

Geometry · Parallel Lines, Transversals and Proofs · Lesson

Common Core G-CO.C.9 · mathovore.fr

A transversal is a line that crosses two other lines. When the two lines are parallel, corresponding angles and alternate interior angles are equal, and same-side interior angles add to 180 degrees. The converses prove lines parallel. Every point on the perpendicular bisector of a segment is equally far from its endpoints.

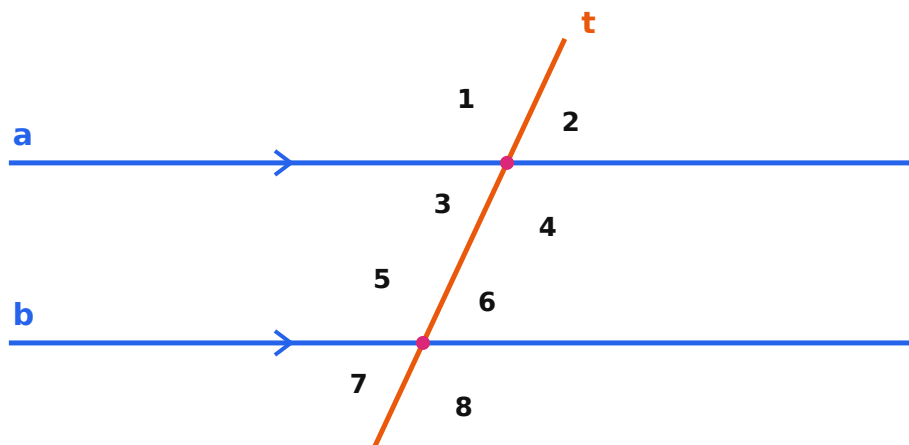
GeometryCommon Core: G-CO.C.9

Key facts:

- Standard G-CO.C.9 covers proving theorems about lines and angles, including parallel lines and perpendicular bisectors.
- Parallel lines cut by a transversal: corresponding angles and alternate interior angles are equal.
- Same-side interior angles between parallel lines are supplementary (sum 180 degrees).
- Converses: equal corresponding or alternate angles, or supplementary same-side interior angles, prove two lines parallel.
- A point is on the perpendicular bisector of a segment exactly when it is equidistant from the endpoints.

What angles form when a line crosses two other lines?

A **transversal** is a line that crosses two or more other lines at different points. When it crosses two lines, it forms eight angles. Angles between the two lines are **interior**; angles outside them are **exterior**.



Angles 1 to 4 sit at the top intersection and angles 5 to 8 at the bottom one.

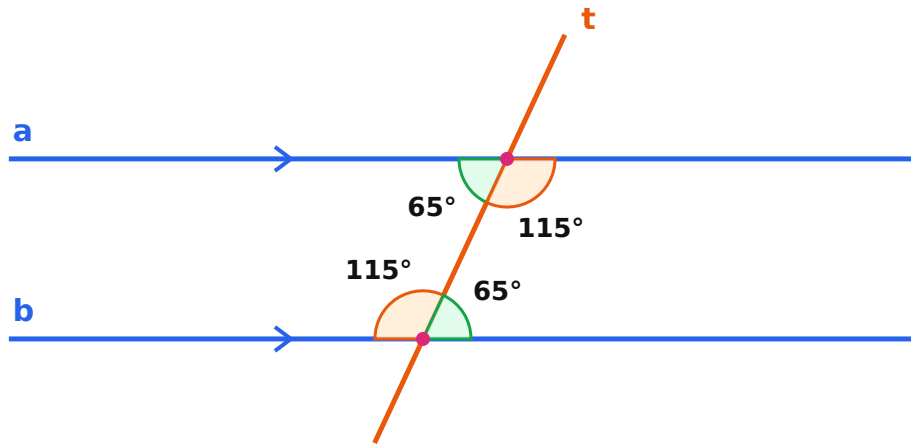
Angle pairs formed by a transversal

Pair name	Example	If the lines are parallel
Corresponding	$\angle 2$ and $\angle 6$	equal measures
Alternate interior	$\angle 3$ and $\angle 6$	equal measures
Alternate exterior	$\angle 1$ and $\angle 8$	equal measures
Same-side interior	$\angle 3$ and $\angle 5$	add to 180°

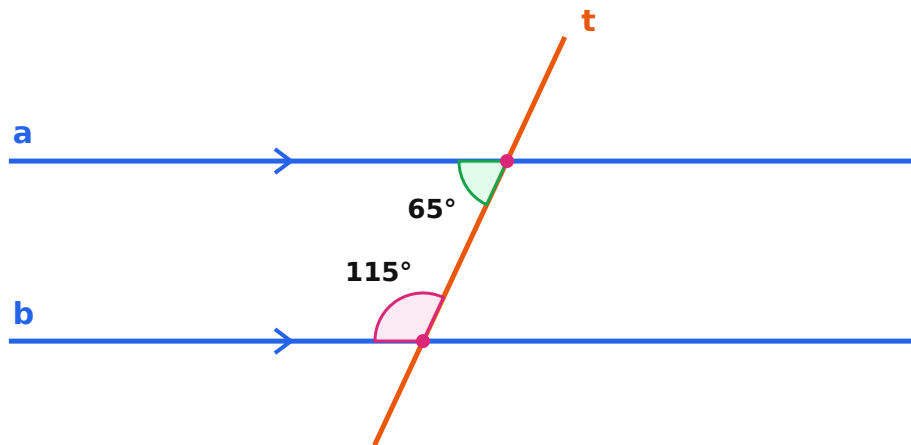
What do parallel lines tell you about these angles?

If two parallel lines are cut by a transversal, then corresponding angles are equal, alternate interior angles are equal, and same-side interior angles are supplementary. The proof below shows why alternate interior angles are equal.

Statements	Reasons
$a \parallel b$	Given
$m\angle 2 = m\angle 6$	Corresponding Angles Theorem
$m\angle 2 = m\angle 3$	Vertical Angles Theorem
$m\angle 3 = m\angle 6$	Substitution Property



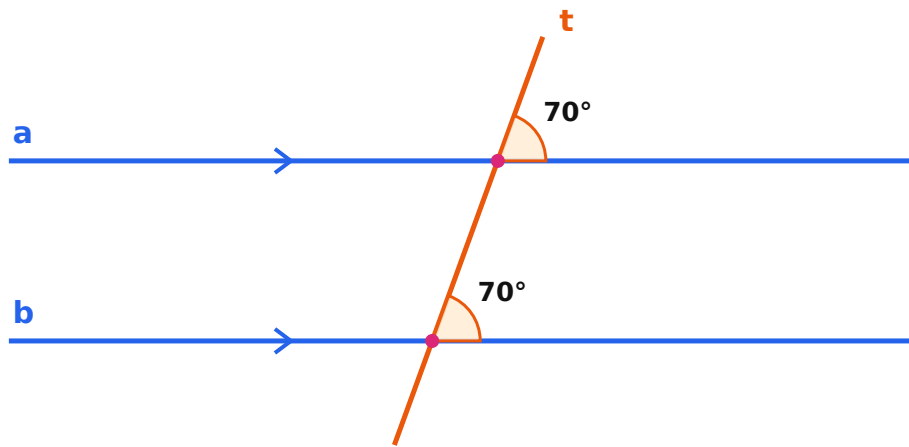
Alternate interior angles form a Z shape and have equal measures: 65° and 65° .



Same-side interior angles (a C shape) add to 180° : $65^\circ + 115^\circ = 180^\circ$.

How do you prove two lines are parallel?

Each theorem works backward too. If corresponding angles are equal, or alternate interior angles are equal, or same-side interior angles add to 180° , then the two lines are parallel.



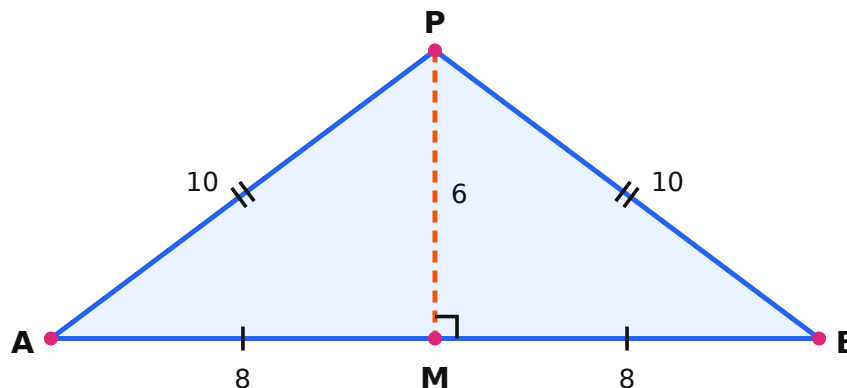
Congruent corresponding angles (70° and 70°) prove that a is parallel to b .

Worked example. Alternate interior angles measure $(4x+6)^\circ$ and $(6x-14)^\circ$. For what value of x are the lines parallel?

1. Parallel lines need equal alternate interior angles: $4x+6=6x-14$.
2. Subtract $4x$ and add 14: $20=2x$, so $x=10$.
3. Check: $4(10)+6=46$ and $6(10)-14=46$. Both angles are 46° .

What is the Perpendicular Bisector Theorem?

A perpendicular bisector cuts a segment into two equal parts at a right angle. Every point on it is the same distance from both endpoints, and every point equally distant from both endpoints lies on it.



P lies on the perpendicular bisector of AB , so $PA = PB = 10$.

In the figure, the right triangles $\triangle PMA$ and $\triangle PMB$ share side PM , have equal legs $AM = BM$ and right angles at M , so the hypotenuses PA and PB are equal.

Parallel Lines, Transversals and Proofs: frequently asked questions

What is the difference between alternate interior and corresponding angles?

Alternate interior angles lie between the two lines on opposite sides of the transversal. Corresponding angles sit in the same position at each intersection. Both pairs are equal when the lines are parallel.

Are same-side interior angles equal or supplementary?

They are supplementary, so their measures add to 180 degrees. They are equal only in the special case where the transversal is perpendicular to both lines, and each angle is 90 degrees.

How can you prove that two lines are parallel?

Show that one pair of corresponding angles is equal, one pair of alternate interior or alternate exterior angles is equal, or one pair of same-side interior angles is supplementary. Then cite the matching converse theorem.

What does the Perpendicular Bisector Theorem say?

Any point on the perpendicular bisector of a segment is the same distance from both endpoints of the segment. The converse also holds: a point equally far from both endpoints lies on the bisector.

Why do proofs use reasons such as Vertical Angles Theorem?

A proof is a chain of statements, and each one needs a justification: a given fact, a definition, a postulate, or a theorem already proved. Naming the reason shows the chain has no gaps.