KEY

2.4 Multiply Real Numbers

Goal • Multiply real numbers.

Your Notes

VOCABULARY

Multiplicative identity IS ONE (1).
THE PROPERTY STATES THE PRODUCT OF 1 and X IS X.

EXAMPLES
① $16 \cdot 1 = 16$
② $1 \cdot X = X$

THE SIGN OF A PRODUCT

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

Examples: $5(2) =$ 10
$-4(-5) =$ 20

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

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

Examples: $5(-3) =$ -15
$-8(4) =$ -32

② AN ODD NUMBER OF FACTORS IS ALWAYS NEGATIVE

Example 1 ***Multiply real numbers***

Find the product.

Solution

a. $-7(-3) =$ 21 — Same signs: product is POSITIVE

b. $3(4)(-2) =$ 12 (-2) — Multiply 3 and 4.
$=$ -24 — Different signs: product is NEGATIVE

c. $\frac{1}{4}(-16)(-3) =$ (-4) (-3) — Multiply $\frac{1}{4}$ and -16.
$=$ 12 — Same signs: product is POSITIVE

EXAMPLES ON NEXT PAGE

③ $-4(-2)(-1)(-10) =$

④ $-5(-1)(-10) =$

⑤ $(-2)^4 =$

⑥ $(-3)^3 =$

Your Notes

Checkpoint Find the product.

1. $-4(-6)$ =	2. $-3(-2)(-7)$ =
24	-42

(A) Why are these $\neq$?

$(-2)^4 \neq -2^4$

$-2 \cdot -2 \cdot -2 \cdot -2$ $\quad -(2 \cdot 2 \cdot 2 \cdot 2)$

$16 \neq -16$

because Even Exponents

Follow order of operations

(B) WHY ARE THESE $=$?

$(-3)^3 = -3^3$

$-3 \cdot -3 \cdot -3$ $\quad -(3 \cdot 3 \cdot 3)$

$-27 = -27$

because odd Exponents

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 · a

Example: $3 \cdot 4 =$ 4 · 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 · (b · c)

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

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

$a \cdot 1 =$ 1 · 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 · 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 · a $=$ −a

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

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

NOTICE THESE ARE OPPOSITES.

VARIABLES

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

(b) $-X \Leftrightarrow -1 \cdot X$ (implied −1 Coefficient)

TRY THESE - NAME THE PROPERTIES

Your Notes

Example 2 *Identify properties of multiplication*

Identify the property illustrated by each expression.

Solution

Statement	Property Illustrated
a. $3 \cdot 0 = 0$	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 → −6 x

NOTES:

① HOW MANY FACTORS IN THIS EXAMPLE? 3

② WHAT ARE THE FACTORS? .5, −2x, 6

③ MULTIPLY THE NUMBERS = .5 • −2 • 6 = −6

④ MULTIPLY VARIABLES x

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

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

7. $-\frac{1}{2}(2)(3y)$ = −3Y

SIMPLIFY Expressions

8. (−2)(a)(−5) = 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 seperated by +, - SIGNS)

Coefficient THE NUMBER THAT PRECEEDS A VARIABLE EX $-5x$ (-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.

DO NOT SIMPLIFY!

Algebra	Examples Show distribution
$a(b + c) = ab + ac$	$4(x + 3) = 4 \cdot x + 4 \cdot 3$
$(b + c)a = ba + ca$ $= ab + ac$	$(x + 5)2 = 2 \cdot x + 2 \cdot 5$
$a(b - c) = ab - ac$	$7(x - 3) = 7 \cdot x + 7 \cdot (-3)$
$(b - c)a = ba - ca$ $= ab - ac$	$(x - 4)9 = 9 \cdot x + 9(-4)$

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

NO – THERE ARE NO VARIABLES – FOLLOW order of operations.

Your Notes

Example 1 *Apply the distributive property*

Use the distributive property to write an equivalent equation.

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

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 → $-x^2 + 4x$

Example 2 *Distribute a negative number*

Use the distributive property to write an equivalent equation.

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.

SIMPLIFY:

Solution

a. $-3(7 + x)$

$= -3(7) + (-3)(x)$ ← Distribute -3. mental ste.

$= -21 - 3x \rightarrow -3x - 21$ Simplify

b. $(6 - a)(-2a)$

$= 6(-2a) - a(-2a)$ ← Distribute $-2A$. mentalstep

$= -12a + 2a^2$ Simplify

$2a^2 - 12a$

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

1. $5(n + 4) =$	2. $-a(3 + a) =$
$5N + 20$	$-3a + (-a^2)$ ⇓ $-a^2 - 3a$

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: (of variables) 2, 8

(6) **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