Reasoning in Algebra and Geometry

Vocabulary

● Review

1. Circle each *equation*.

$2(a - 5)^2$ $\qquad$ $3x + 2 = 4$ $\qquad$ $5 + 3^4$ $\qquad$ $9 < x - 2$

Write an *equation* to represent each problem.

2. Sara has five more than twice the number of apples that Gregg has. If Sara has 21 apples, how many apples does Gregg have?

3. Your brother does one less than twice the number of chores that you do. If he does seven chores, how many chores do you do?

● Vocabulary Builder

justify (verb) ᴊᴜꜱ **tuh fy**

Related Words: justice (noun), justification (noun), justifiable (adjective), justly (adverb)

Definition: To **justify** a step in a solution means to provide a mathematical reason why the step is correct.

Main Idea: When you **justify** an action, you explain why it is reasonable.

● Use Your Vocabulary

4. Draw a line from each equation in Column A to the property you would use to *justify* it in Column B.

Column A	Column B
$3 + 7 = 7 + 3$	Associative Property of Addition
$12(4) = 4(12)$	Associative Property of Multiplication
$2 \cdot (5 \cdot x) = (2 \cdot 5) \cdot x$	Commutative Property of Addition
$1 + (9 + 53) = (1 + 9) + 53$	Commutative Property of Multiplication

Key Concept Properties of Equality

5. Complete the graphic organizer.

If $a = b$,
then b can replace ☐ in any equation.

If $a = b$,
then $a - c = b - $ ☐.

If $a = b$,
then $a \times c = b \times $ ☐.

Substitution

Subtraction   **Multiplication**

If $a = b$,
then $a + c = b + $ ☐.

Addition   **Properties of Equality**   **Division**

If $a = b$, and $c \neq$ ☐,
then $\dfrac{a}{c} = \dfrac{b}{c}$.

Reflexive   **Transitive**

Symmetric

$a = $ ☐.

If $a = b$,
then $b = $ ☐.

If $a = b$ and $b = c$,
then $a = $ ☐.
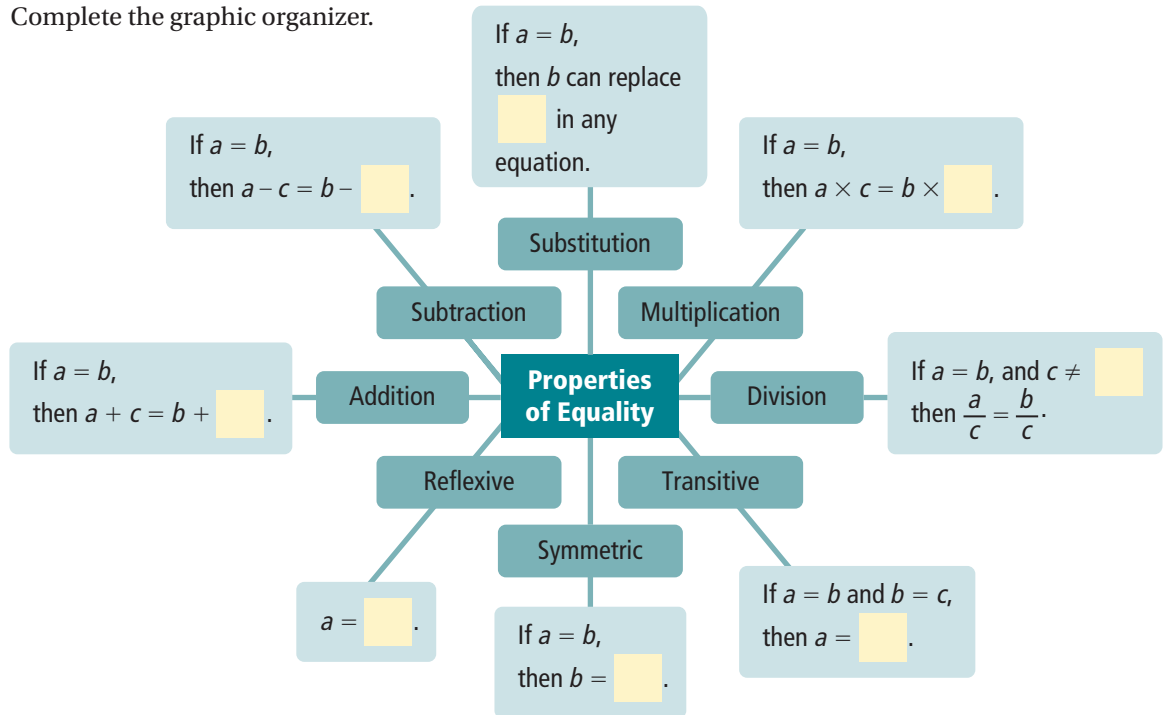
Key Concept The Distributive Property

Use multiplication to distribute a to each term of the sum or difference within the parentheses.

Sum

$a(b + c) = ab + ac$

Difference

$a(b - c) = ab - ac$

Use the Distributive Property to simplify each expression.

6. $5(24) = 5(20 + $ ☐ $)$

$= 5($ ☐ $) + 5($ ☐ $)$

$= $ ☐ $ + $ ☐

$= $ ☐

7. $17(3) = (20 - 3)($ ☐ $)$

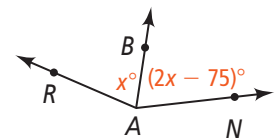$= 20($ ☐ $) - 3($ ☐ $)$

$= $ ☐ $ - $ ☐

$= $ ☐

✓ **Problem 1** **Justifying Steps When Solving an Equation**

Got It? What is the value of x? Justify each step.

Given: $\overrightarrow{AB}$ bisects $\angle RAN$.

8. Circle the statement you can write from the given information.

$\angle RAB$ is obtuse. $\angle RAB \cong \angle NAB$ $\angle NAB \cong \angle RAN$

B

$x°$ $(2x - 75)°$

R

A N

9. Use the justifications below to find the value of x.

$\overrightarrow{AB}$ bisects $\angle RAN$.	Given
$\angle RAB \cong \angle \boxed{}$	Definition of angle bisector
$m\angle RAB = m\angle \boxed{}$	Congruent angles have equal measures.
$x = \boxed{}$	Substitute.
$0 = \boxed{}$	Subtraction Property of Equality
$75 = \boxed{}$	Addition Property of Equality

take note

Key Concept   Properties of Congruence

Reflexive	**Symmetric**	**Transitive**
$\overline{AB} \cong \overline{AB}$	If $\overline{AB} \cong \overline{CD}$, then $\overline{CD} \cong \overline{AB}$.	If $\overline{AB} \cong \overline{CD}$ and $\overline{CD} \cong \overline{EF}$, then $\overline{AB} \cong \overline{EF}$.
$\angle A \cong \angle A$	If $\angle A \cong \angle B$, then $\angle B \cong \angle A$.	If $\angle A \cong \angle B$ and $\angle B \cong \angle C$, then $\angle A \cong \angle C$.

Complete each statement.

10. If $\angle P \cong \angle R$ and $\angle R \cong \angle A$, then $\angle P \cong \angle \boxed{}$.

11. If $\angle X \cong \angle N$ and $\angle \boxed{} \cong \angle Y$, then $\angle X \cong \angle Y$.

12. If $\angle L \cong \angle T$ and $\angle T \cong \angle \boxed{}$, then $\angle L \cong \angle Q$.
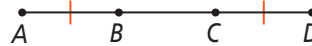
Problem 3   Writing a Two-Column Proof

Got It? Write a two-column proof.

Given: $\overline{AB} \cong \overline{CD}$ **Prove:** $\overline{AC} \cong \overline{BD}$

$$A \quad B \quad C \quad D$$

13. The statements are given below. Write a reason for each statement.

Statements	Reasons
1) $\overline{AB} \cong \overline{CD}$	1)
2) $AB = CD$	2)
3) $BC = BC$	3)
4) $AB + BC = BC + CD$	4)
5) $AC = BD$	5)
6) $\overline{AC} \cong \overline{BD}$	6)

Lesson Check • Do you UNDERSTAND?

Developing Proof Fill in the reasons for this algebraic proof.

Given: $5x + 1 = 21$

Prove: $x = 4$

Statements	Reasons
1) $5x + 1 = 21$	1) __?__
2) $5x = 20$	2) __?__
3) $x = 4$	3) __?__

14. The first step in a proof is what you are given / to prove .

Underline the correct word(s) to complete each sentence. Then circle the property of equality that justifies the step.

15. First, the number 1 was added to / subtracted from each side of the equation.

    Addition Property of Equality   Subtraction Property of Equality   Reflexive Property

16. Then, each side of the equation was multiplied / divided by 5.

    Division Property of Equality   Multiplication Property of Equality   Transitive Property

17. Now write a reason for each step.

1) _____

2) _____

3) _____

Math Success

Check off the vocabulary words that you understand.

☐ Reflexive Property   ☐ Symmetric Property   ☐ Transitive Property

☐ proof   ☐ two-column proof

Rate how well you can *use properties of equality and congruence in proofs.*

Need to review	0	2	4	6	8	10	Now I get it!

Lesson 2-5