## Lesson 20: Transformations, Transversals, and Proof

* Let’s prove statements about parallel lines.

### 20.1: Math Talk: Angle Relationships

Lines and are parallel. Mentally evaluate the measure in each figure.

Figure A

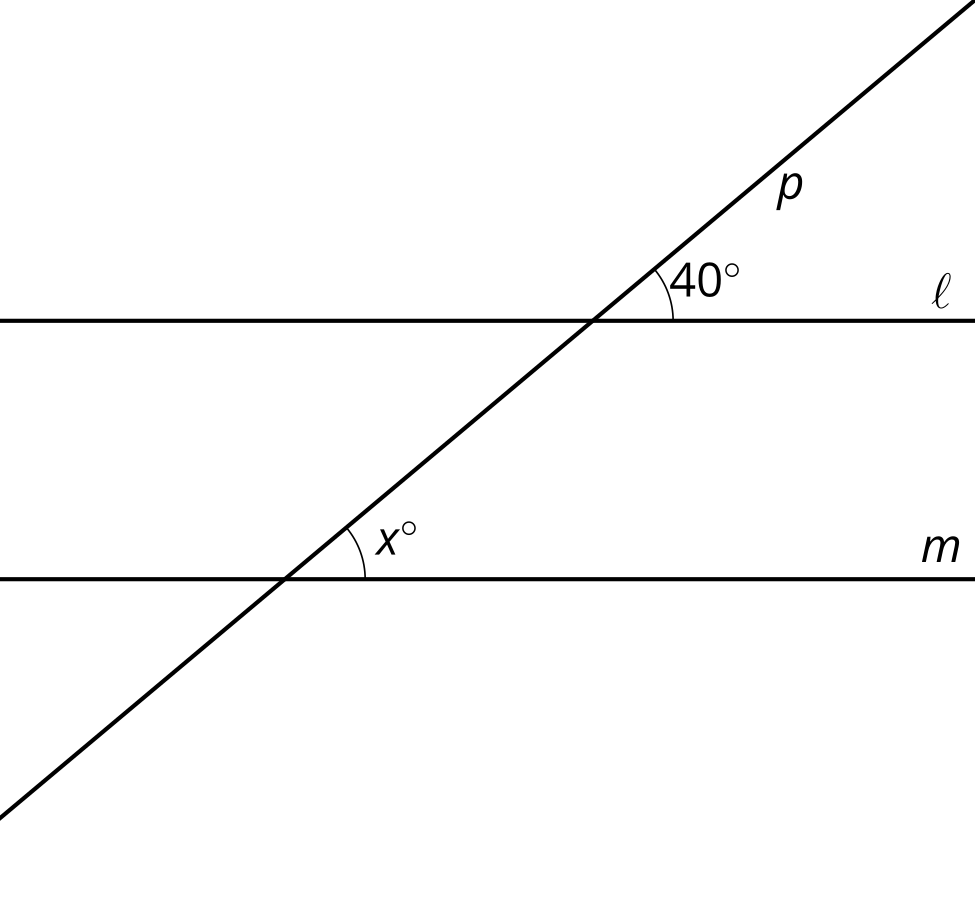


Figure B

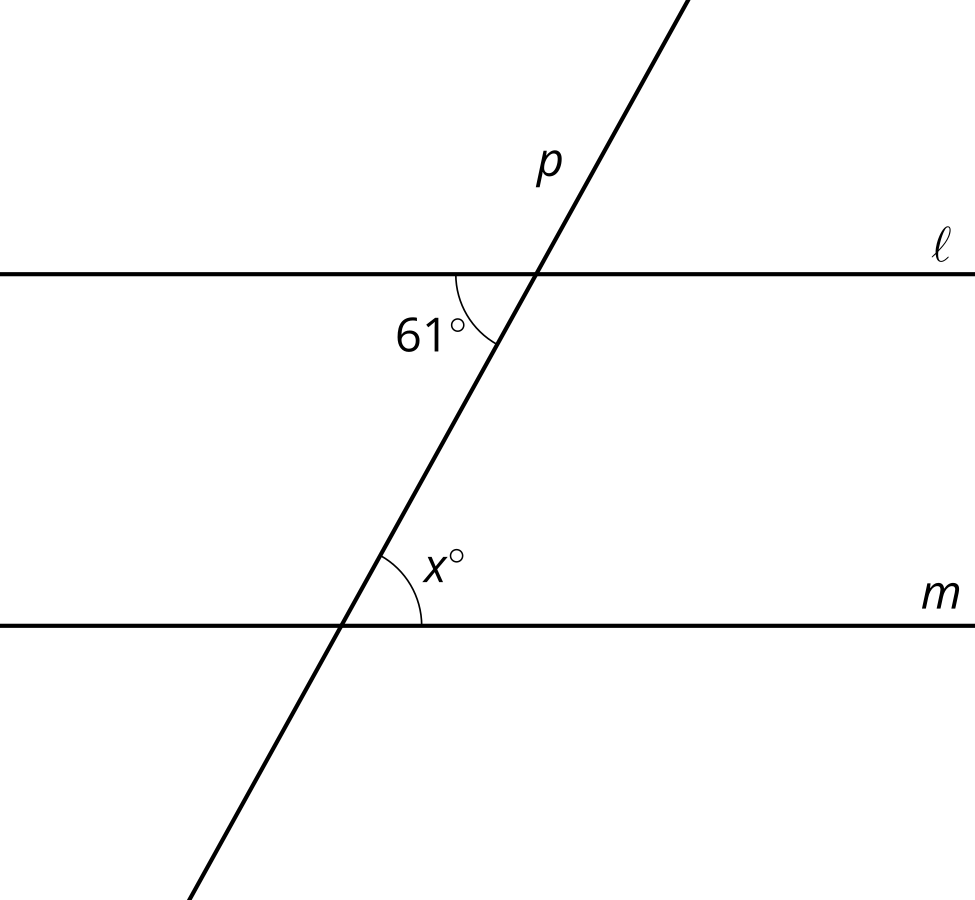


Figure C

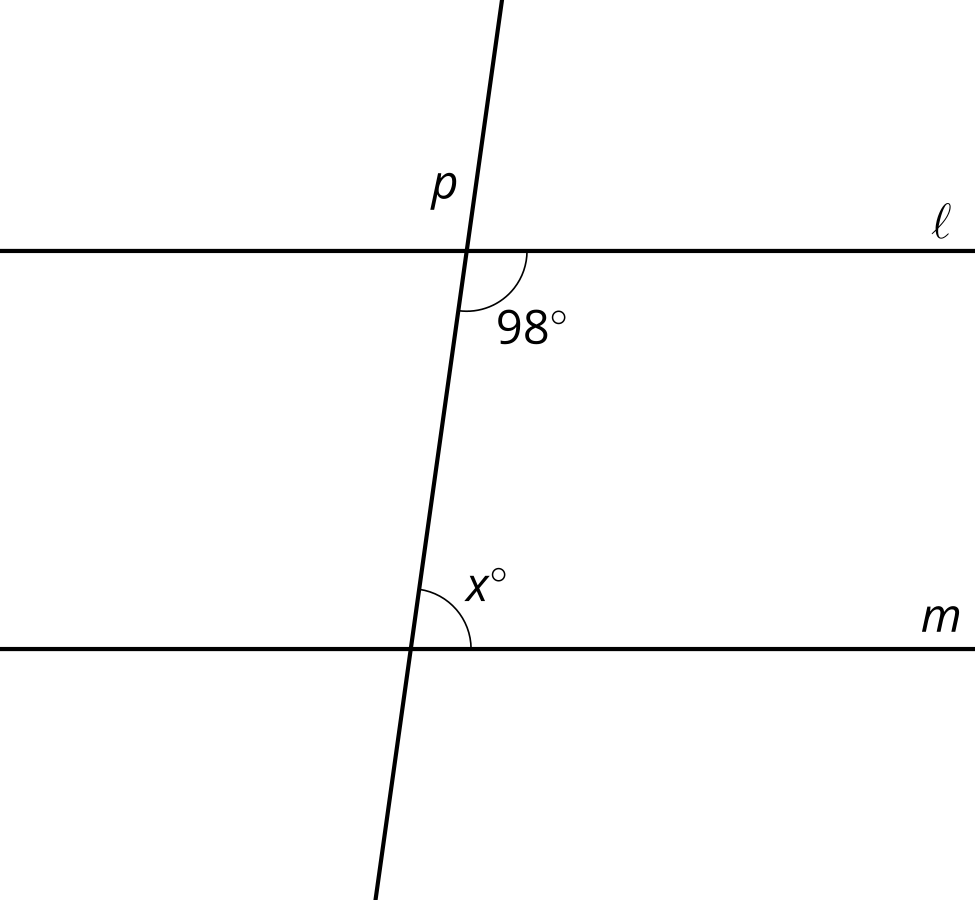
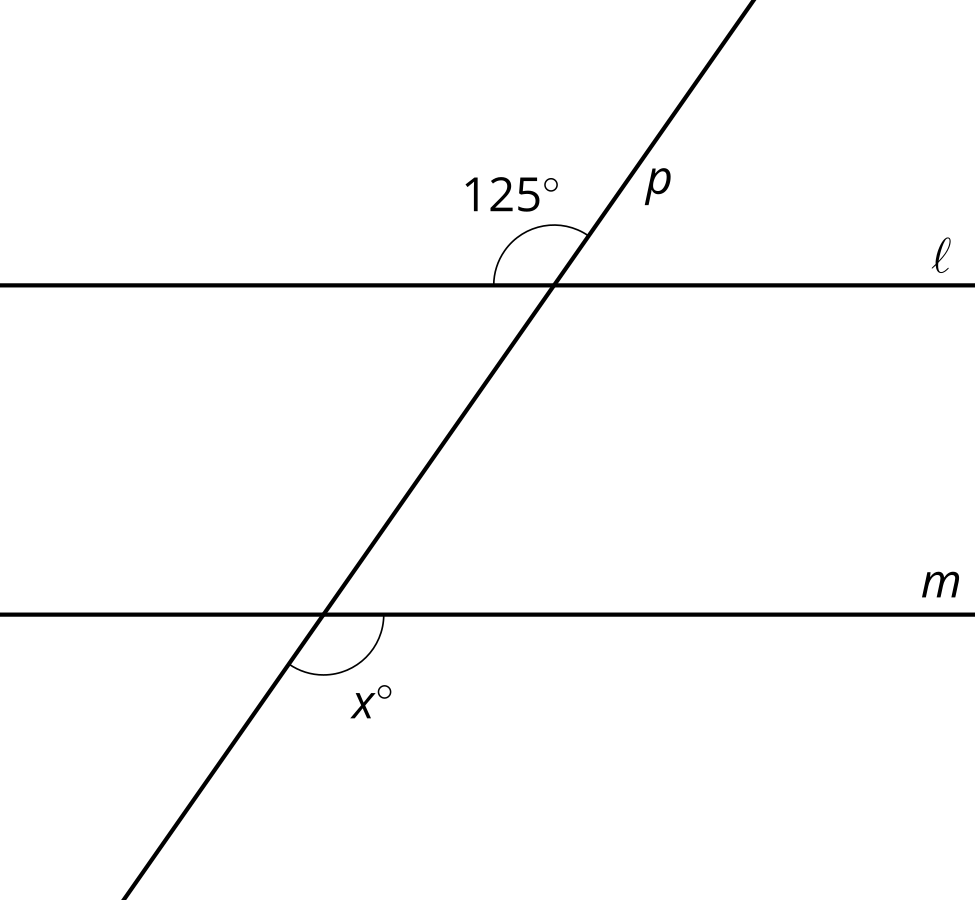
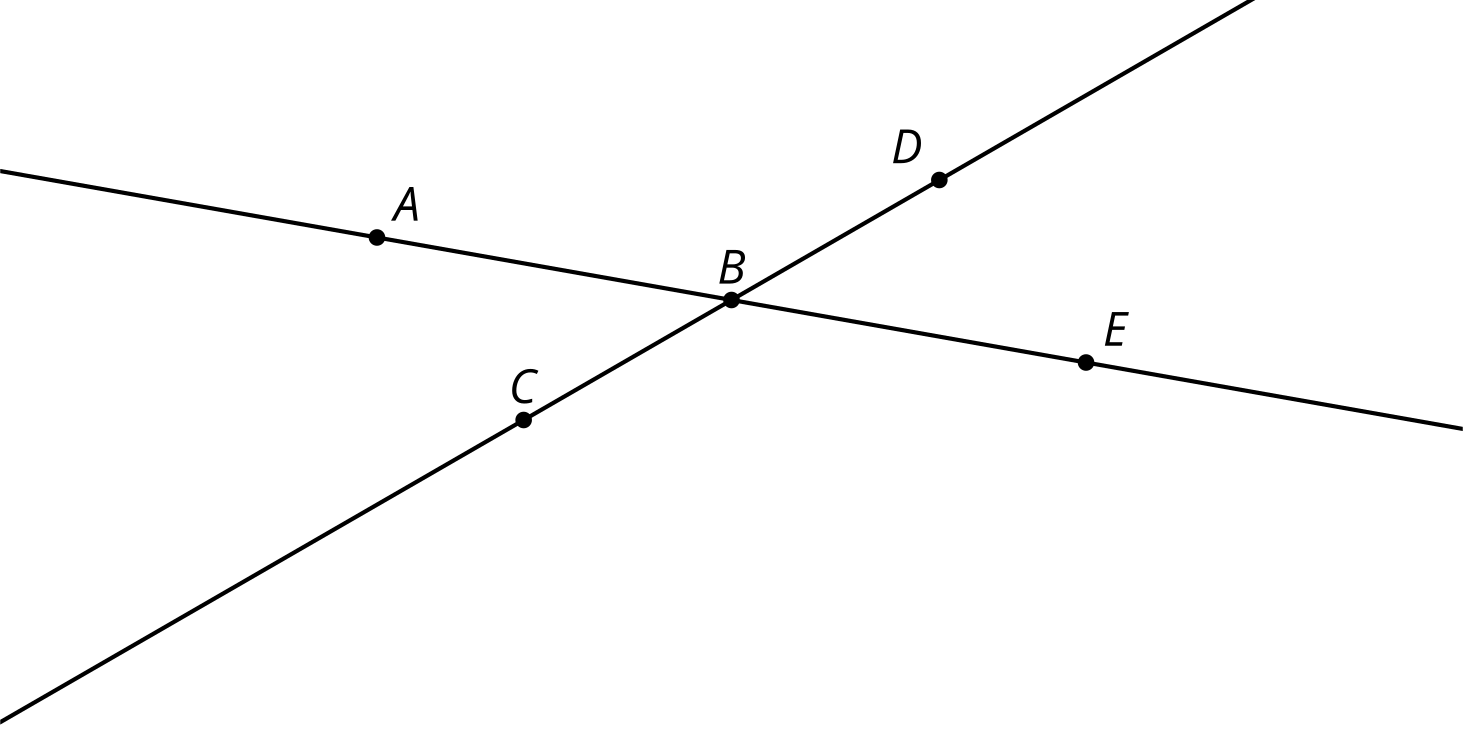


Figure D



### 20.2: Make a Mark? Give a Reason.

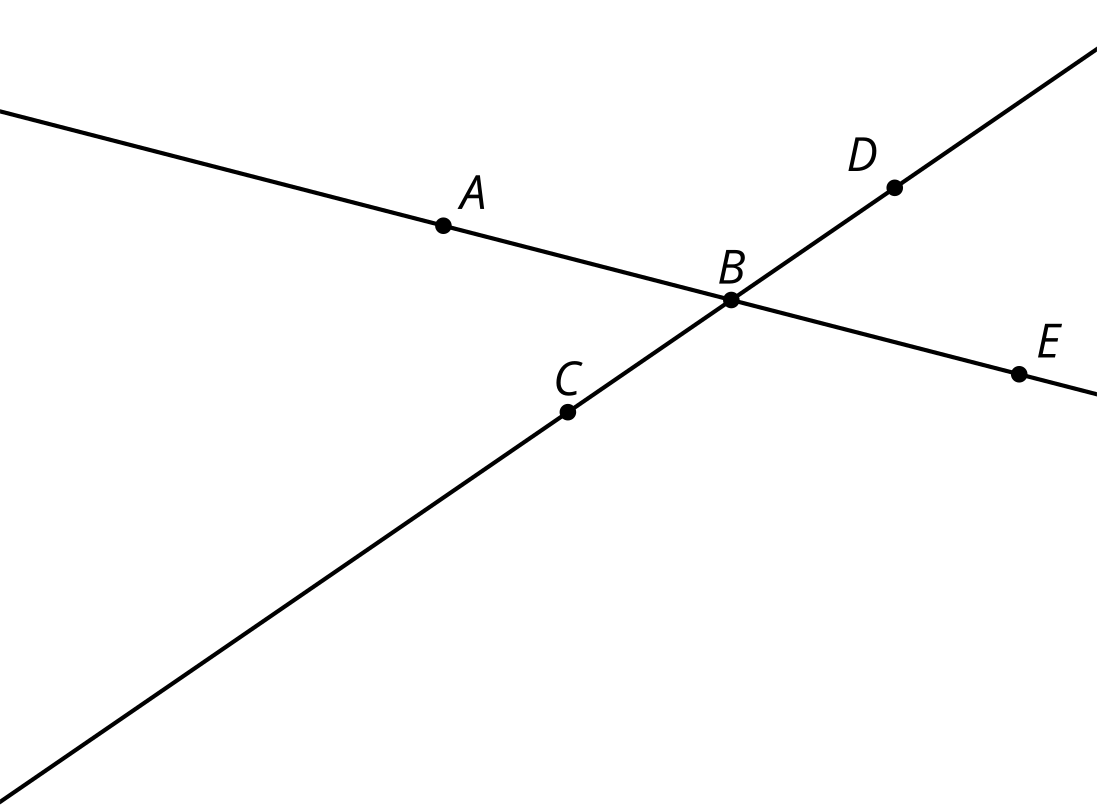
Here are intersecting lines and :



1. Translate lines  and  by the directed line segment from to . Label the images of as .
2. What is true about lines and ? Explain your reasoning.
3. Take turns with your partner to identify congruent angles.
   1. For each pair of congruent angles that you find, explain to your partner how you know the angles are congruent.
   2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.

### 20.3: An Alternate Explanation

Here are intersecting lines and :



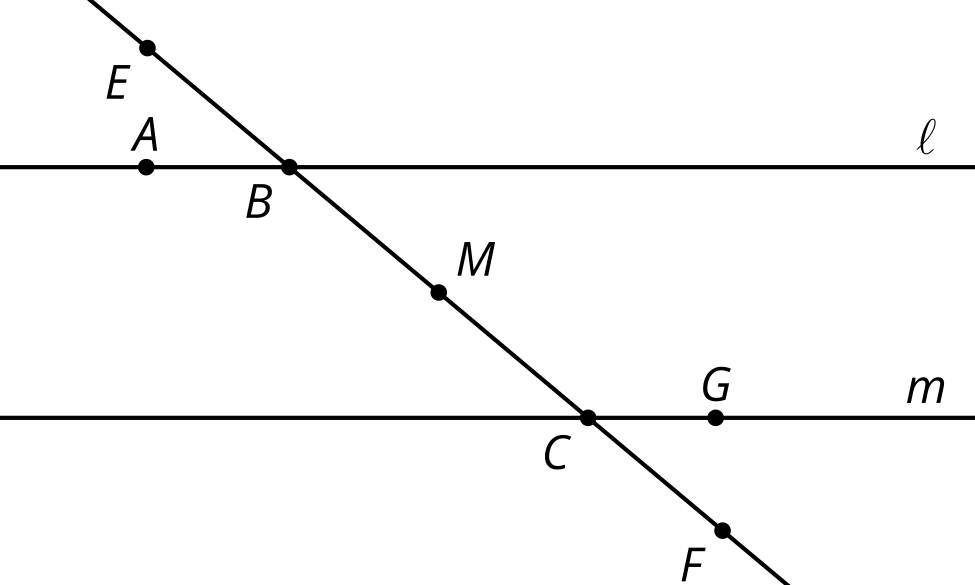
1. Rotate line by 180 degrees around point . Label the images of as .
2. What is true about lines and ? Explain your reasoning.
3. Take turns with your partner to identify congruent angles.
   1. For each pair of congruent angles that you find, explain to your partner how you know the angles are congruent.
   2. For each match that your partner finds, listen carefully to their explanation. If you disagree, discuss your thinking and work to reach an agreement.

#### Are you ready for more?

1. Prove that 180 degree rotations take lines that do not pass through the center of rotation to parallel lines.
2. What is the image of a line that is rotated 180 degrees around a point on the line?

### Lesson 20 Summary

There are often several different ways to explain why statements are true. Comparing the different ways can lead to new insights or more flexible understanding. Consider the angles formed when 2 parallel lines and are cut by a transversal:



Suppose we want to explain why angle is congruent to angle . Label the midpoint of as . Rotating 180 degrees around takes angle to angle . Why? Well, and are equidistant from , so the rotation takes to . Also, it takes the transversal to itself, so it takes the ray to the ray . Finally, the rotation takes line onto line because 180 degree rotations take lines onto parallel lines and is the only line parallel to that also goes through .

A different explanation can prove the same fact using a translation and the idea that vertical angles are congruent. Try thinking of that explanation yourself.



© CC BY 2019 by Illustrative Mathematics®