Writing Two-Column Proofs in Geometry

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Name: _____ Date: _____ Score: / 10

Learning Objectives

- Identify and apply basic algebraic properties of equality in proofs
- Identify and apply geometric properties (congruence, segment and angle addition)
- Justify each step in a two-column proof with a valid reason
- Construct complete two-column proofs for algebraic and geometric statements

For each item, write the missing statement or reason, or construct the complete two-column proof using the given information.

1. Name the property of equality illustrated: If a = b, then a + c = b + c.

$a = b \Rightarrow a + c = b + c$

Answer: _____

2. Identify the property: If x = 7, then 7 = x.

$x = 7 \Rightarrow 7 = x$

Answer: _____

3. Identify the property of equality used: If a = b and b = c, then a = c.

$a = b \text{ and } b = c \Rightarrow a = c$

Answer: _____

4. Name the property: 3(x + 4) = 3x + 12.

$3(x + 4) = 3x + 12$

Answer: _____

5. Solve for x and give the reason for each step: 2x + 5 = 19.

$2x + 5 = 19$

Answer: _____

6. State the geometric property: Segment AB is congruent to segment AB.

$\overline{AB} \cong \overline{AB}$

Answer: _____

7. Point B lies on segment AC with AB = 5 and BC = 8. Find AC and name the postulate used.

$AB + BC = AC,\ AB = 5,\ BC = 8$

Answer: _____

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8. Ray BD lies in the interior of angle ABC. If the measure of angle ABD is 35° and the measure of angle DBC is 40°, find the measure of angle ABC and name the postulate used.

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

Answer: _____

9. Write a two-column proof. Given: 4x – 7 = 13. Prove: x = 5.

$$4x - 7 = 13 \Rightarrow x = 5$$

Answer: _____

10. Write a two-column proof. Given: M is the midpoint of segment AB. Prove: AM is congruent to MB.

$$M \text{ is the midpoint of } \overline{AB} \Rightarrow \overline{AM} \cong \overline{MB}$$

Answer: _____

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ANSWER KEY & SOLUTIONS

This worksheet covers the foundations of two-column proofs as introduced in the video: what a proof is, the algebraic properties of equality (Reflexive, Symmetric, Transitive, Addition, Subtraction, Multiplication, Division, Substitution, Distributive), and the geometric properties (Segment Addition Postulate, Angle Addition Postulate, congruence of segments and angles, and the Reflexive, Symmetric, and Transitive Properties of Congruence). Students practice identifying properties and writing complete two-column proofs.

Solutions

1. Name the property of equality illustrated: If a = b, then a + c = b + c.

$a = b \Rightarrow a + c = b + c$

→ *The same quantity c is added to both sides of an equation.*
→ *Adding the same value to both sides keeps the equation true, which is the Addition Property of Equality.*

Answer: Addition Property of Equality

2. Identify the property: If x = 7, then 7 = x.

$x = 7 \Rightarrow 7 = x$

→ *The sides of the equation are swapped without changing anything else.*
→ *Swapping the two sides of an equation is the Symmetric Property of Equality.*

Answer: Symmetric Property of Equality

3. Identify the property of equality used: If a = b and b = c, then a = c.

$a = b \text{ and } b = c \Rightarrow a = c$

→ *Two equal quantities share a common middle value b.*
→ *When two quantities equal the same thing, they equal each other, which is the Transitive Property of Equality.*

Answer: Transitive Property of Equality

4. Name the property: 3(x + 4) = 3x + 12.

$3(x + 4) = 3x + 12$

→ *The factor 3 is multiplied across both terms inside the parentheses.*
→ *Distributing a factor across a sum is the Distributive Property.*

Answer: Distributive Property

5. Solve for x and give the reason for each step: 2x + 5 = 19.

$2x + 5 = 19$

→ *Subtract 5 from both sides using the Subtraction Property of Equality to get 2x equals 14.*
→ *Divide both sides by 2 using the Division Property of Equality to get x equals 7.*

Answer: $x = 7$

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6. State the geometric property: Segment AB is congruent to segment AB.

$\overline{AB} \cong \overline{AB}$

→ *A segment is being compared to itself.*
→ *Any segment is congruent to itself by the Reflexive Property of Congruence.*

Answer: Reflexive Property of Congruence

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7. Point B lies on segment AC with AB = 5 and BC = 8. Find AC and name the postulate used.

$AB + BC = AC,\ AB = 5,\ BC = 8$

→ *By the Segment Addition Postulate, AC equals AB plus BC.*
→ *Add 5 and 8 to get AC equals 13.*

Answer: $AC = 13$ (Segment Addition Postulate)

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8. Ray BD lies in the interior of angle ABC. If the measure of angle ABD is 35° and the measure of angle DBC is 40°, find the measure of angle ABC and name the postulate used.

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

→ *By the Angle Addition Postulate, the measure of angle ABC equals the sum of the measures of angles ABD and DBC.*
→ *Add 35 degrees and 40 degrees to get 75 degrees.*

Answer: $m\angle ABC = 75^\circ$ (Angle Addition Postulate)

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9. Write a two-column proof. Given: 4x – 7 = 13. Prove: x = 5.

$4x - 7 = 13 \Rightarrow x = 5$

→ *Statement 1: 4x minus 7 equals 13, with reason Given.*
→ *Statement 2: 4x equals 20, with reason Addition Property of Equality after adding 7 to both sides.*
→ *Statement 3: x equals 5, with reason Division Property of Equality after dividing both sides by 4.*

Answer: $x = 5$

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10. Write a two-column proof. Given: M is the midpoint of segment AB. Prove: AM is congruent to MB.

M is the midpoint of $\overline{AB} \Rightarrow \overline{AM} \cong \overline{MB}$

→ *Statement 1: M is the midpoint of segment AB, with reason Given.*
→ *Statement 2: AM equals MB, with reason Definition of Midpoint.*
→ *Statement 3: Segment AM is congruent to segment MB, with reason Definition of Congruent Segments.*

Answer: $\overline{AM} \cong \overline{MB}$