

Angle Connection Lab

Use congruent angles and equal distances to solve for unknowns.

HIGH SCHOOL • HSG-CO.C.9

CCSS.Math.Content.HSG-CO.C.9 "Prove theorems about lines and angles. Theorems include: vertical angles are congruent; when a transversal crosses parallel lines, alternate interior angles are congruent and corresponding angles are congruent..."

NAME _____

DATE _____

THE BIG IDEA

Vertical angles are opposite angles formed by two intersecting lines, and they have equal measures. When a transversal crosses parallel lines, corresponding angles and alternate interior angles have equal measures. A point is on a segment's perpendicular bisector exactly when it is the same distance from both endpoints.

WORKED EXAMPLE

Parallel lines p and q are cut by a transversal. A pair of corresponding angles measure 68° and $(5x + 3)^\circ$. Find x .

1. Corresponding angles are congruent, so $5x + 3 = 68$.
2. Subtract 3 from both sides: $5x = 65$.
3. Divide by 5: $x = 13$.

Answer: $x = 13$

PRACTICE 6 problems

- 1** Two vertical angles measure $(7x - 4)^\circ$ and $(2x + 36)^\circ$. Find x and the measure of each vertical angle.

ANSWER _____

- 2** Parallel lines are cut by a transversal. Corresponding angles measure $(x + 9)^\circ$ and 72° . Find x .

ANSWER _____

- 3** Parallel lines are cut by a transversal. Alternate interior angles measure $(2x + 10)^\circ$ and $(4x - 30)^\circ$. Find x and the measure of each angle.

ANSWER _____

- 4** Two vertical angles measure $(8x + 2)^\circ$ and $(4x + 26)^\circ$. Find x and the measure of each vertical angle.

ANSWER _____

- 5** Segment AB has perpendicular bisector l . Point P lies on l . If $PA = 2x + 7$ and $PB = 4x - 9$, find x and PA .

ANSWER _____

- 6** For segment CD , $PC = 4x + 1$ and $PD = 2x + 15$. Point P is equidistant from C and D . Find x , then state where P lies.

ANSWER _____

APPLY IT Show your work

- 1** A student designs a mural with two parallel horizontal stripes. A diagonal design line crosses both stripes. An angle at the upper stripe measures 118° , and the corresponding angle at the lower stripe measures $(7x - 8)^\circ$. Find x and the measure of the lower angle.

WORK SPACE

ANSWER _____

- 2** For a concert, speakers A and B stand at the ends of a straight stage edge. A sound engineer places a microphone at P on the perpendicular bisector of AB. If $PA = 4x + 10$ meters and $PB = 6x - 6$ meters, find x and each cable length.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

Parallel lines r and s , with r above s , are cut by transversal t . At the intersection with r , the angle above r and to the left of t measures 124° . Give the measures of all eight angles by position, and explain your reasoning.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	Two vertical angles measure $(7x - 4)^\circ$ and $(2x + 36)^\circ$. Find x and the measure of each vertical angle.	$x = 8$; each vertical angle measures 52°.
2	Parallel lines are cut by a transversal. Corresponding angles measure $(x + 9)^\circ$ and 72° . Find x .	$x = 63$
3	Parallel lines are cut by a transversal. Alternate interior angles measure $(2x + 10)^\circ$ and $(4x - 30)^\circ$. Find x and the measure of each angle.	$x = 20$; each alternate interior angle measures 50°.
4	Two vertical angles measure $(8x + 2)^\circ$ and $(4x + 26)^\circ$. Find x and the measure of each vertical angle.	$x = 6$; each vertical angle measures 50°.
5	Segment AB has perpendicular bisector l . Point P lies on l . If $PA = 2x + 7$ and $PB = 4x - 9$, find x and PA.	$x = 8$; PA = 23.
6	For segment CD, $PC = 4x + 1$ and $PD = 2x + 15$. Point P is equidistant from C and D. Find x , then state where P lies.	$x = 7$; P lies on the perpendicular bisector of CD.

PART 2 • APPLY IT

- $x = 18$; the lower angle measures 118° .** Corresponding angles formed by a transversal through parallel lines are congruent, so $7x - 8 = 118$. Solving gives $x = 18$.
- $x = 8$; PA = PB = 42 meters.** Because P is on the perpendicular bisector of AB, $PA = PB$. Set $4x + 10$ equal to $6x - 6$ and solve.

CHALLENGE

At line r : above-left = 124° , above-right = 56° , below-left = 56° , below-right = 124° . At line s : above-left = 124° , above-right = 56° , below-left = 56° , below-right = 124° . The vertical angle to the 124° angle is also 124° , and each adjacent angle is 56° because it forms a straight angle with 124° . Corresponding angles at line s match the angles in the same positions at line r .

Accept equivalent equations and equivalent wording for the perpendicular-bisector conclusion. For the challenge, students should identify four 124° angles and four 56° angles with valid vertical, straight-angle, and corresponding-angle reasoning.