 + 2 + 3 + 3)x = 9x$

73. Follow the process in Example 2.7. The common denominator is $C_1 C_2$. This produces the following result:
$$\frac{1}{C_T} = \frac{C_2}{C_1C_2} + \frac{C_1}{C_1C_2} = \frac{C_2 + C_1}{C_1C_2}.$$

74. Follow the process in Example 2.7. The common denominator is $L_1L_2L_3$. This produces the following result:
$$\frac{1}{L_T} = \frac{L_2L_3}{L_1L_2L_3} + \frac{L_1L_3}{L_1L_2L_3} + \frac{L_1L_2}{L_1L_2L_3} = \frac{L_2L_3 + L_1L_3 + L_1L_2}{L_1L_2L_3}.$$

75. **(a)** $N = W - (0.134W + 0.046W + 0.011W + 0.075W + 0.010W + 0.002W + 0.082W)$
(b) $N = W - (0.36W) = 0.64W$

76. $L = 0.4x + 0.75x + 1.07x + 0.75x + 0.4x = 3.37x$

77. $14(3I_a^2 + 5I_b^2) = 14 \times 3I_a^2 + 14 \times 5I_b^2 = 42I_a^2 + 70I_b^2$

78.
$$5t^2 + 7t + 3t^2 - 6t + 2 = (5t^2 + 3t^2) + (7t - 6t) + 2$$
$$= (5 + 3)t^2 + (7 - 6)t + 2$$
$$= 8t^2 + t + 2$$

2.2   MULTIPLICATION

1. $(a^2x)(ax^2) = a^{2+1} \cdot x^{1+2} = a^3x^3$

2. $(by^2)(b^2y) = b^{1+2} \cdot y^{2+1} = b^3\,y^3$

3. $(3ax)(2ax^2) = 3 \cdot 2 \cdot a^{1+1}\,x^{1+2} = 6a^2\,x^3$

4. $(5by)(3b^2\,y) = 5 \cdot 3 \cdot b^{1+2}\,y^{1+1} = 15b^3\,y^2$

5. $(2xw^2z)(-3x^2w) = 2(-3)x^{1+2} \cdot w^{2+1} \cdot z = -6x^3w^3z$

6. $(-4ya^2b)(6y^2b) = (-4)6y^{1+2} \cdot a^2 \cdot b^{1+1} = -24y^3\,a^2\,b^2$

7. $(3x)(4ax)(-2x^2b) = 3 \cdot 4(-2)x^{1+1+2} \cdot ab = -24x^4ab$

8. $(4y)(3y^2b)(-5by^2) = 4 \cdot 3(-5)y^{1+2+2} \cdot b^{1+1} = -60b^2y^5$

9. $2(5y - 6) = 2 \cdot 5y + 2(-6) = 10y - 12$

10. $4(3x - 5) = 4(3x) + 4(-5) = 12x - 20$

11. $-5(4w - 7) = -5(4w) + (-5)(-7) = -20w + 35$ or $35 - 20w$

12. $-3(8 + 5p) = -24 - 15p$

13. $3x(7y + 4) = 3x(7y) + 3x(4) = 21xy + 12x$

14. $6x(8y - 7) = 6x(8y) + 6x(-7) = 48xy - 42x$

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

16. $-3n(2n - 5) = -3n(2n) - 3n(-5) = -6n^2 + 15n$ or $15n - 6n^2$

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

18. $\frac{1}{3}x(-21x - 15) = \frac{1}{3}x(-21x) + \frac{1}{3}x(-15) = -7x^2 - 5x$

19. $2x(3x^2 - x + 4) = 2x(3x^2) + 2x(-x) + 2x(4) = 6x^3 - 2x^2 + 8x$

20. $3y(4y^2 - 5y - 7) = 3y(4y^2) + 3y(-5y) + 3y(-7) = 12y^3 - 15y^2 - 21y$

21. $4y^2(-5y^2 + 2y - 5 + 3y^{-1} - 6y^{-2}) = 4y^2(-5y^2) + 4y^2(2y) + 4y^2(-5) + 4y^2(3y^{-1}) + 4y^2(-6y^{-2}) = -20y^4 + 8y^3 - 20y^2 + 12y - 24$

22. $5p^2(-4p^3 - 3p + 2 + p^{-1} - 7p^{-2})5p^2(-4p^3) + 5p^2(-3p) + 5p^2(2) + 5p^2(p^{-1}) + 5p^2\,(-7p^{-2}) = -20p^5 - 15p^3 + 10p^2 + 5p - 35$

23. $(a + b)(a + c) = (a + b)a + (a + b)c = a^2 + ab + ac + bc$ or by FOIL $a^2 + ac + ab + bc$

24. $(s + t)(s + 2t) = s^2 + 2st + st + 2t^2 = s^2 + 3st + 2t^2$

25. $(x + 5)(x^2 + 6) = x^3 + 6x + 5x^2 + 30$ or $x^3 + 5x^2 + 6x + 30$

26. $(y + 3)(y^2 + 7) = y^3 + 7y + 3y^2 + 21$ or $y^3 + 3y^2 + 7y + 21$

27. $(2x + y)(3x - y) = 6x^2 - 2xy + 3xy - y^2 = 6x^2 + xy - y^2$

28. $(4a + b)(8a - b) = 32a^2 - 4ab + 8ab - b^2 = 32a^2 + 4ab - b^2$

29. $(2a - b)(3a - 2b) = 6a^2 - 4ab - 3ab + 2b^2 = 6a^2 - 7ab + 2b^2$

30. $(4p + q)(3p - 2q) = 12p^2 - 8pq + 3pq - 2q^2 = 12p^2 - 5pq - 2q^2$

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

32. $(4x - 1)(3x - 2) = 12x^2 - 8x - 3x + 2 = 12x^2 - 11x + 2$

33. $(7a^2b + 3c)(8a^2b - 3c) = 56a^4b^2 - 21a^2bc + 24a^2bc - 9c^2 = 56a^4b^2 + 3a^2bc - 9c^2$

34. $(6p^2r + 2t)(5p^2r + 4t) = 30p^4r^2 + 24p^2rt + 10p^2rt + 8t^2 = 30p^4r^2 + 34p^2rt + 8t^2$

35. $(x + 4)(x - 4) = x^2 - 16$ (Difference of Squares)

36. $(a + 8)(a - 8) = a^2 - 64$ (Difference of Squares)

37. $(p - 6)(p + 6) = p^2 - 36$

38. $(b - 10)(b + 10) = b^2 - 100$

39. $(ax + 2)(ax - 2) = a^2x^2 - 4$

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

41. $(2r^2 + 3x)(2r^2 - 3x) = 4r^4 - 9x^2$

42. $(4p^3 - 7d)(4p^3 + 7d) = 16p^6 - 49d^2$

43. $(5a^2x^3 - 4d)(5a^2x^3 + 4d) = 25a^4x^6 - 16d^2$

44. $(3p^2st - \frac{11}{3}w^3)(3p^2st + \frac{11}{3}w^3) = 9p^4s^2t^2 - \frac{121}{9}w^6$

45. $(\frac{2}{3}pa^2f + \frac{3}{4}tb^3)(-\frac{2}{3}pa^2f + \frac{3}{4}tb^3) = (\frac{3}{4}tb^3 + \frac{2}{3}pa^2f)(\frac{3}{4}tb^3 - \frac{2}{3}pa^2f) = \frac{9}{16}t^2b^6 - \frac{4}{9}p^2a^4f^2$

46. $\left(\frac{\sqrt{3}}{2} + \frac{7}{5}t^2u\right)\left(-\frac{\sqrt{3}}{2} + \frac{7}{5}t^2u\right) = \left(\frac{7}{5}t^2u + \frac{\sqrt{3}}{2}\right)\left(\frac{7}{5}t^2u - \frac{\sqrt{3}}{2}\right) = \frac{49}{25}t^4u^2 - \frac{3}{4}$

47. $(x + y)^2 = x^2 + 2xy + y^2$ (Square of a Binomial)

48. $(p + r)^2 = p^2 + 2pr + r^2$ (Square of a Binomial)

49. $(x - 5)^2 = x^2 - 10x + 25$

50. $(b - 7)^2 = b^2 - 14b + 49$

51. $(a + 3)^2 = a^2 + 6a + 9$

52. $(w + 5)^2 = w^2 + 10w + 25$

53. $(2a + b)^2 = 4a^2 + 4ab + b^2$

54. $(3c + d)^2 = 9c^2 + 6cd + d^2$

55. $(3x - 2y)^2 = 9x^2 - 12xy + 4y^2$

56. $(5a - 6f)^2 = 25a^2 - 60af + 36f^2$

57. $4x(x + 4)(3x - 2) = 4x(3x^2 - 2x + 12x - 8) = 4x(3x^2 + 10x - 8) = 12x^3 + 40x^2 - 32x$

58. $5y(y - 6)(2y + 3) = 5y(2y^2 - 9y - 18) = 10y^3 - 45y^2 - 90y$

59. $(x + y - z)(x - y + z) = (x + y - z)(x) +$
$(x + y - z)(-y) + (x + y - z)(z) = x^2 + xy - xz -$
$xy - y^2 + yz + xz + yz - z^2 = x^2 - y^2 - z^2 + 2yz$
or $[x + (y - z)][x - (y - z)] = x^2 - (y - z)^2 =$
$x^2 - y^2 - z^2 + 2yz$

60. $(a + b + c)(a - b - c) = [a + (b + c)][a -$
$(b + c)] = a^2 - (b + c)^2 = a^2 - (b^2 + 2bc + c^2) =$
$a^2 - b^2 - c^2 - 2bc$

61. Think of $(a + 2)^3$ as $(a + 2)^2(a + 2)$. $(a + 2)^3 =$
$(a + 2)^2 (a + 2) = (a^2 + 4a + 4)(a + 2) = (a^2 +$
$4a + 4)(a) + (a^2 + 4a + 4)(2) = (a^3 + 4a^2 + 4a) +$
$(2a^2 + 8a + 8) = a^3 + 6a^2 + 12a + 8$

62. Think of $(m - n)^3$ as $(m - n)^2(m - n)$. $(m - n)^3 =$
$(m - n)^2(m - n) = (m^2 - 2mn + n^2)(m - n) =$
$(m^2 - 2mn + n^2)(m) + (m^2 - 2mn + n^2)$
$(-n) = (m^3 - 2m^2n + mn^2) + (-m^2n + 2mn^2 -$
$n^3) = m^3 - 3m^2n + 3mn^2 - n^3$

63. $2[n(n + 2) + n] = 2[n^2 + 2n + n] = 2[n^2 + 3n] =$
$2n^2 + 6n$

64. $(2R - x)^2 - x^2 - R^2 = (4R^2 - 4Rx + x^2) - x^2 -$
$R^2 = 3R^2 - 4Rx$

65. $\frac{1}{2}(y_2 - y_1)(y_2 + y_1) = \frac{1}{2}(y_2^2 - y_1^2) = \frac{1}{2}y_2^2 - \frac{1}{2}y_1^2$

66. $500(1 + r)^3 = 500(1 + r)^2(1 + r) = 500(1 + 2r + r^2)$
$(1 + r) = 500(1 + 3r + 3r^2 + r^3) = 500 + 1500r +$
$1500r^2 + 500r^3$

67. $x = 3(t + 4)(t + 1) = 3(t^2 + 5t + 4) = 3t^2 +$
$15t + 12$

68. $E(4I - 5) = 4EI - 5E$

69. $A = \dfrac{1}{2}(4 + x)[(6 + x) + (8 + x)] =$
$x^2 + 11.0 + 28$

70. $Q = \bar{e}A\left\{\left(\dfrac{T_1}{100} - \dfrac{T_2}{100}\right)\left(\dfrac{T_1}{100} + \dfrac{T_2}{100}\right)\left[\left(\dfrac{T_1}{100}\right)^2 +\right.\right.$
$\left.\left.\left(\dfrac{T_2}{100}\right)^2\right]\right\}10^8 t = \bar{e}A\left\{\left[\left(\dfrac{T_1}{100}\right)^2 - \left(\dfrac{T_2}{100}\right)^2\right]\right.$
$\left[\left(\dfrac{T_1}{100}\right)^2 + \left(\dfrac{T_2}{100}\right)^2\right]\right\}10^8 t = \bar{e}A\left[\left(\dfrac{T_1}{100}\right)^4 - \left(\dfrac{T_2}{100}\right)^4\right]10^8 t$

2.3 DIVISION

1. x^7 by $x^3 = \frac{x^7}{x^3} = x^{7-3} = x^4$

2. y^8 by $y^6 = \frac{y^8}{y^6} = y^{8-6} = y^2$

3. $2x^6$ by $x^4 = \frac{2x^6}{x^4} = 2x^2$

4. $3w^4$ by $w^2 = \frac{3w^4}{w^2} = 3w^2$

5. $12y^5$ by $4y^3 = \frac{12y^5}{4y^3} = \frac{12}{4} \cdot \frac{y^5}{y^3} = 3y^2$

6. $15a^7$ by $3a^4 = \frac{15a^7}{3a^4} = 5a^3$

7. $-45ab^2$ by $15ab = \frac{-45ab^2}{15ab} = -3b$

8. $-55xy^3$ by $-11xy = \frac{-55xy^3}{-11xy} = 5y^2$

9. $33xy^2z$ by $3xyz = \frac{33xy^2z}{3xyz} = 11y$

10. $65x^2yz$ by $5xyz = \frac{65x^2yz}{5xyz} = 13x$

11. $96a^2xy^3$ by $-16axy^2 = \frac{96a^2xy^3}{-16axy^2} = -6ay$

12. $105b^3yw^2$ by $-15b^2yw = \frac{105b^3yw^2}{-15b^2yw} = -7bw$

13. $144c^3d^2f$ by $8cf = \frac{144c^3d^2f}{8cf} = 18c^2d^2$

14. $162\,x^2yz^3$ by $9x^2z^2 = \frac{162x^2yz^3}{9x^2z^2} = 18yz$

15. $9np^3$ by $-15n^3p^2 = \frac{9np^3}{-15n^3p^2} = \frac{3p}{-5n^2}$ or $\frac{-3p}{5n^2} = -\frac{3}{5}\frac{p}{n^2}$

16. $15rs^2t$ by $-27r^2st^3 = \frac{15rs^2t}{-27r^2st^3} = \frac{-5s}{9rt^2}$

17. $8abcdx^2y$ by $14adxy^2 = \frac{8abcdx^2y}{14adxy^2} = \frac{4bcx}{7y}$

18. $9efg^2hr$ by $24e^2fh^3r = \frac{9efg^2hr}{24e^2fh^3r} = \frac{3g^2}{8eh^2}$

19. $2a^3 + a^2$ by $a = \frac{2a^3 + a^2}{a} = \frac{2a^3}{a} + \frac{a^2}{a} = 2a^2 + a$

20. $4x^4 - x^3$ by $x^2 = \frac{4x^4 - x^3}{x^2} = \frac{4x^4}{x^2} - \frac{x^3}{x^2} = 4x^2 - x$

21. $36b^4 - 18b^2$ by $9b = \frac{36b^4 - 18b^2}{9b} = \frac{36b^4}{9b} - \frac{18b^2}{9b} =$
$4b^3 - 2b$

22. $49y^5 + 35y^3$ by $7y^2 = \frac{49y^5 + 35y^3}{7y^2} = \frac{49y^5}{7y^2} + \frac{35y^3}{7y^2} =$
$7y^3 + 5y$

23. $42x^2 + 28x$ by $7 = \frac{42x^2 + 28x}{7} = \frac{42x^2}{7} + \frac{28x}{7} =$
$6x^2 + 4x$

24. $56z^6 - 48z^3$ by $8 = \frac{56z^6 - 48z^3}{8} = \frac{56z^6}{8} - \frac{48z^3}{8} =$
$7z^6 - 6z^3$

25. $34x^5 - 51x^2$ by $17x^2 = \frac{34x^5 - 51x^2}{17x^2} = \frac{34x^5}{17x^2} - \frac{51x^2}{17x^2} =$
$2x^3 - 3$

26. $105w^6 + 63w^4$ by $21w^2 = \frac{105w^6 + 63w^4}{21w^2} = 5w^4 + 3w^2$

27. $24x^6 - 8x^4$ by $-4x^3 = \frac{24x^6 - 8x^4}{-4x^3} = \frac{24x^6}{-4x^3} - \frac{8x^4}{-4x^3} =$
$-6x^3 + 2x$

28. $42y^7 - 24y^5$ by $6y^4 = \frac{42y^7 - 24y^5}{6y^4} = \frac{42y^7}{6y^4} - \frac{24y^5}{6y^4} =$
$7y^3 - 4y$

29. $5x^2y + 5xy^2$ by $xy = \frac{5x^2y + 5xy^2}{xy} = \frac{5x^2y}{xy} + \frac{5xy^2}{xy} =$
$5x + 5y$

30. $7a^2b - 7ab^2$ by $ab = \frac{7a^2b - 7ab^2}{ab} = \frac{7a^2b}{ab} - \frac{7ab^2}{ab} =$
$7a - 7b$

31. $10x^2y + 15xy^2$ by $5xy = \frac{10x^2y + 15xy^2}{5xy} = \frac{10x^2y}{5xy} + \frac{15xy^2}{5xy} = 2x + 3y$

32. $25p^2q - 15pq^2$ by $5pq = \frac{25p^2q - 15pq^2}{5pq} = \frac{25p^2q}{5pq} - \frac{15pq^2}{5pq} = 5p - 3q$

33. $ap^2q - 2pq$ by $pq = \frac{ap^2q - 2pq}{pq} = \frac{ap^2q}{pq} - \frac{2pq}{pq} = ap - 2$

34. $bx^2w + 3xw$ by $xw = \frac{bx^2w + 3xw}{xw} = \frac{bx^2w}{xw} + \frac{3xw}{xw} = bx + 3$

35. $a^2bc + abc$ by $abc = \frac{a^2bc + abc}{abc} = \frac{a^2bc}{abc} + \frac{abc}{abc} = a + 1$

36. $x^3yz - xyz$ by $xyz = \frac{x^3yz}{xyz} - \frac{xyz}{xyz} = x^2 - 1$

37. $9x^2y^2z - 3xyz^2$ by $-3xyz = \frac{9x^2y^2z}{-3xyz} - \frac{3xyz^2}{-3xyz} = -3xy + z$

38. $12a^2b^2c + 4abc^2$ by $-4abc = \frac{12a^2b^2c}{-4abc} + \frac{4abc^2}{-4abc} = -3ab - c$

39. $b^3x^2 + b^3$ by $-b = \frac{b^3x^2}{-b} + \frac{b^3}{-b} = -b^2x^2 - b^2$

40. $c^5y^3 - cy^2$ by $-c = \frac{c^5y^3}{-c} - \frac{cy^2}{-c} = -c^4y^3 + y^2$

41. $x^2y + xy - xy^2$ by $xy = \frac{x^2y}{xy} + \frac{xy}{xy} - \frac{xy^2}{xy} = x + 1 - y$

42. $ab^2 - ab + a^2b$ by $ab = \frac{ab^2}{ab} - \frac{ab}{ab} + \frac{a^2b}{ab} = b - 1 + a$

43. $18x^3y^2z - 24x^2y^3z$ by $-12x^2yz = \frac{18x^3y^2z}{-12x^2yz} - \frac{24x^2y^3z}{-12x^2yz} = -\frac{3}{2}xy + 2y^2$

44. $36a^4b^2c - 27a^2b^4c^2$ by $-27a^2bc = \frac{36a^4b^2c}{-27a^2bc} - \frac{27a^2b^4c^2}{-27a^2b^4c} = -\frac{4}{3}a^2b + b^3c$

45.
$$
\begin{array}{r}
x + 4 \\
x + 3 \overline{)x^2 + 7x + 12} \\
\underline{x^2 + 3x} \\
4x + 12 \\
\underline{4x + 12} \\
0
\end{array}
$$

46.
$$
\begin{array}{r}
x - 3 \\
x + 4 \overline{)x^2 + x - 12} \\
\underline{x^2 + 4x} \\
-3x - 12 \\
\underline{-3x - 12} \\
0
\end{array}
$$

47.
$$
\begin{array}{r}
x - 1 \\
x - 2 \overline{)x^2 - 3x + 2} \\
\underline{x^2 - 2x} \\
-x + 2 \\
\underline{-x + 2} \\
0
\end{array}
$$

48.
$$
\begin{array}{r}
x + 3 \\
x - 5 \overline{)x^2 - 2x - 15} \\
\underline{x^2 - 5x} \\
3x - 15 \\
\underline{3x - 15} \\
0
\end{array}
$$

49.
$$
\begin{array}{r}
x - 1 \\
x + 2 \overline{)x^2 + x - 2} \\
\underline{x^2 + 2x} \\
-x - 2 \\
\underline{-x - 2} \\
0
\end{array}
$$

50.
$$
\begin{array}{r}
x - 2 \\
x - 3 \overline{)x^2 + x + 6} \\
\underline{x^2 + 3x} \\
-2x - 6 \\
\underline{-2x - 6} \\
0
\end{array}
$$

51.
$$
\begin{array}{r}
2a + 1 \\
3a + 7 \overline{)6a^2 + 17a + 7} \\
\underline{6a^2 + 14a} \\
3a + 7 \\
\underline{3a + 7} \\
0
\end{array}
$$

52.
$$
\begin{array}{r}
b + 3 \\
4b - 2 \overline{)4b^2 + 10b - 6} \\
\underline{4b^2 - 2b} \\
12b - 6 \\
\underline{12b - 6} \\
0
\end{array}
$$

53.
$$
\begin{array}{r}
4y + 2 \\
2y - 3 \overline{)8y^2 - 8y - 6} \\
\underline{8y^2 - 12y} \\
4y - 6 \\
\underline{4y - 6} \\
0
\end{array}
$$

54.
$$
\begin{array}{r}
3t - 2 \\
4t + 3 \overline{)12t^2 + t - 6} \\
\underline{12t^2 + 9t} \\
-8t - 6 \\
\underline{-8t - 6} \\
0
\end{array}
$$

55.
$$
\begin{array}{r}
x - 2 \\
x^2 + 2x - 1 \overline{)x^3 + 0x^2 - 5x + 2} \\
\underline{x^3 + 2x^2 - x} \\
-2x^2 - 4x + 2 \\
\underline{-2x^2 - 4x + 2} \\
0
\end{array}
$$

56.
$$
\begin{array}{r}
d \\
d^2 + d + 2 \overline{)d^3 + d^2 - 3d + 2} \\
\underline{d^3 + d^2 + 2d} \\
-5d + 2
\end{array}
$$

57.
$$
\begin{array}{r}
2a - 1 \\
3a^2 - 2a + 4 \overline{)6a^3 - 7a^2 + 10a - 4} \\
\underline{6a^3 - 4a^2 + 8a} \\
-3a^2 + 2a - 4 \\
\underline{-3a^2 + 2a - 4} \\
0
\end{array}
$$

58.
$$3y^2 + 3y - 4 \overline{\smash{\big)}\, 9y^3 + 0y^2 - 16y + 8} \atop { 3y - 3}$$

$$\begin{array}{r}
3y - 3 \\
3y^2 + 3y - 4 \overline{\smash{\big)}\, 9y^3 + 0y^2 - 16y + 8} \\
\underline{9y^3 + 9y^2 - 12y} \\
-9y^2 - 4y + 8 \\
\underline{-9y^2 - 9y + 12} \\
5y - 4
\end{array}$$

59.
$$\begin{array}{r}
2x^2 + x - 1 \\
2x - 1 \overline{\smash{\big)}\, 4x^3 + 0x^2 - 3x + 4} \\
\underline{4x^3 - 2x^2} \\
2x^2 - 3x + 4 \\
\underline{2x^2 - x} \\
-2x + 4 \\
\underline{-2x + 1} \\
3
\end{array}$$

60.
$$\begin{array}{r}
\frac{7}{3}p^2 - \frac{14}{9}p + \frac{46}{27} \\
3p + 2 \overline{\smash{\big)}\, 7p^3 + 0p^2 + 2p - 5} \\
\underline{7p^3 + \frac{14}{3}p^2} \\
-\frac{14}{3}p^2 + 2p - 5 \\
\underline{-\frac{14}{3}p^2 - \frac{28}{9}} \\
\frac{46}{9}p - 5 \\
\underline{\frac{46}{9}p + \frac{92}{27}} \\
-\frac{227}{27}
\end{array}$$

61.
$$\begin{array}{r}
r^2 - 3r \\
r + 2 \overline{\smash{\big)}\, r^3 - r^2 - 6r + 5} \\
\underline{r^3 + 2r^2} \\
-3r^2 - 6r + 5 \\
\underline{-3r^2 - 6r} \\
5
\end{array}$$

62.
$$\begin{array}{r}
2c^2 + c + 3 \\
c - 2 \overline{\smash{\big)}\, 2c^3 - 3c^2 + c - 4} \\
\underline{2c^3 - 4c^2} \\
c^2 + c - 4 \\
\underline{c^2 - 2c} \\
3c - 4 \\
\underline{3c - 6} \\
2
\end{array}$$

63.
$$\begin{array}{r}
x^3 + 3x^2 + 9x + 27 \\
x - 3 \overline{\smash{\big)}\, x^4 - 81} \\
\underline{x^4 - 3x^3} \\
3x^3 - 81 \\
\underline{3x^3 - 9x^2} \\
9x^2 - 81 \\
\underline{9x^2 - 27x} \\
27x - 81 \\
\underline{27x - 81} \\
0
\end{array}$$

64.
$$\begin{array}{r}
y^3 - 3y^2 + 9y - 27 \\
y + 3 \overline{\smash{\big)}\, y^4 - 81} \\
\underline{y^4 + 3y^3} \\
-3y^3 - 81 \\
\underline{-3y^3 - 9y^2} \\
9y^2 - 81 \\
\underline{9y^2 - 27y} \\
-27y - 81 \\
\underline{-27y - 81} \\
0
\end{array}$$

65.
$$\begin{array}{r}
4x^3 - 3x^2 - 2x - 6 \\
3x^2 + x - 2 \overline{\smash{\big)}\, 12x^5 - 5x^4 - 14x^3 + 23x^2 + 8x - 12} \\
\underline{12x^5 + 4x^4 - 8x^3} \\
-9x^4 - 6x^3 + 23x^2 \\
\underline{-9x^4 - 3x^3 + 6x^2} \\
-3x^3 + 17x^2 + 8x \\
\underline{-3x^3 - x^2 + 2x} \\
18x^2 + 6x - 12 \\
\underline{18x^2 + 6x - 12} \\
0
\end{array}$$

66.
$$\begin{array}{r}
3a^4 - 22a^3 \\
7a^3 + 2a - 7 \overline{\smash{\big)}\, 21a^7 - 14a^6 + 6a^5 - 25a^4 + 21a^3 + 0a^2 + 10a - 35} \\
\underline{21a^7 + 6a^5 - 21a^4} \\
-14a^6 + 0a^5 - 4a^4 + 21a^3 + 0a^2 + 10a - 35 \\
\underline{-14a^6 - 4a^4 + 14a^3} \\
7a^3 + 0a^2 + 10a - 35 \\
\underline{7a^3 + 2a - 7} \\
8a - 28
\end{array}$$

67.
$$\begin{array}{r} x + y \\ x - y \overline{) x^2 \qquad - y^2} \\ \underline{x^2 - xy} \\ xy - y^2 \\ \underline{} \\ 0 \end{array}$$

68.
$$\begin{array}{r} a - b \\ a + b \overline{) a^2 \qquad - b^2} \\ \underline{a^2 + ab} \\ -ab - b^2 \\ \underline{-ab - b^2} \\ 0 \end{array}$$

69.
$$\begin{array}{r} w^2 + wz + z^2 \\ w - z \overline{) w^3 \qquad\qquad - z^3} \\ \underline{w^3 - w^2z} \\ w^2z \qquad - z^3 \\ \underline{w^2z - wz^2} \\ wz^2 - z^3 \\ \underline{wz^2 - z^3} \\ 0 \end{array}$$

70.
$$\begin{array}{r} x^2 - xy + y^2 \\ x + y \overline{) x^3 \qquad\qquad + y^3} \\ \underline{x^3 - x^2y} \\ -x^2y \qquad - y^3 \\ \underline{-x^2y - xy^2} \\ xy^2 + y^3 \\ \underline{xy^2 + y^3} \\ 0 \end{array}$$

71.
$$\begin{array}{r} x^2 + y^2 \\ x + y \overline{) x^3 + x^2y + xy^2 + y^3} \\ \underline{x^3 + x^2y} \\ 0 + xy^2 + y^3 \\ \underline{xy^2 + y^3} \\ 0 \end{array}$$

72.
$$\begin{array}{r} a^2 + b^2 \\ a - b \overline{) a^3 - a^2b + ab^2 - b^3} \\ \underline{a^3 - a^2b} \\ 0 + ab^2 - b^3 \\ \underline{ab^2 - b^3} \\ 0 \end{array}$$

73.
$$\begin{array}{r} c^2d^2 + 2cd + 4 \\ cd - 2 \overline{) c^3d^3 \qquad\qquad - 8} \\ \underline{c^3d^3 - 2c^2d^2} \\ 2c^2d^2 \qquad - 8 \\ \underline{2c^2d^2 - 4cd} \\ 4cd - 8 \\ \underline{4cd - 8} \\ 0 \end{array}$$

74.
$$\begin{array}{r} e^2f^2 - 3ef + 9 \\ ef + 3 \overline{) e^3f^3 \qquad\qquad + 27} \\ \underline{e^3f^3 + 3e^2f^2} \\ -3e^2f^2 \qquad + 27 \\ \underline{-3e^2f^2 - 9ef} \\ 9ef + 27 \\ \underline{9ef + 27} \\ 0 \end{array}$$

75.
$$\begin{array}{r} x - y \\ x - y \overline{) x^2 - 2xy + y^2} \\ \underline{x^2 - xy} \\ -xy + y^2 \\ \underline{-xy + y^2} \\ 0 \end{array}$$

76.
$$\begin{array}{r} a + 3b \\ a + 3b \overline{) a^2 + 6ab + 9b^2} \\ \underline{a^2 + 3ab} \\ 3ab + 9b^2 \\ \underline{3ab + 9b^2} \\ 0 \end{array}$$

77.
$$\begin{array}{r} p^2r - 2p + 3r^2 \\ 5p - r \overline{) 5p^3r - p^2r^2 - 10p^2 + 2pr + 15pr^2 - 3r^3} \\ \underline{5p^3r - p^2r^2} \\ 0 - 10p^2 + 2pr + 15pr^2 - 3r^3 \\ \underline{-10p^2 + 2pr} \\ 0 + 15pr^2 - 3r^3 \\ \underline{0 + 15pr^2 - 3r^3} \\ 0 \end{array}$$

78.
$$\begin{array}{r} 4x^2 - 4xy + y^2 \\ 2x - y \overline{) 8x^3 - 12x^2y + 6xy^2 - y^3} \\ \underline{8x^3 - 4x^2y} \\ -8x^2y + 6xy^2 - y^3 \\ \underline{-8x^2y + 4xy^2} \\ 2xy^2 - y^3 \\ \underline{2xy^2 - y^3} \\ 0 \end{array}$$

79.

$$
\begin{array}{r}
a + d + 4 \\
a - 3d - 1\overline{)a^2 - 2ad - 3d^2 + 3a - 13d - 8} \\
\underline{a^2 - 3ad - a} \\
ad - 3d^2 + 4a - 13d - 8 \\
\underline{ad - 3d^2 - d} \\
4a - 12d - 8 \\
\underline{4a - 12d - 4} \\
- 4
\end{array}
$$

80.

$$
\begin{array}{r}
x - 2y + 3 \\
2x + 3y - 5\overline{)2x^2 - xy - 6y^2 + x + 19y - 15} \\
\underline{2x^2 + 3xy - 5x} \\
- 4xy - 6y^2 + 6x + 19y - 15 \\
\underline{- 4xy - 6y^2 + 10y} \\
6x + 19y - 15 \\
\underline{6x + 19y - 15} \\
0
\end{array}
$$

81.

$$
\begin{array}{r}
af \\
a - f\overline{)a^2f - af^2} \\
\underline{a^2f - af^2} \\
0
\end{array}
$$

82.

$$
\begin{array}{r}
d^2 - 2m^2 \\
d - m\overline{)d^3 - 2dm^2 + 2m^3 - d^2m} \\
\underline{d^3 - d^2m} \\
- 2dm^2 + 2m^3 \\
\underline{- 2dm^2 + 2m^3} \\
0
\end{array}
$$

83.

$$
\begin{array}{r}
a + b - c \\
a - b + c\overline{)a^2 - b^2 + 2bc - c^2} \\
\underline{a^2 - ab + ac} \\
ab - ac - b^2 + 2bc - c^2 \\
\underline{ab - b^2 + bc} \\
- ac + bc - c^2 \\
\underline{- ac + bc - c^2} \\
0
\end{array}
$$

84.

$$
\begin{array}{r}
e - f + h \\
e + f + h\overline{)e^2 + 2eh - f^2 + h^2} \\
\underline{e^2 + ef + eh} \\
- ef + eh - f^2 + h^2 \\
\underline{- ef - fh - f^2} \\
eh + fh + h^2 \\
\underline{eh + fh + h^2} \\
0
\end{array}
$$

85.

$$
\begin{array}{r}
a^2 - a + 1 \\
a^2 + a + 2\overline{)a^4 + 0a^3 + 2a^2 - a + 2} \\
\underline{a^4 + a^3 + 2a^2} \\
- a^3 + 0a^2 - a + 2 \\
\underline{- a^3 - a^2 - 2a} \\
a^2 + a + 2 \\
\underline{a^2 + a + 2} \\
0
\end{array}
$$

86.

$$
\begin{array}{r}
x^3 - 1 \\
x^3 - x + 1\overline{)x^6 - x^4 + 2x^2 - 1} \\
\underline{x^6 - x^4 + x^3} \\
- x^3 + 2x^2 - 1 \\
\underline{- x^3 + x - 1} \\
2x^2 - x
\end{array}
$$

87. Reciprocal is $\dfrac{R_2R_3 + R_1R_3 + R_1R_2}{R_1R_2R_3} = \dfrac{R_2R_3}{R_1R_2R_3} +$

$\dfrac{R_1R_3}{R_1R_2R_3} + \dfrac{R_1R_2}{R_1R_2R_3} = \dfrac{1}{R_1} + \dfrac{1}{R_2} + \dfrac{1}{R_3}$

88. $\overline{e} = \dfrac{\sigma}{\dfrac{e_1 + e_2 + e_3}{e_1e_2}} = \dfrac{\sigma}{\dfrac{e_1}{e_1e_2} + \dfrac{e_2}{e_1e_2} - \dfrac{e_1e_2}{e_1e_2}} =$

$\dfrac{\sigma}{\dfrac{1}{e_2} + \dfrac{1}{e_1} - 1} = \dfrac{\sigma}{\dfrac{1}{e_1} + \dfrac{1}{e_2} - 1}$

89. $V_2 = V_1\left(1 + \dfrac{T_2 - T_1}{T_1}\right) = V_1\left(1 + \dfrac{T_2}{T_1} - 1\right) =$

$V_1\left(\dfrac{T_2}{T_1}\right) = \dfrac{V_1T_2}{T_1}$

90. **(a)** Divide $x^3 + 6x^2 - 7x$ by $x + 7$. The quotient is $x^2 - x$, and the length of the rectangle is $x^2 - x$ ft.
(b) The area is $4^3 + 6 \cdot 4^2 - 7 \cdot 4 = 132$ ft^2, the length is $4 + 7 = 11$ ft, and the width is $4^2 - 4 = 12$ ft.

91. $R = \dfrac{24r^2 - 15r}{3r} = 8r - 5$

92. $T = \dfrac{WL}{NV} = \dfrac{(4x^2 + 2x - 2)(15x + 75)}{(4x + 20)(2x^2 + x - 1)} =$

$\dfrac{2(2x^2 + x - 1)15(x + 5)}{4(x + 5)(2x^2 + x - 1)} = \dfrac{2 \cdot 15}{4} = \dfrac{30}{4} = 7.5$

2.4   SOLVING EQUATIONS

1. $x - 7 = 32; (x - 7) + 7 = 32 + 7; x = 39$
2. $y - 8 = 41; (y - 8) + 8 = 41 + 8; y = 49$
3. $a + 13 = 25; (a + 13) - 13 = 25 - 13; a = 12$
4. $b + 21 = 34; b + 21 - 21 = 34 - 21; b = 13$
5. $25 + c = 10; 25 + c - 25 = 10 - 25; c = -15$
6. $28 + d = 12; 28 + d - 28 = 12 - 28; d = -16$
7. $4x = 18; \frac{4x}{4} = \frac{18}{4}; x = \frac{9}{2}$ or $4\frac{1}{2}$
8. $5y = 12; \frac{5y}{5} = \frac{12}{5}; y = \frac{12}{5}$ or $2\frac{2}{5}$ or 2.4
9. $-3w = 24; \frac{-3w}{-3} = \frac{24}{-3}; w = -8$
10. $6z = -42; \frac{6z}{6} = \frac{-42}{6}; w = -7$
11. $21c = -14; \frac{21c}{21} = \frac{-14}{21}; c = -\frac{2}{3}$
12. $24d = 16; \frac{24d}{24} = \frac{16}{24}; d = \frac{2}{3}$
13. $\frac{p}{3} = 5; 3 \cdot \frac{p}{3} = 5 \cdot 3; p = 15$
14. $\frac{r}{5} = 4; 5 \cdot \frac{r}{5} = 5 \cdot 4; r = 20$
15. $\frac{t}{4} = -6; 4 \cdot \frac{t}{4} = -6 \cdot 4; t = -24$
16. $\frac{s}{-3} = -5; -3\frac{s}{-3} = -5(-3); s = 15$
17. $4a + 3 = 11; 4a + 3 - 3 = 11 - 3; 4a = 8;$ $\frac{4a}{4} = \frac{8}{4}; a = 2$
18. $3b + 4 = 16; 3b + 4 - 4 = 16 - 4; 3b = 12;$ $\frac{3b}{3} = \frac{12}{3}; b = 4$
19. $7 - 8d = 39; 7 - 8d - 7 = 39 - 7; -8d = 32;$ $\frac{-8d}{-8} = \frac{32}{-8}; d = -4$
20. $9 - 7c = 44; 9 - 7c - 9 = 44 - 9; -7c = 35;$ $\frac{-7c}{-7} = \frac{35}{-7}; c = -5$
21. $2.3w + 4.1 = 13.3; 2.3w + 4.1 - 4.1 = 13.3 - 4.1; 2.3w = 9.2; \frac{2.3w}{2.3} = \frac{9.2}{2.3}; w = 4$
22. $3.5z + 5.2 = 22.7; 3.5z + 5.2 - 5.2 = 22.7 - 5.2; 3.5z = 17.5; \frac{3.5z}{3.5} = \frac{17.5}{3.5}; z = 5$
23. $2x + 5x = 28; 7x = 28; \frac{7x}{7} = \frac{28}{7}; x = 4$
24. $3y + 8y = 121; 11y = 121; \frac{11y}{11} = \frac{121}{11}; y = 11$
25. $3a + 2(a + 5) = 45; 3a + 2a + 10 = 45; 5a + 10 = 45; 5a = 35; a = 7$
26. $4b + 3(7 + b) = 56; 4b + 21 + 3b = 56; 7b + 21 = 56; 7b = 35; b = 5$
27. $4(6 + c) - 5 = 21; 24 + 4c - 5 = 21; 4c + 19 = 21; 4c = 2; c = \frac{1}{2}$
28. $5(7 + d) + 4 = 31; 35 + 5d + 4 = 31; 5d + 39 = 31; 5d = -8; d = \frac{-8}{5}$
29. $2(p - 4) + 3p = 16; 2p - 8 + 3p = 16; 5p - 8 = 16; 5p = 24; p = \frac{24}{5}$
30. $7(n - 5) + 4n = 16; 7n - 35 + 4n = 16; 11n - 35 = 16; 11n = 51; n = \frac{51}{11}$

31. $3x = 2x + 5; 3x - 2x = 5; x = 5$
32. $4y = 3y + 7; 4y - 3y = 7; y = 7$
33. $4w = 6w + 12; 4w - 6w = 12; -2w = 12; w = -6$
34. $7z = 10z + 42; 7z - 10z = 42; -3z = 42;$ $z = -14$
35. $9a = 54 + 3a; 9a - 3a = 54; 6a = 54; a = 9$
36. $8b = 55 + 3b; 8b - 3b = 55; 5b = 55; b = 11$
37. $\frac{5x}{2} = \frac{4x}{3} - 7; 6\left(\frac{5x}{2}\right) = 6\left(\frac{4x}{3} - 7\right); 3 \cdot 5x = \frac{6 \cdot 4x}{3} - 6 \cdot 7; 15x = 8x - 42; 15x - 8x = -42; 7x = -42;$ $x = -6$
38. $\frac{3y}{7} = \frac{2y}{3} + 4; 21\left(\frac{3y}{7}\right) = 21\left(\frac{2y}{3} + 4\right); 3 \cdot 3y = 7 \cdot 2y + 21 \cdot 4; 9y = 14y + 84; -5y = 84; y = \frac{-84}{5}$
39. $\frac{6p}{5} = \frac{3p}{2} + 4; 10\left(\frac{6p}{5}\right) = 10\left(\frac{3p}{2} + 4\right); 2 \cdot 6p = 5 \cdot 3p + 40; 12p = 15p + 40; -3p = 40; p = -\frac{40}{3}$
40. $\frac{5z}{2} = \frac{4z}{5} - 3; 15 \cdot \frac{5z}{3} = 15\left(\frac{4z}{3} - 3\right); 5 \cdot 5z = 3 \cdot 4z - 15 \cdot 3; 25z = 12z - 45; 13z = -45; z = -\frac{45}{13}$
41. $8n - 4 = 5n + 14; 8n - 5n = 14 + 4; 3n = 18;$ $n = 6$
42. $9p - 5 = 6p + 37; 9p - 6p = 37 + 5; 3p = 42;$ $p = 14$
43. $7r + 3 = 11r - 21; 7r - 11r = -21 - 3; -4r = -24; r = 6$
44. $8s + 7 = 15s - 56; 8s - 15s = -56 - 7; -7s = -63; s = 9$
45. $\frac{6x - 3}{2} = \frac{7x + 2}{3}; 6\left(\frac{6x - 3}{2}\right); 6\left(\frac{7x + 2}{3}\right); 3(6x - 3) = 2(7x + 2); 18x - 9 = 14x + 4; 18x - 14x = 4 + 9; 4x = 13; x = \frac{13}{4}$
46. $\frac{4r - 3}{3} = \frac{5r + 2}{2}; 6\left(\frac{4r - 3}{3}\right) = 6\left(\frac{5r + 2}{2}\right); 2(4r - 3) = 3(5r + 2); 8r - 6 = 15r + 6; 8r - 15r = 6 + 6; -7r = 12; r = -\frac{12}{7}$
47. $\frac{3t + 4}{4} = \frac{2t - 5}{2}; 8\left(\frac{3t + 4}{4}\right) = 8\left(\frac{2t - 5}{2}\right); 2(3t + 4) = 4(2t - 5); 6t + 8 = 8t - 20; 6t - 8t = -20 - 8; -2t = -28; t = 14$
48. $\frac{6a - 5}{3} = \frac{7a + 5}{6}; 6\left(\frac{6a - 5}{3}\right) = 6\left(\frac{7a + 5}{6}\right); 2(6a - 5) = 1(7a + 5); 12a - 10 = 7a + 5; 12a - 7a = 5 + 10; 5a = 15; a = 3$
49. $3(x + 5) = 2x - 3; 3x + 15 = 2x - 3; 3x - 2x = -3 - 15; x = -18$
50. $2(y - 3) = 4 + 3y; 2y - 6 = 4 + 3y; 2y - 3y = 4 + 6; -y = 10; (-1)(-y) = (-1)10; y = -10$
51. $\frac{x}{2} + \frac{x}{3} - \frac{x}{4} = 2; 12\left(\frac{x}{2} + \frac{x}{3} - \frac{x}{4}\right) = 12 \cdot 2; \frac{12x}{2} + \frac{12x}{3} - \frac{12x}{4} = 24; 6x + 4x - 3x = 24; 7x = 24; x = \frac{24}{7}$
52. $\frac{9}{2} - \frac{p}{3} - \frac{p}{4} = 3; \frac{12p}{2} - \frac{12p}{3} - \frac{12p}{4} = 12 \cdot 3;$ $6p - 4p - 3p = 36; -p = 36; p = -36$

53. $\frac{4(a-3)}{5} = \frac{3(a+2)}{4}$; $20\left(\frac{4(a-3)}{5}\right) = 20\left(\frac{3(a+2)}{4}\right)$; $4(4(a-3)) = 5(3(a+2))$; $16a - 48 = 15a + 30$; $16a - 15a = 30 + 48$; $a = 78$

54. $\frac{5(b+4)}{3} = \frac{4(b-5)}{5}$; $15\left(\frac{5(b+4)}{3}\right) = 15\left(\frac{4(b-5)}{5}\right)$; $5(5(b+4)) = 3(4(b-5))$; $25b + 100 = 12b - 60$; $25b - 12b = -60 - 100$; $13b = -160$; $b = -\frac{160}{13}$

55. Solve $ax + b = 3ax$ for x; $ax - 3ax = -b$; $x(a - 3a) = -b$; $x(-2a) = -b$; $x = \frac{-b}{-2a} = \frac{b}{2a}$

56. Solve $2by = 6 + 4by$ for y; $2by - 4by = 6$; $-2by = 6$; $y = \frac{6}{-2b} = -\frac{3}{b}$

57. Solve $ax - 3a + x = 5a$ for a; $ax + x = 8a$; $ax - 8a = -x$; $a(x - 8) = -x$; $a = \frac{-x}{x - 8} = \frac{x}{8 - x}$

58. Solve $2(by - c) = 3\left(\frac{y}{2} - c\right)$ for y; $2by - 2c = \frac{3y}{2} - 3c$; $4by - 4c = 3y - 6c$; $4by - 3y = -2c$; $y(4b - 3) = -2c$; $y = \frac{-2c}{4b - 3}$

59. $\frac{3}{x} + \frac{4}{x} = 3$; $x\left(\frac{3}{x} + \frac{4}{x}\right) = x \cdot 3$; $3 + 4 = 3x$; $7 = 3x$; $3x = 7$; $x = \frac{7}{3}$

60. $\frac{5}{y} - \frac{3}{y} = 6$; $y\left(\frac{5}{y} - \frac{3}{y}\right) = 6y$; $5 - 3 = 6y$; $2 = 6y$; $6y = 2$; $y = \frac{2}{6} = \frac{1}{3}$

61. $\frac{3}{4p} + \frac{1}{p} = \frac{7}{4}$; $4p\left(\frac{3}{4p} + \frac{1}{p}\right) = 4p\frac{7}{4}$; $3 + 4 = 7p$; $7 = 7p$; $p = 1$

62. $\frac{6}{5q} - \frac{2}{q} = \frac{6}{5}$; $5q\left(\frac{6}{5q} - \frac{2}{q}\right) = 5q\left(\frac{6}{5}\right)$; $6 - 10 = 6q$; $-4 = 6q$; $q = -\frac{4}{6} = -\frac{2}{3}$

63. $\frac{1}{x+1} - \frac{2}{x-1} = 0$; $(x+1)(x-1)\left(\frac{1}{x+1} - \frac{2}{x-1}\right) = 0(x+1)(x-1)$; $(x-1) - 2(x+1) = 0$; $x - 1 - 2x - 2 = 0$; $-x - 3 = 0$; $-x = 3$; $x = -3$

64. $\frac{3}{x+2} - \frac{4}{x-2} = 0$; $(x+2)(x-2)\left[\frac{3}{x+2} - \frac{4}{x-2}\right] = 0$; $3(x-2) - 4(x+2) = 0$; $3x - 6 - 4x - 8 = 0$; $-x - 14 = 0$; $-x = 14$; $x = -14$

65. $\frac{3}{2x} = \frac{1}{x+5}$; $(x+5)2x \cdot \frac{3}{2x} = (x+5)2x\left(\frac{1}{x+5}\right)$; $3(x+5) = 2x$; $3x + 15 = 2x$; $3x - 2x = -15$; $x = -15$

66. $\frac{4}{3x} = \frac{2}{x+1}$; $4(x+1) = 2 \cdot 3x$; $4x + 4 = 6x$; $4 = 2x$; $2x = 4$; $x = 2$

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

68. $\frac{2x+3}{2x+5} = \frac{5x+4}{5x+2}$; $(2x+3)(5x+2) = (5x+4)(2x+5)$; $10x^2 + 19x + 6 = 10x^2 + 33x + 20$; $19x - 33x = 20 - 6$; $-14x = 14$; $x = -1$

69. A common denominator of these expressions is 12. Multiplying by 12 and simplifying produces the following:

$(12)\left(\frac{6b-5a}{3}\right) + (12)\left(\frac{5a+b}{2}\right) = (12)\left(\frac{5(a+2b)}{4}\right) + (12)5$; $4(6b - 5a) + 6(5a + b) = 15(a + 2b) +$

60; $24b - 20a + 30a + 6b = 15a + 30b + 60$; $30b + 10a = 15a + 30b + 60$; $-5a = 60$; $a = -12$

70. A common denominator of these expressions is $15t$. Multiplying by $15t$ and simplifying produces the following:

$(15t)\left(\frac{3r+t}{5t}\right) - (15t)\left(\frac{r+5t}{3t}\right) = (15t)\left(\frac{2(r-4t)}{15t}\right) + (15t)2$; $3(3r + t) - 5(r + 5t) = 2(r - 4t) + 30t$; $9r + 3t - 5r - 25t = 2r - 8t + 30t$; $4r - 22t = 2r + 22t$; $2r = 44t$; $r = 22t$

71. Multiplying by a common denominator of $6x$ produces the following:

$(6x)\left(\frac{2z+a}{3x}\right) - (6x)\left(\frac{9z+a}{6x}\right) = (6x)\left(\frac{z-a}{2x}\right) + (6x)\left(\frac{4a}{3x}\right)$; $2(2z + a) - (9z + a) = 3(z - a) + 2(4a)$; $4z + 2a - 9z - a = 3z - 3a + 8a$; $-5z + a = 3z + 5a$; $a - 5a = 3z + 5z$; $-4a = 8z$; $a = -2z$

72. Multiplying by a common denominator of $6y$ produces the following:

$(6y)\left(\frac{3p+2x}{2y}\right) - (6y)\left(\frac{5p-3x}{3y}\right) = (6y)\left(\frac{x-2p}{y}\right) + (6y)\left(\frac{3x+p}{6y}\right)$; $3(3p + 2x) - 2(5p - 3x) = 6(x - 2p) + (3x + p)$; $9p + 6x - 10p + 6x = 6x - 12p + 3x + p$; $-p + 12x = 9x - 11p$; $12x - 9x = -11p + p$; $3x = -10p$; $x = -\frac{10}{3}p$

73. \$1.38 for 16 bolts is 1.38 : 16.

74. 725 revolutions per min is 725 : 1.

75. 86 L per km is 86 : 1.

76. 236 mi in 4 h is 236 : 4.

77. $\frac{9}{2} = \frac{4.5}{1}$ or 4.5 : 1

78. $\frac{7}{5} = \frac{1.4}{1}$ or 1.4 : 1

79. $\frac{23}{7} \approx \frac{3.2857}{1}$ or 3.2857 : 1

80. $\frac{37}{4} = \frac{9.25}{1}$ or 9.25 : 1

81. $8c = 7 \times 32$; $c = \frac{7 \times 32}{8}$; $c = 7 \times 4 = 28$

82. $9b = 3 \times 24$; $b = \frac{3 \times 24}{9} = 8$

83. $124d = 62 \times 158$; $d = \frac{62 \times 158}{124} = 79$

84. $20a = 8 \times 3.5$; $a = \frac{8 \times 3.5}{20} = 1.4$

85. $0.15a = 4 \times 0.16$; $a = \frac{4 \times 0.16}{0.15} \approx 4.267$

86. $10.5x = 7.5 \times 6.3$; $x = \frac{7.5 \times 6.3}{10.5} = 4.5$

87. $8b = 20 \times 5.6$; $b = \frac{20 \times 5.6}{8} = 14$

88. $2.4d = 10.8 \times 1.6$; $d = \frac{10.8 \times 1.6}{2.4} = 7.2$

89. $F - 32 = \frac{9}{5}C$; $\frac{9}{5}C = F - 32$; $\frac{5}{9} \cdot \frac{9}{5}C = \frac{5}{9}(F - 32)$; $C = \frac{5}{9}(F - 32)$

90. (a) $v - v_0 = at$; $at = v - v_0$; $t = \frac{v - v_0}{a}$

(b) $t = \frac{97 - 12}{9.8} = \frac{85}{9.8} \approx 8.7$ sec.

2.5 DIMENSIONAL ANALYSIS

1. $3 \text{ h} \times \dfrac{60 \text{ min}}{1 \text{ h}} \times \dfrac{60 \text{ s}}{1 \text{ min}} = 10{,}800 \text{ sec}$

2. $64 \text{ in.} \times \dfrac{1 \text{ ft}}{12 \text{ in.}} = 5.3 \text{ ft}$

3. $7656 \text{ ft} \times \dfrac{1 \text{ mi}}{5280 \text{ ft}} = 1.45 \text{ mi}$

4. $3.2 \text{ years} \times \dfrac{365 \text{ days}}{1 \text{ year}} \times \dfrac{24 \text{ h}}{1 \text{ day}} = 28{,}032 \text{ h}$

5. $15.25 \text{ in.} \times \dfrac{2.54 \text{ cm}}{1 \text{ in.}} = 38.735 \text{ cm}$

6. $7656 \text{ m} \times \dfrac{3.2808 \text{ ft}}{1 \text{ m}} \times \dfrac{1 \text{ mi}}{5280 \text{ ft}} = 4.76 \text{ mi}$

7. $\dfrac{88 \text{ ft}}{1 \text{ sec}} \times \dfrac{1 \text{ mi}}{5280 \text{ ft}} \times \dfrac{3600 \text{ sec}}{1 \text{ h}} = 60 \text{ mph}$

8. $65 \text{ mph} \times \dfrac{1.6093 \text{ km}}{1 \text{ mi}} = 104.6 \text{ kph}$

9. $250 \text{ mm} \times 0.03937 \text{ in./mm} = 9.84 \text{ in.}$

10. $225.5 \text{ ft}^2 \times 0.0929 \text{ m}^2/\text{ft}^2 = 20.84 \text{ m}^2$

11. $2.14 \text{ in.} \times 2.54 \text{ cm/in.} = 5.44 \text{ cm}$

12. $65 \text{ lb} \times 0.4535 \text{ kg/lb} \times 0.05 \text{ mg/kg} = 1.5 \text{ mg}$

13. $54 : 13$ or $4.1538 : 1$

14. $\frac{15}{12} = \frac{5}{4}$ or $5 : 4$

15. A steering wheel that makes $4\frac{2}{3}$ complete turns rotates a total of $4\frac{2}{3} \times 360° = \frac{14}{3} \times 360° = 1680°$. Thus, the steering ratio is $\frac{1680}{60} = \frac{28}{1}$ or $28 : 1$.

16. $19 : 1$, or just 19

17. $\frac{5 \times 10^{-4}}{300} \approx 1.67 \times 10^{-6} \text{ F} = 1.67 \ \mu\text{F}$

18. $\frac{20 \text{ mm}}{80 \text{ mm}} = \frac{1}{4}$ or $1 : 4$

19. $\frac{8.7}{1} = \frac{96}{x}$; $x = \frac{96}{8.7} \approx 11.03$ or 11.03 cm^3

20. $\frac{90 \text{ mL}}{20 \text{ L}} = \frac{x \text{ mL}}{54 \text{ L}}$; $x = \frac{90 \times 54}{20} \text{ mL} = 243 \text{ mL}$

21. $\frac{80 \text{ cal}}{1 \text{ g}} = \frac{x \text{ cal}}{785 \text{ kg}} = \frac{x \text{ cal}}{785\,000 \text{ g}}$; $x = 80 \times 785\,000$; $x = 62{,}800{,}000$ calories

22. $\frac{120}{V} = \frac{100}{750}$; $V = \frac{120 \times 750}{100} = 900 \text{ V}$

23. $\frac{25.4 \text{ mm}}{1 \text{ in.}} = \frac{88.9 \text{ mm}}{x \text{ in.}}$; $x = \frac{88.9 \text{ mm}}{25.4 \text{ mm}} = 3.5$; 3.5 in.

24. $\frac{9.78039}{32.0878} = \frac{9.83217}{x}$; $x = \frac{9.83217 \times 32.0878}{9.78039}$; $x = 32.257681 \text{ ft/sec}^2$

25. We have the proportion $\frac{x \text{ L}}{14.2 \text{ gal}} = \frac{1 \text{ L}}{0.2642 \text{ gal}}$. Multiplying by 14.2 gal produces a total of 53.7472 L.

26. We have the proportion $\frac{1.25 \text{ oz}}{140} = \frac{14.1 \text{ oz}}{x}$ or $x \text{ cal} = 14.1 \text{ oz} \cdot \frac{140 \text{ cal}}{1.25 \text{ oz}} = 1579.2 \text{ cal}$. Similarly, $\frac{1.25 \text{ oz}}{3 \text{ g fiber}}$ or $x \text{ g fiber} = 14.1 \text{ oz.} \cdot \frac{3 \text{ g}}{1.25 \text{ oz}} = 33.84 \text{ g}$ of dietary fiber.

27. The incoming thickness—outgoing thickness is the amount etched. For this wafer, the amount etched is 5000 A–2000 A = 3000 A. From the definition of the etch rate, we have $\dfrac{\text{amount etched}}{\text{etch time}} = \text{etch rate}$. Thus, the etch rate is $\dfrac{3000 \text{ A}}{2 \text{ min}} = 1500 \text{ A/min}$.

28. The required polish time is
$$\dfrac{\text{incoming thickness} - \text{outgoing target thickness}}{\text{polish rate}} =$$
required polish time.
Applying this to the given data, we have:
$$\dfrac{5{,}000 \text{ A} - 3{,}500 \text{ A}}{1{,}000 \text{ A/min}} =$$
$$\dfrac{1{,}500 \text{ A}}{1{,}000 \text{ A/min}} = 1.5 \text{ min.}$$
So, 1.5 min is required to hit the target thickness.

29. (a) Use the following proportion:
$$\dfrac{\text{blueprint scale length}}{\text{actual scale length}} =$$
$$\dfrac{\text{blueprint length of panel}}{\text{actual panel length}}.$$ Substituting the given values, we get $\dfrac{20 \text{ mm}}{1.25 \text{ m}} = \dfrac{\text{blueprint length of panel}}{2.75 \text{ m}}$.
Solving this proportion, we get blueprint length of panel $= \dfrac{20 \text{ mm} \times 2.75 \text{ m}}{1.25 \text{ m}} = 44 \text{ mm}$. The solar panel measures 44 mm long on the blueprint.

(b) Substituting the given values into the above proportion produces
$$\dfrac{20 \text{ mm}}{1.25 \text{ m}} = \dfrac{\text{blueprint length of panel}}{0.48 \text{ m}}.$$
Solving this proportion, we get
blueprint length of panel $= \dfrac{20 \text{ mm} \times 0.48 \text{ m}}{1.25 \text{ m}} =$ 7.68 mm.
The solar panel measures 8 mm wide on the blueprint when rounded to the nearest millimeter.

30. Use the proportion $\dfrac{\text{original depth}}{\text{original cubic yards}} =$

$\dfrac{\text{new depth}}{\text{total cubic yards}}$. Substituting the given values, the

proportion becomes $\dfrac{6 \text{ ft}}{2{,}700 \text{ yard}^3} = \dfrac{8.5 \text{ ft}}{\text{total cubic yards}}$.

Solving this proportion, we get:

$$\text{Total cubic feet} = \frac{8.5 \text{ ft} \times 2{,}700 \text{ yard}^3}{6 \text{ ft}} = 3{,}825 \text{ yard}^3$$

2.6 APPLICATIONS OF EQUATIONS

1. $\frac{79 + 85 + 74 + x}{4} = 80$; $\frac{238 + x}{4} = 80$; $238 + x = 320$; $x = 82$

2. $\frac{65 + 72 + x}{3} = 75$; $\frac{137 + x}{3} = 75$; $137 + x = 225$; $x = 88$

3. $\frac{85 + 82 + x}{3} = 75$; $167 + x = 225$; $x = 58$; minimum of 60

4. $\frac{69 + 73 + 68 + t}{4} = 72$; $210 + t = 288$; $t = 78°$

5. $0.80w = 920$; $w = \frac{920}{0.8} = \$1150$; $1150 - 920 = \$230$

6. $c + 0.15c = 920$; $1.15c = 920$; $c = \frac{920}{1.15} = \$800$

7. $0.30c = 1839$; $c = \frac{1839}{0.30}$; $c = \$6130$

8. $p + 0.03p + 0.04(p + 0.03p) = 227.63$; $1.03p + 0.04(1.03p) = 227.63$; $103p + 0.0412p = 227.63$; $1.0712p = 227.63$; $p = \frac{227.63}{1.0712}$; $p = \$212.50$

9. $a =$ amount at 7.5%; $(4500 - a) =$ amount at 6%; $0.075 \times a + 0.06(4500 - a) = 303$; $0.075a + 270 - 0.06a = 303$; $0.015a = 33$; $a = \frac{33}{0.015} = \$2200$ at 7.5%; $4500 - 2200 = \$2300$ at 6%

10. Let a be the amount invested at 4.2%.
Then, $8200 - a$ is the amount invested at 3.25%.
As the total amount earned was \$325.65, we have

$$0.042a + 0.0325(8200 - a) = 320.65$$
$$0.042a + 266.5 - a = 320.65$$
$$0.0095a + 266.5 = 320.65$$
$$0.0095a = 54.15$$
$$a = \frac{54.15}{0.0095} = 5700$$
$$8200 - a = 8200 - 5700$$
$$= 2500$$

Thus, José invested \$5,700 at 4.2% and \$2500 at 3.25%.

11. $40 \times 8.50 + x(1.5)8.50 = 429.25$
$$340 + 12.75x = 429.25$$
$$12.75x = 89.25$$
$$x = 80.25 \div 12.75 = 6.29 \text{ h}$$

12.
$$w = \text{weekend}$$
$$14 - w = \text{regular}$$
$$\text{overtime}$$
$$40 \times 8.20 + (14 - w)(1.5)8.20 + 2(w)8.20 = 524.80$$
$$328 + 172.220 - 12.30w + 16.40w = 524.80$$
$$500.2 + 4.1w = 524.80$$
$$4.1w = 24.60w = 6 \text{ h}$$

13. $d = rt$; $d = 38 \text{ mph} \times 7 \text{ h} = 266 \text{ mi}$

14. $d = rt$; $475 = 38t$; $\frac{475}{38} = t$; $t = 12.5 \text{ h}$

15.
$$t = \text{days of ships}$$
$$380 - 12 \times (t + 1) = 80t$$
$$380 - 12t - 12 = 80t$$
$$368 = 80t + 12t$$
$$368 = 92t$$
$$\frac{368}{92} = t$$
$$t = 4 \text{ days}$$
$$80 \times 4 = 320 \text{ km}$$

16. $60(t) = 80(t - \frac{1}{2})$; $60t = 80t - 40$; $-20t = -40$; $t = 2 \text{ h}$; $1:00 + 2 = 3:00 \text{ p.m.}$; $60 \times 2 = 120 \text{ mi}$

17. $h = h$ together $\frac{1}{6} + \frac{1}{4} = \frac{1}{h}$; $12h =$ LCD; $12h \cdot \frac{1}{6} +$ $12h \cdot \frac{1}{4} = 12h \cdot \frac{1}{h}$; $2h + 3h = 12$; $5h = 12$; $h = \frac{12}{5} = 2\frac{2}{5}$; 2 hours 24 min

18. $\frac{1}{45} + \frac{1}{e} = \frac{1}{30}$; $90e\frac{1}{45} + 90e\frac{1}{e} = 90e \cdot \frac{1}{30}$; $2e + 90 = 3e$; $90 = e$; 90 days

19. $\frac{1}{4} + \frac{1}{2} = \frac{1}{h}$; $4h \cdot \frac{1}{4} + 4h \cdot \frac{1}{2} = 4h \cdot \frac{1}{h}$; $h + 2h = 4$; $3h = 4$; $h = \frac{4}{3} = 1$ h 20 min

20. $\frac{70}{12} + \frac{70}{4} = \frac{70}{h}$; $12h \cdot \frac{70}{12} + 12h \cdot \frac{70}{4} = 12h \cdot \frac{70}{h}$; $70h + 210h = 840$; $280h = 840$; $h = 3$ min

21. $50 \times 0.86 = (50 + w) \times 0.40$; $43 = 20 + 0.40$; $23 = 0.4w$; $\frac{23}{0.4} = w$; 57.5 mL $= w$

22. $x =$ amount of 8% alcohol; $1{,}000{,}000 - x =$ amount of 14% alcohol; $0.08x + 0.14(1{,}000{,}000 - x) =$ $0.09 \times 1{,}000{,}000$; $140{,}000 - 0.06x = 90{,}000$; $-0.06x = -50{,}000$; $x = \frac{50{,}000}{0.06} = 833{,}333$ of 8%; $1{,}000{,}000 - 833{,}333 = 166{,}667$; the tank should be filled with 166,667 L of 14% alcohol and 833,333 L of 8% alcohol.

23. $x =$ amount of 35%; $750 - x =$ amount of 75%; $0.35x + 0.75(750 - x) = 0.60 \times 750$; $0.35x + 562.5 - 0.75x = 450$; $-0.4x = -112.5$; $x = 281.25$ of 35% copper; $750 - 281.25 = 468.75$ of 75% copper.

24. $0.20x + 0.30 \times 50 = 0.27(50 + x)$
$0.2x + 15 = 13.5 + 0.27x$
$15 - 13.5 = 0.27x - 0.2x$
$1.5 = 0.07x$
$x = \dfrac{1.5}{0.07} = 21.428571$ lb

25. $850 - 500 = 350$ lb; $500x = 350(20 - x)$; $500x = 7000 - 350x$; $(500 + 350)x = 7000$; $850x = 7000$; $x = 8.24$ ft from 500 lb end

26. $140{,}000 - 60{,}000 = 80{,}000$ N on rear wheels
$x =$ distance from front
$60{,}000x = 80{,}000(4.2 - x)$
$60{,}000x = 336{,}000 - 80{,}000x$
$60{,}000x + 80{,}000x = 336{,}000$
$140{,}000x = 336{,}000$
$x = 2.4$ m from front axle

27. $x =$ distance from left
$25x = 15(12 - x)$
$25x = 180 - 15x$
$40x = 180$
$x = 180 \div 40$
$x = 4.5$ ft from the left end

28. Let d be the location of the center of gravity in cm from the right end. The torque to the left of the center of gravity is $48 + 8(18 - d)$. To the right of the center of gravity, it is $8d$. Thus, $48 + 8(18 - d) = 8d$ or $192 = 16d$ and $d = 12$. The center of gravity is 12 cm from the right end.

29. Let d be the location of the center of gravity in cm from the right end. The torque to the left of the center of gravity is $4 + 2(8 - d)$. To the right of the center of gravity, it is $2d$. Thus, $4 + 2(8 - d) = 2d$ or $20 = 4d$ and $d = 5$. The center of gravity is 5 in. from the right end.

30. Let x be the thickness in cm of the right side. The torque to the left of the center of gravity is $72 + 48x$. To the right of the center of gravity, it is $84x$. Thus, $72 + 48x = 84x$ or $72 = 36x$ and $x = 2$. The thickness of the right side is 2 cm.

31. Let n represent the number of ccs (cm^3) of pure alcohol that the nurse must add.

$$100\%(n) + 60\%(10) = 90\%(n + 10)$$
$$n + 6 = 0.9n + 9$$
$$0.1n = 3$$
$$n = 30$$

The nurse must add 30 cc of pure alcohol.

32. Let n represent the number of grams of the 80% solution of hydrochloric acid that must be added.

$$20\%(300 - n) + 80\%(n) = 25\%(300)$$
$$60 - 0.2n + 0.8n = 75$$
$$0.6n = 15$$
$$n = 25$$

The nurse must add 25 g of the 80% solution of hydrochloric acid.

33. (a) The equation is $V = \sqrt{PR}$, where V is the voltage, P the power, and R the resistance.

(b) Substituting the given values makes the equation $240 = \sqrt{2500R}$. We solve this equation as follows:

$$240 = \sqrt{2500R}$$
$$240^2 = \left(\sqrt{2500R}\right)^2$$
$$57{,}600 = 2500\,R$$
$$R = \frac{57{,}600}{2500} = 23.04$$

To the nearest whole ohm, the resistance is 23 Ω.

34. (a) The equation is $P = \dfrac{V^2}{R}$, where V is the voltage, P the power, and R the resistance.

(b) Substituting the given values makes the equation $4.25 = \dfrac{V^2}{2850}$.

$$4.25 = \frac{V^2}{2850}$$

$$4.25 \times 2850 = V^2$$

$$12\ 112.5 = V^2$$

$$V = \sqrt{12\ 112.5} \approx 110.057$$

To the nearest volt, the voltage is 110 V.

35. (a) The equation is $Z = \sqrt{R^2 + X^2}$, where Z is the impedance, R the resistance, and X the reactance.

(b) Substituting the given values makes the equation

$$10 = \sqrt{4.5^2 + X^2}$$

$$10 = \sqrt{4.5^2 + X^2}$$

$$10^2 = 4.5^2 + X^2$$

$$100 = 20.25 + X^2$$

$$X^2 = 100 - 20.25 = 79.75$$

$$X = \sqrt{79.75} \approx 8.93$$

To the nearest tenth ohm, the reactance is 8.9 Ω.

CHAPTER 2 REVIEW

1. $8y - 5y = (8 - 5)y = 3y$

2. $4z + 15z = (4 + 15)z = 19z$

3. $7x - 4x + 2x - 8 = (7 - 4 + 2)x - 8 = 5x - 8$

4. $-9a + 4a - 3a + 2 = (-9 + 4 - 3)a + 2 = -8a + 2$

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

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

7. $2(8x + 4) = 2 \cdot 8x + 2 \cdot 4 = 16x + 8$

8. $-3(4a - 2) = -3 \cdot 4a - 3(-2) = -12a + 6$

9. $-3(x - 1) = -3x + 1$ or $1 - 3x$

10. $-(2z + 5) = -2z - 5$

11. $(4x^2 + 3x) - (2x - 5x^2 + 2) = 4x^2 + 3x - 2x + 5x^2 - 2 = 9x^2 + x - 2$

12. $(7y^2 + 6y) - (6y - 7y^2) + 2y - 5 = 7y^2 + 6y - 6y + 7y^2 + 2y - 5 = 14y^2 + 2y - 5$

13. $2(a + b) - 3(a - b) + 4(a + b) = 2a + 2b - 3a + 3b + 4a + 4b = 3a + 9b$

14. $6(c - d) - 4(d - c) + 2(c + d) = 6c - 6d - 4d + 4c + 2c + 2d = 12c - 8d$

15. $(ax^3)(a^2x) = (aa^2)(x^3x) = a^{1+2}x^{2+1} = a^3x^3$

16. $(cy^3)(dy) = cdy^{3+1} = cdy^4$

17. $(9ax^2)(3x) = (9 \cdot 3)(ax^{2+1}) = 27ax^3$

18. $(6cy^2z)(2cz^3) = 6 \cdot 2c^{1+1}y^2z^{1+3} = 12c^2y^2z^4$

19. $4(5x - 6) = 4 \cdot 5x - 4 \cdot 6 = 20x - 24$

20. $3(12y - 5) = 3 \cdot 12y - 3 \cdot 5 = 36y - 15$

21. $2x(4x - 5) = 2x \cdot 4x - 2x \cdot 5 = 8x^2 - 10x$

22. $3a(6a + a^2) = 3a \cdot 6a + 3a \cdot a^2 = 18a^2 + 3a^3$

23. $(a + 4)(a - 4) = a^2 - 16$ (Difference of Squares)

24. $(x - 9)(x + 9) = x^2 - 81$ (Difference of Squares)

25. $(2a - b)(3a - b) = 6a^2 - 2ab - 3ab + b^2 = 6a^2 - 5ab + b^2$ FOIL

26. $(4x + 1)(3x - 7) = 12x^2 - 28x + 3x - 7 = 12x^2 - 25x - 7$ FOIL

27. $(3x^2 + 2)(2x^2 - 3) = 6x^4 - 9x^2 + 4x^2 - 6 = 6x^4 - 5x^2 - 6$ FOIL

28. $(4a^3 + 2)(6a - 3) = 24a^4 - 12a^3 + 12a - 6$ FOIL

29. $(x + 2)^2 = x^2 + 2 \cdot x \cdot 2 + 2^2 = x^2 + 4x + 4$ (Binomial Squared)

30. $(3 - y)^2 = 3^2 - 2 \cdot 3 \cdot y + y^2 = 9 - 6y + y^2$ (Binomial Squared)

31. $5x(3x - 4)(2x + 1) = 5x[6x^2 + 3x - 8x - 4] = 5x[6x^2 - 5x - 4] = 30x^3 - 25x^2 - 20x$

32. $6a(4a + 3)(a - 2) = 6a[4a^2 - 8a + 3a - 6] = 6a[4a^2 - 5a - 6] = 24a^3 - 30a^2 - 36a$

33. $a^5 \div a^2 = \dfrac{a^5}{a^2} = a^{5-2} = a^3$

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

35. $8a^2 \div 2a = \dfrac{8a^2}{2a} = \dfrac{8}{2} \cdot a^{2-1} = 4a$

36. $27b^3 \div 3b = \dfrac{27b^3}{3b} = \dfrac{27}{3} \cdot b^{3-1} = 9b^2$

37. $45a^2x^3 \div -5ax = \dfrac{45a^2x^3}{-5ax} = -9ax^2$

38. $52b^4c^2 \div -4b^2 = \dfrac{52b^4c^2}{-4b^2} = -13b^2c^2$

39. $(36x^2 - 16x) \div 2x = \dfrac{36x^2 - 16x}{2x} = \dfrac{36x^2}{2x} - \dfrac{16x}{2x} = 18x - 8$

40. $(39b^3 + 52b^5) \div 13b^2 = \dfrac{39b^3 + 52b^5}{13b^2} = \dfrac{39b^3}{13b^2} + \dfrac{52b^5}{13b^2} = 3b + 4b^3$

41.
$$
\begin{array}{r}
x - 4 \\
x + 3\overline{)x^2 - x - 12} \\
\underline{x^2 + 3x} \\
-4x - 12 \\
\underline{-4x - 12} \\
0
\end{array}
$$

42.
$$
\begin{array}{r}
x + 5 \\
x - 6\overline{)x^2 - x - 30} \\
\underline{x^2 - 6x} \\
5x - 30 \\
\underline{5x - 30} \\
0
\end{array}
$$

43.
$$
\begin{array}{r}
x^2 + 3x + 9 \\
x - 3\overline{)x^3 \qquad\quad - 27} \\
\underline{x^3 - 3x^2} \\
3x^2 \quad - 27 \\
\underline{3x^2 - 9x} \\
9x - 27 \\
\underline{9x - 27} \\
0
\end{array}
$$

44.
$$
\begin{array}{r}
4a^2 - 8a + 16 \\
2a + 4\overline{)8a^3 \qquad\qquad + 64} \\
\underline{8a^3 + 16a^2} \\
-16a^2 \quad + 64 \\
\underline{-16a^2 - 32a} \\
32a + 64 \\
\underline{32a + 64} \\
0
\end{array}
$$

45.
$$
\begin{array}{r}
x - y \\
x + y\overline{)x^2 \qquad - y^2} \\
\underline{x^2 + xy} \\
-xy - y^2 \\
\underline{-xy - y^2} \\
0
\end{array}
$$

46.
$$
\begin{array}{r}
y - a \\
y + a\overline{)y^2 \qquad - a^2} \\
\underline{y^2 + ya} \\
-ya - a^2 \\
\underline{-ya - a^2} \\
0
\end{array}
$$

47.
$$
\begin{array}{r}
x - 2y \\
x^2 - y^2\overline{)x^3 - 2x^2y - xy^2 + 2y^3} \\
\underline{x^3 \qquad\quad - xy^2} \\
-2x^2y \qquad + 2y^3 \\
\underline{-2x^2y \qquad + 2y^3} \\
0
\end{array}
$$

48.
$$
\begin{array}{r}
a^2 + 4ab + b^2 \\
a - b\overline{)a^3 + 3a^2b + 2ba - 3ab^2 - b^3} \\
\underline{a^3 - a^2b} \\
4a^2b + 2ba - 3ab^2 - b^3 \\
\underline{4a^2b \qquad\quad - 4ab^2} \\
2ba + ab^2 - b^3 \\
\underline{ab^2 - b^3} \\
2ba
\end{array}
$$

49. $x + 9 - 9 = 47 - 9; x = 38$

50. $y - 19 + 19 = -32 + 19; y = -13$

51. $\frac{2x}{2} = \frac{15}{2}; x = \frac{15}{2}$

52. $\frac{-3y}{-3} = \frac{14}{-3}; y = -\frac{14}{3}$

53. $4 \cdot \frac{x}{4} = 4 \cdot 9; x = 36$

54. $\frac{y}{3} = -7; 3\frac{y}{3} = 3(-7); y = -21$

55. $4x - 3 = 17; 4x - 3 + 3 = 17 + 3; 4x = 20;$
$\frac{4x}{4} = \frac{20}{4}; x = 5$

56. $7 + 8y = 23; 7 + 8y - 7 = 23 - 7; 8y = 16; \frac{8y}{8} = \frac{16}{8};$
$y = 2$

57. $3.4a - 7.1 = 8.2; 3.4a - 7.1 + 7.1 = 8.2 + 7.1;$
$3.4a = 15.3; a = \frac{15.3}{3.4} = 4.5$

58. $6.2b + 19.1 = 59.4; 6.2b = 59.4 - 19.1; 6.2b = 40.3;$
$b = \frac{40.3}{6.2} = 6.5$

59. $4x + 3 = 2x; 4x - 2x = -3; 2x = -3; x = -\frac{3}{2}$

60. $7a - 2 = 2a; 7a - 2a = 2; 5a = 2; a = \frac{2}{5}$

61. $4b + 2 = 3b - 5; 4b - 3b = -5 - 2; b = -7$

62. $7c + 9 = 12c - 4; 7c - 12c = -4 - 9; -5c = -13; c = \frac{13}{5}$

63. $3 : x = 4 : 6; 4x = 3 \times 6; 4x = 18; x = \frac{18}{4} = \frac{9}{2} = 4.5$

64. $x : 5 = 3 : 15; 15x = 5 \times 3; x = 1$

65. $\frac{7}{9} = \frac{21}{d}; 7d = 21 \cdot 9; d = \frac{21 \cdot 9}{7} = 27$

66. $\frac{14}{6} = \frac{c}{27}; 6c = 14 \times 27; c = \frac{14 \times 27}{6} = 63$

67. $4 : 8 = 19 : x; 4x = 8 \times 19; x = \frac{8 \times 19}{4} = 38$

68. $x : 12 = 15 : 32; 32x = 12 \times 15; x = \frac{12 \times 15}{32} = 5.625$

69. $\frac{4(x - 3)}{3} = \frac{5(x + 4)}{2}; 6\left(\frac{4(x - 3)}{3}\right) = 6\left(\frac{5(x + 4)}{2}\right); 2 \cdot$
$4(x - 3) = 3 \cdot 5(x + 4); 8x - 24 = 15x + 60;$
$-7x = 84; x = -12$

70. $\frac{3(y - 7)}{5} = \frac{5(y + 4)}{2}; 10\left(\frac{3(y - 7)}{5}\right) = 10\left(\frac{5(y + 4)}{2}\right);$
$2 \cdot 3(y - 7) = 5 \cdot 5(y + 4); 6y - 42 = 25y + 100;$
$-19y = 142; y = -\frac{142}{19}$

71. $\frac{2}{a} - \frac{3}{a} = 5; a\left(\frac{2}{a} - \frac{3}{a}\right) = a \cdot 5; 2 - 3 = 5a; -1 = 5a;$
$a = -\frac{1}{5}$

72. $\frac{4}{x} + \frac{5}{x} = \frac{1}{8}; 8x\left(\frac{4}{x} + \frac{5}{x}\right) = 8x \cdot \frac{1}{8}; 32 + 40 = x; 72 = x$

73. $\frac{3}{2a} = \frac{3}{a+2}$; $2a(a+2)\frac{3}{2a} = 2a(a+2) \cdot \frac{3}{a+2}$;
$(a+2)3 = 2a \cdot 3$; $3a+6 = 6a$; $6 = 3a$; $a = 2$

74. $\frac{9}{4b} = \frac{12}{b+4}$; $(b+4)9 = 4b(12)$; $9b+36 = 48b$;
$36 = 39b$; $b = \frac{36}{39} = \frac{12}{13}$

75. Newtons is a force unit. Thus, we must assume that 36.8 oz is also a force unit. This is 36.8 ozf. Since there are 16 oz in 1 lb, we have 16 ozf = 1 lbf. We begin by changing ounces to pounds and then use the conversion factor in Table A.5 to convert from lbf to newtons.

$$\frac{36.8\ \text{ozf}}{1} \cdot \frac{1\ \text{lbf}}{16\ \text{ozf}} \cdot \frac{4.4482\ \text{N}}{1\ \text{lbf}} = 10.23086\ \text{N}$$

Thus, 36.8 ozf ≈ 10.2 N.

76. Table A.5 does not have a conversion factor for changing yards to meters. This means that we will have to first convert yards to either feet or inches and then convert the result into meters. We will convert yards to feet.

$$\frac{76.0\ \text{yards}}{1} \cdot \frac{3\ \text{ft}}{1\ \text{yard}} \cdot \frac{0.3048\ \text{m}}{1\ \text{ft}} = 69.4944\ \text{m}$$

Thus, 76.0 yards ≈ 69.5 m.

77. We know that there are 60 min in 1 hour and from Table A.5 we determine that 1 mi is about 1.6093 km. Using these facts we have

$$\frac{55.0\ \text{mi}}{1\ \text{hour}} \cdot \frac{1\ \text{hour}}{60\ \text{min}} \cdot \frac{1.6093\ \text{km}}{1\ \text{mile}} \approx 1.4752\ \text{km/min}$$

Thus, 55.0 mph ≈ 1.48 km/min.

78. Using Table A.5 we find that 1 lb/in.^{2} is about 6.8948 kPa. From Table A.3 we see that 1 Pa = 1 N/m^2.

Using these facts, plus the fact that 1 kPa = 100 Pa, we see that

$$\frac{8.44\ \text{lb/in.}^2}{1} \cdot \frac{6.8948\ \text{kPa}}{1\ \text{lb/in.}^2} \cdot \frac{1000\ \text{Pa}}{1\ \text{kPa}} \approx 58192.1\ \text{Pa}$$

So, 8.44 lb/in.^{2} ≈ 58.192.1 N/m^2.

79. $TR = \frac{N_p}{N_s}$; $25 = \frac{4000}{N_s}$; $N_s = \frac{4000}{25} = 160$

80. $\Delta S = kI$; $12.50 = k6.5$; $k \approx 1.923$; $\Delta S = 1.923 \times 9.6 \approx \$18.46$

81. $\frac{68+70+74+x}{4} = 72$; $\frac{212+x}{4} = 72$; $212+x = 72 \times 4$; $212+x = 288$; $x = 288-212 = 76$

82. $p + 0.065p = \$342.93$; $1.065p = 342.93$;
$p = 342.93 \div 1.065 = \$322$

83. $d = rt$; $\frac{2718}{755} = \frac{755t}{755}$; $t = 3.6$ hours or 3 hours 36 min

84. t = satellite time; $t - 1\frac{3}{4}$ = shuttle time; $330t = 430(t - 1.75)$; $330t = 430t - 752.5$; $-100t = -752.5$; $t = 7.525$ hours or at $7{:}31\frac{1}{2}$ min = 7:31:30

85. $40\ \text{kg} \times 50\% + 15 = 20 + 15 = 35\ \text{kg lead}$; $\frac{35}{40+15} = \frac{35}{55} = 63.64\%$ lead

86. $460 - 320 = 140$N; $320x = 140(8-x)$; $320x = 1120 - 140x$; $(320+140)x = 1120$; $460x = 1120$ $x = 2.43$ m from 320 force

87. Use the formula $F = ma$. $F_1 = 1538.6$ N;
$F_2 = 1107.4$ N; $m_1 = \frac{F_1}{a} = \frac{1538.6}{9.8} = 157$ kg; $m_2 = \frac{F_2}{a} = \frac{1107.4}{9.8} = 113$ kg

88. Let n represent the number of grams of the 40% solution of the medicine that the pharmacist must use. Then $20 - n$ is the number of grams of the 70% solution that must be used.

$$40\%(n) + 70\%(20-n) = 52\%(20)$$
$$0.4n + 14 - 0.7n = 10.4$$
$$-0.3n = -3.6$$
$$n = 12$$

The pharmacist should use 12 g of the 40% solution and $20 - 12 = 8$ g of the 70% solution.

89. Using the conversion factors from Table A.5, we get the following

$$\frac{1.6\ \text{lb}}{2\ \text{gal}} = \frac{1.6\ \text{lb}}{2\ \text{gal}} \cdot \frac{0.4536\ \text{kg}}{1\ \text{lb}} \cdot \frac{1000\ \text{g}}{1\ \text{kg}} \cdot \frac{1\ \text{gal}}{3.7854\ \text{L}} \approx$$
95.8631 g/L

Thus, 1.6 lb/2 gal is about 95.9 g/L.

CHAPTER 2 TEST

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

2. $(4a^3 - 2b) - (3b + a^3) = 4a^3 - 2b - 3b - a^3 = (4a^3 - a^3) - (2b + 3b) = 3a^3 - 5b$

3. $\frac{a}{28} = \frac{12}{20}$; $20a = 12 \times 28$; $a = 16.8$

4. $\frac{24}{42} = \frac{78}{d}$; $24d = 78 \times 42$; $d = 136.5$

5. $4x + [3(x+y-2) - 5(x-y)] = 4x + [3x+3y - 6 - 5x + 5y] = (4x + 3x - 5x) + (3y + 5y) - 6 = 2x + 8y - 6$

6. $(4xy^3z)(\frac{1}{2}xy^{-2}z^2) = 4(\frac{1}{2})x^{1+1}y^{3-2}z^{1+2} = 2x^2yz^3$

7. $(2b-3)(2b+3) = (2b)^2 - 3^2 = 4b^2 - 9$

8. $(x^3 + 3x) \div x;\ \frac{x^3 + 3x}{x} = \frac{x^3}{x} + \frac{3x}{x} = x^{3-1} + 3x^{1-1} = x^2 + 3x^0 = x^2 + 3$

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

10.

$$
\begin{array}{r}
3x^2 - 8x + 17 \\
x + 2\overline{\smash{\big)}\,3x^3 - 2x^2 + x - 3} \\
\underline{3x^3 + 6x^2} \\
-8x^2 + x - 3 \\
\underline{-8x^2 - 16x} \\
17x - 3 \\
\underline{17x + 34} \\
-37
\end{array}
$$

11. $\frac{y}{3y + 2} - \frac{4}{y - 1} = \frac{y(y - 1)}{(3y + 2)(y - 1)} - \frac{4(3y + 2)}{(3y + 2)(y - 1)} = \frac{y(y - 1) - 4(3y + 2)}{(3y + 2)(y - 1)} = \frac{y^2 - y - 12y - 8}{(3y + 2)(y - 1)} = \frac{y^2 - 13y - 8}{(3y + 2)(y - 1)}$

12. $5x - 8 = 3x;\ 5x - 3x = 8;\ 2x = 8;\ x = \frac{8}{2};\ x = 4$

13. $\frac{7x + 3}{2} - \frac{9x - 12}{4} = 8;\ 4\left(\frac{7x + 3}{2}\right) - 4\left(\frac{9x - 12}{4}\right) = 4 \cdot 8;$ $14x + 6 - 9x + 12 = 32;\ 5x + 18 = 32;\ 5x = 14;$ $x = \frac{14}{5}$

14. $p + 0.7p = 74.85;\ 1.07p = 74.85;\ p = 74.85 \div 1.07;$ $p = \$69.95$

15. Let n be the amount of original solution to be removed. Then $9 - n$ is the amount left. You want to end with 60% of 9 qt or 5.4 qt of antifreeze. The antifreeze left from the original solution is 50% of $9 - n$, so 50% $(9 - n) + n = 5.4;\ 0.5(9 - n) + n = 5.4;$ $4.5 - 0.5n + n = 5.4;\ 0.5n = 0.9;\ n = 1.8$ qt.

16. $3x + 2x = \frac{540}{2};\ 5x = 270;\ x = 54;\ \ell = 3 \cdot 54 = 162$ cm; $w = 2 \cdot 54 = 108$ cm

17. $2' - 6\frac{3}{8} = 30\frac{3''}{8} = 30.375 \times 2.54 = 77.153$ cm $D = 1.25 \times 2.54 = 3.175$ cm