

Section 1.5 Multiplication with Whole Numbers

1. Definition of Multiplication and Multiplication Notation:

Multiplication is repeated addition. Thus, 5 times 8 means $8 + 8 + 8 + 8 + 8$. To denote multiplication, you may use a dot, parenthesis or 'x'. Since we often use 'x' for a variable in algebra, the dot or parenthesis notation is preferable.

To write 3 times 4 in math notation, you can write

$$3 \bullet 4, 3(4), (3)(4), \text{ or } 3 \times 4$$

2. Vocabulary: The product of two numbers a and b is $a \bullet b$. The "a" and "b" are called factors. The product may be written "ab" (omit the dot between the letters) if the at least one of the factors is a variable.

English Words	Math Symbols
The product of 2 and 5	
The product of 2 and y	
The product m and n	
The product of x and 2	
The product of p and q	

3. The Distributive Property: If a, b and c are any numbers, then

$$a(b + c) = ab + ac$$

Example: Use the distributive property to simplify:

a. $5(4 + 3)$

b. $7(2 + 6)$

c. $2(x + 3)$

d. $3(y + 7)$

e. $5(m + 3)$

f. $6(x + 6)$

g. $8(21 + 10)$

When expressions such as those above contain “like quantities” inside the parenthesis, there are two ways to proceed in simplifying:

- you can first perform the addition or subtraction inside the parentheses, and then perform the multiplication, or
- you can use the distributive property, and then simplify.

However, if the quantity inside the parenthesis contains “unlike quantities”, you can’t do the addition or subtraction first, so you must use the distributive property in order to simplify.

Example: Simplify each of the following by adding or subtracting first, then performing the multiplication.

a. $5(4 + 3)$

b. $7(2 + 6)$

c. $8(21 + 10)$

4. Geometric Representation of the Distributive Property: The distributive property can be shown geometrically as follows:

Example: Show the distributive property geometrically.

a. $3(4 + 5) = 3 \cdot 4 + 3 \cdot 5$

Use 3 rows, 4 X’s and 5 O’s

$$\begin{pmatrix} \text{X X X X O O O O O} \\ \text{X X X X O O O O O} \\ \text{X X X X O O O O O} \end{pmatrix} = \begin{pmatrix} \text{X X X X} \\ \text{X X X X} \\ \text{X X X X} \end{pmatrix} + \begin{pmatrix} \text{O O O O O} \\ \text{O O O O O} \\ \text{O O O O O} \end{pmatrix}$$

b. $5(2 + 6)$

5. Distributive Property and the Multiplication Algorithm: The multiplication algorithm is based on the distributive property. To see this, consider the following example:

Example: Simplify.

$$\begin{aligned} \text{a. } 25(12) &= 25(10 + 2) \\ &= 25 \bullet 10 + 25 \bullet 2 \\ &= 250 + 50 \\ &= 300 \end{aligned}$$

Example: Multiply the following numbers in your head.

a. $25(14)$

b. $15(12)$

c. $22(13)$

6. Multiplication Algorithm: Please review multiplication facts and the multiplication algorithm.

Example: Find the product of 849 and 76

7. Properties of Multiplication: The four properties of multiplication are:

- the multiplication property of zero
- the multiplication property of one
- the commutative property of multiplication
- the associative property of multiplication.

These properties are stated below. On the first test, you may be asked to state these properties in proper mathematical vocabulary. You should memorize them as given below:

Multiplication property of zero: If a is any number, then

$$a \bullet 0 = 0 \bullet a = 0$$

Multiplication property of one: If a is any number, then

$$a \bullet 1 = 1 \bullet a = a$$

Commutative property of multiplication: If a and b are any numbers, then

$$a \bullet b = b \bullet a$$

Associative property of multiplication: If a, b and c are any numbers, then

$$a(bc) = (ab)c$$

Example: Name the property or properties that are illustrated in each of the following.

a. $3(4 \cdot 7) = (3 \cdot 4) \cdot 7$

b. $4(8 \cdot 9) = 4(9 \cdot 8)$

c. $5 \cdot 0 = 0 \cdot 5 = 0$

d. $6(7 \cdot 2) = (6 \cdot 2) \cdot 7$

8. Solving Equations by Inspection:

Example: Solve by inspection.

a. $5n = 25$

$n = 5$ (guess the solution)

b. $7n = 28$

9. Multiplying by Powers of Ten: To multiply by a power of ten, count the number of zeros on the power of ten and place that many zeros on the end of the other factor to get the answer.

Example:

a. $100 \cdot 27 = 2700$

b. $10,000 \cdot 82$

c. $1,000,000 \cdot 132$

To multiply by a number that ends in zeros:

1. Drop the zeros.
2. Multiply the two remaining numbers.
3. Place the zeros at the end of the product.

Example:

a. $2700 \bullet 3 = 8100$

b. $42 \bullet 2,000$

c. $32,000 \bullet 80$