Warm Up
Solve each equation.

1. $3x + 5 = 17 \quad x = 4$
2. $r - 3.5 = 8.7 \quad r = 12.2$
3. $4t - 7 = 8t + 3 \quad t = -\frac{5}{2}$
4. $\frac{n+8}{5} = -6 \quad n = -38$
5. $2(y - 5) - 20 = 0 \quad y = 15$

Agenda:
Warm-Up/Pull SG
Algebraic Proofs
Notes
Practice Proofs
Essential Questions

How do we identify and use the properties of equality to write algebraic proofs?

Unit 2A Day 6
Algebraic Proof
Section 2-2
Vocabulary

proof
A **proof** is an argument that uses logic, definitions, properties, and previously proven statements to show that a conclusion is true.

An important part of writing a proof is giving justifications to show that every step is valid.
## Algebraic Proof

### Properties of Equality

<table>
<thead>
<tr>
<th>Property</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Addition Property of Equality</td>
<td>If ( a = b ), then ( a + c = b + c ).</td>
</tr>
<tr>
<td>Subtraction Property of Equality</td>
<td>If ( a = b ), then ( a - c = b - c ).</td>
</tr>
<tr>
<td>Multiplication Property of Equality</td>
<td>If ( a = b ), then ( ac = bc ).</td>
</tr>
<tr>
<td>Division Property of Equality</td>
<td>If ( a = b ) and ( c \neq 0 ), then ( \frac{a}{c} = \frac{b}{c} ).</td>
</tr>
<tr>
<td>Reflexive Property of Equality</td>
<td>( a = a ).</td>
</tr>
<tr>
<td>Symmetric Property of Equality</td>
<td>If ( a = b ), then ( b = a ).</td>
</tr>
<tr>
<td>Transitive Property of Equality</td>
<td>If ( a = b ) and ( b = c ), then ( a = c ).</td>
</tr>
<tr>
<td>Substitution Property of Equality</td>
<td>If ( a = b ), then ( b ) can be substituted for ( a ) in any expression.</td>
</tr>
</tbody>
</table>
Algebraic Proof

Remember!
The Distributive Property states that

\[ a(b + c) = ab + ac. \]
Example 1: Solving an Equation in Algebra

Solve the equation $4m - 8 = -12$. Write a justification for each step.

\[
4m - 8 = -12 \quad \text{Given equation}
\]

\[
+8 \quad +8 \quad \text{Addition Property of Equality}
\]

\[
4m = -4 \quad \text{Simplify.}
\]

\[
\frac{4m}{4} = \frac{-4}{4} \quad \text{Division Property of Equality}
\]

\[
m = -1 \quad \text{Simplify.}
\]
Your turn:

Solve the equation \(-5 = 3n + 1\) and write a justification for each step.

Steps:

-5 = 3n + 1

-1 \[\text{Subtract 1 from both sides.}\]

\[\frac{-6}{3} = \frac{3n}{3}\]

-2 = n

n = -2

Justification:

Given equation

Subtraction property of equality

Division property of equality

Substitution property
Example 2: Problem-Solving Application

What is the temperature in degrees Fahrenheit $F$ when it is $15^\circ C$? Solve the equation $F = \frac{9}{5}C + 32$ for $F$ and justify each step.

\[
F = \frac{9}{5}C + 32 \quad \text{Given.}
\]

\[
F = \frac{9}{5}(15) + 32 \quad \text{Substitution.}
\]

\[
F = 27 + 32 \quad \text{Simplify.}
\]

\[
F = 59 \quad \text{Simplify.}
\]
Your Turn!

What is the temperature in degrees Celsius $C$ when it is 86°F? Solve the equation $C = \frac{5}{9}(F - 32)$ for $C$ and justify each step.

$C = \frac{5}{9}(F - 32)$  Given.

$C = \frac{5}{9}(86 - 32)$  Substitution.

$C = \frac{5}{9}(54)$  Simplify.

$C = 30^\circ$  Simplify.
Like algebra, geometry also uses numbers, variables, and operations. For example, segment lengths and angle measures are numbers. So you can use these same properties of equality to write algebraic proofs in geometry.

Helpful Hint

\[ \overline{AB} \] represents the length \( \overline{AB} \), so you can think of \( AB \) as a variable representing a number.
Example 3: Solving an Equation in Geometry

Write a justification for each step.

\[ NO = NM + MO \]  \hspace{1cm} \text{Segment Addition Post.}

\[ 4x - 4 = 2x + (3x - 9) \]  \hspace{1cm} \text{Substitution Property of Equality}

\[ 4x - 4 = 5x - 9 \]  \hspace{1cm} \text{Simplify.}

\[ -4 = x - 9 \]  \hspace{1cm} \text{Subtraction Property of Equality}

\[ 5 = x \]  \hspace{1cm} \text{Addition Property of Equality}
Your Turn!

Write a justification for each step.

\[ \text{m} \angle ABC = \text{m} \angle ABD + \text{m} \angle DBC \]

\[ 8x^\circ = (3x + 5)^\circ + (6x - 16)^\circ \]

\[ 8x = 9x - 11 \]

\[ -x = -11 \]

\[ x = 11 \]
You learned in Chapter 1 that segments with equal lengths are congruent and that angles with equal measures are congruent. So the Reflexive, Symmetric, and Transitive Properties of Equality have corresponding properties of congruence.
## Properties of Congruence

<table>
<thead>
<tr>
<th>SYMBOLES</th>
<th>EXAMPLE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Reflexive Property of Congruence</strong></td>
<td></td>
</tr>
<tr>
<td>figure $A \cong \text{figure } A$</td>
<td>$\overline{EF} \cong \overline{EF}$</td>
</tr>
<tr>
<td>(Reflex. Prop. of $\cong$)</td>
<td></td>
</tr>
<tr>
<td><strong>Symmetric Property of Congruence</strong></td>
<td></td>
</tr>
<tr>
<td>If figure $A \cong \text{figure } B$, then figure $B \cong \text{figure } A$.</td>
<td>If $\angle 1 \cong \angle 2$, then $\angle 2 \cong \angle 1$.</td>
</tr>
<tr>
<td>(Sym. Prop. of $\cong$)</td>
<td></td>
</tr>
<tr>
<td><strong>Transitive Property of Congruence</strong></td>
<td></td>
</tr>
<tr>
<td>If figure $A \cong \text{figure } B$ and figure $B \cong \text{figure } C$, then figure $A \cong \text{figure } C$.</td>
<td>If $\overline{PQ} \cong \overline{RS}$ and $\overline{RS} \cong \overline{TU}$, then $\overline{PQ} \cong \overline{TU}$.</td>
</tr>
<tr>
<td>(Trans. Prop. of $\cong$)</td>
<td></td>
</tr>
</tbody>
</table>
Remember!

Numbers are equal (=) and figures are congruent (\(\cong\)).
Example 4: Identifying Property of Equality and Congruence

Identify the property that justifies each statement.

A. \( \angle QRS \cong \angle QRS \) \hspace{1cm} \text{Reflex. Prop. of } \cong.

B. \( m\angle 1 = m\angle 2 \) so \( m\angle 2 = m\angle 1 \) \hspace{1cm} \text{Symm. Prop. of } =

C. \( \overline{AB} \cong \overline{CD} \) and \( \overline{CD} \cong \overline{EF} \), so \( \overline{AB} \cong \overline{EF} \) \hspace{1cm} \text{Trans. Prop of } \cong

D. \( 32^\circ = 32^\circ \) \hspace{1cm} \text{Reflex. Prop. of } =
Your turn!

Identify the property that justifies each statement.

A. $DE = GH$, so $GH = DE$. Sym. Prop. of $=\$

B. $94^\circ = 94^\circ$ Reflex. Prop. of $=\$

C. $0 = a$, and $a = x$. So $0 = x$. Trans. Prop. of $=\$

D. $\angle A \cong \angle Y$, so $\angle Y \cong \angle A$ Sym. Prop. of $\cong$
Assignment:

• p. 55 # 2-8 even, 11-15 all, 24, 30 – 32 all
Lesson Quiz: Part I

Solve each equation. Write a justification for each step.

1. \( \frac{z - 5}{6} = -2 \)

\[
\frac{z - 5}{6} = -2 \quad \text{Given}
\]

\[
z - 5 = -12 \quad \text{Mult. Prop. of } =
\]

\[
z = -7 \quad \text{Add. Prop. of } =
\]
Lesson Quiz: Part II

Solve each equation. Write a justification for each step.

2. \(6r - 3 = -2(r + 1)\)

\[
\begin{align*}
6r - 3 &= -2(r + 1) & \text{Given} \\
6r - 3 &= -2r - 2 & \text{Distrib. Prop.} \\
8r - 3 &= -2 & \text{Add. Prop. of =} \\
8r &= 1 & \text{Add. Prop. of =} \\
r &= \frac{1}{8} & \text{Div. Prop. of =}
\end{align*}
\]
Lesson Quiz: Part III

Identify the property that justifies each statement.

3. \( x = y \) and \( y = z \), so \( x = z \).  Trans. Prop. of =

4. \( \angle DEF \cong \angle DEF \)  Reflex. Prop. of \( \cong \)

5. \( \overline{AB} \cong \overline{CD} \), so \( \overline{CD} \cong \overline{AB} \).  Sym. Prop. of \( \cong \)