SECTION

1.3 Subtraction of Whole Numbers

OBJECTIVE A To subtract whole numbers without borrowing

Subtraction is the process of finding the difference between two numbers.

√ Take Note

The **minuend** is the number from which another number is subtracted. The **subtrahend** is the number that is subtracted from another number. The result is the **difference**.
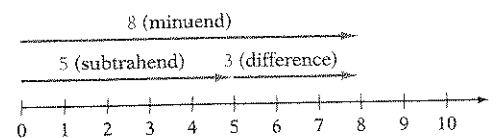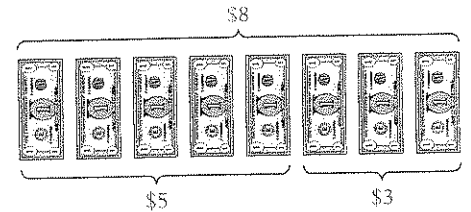
By counting, we see that the difference between $8 and $5 is $3.

$$\$8 \quad - \quad \$5 \quad = \quad \$3$$

Minuend   Subtrahead   Difference

The difference $8 - 5$ can be shown on the number line.

Note from the number line that addition and subtraction are related.

$$\begin{array}{ll} & \text{Subtrahend} \quad 5 \\ + & \text{Difference} \quad +3 \\ = & \text{Minuend} \quad 8 \end{array}$$

Point of Interest

The use of the minus sign dates from the same period as the plus sign, around 1515.

The fact that the sum of the subtrahend and the difference equals the minuend can be used to check subtraction.

To subtract large numbers, begin by arranging the numbers vertically, keeping the digit that have the same place value in the same column. Then subtract the digits in each column.

HOW TO 1 Subtract $8955 - 2432$ and check.

$$\begin{array}{r} 8\,9\,5\,5 \\ -\,2\,4\,3\,2 \\ \hline 6\,5\,2\,3 \end{array}$$

Check:
$$\begin{array}{ll} \text{Subtrahend} & 2432 \\ +\ \text{Difference} & +\ 6523 \\ =\ \text{Minuend} & 8955 \end{array}$$

EXAMPLE 1

Subtract $6594 - 3271$ and check.

Solution
$$\begin{array}{r} 6594 \\ -\ 3271 \\ \hline 3323 \end{array}$$

Check:
$$\begin{array}{r} 3271 \\ +\ 3323 \\ \hline 6594 \end{array}$$

YOU TRY IT 1

Subtract $8925 - 6413$ and check.

Your solution

EXAMPLE 2

Subtract $15,762 - 7541$ and check.

Solution
$$\begin{array}{r} 15,762 \\ -\ 7,541 \\ \hline 8,221 \end{array}$$

Check:
$$\begin{array}{r} 7,541 \\ +\ 8,221 \\ \hline 15,762 \end{array}$$

YOU TRY IT 2

Subtract $17,504 - 9302$ and check.

Your solution

To subtract whole numbers with borrowing

In all the subtraction problems in the previous objective, for each place value the lower digit was not larger than the upper digit. When the lower digit is larger than the upper digit, subtraction will involve **borrowing.**

HOW TO 2 Subtract: 692 − 378

$$
\begin{array}{c|c|c}
\text{HUNDREDS} & \text{TENS} & \text{ONES} \\
\hline
& 8+1 & \\
6 & \not{9} & 2 \\
-3 & 7 & 8 \\
\end{array}
\qquad
\begin{array}{c|c|c}
\text{HUNDREDS} & \text{TENS} & \text{ONES} \\
\hline
& 8+\!①\!\to & 10 \\
6 & \not{9} & 2 \\
-3 & 7 & 8 \\
\end{array}
\qquad
\begin{array}{c|c|c}
\text{HUNDREDS} & \text{TENS} & \text{ONES} \\
\hline
& 8 & 12 \\
6 & \not{9} & \not{2} \\
-3 & 7 & 8 \\
\end{array}
\qquad
\begin{array}{c|c|c}
\text{HUNDREDS} & \text{TENS} & \text{ONES} \\
\hline
& 8 & 12 \\
6 & \not{9} & \not{2} \\
-3 & 7 & 8 \\
\hline
3 & 1 & 4 \\
\end{array}
$$

Because 8 > 2, borrowing is necessary. 9 tens = 8 tens + 1 ten.

Borrow 1 ten from the tens column and write 10 in the ones column.

Add the borrowed 10 to 2.

Subtract the digits in each column.

The phrases below are used to indicate the operation of subtraction. An example is shown at the right of each phrase.

minus	8 minus 5	8 − 5
less	9 less 3	9 − 3
less than	2 less than 7	7 − 2
the difference between	the difference between 8 and 2	8 − 2
decreased by	5 decreased by 1	5 − 1

HOW TO 3 Find the difference between 1234 and 485, and check.

"The difference between 1234 and 485" means 1234 − 485.

$$
\begin{array}{cccc}
& & 2 & 14 \\
1 & 2 & \not{3} & \not{4} \\
- & 4 & 8 & 5 \\
\hline
& & & 9 \\
\end{array}
\qquad
\begin{array}{cccc}
& 1 & 12 & 14 \\
\not{1} & \not{2} & \not{3} & \not{4} \\
- & 4 & 8 & 5 \\
\hline
& 4 & & 9 \\
\end{array}
\qquad
\begin{array}{cccc}
0 & 11 & 12 & 14 \\
\not{1} & \not{2} & \not{3} & \not{4} \\
- & 4 & 8 & 5 \\
\hline
& 7 & 4 & 9 \\
\end{array}
\qquad
Check: \quad
\begin{array}{r}
{}^{1}{}^{1} \\
485 \\
+ 749 \\
\hline
1234 \\
\end{array}
$$

Subtraction with a zero in the minuend involves repeated borrowing.

HOW TO 4 Subtract: 3904 − 1775

$$
\begin{array}{cccc}
& 8 & 10 & \\
3 & \not{9} & \not{0} & 4 \\
-1 & 7 & 7 & 5 \\
\end{array}
\qquad
\begin{array}{cccc}
& & 9 & \\
& 8 & 10 & 14 \\
3 & \not{9} & \not{0} & \not{4} \\
-1 & 7 & 7 & 5 \\
\end{array}
\qquad
\begin{array}{cccc}
& & 9 & \\
& 8 & 10 & 14 \\
3 & \not{9} & \not{0} & \not{4} \\
-1 & 7 & 7 & 5 \\
\hline
2 & 1 & 2 & 9 \\
\end{array}
$$

5 > 4
There is a 0 in the tens column. Borrow 1 hundred (= 10 tens) from the hundreds column and write 10 in the tens column.

Borrow 1 ten from the tens column and add 10 to the 4 in the ones column.

Subtract the digits in each column.

EXAMPLE • 3

Subtract 4392 − 678 and check.

Solution

$$
\begin{array}{r}
\overset{3}{4}\;\overset{13}{\cancel{3}}\;\overset{8}{\cancel{9}}\;\overset{12}{\cancel{2}} \\
-\;\;6\;\;7\;\;8 \\
\hline
3\;\;7\;\;1\;\;4
\end{array}
\qquad
Check: \quad
\begin{array}{r}
678 \\
+\;3714 \\
\hline
4392
\end{array}
$$

YOU TRY IT • 3

Subtract 3481 − 865 and check.

Your solution

EXAMPLE • 4

Find 23,954 less than 63,221 and check.

Solution

$$
\begin{array}{r}
\overset{5}{\cancel{6}}\;\overset{12}{\cancel{3}},\overset{11}{\cancel{2}}\;\overset{11}{\cancel{2}}\;\overset{11}{\cancel{1}} \\
-\;2\;\;3,9\;\;5\;\;4 \\
\hline
3\;\;9,\;2\;\;6\;\;7
\end{array}
\qquad
Check: \quad
\begin{array}{r}
23,954 \\
+\;39,267 \\
\hline
63,221
\end{array}
$$

YOU TRY IT • 4

Find 54,562 decreased by 14,485 and check.

Your solution

EXAMPLE • 5

Subtract 46,005 − 32,167 and check.

Solution

$$
\begin{array}{r}
\overset{5}{\cancel{4}}\overset{10}{6},\;\overset{}{\cancel{0}}\;0\;5 \\
-\;3\;2,\;1\;6\;7
\end{array}
$$

• There are two zeros in the minuend. Borrow 1 thousand from the thousands column and write 10 in the hundreds column.

$$
\begin{array}{r}
\overset{5}{\cancel{4}}\overset{9}{\cancel{6}},\;\overset{10}{\cancel{0}}\;\cancel{0}\;5 \\
-\;3\;2,\;1\;6\;7
\end{array}
$$

• Borrow 1 hundred from the hundreds column and write 10 in the tens column.

$$
\begin{array}{r}
\overset{5}{\cancel{4}}\overset{9}{\cancel{6}},\;\overset{9}{\cancel{0}}\;\overset{15}{\cancel{8}} \\
-\;3\;2,\;1\;6\;7 \\
\hline
1\;3,\;8\;3\;8
\end{array}
$$

• Borrow 1 ten from the tens column and add 10 to the 5 in the ones column.

$$
Check: \quad
\begin{array}{r}
32,167 \\
+\;13,838 \\
\hline
46,005
\end{array}
$$

YOU TRY IT • 5

Subtract 64,003 − 54,936 and check.

Your solution

ESTIMATION

Estimating the Difference Between Two Whole Numbers

Calculate 323,502 − 28,912. Then use estimation to determine whether the difference is reasonable.

Subtract to find the exact difference. To estimate the difference, round each number to the same place value. Here we have rounded to the nearest ten-thousand. Then subtract. The estimated answer is 290,000, which is very close to the exact difference 294,590.

$$
\begin{array}{rcr}
323,502 & \approx & 320,000 \\
-\;28,912 & \approx & -\;30,000 \\
\hline
294,590 & & 290,000
\end{array}
$$

The table at the right shows the number of personnel on active duty in the branches of the U.S. military in 1940 and 1945. Use this table for Example 6 and You Try It 6.

Branch	1940	1945
U.S. Army	267,767	8,266,373
U.S. Navy	160,997	3,380,817
U.S. Air Force	51,165	2,282,259
U.S. Marine Corps	28,345	474,680

Source: Dept. of the Army, Dept. of the Navy, Air Force Dept., Dept. of the Marines, U.S. Dept. of Defense

EXAMPLE 6

Find the difference between the number of U.S. Army personnel on active duty in 1945 and the number in 1940.

Strategy
To find the difference, subtract the number of U.S. Army personnel on active duty in 1940 (267,767) from the number on active duty in 1945 (8,266,373).

Solution

$$\begin{array}{r} 8,266,373 \\ -\ \ \ 267,767 \\ \hline 7,998,606 \end{array}$$

There were 7,998,606 more personnel on active duty in the U.S. Army in 1945 than in 1940.

YOU TRY IT 6

Find the difference between the number of personnel on active duty in the Navy and the number in the Air Force in 1945.

Your strategy

Your solution

EXAMPLE 7

You had a balance of $415 on your student debit card. You then used the card, deducting $197 for books, $48 for art supplies, and $24 for theater tickets. What is your new student debit card balance?

Strategy
To find your new debit card balance:
- Add to find the total of the three deductions (197 + 48 + 24).
- Subtract the total of the three deductions from the old balance (415).

Solution

$$\begin{array}{r} 197 \\ 48 \\ +\ 24 \\ \hline 269 \end{array} \qquad \begin{array}{r} 415 \\ -\ 269 \\ \hline 146 \end{array}$$

269 total deductions

Your new debit card balance is $146.

YOU TRY IT 7

Your total weekly salary is $638. Deductions of $127 for taxes, $18 for insurance, and $35 for savings are taken from your pay. Find your weekly take-home pay.

Your strategy

Your solution

1.3 EXERCISES

OBJECTIVE A   To subtract whole numbers without borrowing

For Exercises 1 to 35, subtract.

1. 9
   − 5

2. 8
   − 7

3. 8
   − 4

4. 7
   − 3

5. 10
   − 0

6. 11
   − 4

7. 12
   − 8

8. 19
   − 8

9. 15
   − 6

10. 16
    − 7

11. 25
    − 3

12. 55
    − 4

13. 68
    − 8

14. 77
    − 3

15. 89
    − 23

16. 54
    − 21

17. 88
    − 57

18. 1202
    − 701

19. 1305
    − 404

20. 1763
    − 801

21. 1497
    − 706

22. 8974
    − 3972

23. 2836
    − 1711

24. 8976
    − 7463

25. 9273
    − 6142

26. 77 − 36

27. 129 − 82

28. 132 − 61

29. 969 − 44

30. 1347 − 103

31. 4865 − 304

32. 1525 − 702

33. 9999 − 6794

34. 7806 − 3405

35. 8843 − 762

36. Suppose three whole numbers, called *minuend*, *subtrahend*, and *difference*, are related by the subtraction statement *minuend − subtrahend = difference*. State whether the given relationship *must be true, might be true*, or *cannot be true*.

   a. minuend > difference   **b.** subtrahend < difference

OBJECTIVE B   To subtract whole numbers with borrowing

For Exercises 37 to 80, subtract.

37. 71
    − 18

38. 93
    − 28

39. 47
    − 18

40. 44
    − 27

41. 37
    − 29

42. 50
    − 27

43. 70
    − 33

44. 993
    − 537

45. $\begin{array}{r} 250 \\ -192 \\ \hline \end{array}$ **46.** $\begin{array}{r} 840 \\ -783 \\ \hline \end{array}$ **47.** $\begin{array}{r} 768 \\ -194 \\ \hline \end{array}$ **48.** $\begin{array}{r} 770 \\ -395 \\ \hline \end{array}$

49. 674 − 337   **50.** 3526 − 387   **51.** 1712 − 289   **52.** 4350 − 729

53. 1702 − 948   **54.** 1607 − 869   **55.** 5933 − 3754   **56.** 7293 − 3748

57. 9407 − 2918   **58.** 3706 − 2957   **59.** 8605 − 7716   **60.** 8052 − 2709

61. 80,305 − 9176   **62.** 70,702 − 4239   **63.** 10,004 − 9306   **64.** 80,009 − 63,419

65. 70,618 − 41,213   **66.** 80,053 − 27,649   **67.** 70,700 − 21,076   **68.** 80,800 − 42,023

69. $\begin{array}{r} 2600 \\ -1972 \\ \hline \end{array}$ **70.** $\begin{array}{r} 8400 \\ -3762 \\ \hline \end{array}$ **71.** $\begin{array}{r} 9003 \\ -2471 \\ \hline \end{array}$ **72.** $\begin{array}{r} 6004 \\ -2392 \\ \hline \end{array}$

73. $\begin{array}{r} 8202 \\ -3916 \\ \hline \end{array}$ **74.** $\begin{array}{r} 7050 \\ -4137 \\ \hline \end{array}$ **75.** $\begin{array}{r} 7015 \\ -2973 \\ \hline \end{array}$ **76.** $\begin{array}{r} 4207 \\ -1624 \\ \hline \end{array}$

77. $\begin{array}{r} 7005 \\ -1796 \\ \hline \end{array}$ **78.** $\begin{array}{r} 8003 \\ -2735 \\ \hline \end{array}$ **79.** $\begin{array}{r} 20,005 \\ -9,627 \\ \hline \end{array}$ **80.** $\begin{array}{r} 80,004 \\ -8,237 \\ \hline \end{array}$

81. Which of the following phrases represent the subtraction 673 − 571?
  (i) 571 less 673   **(ii)** 571 less than 673   **(iii)** 673 decreased by 571

82. Find 10,051 less 9027.   **83.** Find 17,031 less 5792.

84. Find the difference between 1003 and 447.   **85.** What is 29,874 minus 21,392?

86. What is 29,797 less than 68,005?   **87.** What is 69,379 less than 70,004?

88. What is 25,432 decreased by 7994?   **89.** What is 86,701 decreased by 9976?

For Exercises 90 to 93, use the relationship between addition and subtraction to complete the statement.

90. ___ + 39 = 104   **91.** 67 + ___ = 90   **92.** ___ + 497 = 862   **93.** 253 + ___ = 4901

For Exercises 94 to 99, use a calculator to subtract. Then round the numbers to the nearest ten-thousand and use estimation to determine whether the difference is reasonable.

94.   80,032
       − 19,605

95.   90,765
       − 60,928

96.   32,574
       − 10,961

97.   96,430
       − 59,762

98.   567,423
       − 208,444

99.   300,712
       − 198,714

OBJECTIVE C   **To solve application problems**

100. **Banking** You have $304 in your checking account. If you write a check for $139, how much is left in your checking account?

101. **Insects** The table at the right shows the number of taste genes and the number of smell genes in the mosquito, fruit fly, and honey bee.
  a. How many more smell genes does the honey bee have than the mosquito?
  b. How many more taste genes does the mosquito have than the fruit fly?
  c. Which of these insects has the best sense of smell?
  d. Which of these insects has the worst sense of taste?

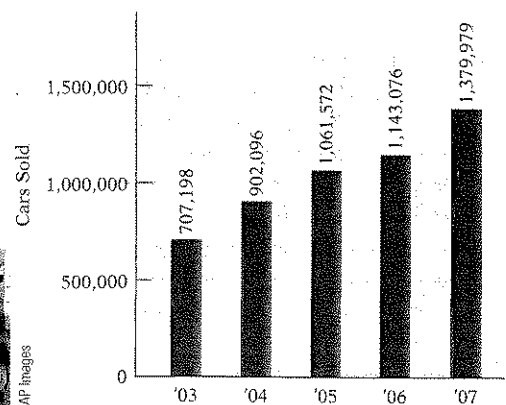|	Mosquito	Fruit Fly	Honey Bee
Taste genes	76	68	10
Smell genes	79	62	170

Source: www.sciencedaily.com

102. **Car Sales** The graph at the right shows the number of cars sold in India for each year from 2003 to 2007.
  a. Has the number of cars sold increased each year from 2003 to 2007?
  b. How many more cars were sold in India in 2007 than in 2003?
  c. Between which two years shown did car sales increase the most?
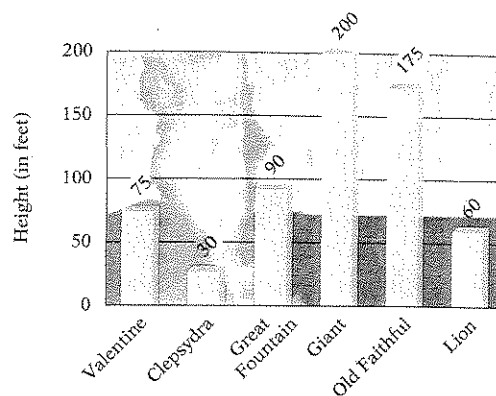
Tata Motors' One Lakh Car

Cars Sold in India
'03 707,198
'04 902,096
'05 1,061,572
'06 1,143,076
'07 1,379,979

Source: Society of Indian Automobile Manufacturers

103. Earth Science Use the graph at the right to find the difference between the maximum height to which Great Fountain geyser erupts and the maximum height to which Valentine erupts.

104. Earth Science According to the graph at the right, how much higher is the eruption of the Giant than that of Old Faithful?

105. Education In a recent year, 775,424 women and 573,079 men earned a bachelor's degree. How many more women than men earned a bachelor's degree in that year? (*Source: The National Center for Education Statistics*)

The Maximum Heights of the Eruptions of Six Geysers at Yellowstone National Park
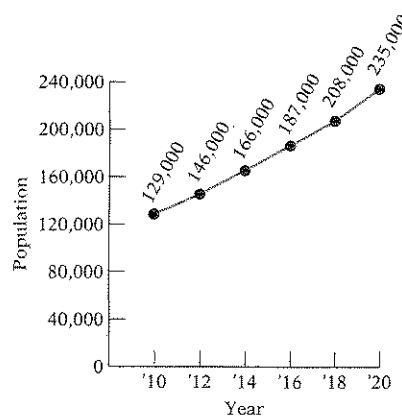
Demographics The graph at the right shows the expected U.S. population aged 100 and over for every 2 years from 2010 to 2020. Use this information for Exercises 106 to 108.

106. What is the expected growth in the population aged 100 and over during the 10-year period?

107. a. Which 2-year period has the smallest expected increase in the number of people aged 100 and over?
b. Which 2-year period has the greatest expected increase?

108. What does the difference $208,000 - 166,000$ represent?

Expected U.S. Population Aged 100 and Over
Source: Census Bureau

109. Finances You had a credit card balance of $409 before you used the card to purchase books for $168, CDs for $36, and a pair of shoes for $97. You then made a payment to the credit card company of $350. Find your new credit card balance.

Applying the Concepts

110. Answer true or false.
a. The phrases "the difference between 9 and 5" and "5 less than 9" mean the same thing.
b. $9 - (5 - 3) = (9 - 5) - 3$
c. Subtraction is an associative operation. *Hint:* See part (b) of this exercise.

111. Make up a word problem for which the difference between 15 and 8 is the answer.