Lesson 1
The Language of Algebra

Outline

Part A
Real Numbers

- Rational Numbers and Irrational Numbers
- Classifying Real Numbers

Part B
Algebraic Properties

- Commutative and Associative Properties
- Inverse, Identity, and Zero-Product Property
- Distributive Property
- Properties of Equality

Targeted Review

Vocabulary

- real numbers ($\mathcal{R}$)
- rational numbers ($\mathcal{Q}$)
- integers ($\mathcal{Z}$)
- whole numbers ($\mathcal{W}$)
- natural numbers ($\mathcal{N}$)
- irrational numbers ($\mathcal{I}$)
- term
- like terms

Check out **More to Explore** in the Digital Pack to see if there are additional activities for this part of the lesson.

Warm Up

Your student should spend no more than 5 minutes on the Warm Up. This should be a quick review to activate prior knowledge.

Part A: Real Numbers

Objectives

In this part of the lesson, you will learn about real numbers.

By the end of this lesson you will be able to do the following:

- Identify numbers as:
  - real
  - whole
  - irrational
  - integers
  - rational
  - natural
- Draw a scaled number line showing numbers and approximate numbers.
- Explain why:

  a rational number + a rational number = a rational number.

  a rational number + an irrational number = an irrational number.

  an irrational number · a rational number = an irrational number.

Why?

It is important to understand the language of algebra. If the directions tell you that all solutions are integer values or all solutions are irrational, you need to be familiar with those words so that you can determine if you have the correct answer.

Warm Up

Fill in the word from the list that matches the definition.

algebra	coefficient	integer	terminating	variable

algebra **1)** a branch of mathematics that deals with numbers that may be represented by variables

variable **2)** a letter that represents an unknown quantity or number

coefficient **3)** a quantity (often a number) placed in front of a variable in an expression

integer **4)** positive and negative whole numbers, $\{\ldots, -3, -2, -1, 0, 1, 2, \ldots\}$

terminating **5)** ending

How many of these words did you already know? Whether new or a review, you will use these words throughout your exploration of algebra.

Now that your mind is ready for math, it is time to explore something new. In this part of the lesson, you will watch videos, fill in guided notes, and confirm your understanding at each checkpoint.

EXPLORE 1A

Rational and Irrational Numbers

- All numbers in Algebra 1 are **real** numbers ($\mathcal{R}$).
- Each set of numbers has a letter that can be used as **mathematical shorthand** for that set.
- The **Real Number System** diagram is a visual way to categorize number sets because a number can *only* be rational or irrational, never both.
- The first two subsets of $\mathcal{R}$ are $\mathcal{Q}$ and $\mathcal{I}$.

The Real Number System ($\mathcal{R}$)

$\mathcal{Q}$ **Rational** **Ratio of integers**	$\mathcal{I}$ **Irrational** **No exact ratio**

Rational numbers

- Rational numbers can be written as a **ratio** of integers.
- When you add, subtract, multiply, or divide a **rational expression** the result is a rational number. Rational numbers are **closed** under the four operations.
- Using symbols, this means that:

$\mathcal{Q} + \mathcal{Q} = \mathcal{Q}$ $\quad \mathcal{Q} - \mathcal{Q} = \mathcal{Q}$ $\quad \mathcal{Q} \cdot \mathcal{Q} = \mathcal{Q}$ $\quad \mathcal{Q} \div \mathcal{Q} = \mathcal{Q}$

- In other words, if you **start** with a rational number, your **answer** will be a rational number.
- Rational numbers can be written as fractions or decimals. However, when rational numbers are written as decimals they will terminate, or be a repeating decimal.

A) $\frac{1}{4} = 0.25$ **terminating** **B)** $\frac{1}{9} = 0.1111... = 0.\overline{1}$ **repeating**

1A EXPLORE

Irrational Numbers

- With irrational numbers, there is **no ratio** or **fraction** that is exactly equal to the decimal value.
- This is because irrational numbers are **non-ending** and **non-repeating** when written in decimal form.
- The sum or product of a rational and irrational number will *always* be irrational *except* when multiplying by **zero**.
- Assuming all values are non-zero, these expressions are *always* true:
  - $I + Q = I$
  - $I \cdot Q = I$
  - $I + I = I$
- Assuming all values are non-zero, this expression may only be true *sometimes*: $I \cdot I = I$

Example 1

Determine whether the expression will be rational or irrational using the mathematical shorthand $\{Q, I\}$. Then place each number in the diagram in your Guided Notes.

A) $5 + 0.\overline{3} = 5.\overline{3}$

$Q + Q = Q$

B) $-3 - 0.75077507775... = -3.75077507775...$

$Q - I = I$

The Real Number System ($\mathbb{R}$)

Q	I
5, $0.\overline{3}$, -3, -50%, $-\frac{6}{3}$, $\frac{8}{8}$, 0.75	$-0.75077507775...$, π

EXPLORE 1A

Example 2

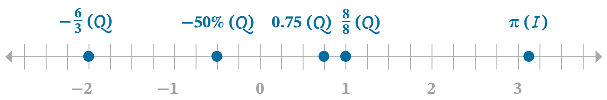
Place the numbers on the Real Number diagram. Then order them on a number line.

A) -50% **B)** $\frac{8}{8}$ **C)** π **D)** $-\frac{6}{3}$ **E)** 0.75

$-50\% = -\frac{50}{100} = -0.5$ $\frac{8}{8} = \frac{1}{1} = 1$ ≈ 3.14 $-\frac{6}{3} = -\frac{2}{1} = -2$ $0.75 = 0.75$

It may be helpful to write the numbers in the same form, in this case all decimals.

The values range from −2 to approximately 3.14. The number line should extend slightly past these numbers to show a better approximation of the values. You must label the points on the number line with the given numbers; not the decimal values.

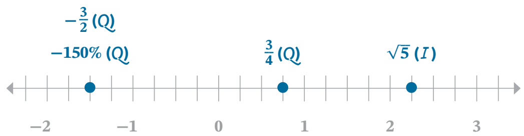


In this course when writing answers as a fraction, mixed fractions will be used less frequently. For example, if your answer is $\frac{6}{4}$, you should write $\frac{3}{2}$ $\left(\text{rather than } 1\frac{1}{2}\right)$.

Checkpoint

Order the given numbers on the number line. Next to the number label with Q for rational or I for irrational.

A) $-\frac{3}{2}$ **B)** $\sqrt{5}$ **C)** -150% **D)** $\frac{3}{4}$



Example 2
π represents the number called pi. The accepted estimate of this irrational number is 3.14.

Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

Classifying Real Numbers

- As you know, Real Numbers have two main subsets: **rational** and **irrational numbers**.
- Rational numbers are also made up of a subset of numbers.
  - Integers **($\mathcal{Z}$)**: positive and negative whole numbers, or **$\{\ldots, -2, -1, 0, 1, 2, \ldots\}$**
  - Whole numbers **($\mathcal{W}$)**: set of numbers that begin with zero, or **$\{0, 1, 2, 3, \ldots\}$**
  - Natural numbers **($\mathcal{N}$)**: set of numbers that begin with one, or **$\{1, 2, 3, \ldots\}$**

Example 3

Use the real number diagram to classify the given number by all of the sets to which it belongs using mathematical shorthand.

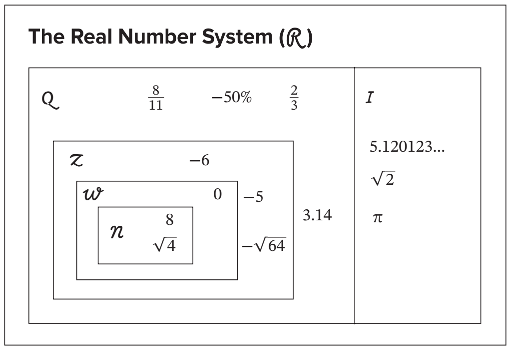
A) -5 $\{\mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

B) $\frac{2}{3}$ $\{\mathcal{Q}, \mathcal{R}\}$

C) 0 $\{\mathcal{W}, \mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

D) $\sqrt{4}$ $\{\mathcal{N}, \mathcal{W}, \mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

E) $\sqrt{2}$ $\{\mathcal{I}, \mathcal{R}\}$



Why is it important to learn math vocabulary in Algebra 1?

If the directions tell you that all solutions are integer values or all solutions are irrational and you do not know the definition of those words, it will be difficult to determine if you have the correct answer.

Example 3

A) Negative whole numbers are integers ($\mathcal{Z}$), they are rational ($\mathcal{Q}$) because you could write $-\frac{5}{1}$, and real ($\mathcal{R}$) because all numbers in Algebra 1 are real.

B) Two thirds is a fraction or ratio.

C) Zero is the first number in the set of whole numbers. It is also an integer and a rational number because you can write $\frac{0}{1}$ when needed.

D) The square root of 4 when simplified is 2 (because $2 \cdot 2 = 2^2 = 4$). Since this is really the number 2, the classification will be natural, whole, integer, rational, and real.

E) Two is a prime number. Primes have only one set of factors, the given number and one. The square root of a prime number is irrational because you cannot write it as an exact ratio. However, estimates can be made.

Your student should understand that each subject has its own set of unique vocabulary. When you are familiar with the vocabulary, the content becomes more manageable.

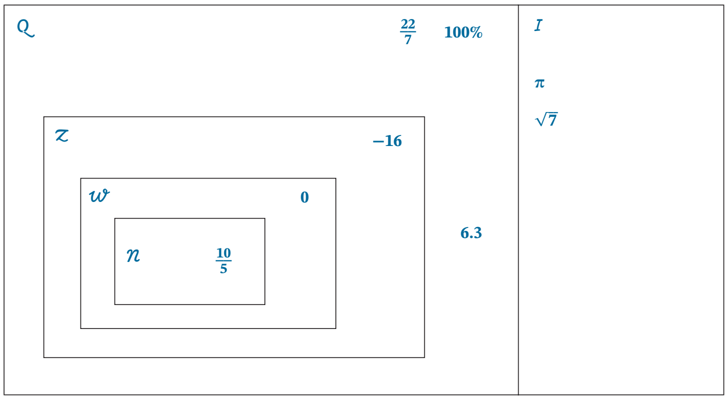
EXPLORE 1A

Example 4

Label each section of the real number diagram with the correct classification. Then place the numbers for A–H onto the diagram correctly.

A) $\sqrt{7}$ **B)** 0 **C)** 100% **D)** $\frac{10}{5}$ **E)** -16 **F)** $\frac{22}{7}$ **G)** 6.3 **H)** π

The Real Number System ($\mathcal{R}$)



Checkpoint

State the most specific classification for the given numbers. Write out the word and the mathematical shorthand.

A) 12 **B)** $\sqrt{12}$ **C)** -12

natural, $\mathcal{N}$ **irrational, $\mathcal{I}$** **integer, $\mathcal{Z}$**

Checkpoint

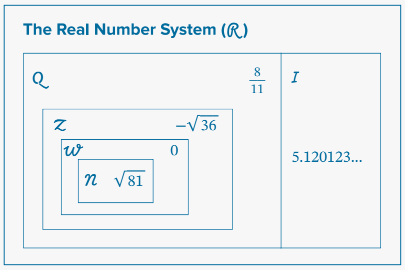
To continue past this checkpoint, students should confidently and correctly answer this problem.

Practice 1

Worked solutions for these problems are located in the Digital Pack.

Encourage your student to look back and use their guided notes, especially the Real Number Diagram. It may also be helpful to have your student write $\{\mathcal{N}, \mathcal{W}, \mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$ and $\{\mathcal{I}, \mathcal{R}\}$ at the top of the Practice so they know the progression of naming numbers.

6)



7–10)

Remind your student to simplify the expression or label each part with $\mathcal{Q}$ for rational and $\mathcal{I}$ for Irrational.

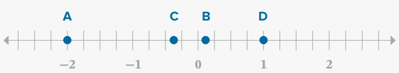
8) Q: What number in this expression will almost always make the answer irrational?

A: π

10) Q: Are all square roots irrational numbers? Explain.

A: *No, because if the number is a perfect square the result is a natural number.*

11)



Practice 1

Complete the problems on a separate sheet of paper.

Classify each number by all sets to which it belongs using math shorthand.

1) $\sqrt{81}$ $\{\mathcal{N}, \mathcal{W}, \mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

2) 0 $\{\mathcal{W}, \mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

3) $\frac{8}{11}$ $\{\mathcal{Q}, \mathcal{R}\}$

4) 5.12012301234012345... $\{\mathcal{I}, \mathcal{R}\}$

5) $-\sqrt{36}$ $\{\mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

6) Draw the real number diagram and label with the correct classifications, then place the numbers from problems 1–5 on the diagram.

Classify each number by the most specific set to which it belongs. You will graph these points in problem 11.

7) Point A: $-24\left(\frac{1}{12}\right)$ $\mathcal{Z}$

8) Point B: $\pi - 3$ $\mathcal{I}$

9) Point C: $\frac{2}{3} - 1$ $\mathcal{Q}$

10) Point D: $\sqrt{25} - \sqrt{16}$ $\mathcal{N}$

11) Draw a number line to graph problems 7–10 as points A, B, C, and D.

Finish the sentence with one of the following words: always, sometimes, never.

12) (irrational) + (irrational) is __always__ irrational.

13) (rational) · (rational) is __never__ irrational.

14) (rational) + (irrational) is __always__ irrational.

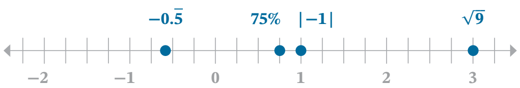
MASTERY CHECK 1A

Mastery Check

Show What You Know

A) Place the given values on the number line.

$\sqrt{9}$ 75% $|-1|$ $-0.\overline{5}$



B) Grant and Jacob are classifying the given numbers. Grant says that $-0.\overline{5}$ is rational. Jacob says that $-0.\overline{5}$ is irrational because it is a non-terminating decimal. Who is correct? Explain.

Grant is correct because $-0.\overline{5}$ can be written as the fraction (or ratio) $\frac{5}{9}$. Rational numbers can be decimals as long as the decimal can also be written as a fraction that represents the decimal exactly.

C) Grant and Jacob decide they want to find the sum of all the given values. Without finding the sum, explain if the solution will be rational or irrational.

All of the given values are rational. The sum will also be a rational number because the operations are closed under addition.

D) Complete the sentence with the word always, sometimes, or never. Explain.

(any irrational number) + (any rational number) is ___**never**___ rational.

Any time you have an irrational number in an addition problem, the answer will be irrational.

Say What You Know

In your own words, talk about what you have learned using the objectives for this part of the lesson and your work on this page.

Mastery Check

Show What You Know

B) Encourage your student to review the definitions of rational and irrational numbers if they struggle to answer this question.

Q: What is $\frac{1}{3}$ as a decimal?

A: *0.3333.... "zero point three repeating".*

Q: What is $\frac{2}{9}$ as a decimal?

A: *0.2222...*

Notice that both have a non-terminating decimal but *are* rational.

C) If needed, this question will help the student answer parts C and D.

Q: What happens when pi is added to any rational number?

A: *The number is irrational.*

D) If your student is not convinced of this have them try a few examples with the values from Practice 1 using a calculator.

Say What You Know

Your student should be able to restate the objectives of the lesson in their own words. If your student is unable to restate the lesson objectives, have them go back and reread the objectives and then explain them.

- Identify numbers as:
  - real
  - whole
  - irrational
  - integers
  - rational
  - natural
- Draw a scaled number line showing numbers and approximate numbers.
- Explain why:

  a rational number + a rational number = a rational number.

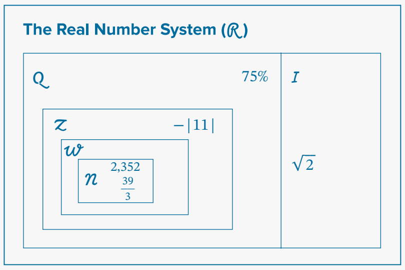
  a rational number + an irrational number = an irrational number.

  an irrational number · a rational number = an irrational number.

Practice 2

Worked solutions for these problems are located in the Digital Pack.

6)



11)

If needed, have your student go back to the Mastery Check and reapply what they have learned to say and show what they know.

1A PRACTICE 2

Practice 2

Complete the problems on a separate sheet of paper.

Classify each number by all sets to which it belongs using math shorthand.

1) $\sqrt{2}$ $\{\mathcal{I}, \mathcal{R}\}$

2) $\frac{39}{3}$ $\{\mathcal{N}, \mathcal{W}, \mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

3) $-|11|$ $\{\mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

4) 75% $\{\mathcal{Q}, \mathcal{R}\}$

5) 2,352 $\{\mathcal{N}, \mathcal{W}, \mathcal{Z}, \mathcal{Q}, \mathcal{R}\}$

6) Draw the real number diagram and label with the correct classifications, then place the numbers from problems 1–5 on the diagram.

Classify each number by the most specific set to which it belongs. You will graph these points in problem 11.

7) Point P: $\frac{5}{2} + \frac{1}{2}$ $\mathcal{N}$

8) Point Q: $\frac{1}{9} - \frac{5}{9}$ $\mathcal{Q}$

9) Point R: $\sqrt{5}(0)$ $\mathcal{W}$

10) Point S: $\pi - \pi$ $\mathcal{W}$

11) Draw a number line to graph problems 7–10.

12) Name all of the sets that fall under rational numbers.

Rational numbers include all natural numbers, whole numbers, and integers.

EXPLORE 1B

Part B: Algebraic Properties

Objectives

In this part of the lesson, you will learn about algebraic properties.

By the end of this lesson, you will be able to do the following:

- Identify algebraic properties within an equation or scenario.
- Use algebraic properties to explain the steps in an expression or equation.

Why?

Being able to use the correct algebraic properties from your Formula Sheet to solve problems is foundational to algebra. Being able to explain why you are using them completes the problem-solving plan and deepens your understanding of algebra.

Warm Up

Find the formula on your Formula Sheet.

1) Write the formula for the Surface Area of a rectangular prism. $SA = 2lw + 2wh + 2lh$

2) How many feet are in one mile? **5,280 feet**

3) What is the formula for Standard Form of a Linear Equation? $Ax + By = C$

Using the correct formula is the basis for solving algebraic problems. Using your Formula Sheet can help you make sure you are starting on the right path.

Commutative and Associative Properties

- With **algebraic properties** you can simplify expressions to solve equations.
- A **property** is an accepted rule of mathematics when working with terms.
- A single number, variable, or the product of a number and a variable is a **term**.
- The **Commutative** Property can be demonstrated by $a + b = b + a$
  $ab = ba$
- The **Associative** Property can be demonstrated by $a + (b + c) = (a + b) + c$
  $a(bc) = (ab)c$
- The properties work for all real numbers because $\mathbb{R}$ are used in Algebra 1.

Check out **More to Explore** in the Digital Pack to see if there are additional activities for this part of the lesson.

Warm Up

Your student should spend no more than 5 minutes on the Warm Up. This should be a quick review to activate prior knowledge.

3) Encourage your student to have their Formula Sheet accessible at all times. This will allow them to focus on the new material rather than memorizing every math formula needed for the course.

Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

Q: Why does the Associative Property have three terms?

A: *So there is a way to make different groups, or associations.*

1B EXPLORE

- The Commutative Property is true for the math operation(s) of: **+ and ·**.
- The Associative Property is true for the math operation(s) of: **+ and ·**.

Example 1

Determine the property being demonstrated.

A) Amelie was given the expression $8 + 9 + 2$. She wrote $8 + 2 + 9$ and still found the correct sum.

Commutative Property

B) Ivan was given the expression $(3 \cdot 7)(5)$. He decided to simplify $(3)(7 \cdot 5)$.

Associative Property

C) Chip was given the expression $-6 + 4 + (-2)$. He wrote $-2 + (-6) + 4$ and still found the correct answer.

Commutative Property

Checkpoint

Using variables to represent real numbers, create your own example equations demonstrating the Commutative and Associative Properties for Multiplication.

Sample:
a, b, c represent all real numbers
Commutative: $ab = ba$
Associative: $a(bc) = (ab)c$

Inverse, Identity, and Zero-Product Property

- **Identity** Property $a + 0 = a$, $a \cdot 1 = a$
- **Zero-Product** Property $a \cdot 0 = 0$, If $ab = 0$, then either a or b equals zero.
  - The Zero-Product Property is true for the math operation(s): **multiplication**.
- **Inverse** Property $\frac{a}{b} \cdot \frac{b}{a} = 1$, $a + (-a) = 0$
  - The **Additive Inverse** Property is used when adding a number and its opposite together to "undo" a given term.
  - A number and its reciprocal that multiply to one is called a **multiplicative inverse**.

EXPLORE 1B

Example 2

Name the property being used and whether addition or multiplication is being used.

A) $3 \cdot \frac{1}{3} = 1$ **Inverse Property for Multiplication**

B) $26 + 0 = 26$ **Identity Property for Addition**

Checkpoint

Name the property being demonstrated. Answers can be used more than once.

Inverse Property   Identity Property   Zero-Product Property

A) $x + (5 + -5) = x$ **Identity Property**

B) $3b \cdot (0) = 0$ **Zero-Product Property**

C) $\left(\frac{8}{8}\right)m = m$ **Identity Property**

D) $\left(\frac{1}{2}\right)(2) = 1$ **Inverse Property**

E) $11n - 11n = 0$ **Inverse Property**

Distributive Property

- The Distributive Property **multiplies** one term by a set of terms found inside **grouping** symbols.
- The Distributive Property is the only property that uses a **subtraction (–)** symbol.
- The Distributive Property states that: $a(b + c) = ab + ac$
  $a(b - c) = ab - ac$
- **Like terms** are terms with the same variable raised to the same power.

Example 3

Simplify the expression using the Distributive Property.

A) $7(2x - 11)$

$7(2x) - 7(11)$ ◂ Each term in the parentheses will be multiplied by 7.

$14x - 77$ ◂ This is the simplified expression because there are no more like terms.

B) $x(y + 8)$

$x(y) + x(8)$

$xy + 8x$

When there is more than one variable, write the variables alphabetically. When a variable and number are multiplied together, write the number then the variable.

Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

Q: What is the difference between B) and E) when both are equivalent to 0?

A: *B) multiplies $3b$ by 0, E) subtracts $11n$ from itself. OR B) is a product and E) is a difference.*

Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

Q: If you do not remember the name of an algebraic property, what math tool can you use?

A: *The Formula Sheet*

1B EXPLORE

Checkpoint

Name the property being described.

A) $4(a+3) = 4a + 12$ **Distributive Property**

B) $-15 + 15 = 0$ **Inverse Property for Addition**

C) $82(0) = 0$ **Zero-Product Property**

Properties of Equality

- The Reflexive Property states that: $a = a$.
- The Property of Symmetry states that: If $a = b$, then $b = a$.
- The **Substitution** Property states that: If $a = b$, then b can replace a in expressions and equations.
- The **Addition Property of Equality** says: If $a = b$, then $a + c = b + c$.
- When using the Addition Property of Equality, the same number is **added** to both sides to maintain **equality**.
- The **Multiplication Property of Equality** says: If $a = b$, then $ac = bc$.
- When using the Multiplication Property of Equality, **both sides** of the equation must be multiplied by the **same number** to maintain equality.

Example 4

Name the property that justifies each step.

$\frac{2}{9}x - 6 = 1$	Given
$\frac{2}{9}x - 6 = 1$ $+6 \quad +6$	Addition Property of Equality (add 6 to both sides of the equation)
$\frac{2}{9}x = 7$	Inverse Property for Addition $(-6 + 6)$
$\left(\frac{9}{2}\right)\frac{2}{9}x = 7\left(\frac{9}{2}\right)$	Multiplication Property of Equality (multiply both sides of the equation by the same value)
$x = \frac{63}{2}$	Inverse Property for Multiplication $\left(\text{simplify } \left(\frac{9}{2}\right)\left(\frac{2}{9}\right) \text{ to find the value of } x\right)$

EXPLORE 1B

Example 5

Name the property that justifies each step.

$7 - 2c = -3(c + 1)$	◂ Given
$7 - 2c = -3c - 3$	◂ **Distributive Property**
$+ 2c \quad + 2c$	
$7 = -c - 3$	◂ **Addition Property of Equality**
$7 = -c - 3$	
$+ 3 \quad\quad + 3$	◂ **Addition Property of Equality**
$10 = -c$	◂ **Inverse Property**
$10(-1) = -1(-c)$	◂ **Multiplication Property of Equality**
$c = -10$	◂ **Symmetric Property**

☑ Checkpoint

Name the property being described. Use your Formula Sheet.

A) Caleb says that $4 = m$ is the same as $m = 4$.

Property of Symmetry/Symmetric Property

B) Jimena was given the equation $\frac{5}{4}x = 10$. Her first step was to multiply both sides by $\frac{4}{5}$.

Multiplication Property of Equality

C) Albie checked Jimena's work by substituting $x = 8$ into the equation $\frac{5}{4}x = 10$. His result was $10 = 10$. What *two* properties does this demonstrate?

Substitution Property, Reflexive Property

Example 5

A) -3 is distributed on the right side of the equation using the Distributive Property

B) $2c$ is added to both sides of the equation using the Addition Property of Equality

C) 3 is added to both sides of the equation using the Addition Property of Equality

D) $-3 + 3 = 0$ by the Inverse Property

E) -1 is being multiplied on both sides of the equation using the Multiplication Property of Equality

F) Using the Symmetric Property, c can be written on the left side of the equation

☑ Checkpoint

To continue past this checkpoint, students should confidently and correctly answer this problem.

Q: When solving equations, when should you use the Substitution Property?

A: *To check if the solution is correct*

Practice 1

Worked solutions for these problems are located in the Digital Pack.

1) Commutative Property
2) Inverse Property (of Multiplication)
3) Zero-Product Property
4) Distributive Property
5) Inverse Property (for Addition)
6) Identity Property (for Addition)
7) Additive Property of Equality
8) Multiplicative Property of Equality
9) Substitution Property
10) Symmetric Property or Property of Symmetry

Problems 11 and 12 may be solved in other ways. Encourage your student to look at the worked solution and write what is happening in the given problem. Justification of steps with algebraic properties will continue throughout the course.

Practice 1

Complete the problems on a separate sheet of paper.

Determine the property being used.

1) Milo was given the expression $9 \cdot 5$. Milo wrote $5 \cdot 9$.
2) Gemma needs to determine the reciprocal of $\frac{7}{8}$. What property will she use?
3) Kevin knows that any number multiplied by zero is zero. What property is this?
4) Calen simplified the expression $5(x - 12)$ to $5x - 60$. What property is this?
5) Maria was asked to write an example of a number added to its opposite is zero. She wrote: $-3 + 3 = 0$.
6) After working on the first step of an equation, Sharla had $6x + 0 = 5$, then wrote $6x = 5$.
7) Sam was solving the problem $3x + 5 = 9$. They added -5 to both sides of the equation.
8) Given the problem $3x = 4$, Qorban wanted to multiply each side by $\frac{1}{3}$.
9) Joseph solved an equation and found that $x = 12$. He replaced x with 12 to check his answer.
10) Mille wrote $n = 16$, Connier wrote $16 = n$. Which property says they have the same answer?

11) Name the property to justify each step. Use your Formula Sheet.

$5x - 6 = 14$ ◀ Given

A) $$\begin{aligned} 5x - 6 &= 14 \\ +6 \quad &\; +6 \\ 5x &= 20 \end{aligned}$$
A) Addition Property of Equality

B) $\left(\frac{1}{5}\right)(5x) = \left(\frac{1}{5}\right)(20)$
$x = 4$
B) Multiplication Property of Equality

12) Name the property to justify each step.

$11 = \frac{1}{3}x + 8$ ◀ Given

A) $$\begin{aligned} 11 &= \tfrac{1}{3}x + 8 \\ -8 \quad &\quad\; -8 \\ 3 &= \tfrac{1}{3}x \end{aligned}$$
A) Addition Property of Equality

B) $(3)(3) = (3)\left(\frac{1}{3}x\right)$
$9 = x$
B) Multiplication Property of Equality

C) $x = 9$
C) Property of Symmetry

MASTERY CHECK 1B

Mastery Check

Show What You Know

A) Finish each sentence with one of the following words: always, sometimes, never.

- All integers are **always** rational numbers.
- $\mathbb{R}$ numbers are **sometimes** integers.

B) Finish each sentence with one of the following words: always, sometimes, never.

- The associative property is **never** true for division.
- The Identity Property for Addition **sometimes** equals zero.

  $0 + 0 = 0$ is the exception

- The Distributive Property **sometimes** uses subtraction.
- The Multiplication Property of Equality **always** multiplies both sides of an equation by the same number.

Say What You Know

In your own words, talk about what you have learned using the objectives for this part of the lesson and your work on this page.

Mastery Check

Show What You Know

For Always, Sometimes, and Never have your student try to think of a counter-example. If they can think of a way that something can be true and false, the correct answer would be "sometimes." This Mastery Check helps determine any misconceptions related to how numbers and properties work together. Trying some examples with real numbers will help students test their hypotheses.

Say What You Know

Your student should be able to restate the objectives of the lesson in their own words. If your student is unable to restate the lesson objectives, have them go back and reread the objectives and then explain them.

- Identify algebraic properties within an equation or scenario.
- Use algebraic properties to explain the steps in an expression or equation.

Lesson Test

After achieving mastery for Parts A and B of this lesson, your student has the option to take the test. Before taking the test, ask your student these questions:

- Do you know all the new vocabulary words?
- Can you explain the objectives?
- Do you know how to check your work?
- Do you know how to use your Formula Sheet?
- Were you able to complete the practice questions without help?

YES

If your student can answer "yes" to all of these questions, decide if your student is ready to take the Lesson Test.

NOT YET

If your student cannot answer "yes" to all of these questions, consider having your student complete some of these options:

- Rework Practice 1.
- Complete Practice 2.
- Review the videos, Guided Notes, and Examples.

Practice 2

Worked solutions for these problems are located in the Digital Pack.

1) Inverse Property (of Multiplication)
2) Associative Property of Addition
3) Commutative Property of Addition
4) Inverse Property of Addition (additive inverse)
5) Identity Property of Multiplication $\frac{8}{8} = 1$, so 4 is being multiplied by 1
6) Distributive Property
7) Multiplication Property of Equality
8) Substitution Property
9) Symmetric Property or Property of Symmetry
10) Addition Property of Equality

If needed, have your student go back to the Mastery Check and reapply what they have learned to say and show what they know.

Lesson Test

Refer to the Part B Mastery Check instructor note to determine if your student is ready for the test.

Practice 2

Complete the problems on a separate sheet of paper.

1) DeAnne was asked to write an example for a number multiplied by its reciprocal is one. She wrote: $-\frac{5}{6}\left(-\frac{6}{5}\right) = 1$

2) Hunter wanted to quickly add the expression $(9 + 8) + 2$. He decided to write $9 + (8 + 2)$. What property is demonstrated?

3) Elle was given the expression $-3 + 6 + 3$. She wrote $-3 + 3 + 6$. What property is this?

4) Elle decided to simplify the expression $-3 + 6 + 3$ another way. She wrote $0 + 6$ as her first step. What property did she use?

5) Fahrid said that $4 \cdot \frac{8}{8} = 4$. What property does this show?

6) The directions on Zeke's math lesson said to simplify. He was given $x(y + 8)$. What property can he use to simplify this?

7) What property allows you to multiply an equation by the same number on both sides?

8) If you solve an equation and want to check that your answer is correct, what property would you use to check your answer?

9) Betsy solved an equation and found the solution $-4 = m$. Patty found the solution to be $m = -4$. What property shows this is the same solution?

10) The equation $34x + 95 = 5$ was given. Gary's first step was to add -95 to both sides. What property did Gary use?

11) Name the property to justify each step.

$4(x + 7) = -3$ ◂ Given

A) $4x + 28 = -3$ — **A) Distributive Property**

B) $4x + 28 = -3$; $-28 \quad -28$; $4x = -31$ — **B) Addition Property of Equality**

C) $\left(\frac{1}{4}\right)(4x) = \left(\frac{1}{4}\right)(-31)$; $x = -\frac{31}{4}$ — **C) Multiplication Property of Equality**

12) Name the property to justify each step.

$-\frac{1}{6}x = 12$ ◂ Given

A) $(-6)\left(-\frac{1}{6}x\right) = (-6)(12)$; $x = -72$ — **A) Multiplication Property of Equality**

Check:

B) $-\frac{1}{6}(-72) = 12$ — **B) Substitution Property**

C) $12 = 12$ — **C) Reflexive Property**

TARGETED REVIEW 1

Targeted Review

In the Targeted Review, you will practice topics you have mastered in earlier lessons. Reviewing these concepts will help you be successful as you work through this unit.

Complete the problems on a separate sheet of paper.

Evaluate.

1) $|-6| - |4|$ **2**

2) $|-6-4|$ **10**

Simplify. Name the least common denominator.

3) $\frac{4}{5}+\frac{2}{3}$ **LCD = 15, $\frac{22}{15}$**

4) $\frac{1}{8}+\frac{2}{5}-\frac{1}{10}$ **LCD = 40, $\frac{17}{40}$**

5) $-\frac{3}{4}+\frac{2}{3}$ **LCD = 12, $-\frac{1}{12}$**

6) $\frac{12}{5}-\frac{2}{3}-\frac{1}{2}$ **LCD = 30, $\frac{37}{30}$**

Determine the value of the expression.

7) $\sqrt{81}$ **9**

8) $\sqrt{25}$ **5**

Simplify using order of operations.

9) $|-8| + 2(6)\left(\frac{1}{4}\right) - \left(\sqrt{25} \div \frac{1}{5}\right)$ **−14**

10) $9\left(\frac{2}{3}\right) - |5-11| + (-3)(13)$ **−39**

Solve.

11) $\frac{1}{5}x = -8$ **$x = -40$**

12) $12 - x = -3$ **$x = 15$**

13) $\frac{x}{2} + 6 = -5$ **$x = -22$**

14) $4x - 3 = 7$ **$x = \frac{5}{2}$**

Multiple Choice

D **15)** What is the value of the expression, $2c^2 - c$, when $c = -3$?

A) -15

B) -9

C) 15

D) **21**

16) Select *all* expressions that are equivalent to $5x$.

- ■ **$x + 4x$**
- □ $x + 5$
- ■ **$2x + 3x$**
- ■ **$10x - 5x$**

Targeted Review

Worked solutions for these problems are located in the Digital Pack.

If your student is going to take the Lesson Test, it is recommended that they do so before beginning the Targeted Review.

15) Distractor Rationale:

A) This happens when you write the square of −3 as −9 rather than 9.

B) This happens when you double −3 rather than squaring it.

C) This happens when you ignore the subtraction sign in the expression.

$2(-3)^2 - (-3)$

$2(9) + 3$

$18 + 3$

21

16) Distractor Rationale:

$x + 5$ (These are not like terms and cannot be combined.)

Problem	1–16
Lesson Origin	Pre-Algebra