SOLUTIONS MANUAL

THE HUTCHISON SERIES
IN MATHEMATICS

BARATTO ∞ BERGMAN

Beginning
Algebra

eighth edition

Prerequisite Test

1. $10 - 8 = 2$

2. $3 + 5 \times 6 = 33$

3. Reciprocal of

12 is $\dfrac{1}{12}$

4. $4\dfrac{5}{8} = \dfrac{8 \times 4 + 5}{8} = \dfrac{37}{8}$

Reciprocal of $\dfrac{37}{8}$ is $\dfrac{8}{37}$

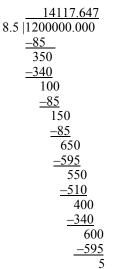**5.** $\left(\dfrac{3}{2}\right) \times \left(\dfrac{2}{3}\right) = 1$

6. $(4) \times \left(\dfrac{1}{4}\right) = 1$

7. $\dfrac{2}{2} = 1$

8. $5 + 2 \times 3^2$
$= 5 + 2 \times 9$
$= 5 + 18$
$= 23$

9. $8^2 = 8 \times 8 = 64$

10. $3 + 2(2 + 3)^2 - (4 - 1)^3$
$= 3 + 2(5)^2 - (3)^3$
$= 3 + 2(25) - 27$
$= 3 + 50 - 27$
$= 53 - 27$
$= 26$

11. Change 8½ to 8.5
Move decimal in divisor one place to right and decimal in dividend one place to right.
Continue to divide until reaching the thousandths place then round to hundredths place.

```
        14117.647
8.5 |1200000.000
    −85
     350
    −340
     100
     −85
      150
      −85
       650
      −595
       550
      −510
       400
      −340
        600
       −595
          5
```

14117.647 rounded to the hundredths place
$= \$14{,}117.65$

12. Change 30% to a decimal by dividing by 100. Drop the % sign and move the decimal two places left to get 0.30 then multiply 0.30 by 1.19

```
    1.19
×   0.30
  0.3570    Markup amount- four decimal places
            in the product because a total of four
            decimal places in the factors.
```

Add the markup amount to the original price.
Line up decimals to add.

```
    1.19
+   0.357
    1.547   Round to hundredths place for money.
```

$= \$1.55$

Shortcut
Take 130% of 1.19; so change 130% to a decimal then multiply 1.30 by 1.19

```
      1.30
×     1.19
     1170
     1300
  +13000
    1.5470  Round to hundredths place for money.
   =$1.55
```

Exercises 1.1

1. $5 + 9 = 9 + 5$ demonstrates the commutative property of addition.

2. $6 + 3 = 3 + 6$ demonstrates the commutative property of addition.

3. $2 \cdot (3 \cdot 5) = (2 \cdot 3) \cdot 5$ demonstrates the associative property of multiplication.

4. $3 \cdot (5 \cdot 6) = (3 \cdot 5) \cdot 6$ demonstrates the associative property of multiplication.

5. $\dfrac{1}{4} \cdot \dfrac{1}{5} = \dfrac{1}{5} \cdot \dfrac{1}{4}$ demonstrates the commutative property of multiplication.

6. $7 \cdot 9 = 9 \cdot 7$ demonstrates the commutative property of multiplication.

7. $8 + 12 = 12 + 8$ demonstrates the commutative property of addition.

8. $6 + 2 = 2 + 6$ demonstrates the commutative property of addition.

9. $(5 \cdot 7) \cdot 2 = 5 \cdot (7 \cdot 2)$ demonstrates the associative property of multiplication.

10. $(8 \cdot 9) \cdot 2 = 8 \cdot (9 \cdot 2)$ demonstrates the associative property of multiplication.

11. $7 \cdot (2 \cdot 5) = (7 \cdot 2) \cdot 5$ demonstrates the associative property of multiplication.

12. $\dfrac{1}{2} \cdot 6 = 6 \cdot \dfrac{1}{2}$ demonstrates the commutative property of multiplication.

13. $2 \cdot (3 + 5) = 2 \cdot 3 + 2 \cdot 5$ demonstrates the distributive property.

14. $5 \cdot (4 + 6) = 5 \cdot 4 + 5 \cdot 6$ demonstrates the distributive property.

15. $5 + (7 + 8) = (5 + 7) + 8$ demonstrates the associative property of addition.

16. $8 + (2 + 9) = (8 + 2) + 9$ demonstrates the associative property of addition.

17. $(\dfrac{1}{3} + 4) + \dfrac{1}{5} = \dfrac{1}{3} + (4 + \dfrac{1}{5})$ demonstrates the associative property of addition.

18. $(5 + 5) + 3 = 5 + (5 + 3)$ demonstrates the associative property of addition.

19. $7 \cdot (3 + 8) = 7 \cdot 3 + 7 \cdot 8$ demonstrates the distributive property.

20. $5 \cdot (6 + 8) = 5 \cdot 6 + 5 \cdot 8$ demonstrates the distributive property.

21. $7 \cdot (3 + 4) = 7 \cdot 7 = 49$
$7 \cdot 3 + 7 \cdot 4 = 21 + 28 = 49$
Since $49 = 49$,
$7 \cdot (3 + 4) = 7 \cdot 3 + 7 \cdot 4$

22. $4 \cdot (5 + 1) = 4 \cdot 6 = 24$
$4 \cdot 5 + 4 \cdot 1 = 20 + 4 = 24$
Since $24 = 24$,
$4 \cdot (5 + 1) = 4 \cdot 5 + 4 \cdot 1$

23. $2 + (9 + 8) = 2 + 17 = 19$
$(2 + 9) + 8 = 11 + 8 = 19$
Since $19 = 19$,
$2 + (9 + 8) = (2 + 9) + 8$

24. $6 + (15 + 3) = 6 + 18 = 24$
$(6 + 15) + 3 = 21 + 3 = 24$
Since $24 = 24$,
$6 + (15 + 3) = (6 + 15) + 3$

25. $\dfrac{1}{3} \cdot (6 \cdot 3) = \dfrac{1}{3} \cdot 18 = 6$
$(\dfrac{1}{3} \cdot 6) \cdot 3 = 2 \cdot 3 = 6$
Since $6 = 6$,
$\dfrac{1}{3} \cdot (6 \cdot 3) = (\dfrac{1}{3} \cdot 6) \cdot 3$

26. $2 \cdot (9 \cdot 10) = 2 \cdot 90 = 180$
$(2 \cdot 9) \cdot 10 = 18 \cdot 10 = 180$
Since $180 = 180$,
$2 \cdot (9 \cdot 10) = (2 \cdot 9) \cdot 10$

27. $5 \cdot (2 + 8) = 5 \cdot 10 = 50$
$5 \cdot 2 + 5 \cdot 8 = 10 + 40 = 50$
Since $50 = 50$,
$5 \cdot (2 + 8) = 5 \cdot 2 + 5 \cdot 8$

28. $\dfrac{1}{4} \cdot (10 + 2) = \dfrac{1}{4} \cdot 12 = 3$

$\dfrac{1}{4} \cdot 10 + \dfrac{1}{4} \cdot 2 = 2.5 + .5 = 3$

Since $3 = 3$,

$\dfrac{1}{4} \cdot (10 + 2) = \dfrac{1}{4} \cdot 10 + \dfrac{1}{4} \cdot 2$

29. $(3 + 12) + 8 = 15 + 8 = 23$
$3 + (12 + 8) = 3 + 20 = 23$
Since $23 = 23$,
$(3 + 12) + 8 = 3 + (12 + 8)$

30. $(8 + 12) + 7 = 20 + 7 = 27$
$8 + (12 + 7) = 8 + 19 = 27$
Since $27 = 27$,
$(8 + 12) + 7 = 8 + (12 + 7)$

31. $(4 \cdot 7) \cdot 2 = 28 \cdot 2 = 56$
$4 \cdot (7 \cdot 2) = 4 \cdot 14 = 56$
Since $56 = 56$,
$(4 \cdot 7) \cdot 2 = 4 \cdot (7 \cdot 2)$

32. $(6 \cdot 5) \cdot 3 = 30 \cdot 3 = 90$
$6 \cdot (5 \cdot 3) = 6 \cdot 15 = 90$
Since $90 = 90$,
$(6 \cdot 5) \cdot 3 = 6 \cdot (5 \cdot 3)$

33. $\dfrac{1}{2} \cdot (2 + 6) = \dfrac{1}{2} \cdot 8 = 4$

$\dfrac{1}{2} \cdot 2 + \dfrac{1}{2} \cdot 6 = 1 + 3 = 4$

Since $4 = 4$,

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

34. $\dfrac{1}{3} \cdot (6 + 9) = \dfrac{1}{3} \cdot (15) = 5$

$\dfrac{1}{3} \cdot 6 + \dfrac{1}{3} \cdot 9 = 2 + 3 = 5$

Since $5 = 5$,

$\dfrac{1}{3} \cdot (6 + 9) = \dfrac{1}{3} \cdot 6 + \dfrac{1}{3} \cdot 9$

35. $\left(\dfrac{2}{3} + \dfrac{1}{6}\right) + \dfrac{1}{3} = \dfrac{5}{6} + \dfrac{1}{3} = \dfrac{7}{6}$

$\dfrac{2}{3} + \left(\dfrac{1}{6} + \dfrac{1}{3}\right) = \dfrac{2}{3} + \dfrac{3}{6} = \dfrac{7}{6}$

Since $\dfrac{7}{6} = \dfrac{7}{6}$,

$\left(\dfrac{2}{3} + \dfrac{1}{6}\right) + \dfrac{1}{3} = \dfrac{2}{3} + \left(\dfrac{1}{6} + \dfrac{1}{3}\right)$

36. $\dfrac{3}{4} + \left(\dfrac{5}{8} + \dfrac{1}{2}\right) = \dfrac{3}{4} + \dfrac{9}{8} = \dfrac{15}{8}$

$\left(\dfrac{3}{4} + \dfrac{5}{8}\right) + \dfrac{1}{2} = \dfrac{11}{8} + \dfrac{1}{2} = \dfrac{15}{8}$

Since $\dfrac{15}{8} = \dfrac{15}{8}$,

$\dfrac{3}{4} + \left(\dfrac{5}{8} + \dfrac{1}{2}\right) = \left(\dfrac{3}{4} + \dfrac{5}{8}\right) + \dfrac{1}{2}$

37. $(2.3 + 3.9) + 4.1 = 6.2 + 4.1 = 10.3$
$2.3 + (3.9 + 4.1) = 2.3 + 8.0 = 10.3$
Since $10.3 = 10.3$,
$(2.3 + 3.9) + 4.1 = 2.3 + (3.9 + 4.1)$

38. $(1.7 + 4.1) + 7.6 = 5.8 + 7.6 = 13.4$
$1.7 + (4.1 + 7.6) = 1.7 + 11.7 = 13.4$
Since $13.4 = 13.4$,
$(1.7 + 4.1) + 7.6 = 1.7 + (4.1 + 7.6)$

39. $\dfrac{1}{2} \cdot (2 \cdot 8) = \dfrac{1}{2} \cdot 16 = 8$

$\left(\dfrac{1}{2} \cdot 2\right) \cdot 8 = 1 \cdot 8 = 8$

Since $8 = 8$,

$\dfrac{1}{2} \cdot (2 \cdot 8) = \left(\dfrac{1}{2} \cdot 2\right) \cdot 8$

40. $\dfrac{1}{5} \cdot (5 \cdot 3) = \dfrac{1}{5} \cdot 15 = 3$

$\left(\dfrac{1}{5} \cdot 5\right) \cdot 3 = 1 \cdot 3 = 3$

Since $3 = 3$,

$\dfrac{1}{5} \cdot (5 \cdot 3) = \left(\dfrac{1}{5} \cdot 5\right) \cdot 3$

41. $\left(\dfrac{3}{5} \cdot \dfrac{5}{6}\right) \cdot \dfrac{4}{3} = \dfrac{1}{2} \cdot \dfrac{4}{3} = \dfrac{2}{3}$

$\dfrac{3}{5} \cdot \left(\dfrac{5}{6} \cdot \dfrac{4}{3}\right) = \dfrac{3}{5} \cdot \dfrac{10}{9} = \dfrac{2}{3}$

Since $\dfrac{2}{3} = \dfrac{2}{3}$,

$\left(\dfrac{3}{5} \cdot \dfrac{5}{6}\right) \cdot \dfrac{4}{3} = \dfrac{3}{5} \cdot \left(\dfrac{5}{6} \cdot \dfrac{4}{3}\right)$

42. $\dfrac{4}{7} \cdot \left(\dfrac{21}{16} \cdot \dfrac{8}{3}\right) = \dfrac{4}{7} \cdot \dfrac{7}{2} = 2$

$\left(\dfrac{4}{7} \cdot \dfrac{21}{16}\right) \cdot \dfrac{8}{3} = \dfrac{3}{4} \cdot \dfrac{8}{3} = 2$

Since $2 = 2$,

$\dfrac{4}{7} \cdot \left(\dfrac{21}{16} \cdot \dfrac{8}{3}\right) = \left(\dfrac{4}{7} \cdot \dfrac{21}{16}\right) \cdot \dfrac{8}{3}$

43. $2.5 \cdot (4 \cdot 5) = 2.5 \cdot 20 = 50$
$(2.5 \cdot 4) \cdot 5 = 10 \cdot 5 = 50$
Since $50 = 50$,
$2.5 \cdot (4.5) = (2.5 \cdot 4) \cdot 5$

44. $4.2 \cdot (5 \cdot 2) = 4.2 \cdot 10 = 42$
$(4.2 \cdot 5) \cdot 2 = 21 \cdot 2 = 42$
Since $42 = 42$,
$4.2 \cdot (5 \cdot 2) = (4.2 \cdot 5) \cdot 2$

45. $3 \cdot (2 + 6) = 3 \cdot 2 + 3 \cdot 6$
$= 6 + 18$
$= 24$

46. $5 \cdot (4 + 6) = 5 \cdot 4 + 5 \cdot 6$
$= 20 + 30$
$= 50$

47. $2 \cdot (12 + 10) = 2(22) = 44$

48. $9 \cdot (1 + 8) = 9(9) = 81$

49. $0.1 \cdot (2 + 10) = 0.1(12) = 1.2$

50. $1.2 \cdot (3 + 8) = 1.2(11) = 13.2$

51. $\dfrac{2}{3} \cdot (6 + 9) = \dfrac{2}{3}(15) = 2(5) = 10$

52. $\dfrac{1}{2}\left(4 + \dfrac{1}{3}\right) = \dfrac{1}{2}\left(\dfrac{12}{3} + \dfrac{1}{3}\right) = \dfrac{1}{2}\left(\dfrac{13}{3}\right) = \dfrac{13}{6} = 2\dfrac{1}{6}$

53. $\dfrac{1}{3} \cdot (15 + 9) = \dfrac{1}{3} \cdot 15 + \dfrac{1}{3} \cdot 9$
$= 5 + 3$
$= 8$

54. $\dfrac{1}{6} \cdot (36 + 24) = \dfrac{1}{6} \cdot 36 + \dfrac{1}{6} \cdot 24$
$= 6 + 4$
$= 10$

55. $5 + 7 = \mathbf{7} + 5$ by the commutative property of addition.

56. $(5 + 3) + 4 = 5 + (\mathbf{3} + 4)$ by the associative property of addition.

57. $(8)(3) = (3)(\mathbf{8})$ by the commutative property of multiplication.

58. $8(3 + 4) = 8 \cdot 3 + \mathbf{8} \cdot 4$ by the distributive property.

59. $7(2 + 5) = 7 \cdot \mathbf{2} + 7 \cdot 5$ by the distributive property.

60. $4 \cdot (2 \cdot 4) = (\mathbf{4} \cdot \mathbf{2}) \cdot 4$ by the associative property of multiplication.

61. $3 + 7 = \mathbf{7} + \mathbf{3}$ by the commutative property of addition.

62. $2 \cdot (3 + 4) = \mathbf{2} \cdot \mathbf{3} + \mathbf{2} \cdot \mathbf{4}$ by the distributive property.

63. $5 \cdot (3 \cdot 2) = (\mathbf{5} \cdot \mathbf{3}) \cdot \mathbf{2}$ by the associative property of multiplication.

64. $(3 + 5) + 2 = \mathbf{3} + (\mathbf{5} + \mathbf{2})$ by the associative property of addition.

65. $2 \cdot 4 + 2 \cdot 5 = \mathbf{2} \cdot (\mathbf{4} + \mathbf{5})$ by the distributive property.

66. $7 \cdot 9 = \mathbf{9} \cdot \mathbf{7}$ by the commutative property of multiplication.

67. $8 - 5 = 3$
$5 - 8 = -3$
Since 3 is not equal to -3,
subtraction is not commutative.

68. $12 \div 3 = 4$
$3 \div 12 = \dfrac{1}{4}$
Since 4 is not equal to $\dfrac{1}{4}$, division is not commutative.

69. $(12 - 8) - 4 = 4 - 4 = 0$
$12 - (8 - 4) = 12 - 4 = 8$
Since 0 is not equal to 8, subtraction is not associative.

70. $(48 \div 16) \div 4 = 3 \div 4 = \dfrac{3}{4}$
$48 \div (16 \div 4) = 48 \div 4 = 12$
Since $\dfrac{3}{4}$ is not equal to 12, division is not associative.

71. $3(6 - 2) = 3(4) = 12$
$3 \cdot 6 - 3 \cdot 2 = 18 - 6 = 12$
Since $12 = 12$, multiplication is distributive over subtraction.

72. $\dfrac{1}{2}(16 - 10) = \dfrac{1}{2}(6) = 3$
$\dfrac{1}{2} \cdot 16 - \dfrac{1}{2} \cdot 10 = 8 - 5 = 3$
Since $3 = 3$, multiplication is distributive over subtraction.

73. a. $5 \cdot (3 + 4) = 5 \cdot 3 + 5 \cdot 4$ by the distributive property.
b. $5 \cdot (3 + 4) = 5 \cdot (4 + 3)$ by the commutative property of addition.
c. $5 \cdot (3 + 4) = (3 + 4) \cdot 5$ by the commutative property of multiplication.

74. a. $6 \cdot (5 + 4) = 6 \cdot 5 + 6 \cdot 4$ by the distributive property.
b. $6 \cdot (5 + 4) = 6 \cdot (4 + 5)$ by the commutative property of addition.
c. $6 \cdot (5 + 4) = (5 + 4) \cdot 6$ by the commutative property of multiplication.

75. $5 + (6 + 7) = (5 + 6) + 7$ demonstrates the associative property of addition.

76. $5 + (6 + 7) = 5 + (7 + 6)$ demonstrates the commutative property of addition.

77. $4 \cdot (3 + 2) = 4 \cdot (2 + 3)$ demonstrates the commutative property of addition.

78. $4 \cdot (3 + 2) = (3 + 2) \cdot 4$ demonstrates the commutative property of multiplication.

Exercises 1.2

1. $3 + 6 = 9$

2. $8 + 7 = 15$

3. $\dfrac{4}{5} + \dfrac{6}{5} = \dfrac{10}{5} = 2$

4. $\dfrac{7}{3} + \dfrac{8}{3} = \dfrac{15}{3} = 5$

5. $\dfrac{1}{2} + \dfrac{4}{5} = \dfrac{5}{10} + \dfrac{8}{10} = \dfrac{13}{10}$

6. $\dfrac{2}{3} + \dfrac{5}{9} = \dfrac{6}{9} + \dfrac{5}{9} = \dfrac{11}{9}$

7. $(-4) + (-1) = -5$

8. $(-1) + (-9) = -10$

9. $\left(-\dfrac{1}{2}\right) + \left(-\dfrac{3}{8}\right) = \left(-\dfrac{4}{8}\right) + \left(-\dfrac{3}{8}\right) = -\dfrac{7}{8}$

10. $\left(-\dfrac{4}{7}\right) + \left(-\dfrac{3}{14}\right) = \left(-\dfrac{8}{14}\right) + \left(-\dfrac{3}{14}\right) = -\dfrac{11}{14}$

11. $(-1.6) + (-2.3) = -3.9$

12. $(-3.5) + (-2.6) = -6.1$

13. $3 + (-9) = -6$

14. $11 + (-7) = 4$

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

16. $\dfrac{2}{3} + \left(-\dfrac{1}{6}\right) = \dfrac{4}{6} + \left(-\dfrac{1}{6}\right) = \dfrac{3}{6} = \dfrac{1}{2}$

17. $13.4 + (-11.4) = 2$

18. $5.2 + (-9.2) = -4$

19. $-5 + 3 = -2$

20. $-12 + 17 = 5$

21. $\left(-\dfrac{4}{5}\right) + \dfrac{9}{20} = \left(-\dfrac{16}{20}\right) + \dfrac{9}{20} = -\dfrac{7}{20}$

22. $\left(-\dfrac{11}{6}\right) + \dfrac{5}{12} = \left(-\dfrac{22}{12}\right) + \dfrac{5}{12} = -\dfrac{17}{12}$

23. $-8.6 + 4.9 = -3.7$

24. $-3.6 + 7.6 = 4$

25. $0 + (-8) = -8$

26. $-15 + 0 = -15$

27. $7 + (-7) = 0$

28. $-12 + 12 = 0$

29. $-4.5 + 4.5 = 0$

30. $\dfrac{2}{3} + \left(-\dfrac{2}{3}\right) = 0$

31. $82 - 45 = 37$

32. $45 - 82 = -37$

33. $18 - 20 = -2$

34. $136 - 352 = 136 + (-352) = -216$

35. $\dfrac{8}{7} - \dfrac{15}{7} = \dfrac{8}{7} + \left(-\dfrac{15}{7}\right) = \dfrac{-7}{7} = -1$

36. $\dfrac{17}{8} - \dfrac{9}{8} = \dfrac{17}{8} + \left(-\dfrac{9}{8}\right) = \dfrac{8}{8} = 1$

37. $5.4 - 7.9 = 5.4 + (-7.9) = -2.5$

38. $11.7 - 4.5 = 11.7 + (-4.5) = 7.2$

39. $-3 - 1 = -3 + (-1) = -4$

40. $-15 - 8 = -15 + (-8) = -23$

41. $-14 - 9 = -14 + (-9) = -23$

42. $-8 - 12 = -8 + (-12) = -20$

43. $-\dfrac{2}{5} - \dfrac{7}{10} = -\dfrac{4}{10} + \left(-\dfrac{7}{10}\right) = -\dfrac{11}{10}$

44. $-\dfrac{7}{18} - \dfrac{5}{9} = -\dfrac{7}{18} + \left(-\dfrac{10}{18}\right) = -\dfrac{17}{18}$

45. $-3.4 - 4.7 = -3.4 + (-4.7) = -8.1$

46. $-8.1 - 7.6 = -8.1 + (-7.6) = -15.7$

47. $5 - (-11) = 5 + 11 = 16$

48. $8 - (-4) = 8 + 4 = 12$

49. $12 - (-7) = 12 + 7 = 19$

50. $3 - (-10) = 3 + 10 = 13$

51. $\dfrac{3}{4} - \left(-\dfrac{3}{2}\right) = \dfrac{3}{4} + \dfrac{3}{2} = \dfrac{3}{4} + \dfrac{6}{4} = \dfrac{9}{4}$

52. $\dfrac{11}{16} - \left(-\dfrac{5}{8}\right) = \dfrac{11}{16} + \dfrac{5}{8} = \dfrac{11}{16} + \dfrac{10}{16} = \dfrac{21}{16}$

53. $8.3 - (-5.7) = 8.3 + 5.7 = 14$

54. $14.5 - (-54.6) = 14.5 + 54.6 = 69.1$

55. $-28 - (-11) = -28 + 11 = -17$

56. $-11 - (-16) = -11 + 16 = 5$

57. $-19 - (-27) = -19 + 27 = 8$

58. $-13 - (-4) = -13 + 4 = -9$

59. $\left(-\dfrac{3}{4}\right) - \left(-\dfrac{11}{4}\right) = -\dfrac{3}{4} + \dfrac{11}{4} = \dfrac{8}{4} = 2$

60. $-\dfrac{5}{5} - \left(-\dfrac{1}{2}\right) = -\dfrac{5}{8} + \dfrac{1}{2} = -\dfrac{5}{8} + \dfrac{4}{8} = -\dfrac{1}{8}$

61. $100 + (-23) + 51 = 128$
His new balance is $128.

62. $250 + 52 + (-77) = 225$
Her new balance is $225.

63. $23 + (-5) + 15 + (-10) = 23$
His net yardage change is 23 yards gained.

64. $780 + (-43.10) + (-36.80) + (-125.00)$
$+ (-400) + 82.75 = 257.85.$
Ramon still owes $257.85 on his VISA account.

65. $82 + (-12) = 70$
The temperature was 70° at 4:00 P.M.

66. $6{,}000 + (-725) = 5{,}275$
She is at a point 5,275 feet above sea level.

67. $-72 + (-23.50) = -95.5$
His checking account was overdrawn by $95.50.

68. $-15 + (-10) = -25$
−25 represents his current financial condition.

69. $-750 + (-425) = -1175$
The total decrease in enrollment was
1,175 students.

70. $-15 + 18 = 3$
The temperature was 3°F at 1:00 P.M.

71. $9 + (-7) + 6 + (-5) = 15 + (-12) = 3$

72. $(-4) + 6 + (-3) + 0 = (-7) + 6 = -1$

73. $-8 - 4 - 1 - (-2) - (-5) = -13 + 2 + 5 = -6$

74. $6 - (-9) - 7 - (-5) = 6 + 9 - 7 + 5 = 15 - 7 + 5$
$= 8 + 5 = 13$

75. $3 - 7 + (-12) - (-2) - 9 = 3 - 7 - 12 + 2 - 9$
$= -4 - 12 + 2 - 9 = -16 + 2 - 9 = -14 - 9$
$= -23$

76. $-12 + (-5) - 7 - (-13) + 4 = -12 - 5 - 7 + 13 + 4$
$= -17 - 7 + 13 + 4 = -24 + 13 + 4 = -11 + 4$
$= -7$

77. $-\dfrac{3}{2} + \left(-\dfrac{7}{4}\right) + \dfrac{1}{4} = -\dfrac{6}{4} + \left(-\dfrac{7}{4}\right) + \dfrac{1}{4} = -\dfrac{12}{4} = -3$

78. $\left(-\dfrac{1}{2}\right)+\dfrac{1}{3}+\left(-\dfrac{5}{6}\right)=\left(-\dfrac{3}{6}\right)+\dfrac{2}{6}+\left(-\dfrac{5}{6}\right)$

$$=-\dfrac{6}{6}=-1$$

79. $2.3 + (-5.4) - (-2.9) = -0.2$

80. $-5.4 - (-2.1) + (-3.5) = -6.8$

81. $-\dfrac{1}{2}-\left(-\dfrac{3}{4}\right)+(-2)-3\dfrac{1}{2}+\dfrac{3}{2}$

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

$=-\dfrac{2}{4}+\dfrac{3}{4}-\dfrac{8}{4}-\dfrac{14}{4}+\dfrac{6}{4}$

$=\dfrac{1}{4}-\dfrac{8}{4}-\dfrac{14}{4}+\dfrac{6}{4}=-\dfrac{7}{4}-\dfrac{14}{4}+\dfrac{6}{4}$

$=-\dfrac{21}{4}+\dfrac{6}{4}=-\dfrac{15}{4}$

82. $0.25 + 0.7 - 1.5 - (-2.95) + (-3.1)$

$= 0.25 + 0.7 - 1.5 + 2.95 - 3.1$

$= 0.95 - 1.5 + 2.95 - 3.1$

$= -0.55 + 2.95 - 3.1 = 2.4 - 3.1 = -0.7$

83. $-4.1967 - 5.2943 = -9.491$

84. $5.3297 - (-4.1897) = 9.5194$

85. $-4.1623 - (-3.1468) = -1.0155$

86. $(-3.6829) - 4.5687 = -8.2516$

87. $-6.3267 + 8.6789 - (-6.6712) + (-5.3245)$
$= 2.3522 + 6.6712 - 5.3245$
$= 9.0234 - 5.3245$
$= 3.6989$

88. $32.456 + (-67.004) - (-21.6059) - 13.4569$
$= 32.456 - 67.004 + 21.6059 - 13.4569$
$= -34.548 + 21.6059 - 13.4569$
$= -12.9421 - 13.4569$
$= -26.399$

89. $126 - 12 - 7 + 32 - 17 - 15 + 31 - 4 - 14$
$= 114 - 7 + 32 - 17 - 15 + 31 - 4 - 14$
$= 107 + 32 - 17 - 15 + 31 - 4 - 14$
$= 139 - 17 - 15 + 31 - 4 - 14$
$= 122 - 15 + 31 - 4 - 14$
$= 107 + 31 - 4 - 14$
$= 138 - 4 - 14$
$= 134 - 14$
$= 120$ psi

90. $18 - 7 + 4 = 11 + 4 = 15$ qt

91. $24V - 12V = 12V$

92. $24V - 18V + 12V = 6V + 12V = 18V$

93. 2,581 lbs $-$ 2,489 lbs $= +92$ lbs

94. 2,489 lbs $-$ 2,111 $= -378$ lbs

95. (a) $59 - 52 = +7$
(b) $39 - 59 = -20$
(c) $93 - 39 = +54$

96. Above and Beyond

97. Above and Beyond

98. Above and Beyond

99. Above and Beyond

100. Above and Beyond

Exercises 1.3

1. $4 \cdot 10 = 40$

2. $3 \cdot 14 = 42$

3. $(-4)(10) = -40$

4. $(3)(-14) = -42$

5. $(-4)(-10) = 40$

6. $(-3)(-14) = 42$

7. $(-13)(5) = -65$

8. $(11)(-9) = -99$

9. $(-4)(-17) = 68$

10. $(-23)(-8) = 184$

11. $(4)\left(-\dfrac{3}{2}\right) = -6$

12. $(-9)\left(-\dfrac{2}{3}\right) = 6$

13. $\left(-\dfrac{1}{4}\right)(-8) = 2$

14. $\left(-\dfrac{5}{3}\right)(6) = -10$

15. $\left(-\dfrac{2}{3}\right)\left(\dfrac{3}{5}\right) = -\dfrac{2}{5}$

16. $\left(\dfrac{5}{8}\right)\left(-\dfrac{2}{3}\right) = -\dfrac{5}{12}$

17. $\left(-\dfrac{1}{2}\right)\left(-\dfrac{10}{3}\right) = \dfrac{5}{3}$

18. $\left(-\dfrac{7}{10}\right)\left(-\dfrac{5}{8}\right) = \dfrac{7}{16}$

19. $(3.25) \cdot (-4) = -13$

20. $(5.4)\,(-5) = -27$

21. $(-1.1)(-1.2) = 1.32$

22. $(0.8)(-3.5) = -2.8$

23. $(0)\,(-18) = 0$

24. $(-5)(0) = 0$

25. $\left(-\dfrac{11}{12}\right)(0) = 0$

26. $(0)(-2.37) = 0$

27. $\left(-\dfrac{1}{2}\right)(2) = -1$

28. $\left(-\dfrac{1}{3}\right)(-3) = 1$

29. $\left(-\dfrac{3}{2}\right)\left(-\dfrac{2}{3}\right) = 1$

30. $\left(\dfrac{4}{7}\right)\left(-\dfrac{7}{4}\right) = -1$

31. $\dfrac{70}{14} = 5$

32. $48 \div 6 = 8$

33. $(-35) \div (-7) = 5$

34. $\dfrac{-48}{-12} = 4$

35. $\dfrac{50}{-5} = -10$

36. $\dfrac{-60}{15} = -4$

37. $\dfrac{-125}{5} = -25$

38. $\dfrac{24}{-8} = -3$

39. $\dfrac{-11}{-1} = 11$

40. $\dfrac{-13}{1} = -13$

41. $\dfrac{32}{-1} = -32$

42. $\dfrac{-1}{-8} = \dfrac{1}{8}$

43. $\dfrac{0}{-8} = 0$

44. $\dfrac{-10}{0} =$ is undefined.

45. $\dfrac{-14}{0} =$ is undefined.

46. $\dfrac{0}{-2} = 0$

47. $\dfrac{(-6)(-3)}{2} = \dfrac{18}{2} = 9$

48. $\dfrac{(-9)(5)}{-3} = \dfrac{-45}{-3} = 15$

49. $\dfrac{(-8)(2)}{-4} = \dfrac{-16}{-4} = 4$

50. $\dfrac{(7)(-8)}{-14} = \dfrac{-56}{-14} = 4$

51. $\dfrac{24}{-4-8} = \dfrac{24}{-12} = -2$

52. $\dfrac{-36}{-7+3} = \dfrac{-36}{-4} = 9$

53. $\dfrac{55-19}{-12-6}=\dfrac{36}{-18}=-2$

54. $\dfrac{-11-7}{-14+8}=\dfrac{-18}{-6}=3$

55. $\dfrac{5-7}{4-4}=\dfrac{-2}{0}$ is undefined.

56. $\dfrac{-3-(-3)}{6-10}=\dfrac{0}{-4}=0$

57. $5(7-2)=5(5)=25$

58. $5(2-7)=5(-5)=-25$

59. $-3(-2-5)=-3(-7)=21$

60. $-2[-7-(-3)]=-2[-7+3]=-2[-4]=8$

61. $(-2)(3)-5=-6-5=-11$

62. $(-8)(6)-27=-48-27=-75$

63. $(-5)(-2)-12=10-12=-2$

64. $(-7)(-3)-25=21-25=-4$

65. $-3+(-2)(4)=-3+(-8)=-11$

66. $-5-(-5)(4)=-5-(-20)=15$

67. $12-(-3)(-4)=12-(12)=0$

68. $20+(-4)(-5)=20+20=40$

69. $(-8)^2-5^2=64-25=39$

70. $(-8)^2-(-4)^2=64-16=48$

71. $-8^2-(-5)^2=-64-25=-89$

72. $-8^2-4^2=-64-16=-80$

73. $-(-(-(-(-3))))=-3$

74. $-(-(-(-3.45)))=3.45$

75. $\dfrac{-(-2)}{-(-8)}=\dfrac{2}{8}=\dfrac{1}{4}$

76. $\dfrac{-3}{-(-(-4))}=\dfrac{-3}{-4}=\dfrac{3}{4}$

77. $-6-(2\cdot 8)=-22$
The temperature is –22°F.

78. $(-42)\div(-3)=14$
She has been dieting 14 weeks.

79. $125-(9\cdot 9)=44$
He had $44.

80. $\dfrac{16,232-20,000}{3}=\dfrac{-3,768}{3}=-1,256$
Each person lost $1,256

81. $\dfrac{58-70}{5}=\dfrac{-12}{5}=-2.4$
The temperature dropped 2.4°F per hour.

82. $84\div\dfrac{2}{3}=126$
He can fill 126 test tubes.

83. A product made up of an odd number of negative factors is **always** negative.

84. A product of an even number of negative factors is **never** negative.

85. The quotient $\dfrac{x}{y}$ is **sometimes** positive.

86. The quotient $\dfrac{x}{y}$ is **sometimes** negative.

87. $4\cdot 8\div 2-5^2=32\div 2-25=16-25=-9$

88. $36\div 4\cdot 3-(-25)=9\cdot 3-(-25)=27+25=52$

89. $-8+14-2\cdot 4-3=-8+14-8-3=-5$

90. $(-3)^3-(-8)(-2)=-27-(-8)(-2)$
$\qquad\qquad\qquad\quad =-27-16$
$\qquad\qquad\qquad\quad =-43$

91. $8+[2\cdot(-3)+3]^2=8+[-6+3]^2=8+9=17$

92. $-8^2-5^2+8\div 8=-64-25+8\div 8$
$\qquad =-64-25+1=-88$

93. $\dfrac{-\dfrac{3}{8}}{\dfrac{3}{4}} = -\dfrac{3}{8} \div \dfrac{3}{4} = -\dfrac{3}{8} \cdot \dfrac{4}{3} = -\dfrac{1}{2}$

94. $\left(-\dfrac{5}{12}\right) \div \left(-\dfrac{3}{16}\right) = -\dfrac{5}{12} \cdot -\dfrac{16}{3} = \dfrac{20}{9}$

95. $\left(\dfrac{7}{4}\right) \div \left(-\dfrac{3}{2}\right) = \left(\dfrac{7}{4}\right) \cdot \left(-\dfrac{2}{3}\right) = -\dfrac{7}{6}$

96. $\dfrac{-\dfrac{1}{2}}{-\dfrac{3}{4}} = -\dfrac{1}{2} \div \dfrac{3}{4} = -\dfrac{1}{2} \cdot \dfrac{4}{3} = -\dfrac{2}{3}$

97. $\left(-1\dfrac{1}{2}\right)\left(3\dfrac{1}{3}\right) = \left(-\dfrac{3}{2}\right)\left(\dfrac{10}{3}\right) = -5$

98. $\left(-2\dfrac{1}{2}\right)\left(-3\dfrac{3}{4}\right) = \left(-\dfrac{5}{2}\right)\left(-\dfrac{15}{4}\right) = \dfrac{75}{8} = 9\dfrac{3}{8}$

99. $\left(-5\dfrac{1}{4}\right) \div \left(-2\dfrac{1}{2}\right) = \left(-\dfrac{21}{4}\right) \cdot \left(-\dfrac{2}{5}\right) = \dfrac{21}{10} = 2\dfrac{1}{10}$

100. $\left(1\dfrac{1}{3}\right) \div \left(-6\dfrac{2}{3}\right) = \left(\dfrac{4}{3}\right) \cdot \left(-\dfrac{3}{20}\right) = -\dfrac{4}{20} = -\dfrac{1}{5}$

101. $\dfrac{7}{4-5} = -7$

102. $\dfrac{-8}{-4+2} = 4$

103. $\dfrac{-6-9}{-4+1} = 5$

104. $\dfrac{-10+4}{-7+10} = -2$

105. $(-1.23) \cdot (3.4) = -4.182$

106. $\dfrac{(3.55)(-12.12)}{(-6.4)} = \dfrac{(-43.026)}{(-6.4)} = 6.723$

107. $3.4 - 5.1^2 + (-1.02)^2 \div 22 \cdot (-4.8)$

$= 3.4 - 26.01 + 1.0404 \div 22 \cdot (-4.8)$

$= 3.4 - 26.01 - 0.227$

$= -22.837$

108. $-14.6 - \dfrac{3-4}{3} + 2(5+6)^2 - (1.1)^3$

$= -14.6 - \dfrac{1}{3} + 2(121) - 1.331$

$= -14.6 + \dfrac{1}{3} + 242 - 1.331$

$= -14.6 + 0.333 + 242 - 1.331$

$= 226.402$

109. Let A = \$18, B = −\$4, C = \$11,
D = \$38, and E = −\$15
$127\,(18) + 273\,(-4) + 201\,(11) + 377\,(38) + 43\,(-15) =$

$2,286 - 1,092 + 2,211 + 14,326 - 645 = 17,086$
The profit was +\$17,086.

110. $-\dfrac{1}{4}(2,062)\left(12^3\right) = -890,784$ ft-lb

111. Above and Beyond

Exercises 1.4

1. The sum of c and d is written as $c + d$.

2. a plus 7 is written as $a + 7$.

3. w plus z is written as $w + z$.

4. The sum of m and n is written as $m + n$.

5. x increased by 5 is written as $x + 5$.

6. 4 more than c is written as $c + 4$.

7. 10 more than y is written as $y + 10$.

8. m increased by 4 is written as $m + 4$.

9. b minus a is written as $b - a$.

10. 5 less than w is written as $w - 5$.

11. b decreased by 4 is written as $b - 4$.

12. r minus 3 is written as $r - 3$.

13. 6 less than r is written as $r - 6$.

14. x decreased by 3 is written as $x - 3$.

15. w times z is written as wz.

16. The product of 3 and *c* is written as 3*c*.

17. The product of 5 and *t* is written as 5*t*.

18. 8 times *a* is written as 8*a*.

19. The product of 8, *m*, and *n* is written as 8*mn*.

20. The product of 7, *r*, and *s* is written as 7*rs*.

21. The product of 3 and the quantity *p* plus *q* is written as 3(*p* + *q*).

22. The product of 5 and the sum of *a* and *b* is written as 5(*a* + *b*).

23. Twice the sum of *x* and *y* is written as 2(*x* + *y*).

24. 7 times the sum of *m* and *n* is written as 7(*m* + *n*).

25. The sum of twice *x* and *y* is written as 2*x* + *y*.

26. The sum of 3 times *m* and *n* is written as 3*m* + *n*.

27. Twice the difference of *x* and *y* is written as 2(*x* − *y*).

28. 3 times the difference of *a* and *c* is written as 3(*a* − *c*).

29. The quantity *a* plus *b* times the quantity *a* minus *b* is written as (*a* + *b*)(*a* − *b*).

30. The product of *x* plus *y* and *x* minus *y* is written as (*x* + *y*)(*x* − *y*).

31. The product of *m* and 3 more than *m* is written as *m*(*m* + 3).

32. The product of *a* and 7 less than *a* is written as *a*(*a* - 7).

33. *x* divided by 5 is written as $\frac{x}{5}$.

34. The quotient when *b* is divided by 8 is written as $\frac{b}{8}$.

35. The quotient of *a* minus *b*, divided by 9 is written as $\frac{a-b}{9}$.

36. The difference *x* minus *y*, divided by 9 is written as $\frac{x-y}{9}$.

37. The sum of *p* and *q*, divided by 4 is written as $\frac{p+q}{4}$.

38. The sum of *a* and 5, divided by 9 is written as $\frac{a+5}{9}$.

39. The sum of *a* and 3, divided by the difference of *a* and 3 is written as $\frac{a+3}{a-3}$.

40. The sum of *m* and *n*, divided by the difference of *m* and *n* is written as $\frac{m+n}{m-n}$.

41. 2(*x* + 5) is an expression. It means we multiply 2 by the sum of *x* and 5.

42. 4 + (*x* − 3) is an expression. It means we add 4 to the difference of *x* and 3.

43. *m* ÷ +4 is not an expression. The two operations in a row have no meaning.

44. 6 + *a* = 7 is not an expression. The equal sign is not an operation sign.

45. *y*(*x* + 3) is an expression. It means to multiply *y* times the sum of *x* and 3.

46. 8 = 4*b* is not an expression. The equal sign is not an operation sign.

47. 2*a* + 5*b* is an expression. It means we add 5 times *b* to 2 times *a*.

48. 4*x* + · 7 is not an expression. The two operations in a row have no meaning.

49. Let *x* = Earth's population 40 years ago. Then 2*x* = Earth's population today.

50. Let *S* = number of species living last year. Then *S* − 4000 = number of species living this year.

51. The interest (*I*) equals the principal (*P*) times the rate (*r*) times the time (*t*) is written as *I* = *Prt*.

52. Kinetic energy (*KE*) equals one-half of the product of the mass (*m*) and the square of the velocity (*v*) is written as $KE = \frac{1}{2}mv^2$.

53. 8 decreased by a number is written as $8-x$
(b)

54. 8 less than x is written as $x-8$
(a)

55. The difference between 8 and x is written as $8-x$
(b)

56. 8 from x is written as $x-8$.

57. 5 more than a number is written as $x + 5$.

58. A number increased by 8 is written as $x + 8$.

59. 7 less than a number is written as $x - 7$.

60. A number decreased by 10 is written as $x - 10$.

61. 9 times a number is written as $9x$.

62. Twice a number is written as $2x$.

63. 6 more than 3 times a number is written as $3x + 6$.

64. 5 times a number, decreased by 10 is written as $5x - 10$.

65. Twice the sum of a number and 5 is written as $2(x + 5)$.

66. 3 times the difference of a number and 4 is written as $3(x - 4)$.

67. The product of 2 more than a number and 2 less than that same number is written as $(x + 2)(x - 2)$.

68. The product of 5 less than a number and 5 more than that same number is written as $(x - 5)(x + 5)$.

69. The quotient of a number and 7 is written as $\dfrac{x}{7}$.

70. A number divided by 3 is written as $\dfrac{x}{3}$.

71. The sum of a number and 5, divided by 8 is written as $\dfrac{x+5}{8}$.

72. The quotient when 7 less than a number is divided by 3 is written as $\dfrac{x-7}{3}$.

73. 6 more than a number divided by 6 less than that same number is written as $\dfrac{x+6}{x-6}$.

74. The quotient when 3 more than a number is divided by 3 less than that same number is written as $\dfrac{x+3}{x-3}$.

75. Four times the length of a side (*s*) is written as $4s$.

76. $\dfrac{4}{3}$ times π times the cube of the radius (*r*) is written as $\dfrac{4}{3}\pi r^3$.

77. The radius (*r*) squared times the height (*h*) times π is written as $r^2 h\pi$ or $\pi r^2 h$.

78. Twice the length (*L*) plus twice the width (*W*) is written as $2L + 2W$.

79. One-half the product of the height (*h*) and the sum of two unequal sides (b_1 and b_2) is written as $\dfrac{1}{2}h(b_1 + b_2)$.

80. Six times the length of a side (*s*) squared is written as $6s^2$.

81. The desired dose (D) and the available quantity (Q) divided by the available dose H is written as $\dfrac{DQ}{H}$

82. To figure out the average number of customers, take the quotient of customer arrivals (a) and the average rate at which customers are served (h) minus the average rate of customer arrivals. The formula is written as $\dfrac{a}{h-a}$

83. K Jones Manufacturing sold 284 more hex bolts than carriage bolts last month the formula is written as $H-284$

84. Electrical power (P) is the product of voltage (V) and current (I) the formula is written as $P = VI$

85. Above and Beyond

86. Above and Beyond

87. Above and Beyond

88. Above and Beyond

89. Above and Beyond

90. Above and Beyond

Exercises 1.5

For exercises 1–42, $a = -2$, $b = 5$ and $c = -4$, and $d = 6$.

1. $\begin{aligned}3c - 2b &= 3(-4) - 2(5) \\ &= -12 - 10 \\ &= -22\end{aligned}$

2. $\begin{aligned}4c - 2b &= 4(-4) - 2(5) \\ &= -16 - 10 \\ &= -26\end{aligned}$

3. $\begin{aligned}8b + 2c &= 8(5) + 2(-4) \\ &= 40 + (-8) \\ &= 32\end{aligned}$

4. $\begin{aligned}7a - 2c &= 7(-2) - 2(-4) \\ &= -14 + 8 \\ &= -6\end{aligned}$

5. $\begin{aligned}-b^2 + b &= -5^2 + 5 \\ &= -25 + 5 \\ &= -20\end{aligned}$

6. $\begin{aligned}(-b)^2 + b &= (-5)^2 + 5 \\ &= 25 + 5 \\ &= 30\end{aligned}$

7. $\begin{aligned}3a^2 &= 3(-2)^2 \\ &= 3(4) \\ &= 12\end{aligned}$

8. $\begin{aligned}6c^2 &= 6(-4)^2 \\ &= 6(16) \\ &= 96\end{aligned}$

9. $\begin{aligned}c^2 - 2d &= (-4)^2 - 2(6) \\ &= 16 - 12 \\ &= 4\end{aligned}$

10. $\begin{aligned}3b^2 + 4c &= 3(5)^2 + 4(-4) \\ &= 3(25) + (-16) \\ &= 75 - 16 \\ &= 59\end{aligned}$

11. $\begin{aligned}2a^2 + 3b^2 &= 2(-2)^2 + 3(5)^2 \\ &= 2(4) + 3(25) \\ &= 8 + 75 \\ &= 83\end{aligned}$

12. $\begin{aligned}4b^2 - 2c^2 &= 4(5)^2 - 2(-4)^2 \\ &= 4(25) - 2(16) \\ &= 100 - 32 \\ &= 68\end{aligned}$

13. $\begin{aligned}2(a + b) &= 2(-2 + 5) \\ &= 2(3) \\ &= 6\end{aligned}$

14. $\begin{aligned}5(b - c) &= 5[5 - (-4)] \\ &= 5(5 + 4) \\ &= 5(9) \\ &= 45\end{aligned}$

15. $\begin{aligned}-4(2c - a) &= -4[2(-4) - (-2)] \\ &= -4(-8 + 2) \\ &= -4(-6) \\ &= 24\end{aligned}$

16. $\begin{aligned}6(3c - d) &= 6[3(-4) - 6] \\ &= 6(-12 - 6) \\ &= 6(-18) \\ &= -108\end{aligned}$

17. $\begin{aligned}a(b + 3c) &= -2[5 + 3(-4)] \\ &= -2(5 - 12) \\ &= -2(-7) \\ &= 14\end{aligned}$

18. $\begin{aligned}c(3a - d) &= -4[3(-2) - 6] \\ &= -4(-6 - 6) \\ &= -4(-12) \\ &= 48\end{aligned}$

19. $\begin{aligned}\frac{6d}{c} &= \frac{6 \cdot 6}{-4} \\ &= \frac{36}{-4} \\ &= -9\end{aligned}$

20. $\begin{aligned}\frac{8c}{2a} &= \frac{8(-4)}{2(-2)} \\ &= \frac{-32}{-4} \\ &= 8\end{aligned}$

21. $\dfrac{3d+2c}{b} = \dfrac{3(6)+2(-4)}{5}$

$= \dfrac{18+(-8)}{5}$

$= \dfrac{10}{5}$

$= 2$

22. $\dfrac{2b+3d}{2a} = \dfrac{2(5)+3(6)}{2(-2)}$

$= \dfrac{10+18}{-4}$

$= \dfrac{28}{-4}$

$= -7$

23. $\dfrac{2b-3a}{c+2d} = \dfrac{2(5)-3(-2)}{-4+2(6)}$

$= \dfrac{10+6}{-4+12}$

$= \dfrac{16}{8}$

$= 2$

24. $\dfrac{3d-2b}{5a+d} = \dfrac{3(6)-2(5)}{5(-2)+6}$

$= \dfrac{18-10}{-10+6}$

$= \dfrac{8}{-4}$

$= -2$

25. $d^2 - b^2 = 6^2 - 5^2$

$= 36 - 25$

$= 11$

26. $c^2 - a^2 = (-4)^2 - (-2)^2$

$= 16 - 4$

$= 12$

27. $(d-b)^2 = (6-5)^2$

$= 1^2$

$= 1$

28. $(c-a)^2 = [-4-(-2)]^2 = (-2)^2 = 4$

29. $(d-b)(d+b) = (6-5)(6+5) = (1)(11) = 11$

30. $(c-a)(c+a) = [-4-(-2)][-4+(-2)]$

$= (-2)(-6)$

$= 12$

31. $d^3 - b^3 = (6)^3 - (5)^3 = 216 - 125 = 91$

32. $c^3 + a^3 = (-4)^3 + (-2)^3 = -64 - 8 = -72$

33. $(d-b)^3 = (6-5)^3 = 1^3 = 1$

34. $(c+a)^3 = [-4+(-2)]^3 = (-6)^3 = -216$

35. $(d-b)(d^2 + db + b^2) = (6-5)[6^2 + (6)(5) + 5^2]$

$= (1)(36 + 30 + 25)$

$= (1)(91)$

$= 91$

36. $(c+a)(c^2 - ac + a^2)$

$= [-4+(-2)][(-4)^2 - (-2)(-4) + (-2)^2]$

$= (-6)(16 - 8 + 4)$

$= (-6)(12)$

$= -72$

37. $-(b+a)^2 = -(5+-2)^2 = -(-3)^2 = -9$

38. $(d-a)^2 = (6--2)^2 = 8^2 = 64$

39. $3a - 2b + \dfrac{2d}{c} = 3(-2) - 2(5) + \dfrac{2(6)}{-4}$

$= -6 - 10 + (-3) = -19$

40. $4b + 5d - \dfrac{c}{a} = 4(5) + 5(6) - \dfrac{-4}{-2} = 20 + 30 - 2 = 48$

41. $a^2 + 2ad + d^2 = (-2)^2 + 2(-2)(6) + (6)^2$

$= 4 - 24 + 36$

$= 16$

42. $b^2 - 2bc + c^2 = (5)^2 - 2(5)(-4) + (-4)^2$

$= 25 + 40 + 16$

$= 81$

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

44. $\dfrac{y-x}{z} = \dfrac{5-(-3)}{\frac{2}{3}} = 8 \div \dfrac{2}{3} = 8 \cdot \dfrac{3}{2} = 12$

45. $z - y^2 = \dfrac{2}{3} - 5^2 = \dfrac{2}{3} - 25 = \dfrac{2}{3} - \dfrac{75}{3} = -\dfrac{73}{3}$

46. $z - \dfrac{z+x}{y-x} = \dfrac{2}{3} - \dfrac{\dfrac{2}{3}+(-3)}{5-(-3)} = \dfrac{2}{3} - \dfrac{\dfrac{2}{3}-\dfrac{9}{3}}{5+3}$

$= \dfrac{2}{3} - \dfrac{\dfrac{-7}{3}}{8} = \dfrac{2}{3} - \left(\dfrac{-7}{3} \div 8\right)$

$= \dfrac{2}{3} - \left(\dfrac{-7}{3} \cdot \dfrac{1}{8}\right) = \dfrac{2}{3} - \left(\dfrac{-7}{24}\right)$

$= \dfrac{16}{24} + \dfrac{7}{24} = \dfrac{23}{24}$

47. $mn - np + m^2 = 4\left(-\dfrac{3}{2}\right) - \left(-\dfrac{3}{2}\right)\cdot\left(\dfrac{2}{3}\right) + 4^2$

$= -6 - (-1) + 16 = -6 + 1 + 16 = 11$

48. $n^2 + 2np + p^2 = \left(-\dfrac{3}{2}\right)^2 + 2\left(-\dfrac{3}{2}\right)\left(\dfrac{2}{3}\right) + \left(\dfrac{2}{3}\right)^2$

$= \dfrac{9}{4} - 2(1) + \left(\dfrac{4}{9}\right) = \dfrac{81}{36} - \dfrac{72}{36} + \dfrac{16}{36} = \dfrac{25}{36}$

49. $\dfrac{mn}{np} = \dfrac{4\left(-\dfrac{3}{2}\right)}{-\dfrac{3}{2}\left(\dfrac{2}{3}\right)} = \dfrac{-6}{-1} = 6$

50. $-\dfrac{np}{mn} = -\dfrac{-\dfrac{3}{2}\left(\dfrac{2}{3}\right)}{4\left(-\dfrac{3}{2}\right)} = -\dfrac{-1}{-6} = -\dfrac{1}{6}$

51. $R_T = \dfrac{R_1 R_2}{(R_1 + R_2)}$

$= \dfrac{(6\cdot 10)}{(6+10)} = 3.75$

The total resistance is $3.75\,\Omega$.

52. $A = \dfrac{1}{2}bh = \dfrac{1}{2}(4)(8) = 16$

The area is 16 cm^2.

53. $P = 2L + 2W = 2(10) + 2(5) = 30$
The perimeter is 30 inches.

54. $I = PRT = (6{,}000)(0.03)(2) = 360$.
The simple interest is $360.

55. $I = PRT = (1{,}875)(0.04)(2) = 150$
The simple interest is $150.

56. $I = PRT = (5{,}000)(0.02)(3) = 300$
The simple interest is $300.

57. $F = \dfrac{9}{5}C + 32 = \dfrac{9}{5}(-10) + 32 = 14$
The temperature is 14° F.

58. $A = \pi r^2 = (3.14)(3)^2 = 28.26$
The area is 28.26 m^2.

59. $x - 7 = 2y + 5$
$22 - 7 = 2(5) + 5$
$15 = 15$
True

60. $3(x - y) = 6$
$3(5 - (-3)) = 6$
$3(5+3)=6$
$3(8)=6$
$24 \neq 6$
False

61. $2(x + y) = 2x + y$
$2(-4 + (-2)) = 2(-4) + (-2)$
$2(-6) = -8 - 2$
$-12 = -10$
False

62. $x^2 - y^2 = x - y$
$4^2 - (-3)^2 = 4 - (-3)$
$16 - 9 = 4 + 3$
$7 = 7$
True

63. $x + yz = -2.34 + (-3.14)(4.12) = -15.3$

64. $y - 2z = -3.14 - 2(4.12) = -11.4$

65. $x^2 - z^2 = (-2.34)^2 - (4.12)^2 = -11.5$

66. $x^2 + y^2 = (-2.34)^2 + (-3.14)^2 = 15.3$

67. $\dfrac{xy}{z-x} = \dfrac{(-2.34)(-3.14)}{4.12 - (-2.34)} = 1.1$

68. $\dfrac{y^2}{zy} = \dfrac{(-3.14)^2}{4.12(-3.14)} = -0.8$

69. $\dfrac{2x+y}{2x+z} = \dfrac{2(-2.34)+(-3.14)}{2(-2.34)+(4.12)} = \dfrac{-4.68-3.14}{-4.68+4.12}$

$= \dfrac{-7.82}{-0.56} = 13.96 \approx 14$

70. $\dfrac{x^2y^2}{xz} = \dfrac{(-2.34)^2(-3.14)^2}{(-2.34)(4.12)} = -5.6$

71. $m + np^2 = 232 + (-487)(58)^2$

$= 232 + (-487)(3,364) = 232 - 1,638,268$

$= -1,638,036$

72. $p - (m + 2n) = 58 - (232 + 2(-487))$

$= 58 - (232 - 974) = 58 - (-742)$

$= 58 + 742 = 800$

73. $(p + n)^2 - m^2 = (58 - 487)^2 - (232)^2$

$= 130{,}217$

74. $\dfrac{pm - 2n}{n - 2m} = \dfrac{58(232) - 2(-487)}{-487 - 2(232)}$

$= -15.2$

75. $\dfrac{n^2 - p^2}{p^2 - m^2} = \dfrac{(-487)^2 - (58)^2}{(58)^2 - (232)^2}$

$= -4.6$

76. $m^2 + (-n)^2 + (-p^2)$

$= (232)^2 + (-(-487))^2 + (-58^2)$

$= 287{,}629$

77. $-2t^2 + 13t + 1$ if $t = 1$

$-2(1)^2 + 13(1) + 1 = -2 + 13 + 1 = 11 + 1 = 12$

12 mcg/ mL

78. $-2t^2 + 13t + 1$ if $t = 3$

$-2(3)^2 + 13(3) + 1 = -18 + 39 + 1 = 21 + 1 = 22$

22 mcg/ mL

79. $\dfrac{rT}{5{,}252} = \dfrac{(1{,}180)(3)}{5{,}252} = \dfrac{3{,}540}{5{,}252} = 0.674$

80. $\dfrac{1}{2}mv^2 = \dfrac{1}{2}(60)(6)^2 = \dfrac{1}{2}(60)(36) = 30(36)$

$= 1{,}080$ joules

81. Above and Beyond

82. Above and Beyond

83. Above and Beyond

Exercises 1.6

1. $5a + 2$ has two terms: $5a$ and 2.

2. $7a - 4b$ or $7a + (-4b)$ has two terms: $7a$ and $-4b$.

3. $4x^3$ has one term: $4x^3$.

4. $3x^2$ has one term: $3x^2$.

5. $3x^2 + 3x - 7$ or $3x^2 + 3x + (-7)$ has three terms: $3x^2$, $3x$, and -7.

6. $2a^3 - a^2 + a$ or $2a^3 + (-a^2) + a$ has three terms: $2a^3$, $-a^2$ and a.

7. In the group of terms $5ab$, $3b$, $3a$, $4ab$, the like terms are $5ab$ and $4ab$.

8. In the group of terms $9m^2$, $8mn$, $5m^2$, $7m$, the like terms are $9m^2$ and $5m^2$.

9. In the group of terms $4xy^2$, $2x^2y$, $5x^2$, $-3x^2y$, $5y$, $6x^2y$, the like terms are $2x^2y$, $-3x^2y$, and $6x^2y$.

10. In the group of terms $8a^2b$, $4a^2$, $3ab^2$, $-5a^2b$, $3ab$, $5a^2b$, the like terms are $8a^2b$, $-5a^2b$, and $5a^2b$.

11. $4m + 6m = (4 + 6)m = 10m$

12. $6a^2 + 8a^2 = (6 + 8)a^2 = 14a^2$

13. $7b^3 + 10b^3 = (7 + 10)b^3 = 17b^3$

14. $7rs + 13rs = (7 + 13)rs = 20rs$

15. $21xyz + 7xyz = (21 + 7)xyz = 28xyz$

16. $-3mn^2 + 9mn^2 = (-3 + 9)mn^2 = 6mn^2$

17. $9z^2 - 3z^2 = 9z^2 + (-3z^2) = 6z^2$

18. $7m - 6m = 7m + (-6m) = 1m = m$

19. $9a^5 - 9a^5 = 9a^5 + (-9a^5) = 0$

20. $13xy - 9xy = 13xy + (-9xy) = 4xy$

21. $19n^2 - 18n^2 = 19n^2 + (-18n^2) = 1n^2 = n^2$

22. $7cd - 7cd = 7cd + (-7cd) = 0$

23. $21p^2q - 6p^2q = 21p^2q + (-6p^2q) = 15p^2q$

24. $17r^3s^2 - 8r^3s^2 = 17r^3s^2 + (-8r^3s^2) = 9r^3s^2$

25. $5x^2 - 3x^2 + 9x^2 = 5x^2 + (-3x^2) + 9x^2$
$$= (5 + (-3) + 9)x^2$$
$$= 11x^2$$

26. $13uv + uv - 12uv = 13uv + uv + (-12uv)$
$$= (13 + 1 + (-12))uv$$
$$= 2uv$$

27. $11b - 9a - 6b = 11b + (-6b) - 9a$
$$= (11 + (-6))b + (-9a)$$
$$= 5b - 9a = -9a + 5b$$

28. $5m^2 - 3m + 6m^2 = 5m^2 + 6m^2 - 3m$
$$= (5 + 6)m^2 - 3m$$
$$= 11m^2 - 3m$$

29. $7x + 5y - 4x - 4y = 7x + (-4x) + 5y + (-4y)$
$$= (7 + (-4))x + (5 + (-4))y$$
$$= 3x + 1y$$
$$= 3x + y$$

30. $6a^2 + 11a + 7a^2 - 9a = 6a^2 + 7a^2 + 11a + (-9a)$
$$= (6 + 7)a^2 + (11 + (-9))a$$
$$= 13a^2 + 2a$$

31. $4a + 7b + 3 - 2a + 3b - 2$
$$= 4a + (-2a) + 7b + 3b + 3 + (-2)$$
$$= (4 + (-2))a + (7 + 3)b + 3 + (-2)$$
$$= 2a + 10b + 1$$

32. $5p^2 + 2p + 8 + 4p^2 + 5p - 6$
$$= 5p^2 + 4p^2 + 2p + 5p + 8 + (-6)$$
$$= (5 + 4)p^2 + (2 + 5)p + 8 + (-6)$$
$$= 9p^2 + 7p + 2$$

33. $P = 2L + 2W$
$P = 2(2x^2 - x + 1) + 2(3x - 2)$
$P = 4x^2 - 2x + 2 + 6x - 4$
$P = 4x^2 + (-2 + 6)x + 2 - 4$
$P = (4x^2 + 4x - 2)$ cm

34. $P = x + 3x + 3 + 2x^2 - 5x + 1$
$P = 2x^2 + (1 + 3 + (-5))x + 3 + 1$
$P = (2x^2 - x + 4)$ ft

35. $P = 2L + 2W$
$P = 2(8x + 9) + 2(6x - 7)$
$P = 16x + 18 + 12x - 14$
$P = (16 + 12)x + 18 - 14$
$P = (28x + 4)$ in.

36. $P = 3x + 7 + 4x - 9 + 5x + 6$
$P = (3 + 4 + 5)x + 7 - 9 + 6$
$P = (12x + 4)$ mm

37. $P = 90x - x^2 - (150 + 25x)$
$P = -x^2 + (90 - 25)x - 150$
$P = -x^2 + 65x - 150$

38. $P = 3y^2 - 2y + 5 - (y^2 + y - 3)$
$P = (3 - 1)y^2 + (-2 - 1)y + 5 + 3$
$P = 2y^2 - 3y + 8$

39. $\dfrac{2}{3}m + 3 + \dfrac{4}{3}m = \left(\dfrac{2}{3} + \dfrac{4}{3}\right)m + 3$
$$= \dfrac{6}{3}m + 3 = 2m + 3$$

40. $\dfrac{a}{5} - 2 + \dfrac{4a}{5} = \left(\dfrac{1}{5} + \dfrac{4}{5}\right)a - 2$
$$= \dfrac{5}{5}a - 2$$
$$= a - 2$$

41. $\dfrac{13x}{5} + 2 - \dfrac{3x}{5} + 5 = \left(\dfrac{13}{5} - \dfrac{3}{5}\right)x + 2 + 5$
$$= \dfrac{10}{5}x + 7$$
$$= 2x + 7$$

42. $\dfrac{17}{12}y + 7 + \dfrac{7}{12}y - 3 = \left(\dfrac{17}{12} + \dfrac{7}{12}\right)y + 7 - 3$
$$= \dfrac{24}{12}y + 4$$
$$= 2y + 4$$

43. $2.3a + 7 + 4.7a + 3 = (2.3 + 4.7)a + 7 + 3$
$$= 7a + 10$$

44. $5.8m + 4 - 2.8m + 11 = (5.8 + (-2.8))m + 4 + 11$
$= 3m + 15$

45. $5a^4 + 8a^4 = (5 + 8)a^4$
$= 13a^4$

46. $9p^2 + 12p^2 = (9 + 12)p^2$
$= 21p^2$

47. $15a^3 - 12a^3 = 15a^3 + (-12a^3)$
$= 3a^3$

48. $18m^3 - 5m^3 = 18m^3 + (-5m^3)$
$= 13m^3$

49. $(9mn^2 + 5mn^2) - 3mn^2 = 14mn^2 - 3mn^2$
$= 11mn^2$

50. $(6x^2y + 12x^2y) - 4x^2y = 18x^2y - 4x^2y$
$= 14x^2y$

51. $2(3x + 2) + 4 = 6x + 4 + 4$
$= 6x + 8$

52. $3(4z + 5) - 9 = 12z + 15 - 9$
$= 12z + 6$

53. $5(6a - 2) + 12a = 30a - 10 + 12a$
$= 42a - 10$

54. $7(4w - 3) - 25w = 28w - 21 - 25w$
$= 3w - 21$

55. $4s + 2(s + 4) + 4 = 4s + 2s + 8 + 4$
$= 6s + 12$

56. $5p + 4(p + 3) - 8 = 5p + 4p + 12 - 8$
$= 9p + 4$

57. $105 + 5(h - 60) = 105 + 5h - 300 = 5h - 195$

58. $5'4" = 5(12) + 4 = 64"$
$105 + 5(64 - 60) = 105 + 5(4) = 105 + 20 = 125$ lbs

59. $54p + 32p = 86p$

60. $\dfrac{6^3}{12}b + \dfrac{30^3}{36}b = \dfrac{216}{12}b + \dfrac{27{,}000}{36}b$
$= 18b + 750b = 768b$

61. Above and Beyond

62. Above and Beyond

63. Above and Beyond

64. Above and Beyond

65. Above and Beyond

66. Above and Beyond

Exercises 1.7

1. $x^5 \cdot x^7 = x^{5+7} = x^{12}$

2. $b^2 \cdot b^4 = b^{2+4} = b^6$

3. $3^2 \cdot 3^6 = 3^{2+6} = 3^8$

4. $y^6 \cdot y^4 = y^{6+4} = y^{10}$

5. $a^9 \cdot a = a^9 \cdot a^1 = a^{9+1} = a^{10}$

6. $3^4 \cdot 3^5 = 3^{4+5} = 3^9$

7. $z^{10} \cdot z^3 = z^{10+3} = z^{13}$

8. $x^6 \cdot x^3 = x^{6+3} = x^9$

9. $p^5 \cdot p^7 = p^{5+7} = p^{12}$

10. $s^6 \cdot s^9 = s^{6+9} = s^{15}$

11. $x^3y \cdot x^2y^4 = x^{3+2}y^{1+4} = x^5y^5$

12. $m^2n^3 \cdot mn^4 = m^{2+1}n^{3+4} = m^3n^7$

13. $w^3 \cdot w^4 \cdot w^2 = w^{3+4+2} = w^9$

14. $x^5 \cdot x^4 \cdot x^6 = x^{5+4+6} = x^{15}$

15. $m^3 \cdot m^2 \cdot m^4 = m^{3+2+4} = m^9$

16. $r^3 \cdot r \cdot r^5 = r^{3+1+5} = r^9$

17. $a^3b \cdot a^2b^2 \cdot ab^3 = a^{3+2+1}b^{1+2+3} = a^6b^6$

18. $w^2z^3 \cdot wz \cdot w^3z^4 = w^{2+1+3}z^{3+1+4}$
$= w^6z^8$

19. $p^2q \cdot p^3q^5 \cdot pq^4 = p^{2+3+1}q^{1+5+4}$
$= p^6q^{10}$

20. $c^3 d \cdot c^4 d^2 \cdot cd^5 = c^{3+4+1} d^{1+2+5}$
$$= c^8 d^8$$

21. $2a^5 \cdot 3a^2 = 6 \cdot a^{5+2} = 6a^7$

22. $5x^3 \cdot 3x^2 = 15x^{3+2} = 15x^5$

23. $x^2 \cdot 3x^5 = (1 \cdot 3)(x^2 \cdot x^5)$
$$= 3x^7$$

24. $2m^4 \cdot 6m^7 = (2 \cdot 6)(m^4 \cdot m^7)$
$$= 12m^{11}$$

25. $5m^3 n^2 \cdot 4mn^3 = (5 \cdot 4)(m^3 \cdot m)(n^2 \cdot n^3)$
$$= 20m^4 n^5$$

26. $7x^2 y^5 \cdot 6xy^4 = (7 \cdot 6)(x^2 \cdot x)(y^5 \cdot y^4)$
$$= 42x^3 y^9$$

27. $4x^5 y \cdot 3xy^2 = (4 \cdot 3)(x^5 \cdot x)(y \cdot y^2) = 12x^6 y^3$

28. $5a^3 b \cdot 10ab^4 = (5 \cdot 10)(a^3 \cdot a)(b \cdot b^4)$
$$= 50a^4 b^5$$

29. $2a^2 \cdot a^3 \cdot 3a^7 = (2 \cdot 1 \cdot 3)(a^2 \cdot a^3 \cdot a^7)$
$$= 6a^{12}$$

30. $2x^3 \cdot 3x^4 \cdot x^5 = (2 \cdot 3 \cdot 1)(x^3 \cdot x^4 \cdot x^5) = 6x^{12}$

31. $3c^2 d \cdot 4cd^3 \cdot 2c^5 d = (3 \cdot 4 \cdot 2)(c^2 \cdot c \cdot c^5)(d \cdot d^3 \cdot d)$
$$= 24c^8 d^5$$

32. $5p^2 q \cdot p^3 q^2 \cdot 3pq^3$
$$= (5 \cdot 1 \cdot 3)(p^2 \cdot p^3 \cdot p)(q \cdot q^2 \cdot q^3)$$
$$= 15p^6 q^6$$

33. $5m^2 \cdot m^3 \cdot 2m \cdot 3m^4$
$$= (5 \cdot 1 \cdot 2 \cdot 3)(m^2 \cdot m^3 \cdot m \cdot m^4)$$
$$= 30m^{10}$$

34. $3a^3 \cdot 2a \cdot a^4 \cdot 2a^5 = (3 \cdot 2 \cdot 1 \cdot 2)(a^3 \cdot a \cdot a^4 \cdot a^5)$
$$= 12a^{13}$$

35. $2r^3 s \cdot rs^2 \cdot 3r^2 s \cdot 5rs$
$$= (2 \cdot 1 \cdot 3 \cdot 5)(r^3 \cdot r \cdot r^2 \cdot r)(s \cdot s^2 \cdot s \cdot s)$$
$$= 30r^7 s^5$$

36. $6a^2 b \cdot ab \cdot 3ab^3 \cdot 2a^2 b$
$$= (6 \cdot 1 \cdot 3 \cdot 2)(a^2 \cdot a \cdot a \cdot a^2)(b \cdot b \cdot b^3 \cdot b)$$
$$= 36a^6 b^6$$

37. $\dfrac{a^{10}}{a^7} = a^{10-7} = a^3$

38. $\dfrac{m^8}{m^2} = m^{8-2} = m^6$

39. $\dfrac{y^{10}}{y^4} = y^{10-4} = y^6$

40. $\dfrac{b^9}{b^4} = b^{9-4} = b^5$

41. $\dfrac{p^{15}}{p^{10}} = p^{15-10} = p^5$

42. $\dfrac{s^{15}}{s^9} = s^{15-9} = s^6$

43. $\dfrac{x^5 y^3}{x^2 y^2} = x^{5-2} \cdot y^{3-2} = x^3 y$

44. $\dfrac{s^5 t^4}{s^3 t^2} = s^{5-3} \cdot t^{4-2} = s^2 t^2$

45. $\dfrac{10m^6}{5m^4} = 2m^{6-4} = 2m^2$

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

47. $\dfrac{24a^7}{6a^4} = 4a^{7-4} = 4a^3$

48. $\dfrac{25x^9}{5x^8} = 5x^{9-8} = 5x$

49. $\dfrac{26m^8 n}{13m^6} = 2m^{8-6} \cdot n = 2m^2 n$

50. $\dfrac{30a^4 b^5}{6b^4} = 5a^4 \cdot b^{5-4} = 5a^4 b$

51. $\dfrac{35w^4 z^6}{5w^2 z} = 7w^{4-2} \cdot z^{6-1}$

$\qquad = 7w^2 z^5$

52. $\dfrac{48p^6 q^7}{8p^4 q} = 6p^{6-4} \cdot q^{7-1} = 6p^2 q^6$

53. $\dfrac{48x^4 y^5 z^9}{24x^2 y^3 z^6} = 2x^{4-2} \times y^{5-3} \times z^{9-6}$

$\qquad = 2x^2 y^2 z^3$

54. $\dfrac{25a^5 b^4 c^3}{5a^4 bc^2} = 5a^{5-4} \cdot b^{4-1} \cdot c^{3-2} = 5ab^3 c$

55. $3a^4 b^3 \cdot 2a^2 b^4 = (3 \cdot 2)(a^4 \cdot a^2)(b^3 \cdot b^4)$

$\qquad = 6a^6 b^7$

56. $2xy^3 \cdot 3xy^2 = (2 \cdot 3)(x \cdot x)(y^3 \cdot y^2)$

$\qquad = 6x^2 y^5$

57. $2a^3 b + 3a^2 b$ cannot be simplified. The bases are not the same.

58. $2xy^3 + 3xy^2$ cannot be simplified. The bases are not the same.

59. $2x^2 y^3 \cdot 3x^2 y^3 = (2 \cdot 3)(x^2 \cdot x^2)(y^3 \cdot y^3)$

$\qquad = 6x^4 y^6$

60. $5a^3 b^2 \cdot 10a^3 b^2 = (5 \cdot 10)(a^3 \cdot a^3)(b^2 \cdot b^2)$

$\qquad = 50a^6 b^4$

61. $2x^3 y^2 + 3x^3 y^2 = (2+3)x^3 y^2$

$\qquad = 5x^3 y^2$

62. $5a^3 b^2 + 10a^3 b^2 = (5+10)a^3 b^2$

$\qquad = 15a^3 b^2$

63. $\dfrac{8a^2 b \cdot 6a^2 b}{2ab} = \dfrac{(8 \cdot 6)a^{2+2} b^{1+1}}{2ab}$

$\qquad = \dfrac{48a^4 b^2}{2ab}$

$\qquad = 24a^{4-1} \cdot b^{2-1}$

$\qquad = 24a^3 b$

64. $\dfrac{6x^2 y^3 \cdot 9x^2 y^3}{3x^2 y^2} = \dfrac{(6 \cdot 9)x^{2+2} y^{3+3}}{3x^2 y^2}$

$\qquad = \dfrac{54x^4 y^6}{3x^2 y^2}$

$\qquad = 18x^{4-2} \cdot y^{6-2}$

$\qquad = 18x^2 y^4$

65. $\dfrac{8a^2 b + 6a^2 b}{2ab} = \dfrac{(8+6)a^2 b}{2ab}$

$\qquad = \dfrac{14a^2 b}{2ab}$

$\qquad = 7a^{2-1} b^{1-1}$

$\qquad = 7a^1 b^0$

$\qquad = 7a$

66. $\dfrac{6x^2 y^3 + 9x^2 y^3}{3x^2 y^2} = \dfrac{(6+9)x^2 y^3}{3x^2 y^2}$

$\qquad = \dfrac{15x^2 y^3}{3x^2 y^2}$

$\qquad = 5x^{2-2} \cdot y^{3-2}$

$\qquad = 5x^0 y^1$

$\qquad = 5y$

67. Above and Beyond

68. Above and Beyond

69. Above and Beyond

Summary Exercises for Chapter 1

1. $5 + (7 + 12) = (5 + 7) + 12$ demonstrates the associative property of addition.

2. $2(8 + 3) = 2 \cdot 8 + 2 \cdot 3$ demonstrates the distributive property.

3. $4 \cdot (5 \cdot 3) = (4 \cdot 5) \cdot 3$ demonstrates the associative property of multiplication.

4. $4 \cdot 7 = 7 \cdot 4$ demonstrates the commutative property of multiplication.

5. $8(5 + 4) = 8(9) = 72$
$8 \cdot 5 + 8 \cdot 4 = 40 + 32 = 72$
Since $72 = 72$,
$8(5 + 4) = 8 \cdot 5 + 8 \cdot 4$

6. $2(3 + 7) = 2(10) = 20$
$2 \cdot 3 + 2 \cdot 7 = 6 + 14 = 20$
Since $20 = 20$,
$2(3 + 7) = 2 \cdot 3 + 2 \cdot 7$

7. $(7 + 9) + 4 = 16 + 4 = 20$
$7 + (9 + 4) = 7 + 13 = 20$
Since $20 = 20$,
$(7 + 9) + 4 = 7 + (9 + 4)$

8. $(2 + 3) + 6 = 5 + 6 = 11$
$2 + (3 + 6) = 2 + 9 = 11$
Since $11 = 11$,
$(2 + 3) + 6 = 2 + (3 + 6)$

9. $(8 \cdot 2) \cdot 5 = 16 \cdot 5 = 80$
$8(2 \cdot 5) = 8(10) = 80$
Since $80 = 80$,
$(8 \cdot 2) \cdot 5 = 8(2 \cdot 5)$

10. $(3 \cdot 7) \cdot 2 = 21 \cdot 2 = 42$
$3 \cdot (7 \cdot 2) = 3 \cdot 14 = 42$
Since $42 = 42$,
$(3 \cdot 7) \cdot 2 = 3 \cdot (7 \cdot 2)$

11. $3(7 + 4) = 3 \cdot 7 + 3 \cdot 4$

12. $4(2 + 6) = 4 \cdot 2 + 4 \cdot 6$

13. $\dfrac{1}{2}(5 + 8) = \dfrac{1}{2} \cdot 5 + \dfrac{1}{2} \cdot 8$

14. $0.05(1.35 + 8.1) = 0.05 \cdot 1.35 + 0.05 \cdot 8.1$

15. $-3 + (-8) = -11$

16. $10 + (-4) = 6$

17. $6 + (-6) = 0$

18. $-16 + (-16) = -32$

19. $-18 + 0 = -18$

20. $\dfrac{3}{8} + \left(-\dfrac{11}{8}\right) = \dfrac{-8}{8} = -1$

21. $5.7 + (-9.7) = -4$

22. $-18 + 7 + (-3) = -14$

23. $8 - 13 = 8 + (-13) = -5$

24. $-7 - 10 = -7 + (-10) = -17$

25. $10 - (-7) = 10 + 7 = 17$

26. $-5 - (-1) = -5 + 1 = -4$

27. $-9 - (-9) = -9 + 9 = 0$

28. $0 - (-2) = 0 + 2 = 2$

29. $-\dfrac{5}{4} - \left(-\dfrac{17}{4}\right) = -\dfrac{5}{4} + \dfrac{17}{4} = \dfrac{12}{4} = 3$

30. $7.9 - (-8.1) = 7.9 + 8.1 = 16$

31. $489 + (-332) = 489 - 332 = 157$

32. $1,024 - (-3,206) = 1,024 + 3,206 = 4,230$

33. $-234 + (-321) - (-459)$
$-234 - 321 + 459 = -555 + 459 = -96$

34. $981 - 1,854 - (-321) = 981 - 1,854 + 321$
$-873 + 321 = -552$

35. $4.56 + (-0.32) = 4.56 - 0.32 = 4.24$

36. $-32.14 - 2.56 = -34.7$

37. $-3.112 - (-0.1) + 5.06 = -3.112 + 0.1 + 5.06$
$-3.012 + 5.06 = 2.048$

38. $10.01 - 12.566 + 2 = -2.556 + 2 = -0.556$

39. $13 - (-12.5) + 4\dfrac{1}{4} = 13 + 12.5 + 4.25 = 25.5 + 4.25$
$= 29.75$

40. $3\dfrac{1}{8} - 6.19 + (-8) = 3.125 - 6.19 - 8$
$= -3.065 - 8 = -11.065$

41. $(10)(-7) = -70$

42. $(-8)(-5) = 40$

43. $(-3)(-15) = 45$

44. $(1)(-15) = -15$

45. $(0)(-8) = 0$

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

47. $(-4)\left(\dfrac{3}{8}\right) = -\dfrac{3}{2}$

48. $\left(-\dfrac{5}{4}\right)(-1) = \dfrac{5}{4}$

49. $\dfrac{80}{16} = 5$

50. $\dfrac{-63}{7} = -9$

51. $\dfrac{-81}{-9} = 9$

52. $\dfrac{0}{-5} = 0$

53. $\dfrac{32}{-8} = -4$

54. $\dfrac{-7}{0}$ is undefined.

55. $\dfrac{-8+6}{-8-(-10)} = \dfrac{-2}{-8+10}$

$\qquad = \dfrac{-2}{2}$

$\qquad = -1$

56. $\dfrac{-6-1}{5-(-2)} = \dfrac{-6+(-1)}{5+2}$

$\qquad = \dfrac{-7}{7}$

$\qquad = -1$

57. $\dfrac{25-4}{-5-(-2)} = \dfrac{25+(-4)}{-5+2}$

$\qquad = \dfrac{21}{-3}$

$\qquad = -7$

58. $\dfrac{3-(-6)}{-4+2} = \dfrac{3+6}{-2} = -\dfrac{9}{2}$

59. 5 more than y is written as $y + 5$.

60. c decreased by 10 is written as $c - 10$.

61. The product of 8 and a is written as $8a$.

62. The quotient when y is divided by 3 is written as $\dfrac{y}{3}$.

63. 5 times the product of m and n is written as $5mn$.

64. The product of a and 5 less than a is written as $a(a - 5)$.

65. 3 more than the product of 17 and x is written as $17x + 3$.

66. The quotient when a plus 2 is divided by a minus 2 is written as $\dfrac{a+2}{a-2}$.

67. $4(x + 3)$ is an expression. It means we multiply 4 by the sum of x and 3.

68. $7 \div \cdot 8$ is not an expression. The two operations in a row have no meaning.

69. $y + 5 = 9$ is not an expression. The equal sign is not an operation sign.

70. $11 + 2(3x - 9)$ is an expression. Its meaning is clear.

71. $18 - 3 \cdot 5 = 18 - 15$

$\qquad = 3$

72. $(18 - 3) \cdot 5 = 15 \cdot 5$

$\qquad = 75$

73. $5 \cdot 4^2 = 5 \cdot 16 = 80$

74. $(5 \cdot 4)^2 = 20^2 = 400$

75. $5 \cdot 3^2 - 4 = 5 \cdot 9 - 4 = 45 - 4 = 41$

76. $5(3^2 - 4) = 5(9 - 4) = 5(5) = 25$

77. $5(4 - 2)^2 = 5(2)^2 = 5(4) = 20$

78. $5 \cdot 4 - 2^2 = 5 \cdot 4 - 4 = 20 - 4 = 16$

79. $(5 \cdot 4 - 2)^2 = (20 - 2)^2 = 18^2 = 324$

80. $3(5 - 2)^2 = 3(3)^2 = 3(9) = 27$

81. $3 \cdot 5 - 2^2 = 3 \cdot 5 - 4 = 15 - 4 = 11$

82. $(3 \cdot 5 - 2)^2 = (15 - 2)^2 = 13^2 = 169$

83. $3x + w = 3(-3) + 2$

$\qquad = -9 + 2$

$\qquad = -7$

84. $5y - 4z = 5(6) - 4(-4)$

$\qquad = 30 + 16$

$\qquad = 46$

85. $x + y - 3z = -3 + 6 - 3(-4)$
$= -3 + 6 + 12$
$= 15$

86. $5z^2 = 5(-4)^2$
$= 5(16)$
$= 80$

87. $3x^2 - 2w^2 = 3(-3)^2 - 2(2)^2$
$= 3(9) - 2(4)$
$= 27 - 8$
$= 19$

88. $3x^3 = 3(-3)^3$
$= 3(-27)$
$= -81$

89. $5(x^2 - w^2) = 5[(-3)^2 - 2^2]$
$= 5(9 - 4)$
$= 5(5)$
$= 25$

90. $\dfrac{6z}{2w} = \dfrac{6(-4)}{2(2)}$
$= \dfrac{-24}{4}$
$= -6$

91. $\dfrac{2x - 4z}{y - z} = \dfrac{2(-3) - 4(-4)}{6 - (-4)}$
$= \dfrac{-6 + 16}{6 + 4}$
$= \dfrac{10}{10}$
$= 1$

92. $\dfrac{3x - y}{w - x} = \dfrac{3(-3) - 6}{2 - (-3)}$
$= \dfrac{-9 - 6}{2 + 3}$
$= \dfrac{-15}{5}$
$= -3$

93. $\dfrac{x(y^2 - z^2)}{(y + z)(y - z)} = \dfrac{-3[6^2 - (-4)^2]}{[6 + (-4)][6 - (-4)]}$
$= \dfrac{-3(36 - 16)}{(2)(10)}$
$= \dfrac{-3(20)}{20}$
$= -3$

94. $\dfrac{y(x - w)^2}{x^2 - 2xw + w^2} = \dfrac{6(-3 - 2)^2}{(-3)^2 - 2(-3)(2) + 2^2}$
$= \dfrac{6(-5)^2}{9 - (-12) + 4}$
$= \dfrac{6(25)}{9 + 12 + 4}$
$= \dfrac{150}{25}$
$= 6$

95. $4a^3 - 3a^2$ or $4a^3 + (-3a^2)$ has two terms:
$4a^3$ and $-3a^2$.

96. $5x^2 - 7x + 3$ or $5x^2 + (-7x) + 3$ has three terms:
$5x^2$, $-7x$, and 3.

97. In the group of terms
$5m^2$, $-3m$, $-4m^2$, $5m^3$, m^2, the like terms are
$5m^2$, $-4m^2$, and m^2.

98. In the group of terms
$4ab^2, 3b^2, -5a, ab^2, 7a^2, -3ab^2, 4a^2b$, the like
terms are $4ab^2$, ab^2, and $-3ab^2$.

99. $5c + 7c = (5 + 7)c$
$= 12c$

100. $2x + 5x = (2 + 5)x$
$= 7x$

101. $4a - 2a = 4a + (-2a)$
$= 2a$

102. $6c - 3c = 6c + (-3c)$
$= 3c$

103. $9xy - 6xy = 9xy + (-6xy)$
$= 3xy$

104. $5ab^2 + 2ab^2 = (5 + 2)ab^2$
$= 7ab^2$

105. $7a + 3b + 12a - 2b$
$= 7a + 12a + 3b + (-2b)$
$= 19a + 1b$
$= 19a + b$

106. $6x - 2x + 5y - 3x = 6x + (-2x) + (-3x) + 5y$
$= (6 + (-2) + (-3))x + 5y$
$= 1x + 5y$
$= x + 5y$

107. $5x^3 + 17x^2 - 2x^3 - 8x^2$
$= 5x^3 + (-2x^3) + 17x^2 + (-8x^2)$
$= 3x^3 + 9x^2$

108. $3a^3 + 5a^2 + 4a - 2a^3 - 3a^2 - a$
$= 3a^3 + (-2a^3) + 5a^2 + (-3a^2) + 4a + (-1a)$
$= a^3 + 2a^2 + 3a$

109. $(2a^3 + 12a^3) - 4a^3 = 14a^3 - 4a^3$
$= 10a^3$

110. $15x^2 - (3x^2 + 5x^2) = 15x^2 - 8x^2$
$= 7x^2$

111. $\dfrac{x^{10}}{x^3} = x^{10-3} = x^7$

112. $\dfrac{a^5}{a^4} = a^{5-4} = a^1 = a$

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

114. $\dfrac{m^2 \cdot m^3 \cdot m^4}{m^5} = \dfrac{m^{2+3+4}}{m^5}$
$= \dfrac{m^9}{m^5}$
$= m^{9-5}$
$= m^4$

115. $\dfrac{18p^7}{9p^5} = 2p^{7-5}$
$= 2p^2$

116. $\dfrac{24x^{17}}{8x^{13}} = 3x^{17-13}$
$= 3x^4$

117. $\dfrac{30m^7 n^5}{6m^2 n^3} = 5m^{7-2} \cdot n^{5-3}$
$= 5m^5 n^2$

118. $\dfrac{108x^9 y^4}{9xy^4} = 12x^{9-1} \cdot y^{4-4}$
$= 12x^8 y^0$
$= 12x^8$

119. $\dfrac{48p^5 q^3}{6p^3 q} = 8p^{5-3} \cdot q^{3-1}$
$= 8p^2 q^2$

120. $\dfrac{52a^5 b^3 c^5}{13a^4 c} = 4a^{5-4} \cdot b^3 \cdot c^{5-1}$
$= 4ab^3 c^4$

121. $(4x^3)(5x^4) = (4 \cdot 5)x^3 \cdot x^4$
$= 20x^7$

122. $(3x)^2 (4xy) = (9x^2)(4xy)$
$= (9 \cdot 4)(x^2 \cdot x)(y)$
$= 36x^3 y$

123. $(8x^2 y^3)(3x^3 y^2) = (8 \cdot 3)(x^2 \cdot x^3)(y^3 \cdot y^2)$
$= 24x^5 y^5$

124. $(-2x^3 y^3)(-5xy) = [-2 \cdot (-5)](x^3 \cdot x)(y^3 \cdot y)$
$= 10x^4 y^4$

125. $(6x^4)(2x^2 y) = (6 \cdot 2)(x^4 \cdot x^2) \cdot y$
$= 12x^6 y$

126. Subtract x from 23.
$23 - x$

127. Subtract the number of dimes, x, from the total number of coins, 25.
$25 - x$

128. Add 5 years to Angela's age, x.
$x + 5$

129. Let $x =$ the amount of money Gerry has.
Then $2x =$ twice the amount of money Gerry has.
$5 more than twice the amount Gerry has is
$2x + 5$.

130. Add 4 to the width. Let $x =$ the width.
$x + 4$

131. 6 times the number n is $6n$.
7 less than 6 times the number is
$6n - 7$.

132. x = length of one piece
$25 - x$ = length of the other piece

133. Dimes are worth 10¢ or $0.10, so x dimes are worth $0.10x$. Quarters are worth 25¢ or $0.25, so quarters are worth $0.25q$.
The total amount of money can be represented by $0.10x + 0.25q$.

Self-Test for Chapter 1

1. $-8 + (-5) = -13$

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

3. $(-9) + (-12) = -21$

4. $-\dfrac{5}{3} + \dfrac{8}{3} = \dfrac{3}{3} = 1$

5. $9 - 15 = 9 + (-15) = -6$

6. $-10 - 11 = -10 + (-11) = -21$

7. $5 - (-4) = 5 + 4 = 9$

8. $-7 - (-7) = -7 + 7 = 0$

9. $(8)(-5) = -40$

10. $(-9)(-7) = 63$

11. $(4.5)(-6) = -27$

12. $(6)(-4) = -24$

13. $\dfrac{-100}{4} = -25$

14. $\dfrac{-36 + 9}{-9} = \dfrac{-27}{-9} = 3$

15. $\dfrac{(-15)(-3)}{-9} = \dfrac{45}{-9} = -5$

16. $\dfrac{9}{0}$ is undefined.

17. $29 - 3 \cdot 4 = 29 - 12 = 17$

18. $4 \cdot 5^2 - 35 = 4 \cdot 25 - 35$
$= 100 - 35$
$= 65$

19. $4(2 + 4)^2 = 4(6)^2 = 4(36) = 144$

20. $16 \div (-4) + (-5) = -4 + (-5)$
$= -9$

21. $9a + 4a = (9 + 4)a = 13a$

22. $10x + 8y + 9x - 3y = 10x + 9x + 8y + (-3y)$
$= 19x + 5y$

23. $a^5 \cdot a^9 = a^{5+9}$
$= a^{14}$

24. $2x^3y^2 \cdot 4x^4y = 8x^{3+4}y^{2+1} = 8x^7y^3$

25. $\dfrac{9x^9}{3x^3} = 3x^{9-3} = 3x^6$

26. $\dfrac{20a^3b^5}{5a^2b^2} = 4a^{3-2}b^{5-2}$
$= 4ab^3$

27. $\dfrac{x^{10} \cdot x^5}{x^6} = \dfrac{x^{10+5}}{x^6}$
$= \dfrac{x^{15}}{x^6}$
$= x^{15-6}$
$= x^9$

28. $(12a^2 + 5a^2) - 9a^2 = 17a^2 + (-9a^2)$
$= 8a^2$

29. 5 less than a is written as $a - 5$.

30. The product of 6 and m is written as $6m$.

31. 4 times the sum of m and n is written as $4(m + n)$.

32. The quotient when the sum of a and b is divided by 3 is written as $\dfrac{a + b}{3}$.

33. If $x = 2$, $y = -1$, and $z = 3$, then

$$\frac{9x^2y}{3z} = \frac{9(2)^2(-1)}{3(3)}$$
$$= \frac{9(4)(-1)}{9}$$
$$= \frac{-36}{9}$$
$$= -4$$

34. $6 \cdot 7 = 7 \cdot 6$ demonstrates the commutative property of multiplication.

35. $2(6 + 7) = 2 \cdot 6 + 2 \cdot 7$ demonstrates the distributive property.

36. $4 + (3 + 7) = (4 + 3) + 7$ demonstrates the associative property of addition.

37. $3(5 + 2) = 3 \cdot 5 + 3 \cdot 2$
$$= 15 + 6$$
$$= 21$$

38. $4(5x + 3) = 4 \cdot 5x + 4 \cdot 3$
$$= 20x + 12$$

39. $5x + 6 = 4$ is not an expression.
The equal sign is not an operation sign.

40. $4 + (6 + x)$ is an expression. Its meaning is clear.

41. If x represents Moira's age, then $2x$ represents twice Moira's age.
8 years younger means subtract 8.
$2x - 8$ represents 8 years younger than twice Moira's age.

42. If w represents the width, then $2w$ represents twice the width. 4 more means add 4.
$2w + 4$ represents 4 more than twice the width.