3-2 Angles Formed by Parallel Lines and Transversals

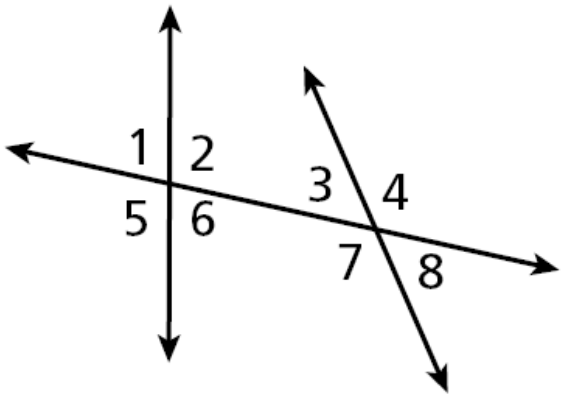
Warm Up

Lesson Presentation

Lesson Quiz

Warm Up

Identify each angle pair.



1. ∠1 and ∠3 corr. ∠s

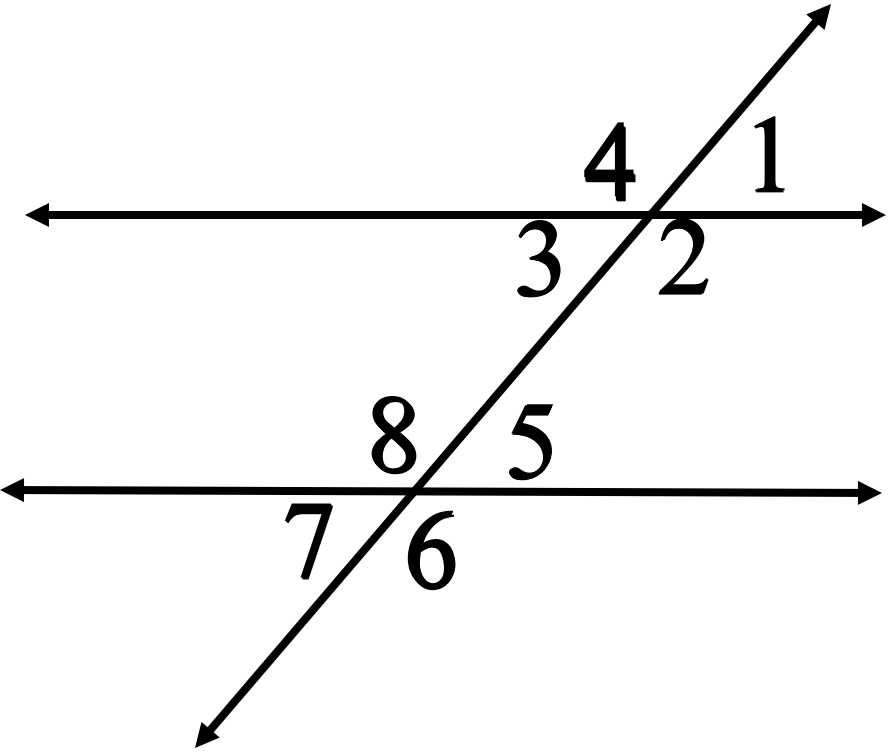
2. ∠3 and ∠6 alt. int. ∠s

3. ∠4 and ∠5 alt. ext. ∠s

4. ∠6 and ∠7 same-side int ∠s

Objective

Prove and use theorems about the angles formed by parallel lines and a transversal.



Corresponding Angles:

∠1 and ∠5
∠2 and ∠6
∠3 and ∠7
∠4 and ∠8

Congruent

Alternate Interior Angles:

∠2 and ∠8
∠3 and ∠5

Congruent

Same Side Interior Angles:

∠2 and ∠5
∠3 and ∠8

Supplementary

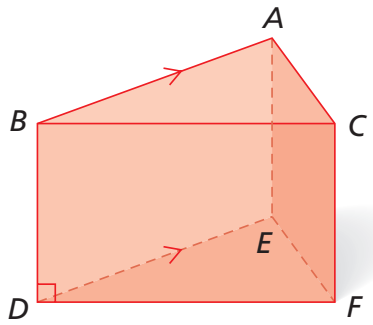
Alternate Exterior Angles:

∠1 and ∠7
∠4 and ∠6

Congruent

PRACTICE AND PROBLEM SOLVING

Identify each of the following. Possible answers:



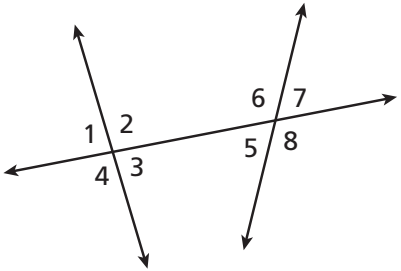
14. one pair of parallel segments $\overline{AB} \parallel \overline{DE}$

15. one pair of skew segments $\overline{AB}$ and $\overline{CF}$ are skew.

16. one pair of perpendicular segments $\overline{BD} \perp \overline{DF}$

17. one pair of parallel planes plane $ABC \parallel$ plane DEF

Give an example of each angle pair. Possible answers:



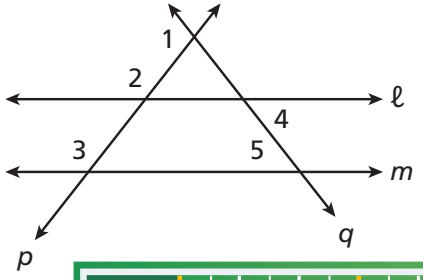
18. same-side interior angles $\angle 2$ and $\angle 6$

19. alternate exterior angles $\angle 1$ and $\angle 8$

20. corresponding angles $\angle 1$ and $\angle 6$

21. alternate interior angles $\angle 2$ and $\angle 5$

Identify the transversal and classify each angle pair.



22. $\angle 2$ and $\angle 3$ transv.: p; corr. $\measuredangle$s

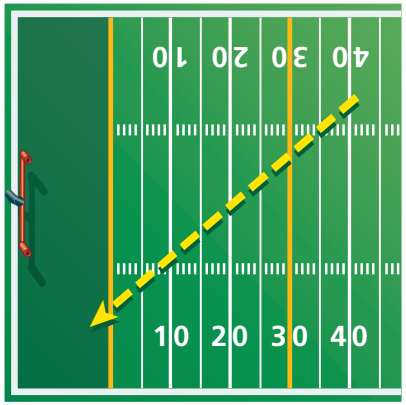
23. $\angle 4$ and $\angle 5$ transv.: q; alt. int. $\measuredangle$s

24. $\angle 2$ and $\angle 4$ transv.: ℓ; alt. ext. $\measuredangle$s

25. $\angle 1$ and $\angle 2$ transv.: p; same-side int. $\measuredangle$s

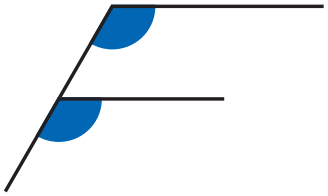
26. **Sports** A football player runs across the 30-yard line at an angle. He continues in a straight line and crosses the goal line at the same angle. Describe two parallel lines and a transversal in the diagram.

The 30-yard line and goal line are $\parallel$, and the path of the runner is the transv.

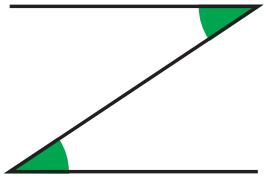


Name the type of angle pair shown in each letter. Possible answers:

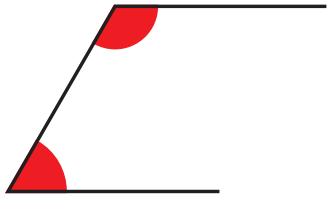
27. F corr. $\angle$s



28. Z alt. int. $\angle$s

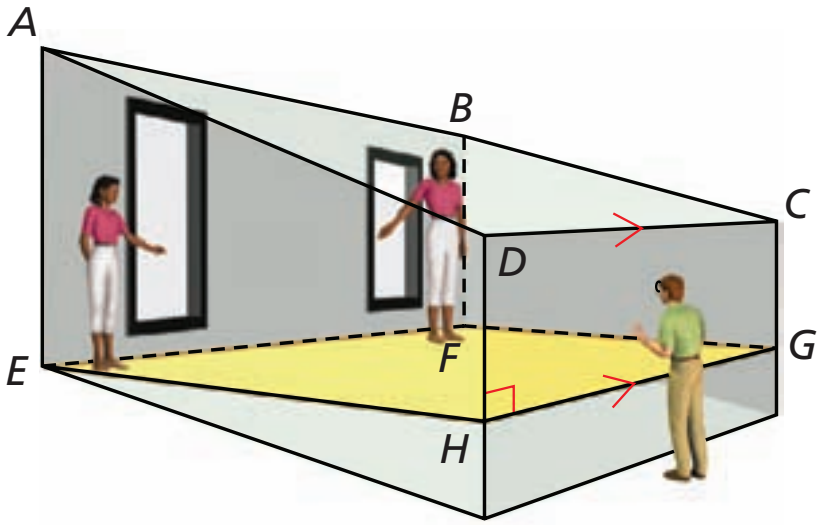


29. C same-side int. $\angle$s



Entertainment **Use the following information for Exercises 30–32.**

In an Ames room, the floor is tilted and the back wall is closer to the front wall on one side.



30. Name a pair of parallel segments in the diagram. $\overline{CD} \parallel \overline{GH}$

31. Name a pair of skew segments in the diagram. Possible answer: $\overline{CD}$ and $\overline{FG}$

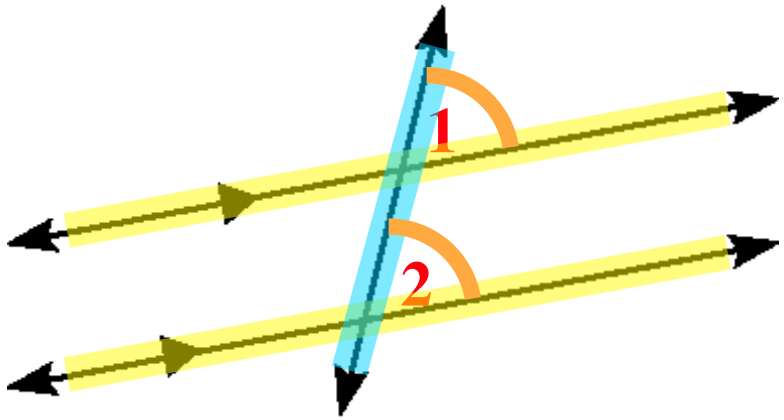
32. Name a pair of perpendicular segments in the diagram. $\overline{DH} \perp \overline{GH}$

PROPERTIES OF PARALLEL LINES

POSTULATE

POSTULATE 15 Corresponding Angles Postulate

If two parallel lines are cut by a transversal, then the pairs of corresponding angles are congruent.



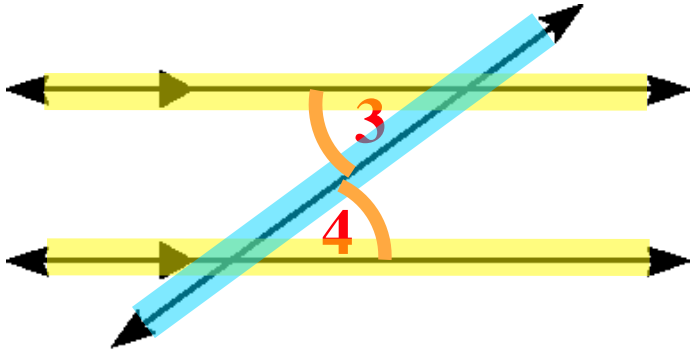
$\angle 1 \cong \angle 2$

PROPERTIES OF PARALLEL LINES

THEOREMS ABOUT PARALLEL LINES

THEOREM 3.4 Alternate Interior Angles

If two parallel lines are cut by a transversal, then the pairs of alternate interior angles are congruent.

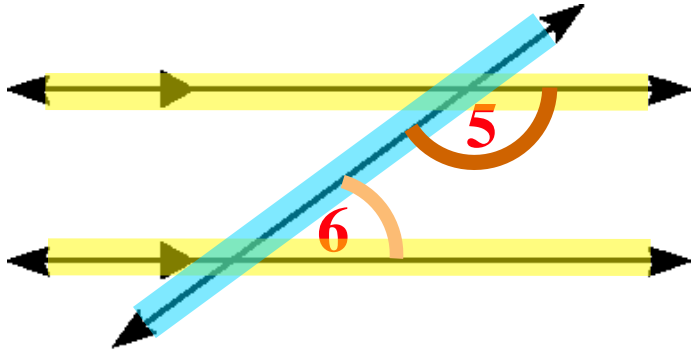


$\angle 3 \cong \angle 4$

THEOREMS ABOUT PARALLEL LINES

THEOREM 3.5 Consecutive Interior Angles

If two parallel lines are cut by a transversal, then the pairs of consecutive interior angles are supplementary.

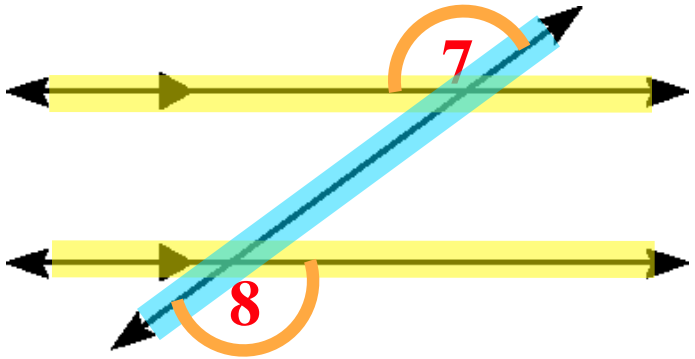


$$m\angle 5 + m\angle 6 = 180°$$

THEOREMS ABOUT PARALLEL LINES

THEOREM 3.6 Alternate Exterior Angles

If two parallel lines are cut by a transversal, then the pairs of alternate exterior angles are congruent.



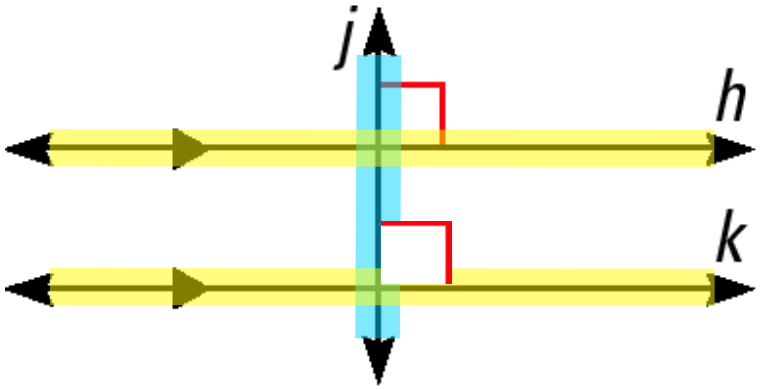
$\angle 7 \cong \angle 8$

PROPERTIES OF PARALLEL LINES

THEOREMS ABOUT PARALLEL LINES

THEOREM 3.7 Perpendicular Transversal

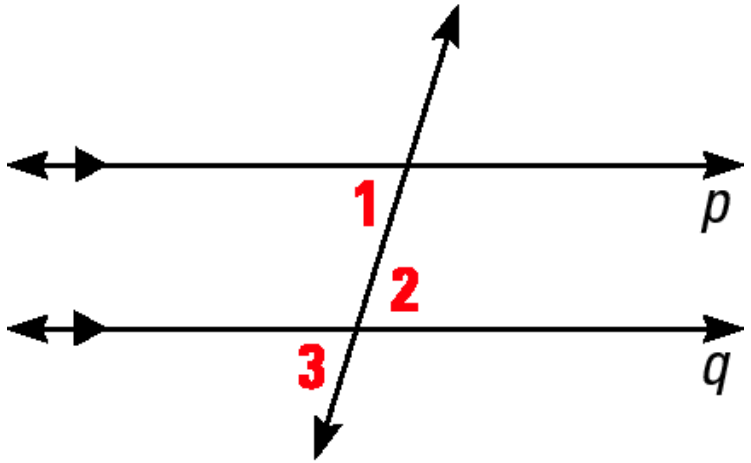
If a transversal is perpendicular to one of two parallel lines, then it is perpendicular to the other.



$j \perp k$

Prove the Alternate Interior Angles Theorem.

SOLUTION



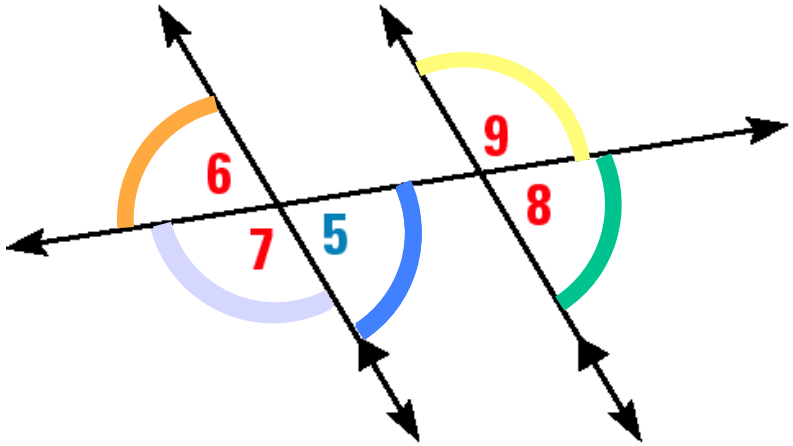
GIVEN ▶ $p \parallel q$

PROVE ▶ $\angle 1 \cong \angle 2$

	Statements	Reasons
1	$p \parallel q$	Given
2	$\angle 1 \cong \angle 3$	Corresponding Angles Postulate
3	$\angle 3 \cong \angle 2$	Vertical Angles Theorem
4	$\angle 1 \cong \angle 2$	Transitive property of Congruence

EXAMPLE Using Properties of Parallel Lines

Given that $m\angle 5 = 65°$, find each measure. Tell which postulate or theorem you use.



SOLUTION

$m\angle 6 = m\angle 5 = 65°$ Vertical Angles Theorem

$m\angle 7 = 180° - m\angle 5 = 115°$ Linear Pair Postulate

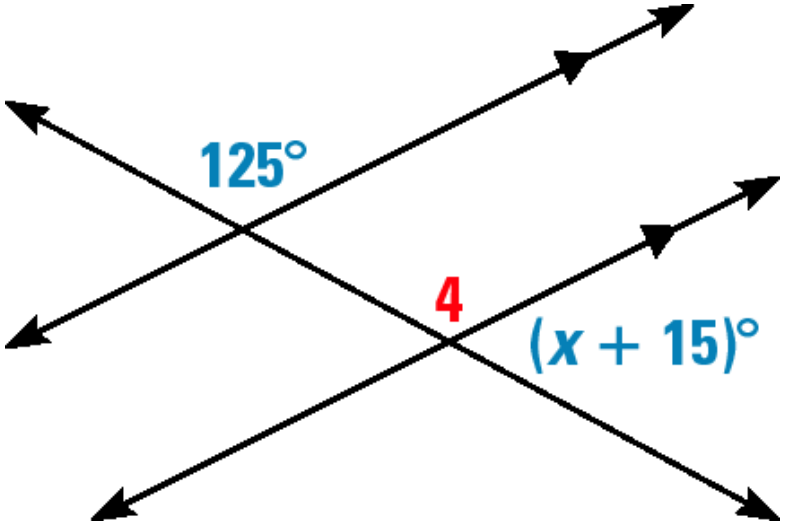
$m\angle 8 = m\angle 5 = 65°$ Corresponding Angles Postulate

$m\angle 9 = m\angle 7 = 115°$ Alternate Exterior Angles Theorem

PROPERTIES OF SPECIAL PAIRS OF ANGLES

EXAMPLE Using Properties of Parallel Lines

Use properties of parallel lines to find the value of x.

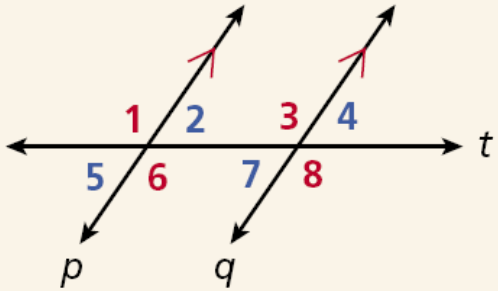


SOLUTION

$m\angle 4 = 125°$	Corresponding Angles Postulate
$m\angle 4 + (x + 15)° = 180°$	Linear Pair Postulate
$125° + (x + 15)° = 180°$	Substitute.
$x = 40°$	Subtract.

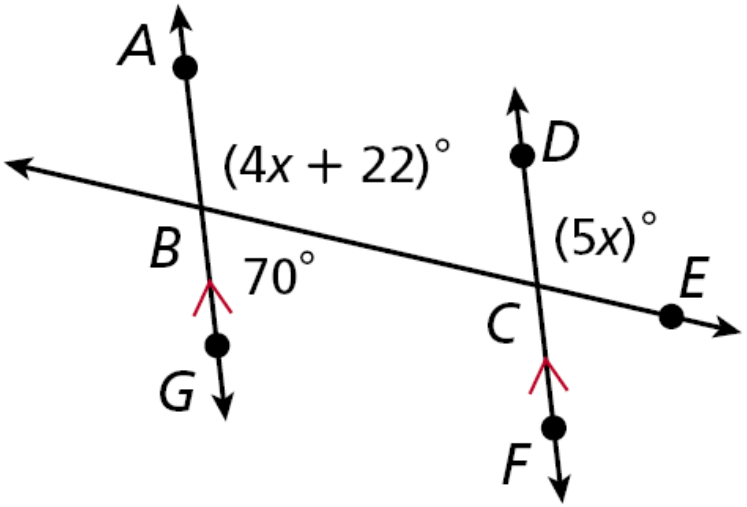
3-2 Angles Formed by Parallel Lines and Transversals

Postulate 3-2-1 Corresponding Angles Postulate

THEOREM	HYPOTHESIS	CONCLUSION
If two parallel lines are cut by a transversal, then the pairs of corresponding angles are congruent.		$\angle 1 \cong \angle 3$ $\angle 2 \cong \angle 4$ $\angle 5 \cong \angle 7$ $\angle 6 \cong \angle 8$

Example 1: Using the Corresponding Angles Postulate

Find each angle measure.



A. m∠*ECF*

$x = 70$ *Corr. ∠s Post.*

m∠*ECF* = 70°

B. m∠*DCE*

$5x = 4x + 22$ *Corr. ∠s Post.*

$x = 22$ *Subtract 4x from both sides.*

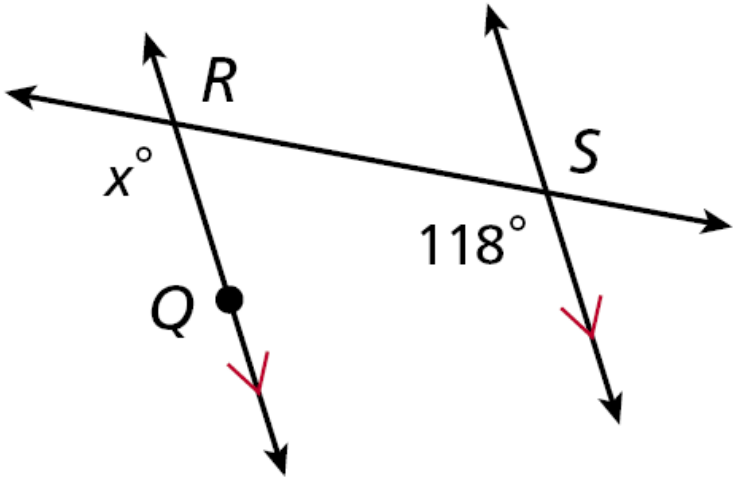
m∠*DCE* = $5x$

$= 5(22)$ *Substitute 22 for x.*

$= 110°$

Check It Out! Example 1

Find m∠*QRS*.



$x = 118$ *Corr. ∠s Post.*

$m\angle QRS + x = 180°$ *Def. of Linear Pair*

$m\angle QRS = 180° - x$ *Subtract x from both sides.*

$= 180° - 118°$ *Substitute 118° for x.*

$= 62°$

Helpful Hint

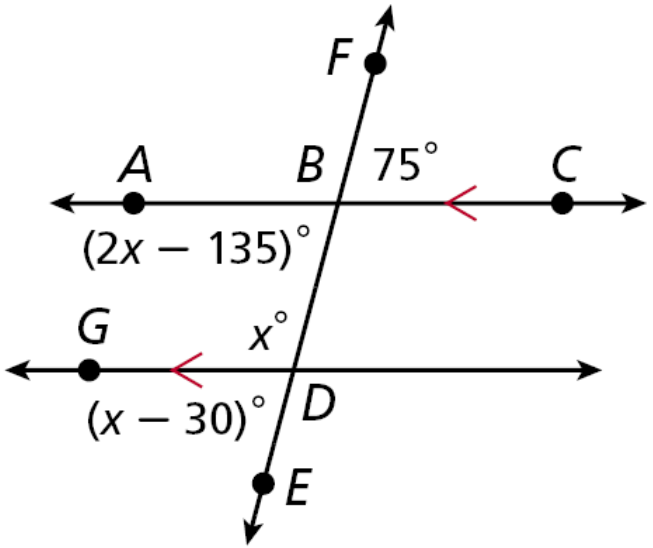
If a transversal is perpendicular to two parallel lines, all eight angles are congruent.

Remember that postulates are statements that are accepted without proof.

Since the Corresponding Angles Postulate is given as a postulate, it can be used to prove the next three theorems.

Example 2: Finding Angle Measures

Find each angle measure.



A. m∠*EDG*

m∠*EDG* = 75° *Alt. Ext. ∠s Thm.*

B. m∠BDG

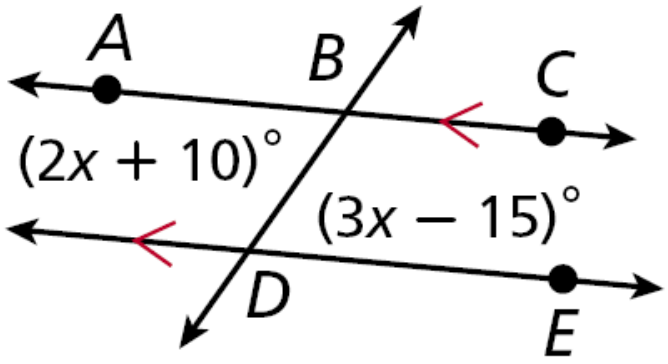
$x - 30° = 75°$ *Alt. Ext. ∠s Thm.*

$x = 105$ *Add 30 to both sides.*

m∠*BDG* = 105°

Check It Out! Example 2

Find m∠ABD.



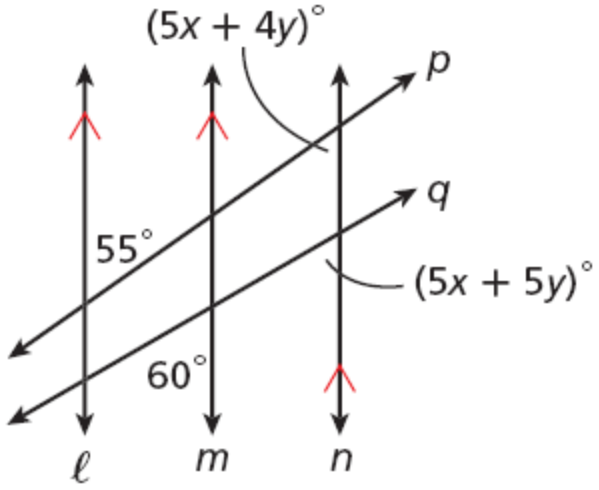
$2x + 10° = 3x - 15°$ *Alt. Int. ∠s Thm.*

$x = 25$ *Subtract 2x and add 15 to both sides.*

$m\angle ABD = 2(25) + 10 = 60°$ *Substitute 25 for x.*

Example 3: Music Application

Find *x* and *y* in the diagram.



By the Alternate Interior Angles Theorem, $(5x + 4y)° = 55°$.

By the Corresponding Angles Postulate, $(5x + 5y)° = 60°$.

$$\begin{array}{r} 5x + 5y = 60 \\ -(5x + 4y = 55) \\ \hline y = 5 \end{array}$$

Subtract the first equation from the second equation.

$5x + 5(5) = 60$

Substitute 5 for y in 5x + 5y = 60. Simplify and solve for x.

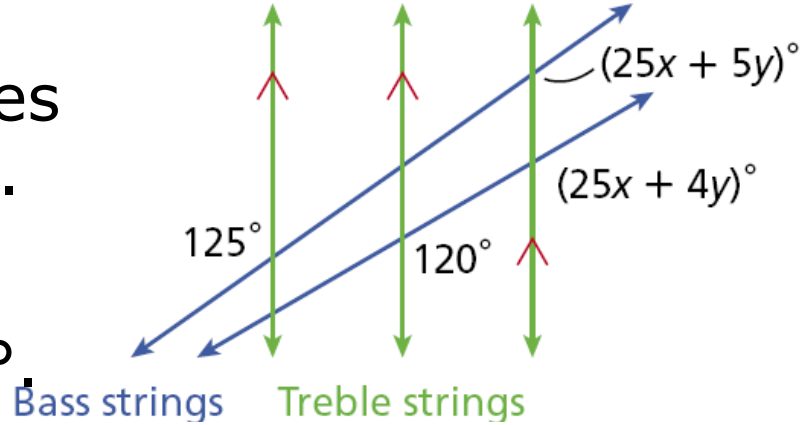
$x = 7, y = 5$

Check It Out! Example 3

Find the measures of the acute angles in the diagram.

By the Alternate Exterior Angles Theorem, $(25x + 5y)° = 125°$.

By the Corresponding Angles Postulate, $(25x + 4y)° = 120°$.



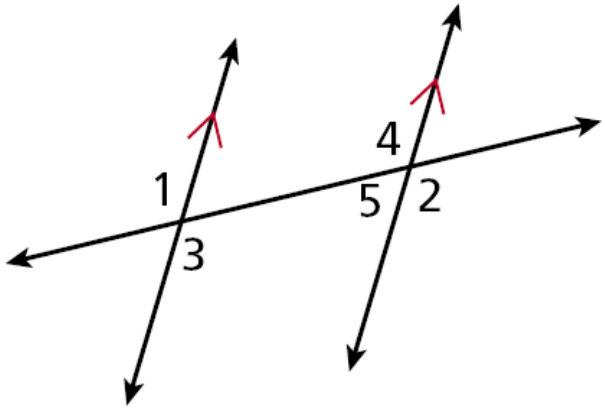
An acute angle will be 180° – 125°, or 55°.

The other acute angle will be 180° – 120°, or 60°.

HW p. 159 #1-19

Lesson Quiz

State the theorem or postulate that is related to the measures of the angles in each pair. Then find the unknown angle measures.



1. $m\angle 1 = 120°$, $m\angle 2 = (60x)°$

Alt. Ext. $\angle$s Thm.; $m\angle 2 = 120°$

2. $m\angle 2 = (75x - 30)°$, $m\angle 3 = (30x + 60)°$

Corr. $\angle$s Post.; $m\angle 2 = 120°$, $m\angle 3 = 120°$

3. $m\angle 3 = (50x + 20)°$, $m\angle 4 = (100x - 80)°$

Alt. Int. $\angle$s Thm.; $m\angle 3 = 120°$, $m\angle 4 = 120°$

4. $m\angle 3 = (45x + 30)°$, $m\angle 5 = (25x + 10)°$

Same-Side Int. $\angle$s Thm.; $m\angle 3 = 120°$, $m\angle 5 = 60°$