

Algebraic Proof

Warm Up

Solve each equation.

1. $3x + 5 = 17$ $x = 4$

2. $r - 3.5 = 8.7$ $r = 12.2$

3. $4t - 7 = 8t + 3$ $t = -\frac{5}{2}$

4. $\frac{n+8}{5} = -6$ $n = -38$

5. $2(y - 5) - 20 = 0$ $y = 15$

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*



Algebraic Proof

Vocabulary

proof

Algebraic 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

Addition Property of Equality

If $a = b$, then $a + c = b + c$.

Subtraction Property of Equality

If $a = b$, then $a - c = b - c$.

Multiplication Property of Equality

If $a = b$, then $ac = bc$.

Division Property of Equality

If $a = b$ and $c \neq 0$, then $\frac{a}{c} = \frac{b}{c}$.

Reflexive Property of Equality

$a = a$

Symmetric Property of Equality

If $a = b$, then $b = a$.

Transitive Property of Equality

If $a = b$ and $b = c$, then $a = c$.

Substitution Property of Equality

If $a = b$, then b can be substituted for a in any expression.

Algebraic Proof

Remember!

The Distributive Property states that

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

Algebraic Proof

Example 1: Solving an Equation in Algebra

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

$$4m - 8 = -12$$

Given equation

$$\underline{\quad +8} \quad \quad \underline{\quad +8}$$

Addition Property of Equality

$$4m \quad = \quad -4$$

Simplify.

$$\frac{4m}{4} = \frac{-4}{4}$$

Division Property of Equality

$$m = -1$$

Simplify.

Algebraic Proof

Your turn:

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

Steps:

$$-5 = 3n + 1$$

$$\begin{array}{r} -1 \\ -1 \end{array}$$

$$\frac{-6}{3} = \frac{3n}{3}$$

$$-2 = n$$

$$n = -2$$

Justification:

Given equation

Algebraic Proof



Example 2: Problem-Solving Application

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

$$F = \frac{9}{5}C + 32$$

Given.

$$F = \frac{9}{5}(15) + 32$$

Substitution.

$$F = 27 + 32$$

Simplify.

$$F = 59$$

Simplify.

Algebraic Proof



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.

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

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

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

$$C = 30^\circ \quad \text{Simplify.}$$

Algebraic Proof

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

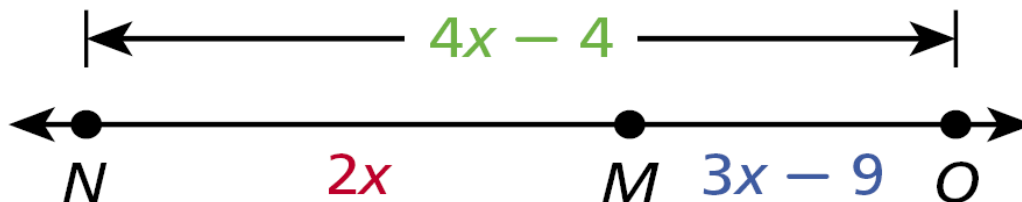


AB represents the length \overline{AB} , so you can think of AB as a variable representing a number.

Algebraic Proof

Example 3: Solving an Equation in Geometry

Write a justification for each step.



$$NO = NM + MO \quad \text{Segment Addition Post.}$$

$$4x - 4 = 2x + (3x - 9) \quad \text{Substitution Property of Equality}$$

$$4x - 4 = 5x - 9 \quad \text{Simplify.}$$

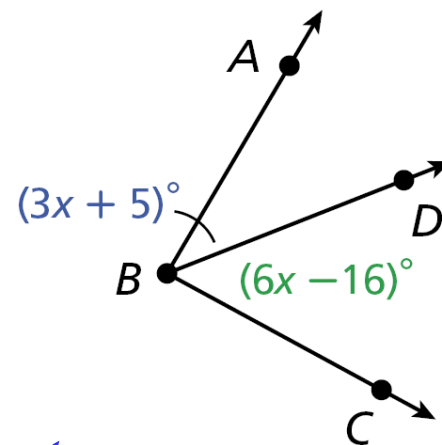
$$-4 = x - 9 \quad \text{Subtraction Property of Equality}$$

$$5 = x \quad \text{Addition Property of Equality}$$

Algebraic Proof

Your Turn!

Write a justification for each step.



$$m\angle ABC = m\angle ABD + m\angle DBC$$

∠ Add. Post.

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

Subst. Prop. of Equality

$$m\angle ABC = 8x^\circ$$

$$8x = 9x - 11$$

Simplify.

$$-x = -11$$

Subtr. Prop. of Equality.

$$x = 11$$

Mult. Prop. of Equality.



Algebraic Proof

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.

Algebraic Proof

Properties of Congruence

SYMBOLS	EXAMPLE
Reflexive Property of Congruence figure $A \cong$ figure A (Reflex. Prop. of \cong)	$\overline{EF} \cong \overline{EF}$
Symmetric Property of Congruence If figure $A \cong$ figure B , then figure $B \cong$ figure A . (Sym. Prop. of \cong)	If $\angle 1 \cong \angle 2$, then $\angle 2 \cong \angle 1$.
Transitive Property of Congruence If figure $A \cong$ figure B and figure $B \cong$ figure C , then figure $A \cong$ figure C . (Trans. Prop. of \cong)	If $\overline{PQ} \cong \overline{RS}$ and $\overline{RS} \cong \overline{TU}$, then $\overline{PQ} \cong \overline{TU}$.

Algebraic Proof

Remember!

Numbers are equal ($=$) and figures are congruent (\cong).

Algebraic Proof

Example 4: Identifying Property of Equality and Congruence

Identify the property that justifies each statement.

A. $\angle QRS \cong \angle QRS$ Reflex. Prop. of \cong .

B. $m\angle 1 = m\angle 2$ so $m\angle 2 = m\angle 1$ Symm. Prop. of $=$

C. $\overline{AB} \cong \overline{CD}$ and $\overline{CD} \cong \overline{EF}$, so $\overline{AB} \cong \overline{EF}$. Trans. Prop. of \cong

D. $32^\circ = 32^\circ$ Reflex. Prop. of $=$

Algebraic Proof

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



Algebraic Proof

Assignment:

- p. 55 # 2-8 even, 11-15 all, 24, 30 – 32 all

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Lesson Quiz: Part I

Solve each equation. Write a justification for each step.

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

$$\frac{z-5}{6} = -2$$

Given

$$z - 5 = -12$$

Mult. Prop. of =

$$z = -7$$

Add. Prop. of =

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Lesson Quiz: Part II

Solve each equation. Write a justification for each step.

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

$6r - 3 = -2(r + 1)$ Given

$6r - 3 = -2r - 2$ Distrib. Prop.

$8r - 3 = -2$ Add. Prop. of =

$8r = 1$ Add. Prop. of =

$r = \frac{1}{8}$ Div. Prop. of =

Algebraic Proof

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