

3-4

Parallel and Perpendicular Lines

Content Standard
G.MG.3 Apply geometric methods to solve design problems.

Objective To relate parallel and perpendicular lines

Essential Understanding You can use the relationships of two lines to a third line to decide whether the two lines are parallel or perpendicular to each other.

Take note

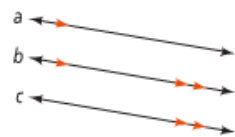
Theorem 3-8

Theorem

If two lines are parallel to the same line, then they are parallel to each other.

If ...

$$a \parallel b \text{ and } b \parallel c$$



Then ...

$$a \parallel c$$

You will prove Theorem 3-8 in Exercise 7.

Take note

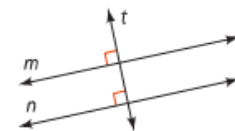
Theorem 3-9

Theorem

In a plane, if two lines are perpendicular to the same line, then they are parallel to each other.

If ...

$$m \perp t \text{ and } n \perp t$$

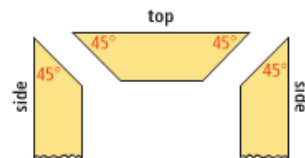


Then ...

$$m \parallel n$$

**Problem 1 Solving a Problem With Parallel Lines** STEM

Carpentry A carpenter plans to install molding on the sides and the top of a doorway. The carpenter cuts the ends of the top piece and one end of each of the side pieces at 45° angles as shown. Will the side pieces of molding be parallel? Explain.



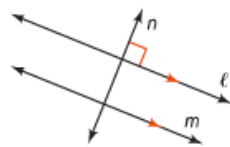
Take note

Theorem 3-10 Perpendicular Transversal Theorem

Theorem

In a plane, if a line is perpendicular to one of two parallel lines, then it is also perpendicular to the other.

If ...
 $n \perp \ell$ and $\ell \parallel m$



Then ...
 $n \perp m$

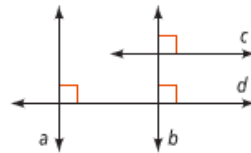


Problem 2 Proving a Relationship Between Two Lines

Given: In a plane, $c \perp b$, $b \perp d$, and $d \perp a$.

Prove: $c \perp a$

Proof: Lines c and d are both perpendicular to line b , so $c \parallel d$ because two lines perpendicular to the same line are parallel. It is given that $d \perp a$. Therefore, $c \perp a$ because a line that is perpendicular to one of two parallel lines is also perpendicular to the other (Perpendicular Transversal Theorem).



Got It? 2. In Problem 2, could you also conclude $a \parallel b$? Explain.



Lesson Check

Do you know HOW?

1. Main Street intersects Avenue A and Avenue B. Avenue A is parallel to Avenue B. Avenue A is also perpendicular to Main Street. How are Avenue B and Main Street related? Explain.
2. In the diagram below, lines a , b , and c are coplanar. What conclusion can you make about lines a and b ? Explain.

