

Parallel Lines Cut by a Transversal

Grade 10 – Geometry math · Lesson · Standards: G-CO.C.9

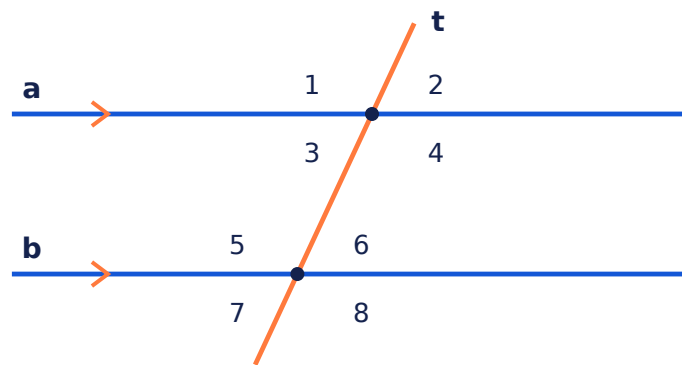
Quick answer: When a transversal crosses two lines, it makes corresponding, alternate interior, alternate exterior and same-side interior angle pairs. If the lines are parallel, the first three pairs are congruent and same-side interior angles are supplementary. The converses prove lines parallel. The Perpendicular Bisector Theorem says points on the bisector are equidistant from a segment's endpoints.

Standards: G-CO.C.9 · **Level:** Grade 10 Geometry

Which angles form when a transversal crosses two lines?

A **transversal** is a line that crosses two or more other lines at different points. Eight angles appear, and they fall into four named pairs.

Pair	Where they sit	Example
Corresponding	Same position at each intersection	$\angle 1$ and $\angle 5$
Alternate interior	Between the lines, opposite sides of the transversal	$\angle 3$ and $\angle 6$
Alternate exterior	Outside the lines, opposite sides of the transversal	$\angle 1$ and $\angle 8$
Same-side interior	Between the lines, same side of the transversal	$\angle 3$ and $\angle 5$



Angles 3, 4, 5, 6 are interior; angles 1, 2, 7, 8 are exterior.

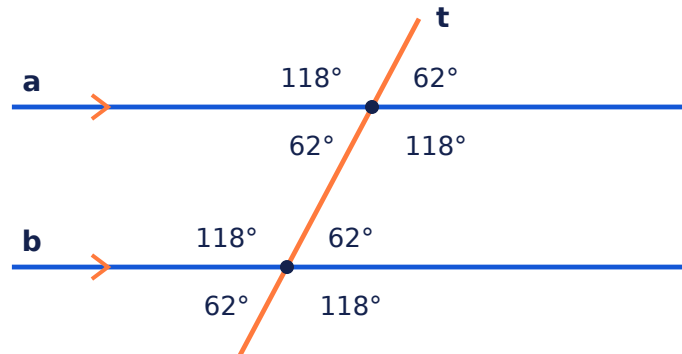
What do parallel lines tell us about these angles?

Parallel Lines Theorems

If two parallel lines are cut by a transversal, then:

- corresponding angles are congruent;

- alternate interior angles are congruent;
- alternate exterior angles are congruent;
- same-side interior angles are supplementary.



Only two measures appear: 62° and 118° . They add to 180° .

One reason underlies all four: a corresponding pair is equal, and vertical angles or linear pairs convert it into the other pairs.

How can you prove that two lines are parallel?

The converses also hold. If a transversal makes any one of these angle relationships, the two lines are **parallel**: congruent corresponding angles, congruent alternate interior angles, congruent alternate exterior angles, or supplementary same-side interior angles.

Method for finding an unknown angle

1. Mark the parallel lines and the transversal.
2. Name the angle pair and decide: equal or supplementary?
3. Write an equation, such as $m\angle 3 = m\angle 6$.
4. Solve, then substitute to get the angle measures.
5. Check with a second angle relationship.

Worked example

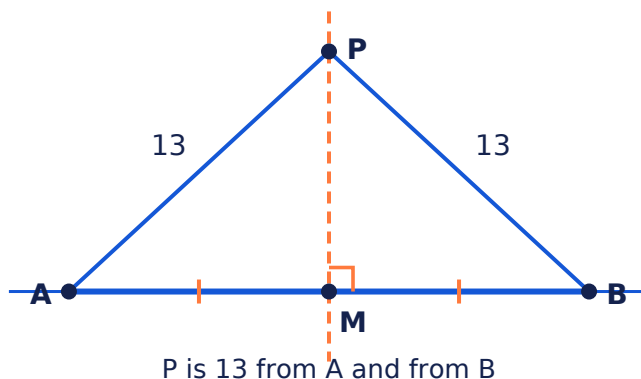
Lines a and b are parallel. Same-side interior angles measure $(5x + 7)^\circ$ and $(3x + 13)^\circ$. They are supplementary, so $8x + 20 = 180$ and $x = 20$. The angles are 107° and 73° , and $107 + 73 = \mathbf{180}$.

What is the Perpendicular Bisector Theorem?

A **perpendicular bisector** of a segment is a line that is perpendicular to the segment at its midpoint. Every point on it is the same distance from both endpoints of the segment.

Perpendicular Bisector Theorem and converse

If a point is on the perpendicular bisector of a segment, then it is equidistant from the endpoints. Conversely, a point equidistant from the endpoints lies on the perpendicular bisector.



Every point on the perpendicular bisector is equally far from A and B.

Common mistake

Same-side interior angles are supplementary, not congruent. Their sum is 180° only when the lines are parallel.

Mathbot's tip

Parallel lines make only two different angle measures. Find one acute and one obtuse angle, and the other six follow.

Key points to remember

- A transversal crossing two parallel lines creates only two different angle measures.
- Corresponding, alternate interior and alternate exterior angles are congruent when lines are parallel.
- Same-side interior angles are supplementary when lines are parallel.
- Converse: matching angle relationships prove that the lines are parallel.
- Points on a perpendicular bisector are equidistant from the segment's endpoints.

Parallel Lines Cut by a Transversal: frequently asked questions

How can you tell alternate interior angles from 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, so one is inside and the other outside the lines.

Do these theorems work if the lines are not parallel?

The angle pairs still exist, but the equal and supplementary relationships hold only for parallel lines. That is why the converses are useful for proving lines parallel.

What is the difference between a bisector and a perpendicular bisector?

A bisector cuts a segment into two equal parts at any angle. A perpendicular bisector also crosses the segment at a right angle.

Why are same-side interior angles supplementary?

One of them is congruent to the linear-pair partner of the other, so together they equal a straight angle of 180° .

Can a point be equidistant from two points without being on the perpendicular bisector?

No. In a plane, every point equidistant from the two endpoints lies on the perpendicular bisector, which is the converse of the theorem.