

## Chapter 2

### Operations and Expressions

#### Homework 2.1

2. Substitute 6 for  $x$  in  $5 + x$ :  $5 + (6) = 11$
4. Substitute 6 for  $x$  in  $x - 4$ :  $(6) - 4 = 2$
6. Substitute 6 for  $x$  in  $x(9)$ :  $(6)(9) = 54$
8. Substitute 6 for  $x$  in  $30 \div x$ :  $30 \div 6 = 5$
10. Substitute 6 for  $x$  in  $x - x$ :  $(6) - (6) = 0$
12. Substitute 6 for  $x$  in  $x \div x$ :  $(6) \div (6) = 1$
14. Substitute 440 for  $T$  in  $T \div 5$ :  $440 \div 5 = 88$   
The student's average test score was 88.
16. Substitute 8.77 for  $M$  in  $M + 2.68$ :  
 $8.77 + 2.68 = 11.45$   
There were approximately 11.45 million female students in college in 2009.

18. a.

Number of Pairs	Total Cost (dollars)
1	$3 \cdot 1$
2	$3 \cdot 2$
3	$3 \cdot 3$
4	$3 \cdot 4$
$n$	$3n$

The expression  $3n$  represents the total cost of the  $n$  pairs of socks.

- b. Substitute 9 for  $n$  in  $3n$ :  $3(9) = 27$   
So, the total cost of 9 pairs of socks is \$27.
20. a.
- | Speed Limit (miles per hour) | Driving Speed (miles per hour) |
|------------------------------|--------------------------------|
| 35                           | $35 + 5$                       |
| 40                           | $40 + 5$                       |
| 45                           | $45 + 5$                       |
| 50                           | $50 + 5$                       |
| $s$                          | $s + 5$                        |

The expression  $s + 5$  represents the driving speed if the speed limit is  $s$  miles per hour.

- b. Substitute 65 for  $s$  in  $s + 5$ :  
 $65 + 5 = 70$   
So, if the speed limit is 65 miles per hour, the person will be driving 70 miles per hour.

22. a.

Width (feet)	Area (square feet)
1	$20 \cdot 1$
2	$20 \cdot 2$
3	$20 \cdot 3$
4	$20 \cdot 4$
$w$	$20w$

The expression  $20w$  represents the area of the garden (in square feet) if the width is  $w$  feet.

- b. Substitute 10 for  $w$  in  $20w$ :  $20(10) = 200$   
So, the area of the garden will be 200 square feet if the width is 10 feet.

24.  $8 - x$   
Substitute 8 for  $x$  in  $8 - x$ :  $8 - (8) = 0$
26.  $6 + x$   
Substitute 8 for  $x$  in  $6 + x$ :  $6 + (8) = 14$
28.  $x + 15$   
Substitute 8 for  $x$  in  $x + 15$ :  $(8) + 15 = 23$
30.  $x - 7$   
Substitute 8 for  $x$  in  $x - 7$ :  $(8) - 7 = 1$
32.  $5x$   
Substitute 8 for  $x$  in  $5x$ :  $5(8) = 40$
34. The quotient of 6 and the number
36. Two less than the number
38. The sum of 4 and the number
40. The product of the number and 5
42. The sum of the number and 3
44. The quotient of the number and 5

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46. Substitute 6 for  $x$  and 3 for  $y$  in the expression  $y + x$ :  $(3) + (6) = 9$

48. Substitute 6 for  $x$  and 3 for  $y$  in the expression  $xy$ :  $(6)(3) = 18$

50. Substitute 6 for  $x$  and 3 for  $y$  in the expression  $x \div y$ :  $6 \div 3 = 2$

52.  $x + y$   
Substitute 9 for  $x$  and 3 for  $y$  in the expression  $x + y$ :  $(9) + (3) = 12$

54.  $x \div y$   
Substitute 9 for  $x$  and 3 for  $y$  in the expression  $x \div y$ :  $(9) \div (3) = 3$

56. Substitute 3758 for  $b$  and 994 for  $d$  in the expression  $b - d$ :  $(3758) - (994) = 2764$   
So, the new balance is \$2764 after a check is written for \$994.

58. Substitute 9000 for  $T$  and 20 for  $n$  in the expression  $T \div n$ :  $9000 \div 20 = 450$   
So, if 20 students go on a ski trip that costs \$9000, the cost per student is \$450.

60. Substitute 501 for  $E$  and 17 for  $t$  (2009 is 17 years after 1992) in the expression  $E + t$ :  $501 + 17 = 518$   
So, if the average verbal score was 501 points in 2009, the average math score was 518.

62. a. 

$n$	$3n$
1	$3 \cdot 1 = 3$
2	$3 \cdot 2 = 6$
3	$3 \cdot 3 = 9$
4	$3 \cdot 4 = 12$

  
So, the cost of 1, 2, 3, or 4 loaves is \$3, \$6, \$9, or \$12, respectively.

b. Each loaf costs \$3. The price per loaf is a constant while the number of loaves is a variable. In the expression  $3n$ , the constant is 3 and the variable is  $n$ .

c. Answers may vary. Example:  
For each additional loaf purchased, the total cost increases by \$3.

64. a. 

$t$	$2t$
1	$2 \cdot 1 = 2$
2	$2 \cdot 2 = 4$
3	$2 \cdot 3 = 6$
4	$2 \cdot 4 = 8$

So, the elevator rises 2, 4, 6, or 8 yards after 1, 2, 3, or 4 seconds, respectively.

b. The elevator is rising at a rate of 2 yards per second. The speed is a constant while the number of seconds rising is a variable. In the expression,  $2t$ , the constant is 2 and the variable is  $t$ .

c. Answers may vary. Example:  
For each additional second the elevator rises, the total distance risen increases by 2 yards.

66. Answers may vary.

68. Answers may vary.

70. Answers may vary.

Homework 2.2

2. The numerator of  $\frac{2}{5}$  is 2.

4.  $18 = 2 \cdot 9 = 2 \cdot (3 \cdot 3) = 2 \cdot 3 \cdot 3$

6.  $24 = 4 \cdot 6 = (2 \cdot 2) \cdot (2 \cdot 3) = 2 \cdot 2 \cdot 2 \cdot 3$

8.  $27 = 3 \cdot 9 = 3 \cdot (3 \cdot 3) = 3 \cdot 3 \cdot 3$

10.  $105 = 5 \cdot 21 = 5 \cdot (3 \cdot 7) = 3 \cdot 5 \cdot 7$

12.  $\frac{10}{14} = \frac{2 \cdot 5}{2 \cdot 7} = \frac{2}{2} \cdot \frac{5}{7} = \frac{5}{7}$

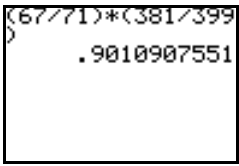
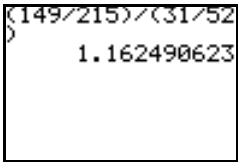
14.  $\frac{7}{28} = \frac{7 \cdot 1}{7 \cdot 4} = \frac{7}{7} \cdot \frac{1}{4} = \frac{1}{4}$

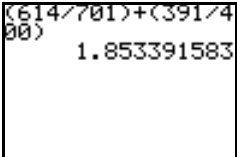
16.  $\frac{27}{54} = \frac{3 \cdot 3 \cdot 3}{3 \cdot 3 \cdot 3 \cdot 2} = \frac{3 \cdot 3 \cdot 3}{3 \cdot 3 \cdot 3} \cdot \frac{1}{2} = \frac{1}{2}$

18.  $\frac{49}{63} = \frac{7 \cdot 7}{7 \cdot 3 \cdot 3} = \frac{7}{7} \cdot \frac{7}{3 \cdot 3} = \frac{7}{3 \cdot 3} = \frac{7}{9}$

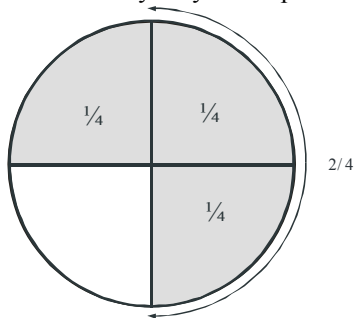
20.  $\frac{9}{81} = \frac{3 \cdot 3}{3 \cdot 3 \cdot 3 \cdot 3} = \frac{3 \cdot 3}{3 \cdot 3} \cdot \frac{1}{3 \cdot 3} = \frac{1}{3 \cdot 3} = \frac{1}{9}$

22.  $\frac{15}{18} = \frac{3 \cdot 5}{3 \cdot 3 \cdot 2} = \frac{3}{3} \cdot \frac{5}{3 \cdot 2} = \frac{5}{3 \cdot 2} = \frac{5}{6}$
24.  $\frac{6}{7} \cdot \frac{4}{9} = \frac{6 \cdot 4}{7 \cdot 9} = \frac{2 \cdot 3 \cdot 2 \cdot 2}{7 \cdot 3 \cdot 3} = \frac{2 \cdot 2 \cdot 2}{7 \cdot 3} = \frac{8}{21}$
26.  $\frac{2}{3} \cdot \frac{5}{6} = \frac{2 \cdot 5}{3 \cdot 6} = \frac{2 \cdot 5}{3 \cdot 2 \cdot 3} = \frac{5}{3 \cdot 3} = \frac{5}{9}$
28.  $\frac{5}{12} \cdot 2 = \frac{5}{12} \cdot \frac{2}{1} = \frac{5 \cdot 2}{2 \cdot 2 \cdot 3} = \frac{5}{2 \cdot 3} = \frac{5}{6}$
30.  $\frac{7}{12} \div \frac{2}{3} = \frac{7}{12} \cdot \frac{3}{2} = \frac{7 \cdot 3}{12 \cdot 2} = \frac{7 \cdot 3}{2 \cdot 2 \cdot 3 \cdot 2} = \frac{7 \cdot 3}{2 \cdot 2 \cdot 2} = \frac{7}{8}$
32.  $\frac{4}{7} \div \frac{8}{3} = \frac{4}{7} \cdot \frac{3}{8} = \frac{4 \cdot 3}{7 \cdot 8} = \frac{2 \cdot 2 \cdot 3}{7 \cdot 2 \cdot 2 \cdot 2} = \frac{3}{7 \cdot 2} = \frac{3}{14}$
34.  $\frac{4}{9} \div 2 = \frac{4}{9} \cdot \frac{1}{2} = \frac{4 \cdot 1}{9 \cdot 2} = \frac{2 \cdot 2}{3 \cdot 3 \cdot 2} = \frac{2}{3 \cdot 3} = \frac{2}{9}$
36.  $\frac{5}{9} + \frac{2}{9} = \frac{5+2}{9} = \frac{7}{9}$
38.  $\frac{2}{15} + \frac{8}{15} = \frac{2+8}{15} = \frac{10}{15} = \frac{2 \cdot 5}{3 \cdot 5} = \frac{2}{3}$
40.  $\frac{5}{7} - \frac{2}{7} = \frac{5-2}{7} = \frac{3}{7}$
42.  $\frac{13}{18} - \frac{9}{18} = \frac{13-9}{18} = \frac{4}{18} = \frac{2 \cdot 2}{2 \cdot 3 \cdot 3} = \frac{2}{3 \cdot 3} = \frac{2}{9}$
44. The LCD is 9:  
 $\frac{1}{3} + \frac{5}{9} = \frac{1}{3} \cdot \frac{3}{3} + \frac{5}{9} = \frac{3}{9} + \frac{5}{9} = \frac{8}{9}$
46. The LCD is 24:  
 $\frac{3}{8} + \frac{1}{6} = \frac{3}{8} \cdot \frac{3}{3} + \frac{1}{6} \cdot \frac{4}{4} = \frac{9}{24} + \frac{4}{24} = \frac{13}{24}$
48. The LCD is 7:  
 $2 + \frac{3}{7} = \frac{2}{1} \cdot \frac{7}{7} + \frac{3}{7} = \frac{14}{7} + \frac{3}{7} = \frac{17}{7}$
50. The LCD is 4:  
 $\frac{3}{4} - \frac{1}{2} = \frac{3}{4} - \frac{1}{2} \cdot \frac{2}{2} = \frac{3}{4} - \frac{2}{4} = \frac{1}{4}$
52. The LCD is 42:  
 $\frac{5}{6} - \frac{4}{7} = \frac{5}{6} \cdot \frac{7}{7} - \frac{4}{7} \cdot \frac{6}{6} = \frac{35}{42} - \frac{24}{42} = \frac{11}{42}$

54. The LCD is 7:  
 $1 - \frac{9}{7} = \frac{1}{1} \cdot \frac{7}{7} - \frac{9}{7} = \frac{7}{7} - \frac{9}{7} = \frac{-2}{7} = -\frac{2}{7}$
56.  $\frac{62}{62} = 1$
58.  $\frac{215}{1} = 215$
60.  $\frac{713}{0}$  is undefined since division by 0 is not defined.
62.  $\frac{0}{798} = 0$
64.  $\frac{173}{190} \cdot \frac{190}{173} = \frac{173 \cdot 190}{173 \cdot 190} = 1$
66.  $\frac{345}{917} - \frac{345}{917} = \frac{345 - 345}{917} = \frac{0}{917} = 0$
68. Substitute 3 for  $x$  and 12 for  $z$  in the expression  $\frac{z}{x}$ :  
 $\frac{12}{3} = \frac{3 \cdot 2 \cdot 2}{3 \cdot 1} = \frac{2 \cdot 2}{1} = \frac{4}{1} = 4$
70. Substitute 4 for  $w$ , 3 for  $x$ , 5 for  $y$ , and 12 for  $z$  in the expression  $\frac{y}{z} \cdot \frac{w}{x}$ :  
 $\frac{5}{12} \cdot \frac{4}{3} = \frac{5 \cdot 2 \cdot 2}{2 \cdot 2 \cdot 3 \cdot 3} = \frac{5}{3 \cdot 3} = \frac{5}{9}$
72. Substitute 3 for  $x$ , 5 for  $y$ , and 12 for  $z$  in the expression  $\frac{y}{x} + \frac{y}{z} : \frac{5}{3} + \frac{5}{12}$   
 The LCD is 12:  
 $\frac{5}{3} + \frac{5}{12} = \frac{5}{3} \cdot \frac{4}{4} + \frac{5}{12} = \frac{20}{12} + \frac{5}{12} = \frac{25}{12}$
74.   $\frac{67}{71} \cdot \frac{381}{399} \approx 0.901$
76.   $\frac{149}{215} \div \frac{31}{52} \approx 1.162$

78.   $\frac{614}{701} + \frac{391}{400} \approx 1.853$

80. Answers may vary. Example:



82. The perimeter of a rectangle is given by the expression  $2L + 2W$ . Substitute  $\frac{2}{3}$  for  $W$  and  $\frac{3}{4}$  for  $L$  in the expression.

$$\begin{aligned} 2 \cdot \frac{3}{4} + 2 \cdot \frac{2}{3} &= \frac{2 \cdot 3}{1 \cdot 4} + \frac{2 \cdot 2}{1 \cdot 3} \\ &= \frac{2 \cdot 3}{2 \cdot 2} + \frac{2 \cdot 2}{3} \\ &= \frac{3}{2} + \frac{4}{3} \end{aligned}$$

The LCD is 6:

$$\frac{3}{2} \cdot \frac{3}{3} + \frac{4}{3} \cdot \frac{2}{2} = \frac{9}{6} + \frac{8}{6} = \frac{17}{6}$$

The perimeter of the picture is  $\frac{17}{6}$  feet.

84. Let  $m$  be the fraction of income for mortgage and  $f$  be the fraction of income for food. The fraction remaining is given by the expression  $1 - m - f$ . Substitute  $\frac{1}{3}$  for  $m$  and  $\frac{1}{6}$  for  $f$  in the expression.

$$\begin{aligned} 1 - m - f &= 1 - \frac{1}{3} - \frac{1}{6} \\ &= \frac{1}{1} \cdot \frac{6}{6} - \frac{1}{3} \cdot \frac{2}{2} - \frac{1}{6} \\ &= \frac{6}{6} - \frac{2}{6} - \frac{1}{6} \\ &= \frac{6 - 2 - 1}{6} \\ &= \frac{3}{6} \\ &= \frac{1}{2} \end{aligned}$$

So,  $\frac{1}{2}$  of the income remains.

86. The quotient of 5 and the number.

Total Time (hours)	Cost per Hour (dollars per hour)
2	$45 \div 2$
3	$45 \div 3$
4	$45 \div 4$
5	$45 \div 5$
$t$	$45 \div t$

So, if a session lasts for  $t$  hours, the total cost per hour will be  $45 \div t$  dollars.

90. a. i.  $\frac{2}{3} \cdot \frac{3}{2} = \frac{2 \cdot 3}{3 \cdot 2} = \frac{6}{6} = 1$

ii.  $\frac{4}{7} \cdot \frac{7}{4} = \frac{4 \cdot 7}{7 \cdot 4} = \frac{28}{28} = 1$

iii.  $\frac{1}{6} \cdot \frac{6}{1} = \frac{1 \cdot 6}{6 \cdot 1} = \frac{6}{6} = 1$

b. Answers may vary. Example:

The product of a fraction and its reciprocal equals 1.

92. Answers may vary. Example:

For addition of fractions, one cannot simply add the numerators and denominators. First get a common denominator, then add numerators, keeping the common denominator.

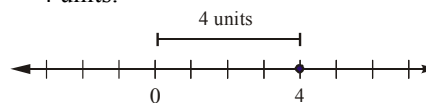
$$\frac{2}{3} + \frac{5}{6} = \frac{2}{3} \cdot \frac{2}{2} + \frac{5}{6} = \frac{4}{6} + \frac{5}{6} = \frac{4+5}{6} = \frac{9}{6} = \frac{3}{2}$$

94. Answers may vary. Example:

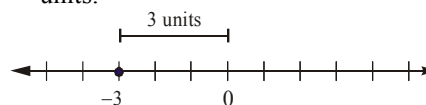
The student should have multiplied the numerator by 3 instead of the denominator. Rewrite 3 as  $\frac{3}{1}$  and then multiply across.

$$3 \cdot \frac{7}{2} = \frac{3}{1} \cdot \frac{7}{2} = \frac{3 \cdot 7}{1 \cdot 2} = \frac{21}{2}$$

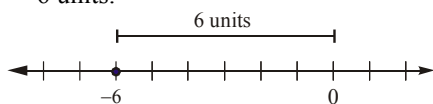
96. a. i. The distance between 0 and 4 is 4 units.



ii. The distance between 0 and -3 is 3 units.



- iii. The distance between 0 and  $-6$  is 6 units.



- b. The distance between 0 and a number on a number line is equal to the absolute value of the number.
98. a. i.  $5 + (-2) = 3$
- ii.  $7 + (-1) = 6$
- iii.  $8 + (-3) = 5$
- b. When adding two numbers with different signs, if the positive number is farther from 0 on a number line, the result will be positive.
- c. i.  $2 + (-5) = -3$
- ii.  $1 + (-7) = -6$
- iii.  $3 + (-8) = -5$
- d. When adding two numbers with different signs, if the positive number is closer to 0 on a number line, the result will be negative.
- e. i.  $4 + (-4) = 0$
- ii.  $7 + (-7) = 0$
- iii.  $9 + (-9) = 0$
- f. When adding two numbers with different signs, if the two numbers are the same distance from 0 on a number line, the result will be 0.
- g. i.  $6 + (-4) = 2$
- ii.  $3 + (-7) = -4$
- iii.  $6 + (-6) = 0$

- h. Answers may vary. Example:  
When adding two numbers with different signs, take the absolute value of the two numbers and subtract the smaller absolute value from the larger. The sign of the result is the same as the sign of the number with the larger absolute value.

100. Answers may vary. Example:  
The denominator of a fraction is the name of the things it represents. The numerator of a fraction is the number of those things it represents. When we add two fractions with the same denominator, we keep the same denominator, or name, and add the two numerators, or number of things.

### Homework 2.3

2.  $-(-9) = 9$
4.  $-(-(-2)) = -(2) = -2$
6.  $|6| = 6$  because 6 is a distance of 6 units from 0 on a number line.
8.  $|-1| = 1$  because  $-1$  is a distance of 1 unit from 0 on a number line.
10.  $-|5| = -(5) = -5$
12.  $-|-9| = -(9) = -9$
14. The numbers have different signs so subtract the smaller absolute value from the larger.  
 $|5| - |-3| = 5 - 3 = 2$   
Since  $|5|$  is greater than  $|-3|$ , the sum is positive.  
 $5 + (-3) = 2$
16. The numbers have the same sign so add the absolute values.  
 $|-3| + |-2| = 3 + 2 = 5$   
The numbers are negative, so the sum is negative.  
 $-3 + (-2) = -5$

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18. The numbers have different signs so subtract the smaller absolute value from the larger.

$$|-9| - |6| = 9 - 6 = 3$$

Since  $|-9|$  is greater than  $|6|$ , the sum is negative.

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

20. The numbers have different signs so subtract the smaller absolute value from the larger.

$$|4| - |-3| = 4 - 3 = 1$$

Since  $|4|$  is greater than  $|-3|$ , the sum is positive.

$$-3 + 4 = 1$$

22. The numbers have the same sign so add the absolute values.

$$|-9| + |-5| = 9 + 5 = 14$$

The numbers are negative, so the sum is negative.

$$-9 + (-5) = -14$$

24. The numbers have different signs so subtract the smaller absolute value from the larger.

$$|8| - |-2| = 8 - 2 = 6$$

Since  $|8|$  is greater than  $|-2|$ , the sum is positive.

$$8 + (-2) = 6$$

26.  $8 + (-8) = 0$  because the numbers are opposites and the sum of opposites is 0.

28.  $-7 + 7 = 0$  because the numbers are opposites and the sum of opposites is 0.

30. The numbers have different signs so subtract the smaller absolute value from the larger.

$$|17| - |-14| = 17 - 14 = 3$$

Since  $|17|$  is greater than  $|-14|$ , the sum is positive.

$$17 + (-14) = 3$$

32. The numbers have different signs so subtract the smaller absolute value from the larger.

$$|-89| - |57| = 89 - 57 = 32$$

Since  $|-89|$  is greater than  $|57|$ , the sum is negative.

$$-89 + 57 = -32$$

34. The numbers have the same sign so add the absolute values.

$$|-347| + |-594| = 347 + 594 = 941$$

The numbers are negative, so the sum is negative.

$$-347 + (-594) = -941$$

36.  $127,512 + (-127,512) = 0$  because the numbers are opposites and the sum of opposites is 0.

38. The numbers have the same sign so add the absolute values.

$$|-3.7| + |-9.9| = 3.7 + 9.9 = 13.6$$

The numbers are negative, so the sum is negative.

$$-3.7 + (-9.9) = -13.6$$

40. The numbers have different signs so subtract the smaller absolute value from the larger.

$$|7| - |-0.3| = 7 - 0.3 = 6.7$$

Since  $|7|$  is greater than  $|-0.3|$ , the sum is positive.

$$-0.3 + 7 = 6.7$$

42. The numbers have different signs so subtract the smaller absolute value from the larger.

$$|37.05| - |-19.26| = 37.05 - 19.26 = 17.79$$

Since  $|37.05|$  is greater than  $|-19.26|$ , the sum is positive.

$$37.05 + (-19.26) = 17.79$$

44. The numbers have different signs so subtract the smaller absolute value from the larger.

$$\left| \frac{2}{5} \right| - \left| -\frac{1}{5} \right| = \frac{2}{5} - \frac{1}{5} = \frac{1}{5}$$

Since  $\left| \frac{2}{5} \right|$  is greater than  $\left| -\frac{1}{5} \right|$ , the sum is positive.

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

46. The numbers have different signs so subtract the smaller absolute value from the larger.

$$\left| -\frac{5}{6} \right| - \left| \frac{1}{6} \right| = \frac{5}{6} - \frac{1}{6} = \frac{4}{6} = \frac{2}{3}$$

Since  $\left| -\frac{5}{6} \right|$  is greater than  $\left| \frac{1}{6} \right|$ , the sum is negative.

$$-\frac{5}{6} + \frac{1}{6} = -\frac{2}{3}$$

48. The numbers have the same sign so add the absolute values.

$$\left|-\frac{2}{3}\right| + \left|-\frac{5}{6}\right| = \frac{2}{3} + \frac{5}{6} = \frac{2}{3} \cdot \frac{2}{2} + \frac{5}{6} = \frac{4}{6} + \frac{5}{6} = \frac{9}{6} = \frac{3}{2}$$

The numbers are negative, so the sum is negative.

$$-\frac{2}{3} + \left(-\frac{5}{6}\right) = -\frac{3}{2}$$

50. The numbers have different signs so subtract the smaller absolute value from the larger.

$$\left|-\frac{3}{4}\right| - \left|\frac{2}{3}\right| = \frac{3}{4} - \frac{2}{3} = \frac{3}{4} \cdot \frac{3}{3} - \frac{2}{3} \cdot \frac{4}{4} = \frac{9}{12} - \frac{8}{12} = \frac{1}{12}$$

Since  $\left|-\frac{3}{4}\right|$  is greater than  $\left|\frac{2}{3}\right|$ , the sum is negative.

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

52.  $-7498.34 + 6435.28 = -1063.06$

54.  $-38,487.26 + (-83,205.87) = -121,693.13$

56.  $-\frac{37}{642} + \left(-\frac{25}{983}\right) \approx -0.08$

58. Substitute  $-4$  for  $a$  and  $3$  for  $b$  in the expression  $b + a$  and then find the sum:  
 $(3) + (-4) = -4 + 3 = -1$

60. Substitute  $3$  for  $b$  and  $-2$  for  $c$  in the expression  $b + c$  and then find the sum:  
 $(3) + (-2) = -2 + 3 = 1$

62.  $x + 3$   
 Substitute  $-6$  for  $x$  in the expression and then find the sum:  $(-6) + 3 = -3$

64.  $x + (-8)$   
 Substitute  $-6$  for  $x$  in the expression and then find the sum:  $(-6) + (-8) = -14$

66. The balance is  $-112.50 + 170$  dollars.  
 The numbers have different signs so subtract the smaller absolute value from the larger.  
 $|170| - |-112.50| = 170 - 112.50 = 57.50$   
 Since  $|170|$  is greater than  $|-112.50|$ , the sum is positive:  $-112.50 + 170 = 57.50$   
 So, the balance is \$57.50.

68. We can find the final balance by finding the balance after each transaction.

Transaction	Balance
Paycheck	$-135.00 + 549.00 = 414.00$
FedEx Kinko's	$414.00 - 10.74 = 403.26$
ATM	$403.26 - 21.50 = 381.76$
Barnes and Noble	$381.76 - 17.19 = 364.57$

So, the final balance is \$364.57.

70. The new balance is  $-2739 + 530$ .  
 The numbers have different signs so subtract the smaller absolute value from the larger.  
 $|-2739| - |530| = 2739 - 530 = 2209$   
 Since  $|-2739|$  is greater than  $|530|$ , the sum is negative.  
 $-2739 + 530 = -2209$   
 So, the new balance is  $-2209$  dollars.

72. The balance after sending the check is  $-873 + 500 = -373$ .  
 The balance after buying the racquet is  $-373 + (-249) = -622$ .  
 The balance after buying the outfit is  $-622 + (-87) = -709$ .  
 So, the final balance is  $-709$  dollars.

74. The current temperature is  $-12 + 8$ .  
 The numbers have different signs so subtract the smaller absolute value from the larger.  
 $|-12| - |8| = 12 - 8 = 4$   
 Since  $|-12|$  is greater than  $|8|$ , the sum is negative.  
 $-12 + 8 = -4$   
 So, the current temperature is  $-4^\circ$  F.

76. a.

Retail Price (dollars)	Sale Price (dollars)
350	$350 + (-35)$
400	$400 + (-35)$
450	$450 + (-35)$
500	$500 + (-35)$
$r$	$r + (-35)$

From the last row of the table, we see that the expression  $r + (-35)$  represents the sale price (in dollars).

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- b. Evaluate  $r + (-35)$  for  $r = 470$ .

$$470 + (-35) = 435$$

So, if the retail price is \$470, the sale price is \$435.

78. a.	Decrease in Temp (°F)	Current Temp (°F)
	1	$-2 + (-1)$
	2	$-2 + (-2)$
	3	$-2 + (-3)$
	4	$-2 + (-4)$
	$x$	$-2 + (-x)$

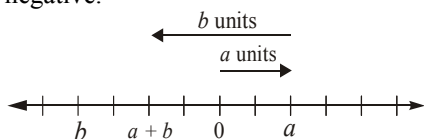
From the last row of the table, we see that the expression  $-2 + (-x)$  represents the current temperature (in °F).

- b. Evaluate  $-2 + (-x)$  for  $x = 7$ .

$$-2 + (-7) = -9$$

The current temperature is  $-9^\circ\text{F}$ .

80. If  $a$  is positive and  $b$  is negative (but with a larger absolute value), the sum  $a + b$  will be negative.



82. If  $a + b$  is positive, then both numbers are positive, or the numbers have opposite signs but the number with the larger absolute value is positive.

84. a. Substitute  $-2$  for  $a$  and  $5$  for  $b$ :

$$a + b = (-2) + 5 = 3$$

- b. Substitute  $-2$  for  $a$  and  $5$  for  $b$ :

$$b + a = 5 + (-2) = 3$$

- c. The results are the same.

- d. Substitute  $-4$  for  $a$  and  $-9$  for  $b$ :

$$a + b = -4 + (-9) = -13$$

$$b + a = -9 + (-4) = -13$$

The results are the same.

- e. Answers may vary.

- f. Yes; when adding two quantities, the order of the addition does not matter.

Homework 2.4

2.  $3 - 7 = 3 + (-7) = -4$

4.  $-3 - 9 = -3 + (-9) = -12$

6.  $5 - (-1) = 5 + 1 = 6$

8.  $-7 - (-3) = -7 + 3 = -4$

10.  $-4 - 7 = -4 + (-7) = -11$

12.  $-4 - (-7) = -4 + 7 = 3$

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

16.  $-100 - 257 = -100 + (-257) = -357$

18.  $-1939 - (-352) = -1939 + 352 = -1587$

20.  $5.8 - 3.7 = 5.8 + (-3.7) = 2.1$

22.  $-1.7 - 7.4 = -1.7 + (-7.4) = -9.1$

24.  $3.1 - (-3.1) = 3.1 + 3.1 = 6.2$

26.  $-159.24 - (-7.8) = -159.24 + 7.8 = -151.44$

28.  $-\frac{1}{5} - \frac{4}{5} = -\frac{1}{5} + \left(-\frac{4}{5}\right) = -\frac{5}{5} = -1$

30.  $-\frac{4}{9} - \left(-\frac{7}{9}\right) = -\frac{4}{9} + \frac{7}{9} = \frac{3}{9} = \frac{1}{3}$

32.  $\frac{5}{12} - \left(-\frac{1}{6}\right) = \frac{5}{12} + \frac{1}{6}$   
 $= \frac{5}{12} + \frac{1}{6} \cdot \frac{2}{2}$   
 $= \frac{5}{12} + \frac{2}{12}$   
 $= \frac{7}{12}$



$$\begin{aligned}
 34. \quad -\frac{2}{3} - \frac{2}{5} &= -\frac{2}{3} + \left(-\frac{2}{5}\right) \\
 &= -\frac{2}{3} \cdot \frac{5}{5} + \left(-\frac{2}{5} \cdot \frac{3}{3}\right) \\
 &= -\frac{10}{15} + \left(-\frac{6}{15}\right) \\
 &= -\frac{16}{15}
 \end{aligned}$$

36.  $-3 + 9 = 6$

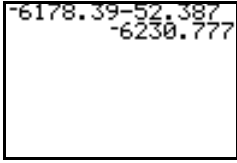
38.  $-4 - (-3) = -4 + 3 = -1$

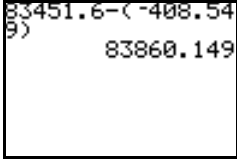
40.  $-\frac{5}{6} + \frac{1}{6} = -\frac{4}{6} = -\frac{2}{3}$

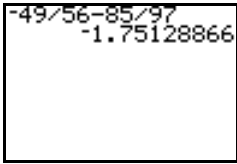
42.  $-6.4 + 3.5 = -2.9$

44.  $-5 + (-8) = -13$

46.  $5 - 9 = 5 + (-9) = -4$

48.   
 $-6178.39 - 52.387 \approx -6230.78$

50.   
 $83,451.6 - (-408.549) \approx 83,860.15$

52.   
 $-\frac{49}{56} - \frac{85}{97} \approx -1.75$

54.  $-12 + 18 = 6$   
 So, the current temperature is  $6^\circ\text{F}$ .

56.  $-13 - (-2) = -13 + 2 = -11$   
 The change in temperature is  $-11^\circ\text{F}$ .

58. a.  $9 - (-6) = 9 + 6 = 15$   
 The change in temperature is  $15^\circ\text{F}$ .

b. To estimate the change in temperature over the past hour, we divide the change over three hours by 3.  
 $\frac{15}{3} = 5$

The estimated change in temperature over the past hour is  $5^\circ\text{F}$ .

c. Answers may vary. Example:  
 The change in temperature is affected by the time of day in addition to the weather conditions. Thus, temperature change need not be uniform.

60.  $29,035 - (-1312) = 29,035 + 1312 = 30,347$   
 The change in elevation is 30,347 feet.

62. a.

Year	Population	Change in Population
2005	118	-
2006	136	$136 - 118 = 18$
2007	171	$171 - 136 = 35$
2008	124	$124 - 171 = -47$
2009	96	$96 - 124 = -28$
2010	97	$97 - 96 = 1$
2011	98	$98 - 97 = 1$

b. The change in population is the greatest from 2006 to 2007. The population change is 35.

c. The change in population is the least from 2007 to 2008. The population change is  $-47$ .

d. No; the change in population is the difference between births and deaths. An increase of 18 wolves means there were 18 more births than deaths.

64. a. Add the changes in the number of billions of bushels of corn harvested from 2005 to 2011:

$$10.8 + (-0.3) + 2.4 + (-0.8) + 1.1 + (-0.5) + 1.1 = 13.8$$

So, there were 13.8 billion bushels of corn harvested in 2011.

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- b. Increasing corn harvests are indicated by positive changes. Thus, harvests were increasing during the periods 2006–2007, 2008–2009, and 2010–2011.
- c. Decreasing corn harvests are indicated by negative changes. Thus, harvests were decreasing during the periods 2005–2006, 2007–2008, and 2009–2010.

66. a.

Current Value (dollars)	Change in Value (dollars)
30	$30 - 35$
35	$35 - 35$
40	$40 - 35$
45	$45 - 35$
$x$	$x - 35$

From the last row of the table, we see that the expression  $x - 35$  represents the change in value (in dollars) of the stock.

- b. Evaluate  $x - 35$  for  $x = 44$  :  
 $44 - 35 = 9$   
 So, if the current value is \$44, the stock has increased in value by \$9 from last year.

68. a.

Change in Population	Current Population
10	$10 + 820$
20	$20 + 820$
30	$30 + 820$
40	$40 + 820$
$c$	$c + 820$

From the last row of the table, we see that the expression  $c + 820$  represents the current population.

- b. Evaluate  $c + 820$  for  $c = -25$  :  
 $-25 + 820 = 795$   
 So, if the change in population is  $-25$ , the current population would be 795 due to the decrease in population of 25 deer in the past year.

70. Evaluate  $a + c$  for  $a = -5$  and  $c = -7$  :  
 $(-5) + (-7) = -12$

72. Evaluate  $c - a$  for  $a = -5$  and  $c = -7$  :  
 $(-7) - (-5) = -7 + 5 = -2$

74. Evaluate  $b - a$  for  $a = -5$  and  $b = 2$  :  
 $(2) - (-5) = 2 + 5 = 7$

76.  $x - 4$   
 Evaluate the expression for  $x = -5$  :  
 $-5 - 4 = -5 + (-4) = -9$

78.  $x - 5$   
 Evaluate the expression for  $x = -5$  :  
 $(-5) - 5 = -5 + (-5) = -10$

80.  $x - (-6)$   
 Evaluate the expression for  $x = -5$  :  
 $(-5) - (-6) = -5 + 6 = 1$

82. The student changed the order of the subtraction without changing the sign of the result.  
 $2 - 6 = 2 + (-6) = -4$

84. a. i.  $2 - 8 = 2 + (-8) = -6$

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

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

- b. Answers may vary. Example:  
 Since the quantity decreased, the final number is smaller than the beginning number. When finding the change in quantity, we subtract the beginning number from the final number. Since the final number is smaller, the result will be negative.

86. a. i.  $-2(-5) = 10$

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

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

- b. Answers may vary. Example:  
 The results are all positive.

c.  $-3(-7) = 3(7) = 21$

- d. Answers may vary. Example:  
 To multiply two negative numbers, multiply their absolute values.

88. Answers may vary. Example:  
In the first situation, the values were on the same side of 0 on a number line, so we subtract to find the distance between the two values on the number line. In the second situation, the values are on opposite sides of 0 on a number line. In this case, we add the distance each number is from 0 to get the overall distance between the numbers.

90. Answers may vary. Example:  
It is impossible to find the sign. If  $|x|$  is greater than  $|y|$ , then  $x - y$  is negative. If  $|x|$  is less than  $|y|$ , then  $x - y$  is positive.

### Homework 2.5

2.  $91\% = 91.0\% = 0.91$
4.  $4\% = 4.0\% = 0.04$
6.  $0.01 = 1\%$
8.  $3.8\% = 0.038$
10.  $0.089 = 8.9\%$
12.  $0.67(4) = 2.68$ ; so, 67% of \$4 is \$2.68.
14.  $0.08(4000) = 320$ ; so, 8% of 4000 students is 320 students.
16.  $0.064(3500) = 224$ ; so, 6.4% of 3500 cars is 224 cars.
18. Since the numbers have different signs, the product is negative:  $-5(4) = -20$
20. Since the numbers have the same sign, the product is positive:  $-8(-9) = 72$
22. Since the numbers have different signs, the product is negative:  $5(-2) = -10$
24. Since the numbers have different signs, the quotient is negative:  $-63 \div 7 = -9$
26. Since the numbers have different signs, the quotient is negative:  $24 \div (-3) = -8$
28. Since the numbers have the same sign, the quotient is positive:  $-1 \div (-1) = 1$
30. Since the numbers have the same sign, the product is positive:  $-124(-29) = 3596$
32. Since the numbers have different signs, the quotient is negative:  $1008 \div (-21) = -48$
34. Since the numbers have the same sign, the product is positive:  $-0.3(-0.3) = 0.09$
36. Since the numbers have different signs, the product is negative:  $3.7(-5.24) = -19.388$
38. Since the numbers have different signs, the quotient is negative:  $-0.12 \div 0.3 = -0.4$
40. Since the numbers have different signs, the quotient is negative:  $\frac{9}{-3} = 9 \div (-3) = -3$
42. Since the numbers have the same sign, the quotient is positive:  $\frac{-72}{-8} = -72 \div (-8) = 9$
44. Since the numbers have different signs, the product is negative:  $\frac{1}{3}\left(-\frac{7}{5}\right) = -\frac{7}{15}$
46. Since the numbers have the same sign, the product is positive:  $\left(-\frac{7}{25}\right)\left(-\frac{5}{21}\right) = \frac{35}{525} = \frac{1}{15}$
48. Since the numbers have different signs, the quotient is negative:  
$$-\frac{5}{7} \div \frac{15}{8} = -\frac{5}{7} \cdot \frac{8}{15} = -\frac{40}{105} = -\frac{8}{21}$$
50. Since the numbers have the same sign, the quotient is positive:  
$$-\frac{3}{8} \div \left(-\frac{9}{20}\right) = \frac{3}{8} \cdot \frac{20}{9} = \frac{60}{72} = \frac{5}{6}$$
52.  $-9 + (-4) = -13$
54.  $-49 \div (7) = -7$
56.  $-2 - 7 = -2 + (-7) = -9$
58.  $(-5)(-9) = 45$

$$\begin{aligned}
 60. \quad -\frac{8}{3} + \left(-\frac{5}{9}\right) &= -\frac{8 \cdot 3}{3 \cdot 3} + \left(-\frac{5}{9}\right) \\
 &= -\frac{24}{9} + \left(-\frac{5}{9}\right) \\
 &= \frac{-24 + (-5)}{9} \\
 &= -\frac{29}{9}
 \end{aligned}$$

$$62. \quad \frac{9}{2} \left(-\frac{4}{21}\right) = -\frac{36}{42} = -\frac{6}{7}$$

$$\begin{aligned}
 64. \quad -\frac{3}{8} - \left(-\frac{1}{10}\right) &= -\frac{3}{8} + \frac{1}{10} \\
 &= -\frac{3 \cdot 5}{8 \cdot 5} + \frac{1 \cdot 4}{10 \cdot 4} \\
 &= -\frac{15}{40} + \frac{4}{40} \\
 &= \frac{-15 + 4}{40} \\
 &= -\frac{11}{40}
 \end{aligned}$$

$$\begin{aligned}
 66. \quad -\frac{22}{9} \div \left(-\frac{33}{18}\right) &= -\frac{22}{9} \cdot \left(-\frac{18}{33}\right) \\
 &= \frac{2 \cdot 11 \cdot 2 \cdot 9}{9 \cdot 3 \cdot 11} \\
 &= \frac{2 \cdot 2}{3} \\
 &= \frac{4}{3}
 \end{aligned}$$

$$68. \quad \frac{-15}{35} = -\frac{3 \cdot 5}{7 \cdot 5} = -\frac{3}{7}$$

$$70. \quad \frac{-35}{-21} = \frac{7 \cdot 5}{7 \cdot 3} = \frac{5}{3}$$

$$72. \quad \frac{5}{-6} + \frac{1}{6} = \frac{-5}{6} + \frac{1}{6} = \frac{-5+1}{6} = \frac{-4}{6} = -\frac{2}{3}$$

$$74. \quad \frac{2}{3} - \left(-\frac{1}{3}\right) = \frac{2}{3} + \frac{1}{3} = \frac{2+1}{3} = \frac{3}{3} = 1$$

$$\begin{aligned}
 76. \quad \frac{1}{4} + \frac{5}{-6} &= \frac{1 \cdot 3}{4 \cdot 3} + \frac{-5 \cdot 2}{6 \cdot 2} \\
 &= \frac{3}{12} + \frac{-10}{12} \\
 &= \frac{3 + (-10)}{12} \\
 &= -\frac{7}{12}
 \end{aligned}$$

$$78. \quad \begin{array}{r} -489.2(-8.39) \\ \hline 4104.388 \end{array}$$

$$-489.2(-8.39) \approx 4104.39$$

$$80. \quad \begin{array}{r} 64.958 \div (-3.716) \\ \hline -17.48062433 \end{array}$$

$$64.958 \div (-3.716) \approx -17.48$$

$$82. \quad \begin{array}{r} (-169/175) \cdot (-64/71) \\ \hline .8705030181 \end{array}$$

$$-\frac{169}{175} \left(-\frac{64}{71}\right) \approx 0.87$$

$$84. \quad \begin{array}{r} (-75/22) \div (13/48) \\ \hline -12.58741259 \end{array}$$

$$-\frac{75}{22} \div \frac{13}{48} \approx -12.59$$

86. Evaluate  $ac$  for  $a = -6$  and  $c = -8$ :  
 $(-6)(-8) = 48$

88. Evaluate  $\frac{b}{a}$  for  $a = -6$  and  $b = 4$ :

$$\frac{4}{-6} = -\frac{2}{3}$$

90. Evaluate  $-bc$  for  $b = 4$  and  $c = -8$ :  
 $-(4)(-8) = -(-32) = 32$

92. Evaluate  $-\frac{a}{c}$  for  $a = -6$  and  $c = -8$ :

$$-\frac{(-6)}{(-8)} = -\frac{3}{4}$$

94.  $\frac{w}{4}$ ; Evaluate the expression for  $w = -8$ :

$$\frac{(-8)}{4} = -2$$

96.  $-2w$ ; Evaluate the expression for  $w = -8$ :  
 $-2(-8) = 16$
98.  $\frac{9}{15} = \frac{3}{5}$
100.  $\frac{2.2 \text{ million}}{1.1 \text{ million}} = \frac{2}{1}$   
 So, twice as many Americans attend Major League Baseball games regularly than attend National Football League games regularly.
102.  $\frac{4.7 \text{ million viewers}}{2.2 \text{ million viewers}} \approx \frac{2.14}{1}$   
 So, there were about 2.14 times as many viewers of Good Morning America than of The Early Show.
104. a.  $\frac{2 \text{ c mushrooms}}{4 \text{ c cooked noodles}} = \frac{0.5 \text{ c mushrooms}}{1 \text{ c cooked noodles}}$   
 For each cup of cooked noodles, a half cup of sliced mushrooms is required.
- b.  $\frac{4 \text{ c cooked noodles}}{2 \text{ c mushrooms}} = \frac{2 \text{ c cooked noodles}}{1 \text{ c mushrooms}}$   
 For each cup of sliced mushrooms, 2 cups of cooked noodles are required.
106. a.  $\frac{19,378,102}{8,791,894} \approx \frac{2.20}{1}$   
 The population of New York is about 2.20 times as great as the population of New Jersey.
- b.  $\frac{571,951}{155,959} \approx \frac{3.67}{1}$   
 The land area of Alaska is about 3.67 times as large as the land area of California.
- c. Alaska:  $\frac{710,231}{571,951} \approx \frac{1.24}{1}$   
 California:  $\frac{37,253,956}{155,959} \approx \frac{238.87}{1}$   
 Michigan:  $\frac{9,883,640}{56,804} \approx \frac{173.00}{1}$   
 New Jersey:  $\frac{8,791,894}{7417} \approx \frac{1185.37}{1}$   
 New York:  $\frac{19,378,102}{47,214} \approx \frac{410.43}{1}$
- d. New Jersey has the greatest population density, while Alaska has the least.
- e. The person is not correct.  
 Answers may vary. Example:  
 Although Michigan has a larger population than New Jersey, it also has a larger land area which serves to lower its population density.
108. a.  $\frac{-6810 \text{ dollars}}{-2950 \text{ dollars}} = \frac{681}{295} \approx \frac{2.31}{1}$
- b. For each \$1 he pays towards his Sears account, he should pay about \$2.31 towards his Visa account.
110.  $0.35(1590) = 556.50$   
 $-1590 + 556.5 = -1033.50$   
 The new balance would be  $-1033.50$  dollars.
112.  $3(89.50) = 268.50$   
 $0 - 268.50 = -268.50$   
 The new balance is  $-\$268.50$ .
114. a.  $-2 + 3 = 1$
- b.  $-2(3) = -6$
- c. The first statement is clearer because it indicates an operation as well. From parts (a) and (b), we see that just having one negative number and one positive number is not enough to guarantee that the result is negative.
- d. Answers may vary.
116. a. Negative; the quotient of two numbers with opposite signs is negative.
- b. Negative; the quotient of two numbers with opposite signs is negative.
- c. No; the variables  $a$  and  $b$  can take on positive or negative values, so the sign of the result is not clear without knowing the signs of  $a$  and  $b$ .
118. Answers may vary. Example:  
 $(-4)(5) = (-4) + (-4) + (-4) + (-4) + (-4)$   
 $= -20$
120. If  $ab$  is positive, we can say that the two numbers have the same sign. We cannot say if the two numbers are positive or negative, but we do know they have the same sign.

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122. If  $\frac{a}{b}$  is negative, we can say that the two numbers have different signs. We cannot say which is positive and which is negative, but we do know they have different signs.

124. a.  $(-1)(-1) = 1$   
 $(-1)(-1)(-1) = -1$   
 $(-1)(-1)(-1)(-1) = 1$   
 $(-1)(-1)(-1)(-1)(-1) = -1$

b. Multiplying  $-1$  by itself an even number of times yields 1 as the result, while doing so an odd number of times results in  $-1$ .

c. Since the number of  $-1$ 's is even, the result will be 1.

d. Since the number of  $-1$ 's is odd, the result will be  $-1$ .

126. a. Answers may vary. Example:  
2, 3, 4

b. Answers may vary. Example:  
0.1, 0.2, 0.3

c. For  $\frac{2}{x}$  to equal 2,  $x$  must be 1.

#### Homework 2.6

2.  $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 9 \cdot 3 \cdot 3 = 27 \cdot 3 = 81$

4.  $5^3 = 5 \cdot 5 \cdot 5 = 25 \cdot 5 = 125$

6.  $-7^2 = -(7 \cdot 7) = -49$

8.  $(-7)^2 = (-7)(-7) = 49$

10.  $\left(\frac{3}{5}\right)^3 = \left(\frac{3}{5}\right)\left(\frac{3}{5}\right)\left(\frac{3}{5}\right) = \frac{27}{125}$

12.  $8 \cdot (2 - 6) = 8(-4) = -32$

14.  $(2 + 8)(3 - 8) = (10)(-5) = -50$

16.  $-6 - (4 - 7) + 5 = -6 - (-3) + 5$   
 $= -6 + 3 + 5$   
 $= -3 + 5$   
 $= 2$

18.  $\frac{3-9}{2-4} = \frac{-6}{-2} = 3$

20.  $\frac{4-7}{-3-(-1)} = \frac{-3}{-3+1} = \frac{-3}{-2} = \frac{3}{2}$

22.  $\frac{1-9}{2-(-4)} = \frac{-8}{2+4} = \frac{-8}{6} = -\frac{4}{3}$

24.  $2 - 3 \cdot 5 = 2 - 15 = -13$

26.  $1 + 9 \cdot (-4) = 1 + (-36) = -35$

28.  $-16 \div (-4) \cdot 2 = 4 \cdot 2 = 8$

30.  $3 - 7 + 1 = -4 + 1 = -3$

32.  $2 - 4(9 - 6) = 2 - 4(3)$   
 $= 2 - 12$   
 $= -10$

34.  $2(2 - 5) + 10 \div 5 = 2(-3) + 10 \div 5$   
 $= -6 + 10 \div 5$   
 $= -6 + 2$   
 $= -4$

36.  $6(2 + 3) - 5 \cdot 7 = 6(5) - 5 \cdot 7 = 30 - 35 = -5$

38.  $-3 - [6 + 2(4 - 8)] = -3 - [6 + 2(-4)]$   
 $= -3 - [6 - 8]$   
 $= -3 - [-2]$   
 $= -1$

40.  $-2[4(3 - 8) + 1] = -2[4(-5) + 1]$   
 $= -2[-20 + 1]$   
 $= -2[-19]$   
 $= 38$

42.  $\frac{5}{6} + \frac{2}{3} \div \frac{2}{5} = \frac{5}{6} + \frac{2}{3} \cdot \frac{5}{2} = \frac{5}{6} + \frac{10}{6} = \frac{15}{6} = \frac{5}{2}$

44.  $8 - 3^2 = 8 - 9 = -1$

46.  $8(-2)^3 = 8(-8) = -64$

48.  $\frac{5^2}{2^5} = \frac{5 \cdot 5}{2 \cdot 2 \cdot 2 \cdot 2 \cdot 2} = \frac{25}{32}$

50.  $5^2 + 2^5 = 25 + 32 = 57$

52.  $-20 \div 2^2 = -20 \div 4 = -5$

54.  $4^3 - (-4)^3 = 64 - (-64) = 64 + 64 = 128$

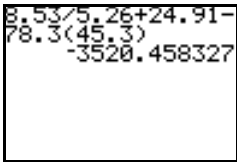
56.  $4(-2)^2 - 3 = 4(4) - 3 = 16 - 3 = 13$

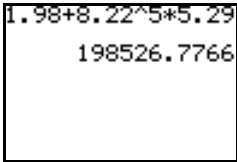
58.  $2(-4)^2 + 3(-4) - 7 = 2(16) + 3(-4) - 7$   
 $= 32 + (-12) - 7$   
 $= 20 - 7$   
 $= 13$

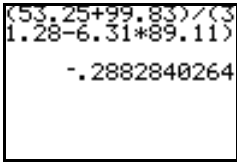
60.  $\frac{10 - (-2)^2}{3^3} = \frac{10 - (4)}{27} = \frac{6}{27} = \frac{2}{9}$

62.  $4 + (3 - 6)^2 - 2 = 4 + (-3)^2 - 2$   
 $= 4 + 9 - 2$   
 $= 13 - 2$   
 $= 11$

64.  $(9 - 7)^2 \cdot (-3) - 2^4 = (2)^2 \cdot (-3) - 2^4$   
 $= 4(-3) - 16$   
 $= -12 - 16$   
 $= -12 + (-16)$   
 $= -28$

66.   
 $8.53 \div 5.26 + 24.91 - 78.3(45.3) \approx -3520.46$

68.   
 $1.98 + 8.22^5 \cdot 5.29 \approx 198,526.78$

70.   
 $\frac{53.25 + 99.83}{31.28 - (6.31)(89.11)} \approx -0.29$

72. Evaluate  $ac - b$  for  $a = -2$ ,  $b = -4$ , and  $c = 3$ :  $(-2)(3) - (-4) = -6 + 4 = -2$

74. Evaluate  $c \div a + abc$  for  $a = -2$ ,  $b = -4$ , and  $c = 3$ :  
 $3 \div (-2) + (-2)(-4)(3) = -\frac{3}{2} + 24$   
 $= -\frac{3}{2} + \frac{48}{2}$   
 $= \frac{45}{2}$

76. Evaluate  $c^2 - b^2$  for  $b = -4$  and  $c = 3$ :  
 $(3)^2 - (-4)^2 = 9 - 16 = -7$

78. Evaluate  $-cb^2 + a^2$  for  $a = -2$ ,  $b = -4$ , and  $c = 3$ :  
 $-(3)(-4)^2 + (-2)^2 = -3(16) + (-2)^2$   
 $= -48 + 4$   
 $= -44$

80. Evaluate  $\frac{a^2 - b}{c^2 - b}$  for  $a = -2$ ,  $b = -4$ , and  $c = 3$ :  
 $\frac{(-2)^2 - (-4)}{(3)^2 - (-4)} = \frac{4 - (-4)}{9 - (-4)} = \frac{4 + 4}{9 + 4} = \frac{8}{13}$

82. Substitute  $a = 5$ ,  $b = -1$ ,  $c = -4$ , and  $d = 7$  in the expression  $\frac{a - b}{c - d}$ :  
 $\frac{(5) - (-1)}{(-4) - (7)} = \frac{5 + 1}{-4 + (-7)} = \frac{6}{-11} = -\frac{6}{11}$

84. Substitute  $a = -2$ ,  $b = 6$ ,  $c = 5$ , and  $d = -1$  in the expression  $\frac{a - b}{c - d}$ :  
 $\frac{(-2) - (6)}{(5) - (-1)} = \frac{-2 + (-6)}{5 + 1} = \frac{-8}{6} = -\frac{4}{3}$

86. Substitute  $a = -3$ ,  $b = -5$ ,  $c = -8$ , and  $d = -3$  in the expression  $\frac{a - b}{c - d}$ :  
 $\frac{(-3) - (-5)}{(-8) - (-3)} = \frac{-3 + 5}{-8 + 3} = \frac{2}{-5} = -\frac{2}{5}$

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88. Evaluate  $5x^2$  for  $x = -3$ :

$$5(-3)^2 = 5(9) = 45$$

90. Evaluate  $-4x^2 + 4$  for  $x = -3$ :

$$\begin{aligned} -4(-3)^2 + 4 &= -4(9) + 4 \\ &= -36 + 4 \\ &= -32 \end{aligned}$$

92. Evaluate  $4x^2 + x - 2$  for  $x = -3$ :

$$\begin{aligned} 4(-3)^2 + (-3) - 2 &= 4(9) + (-3) - 2 \\ &= 36 + (-3) - 2 \\ &= 33 - 2 \\ &= 31 \end{aligned}$$

94.  $-3 - \frac{8}{x}$

Evaluate the expression for  $x = -4$ :

$$\begin{aligned} -3 - \frac{8}{-4} &= -3 - (-2) \\ &= -3 + 2 \\ &= -1 \end{aligned}$$

96.  $x + x(-5)$

Evaluate the expression for  $x = -4$ :

$$-4 + (-4)(-5) = -4 + 20 = 16$$

98. a. 

Years since 2008	Number of Militia Groups
0	$375 \cdot 0 + 149$
1	$375 \cdot 1 + 149$
2	$375 \cdot 2 + 149$
3	$375 \cdot 3 + 149$
4	$375 \cdot 4 + 149$
$t$	$375t + 149$

Years since 2008	Number of Militia Groups
0	$375 \cdot 0 + 149$
1	$375 \cdot 1 + 149$
2	$375 \cdot 2 + 149$
3	$375 \cdot 3 + 149$
4	$375 \cdot 4 + 149$
$t$	$375t + 149$

From the last row of the table, we see that the expression  $375t + 149$  represents the number of militia groups  $t$  years after 2008.

- b. Substitute 8 for  $t$  in  $375t + 149$ :

$$375(8) + 149 = 3000 + 149 = 3149$$

So, in 2016 (8 years after 2008) the number of militia groups is predicted to be 3149.

100. a. 

Years Since 1990	Percent
0	$-1.1 \cdot 0 + 85$
1	$-1.1 \cdot 1 + 85$
2	$-1.1 \cdot 2 + 85$
3	$-1.1 \cdot 3 + 85$
4	$-1.1 \cdot 4 + 85$
$t$	$-1.1t + 85$

From the last row of the table, we see that the expression  $-1.1t + 85$  represents the percentage of companies offering traditional benefit plans  $t$  years since 1990.

- b. Substitute 27 for  $t$  in  $-1.1t + 85$ :

$$-1.1(27) + 85 = -29.7 + 85 = 55.3$$

So, 55.3% of companies in 2017 will offer traditional benefit plans.

102. The increase in revenue from electronic gaming software from 2010 to 2011 was 0.061(16.5) billion dollars. To find the revenue from electronic gaming software (in billions of dollars) in 2011, we add 0.061(16.5) to 16.5:
- $$16.5 + 0.061(16.5) = 16.5 + 1.0065 \approx 17.5$$

The revenue from electronic gaming software was about \$17.5 billion in 2011.

104. The increase in the number of people participating in the Supplemental Nutrition Assistance Program from 2010 to 2011 was 0.105(40) million. To find the number of people participating in the Supplemental Nutrition Assistance Program (in millions) in 2011, we add 0.105(40) to 40:
- $$40 + 0.105(40) = 40 + 4.2 = 44.2$$

About 44.2 million people participated in the Supplemental Nutrition Assistance Program in 2011.

106. The decrease in the number of U.S. troop deaths in the Afghanistan War from 2010 to 2011 was 0.17(499). To find the number of U.S. troop deaths in the Afghanistan War in 2011, we subtract 0.17(499) from 499:
- $$499 - 0.17(499) = 499 - 84.83 \approx 414$$

The number of U.S. troop deaths in the Afghanistan War was 414 in 2011.



108. The decrease in the revenue from televisions from 2009 to 2010 was 0.047(27.5) billion dollars. To find the revenue from televisions (in billion of dollars) in 2010, we subtract 0.047(27.5) from 27.5:  
 $27.5 - 0.047(27.5) = 27.5 - 1.2925 \approx 26.2$   
 The revenue from televisions was about \$26.2 billion in 2010.

110. Substitute 3 for  $r$  in the expression  $\frac{4}{3}\pi r^3$ :

$$\frac{4}{3}\pi(3)^3 = \frac{4}{3}\pi(27) = 36\pi$$

So, the volume is  $36\pi \approx 113.10$  cubic inches.

112. In the first line, the student only squared 3 instead of  $-3$ . Should be:

$$(-3)^2 + 4(-3) + 5 = 9 + (-12) + 5 = -3 + 5 = 2$$

114. The student did not perform multiplication and division in the correct order (from left to right).  $16 \div 2 \cdot 4 = 8 \cdot 4 = 32$ .

116. a.  $(12 \div 3) \cdot 2 = 4 \cdot 2 = 8$

b.  $12 \div (3 \cdot 2) = 12 \div 6 = 2$

- c. Yes, the order makes a difference:

L-R:  $12 \div 3 \cdot 2 = 4 \cdot 2 = 8$  (part (a))

R-L:  $12 \div 3 \cdot 2 = 12 \div 6 = 2$  (part (b))

- d. Order of operations dictates that we multiply and divide from left to right in the order that they appear. Therefore,  
 $12 \div 3 \cdot 2 = 4 \cdot 2 = 8$

118. a.  $(2+3)+4 = 5+4 = 9$

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

- c. The results are the same.

d.  $(4+(-2))+5 = 2+5 = 7$

$$4+(-2+5) = 4+3 = 7$$

The results are the same.

- e. Answers may vary. Example:

In each case, the results should be the same.

- f. Yes; this is the associative property of addition.

- g. Answers may vary. Example:

For a series of additions, the way in which the additions are grouped does not matter.

120. a. i.  $(-1)^2 = (-1)(-1) = 1$

ii.  $(-1)^3 = (-1)^2(-1) = 1(-1) = -1$

iii.  $(-1)^4 = (-1)^3(-1) = (-1)(-1) = 1$

iv.  $(-1)^5 = (-1)^4(-1) = 1(-1) = -1$

v.  $(-1)^{87} = (-1)^{86}(-1) = 1(-1) = -1$

vi.  $(-1)^{596} = 1$

- b.  $(-1)^n = 1$  when  $n$  is an even counting number. Answers may vary. Example:  
 The product of an even number of negative numbers is positive.

- c.  $(-1)^n = -1$  when  $n$  is an odd counting number. Answers may vary. Example:  
 The product of an odd number of negative numbers is negative.

122. Answers may vary.

### Chapter 2 Review

1.  $8 + (-2) = 6$

2.  $(-5) + (-7) = -12$

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

4.  $8 - (-2) = 8 + 2 = 10$

5. Since the numbers have different signs, the product will be negative:  $8(-2) = -16$

6. Since the numbers have different signs, the quotient will be negative:  $8 \div (-2) = -4$

7.  $-24 \div (10 - 2) = -24 \div (8) = -3$

8.  $(2 - 6)(5 - 8) = (-4)(-3) = 12$

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9.  $\frac{7-2}{2-7} = \frac{5}{-5} = -\frac{5}{5} = -1$
10.  $\frac{2-8}{3-(-1)} = \frac{2-8}{3+1} = \frac{-6}{4} = -\frac{6}{4} = -\frac{3}{2}$
11.  $\frac{3-5(-6)}{-2-1} = \frac{3-(-30)}{-2-1}$   
 $= \frac{3+30}{-2+(-1)}$   
 $= \frac{33}{-3}$   
 $= -\frac{33}{3}$   
 $= -11$
12.  $3(-5) + 2 = -15 + 2 = -13$
13.  $-4 + 2(-6) = -4 + (-12) = -16$
14.  $2 - 12 \div 2 = 2 - 6 = -4$
15.  $8 \div (-2) \cdot 5 = (-4) \cdot 5 = -20$
16.  $4 - 6(7 - 2) = 4 - 6(5) = 4 - 30 = -26$
17.  $2(4 - 7) - (8 - 2) = 2(-3) - (6)$   
 $= (-6) - (6)$   
 $= (-6) + (-6)$   
 $= -12$
18.  $-2(3 - 6) + 18 \div (-9) = -2(-3) + 18 \div (-9)$   
 $= 6 + 18 \div (-9)$   
 $= 6 + (-2)$   
 $= 4$
19.  $-14 \div (-7) - 3(1 - 5) = -14 \div (-7) - 3(-4)$   
 $= 2 - 3(-4)$   
 $= 2 - (-12)$   
 $= 2 + 12$   
 $= 14$
20.  $-5 - [3 + 2(1 - 7)] = -5 - [3 + 2(-6)]$   
 $= -5 - [3 - 12]$   
 $= -5 - [-9]$   
 $= -5 + 9$   
 $= 4$
21.  $4.2 - (-6.7) = 4.2 + 6.7 = 10.9$
22.  $\frac{4}{9} \left( -\frac{3}{10} \right) = -\frac{12}{90} = -\frac{2}{15}$
23.  $\left( -\frac{8}{15} \right) \div \left( -\frac{16}{25} \right) = \left( -\frac{8}{15} \right) \left( -\frac{25}{16} \right)$   
 $= \frac{8 \cdot 25}{15 \cdot 16}$   
 $= \frac{200}{240}$   
 $= \frac{5}{6}$
24.  $\frac{5}{9} - \left( -\frac{2}{9} \right) = \frac{5}{9} + \frac{2}{9} = \frac{5+2}{9} = \frac{7}{9}$
25.  $-\frac{5}{6} + \frac{7}{8} = -\frac{5}{6} \cdot \frac{4}{4} + \frac{7}{8} \cdot \frac{3}{3}$   
 $= \frac{-20}{24} + \frac{21}{24}$   
 $= \frac{-20+21}{24}$   
 $= \frac{1}{24}$
26.  $\frac{-5}{2} - \frac{7}{-3} = \frac{-5}{2} + \frac{7}{3}$   
 $= \frac{-5}{2} \cdot \frac{3}{3} + \frac{7}{3} \cdot \frac{2}{2}$   
 $= \frac{-15}{6} + \frac{14}{6}$   
 $= \frac{-15+14}{6}$   
 $= -\frac{1}{6}$
27.  $(-8)^2 = (-8)(-8) = 64$
28.  $-8^2 = -(8 \cdot 8) = -64$
29.  $2^4 = 2 \cdot 2 \cdot 2 \cdot 2 = 16$
30.  $\left( \frac{3}{4} \right)^3 = \frac{3}{4} \cdot \frac{3}{4} \cdot \frac{3}{4} = \frac{3 \cdot 3 \cdot 3}{4 \cdot 4 \cdot 4} = \frac{27}{64}$
31.  $-6(3)^2 = -6(3 \cdot 3) = -6(9) = -54$
32.  $24 \div 2^3 = 24 \div (2 \cdot 2 \cdot 2) = 24 \div 8 = 3$

$$\begin{aligned}
 33. \quad (-2)^3 - 4(-2) &= (-2)(-2)(-2) - 4(-2) \\
 &= -8 - 4(-2) \\
 &= -8 - (-8) \\
 &= -8 + 8 \\
 &= 0
 \end{aligned}$$

$$34. \quad \frac{2^3}{3+3^2} = \frac{2 \cdot 2 \cdot 2}{3+(3 \cdot 3)} = \frac{8}{3+9} = \frac{8}{12} = \frac{2}{3}$$

$$\begin{aligned}
 35. \quad \frac{17 - (-3)^2}{5 - 4^2} &= \frac{17 - (-3)(-3)}{5 - (4 \cdot 4)} \\
 &= \frac{17 - 9}{5 - 16} \\
 &= \frac{8}{-11} \\
 &= -\frac{8}{11}
 \end{aligned}$$

$$\begin{aligned}
 36. \quad -3(2)^2 - 4(2) + 1 &= -3(2 \cdot 2) - 4(2) + 1 \\
 &= -3(4) - 4(2) + 1 \\
 &= -12 - 8 + 1 \\
 &= -20 + 1 \\
 &= -19
 \end{aligned}$$

$$\begin{aligned}
 37. \quad 24 \div (3 - 5)^3 &= 24 \div (-2)^3 \\
 &= 24 \div [(-2)(-2)(-2)] \\
 &= 24 \div (-8) \\
 &= -3
 \end{aligned}$$

$$\begin{aligned}
 38. \quad 7^2 - 3(2 - 5)^2 \div (-3) &= 7^2 - 3(-3)^2 \div (-3) \\
 &= (7 \cdot 7) - 3[(-3)(-3)] \div (-3) \\
 &= 49 - 27 \div (-3) \\
 &= 49 - (-9) \\
 &= 49 + 9 \\
 &= 58
 \end{aligned}$$

$$39. \quad \frac{-18}{-24} = \frac{18}{24} = \frac{2 \cdot 3 \cdot 3}{2 \cdot 2 \cdot 2 \cdot 3} = \frac{3}{2 \cdot 2} = \frac{3}{4}$$

$$40. \quad \frac{-28}{35} = -\frac{28}{35} = -\frac{2 \cdot 2 \cdot 7}{5 \cdot 7} = -\frac{2 \cdot 2}{5} = -\frac{4}{5}$$

$$\begin{array}{|l}
 \hline
 -5.7+2.3^4 \div (-9.4) \\
 \hline
 -8.677031915 \\
 \hline
 \end{array}$$

$$-5.7 + 2.3^4 \div (-9.4) \approx -8.68$$

$$\begin{array}{|l}
 \hline
 (3.5 * 17.4 - 97.6) \div \\
 (54.2 \div 8.4 - 65.3) \\
 \hline
 .6236446027 \\
 \hline
 \end{array}$$

$$\frac{3.5(17.4) - 97.6}{54.2 \div 8.4 - 65.3} \approx 0.62$$

43. Substitute  $\frac{1}{4}$  for  $W$  and  $\frac{5}{6}$  for  $L$  in the expression  $2L + 2W$  :

$$\begin{aligned}
 2\left(\frac{5}{6}\right) + 2\left(\frac{1}{4}\right) &= \frac{2}{1} \cdot \frac{5}{6} + \frac{2}{1} \cdot \frac{1}{4} \\
 &= \frac{10}{6} + \frac{2}{4} \\
 &= \frac{10}{6} + \frac{1}{2} \\
 &= \frac{10}{6} + \frac{1}{2} \cdot \frac{3}{3} \\
 &= \frac{10}{6} + \frac{3}{6} \\
 &= \frac{13}{6}
 \end{aligned}$$

So, the perimeter of the rectangle is

$$\frac{13}{6} = 2\frac{1}{6} \text{ yards.}$$

$$\begin{aligned}
 44. \quad -4789 + 800 - (102.99 + 3.50) \\
 &= -4789 + 800 - 106.49 \\
 &= -3989 - 106.49 = -4095.49
 \end{aligned}$$

The student now owes the credit card company \$4095.49.

$$\begin{aligned}
 45. \quad 27,800 - 32,500 &= -4700 \\
 \text{The plane had a change in altitude of} \\
 &= -4700 \text{ feet.}
 \end{aligned}$$

$$\begin{aligned}
 46. \quad \text{a. } -8 - 4 &= -12 \\
 \text{The change in temperature is } &= -12^\circ \text{F.}
 \end{aligned}$$

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- b. Divide the change for the past three hours by 3 to estimate the change over 1 hour.  

$$\frac{-12}{3} = -4$$
 The estimated change for the past hour is  $-4^\circ\text{F}$ .
- c. Answers may vary. Example:  
 Temperature need not change uniformly.
47. a.  $33.9 - 28.3 = 5.6$   
 The change in individual contributions to the Democratic nominee from 1996 to 2000 was \$5.6 million.
- b.  $220 - 259 = -39$   
 The change in individual contributions to the Republican nominee from 2004 to 2008 was  $-39$  million dollars.
- c.  $454 - 215 = 239$   
 The greatest change in individual contributions to the Democratic nominee occurred between 2004 and 2008. The change was \$239 million.
- d.  $259 - 91.3 = 167.7$   
 The greatest change in individual contributions to the Republican nominee occurred between 2000 and 2004. The change was \$167.7 million.
48.  $\frac{41.5 \text{ messages per day}}{29.7 \text{ messages per day}} \approx \frac{1.40}{1}$   
 The number of messages sent or received per day in 2011 is 1.40 times larger than the number of messages sent or received per day in 2009.
49.  $75\% = 75.0\% = 0.75$
50.  $2.9\% = 0.029$
51.  $0.87(43) = 37.41$   
 So, 87% of \$43 is \$37.41.
52.  $0.08(925) = 74$   
 So, 8% of 925 students is 74 students.
53.  $-5493 + 0.2(5493) = -5493 + 1098.6$   
 $= -4394.4$   
 The new balance is  $-4394.4$  dollars.
54. Substitute 2 for  $a$  and  $-4$  for  $c$  in the expression  $ac + c \div a$ :  

$$(2)(-4) + (-4) \div (2) = -8 + (-4) \div (2)$$

$$= -8 + (-2)$$

$$= -10$$
55. Substitute 2 for  $a$ ,  $-5$  for  $b$ , and  $-4$  for  $c$  in the expression  $b^2 - 4ac$ :  

$$(-5)^2 - 4(2)(-4) = (-5)(-5) - 4(2)(-4)$$

$$= 25 - (-32)$$

$$= 25 + 32$$

$$= 57$$
56. Substitute 2 for  $a$ ,  $-5$  for  $b$ , and  $-4$  for  $c$  in the expression  $a(b - c)$ :  

$$(2)((-5) - (-4)) = 2(-5 + 4) = 2(-1) = -2$$
57. Substitute 2 for  $a$ ,  $-5$  for  $b$ , and  $-4$  for  $c$  in the expression  $\frac{-b - c^2}{2a}$ :  

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

$$= \frac{5 - 16}{4}$$

$$= \frac{-11}{4}$$

$$= -\frac{11}{4}$$
58. Substitute  $-4$  for  $c$  in the expression  $2c^2 - 5c + 3$ :  

$$2(-4)^2 - 5(-4) + 3 = 2(-4)(-4) - 5(-4) + 3$$

$$= 32 - (-20) + 3$$

$$= 32 + 20 + 3$$

$$= 52 + 3 = 55$$
59. Substitute 2 for  $a$ ,  $-5$  for  $b$ ,  $-4$  for  $c$ , and 10 for  $d$  in the expression  $\frac{a - b}{c - d}$ :  

$$\frac{(2) - (-5)}{(-4) - (10)} = \frac{2 + 5}{-4 + (-10)} = \frac{7}{-14} = -\frac{7}{14} = -\frac{1}{2}$$
60.  $x + 5$   
 Evaluate the expression for  $x = -3$ :  

$$(-3) + 5 = 2$$

61.  $-7 - x$

Evaluate the expression for  $x = -3$ :

$$-7 - (-3) = -7 + 3 = -4$$

62.  $2 - x(4)$

Evaluate the expression for  $x = -3$ :

$$2 - (-3)(4) = 2 - (-12) = 2 + 12 = 14$$

63.  $1 + \frac{-24}{x}$

Evaluate the expression for  $x = -3$ :

$$1 + \frac{-24}{-3} = 1 + 8 = 9$$

64. Substitute 650 for  $T$  and 13 for  $n$ .

$$\frac{650}{13} = 50$$

Each player must pay \$50 for the team to join the softball league.

65. a.

Time (hours)	Volume of Water (cubic feet)
0	$-50 \cdot 0 + 400$
1	$-50 \cdot 1 + 400$
2	$-50 \cdot 2 + 400$
3	$-50 \cdot 3 + 400$
4	$-50 \cdot 4 + 400$
$t$	$-50 \cdot t + 400$

From the last row of the table, we see that the expression  $-50t + 400$  represents the volume of water (in cubic feet) remaining in the basement after water has been pumped out for  $t$  hours.

b. Substitute 7 for  $t$  in  $-50t + 400$ :

$$-50(7) + 400 = -350 + 400 = 50$$

After 7 hours of pumping, there will be 50 cubic feet of water remaining in the basement.

66. The decrease in the number of Americans who flew to Europe from 2007 to 2011 was 0.188(13.3) million. To find the number of Americans who flew to Europe in 2011, we subtract 0.188(13.3) (in millions) from 13.3 million:

$$13.3 - 0.188(13.3) = 13.3 - 2.5004 = 10.7996$$

The number of Americans who flew to Europe in 2011 was about 10.8 million.

### Chapter 2 Test

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

2. Since the two numbers have the same sign, the product will be positive:  $-7(-9) = 63$

3.  $-3 + 9 \div (-3) = -3 + (-3) = -6$

4.  $(4 - 2)(3 - 7) = (2)(-4) = -8$

5.  $\frac{4 - 7}{-1 - 5} = \frac{-3}{-6} = \frac{1}{2}$

6.  $5 - (2 - 10) \div (-4) = 5 - (-8) \div (-4) = 5 - 2 = 3$

7.  $-20 \div 5 - (2 - 9)(-3) = -20 \div 5 - (-7)(-3)$   
 $= -4 - 21$   
 $= -25$

8. Since the two numbers have different signs, the product will be negative:

$$0.4(-0.2) = -0.08$$

9.  $-\frac{27}{10} \div \frac{18}{75} = -\frac{27}{10} \cdot \frac{75}{18}$   
 $= -\frac{3 \cdot 3 \cdot 3 \cdot 3 \cdot 5 \cdot 5}{2 \cdot 5 \cdot 2 \cdot 3 \cdot 3}$   
 $= -\frac{3 \cdot 3 \cdot 5}{2 \cdot 2}$   
 $= -\frac{45}{4}$

10.  $-\frac{3}{10} + \frac{5}{8} = -\frac{3}{10} \cdot \frac{4}{4} + \frac{5}{8} \cdot \frac{5}{5}$   
 $= \frac{-12}{40} + \frac{25}{40}$   
 $= \frac{-12 + 25}{40}$   
 $= \frac{13}{40}$

11.  $3^4 = 3 \cdot 3 \cdot 3 \cdot 3 = 81$

12.  $-4^2 = -(4 \cdot 4) = -16$

13.  $7 + 2^3 - 3^2 = 7 + (2 \cdot 2 \cdot 2) - (3 \cdot 3)$   
 $= 7 + 8 - 9$   
 $= 15 - 9$   
 $= 6$

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$$\begin{aligned}
 14. \quad 1 - (3 - 7)^2 + 10 \div (-5) &= 1 - (-4)^2 + 10 \div (-5) \\
 &= 1 - (-4)(-4) + 10 \div (-5) \\
 &= 1 - 16 + (-2) \\
 &= -15 + (-2) \\
 &= -17
 \end{aligned}$$

$$15. \quad \frac{84}{-16} = -\frac{84}{16} = -\frac{2 \cdot 2 \cdot 3 \cdot 7}{2 \cdot 2 \cdot 2 \cdot 2} = -\frac{3 \cdot 7}{2 \cdot 2} = -\frac{21}{4}$$

$$16. \quad 5 - 9 = 5 + (-9) = -4$$

The current temperature is  $-4^\circ\text{F}$ .

17. a.  $6.5 - 5.8 = 0.7$   
The change in the tax audit rate from 2001 to 2003 was 0.7 audit per 1000 returns.

b.  $5.8 - 9.0 = -3.2$   
The change in the tax audit rate from 1999 to 2001 was  $-3.2$  audits per 1000 returns.

c. From 2003 to 2005, the change was 3.2 audits per 1000 returns.

18.  $\frac{26.92}{9.14} \approx \frac{2.95}{1}$   
The average ticket price in 2012 was about 2.95 times the average price in 1991.

19. Substitute  $-6$  for  $a$ ,  $-2$  for  $b$ , and  $5$  for  $c$  in the expression  $ac - \frac{a}{b}$ :

$$\begin{aligned}
 (-6)(5) - \frac{(-6)}{(-2)} &= -30 - \frac{(-6)}{(-2)} \\
 &= -30 - 3 \\
 &= -30 + (-3) \\
 &= -33
 \end{aligned}$$

20. Substitute  $-6$  for  $a$ ,  $-2$  for  $b$ ,  $5$  for  $c$ , and  $-1$  for  $d$  in the expression  $\frac{a-b}{c-d}$ :

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

21. Substitute  $-6$  for  $a$ ,  $-2$  for  $b$ , and  $5$  for  $c$  in the expression  $a + b^3 + c^2$ :

$$\begin{aligned}
 (-6) + (-2)^3 + (5)^2 \\
 &= (-6) + (-2)(-2)(-2) + (5 \cdot 5) \\
 &= -6 + (-8) + 25 \\
 &= -14 + 25 \\
 &= 11
 \end{aligned}$$

22. Substitute  $-6$  for  $a$ ,  $-2$  for  $b$ , and  $5$  for  $c$  in the expression  $b^2 - 4ac$ :

$$\begin{aligned}
 (-2)^2 - 4(-6)(5) &= (-2)(-2) - 4(-6)(5) \\
 &= 4 - (-120) \\
 &= 4 + 120 \\
 &= 124
 \end{aligned}$$

23.  $2x - 3x$   
Evaluate the expression for  $x = -5$ :  
 $2(-5) - 3(-5) = -10 - (-15) = -10 + 15 = 5$

24.  $\frac{-10}{x} - 6$   
Evaluate the expression for  $x = -5$ :  
 $\frac{-10}{-5} - 6 = 2 - 6 = -4$

Years since 2010	First - Class Mail Volume (billions of pieces)
0	$-4.9(0) + 78.2$
1	$-4.9(1) + 78.2$
2	$-4.9(2) + 78.2$
3	$-4.9(3) + 78.2$
4	$-4.9(4) + 78.2$
$t$	$-4.9t + 78.2$

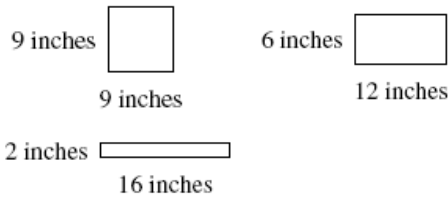
From the last row of the table, we see that the expression  $-4.9t + 78.2$  represents the U.S. Postal Service first-class mail volume (in billions of pieces) in the year that is  $t$  years since 2010.

b. Substitute 8 for  $t$  in  $-4.9t + 78.2$ :  
 $-4.9(8) + 78.2 = -39.2 + 78.2 = 39$   
So, the first-class mail volume will be 39 billion pieces in 2018.

26. The decrease in the number of California methamphetamine labs busted from 2010 to 2011 was  $0.419(203)$ . To find the number of California methamphetamine labs busted in 2011, we subtract  $0.419(203)$  from 203:  
 $203 - 0.419(203) = 203 - 85.057 = 117.943$   
The number of California methamphetamine labs busted in 2011 was about 118.

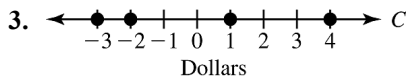
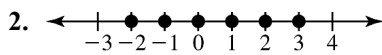
Cumulative Review of Chapters 1 and 2

1. a. Answers may vary. Example:



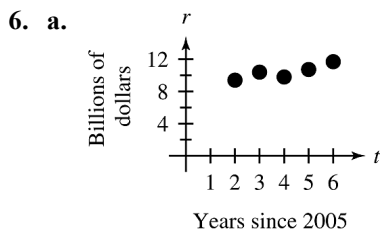
b.  $W$  and  $L$  are variables because their values are not fixed.

c.  $P$  is a constant because the perimeter is fixed at 36 inches.



4. The  $x$ -coordinate is  $-5$ .

5. Independent variable:  $t$   
 Dependent variable:  $V$



b. The revenue was the most in 2011.

c. The revenue was the least in 2007.

d. The revenue decreased the most between 2008 and 2009. The change in revenue was  $9.8 - 10.4 = -0.6$  billion dollars.

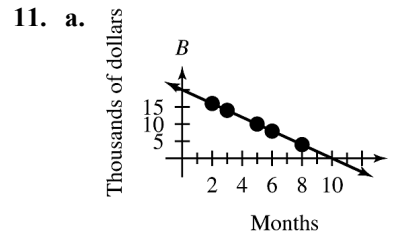
e. The revenue increased the most from 2007 to 2008 and from 2010 to 2011;. The change in revenue was  $10.4 - 9.4 = 1.0$  billion dollars.

7. The input  $x = -4$  leads to the output  $y = -3$ , so  $y = -3$  when  $x = -4$ .

8. The output  $y = 1$  originates from the input  $x = 4$ , so  $y = 1$  when  $x = 4$ .

9. The line and the  $y$ -axis intersect at the point  $(0, -1)$  so the  $y$ -intercept is  $(0, -1)$ .

10. The line and the  $x$ -axis intersect at the point  $(2, 0)$ , so the  $x$ -intercept is  $(2, 0)$ .

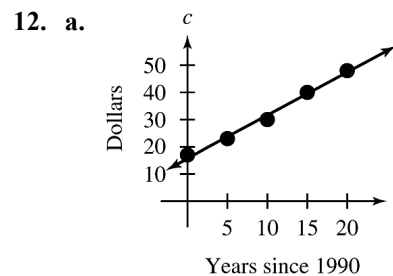


b. The input  $t = 4$  leads to the output  $B = 12$ , so the balance is \$12 thousand after 4 months.

c. The output  $B = 6$  originates from the input  $t = 7$ , so the balance will be \$6 thousand after 7 months.

d. The line and the  $B$ -axis intersect at the point  $(0, 20)$ , so the  $B$ -intercept is  $(0, 20)$ . The original balance was \$20 thousand when she was laid off.

e. The line and the  $t$ -axis intersect at the point  $(10, 0)$ , so the  $t$ -intercept is  $(10, 0)$ . The checking account will be depleted after 10 months.



b. Draw a line that comes close to the points to create the linear model. See the graph in part (a).

c. The line and the  $c$ -axis intersect at the point  $(0, 16)$ , so the  $c$ -intercept is  $(0, 16)$ . The average monthly basic rate for cable TV in 1990 was \$16.

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- d. The output  $c = 63$  originates roughly from the input  $t = 30$ , so the average monthly basic rate for cable TV will be \$63 in 2020.
- e. For 2018, the input is  $t = 28$ . The input  $t = 28$  leads roughly to the output  $c = 60$ , so the average monthly basic rate for cable TV will be \$60 in 2018.
13.  $\frac{3(-8)+15}{2-7(2)} = \frac{-24+15}{2-14} = \frac{-9}{-12} = \frac{3}{4}$
14.  $-4(3)+6-20 \div (-10) = -12+6-20 \div (-10)$   
 $= -12+6-(-2)$   
 $= -12+6+2$   
 $= -6+2$   
 $= -4$
15.  $\left(-\frac{14}{15}\right) \div \left(-\frac{35}{27}\right) = \left(-\frac{14}{15}\right) \left(-\frac{27}{35}\right)$   
 $= \frac{14}{15} \cdot \frac{27}{35}$   
 $= \frac{2 \cdot 7 \cdot 3 \cdot 3 \cdot 3}{3 \cdot 5 \cdot 5 \cdot 7}$   
 $= \frac{2 \cdot 3 \cdot 3}{5 \cdot 5}$   
 $= \frac{18}{25}$
16.  $\frac{3}{8} - \frac{5}{6} = \frac{3}{8} \cdot \frac{3}{3} - \frac{5}{6} \cdot \frac{4}{4} = \frac{9}{24} - \frac{20}{24} = \frac{9-20}{24} = -\frac{11}{24}$
17.  $4 - (7-9)^4 + 20 \div (-4)$   
 $= 4 - (-2)^4 + 20 \div (-4)$   
 $= 4 - (-2)(-2)(-2)(-2) + 20 \div (-4)$   
 $= 4 - 16 + 20 \div (-4)$   
 $= 4 - 16 + (-5)$   
 $= -12 + (-5)$   
 $= -17$
18.  $\frac{5-3^2}{4^2+2} = \frac{5-(3 \cdot 3)}{(4 \cdot 4)+2} = \frac{5-9}{16+2} = \frac{-4}{18} = -\frac{4}{18} = -\frac{2}{9}$
19.  $-3 - 5 = -8$   
The change in temperature is  $-8^\circ\text{F}$ .
20.  $-2692 + 850 - 23 = -1842 - 23 = -1865$   
The student will now owe the credit card company \$1865.
21. Substitute 1 for  $a$ ,  $-4$  for  $b$ ,  $-3$  for  $c$ , and 7 for  $d$  in the expression  $\frac{a-b}{c-d}$ :  
 $\frac{(1)-(-4)}{(-3)-(-7)} = \frac{1+4}{-3+(-7)} = \frac{5}{-10} = -\frac{5}{10} = -\frac{1}{2}$
22. Substitute 2 for  $a$ ,  $-3$  for  $b$ , and  $-5$  for  $c$  in the expression  $b^2 - 4ac$ :  
 $(-3)^2 - 4(2)(-5) = (-3)(-3) - 4(2)(-5)$   
 $= 9 - (-40)$   
 $= 9 + 40$   
 $= 49$
23.  $x - \frac{(-12)}{x}$   
Evaluate the expression for  $x = -4$ :  
 $(-4) - \frac{(-12)}{(-4)} = (-4) - 3 = (-4) + (-3) = -7$
24.  $-2x + 7$   
Evaluate the expression for  $x = -4$ :  
 $-2(-4) + 7 = 8 + 7 = 15$
25. Evaluate  $\frac{100(v-42)}{42}$  for  $v = 45$ :  
 $\frac{100(45-42)}{42} = \frac{100(3)}{42} = \frac{300}{42} = \frac{50}{7} \approx 7.14$   
A stock value today of \$45 represents about a 7.14% growth of the investment.
26. a. 

Years since 2005	Sales (thousands of motorcycles)
0	$4 \cdot 0 + 15$
1	$4 \cdot 1 + 15$
2	$4 \cdot 2 + 15$
3	$4 \cdot 3 + 15$
4	$4 \cdot 4 + 15$
$t$	$4t + 15$

From the last row of the table, we see that the expression  $4t + 15$  represents the sales (in thousands of motorcycles) in the year that is  $t$  years since 2005.

b. Evaluate  $4t + 15$  for  $t = 12$ :  
 $4(12) + 15 = 48 + 15 = 63$   
In 2017 (12 years after 2005), the motorcycle company will sell 63 thousand motorcycles.