Section 1.1 Whole Numbers and Their Properties

Objectives
In this section, you will learn to:

- Identify and apply the four basic operations.
- Define the term *multiplication.*
- Write numbers in factored form.
- Evaluate a mathematical expression.
- Identify and apply the Commutative Properties.
- Identify and apply the Associative Properties.
- Recognize the identities for addition and multiplication.
- Identify and apply the Distributive Property.

INTRODUCTION

Numbers have been around since the beginning of language. People first used numbers to count things, especially when items were being traded, such as five sheep for three pigs. As time progressed, numbers were used to measure things, such as the length of an ark, the distance between two cities, the number of daylight hours in a month, and so on.

Eventually people started doing calculations with numbers, and it was called "arithmetic." They started drawing circles and triangles, and it was called "geometry." They started using letters to represent numbers, and it was called "algebra." They gave all of it a name; they called it "mathematics."

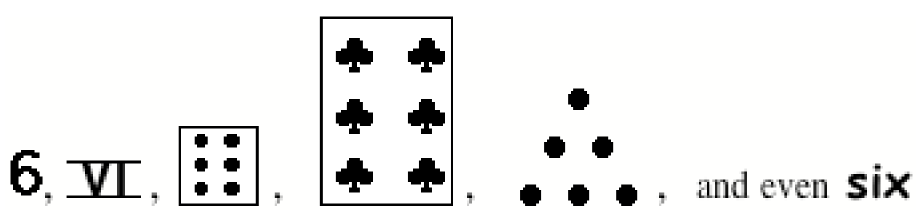
Mathematics is at the heart of every computer, every television set, and every cell phone. In short, mathematics is a hidden part of your everyday life. As complex as our world has become, even the simplest mathematics plays a role.

Most students of prealgebra will continue their studies through algebra; some of you may even go on to study higher levels of math, such as statistics or calculus. Whatever your goal, learning prealgebra is an important step.

NUMBERS AND NUMERALS

In the world of language, a **number** is an adjective; it describes *how many* items there might be, as in "Foofi has *six* puppies."

A **numeral** is a symbol that represents a number. For example, the number *six* can be expressed by any of these symbols (and there are others):



In this text we often use the word "number" in place of the word "numeral" to make the reading easier.

Our way of counting is built on a **base-ten numbering system** that uses ten **digits**, or numerals:

0, 1, 2, 3, 4, 5, 6, 7, 8 and 9.

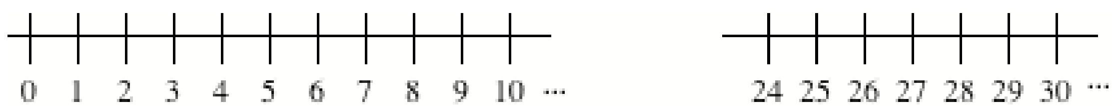
These digits are the first of the **whole numbers**. When we get to 9, we have exhausted all of the single digit whole numbers, so in order to represent the next whole number, ten, we must use two digits, 10.

The whole numbers 0, 1, 2, 3, 4, 5, 6,7, 8, 9, 10, 11, 12, 13, 14 ... and so on.

Even though 0 is written as the first whole number, it is not the first *counting number*.

The counting numbers, or **natural numbers**: 1, 2, 3, 4, 5, ..., 10, 11, 12, ... and so on.

We can represent whole numbers visually along a **number line**:



The further to the right along the number line, the higher the value of each number.

BASIC MATH TERMINOLOGY

There are four basic **operations** in mathematics, addition (+), subtraction (–), multiplication (x), and division (÷). The *written form* of an operation, such as **5 + 4**, is called an **expression**.

We also have words for the results of the operations, as shown in the chart below. To get the result of an operation we must *apply* the operation.

Operation	**Name**	**As an expression**	**Result**	**Meaning:**
Addition **(plus)**	**Sum**	3 + 5	= 8	The sum of 3 and 5 is 8.
Subtraction **(minus)**	**Difference**	9 – 5	= 4	The difference between 9 and 5 is 4.
Multiplication **(times)**	**Product**	2 x 3	= 6	The product of 2 and 3 is 6.
Division **(divided by)**	**Quotient**	6 ÷ 3	= 2	The quotient of 6 and 3 is 2.

For multiplication, the numbers in a product are called **factors**. For example, 2 and 3 are factors of 6 because $2 \times 3 = 6$. 1 and 6 are also factors of 6 because $1 \times 6 = 6$.

For division, the quotient can be expressed in three ways:

1. In standard division form	2. In long division form	3. In fractional form
Dividend ÷ divisor = quotient	$\begin{array}{r} \textbf{quotient} \\ \textbf{divisor}\,\overline{\smash{)}\,\textbf{dividend}} \end{array}$	$\dfrac{\textbf{dividend}}{\textbf{divisor}} = \textbf{quotient}$
$6 \div 3 = 2$	$\begin{array}{r} 2 \\ 3\,\overline{\smash{)}\,6} \end{array}$	$\dfrac{6}{3} = 2$

Example 1: Write both the expression and the result of each of the following.

		Answer: <u>**As an expression**</u>		<u>**As a result**</u>
a)	the sum of 5 and 1	$5 + 1$	=	6
b)	the difference between 10 and 6	$10 - 6$	=	4
c)	the product of 4 and 7	4×7	=	28
d)	the quotient of 20 and 4	$20 \div 4$	=	5

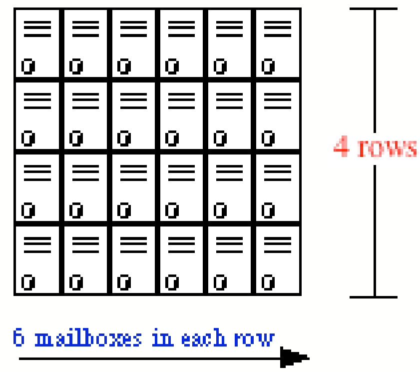
<u>**YTI #1**</u> Write both the expression and the result of each of the following. Use Example 1 as a guide.

		<u>**As an expression**</u>		<u>**As a result**</u>
a)	the sum of 9 and 3	_________________	=	_____________
b)	the difference between 12 and 4	_________________	=	_____________
c)	the product of 5 and 8	_________________	=	_____________
d)	the quotient of 30 and 5	_________________	=	_____________

MULTIPLICATION

What is multiplication? For whole numbers, **multiplication** is an abbreviation for repeated addition.

For example, in the lobby of an apartment building is a rectangular mail box center, which has 4 rows of 6 mailboxes each. How many mailboxes are there altogether?



Because there are four rows of 6 mailboxes, we can answer the question by adding the number of mailboxes in each row:

number in 1^{st} row	+	number in 2^{nd} row	+	number in 3^{rd} row	+	number in 4^{th} row		
6	+	6	+	6	+	6	=	24 mailboxes

We can also think of this as *four* 6's.

This sum of four 6's is an example of *repeated* addition, and it can be abbreviated using multiplication:

four 6's = *4* x 6 = **24**.

Furthermore, there is a variety of ways that multiplication can be represented. For example, *4 times 6* can be written as

4 x 6	typical arithmetic
$4 \cdot 6$, (4)6, 4(6), and (4)(6)	typical algebra

In this text, we will often (though not always) use the raised dot for multiplication.

> **Caution:** The raised dot is *not* a decimal point, and when we get to multiplying decimals (in Section 5.4), we'll use the arithmetic multiplication sign, x, to avoid confusion.

Below is a 12 by 12 multiplication table. You may refer to it as needed, but it is best if you can memorize the multiplication facts in this table.

x	**1**	**2**	**3**	**4**	**5**	**6**	**7**	**8**	**9**	**10**	**11**	**12**
1	1	2	3	4	5	6	7	8	9	10	11	12
2	2	4	6	8	10	12	14	16	18	20	22	24
3	3	6	9	12	15	18	21	**24**	27	30	33	36
4	4	8	12	16	20	24	28	32	36	40	44	48
5	5	10	15	20	25	30	35	40	45	50	55	60
6	6	12	18	24	30	36	42	48	54	60	66	72
7	7	14	21	28	35	42	49	56	63	70	77	84
8	8	16	**24**	32	40	48	56	64	72	80	88	96
9	9	18	27	36	45	54	63	72	81	90	99	108
10	10	20	30	40	50	60	70	80	90	100	110	120
11	11	22	33	44	55	66	77	88	99	110	121	132
12	12	24	36	48	60	72	84	96	108	120	132	144

NUMBERS IN FACTORED FORM

The numbers in a product are called *factors*:

factor x **factor** = **product**

From the multiplication table we see that 4 x 6 = 24, we can say that 4 and 6 are factors of 24.

Also, a number is in **factored form** when it is written as a product of factors. So, we can say that 4 x 6 is a factored form of 24.

There are other factored forms of 24. In fact, in the multiplication table we can locate 24 as a product a total of six times: 2 x 12, 3 x 8, 4 x 6, and—by the Commutative Property—12 x 2, 8 x 3, and 6 x 4.

Also, because 1 is the identity for multiplication, 24 = 1 · 24 and 24 = 24 · 1.

So, in factored form, 24 = 1 · 24, 24 = 2 · 12, 24 = 3 · 8, 24 = 4 · 6, and so on.

Example 2: Write 18 in a factored form six different ways.

Answer: 18 = 2 · 9   18 = 9 · 2   18 = 3 · 6   18 = 6 · 3   18 = 1 · 18   18 = 18 · 1

YTI #2 Write 20 in a factored form six different ways. Use Example 2 as a guide.

20 = ________ ________ ________ ________ ________ ________

MULTIPLES OF A NUMBER

The **multiples** of any number, ***a***, are all of the products involving ***a*** and some other whole number.

For example, the first five multiples of 3 from the multiplication table are

3, 6, 9, 12, and 15.

Each of these is a product of 3 and some other whole number:

3	6	9	12	15.
$1 \cdot 3$	$2 \cdot 3$	$3 \cdot 3$	$4 \cdot 3$	$5 \cdot 3$.

YTI #3 Starting with 4, list the first eight multiples of 4.

First eight multiples of 4: 4, ______________________________

THE MULTIPLICATION PROPERTY OF 0

Consider this: $4 \cdot 0$ = four 0's $= 0 + 0 + 0 + 0 = 0$.

In other words, $4 \cdot 0 = 0$. This is true of any multiple of 0. Also, the Commutative Property allows us to say that $0 \cdot 4 = 0$.

The Multiplication Property of 0

$$\boldsymbol{a \cdot 0 = 0} \quad \text{and} \quad \boldsymbol{0 \cdot a = 0}$$

The product of 0 and any number is always 0.

Think about it: Is 0 a multiple of 3? Explain your answer.

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DIVISION

The division of two numbers, such as 15 divided by 5, can be represented in one of three forms:

Standard form: dividend ÷ divisor = quotient $\quad$ 15 ÷ 5 is read "15 divided *by* 5."

Long division form: $\text{divisor}\overline{\smash{)}\,\text{dividend}}$ with quotient above $\quad$ $5\overline{\smash{)}\,15}$ is read "5 divided *into* 15."

Fraction form: $\dfrac{\text{dividend}}{\text{divisor}} = \text{quotient}$ $\quad$ $\dfrac{15}{5}$ is read "15 divided *by* 5."

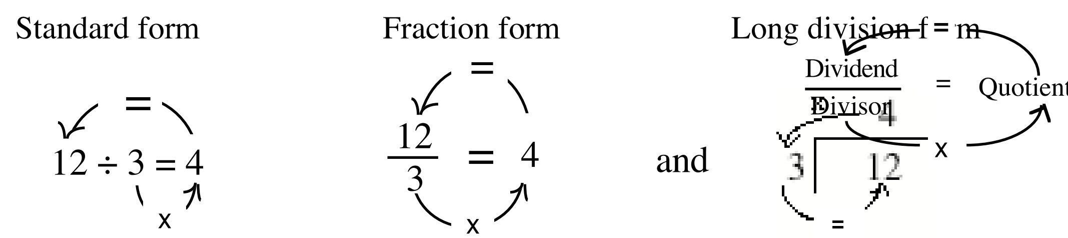
In the fraction form, the line separating the dividend and the divisor is called the **division bar**:

$$\frac{\text{dividend}}{\text{divisor}} \leftarrow \text{division bar}$$

In division, when there is no remainder, such as 15 ÷ 3 = 5, we say that the divisor, 5, *divides evenly* into the dividend, 15.   We can also say that 15 is *divisible* by 5. We also call this *exact division*.

When there is a remainder (besides 0), as in 7 ÷ 3, we say that 3 does *not* divide evenly into 7. 7 is *not* divisible by 3.

Division is *the inverse operation of multiplication.* For exact division, we can use a circular argument of inverses to see how multiplication and division work together:



3 x 4 = 12   3 x 4 = 12   4 x 3 = 12

This circular argument says:

divisor x quotient = dividend

Because of the circular nature of division and multiplication, we can use multiplication to verify the accuracy of our division result, the quotient.

Example 3: Divide. Verify each answer by multiplying the divisor and the quotient.

a) $35 \div 7$ b) $\frac{18}{6}$ c) $5 \div 5$ d) $\frac{0}{4}$ e) $8 \div 1$

Procedure: Think about what number will multiply by the divisor to get the quotient. In other words, use the circular argument for division, divisor x quotient = dividend, to find the quotient.

Answer:

a) $35 \div 7 = \underline{5}$ because $7 \times \underline{5} = 35$

b) $\frac{18}{6} = \underline{3}$ because $6 \times \underline{3} = 18$

c) $5 \div 5 = \underline{1}$ because $5 \times \underline{1} = 5$ — Rule: a natural number divided by itself is 1.

d) $\frac{0}{4} = \underline{0}$ because $4 \times \underline{0} = 0$ — Rule: 0 divided by a natural number is 0.

e) $8 \div 1 = \underline{8}$ because $1 \times \underline{8} = 8$ — Rule: a number divided by 1 is itself.

Parts c), d), and e) of Example 2 demonstrate three basic principles of division:

1. A natural number divided by itself is 1: $c \div c = 1$; $\frac{c}{c} = 1$
2. 0 divided by a natural number is 0: $0 \div c = 0$; $\frac{0}{c} = 0$ (c cannot be 0)
3. A number divided by 1 is itself: $c \div 1 = c$; $\frac{c}{1} = c$

YTI #4 Divide. Verify each answer by multiplying the divisor by the quotient, as in Example 3.

a) $50 \div 5 =$ ________ b) $18 \div 3 =$ ________ c) $\frac{4}{4} =$ ________

d) $\frac{40}{5} =$ ________ e) $0 \div 2 =$ ________ f) $\frac{7}{1} =$ ________

CAN THE DIVISOR EVER BE 0?

We can *never* divide by 0 (zero). We have seen that 0 can be the dividend, but it can never be the divisor. The circular argument shows us why:

$$\frac{3}{0} = ?? \quad \Longrightarrow \quad 0 \times ?? = 3$$

There is no number that fits here because
0 x any number = **0**, never 3.

> In general, we say that **$a \div 0$, or $\frac{a}{0}$, is undefined**.

As an example, you might think of division by 0 in terms of distributing equal lottery winnings among a group of people:

Lottery winnings	÷	# of people	=	Each person gets	
\$0	÷	3	=	\$0	$0 \div 3 = 0$
\$35	÷	0	=	??	$35 \div 0 = ??$ (impossible)

You can't distribute \$35 among 0 people. It isn't possible.

EVALUATING AN EXPRESSION

To **evaluate** means to "find the value of." When we find the sum of the expression 3 + 5, we are simply finding a different way to express the *value* of 3 + 5, which is 8.

YTI #5 Evaluate each expression.

a) $2 + 6 =$ _____ b) $9 - 2 =$ _____ c) $4 \times 5 =$ _____ d) $12 \div 3 =$ _____

Parentheses, (and), are considered **grouping symbols**. Parentheses group different values together so that they can be treated as one *quantity*.

A **quantity** is an expression that is considered to be *one value*. For example, (7 + 3) is a quantity; it has just one value: 10.

> Generally, in any expression that has parentheses, the quantity within those parentheses should be evaluated *first*.

Example 4: Evaluate each expression.

a) (2 x 4) – 3 b) 4 + (9 ÷ 3) c) 2 x (5 + 4)

Procedure: Evaluate the quantity first, then evaluate the new expression.

Answer:

a)	b)	c)
(2 x 4) – 3	4 + (9 ÷ 3)	2 x (5 + 4)
= 8 – 3	= 4 + 3	= 2 x 9
= 5	= 7	= 18

YTI #6 Evaluate each expression. Use Example 4 as a guide.

a) (4 + 6) ÷ 2 b) 9 – (1 x 4) c) 8 + (6 ÷ 3)

THE COMMUTATIVE PROPERTIES

Evaluate 2 + 4 = _____ and 4 + 2 = _____ . For each of these, the resulting sum is 6. These two sums illustrate a simple, yet important, property of mathematics, the *Commutative Property of Addition*.

The **Commutative Property of Addition** states: When adding two numbers, it doesn't matter which number is written first, the resulting sum will be the same.

The Commutative Property is true for multiplication as well. For example, 3 x 5 = 15 and 5 x 3 = 15.

The Commutative Properties are more formally written using letters, *a* and *b*, to represent any two numbers:

The Commutative Properties of Addition and Multiplication

If ***a*** and ***b*** are any numbers, then

Addition	Multiplication
$a + b = b + a$	$a \times b = b \times a$
The order in which we add two numbers doesn't affect the resulting sum.	The order in which we multiply two numbers doesn't affect the resulting product.

Caution: Division is *not* commutative. If we switch the order of the numbers when dividing, then we don't get the same result. For example, 10 ÷ 5 is *not* the same as

5 ÷ 10. Here's an illustration:

At a youth car wash, if 5 youths wash a truck for \$10, they get \$2 each (\$10.00÷ 5 = \$2.00); however, if 10 youths wash a car for \$5, they get only \$0.50 each (\$5.00 ÷ 10 = \$0.50).

Similarly, subtraction is *not* commutative.

Example 5: If possible, use a commutative property to rewrite each expression.

a) 3 + 4 b) 6 x 5 c) 9 – 5 d) 15 ÷ 3

Procedure: Switch the order of the numbers to arrive an equivalent expression.

Answer:

a) 3 + 4 = 4 + 3 b) 6 x 5 = 5 x 6

c) 9 – 5 cannot be rewritten; subtraction is not commutative.

d) 15 ÷ 3 cannot be rewritten; division is not commutative.

YTI #7 If possible, use a commutative property to rewrite each expression. Use Example 5 as a guide.

a) 2 + 6 b) 9 – 2 c) 12 ÷ 3 d) 4 x 5

Think about it:

What could you tell a classmate to help him or her remember why the two properties above are called *commutative* properties?

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THE ASSOCIATIVE PROPERTIES

Another important property of mathematics is the *Associative Property*. There is an Associative Property for addition and one for multiplication.

Whenever we need to add three numbers together, such as 3 + 2 + 4, we must always choose to add two of them first. We can use parentheses to group two of them to create a quantity, then evaluate the quantity first.

For example, with the sum 3 + 2 + 4, we can either group the first two numbers or the last two numbers:

a) $(3 + 2) + 4$ or b) $3 + (2 + 4)$

Add 3 and 2 first. Add 2 and 4 first.

$= 5 + 4$ $= 3 + 6$

$= 9$ $= 9$

Notice that the resulting sum, 9, is the same no matter which grouping we choose.

The same is true of multiplying three numbers together, such as $3 \times 2 \times 4$:

c) $(3 \times 2) \times 4$ or d) $3 \times (2 \times 4)$

Multiply 3 and 2 first. Multiply 2 and 4 first.

$= 6 \times 4$ $= 3 \times 8$

$= 24$ $= 24$

Notice that the resulting product, 24, is the same no matter which grouping we choose.

The Associative Property uses letters *a*, *b,* and *c* to represent any numbers we wish to put in their place.

The Associative Properties of Addition and Multiplication

If ***a***, ***b***, and ***c*** are any three numbers, then

Addition	**Multiplication**
$(a + b) + c = a + (b + c)$	$(a \times b) \times c = a \times (b \times c)$
If the only operation is addition, we can change the grouping of the numbers without affecting the resulting sum.	If the only operation is multiplication, we can change the grouping of the numbers without affecting the resulting product.

Example 6: Write each expression two different ways using parentheses, then evaluate it.

a) $1 + 6 + 3$ b) $5 \times 2 \times 3$

Procedure: Use the Associative Property; notice that the order in which the numbers are written doesn't change.

Answer:

a) $\underline{1 + 6 + 3} = \underline{\overset{7 \quad + 3}{(1 + 6) + 3}} = \underline{\overset{1 + \quad 9}{1 + (6 + 3)}} = \underline{\mathbf{10}}$

b) $\underline{5 \times 2 \times 3} = \underline{\overset{10 \quad \times 3}{(5 \times 2) \times 3}} = \underline{\overset{5 \times \quad 6}{5 \times (2 \times 3)}} = \underline{\mathbf{30}}$

YTI #8 Write each expression two different ways using parentheses, then evaluate it. Use Example 6 as a guide.

a) $\underline{2 + 8 + 6}$ = ____________ = ____________ = ________

b) $\underline{4 + 6 + 9}$ = ____________ = ____________ = ________

c) $\underline{3 \times 2 \times 4}$ = ____________ = ____________ = ________

d) $\underline{6 \times 5 \times 2}$ = ____________ = ____________ = ________

Think about it:

What could you tell a classmate to help him or her remember why the two properties above are called *associative* properties?

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The Associative Properties will be used throughout this text in a variety of areas. One quick example of how the Associative Property of Addition is used is in adding two numbers with a sum greater that 10.

For example, to find the sum 6 + 7, we can think of 7 as 4 + 3, making the sum $6 + (4 + 3)$

The Associative Property allows us to regroup this as $= (6 + 4) + 3$

This type of grouping allows for the quantity to equal 10 $= 10 + 3$

and this sum is easy to evaluate $= 13$

THE IDENTITIES

The notion of *identity* is another important property of addition and multiplication. An **identity** is a number that, when applied, won't change the value of another number or quantity. In other words, the identity value maintains the value of the other number.

For addition, the identity is 0 (zero), because

a) $6 + \mathbf{0} = 6$ b) $\mathbf{0} + 3 = 3$ 0 is called the **additive identity**.

Notice that adding 0 (zero) to a number doesn't change the value of the number.

For multiplication, the identity is 1 (one), because

a) $5 \times \mathbf{1} = 5$ b) $\mathbf{1} \times 8 = 8$ 1 is called the **multiplicative identity**.

Notice that multiplying a number by 1 doesn't change the value of the number.

The Identities for Addition and Multiplication

If ***a*** is any number, then

Addition	**Multiplication**
$a + 0 = 0 + a = a$	$a \times 1 = 1 \times a = a$
Adding 0 to a number doesn't change the number's value.	Multiplying a number by 1 doesn't change the number's value.

Notice that each identity is expressed two ways using the Commutative Property.

YTI #9 Apply the idea of identity by filling in the blank.

a) $4 + 0 =$ ______ b) $9 +$ ______ $= 9$ c) $0 +$ ______ $= 12$

d) $7 \times 1 =$ ______ e) $23 \times$ ______ $= 23$ f) $1 \times$ ______ $= 15$

Think about it: Is 1 an identity for any other operation besides multiplication?

____

____

THE DISTRIBUTIVE PROPERTY OF MULTIPLICATION OVER ADDITION

As we have seen, parentheses group a quantity and make it one value. For example, in the expression $3 \cdot (10 + 2)$, the parentheses suggest that $(10 + 2)$ should be treated as one value, 12.

The expression can become $3 \cdot (12)$ which is just three 12's: $12 + 12 + 12 = 36$. This means that $3 \cdot 12 = 36$.

Treating $3 \cdot (12)$, though, as $3 \cdot (10 + 2)$ suggests that we have three 10's and three 2's:

$$3 \cdot (10 + 2) = (10 + 2) + (10 + 2) + (10 + 2)$$

$$3 \cdot (10 + 2) = (10 + 10 + 10) + (2 + 2 + 2)$$

The Commutative and Associative Properties allow us to rearrange the numbers into groups of three 10's and three 2's.

$$3 \cdot (10 + 2) = (\text{three 10's}) + (\text{three 2's})$$

$$3 \cdot (10 + 2) = 3 \cdot 10 + 3 \cdot 2$$

$$3 \cdot (10 + 2) = 30 + 6$$

$$3 \cdot (10 + 2) = 36$$

We can say that the multiplier 3 is being distributed to both the 10 and the 2.

This diagram is a shortcut to the work shown above:

$$\begin{aligned} \mathbf{3} \cdot (10 + 2) &= \mathbf{3} \cdot 10 + \mathbf{3} \cdot 2 \\ &= 30 + 6 \\ &= 36 \end{aligned}$$

This idea helps to introduce an important property of mathematics, the Distributive Property, formally known as the **Distributive Property of Multiplication over Addition**.

The Distributive Property of Multiplication over Addition

We can distribute a multiplier, $\boldsymbol{a}$, over a sum $(b + c)$ so that it multiplies both numbers in the sum.

$$\boldsymbol{a} \cdot (b + c) \;=\; \boldsymbol{a} \cdot b \;+\; \boldsymbol{a} \cdot c$$

In other words, $\boldsymbol{a}$ is a multiplier of both b and c.

Usually, when evaluating an expression, we evaluate within the parentheses first. However, when specifically applying the Distributive Property, we multiply first.

The notion of the Distributive Property is quite useful in multiplying by numbers with two or more digits. We'll use the fact that every two-digit number can be separated into the sum of its tens and ones.

For example, $14 = 10 + 4$ and $59 = 50 + 9$. We can use this information and the Distributive Property when multiplying horizontally, as in Example 7.

Example 7: Multiply. a) $6 \cdot 14$ b) $7 \cdot 59$

Procedure: Treat 14 as $(10 + 4)$ and 59 as $(50 + 9)$ and use the Distributive Property.

Answer:

a)
$$6 \cdot 14$$
$$= 6 \cdot (10 + 4)$$

b)
$$7 \times 59$$
$$= 7 \cdot (50 + 9)$$

Apply the Distributive Property:

a)
$$6 \cdot (10 + 4) = 6 \cdot 10 + 6 \cdot 4$$
$$= 60 + 24$$
$$= 84$$

$$\boxed{\begin{array}{r} 60 \\ +\ 24 \\ \hline 84 \end{array}}$$

b)
$$7 \cdot (50 + 9) = 7 \cdot 50 + 7 \cdot 9$$
$$= 350 + 63$$
$$= 413$$

$$\boxed{\begin{array}{r} 350 \\ +\ 63 \\ \hline 413 \end{array}}$$

YTI #10 Multiply using the technique demonstrated in Example 7.

a) $4 \cdot 18 = 4 \cdot (10 + 8)$

b) $5 \times 46 = 5 \times (40 + 6)$

c) $7 \cdot 19 = 7 \cdot (\qquad\qquad)$

d) $8 \cdot 53 = 8 \cdot (\qquad\qquad)$

Example 8: Evaluate this expression by first distributing.

a) $7 \cdot (11 + 5)$ b) $5 \times (6 + 9)$

Procedure: Apply the Distributive Property.

Answer:

a)
$$\begin{aligned} & 7 \cdot (11 + 5) \\ = \ & 7 \cdot 11 + 7 \cdot 5 \\ = \ & 77 + 35 \\ = \ & 112 \end{aligned} \qquad \begin{array}{r} 77 \\ \underline{+\,35} \\ 112 \end{array}$$

b)
$$\begin{aligned} & 5 \times (6 + 9) \\ = \ & 5 \times 6 + 5 \times 9 \\ = \ & 30 + 45 \\ = \ & 75 \end{aligned} \qquad \begin{array}{r} 30 \\ \underline{+\,45} \\ 75 \end{array}$$

YTI #11 Evaluate this expression by first distributing. Use Example 8 as a guide.

a) $6 \cdot (9 + 5)$

b) $10 \cdot (7 + 8)$

b) $8 \times (11 + 5)$

You Try It Answers: Section 1.1

YTI #1:	a)	$9 + 3 = 12$		b)	$12 - 4 = 8$		c)	$5 \times 8 = 40$		d)	$30 \div 5 = 6$	
YTI #2:	$20 = 2 \cdot 10$, $20 = 10 \cdot 2$, $20 = 4 \cdot 5$, $20 = 5 \cdot 4$, $20 = 1 \cdot 20$, $20 = 20 \cdot 1$											
YTI #3:	4, 8, 12, 16, 20, 24, 28, and 32											
YTI #4:	a)	10	b)	6	c)	1	d)	8	e)	0	f)	7
YTI #5:	a)	8		b)	7		c)	20		d)	4	
YTI #6:	a)	5		b)	5		c)	10				
YTI #7:	a)	$6 + 2$					b)	cannot be rewritten				
	c)	cannot be rewritten					d)	5×4				
YTI #8:	a)	$(2 + 8) + 6 = 2 + (8 + 6) = 16$					b)	$(4 + 6) + 9 = 4 + (6 + 9) = 19$				
	c)	$(3 \times 2) \times 4 = 3 \times (2 \times 4) = 24$					d)	$(6 \times 5) \times 2 = 6 \times (5 \times 2) = 60$				
YTI #9:	a)	4	b)	0	c)	12	d)	7	e)	1	f)	15
YTI #10:	a)	$40 + 32 = 72$					b)	$200 + 30 = 230$				
	c)	$7 \cdot (10 + 9) = 70 + 63 = 133$					d)	$8 \cdot (50 + 3) = 400 + 24 = 424$				
YTI #11:	a)	84		b)	150		c)	128				

Focus Exercises: Section 1.1

Write both the expression and the result of each of the following.

1. the quotient of 8 and 4

2. the difference between 10 and 3

3. the sum of 2 and 5

4. the product of 2 and 10

Determine whether the expression shown is a sum, difference, product, or quotient.

5. 41 – 13	**6.** 57 ÷ 3	**7.** 19 x 42	**8.** 126 + 379

Write each number in a factored form at least six different ways.

9. 12	**10.** 28	**11.** 30	**12.** 40

List the first eight multiples of each number. (Use the number itself as the first multiple in the list.)

13. 6	**14.** 7	**15.** 8	**16.** 9

Divide, if possible. (Verify each answer by multiplying the divisor and the quotient.)

17. 20 ÷ 2	**18.** 30 ÷ 6	**19.** $\frac{42}{7}$	**20.** $\frac{54}{6}$
21. 12 ÷ 12	**22.** 15 ÷ 15	**23.** $\frac{13}{1}$	**24.** $\frac{19}{1}$
25. 0 ÷ 8	**26.** 12 ÷ 0	**27.** $\frac{6}{0}$	**28.** $\frac{0}{9}$

Evaluate this expression by first evaluating the quantity within the parentheses.

29. (9 – 4) + 3	**30.** 9 – (4 + 3)	**31.** 4 + (5 – 3)	**32.** (4 + 5) – 3
33. (2 + 6) ÷ 2	**34.** 2 + (6 ÷ 2)	**35.** 9 – (6 ÷ 3)	**36.** (9 – 6) ÷ 3
37. 7 – (3 x 2)	**38.** (7 – 3) x 2	**39.** 8 ▯ (4 x 2)	**40.** (8 ▯ 4) x 2

Evaluate this expression by first distributing.

41. $2 \cdot (3 + 9)$

42. $2 \cdot (8 + 7)$

43. $3 \cdot (4 + 11)$

44. $3 \cdot (2 + 10)$

45. $4 \cdot (6 + 5)$

46. $4 \cdot (10 + 6)$

47. $5 \cdot (7 + 9)$

48. $6 \cdot (8 + 5)$

49. $7 \cdot (3 + 11)$

50. $8 \cdot (5 + 10)$

51. $9 \cdot (7 + 6)$

52. $9 \cdot (11 + 8)$

Which property does each represent?

53. $5 + (8 + 2) = (5 + 8) + 2$

54. $12 \times 5 = 5 \times 12$

55. $4 \cdot (3 \cdot 2) = 4 \cdot (3 \cdot 2)$

56. $7 \times (9 + 3) = 7 \times 9 + 7 \times 3$

57. $0 + 11 = 11$

58. $8 \times (5 \times 4) = (8 \times 5) \times 4$

59. $25 + 19 = 19 + 25$

60. $13 \times 1 = 13$