Lesson 3.5 & 3.6 Proving Segment and Angle Relationships

Tuesday, November 8, 2022 10:10 AM

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3.5 and 3.6 Proving

Lesson 3.5 and 3.6: Proving Segment and Angle Relationships

Workbook pages 163-176

Florida's B.E.S.T. Standards for Mathematics

MA.912.GR.1.1

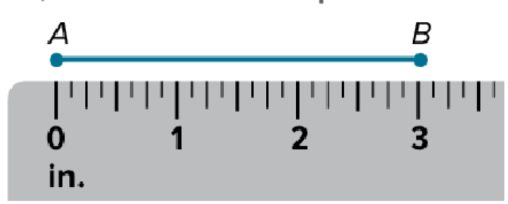
Prove relationships and theorems about lines and angles. Solve mathematical and real-world problems involving postulates, relationships and theorems of lines and angles.

Content Objective

Students prove theorems about line segments.
Students prove theorems about angles.

Learn

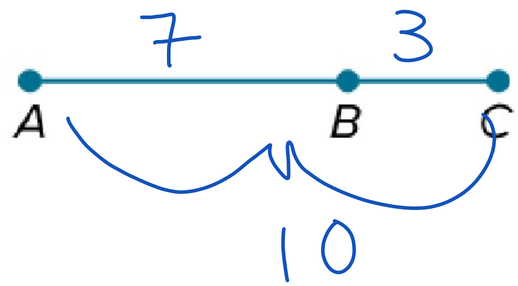
Segment Addition

Postulate 3.8: Ruler Postulate	
Words	The points on any line or line segment can be put into one-to-one correspondence with real numbers.
Example	Given any two points *A* and *B* on a line, if *A* corresponds to zero, then *B* corresponds to a positive real number. 

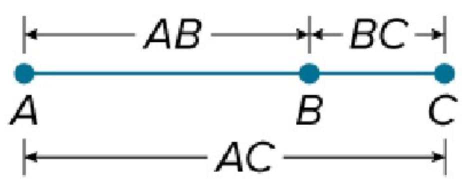
Learn
Segment Addition

In this figure, point B is said to be between points A and C. You can also say that $AB + BC = AC$ by the Segment Addition Postulate.

$7 + 3 = 10$



Learn
Segment Addition

Segment Addition Postulate	
Words	If A, B, and C are collinear, then point B is between A and C if and only if $AB + BC = AC$.
Example	

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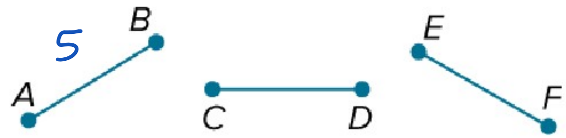
Learn
Segment Addition

Properties of Segment Congruence	
	
Reflexive Property of Congruence (Reflection - Same)	$\overline{AB} \cong \overline{AB}$ (5 ≅ 5)
Symmetric Property of Congruence (line of Symmetry)	If $\overline{AB} \cong \overline{CD}$, then $\overline{CD} \cong \overline{AB}$. flip
Transitive Property of Congruence (syllogism)	If $\overline{AB} \cong \overline{CD}$, and $\overline{CD} \cong \overline{EF}$, then $\overline{AB} \cong \overline{EF}$.

AB = CD
CD = EF

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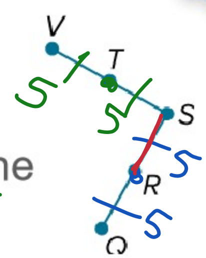
Example 2
Prove Segment Congruence

Write a two-column proof.

Given: *R* is the midpoint of $\overline{QS}$. *T* is the midpoint of $\overline{VS}$. $\overline{QR} \cong \overline{VT}$

congruent =



Prove: $\overline{RS} \cong \overline{TS}$

RS = TS
5 5

Statements	Reasons
1. *R* is the midpoint of $\overline{QS}$. *T* is the midpoint of $\overline{VS}$.	1. Given
2. $\overline{QR} \cong \overline{RS}$; $\overline{VT} \cong \overline{TS}$	2. Midpoint Theorem

VT - TS
QR - VT

3. $\overline{QR} \cong \overline{VT}$ QR ≅ VT
4. $\overline{QR} \cong \overline{TS}$
5. $\overline{RS} \cong \overline{QR}$ ≅ RS ≅ TS

3. Given
4. Transitive Property of Congruence
5. Symmetric Property of Congruence
6. Trans. Property of Congruen

Example 2

Prove Segment Congruence

Proof:

Statements	Reasons
1. R is the midpoint of $\overline{QS}$. T is the midpoint of $\overline{VS}$.	1. Given
2. $\overline{QR} \cong \overline{RS}$; $\overline{VT} \cong \overline{TS}$	2. Midpoint Theorem
3. $\overline{QR} \cong \overline{VT}$	3. Given
4. $\overline{QR} \cong \overline{TS}$	4. Transitive Property of Congruence
5. $\overline{RS} \cong \overline{QR}$	5. Symmetric Property of Congruence
6. $\overline{RS} \cong \overline{TS}$	6. Transitive Property of Congruence

$\overline{VT} \cong \overline{TS}$

$QR \cong \overline{VT}$

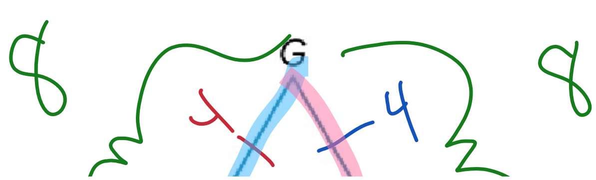
Example 2

Prove Segment Congruence

Check

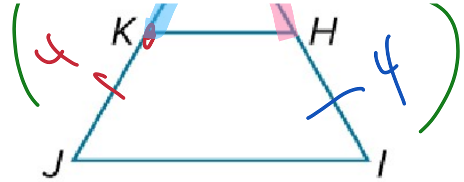
Complete the two-column proof.

Given: $\overline{GJ} \cong \overline{GI}$

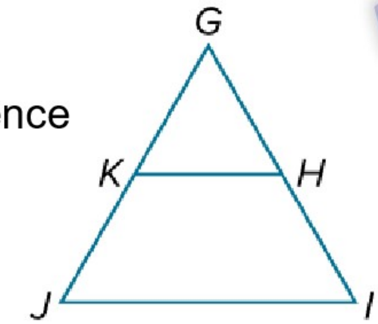


Given: $\overline{GJ} \cong \overline{GI}$
K is the midpoint of $\overline{GJ}$.
H is the midpoint of $\overline{GI}$.

Prove: $\overline{GK} \cong \overline{GH}$



Example 2
Prove Segment Congruence



Proof:

Statements	**Reasons**
1. K is the midpoint of $\overline{GJ}$. H is the midpoint of $\overline{GI}$.	1. Given
2. $\overline{GK} \cong \overline{KJ}$; $\overline{GH} \cong \overline{HI}$	2. Definition of Midpoint / Midpoint Theorem
3. $GK = KJ$; $GH = HI$	3. Definition of Congruency
4. $\overline{GJ} \cong \overline{GI}$	4. Given.
5. $GJ = GI$	5. Definition of Congruency
6. $GJ = GK + KJ$; $GI = GH + HI$	6. Segment Addition Property

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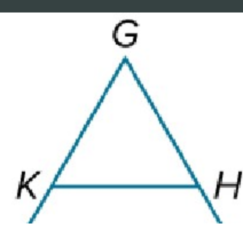
Example 2
Prove Segment Congruence



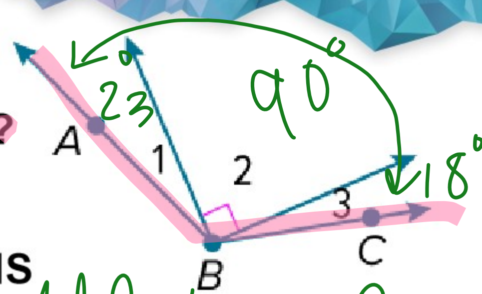
Proof:

Statements	Reasons
7. $GK + KJ = GH + HI$	7. Substitution
8. $GK + GK = GH + GH$	8. Substitution
9. $2GK = 2GH$	9. Combine like terms
10. $GK = GH$	10. Division Prop
11. $\overline{GK} \cong \overline{GH}$	11. Def. of Congruency

Example 1

Angle Addition Postulate

What is $m\angle 3$ if $m\angle 1 = 23°$, $m\angle ABC = 131°$?



STATEMENTS	REASONS
$m\angle 1 + m\angle 2 + m\angle 3 = m\angle ABC$	Angle Addition Prop
$23° + 90° + m\angle 3 = 131°$	Substitution Property of Equality
$113° + m\angle 3 = 131°$	Substitution Property of Equality / Simplify like terms / Combine like terms
$113° + m\angle 3 - 113° = 131° - 113°$	Subtraction Property of Equality
$\angle 3 = 18°$	Substitution Property of Equality

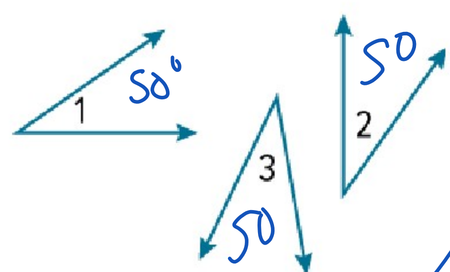
Example 1

Angle Addition Postulate

STATEMENTS	REASONS
$m\angle 1 + m\angle 2 + m\angle 3 = m\angle ABC$	Angle Addition Postulate
$23° + 90° + m\angle 3 = 131°$	Substitution Property of Equality
$113° + m\angle 3 = 131°$	Substitution Property of Equality
$113° + m\angle 3 - 113° = 131° - 113°$	Subtraction Property of Equality
$m\angle 3 = 18°$	Substitution Property of Equality

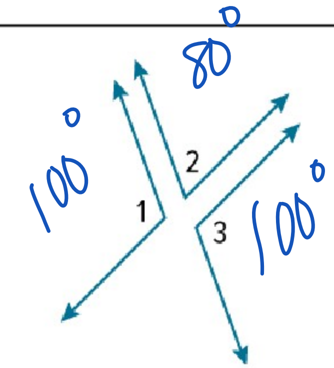
Learn

Congruent Angles

Theorem 3.5: Properties of Angle Congruence	
Reflexive Property of Congruence $\angle 1 \cong \angle 1$ (Reflection - Same) 50° 50°	
Symmetric Property of Congruence If $\angle 1 \cong \angle 2$, then $\angle 2 \cong \angle 1$. line of symmetry flip	
Transitive Property of Congruence If $\angle 1 \cong \angle 2$ and $\angle 2 \cong \angle 3$, then $\angle 1 \cong \angle 3$. law of syllogism	

1 = 2
2 = 3

Learn
Congruent Angles

Theorems	
Theorem 3.6: Congruent Supplements Theorem 180 Angles supplementary to the same angle or to congruent angles are congruent. **Abbreviation** ∠s suppl. to same ∠ or ≅ ∠s are ≅.	 If $m\angle 1 + m\angle 2 = 180°$ and $m\angle 2 + m\angle 3 = 180°$, then $\angle 1 \cong \angle 3$.

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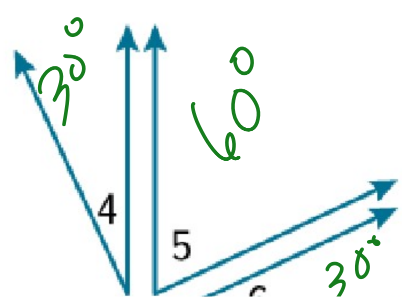
Learn
Congruent Angles

Theorems	
Theorem 3.7: Congruent Complements Theorem 90° Angles complementary to the same angle or to congruent angles are congruent.	

Abbreviation ∠s compl. to same ∠ or ≅ ∠s are ≅.	 If $m\angle 4 + m\angle 5 = 90°$ and $m\angle 5 + m\angle 6 = 90°$, then $\angle 4 \cong \angle 6$.

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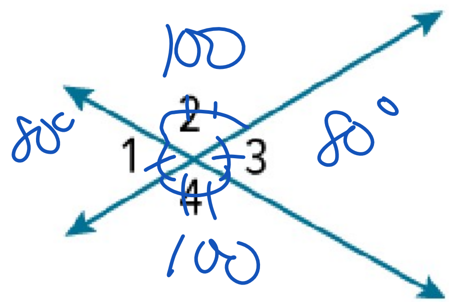
Learn

Congruent Angles

Theorems	
Theorem 3.8: Vertical Angles Theorem If two angles are vertical angles, then they are congruent.	 $\angle 1 \cong \angle 3$ and $\angle 2 \cong \angle 4$

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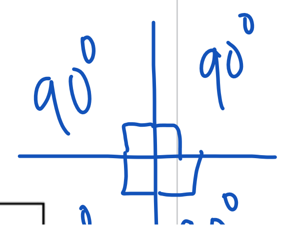
Right Angle Theorems

You can prove the following theorems about right angles using what you already know about angle measures.



Theorem 3.9	Perpendicular lines intersect to form four right angles.
Theorem 3.10	All right angles are congruent.
Theorem 3.11	Perpendicular lines form congruent adjacent angles.

90° | 90

next to

Learn
Right Angle Theorems

180

Theorem 3.12	If two angles are congruent and supplementary, then each angle is a right angle.
Theorem 3.13	If two congruent angles form a linear pair, then they are right angles.

90° 90°

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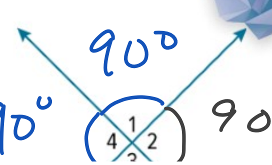
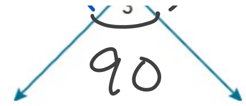
Example 5
Right Angle Theorems in Proofs

Write a proof.



Given: ∠1 ≅ ∠4

Prove: ∠1 and ∠2 are right angles.



Statements	Reasons
1. ∠1 ≅ ∠4	1. Given
2. ∠2 ≅ ∠4	2. Vertical Angles Theorem
3. ∠4 ≅ ∠2	3. Symmetric Property of Congruence
4. ∠1 ≅ ∠2	4. Transitive Property of Congruence
5. ___________ are a linear pair.	5. Definition of linear pair
6. ∠1 and ∠2 are _____ angles.	6. If two congruent angles form a linear pair, then they are right angles.

4 = 2

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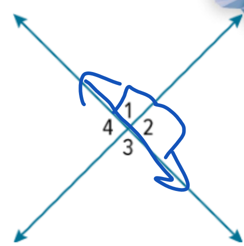
Example 5

Right Angle Theorems in Proofs



Proof:

Statements	Reasons
1. ∠1 ≅ ∠4	1. Given
2. ∠2 ≅ ∠4	2. Vertical Angles Theorem
3. ∠4 ≅ ∠2	3. Symmetric Property of Congruence
4. ∠1 ≅ ∠2	4. Transitive Property of Congruence
5. ∠1 and ∠2 are a linear pair.	5. Definition of linear pair
6. ∠1 and ∠2 are right angles.	6. If two congruent angles form a linear pair, then they are right angles.

~~1 = 4~~
~~4 = 2~~

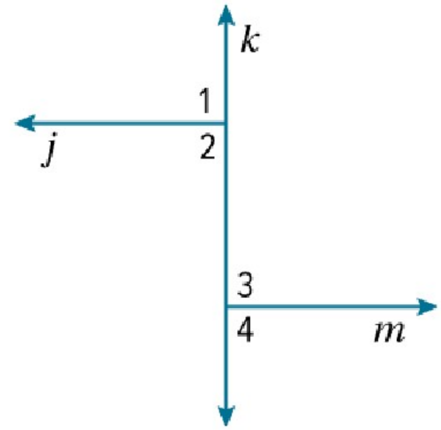
Example 5
Right Angle Theorems in Proofs

Check

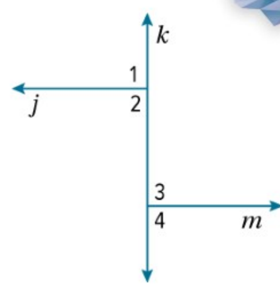
Complete the proof.

Given: Lines j and k are perpendicular.
$\angle 1 \cong \angle 4$

Prove: $\angle 2 \cong \angle 4$



Example 5
Right Angle Theorems in Proofs



Proof:

Statements	Reasons
1. Lines j and k are perpendicular.	1. Given
2. $\angle 2 \cong \angle 1$	2. Perp. Lines Form Congruent adjacent angles
3. $\angle 1 \cong \angle 4$	3. Given
4. $\angle 2 \cong \angle 4$	4. Transitive Property of Congruence

Congruence

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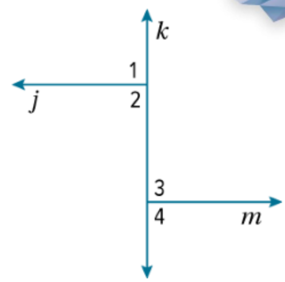
Example 5

Right Angle Theorems in Proofs



Proof:

Statements	Reasons
1. Lines j and k are perpendicular.	1. Given
2. $\angle 2 \cong \angle 1$	2. Perpendicular lines form congruent adjacent angles.
3. $\angle 1 \cong \angle 4$	3. Given
4. $\angle 2 \cong \angle 4$	4. Transitive Property of Congruence