

## Pre-Algebra

**Essential Question:** What are the properties of real numbers?

**Do Now:** Evaluate each numerical expression using the order of operations and answer the questions that follow.

A.  $2 \times 3 + 9 \times 2$

$$6 + 18$$

$$24$$

B.  $2(3 + 9)$

$$2(12)$$

$$24$$

Are the numerical expressions equivalent? How do you know?

Yes both expressions result in the same value.

### Properties of Real Numbers

Property	Definition	Addition	Multiplication
<b>Commutative</b>	Changing the order of numbers will not change the result.	$A + B = B + A$ $3 + 5 = 5 + 3$	$A \cdot B = B \cdot A$ $3 \cdot 5 = 5 \cdot 3$
<b>Associative</b>	Changing the grouping symbols will not change the result.	$(A + B) + C = A + (B + C)$ $(3 + 5) + 6 = 3 + (5 + 6)$ $14 = 14$	$(A \cdot B) \cdot C = A \cdot (B \cdot C)$ $(3 \cdot 5) \cdot 6 = 3 \cdot (5 \cdot 6)$
<b>Identity</b> mirror	Any number plus 0 is equal to itself. Any number times 1 is equal to itself.	$A + 0 = A$ $3\frac{5}{9} + 0 = 3\frac{5}{9}$	$A \cdot 1 = A$ $\frac{3}{4} \cdot 1 = \frac{3}{4}$
<b>Inverse</b>	For each real number (except 0), there exists an opposite number (additive inverse) and a reciprocal (flip) (multiplicative inverse).	$A + (-A) = 0$ $5 + (-5) = 0$	$A \cdot \frac{1}{A} = 1$ $5 \cdot \frac{1}{5} = 1$
<b>Distributive</b>	Multiplication can be distributed over addition or subtraction. Combines 2 operations.	$A(B + C) = AB + AC$ $A(B - C) = AB - AC$	$2(4 + 6) = 2 \cdot 4 + 2 \cdot 6$ $8 + 12 = 20$ $3(8 - 5) = 3 \cdot 8 - 3 \cdot 5$ $24 - 15 = 9$
<b>Zero Product</b> X	Any number times 0 is always equal to zero.	$A \cdot 0 = 0$ $\frac{1}{2} \cdot 0 = 0$	

Name the property shown by each statement. Remember to use the full name of the property.

Ex:  $5 + 4 = 4 + 5$  is an example of the Commutative Property of Addition

Statement	Property
$-5 + 0 = -5$	identity property of addition
$6(4 + 2) = 6(4) + 6(2)$	distributive property
$\sqrt{10} + (-\sqrt{10}) = 0$	inverse property of addition
$-3(7) = 7(-3)$	commutative property of multiplication
$(2 + 10) + 7 = 2 + (10 + 7)$	associative property of addition
$\frac{1}{4} \cdot 4 = 1$	inverse property of multiplication
$\frac{1}{2} \cdot 1 = \frac{1}{2}$	identity property of multiplication

### It's Your Turn Now

1. Which statement below represents the  $0 \times$  zero product property?

A.  $64 \times 1 = 64$

B.  $12.8 + 0 = 12.8$

C.  $-4 + 4 = 0$

D.  $0 \times 32 = 0$

2. Which numerical expression is the same as  $(5 \times 3) \times 7$ ? associative property of multiplication

A.  $5 \times (3 + 7)$

B.  $5 \times (3 \times 7)$

C.  $5 + (3 \times 7)$

D.  $(5 + 3) \times 7$

3. John says that  $\frac{2}{5} \times \frac{3}{3} = \frac{6}{15}$  is an example of the identity property of multiplication. Do you agree or disagree? Explain your reasoning.

Agree because  $\frac{3}{3} = 1$  and  $\frac{6}{15} = \frac{2}{5}$ .

**TAKE AWAY:** Properties of real numbers help us prove equivalence among numerical and algebraic expressions.  
**Important Vocabulary!**

Additive Inverse = opposite

Multiplicative Inverse = reciprocal