

Sect 1.3 - Subtraction of Whole Numbers

Objective a: Relating Addition and Subtraction.

To understand the relationship between addition and subtraction, let us begin with an example.

Ex. 1 In a playoff game against the Mavericks on April 20, 2009, Tony Parker scored 32 points on field goals and 6 points on free throws for a total of 38 points. (Source: www.espn.com) Use this information to write this an addition and as a subtraction problem.

Solution:

As an addition problem, we can write:

Points from Field Goals	+	Points from Free Throws	=	Total Points
32	+	6	=	38

As a subtraction problem, we can write this two ways:

Total Points	−	Points from Free Throws	=	Points from Field Goals
38	−	6	=	32

Or

Total Points	−	Points from Field Goals	=	Points from Free Throws
38	−	32	=	6

So, we can always change an addition problem to a subtraction problem and a subtraction problem into an addition problem. This is very convenient if we need to check our answer since the answer (Difference) plus the number subtracted (Subtrahend) has to be equal to the original number (Minuend).

Subtract the following (check your answers by adding):

Ex. 2a $9 - 4$

Solution:

9	Minuend
− 4	Subtrahend
5	Difference

Check:

Difference + Subtrahend = Minuend

$$5 + 4 = 9$$

Ex. 2b $7 - 5$

Solution:

7	Minuend
− 5	Subtrahend
2	Difference

Check:

Difference + Subtrahend = Minuend

$$2 + 5 = 7$$

In each case, the sum in the check is equal to the Minuend from the original problem.

Objective b: Understanding properties of subtraction.

Recall that addition was commutative and associative. Is the same true for subtraction? To find out, let's consider some examples.

Find the following:

Ex. 3a $9 - 7$

Solution:

$$9 - 7 = 2$$

Ex. 3b $7 - 9$

Solution:

$7 - 9 =$ cannot be done with whole numbers.

So, $9 - 7 \neq 7 - 9$ (the symbol " $\neq$ " means "does not equal"). This means that order is extremely important in subtraction and that subtraction is not commutative. Another way to think about example one is to think in terms of money. If you have \$9 and spend \$7, then you will have \$2 left over. On the other hand, if you have \$7 and spend \$9, then you will have to borrow \$2 from a friend. Owing \$2 is not the same as having \$2 left over.

Ex. 4a $(15 - 7) - 3$

Solution:

$$\begin{aligned} (15 - 7) - 3 \\ = 8 - 3 = 5 \end{aligned}$$

Ex. 4b $15 - (7 - 3)$

Solution:

$$\begin{aligned} 15 - (7 - 3) \\ = 15 - 4 = 11 \end{aligned}$$

So, $(15 - 7) - 3 \neq 15 - (7 - 3)$ which means subtraction is not associative. Changing the grouping changes the answer. This has a profound impact on subtracting whole numbers. Unlike addition, since subtraction is not commutative or associative, we can not stack a series of numbers and subtract in each column. We will have to work the problems two numbers at a time.

In subtracting whole numbers, we can stack the two numbers vertically being careful to align the digits according to their place value. Then, we can subtract the digit on the bottom from the one on top in each place value starting with the ones place and moving from right to left. If the digit on the bottom is larger than the one on top, we subtract one unit (called "borrowing") from the next place value to the left on top and add 10 to the current place value on top. The idea is that one ten is equal to ten ones, one hundred is equal to ten tens, one thousand is equal to ten hundreds,

etc. In terms of money, if you have two ten dollar bills and spend \$7, you can trade one of the ten dollar bill for ten one dollar bills and then pay the \$7. You will have one ten and three ones left over or \$13. Here are some key words for subtraction:

6 minus 4	$6 - 4$
4 less 10	$4 - 10$
4 less than 10	$10 - 4$
the difference between 8 and 3	$(8 - 3)$
34 decreased by 5	$34 - 5$
3 subtract 5	$3 - 5$
3 subtracted from 5	$5 - 3$
56 reduced by 43	$56 - 43$
15 fewer than 61	$61 - 15$

Perform the Indicated Operation. Check the answer on a calculator:

Ex. 5 185 less 21.

Solution:

$$\begin{array}{r} 185 \\ - 21 \\ \hline 164 \end{array}$$

The answer is 164.

$5 - 1 = 4$, write down the 4.

$8 - 2 = 6$, write down the 6.

$1 - 0 = 1$, write down the 1.

Check: $21 + 164 = 185$

Ex. 6 57 less than 96.

Solution:

$$\begin{array}{r} 96 \\ - 57 \\ \hline \end{array}$$

$$\begin{array}{r} 8^1 6 \\ \cancel{9} \cancel{6} \\ - 57 \\ \hline 39 \end{array}$$

The answer is 39.

Cannot subtract 7 from 6 so borrow 10.
from 90 and rewrite 6 as 16.

$16 - 7 = 9$, write down the 9.

$8 - 5 = 3$, write down the 3.

Check: $57 + 39 = 96$

Ex. 7 Find the difference between 9274 and 7956.

Solution:

$$\begin{array}{r} 8^1 26^1 4 \\ 9274 \\ - 7956 \\ \hline 1318 \end{array}$$

The answer is 1318.

Borrow 10 from 70, $14 - 6 = 8$, write down 8.

$6 - 5 = 1$, write down 1.

Borrow 1000 from 9000, $12 - 9 = 3$, write down 3. Finally, $8 - 7 = 1$, write down 1.

Check: $7956 + 1318 = 9274$

Ex. 8 363 subtracted from 480.

Solution:

$$\begin{array}{r} 7^{10} \\ 480 \\ - 363 \\ \hline 117 \end{array}$$

Borrow 10 from 80, $10 - 3 = 7$, write down 7.

$7 - 6 = 1$, write down 1.

$4 - 3 = 1$, write down 1.

Ex. 9 40,000 subtract 2346.

Solution:

This is a borrow like crazy problem: Borrow one from 40,000, that gives us 10 thousands. Next, borrow one from 10 thousands, that gives us 9 thousands and 10 hundreds. Now, borrow one from 10 hundreds, that gives us 9 hundreds and 10 tens. Finally, borrow one from 10 tens, that gives us 9 tens and 10 ones. After doing all that, we can proceed with the subtraction.

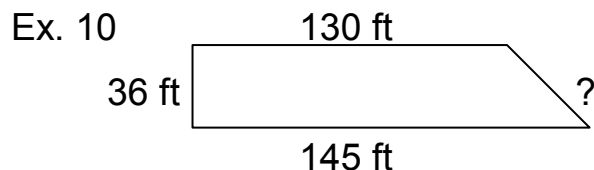
$$\begin{array}{r} 3^{10} \\ 40000 \\ - 2346 \\ \hline \end{array} \Rightarrow \begin{array}{r} 9 \\ 3^{10}10 \\ 40000 \\ - 2346 \\ \hline \end{array} \Rightarrow \begin{array}{r} 99 \\ 3^{10}1010 \\ 40000 \\ - 2346 \\ \hline \end{array}$$

$$\Rightarrow \begin{array}{r} 999 \\ 3^{10}101010 \\ 40000 \\ - 2346 \\ \hline 37654 \end{array} \quad \begin{array}{l} 10 - 6 = 4, \text{ write down the } 4 \\ 9 - 4 = 5, \text{ write down the } 5 \\ 9 - 3 = 6, \text{ write down the } 6 \\ 9 - 2 = 7, \text{ write down the } 7 \\ \text{write down the } 3 \end{array}$$

So, the answer is 37,654.

Objective c: Applications

Find the length of the missing side if the perimeter is 350 ft.



Solution:

We will first add up the known sides and then subtract that result

$$\begin{array}{r}
 \text{from the perimeter: } 11 \\
 130 \\
 36 \\
 + 145 \\
 \hline
 311
 \end{array}$$

$$\begin{array}{r}
 4^{10} \\
 350 \\
 - 311 \\
 \hline
 39
 \end{array}$$

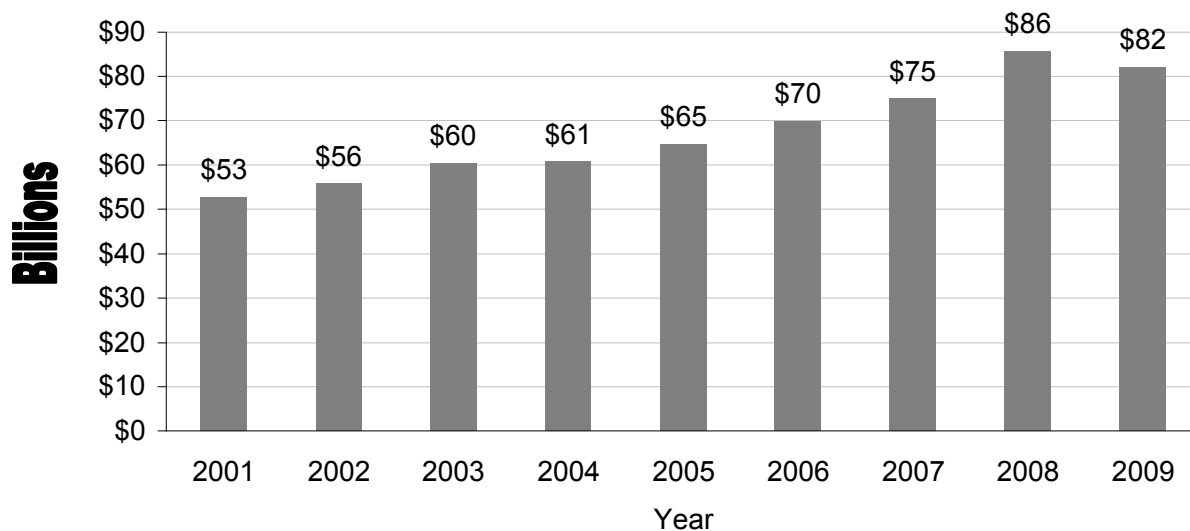
The missing side is 39 ft.

Use the table below to answer the following question:

Ex. 11

Total Spending by the State of Texas

(www.texasbudgetsource.com)



- Find the increase in spending from the year 2002 to 2009.
- Find the decrease in spending from the year 2008 to 2009.

Solution:

a) To find the increase, we need to take the amount of spending in 2009, minus the amount of spending in 2002:

$$\begin{array}{r}
 7^{12} \\
 \$82 \text{ billion} \\
 - \$56 \text{ billion} \\
 \hline
 \$26 \text{ billion}
 \end{array}$$

b) To find the decrease, we need to take the amount of spending in 2008, minus the amount of spending in 2009:

$$\begin{array}{r}
 \$86 \text{ billion} \\
 - \$82 \text{ billion} \\
 \hline
 \$4 \text{ billion}
 \end{array}$$