Subtraction with Whole Numbers

In business, subtraction is used to calculate profit. Profit is found by subtracting costs from revenue. The following double bar chart shows the costs and revenue of the Baby Steps Shoe Company during one 4-week period.

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To find the profit for Week 1, we subtract the costs from the revenue, as follows:

$$\text{Profit} = \$6{,}000 - \$5{,}000$$

$$\text{Profit} = \$1{,}000$$

Subtraction is the opposite operation of addition. If you understand addition and can work simple addition problems quickly and accurately, then subtraction shouldn't be difficult for you.

Vocabulary

The word *difference* always indicates subtraction. We can state this in symbols by letting the letters *a* and *b* represent numbers.

Difference

The **difference** of two numbers *a* and *b* is

$$a - b$$

Table 1 gives some word statements involving subtraction and their mathematical equivalents written in symbols.

In English	In Symbols
The difference of 9 and 1	$9 - 1$
The difference of 1 and 9	$1 - 9$
The difference of m and 4	$m - 4$
The difference of x and y	$x - y$
3 subtracted from 8	$8 - 3$
2 subtracted from t	$t - 2$
The difference of 7 and 4 is 3	$7 - 4 = 3$
The difference of 9 and 3 is 6	$9 - 3 = 6$

Table 1

The Meaning of Subtraction

When we want to subtract 3 from 8, we write

$$8 - 3, \qquad 8 \text{ subtract } 3, \qquad \text{or} \qquad 8 \text{ minus } 3$$

The number we are looking for here is the difference between 8 and 3, or the number we add to 3 to get 8. That is:

$$8 - 3 = ? \qquad \text{is the same as} \qquad ? + 3 = 8$$

In both cases we are looking for the number we add to 3 to get 8. The number we are looking for is 5. We have two ways to write the same statement.

Subtraction   Addition

$$8 - 3 = 5 \qquad \text{or} \qquad 5 + 3 = 8$$

For every subtraction problem, there is an equivalent addition problem. Table 2 lists some examples.

Subtraction		Addition
$7 - 3 = 4$	because	$4 + 3 = 7$
$9 - 7 = 2$	because	$2 + 7 = 9$
$10 - 4 = 6$	because	$6 + 4 = 10$
$15 - 8 = 7$	because	$7 + 8 = 15$

Table 2

To subtract numbers with two or more digits, we align the numbers vertically and subtract in columns.

VIDEO EXAMPLES

SECTION R.4

Example 1   Subtract $376 - 241$.

Solution We write the problem vertically, aligning digits with the same place value. Then we subtract in columns.

$$\begin{array}{r} 376 \\ -\ 241 \\ \hline 135 \end{array}$$ ⟵ Subtract the bottom number in each column from the number above it

We can visualize Example 1 using money.

$$\begin{array}{r} \$300 \\ -\ \$200 \\ \hline \$100 \end{array} \qquad \begin{array}{r} \$70 \\ -\ \$40 \\ \hline \$30 \end{array} \qquad \begin{array}{r} \$6 \\ -\ \$1 \\ \hline \$5 \end{array}$$

Example 2   Subtract 503 from 7,835.

Solution In symbols this statement is equivalent to

$$7{,}835 - 503$$

To subtract we write 503 below 7,835 and then subtract in columns.

$$
\begin{array}{ccccc}
 & 7 & 8 & 3 & 5 \\
- & & 5 & 0 & 3 \\
\hline
 & 7 & 3 & 3 & 2 \\
\end{array}
$$

$5 - 3 = 2$	Ones
$3 - 0 = 3$	Tens
$8 - 5 = 3$	Hundreds
$7 - 0 = 7$	Thousands

The answer is 7,332.

Applying the Concepts

Example 3   In the introduction to this section, we used a bar chart to show the revenue and costs for the Baby Steps Shoe Company over a 4-week period. In week 3, the revenue was $8,400 and the costs totaled $6,300. Recalling that

$$\text{profit} = \text{revenue} - \text{costs}$$

what was the profit for the company in week 3?

Solution Subtracting as we did in Examples 1 and 2, we have

$$
\begin{array}{r}
8{,}400 \\
-6{,}300 \\
\hline
2{,}100 \\
\end{array}
$$

The profit for week 3 was $2,100.

   As you can see, subtraction problems like the ones in Examples 1-3 are fairly simple. We write the problem vertically, lining up the digits with the same place value, and subtract in columns. We always subtract the bottom number from the top number.

Subtraction with Borrowing

Subtraction must involve *borrowing* when the bottom digit in any column is larger than the digit above it. In one sense borrowing is the reverse of the carrying we did in addition.

Example 4   Subtract $92 - 45$.

Solution We write the problem vertically with the place values of the digits showing:

$$92 = 9 \text{ tens} + 2 \text{ ones}$$
$$- 45 = 4 \text{ tens} + 5 \text{ ones}$$

Look at the ones column. We cannot subtract immediately, because 5 is larger than 2. Instead, we borrow 1 ten from the 9 tens in the tens column. We can rewrite the number 92 as

$$9 \text{ tens} + 2 \text{ ones}$$
$$= 8 \text{ tens} + 1 \text{ ten} + 2 \text{ ones}$$
$$= 8 \text{ tens} + 12 \text{ ones}$$

> **Note** The discussion here shows why borrowing is necessary and how we go about it. To understand borrowing you should pay close attention to this discussion.

Now we are in a position to subtract.

$$92 = 9 \text{ tens} + 2 \text{ ones} = 8 \text{ tens} + 12 \text{ ones}$$
$$- 45 = 4 \text{ tens} + 5 \text{ ones} = 4 \text{ tens} + 5 \text{ ones}$$
$$\overline{\phantom{92 = 9 \text{ tens} + 2 \text{ ones} = }4 \text{ tens} + 7 \text{ ones}}$$

The result is 4 tens + 7 ones, which can be written in standard form as 47.

Writing the problem out in this way is more trouble than is actually necessary. The shorthand form of the same problem looks like this:

$$
\begin{array}{cc}
8 & 12 \\
9 & 2 \\
-4 & 5 \\
\hline
4 & 7 \\
\end{array}
$$

← — This shows we have borrowed 1 ten to go with the 2 ones

$12 - 5 = 7$ Ones
$8 - 4 = 4$ Tens

This shortcut form shows all the necessary work involved in subtraction with borrowing. We will use it from now on.

The borrowing that changed 9 tens + 2 ones into 8 tens + 12 ones can be visualized with money.

$90 $2   = $80 $12
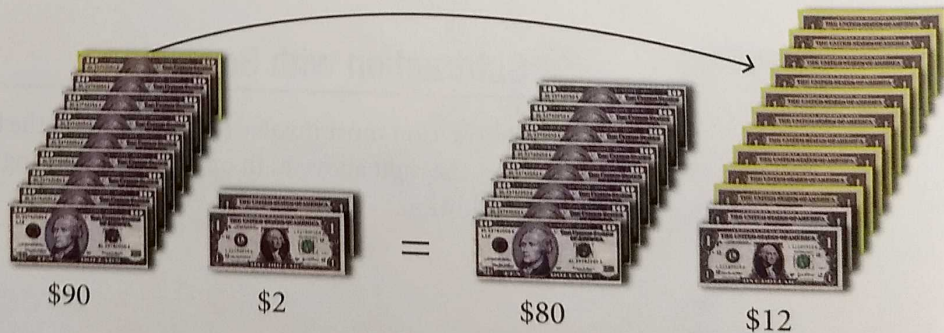
Example 5   Find the difference of 549 and 187.

Solution   In symbols the difference of 549 and 187 is written

$$549 - 187$$

Writing the problem vertically so that the digits with the same place value are aligned, we have

$$\begin{array}{r} 549 \\ -\ 187 \end{array}$$

The top number in the tens column is smaller than the number below it. This means that we will have to borrow from the next larger column.

$$
\begin{array}{ccc}
4 & 14 & \\
\cancel{5} & \cancel{4} & 9 \\
-\ 1 & 8 & 7 \\
\hline
3 & 6 & 2
\end{array}
$$

← Borrow 1 hundred (10 tens) to go with the 4 tens

$9 - 7 = 2$ Ones
$14 - 8 = 6$ Tens
$4 - 1 = 3$ Hundreds

The answer is 362. The actual work we did in borrowing looks like this:

5 hundreds + 4 tens + 9 ones

= 4 hundreds + 1 hundred + 4 tens + 9 ones

= 4 hundreds + 14 tens + 9 ones

Applying the Concepts
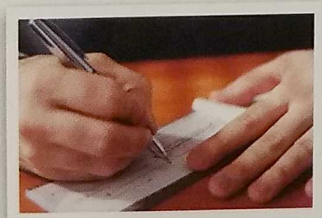
Example 6   Jo Ann has $742 in her checking account. If she writes a check for $615 to pay the rent, how much is left in her checking account?

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RECORD ALL CHARGES OR CREDITS THAT AFFECT YOUR ACCOUNT

NUMBER	DATE	DESCRIPTION OF TRANSACTION	PAYMENT/DEBIT (-)	DEPOSIT/CREDIT (+)	BALANCE
					$742 00
1402	12/1	Rent	$615 00		?

Solution   To find the amount left in the account after she has written the rent check, we subtract

$$
\begin{array}{rccc}
    &   & 3 & 12 \\
\$7 &   & \cancel{4} & \cancel{2} \\
-\ 6 & & 1 & 5 \\
\hline
\$1 & & 2 & 7
\end{array}
$$

She has $127 left in her account after writing a check for the rent.

Using Technology Calculators

Here is how we would work the problem shown in Example 6 on a calculator:

Scientific Calculator 742 $\boxed{-}$ 615 $\boxed{=}$

Graphing Calculator 742 $\boxed{-}$ 615 $\boxed{\text{ENT}}$

Estimating

One way to estimate the answer to the problem shown in Example 6 is to round 742 to 700 and 615 to 600 and then subtract 600 from 700 to obtain 100, which is an estimate of the difference. Making a mental estimate in this manner will help you catch some of the errors that will occur if you press the wrong buttons on your calculator.

Getting Ready for Class

After reading through the preceding section, respond in your own words and in complete sentences.

A. Which sentence below describes the problem in Example 1?
   1. The difference of 241 and 376 is 135.
   2. The difference of 376 and 241 is 135.

B. Write a subtraction problem using the number 234 that involves borrowing from the tens column to the ones column.

C. Write a subtraction problem using the number 234 in which the answer is 111.

D. Describe how you would subtract the number 56 from the number 93.

Problem Set R.4

Perform the indicated operation.

1. Subtract 24 from 56.

2. Subtract 71 from 89.

3. Subtract 23 from 45.

4. Subtract 97 from 98.

5. Find the difference of 29 and 19.

6. Find the difference of 37 and 27.

7. Find the difference of 126 and 15.

8. Find the difference of 348 and 32.

Work each of the following subtraction problems.

9.
$$\begin{array}{r} 975 \\ -\ 663 \\ \hline \end{array}$$

10.
$$\begin{array}{r} 480 \\ -\ 260 \\ \hline \end{array}$$

11.
$$\begin{array}{r} 904 \\ -\ 501 \\ \hline \end{array}$$

12.
$$\begin{array}{r} 657 \\ -\ 507 \\ \hline \end{array}$$

13.
$$\begin{array}{r} 9,876 \\ -\ 8,765 \\ \hline \end{array}$$

14.
$$\begin{array}{r} 5,008 \\ -\ 3,002 \\ \hline \end{array}$$

15.
$$\begin{array}{r} 7,976 \\ -\ 3,432 \\ \hline \end{array}$$

16.
$$\begin{array}{r} 6,980 \\ -\ \ \ 470 \\ \hline \end{array}$$

Find the difference in each case. (These problems all involve borrowing.)

17. $52 - 37$

18. $65 - 48$

19. $70 - 37$

20. $90 - 21$

21. $74 - 69$

22. $31 - 28$

23. $51 - 18$

24. $64 - 58$

25. $329 - 234$

26. $518 - 492$

27. $348 - 196$

28. $759 - 661$

29.
$$\begin{array}{r} 932 \\ -\ 658 \\ \hline \end{array}$$

30.
$$\begin{array}{r} 895 \\ -\ 597 \\ \hline \end{array}$$

31.
$$\begin{array}{r} 647 \\ -\ 159 \\ \hline \end{array}$$

32.
$$\begin{array}{r} 842 \\ -\ 199 \\ \hline \end{array}$$

33.
$$\begin{array}{r} 905 \\ -\ 367 \\ \hline \end{array}$$

34.
$$\begin{array}{r} 804 \\ -\ 238 \\ \hline \end{array}$$

35.
$$\begin{array}{r} 600 \\ -\ 437 \\ \hline \end{array}$$

36.
$$\begin{array}{r} 800 \\ -\ 342 \\ \hline \end{array}$$

37.
$$\begin{array}{r} 4,583 \\ -\ 2,973 \\ \hline \end{array}$$

38.
$$\begin{array}{r} 7,849 \\ -\ 2,957 \\ \hline \end{array}$$

39.
$$\begin{array}{r} 79,040 \\ -\ 32,957 \\ \hline \end{array}$$

40.
$$\begin{array}{r} 86,492 \\ -\ 78,506 \\ \hline \end{array}$$

Complete the following tables.

41.

First Number a	Second Number b	The Difference of a and b a − b
25	15	
24	16	
23	17	
22	18	

42.

First Number a	Second Number b	The Difference of a and b a − b
90	79	
80	69	
70	59	
60	49	

43.

First Number a	Second Number b	The Difference of a and b a − b
400	256	
400	144	
225	144	
225	81	

44.

First Number a	Second Number b	The Difference of a and b a − b
100	36	
100	64	
25	16	
25	9	

Write each of the following expressions in words. Use the word *difference* in each case.

45. $10 - 2$

46. $9 - 5$

47. $a - 6$

48. $7 - x$

49. $8 - 2 = 6$

50. $m - 1 = 4$

Write each of the following expressions in symbols.

51. The difference of 8 and 3

52. The difference of x and 2

53. 9 subtracted from y

54. a subtracted from b

55. The difference of 3 and 2 is 1.

56. The difference of 10 and y is 5.

Applying the Concepts

Not all of the following application problems involve only subtraction. Some involve addition as well. Be sure to read each problem carefully.

57. Checkbook Balance Diane has $504 in her checking account. If she writes five checks for a total of $249, how much does she have left in her account?

58. Checkbook Balance Larry has $763 in his checking account. If he writes a check for each of the three bills listed, how much will he have left in his account?

Item	Amount
Rent	$418
Phone	25
Car repair	117

59. Tallest Mountain The world's tallest mountain is Mount Everest. On May 5, 1999, it was found to be 7 feet taller than it was previously thought to be. Before this date, Everest was thought to be 29,028 feet high. That height was determined by B. L. Gulatee in 1954. The first measurement of Everest was in 1852. At that time the height was thought to be 29,002 feet. What is the difference between the current height of Everest and the height measured in 1852?
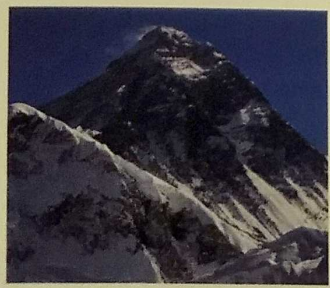
60. Home Prices In 2005, Mr. Hicks paid $137,500 for his home. He sold it in 2013 for $260,600. What is the difference between what he sold it for and what he bought it for?

61. Enrollment Six years ago, there were 567 students attending Smith Elementary School. Today the same school has an enrollment of 399 students. How much of a decrease in enrollment has there been in the last six years at Smith School?

62. Oil Spills In April 2010, an oil platform exploded in the Gulf of Mexico, spilling 205,800,000 gallons of oil. Previously, the worst oil spill in U.S. history was in March 1989 when an oil tanker hit a reef off Alaska and spilled 10,800,000 gallons of oil. How much more oil was spilled in the 2010 disaster?

Checkbook Balance On Monday Gil has a balance of $425 in his checkbook. On Tuesday he deposits $149 into the account. On Wednesday he writes a check for $37, and on Friday he writes a check for $188. Use this information to answer Problems 63–66.

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RECORD ALL CHARGES OR CREDITS THAT AFFECT YOUR ACCOUNT

NUMBER	DATE	DESCRIPTION OF TRANSACTION	PAYMENT/DEBIT (−)	DEPOSIT/CREDIT (+)	BALANCE $425 00
	10/10	Deposit		$149 00	?
1405	10/11	Market	$37 00		?
1406	10/13	Credit Card	$188 00		?

63. Find Gil's balance after he makes the deposit on Tuesday.

64. What is his balance after he writes the check on Wednesday?

65. To the nearest ten dollars, what is his balance at the end of the week?

66. To the nearest ten dollars, what is his balance before he writes the check on Friday?

Profit, Revenue, and Costs The bar chart below is from the introduction to this section and shows the revenue and costs for a company over a 4-week period. Use the information in the bar chart to answer questions 67-70.

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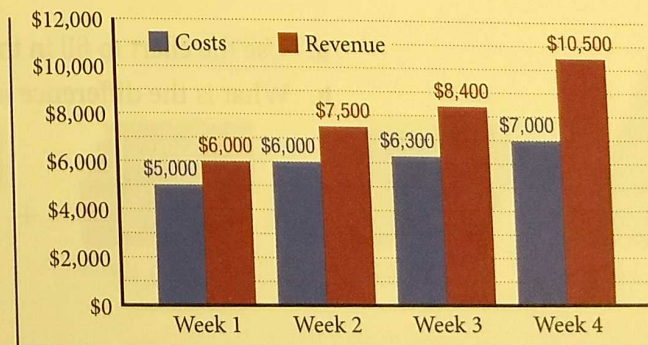
67. What was the total revenue for the company over the 4-week period?

68. What were the total costs for the company over the 4-week period?

69. Using the answers from Problems 67 and 68, determine the company's profit over the 4-week period.

70. Looking at the bar chart, we can see that the profit was the smallest in week 1 because the difference between the red and blue bars is the smallest. In which week was the profit the greatest? What was that profit?

71. Apple iPhone Sales The bar chart below shows the sales (rounded to the nearest million units) of iPhones from 2007 to 2012.
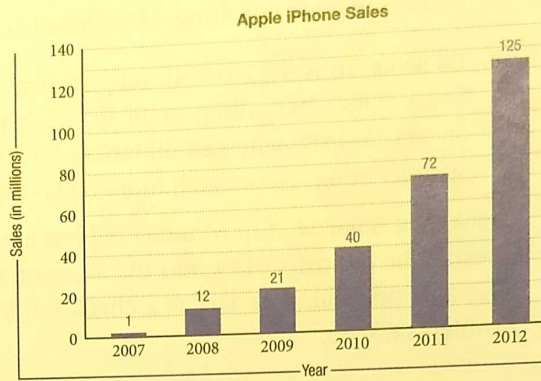
Apple iPhone Sales
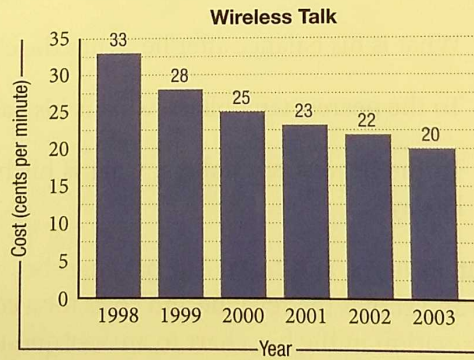
Year	Sales (in millions)
2007	
2008	
2009	
	40
	72
2012	

Data from *Apple Inc.*

a. Use the information in the bar chart to fill in the missing entries in the table.

b. What is the difference in iPhone sales between 2009 and 2012? (Remember: sales are given in millions of units.)

72. Wireless Phone Costs The bar chart below shows the costs of wireless phone use through 2003.

Wireless Talk

Year	Cents/Minute
	33
1999	
2000	
2001	
2002	
	20

a. Use the chart to fill in the missing entries in the table.

b. What is the difference in cost between 1998 and 1999?

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