1-2 Properties of Real Numbers

Starter 1.2

Simplify.

1. $-5+5$ **0**

2. $-7\left(\frac{1}{-7}\right)$ **1**

3. $\frac{1}{2}(3.62)$ **1.81**

4. Find 10% of $61.70. **$6.17**

5. Find the reciprocal of -4. $\frac{1}{-4}$

1-2 Properties of Real Numbers

Properties Real Numbers

For all real numbers *n*,	
Additive Identity Property (0)	The sum of a number and 0, the additive identity, is the original number. $n + 0 = 0 + n = n$
Multiplicative Identity Property (1)	The product of a number and 1, the multiplicative identity, is the original number. $n \cdot 1 = 1 \cdot n = n$
Additive Inverse Property	The sum of a number and its **opposite**, or additive inverse, is 0. $n + (-n) = 0$
Multiplicative Inverse Property	The product of a nonzero number and its **reciprocal**, or multiplicative inverse, is 1. $n \cdot \frac{1}{n} = 1 \quad (n \neq 0)$

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Example 1: Finding Inverses

Find the additive and multiplicative inverse of each number.

12

additive inverse: -12 *The opposite of 12 is –12.*

Check $-12 + 12 = 0$ ✓ *The Additive Inverse Property holds.*

multiplicative inverse: $\frac{1}{12}$ *The reciprocal of 12 is* $\frac{1}{12}$.

Check $12 \cdot \left(\frac{1}{12}\right) = 1$ ✓ *The Multiplicative Inverse Property holds.*

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Example 2: Finding Inverses

Find the additive and multiplicative inverse of each number.

$-\frac{9}{4}$

additive inverse: $\frac{9}{4}$ *The opposite of* $-\frac{9}{4}$ *is* $\frac{9}{4}$.

multiplicative inverse: $-\frac{4}{9}$ *The reciprocal of* $-\frac{9}{4}$ *is* $-\frac{4}{9}$.

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Check It Out! Example 1A

Find the additive and multiplicative inverse of each number.

500

additive inverse: -500 *The opposite of 500 is –500.*

Check $500 + (-500) = 0$ ✓ *The Additive Inverse Property holds.*

multiplicative inverse: $\frac{1}{500}$ *The reciprocal of 500 is* $\frac{1}{500}$.

Check $500 \cdot \left(\frac{1}{500}\right) = 1$ ✓ *The Multiplicative Inverse Property holds.*

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Check It Out! Example 1B

Find the additive and multiplicative inverse of each number.

–0.01

additive inverse: 0.01 *The opposite of –0.01 is 0.01.*

multiplicative inverse: -100 *The reciprocal of –0.01 is –100.*

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Properties Real Numbers

For all real numbers *a* and *b*,

Closure Property	The sum or product of any two real numbers is a real number, $a + b \in \mathbb{R}$, $ab \in \mathbb{R}$
Commutative Property	You can add or multiply real numbers in any **order** without changing the result. $a + b = b + a$, $ab = ba$
Associative Property	The sum or product of three or more real numbers is the same regardless of the way the numbers are **grouped.** $(a + b) + c = a + (b + c)$, $(ab)c = a(bc)$

1-2 Properties of Real Numbers

Properties Real Numbers

For all real numbers *a* and *b*,

Distributive Property	When you multiply a sum by a number, the result is the same whether you add and then multiply or whether you multiply each term by the number and add the products. $a(b + c) = ab + ac$, $(b + c)a = ba + ca$

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Example 3: Identifying Properties of Real Numbers

Identify the property demonstrated by each question.

A) $2 \cdot (3.9) = (3.9) \cdot 2$ *Numbers are multiplied in any order without changing the results.*

Commutative Property of Multiplication

B) $3\left(2\sqrt{8}\right) = (3 \cdot 2)\sqrt{8}$ *The numbers have been regrouped.*

Associative Property of Addition

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Check It Out! Example 2

Identify the property demonstrated by each equation.

2a. $9\sqrt{2} = \left(\sqrt{2}\right)9$ *Numbers are multiplied in any order without changing the results.*

Commutative Property of Multiplication

2b. $9(12\pi) = (9 \cdot 12)\pi$ *The numbers have been regrouped.*

Associative Property of Multiplication

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Example 4: Consumer Economics Application

Use mental math to find a 5% tax on a $42.40 purchase.

Think: 10% of $42.40

$10\%(42.40) = 4.240 = 4.24$ *Move the decimal point left 1 place.*

Think: $5\% = \frac{1}{2}(10\%)$

$\frac{1}{2}(4.24) = 2.12$ *5% is half of 10%, so find half of 4.24.*

A 5% tax on a $42.40 is $2.12.

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Check It Out! Example 3

Use mental math to find a 20% discount on a $15.60 shirt.

Think: 20% = 10% • 2

$10\%(15.60) = 1.560 = 1.56$ *Move the decimal point left 1 place.*

$1.56 \cdot 2 = 3.12$ *20% is double 10%, so multiply 1.56 by 2.*

A 20% discount on a $15.60 shirt is $3.12.

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Example 5: Classifying Statements as Sometimes, Always, or Never True

Classifying each statement as sometimes, always, or never true. Give examples or properties to support your answers.

$a \cdot b = a$, where $b = 3$

sometimes true

true example: $0 \cdot 3 = 0$

false example: $1 \cdot 3 \neq 1$

True and false examples exist. The statement is true when $a = 0$ and false when $a \neq 0$.

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Example 6: Classifying Statements as Sometimes, Always, or Never True

Classifying each statement as sometimes, always, or never true. Give examples or properties to support your answers.

$3(a + 1) = 3a + 3$

always true

Always true by the Distributive Property.

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Check It Out! Example 4a

Classify each statement as sometimes, always, or never true. Give examples or properties to support your answer.

$a + (-a) = b + (-b)$

Always true by the Additive Inverse Property.

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Check It Out! Example 4b

Classify each statement as sometimes, always, or never true. Give examples or properties to support your answer.

$a - (b + c) = (a - b) + (a - c)$

sometimes true

true example:
$0 - (1 + 2) = (0 - 1) + (0 - 2)$
$-3 = -3$

false example:
$1 - (2 + 3) = (1 - 2) + (1 - 3)$
$-4 \neq -3$

True and false examples exist. The statement is true when $a = 0$, $b = 1$, and $c = 2$. False when $a = 1$, $b = 2$, and $c = 3$.