

2.4 Multiply Real Numbers

Goal • Multiply real numbers.

Your Notes

EXAMPLES

① $16 \cdot 1 = 16$

② $1 \cdot x = x$

① THE PRODUCT OF AN EVEN NUMBER OF NEGATIVE FACTORS IS ALWAYS POSITIVE.

② AN ODD NUMBER OF FACTORS IS ALWAYS NEGATIVE

EXAMPLES ON NEXT PAGE

③ $-4(-2)(-1)(-10) =$

④ $-5(-1)(-10) =$

⑤ $(-2)^4 =$

⑥ $(-3)^3 =$

VOCABULARY

Multiplicative identity IS ONE (1).

THE PROPERTY STATES THE PRODUCT OF 1 and X IS X.

THE SIGN OF A PRODUCT

The product of two real numbers with the same sign is POSITIVE.

Examples: $5(2) = 10$

$-4(-5) = 20$

The product of two real numbers with different signs is NEGATIVE.

Examples: $5(-3) = -15$

$-8(4) = -32$

Example 1 Multiply real numbers

Find the product.

Solution

a. $-7(-3) = 21$

Same signs: product is POSITIVE

b. $3(4)(-2) = 12(-2) = -24$

Multiply 3 and 4.

Different signs: product is NEGATIVE

c. $\frac{1}{4}(-16)(-3) = -4(-3) = 12$

Multiply $\frac{1}{4}$ and -16 .

Same signs: product is POSITIVE

Your Notes

(A) Why are these \neq ?
 $(-2)^4 \neq -2^4$

because Even Exponents

$-2 \cdot -2 \cdot -2 \cdot -2 = -(2 \cdot 2 \cdot 2 \cdot 2)$
 $16 \neq -16$

Follow order of operations

(B) WHY ARE THESE = ?

because odd Exponents

$(-3)^3 = -3^3$
 $-3 \cdot -3 \cdot -3 = -(3 \cdot 3 \cdot 3)$
 $-27 = -27$

Checkpoint Find the product.

1. $-4(-6) =$ <div style="border: 1px solid black; padding: 5px; display: inline-block;">24</div>	2. $-3(-2)(-7) =$ <div style="border: 1px solid black; padding: 5px; display: inline-block;">-42</div>
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VARIABLES

(a) $x \Leftrightarrow 1 \cdot x$
 implied 1 Coefficient

(b) $-x \Leftrightarrow -1 \cdot x$
 implied -1 Coefficient

PROPERTIES OF MULTIPLICATION

① **Commutative Property** The order in which two numbers are multiplied does not change the product. (REVERSE ORDER)

$a \cdot b = b \cdot a$

Example: $3 \cdot 4 = 4 \cdot 3$

② **Associative Property** The way you group three numbers when multiplying does not change the product. THINK ()'S. ORDER DOESN'T CHANGE

$(a \cdot b) \cdot c = a \cdot (b \cdot c)$

Example: $(2 \cdot 3) \cdot 4 = 2 \cdot (3 \cdot 4)$

③ **Identity Property** The product of a number and 1 is that number. ANYTHING TIMES 1 IS ITSELF

$a \cdot 1 = 1 \cdot a = a$

Example: $(-2) \cdot 1 = (-2)$

④ **Property of Zero** The product of a number and 0 is 0. ANYTHING TIMES 0 IS 0.

$a \cdot 0 = 0 \cdot a = 0$

Example: $4 \cdot 0 = 0$

⑤ **Property of -1** The product of a number and -1 is the opposite of the number.

$a \cdot (-1) = -1 \cdot a = -a$

Example: $-5 \cdot (-1) = 5$

NOTICE THESE ARE OPPOSITES.

$10 \cdot (-1) = -10$

TRY THESE - NAME THE PROPERTIES

Your Notes

Example 2 Identify properties of multiplication

Identify the property illustrated by each expression.

Solution

Statement

a. $3 \cdot 0 = 0$

Property Illustrated

MULT. PROPERTY OF ZERO

b. $t \cdot 1 = t$

IDENTITY PROPERTY

c. $a \cdot 3 = 3 \cdot a$

COMMUNATIVE PROPERTY

d. $n \cdot (3 \cdot 5) = (n \cdot 3) \cdot 5$

ASSOCIATIVE PROPERTY

e. $-7(-1) = 7$

PROPERTY OF -1

ALL ARE
MULTIPLICATIVE
PROPERTIES

✓ Checkpoint Identify the property illustrated.

3. $-4 \cdot 0 = 0$

PROPERTY OF ZERO

4. $6 \cdot 2 = 2 \cdot 6$

COMMUNATIVE
PROPERTY

5. $(4 \cdot 5) \cdot 6 = 4 \cdot (5 \cdot 6)$

ASSOCIATIVE
PROPERTY

6. $4 \cdot (-1) = -4$

PROPERTY OF -1

Your Notes

Example 3 Use properties of multiplication

Find the product $(0.5)(-2x)(6)$.

Solution Simplify

$(0.5)(-2x)(6) =$

-6 is the Coefficient

$-6x$



NOTES:

- ① HOW MANY FACTORS IN THIS EXAMPLE? $\boxed{3}$
- ② WHAT ARE THE FACTORS? $.5, -2x, 6$
- ③ MULTIPLY THE NUMBERS = $.5 \cdot -2 \cdot 6 = \boxed{-6}$
- ④ MULTIPLY VARIABLES x

⑤ SIMPLIFY means Combine like terms, NO ()'s and NO + -

✓ **Checkpoint** Find the product. Justify your steps.

7. $-\frac{1}{2}(2)(3y) = \boxed{-3y}$

Simplify
Expressions

8. $(-2)(a)(-5) = \boxed{10a}$

Homework

QUESTION

What is the difference between evaluate and simplify an expression?

EVALUATE: means to find the value of the expression

Simplify: means to put an expression in simplest form.

2.5 Apply the Distributive Property

Goal • Apply the distributive property.

Your Notes

VOCABULARY

Equivalent expressions 2 EXPRESSIONS THAT HAVE THE SAME VALUE

Distributive property - A PROPERTY USED TO FIND THE PRODUCT OF A NUMBER AND A SUM OR DIFFERENCE

Terms THE PARTS OF AN EXPRESSION THAT ARE ADDED (ie separated by +, - signs)

Coefficient THE NUMBER THAT PRECEEDS A VARIABLE [EX] $-5x$ \leftarrow -5 is COEF.

Constant term HAS NO VARIABLE PART. IT IS SIMPLY A NUMBER [EX] 5

Like terms ARE TERMS THAT HAVE THE SAME VARIABLES RAISED TO THE SAME EXPONENTS [EX] $-2x^2, 2x^2$
like terms

THE DISTRIBUTIVE PROPERTY

Let a, b, and c be real numbers.

Algebra	Examples <i>Show distribution</i>
$a(b + c) = ab + ac$	$4(x + 3) = 4 \cdot x + 4 \cdot 3$
$(b + c)a = ba + ca$ $\xrightarrow{\text{arrow}} = ab + ac$	$(x + 5)2 = 2 \cdot x + 2 \cdot 5$
$a(b - c) = ab - ac$	$7(x - 3) = 7 \cdot x + 7 \cdot (-3)$
$(b - c)a = ba - ca$ $\xrightarrow{\text{arrow}} = ab - ac$	$(x - 4)9 = 9 \cdot x + 9 \cdot (-4)$

DO NOT SIMPLIFY!

QUESTION: Do you need to distribute $5(2+3)$? WHY!

NO - THERE ARE NO VARIABLES - Follow order of operations.

Your Notes

Be sure to distribute the factor outside of the parentheses to *all* of the numbers inside the parentheses.

Use the distributive property to combine like terms with variable parts. Your expression is *simplified* if there are no grouping symbols and all like terms are combined.

Example 1 Apply the distributive property

Use the distributive property to write an equivalent equation.

Solution DISTRIBUTE MENTALLY + SIMPLIFY

a. $4(a + 3) = 4a + 12$

b. $(a + 5)6 = 6a + 30$

c. $3(x - 8) = 3x - 24$

d. $(4 - x)(x) = 4x - x^2$ reorder \rightarrow $-x^2 + 4x$

Example 2 Distribute a negative number

Use the distributive property to write an equivalent equation.

Solution SIMPLIFY:

a. $-3(7 + x)$
 $= -3(7) + (-3)(x)$ ← Distribute -3 . mental step.
 $= -21 - 3x$ → $(-3x - 21)$ Simplify

b. $(6 - a)(-2a)$
 $= 6(-2a) - a(-2a)$ ← Distribute $-2a$. mental step
 $= -12a + 2a^2$
 \downarrow $(2a^2 - 12a)$ Simplify

✓ **Checkpoint** Use the distributive property to write an equivalent equation. SIMPLIFY

<p>1. $5(n + 4) =$</p> <p>$5n + 20$</p>	<p>2. $-a(3 + a) =$</p> <p>$-3a + (-a^2)$</p> <p>\downarrow</p> <p>$-a^2 - 3a$</p>
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Your Notes

Example 3 Identify parts of an expression

Identify the terms, like terms, coefficients, and constant terms of the expression $2x - 5 + 8x - 3$.

Solution

① $2x + (-5) + 8x + (-3)$ ① Write the expression as a sum.

② Terms: $2x, -5, 8x, -3$ ③ Like terms: $(2x, 8x)$ and $(-5, -3)$

Coefficients (to variables): $2, 8$ ④ Constant terms: $-5, -3$

✓ **Checkpoint** Identify the terms, like terms, coefficients, and constant terms of the expressions.

3. $10 + 3a - 4 - 6a$

Terms: $10, 3a, -4, -6a$
Like Terms: $3a, -6a$ and $10, -4$
Coefficients: $3, -6$
Constant Terms: $10, -4$