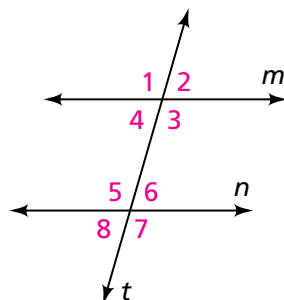


3.5 Parallel Lines, Transversals, and Angle Sums

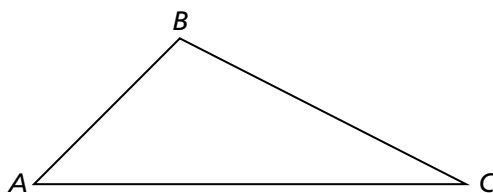
In *Shapes and Designs*, you learned two very important and related properties of geometric figures.

If a transversal cuts two parallel lines, many pairs of angles formed are congruent.



Angles 1, 3, 5, and 7 are congruent.
Angles 2, 4, 6, and 8 are congruent.

In any triangle, the sum of the measures of the interior angles is equal to a straight angle, or 180° .



The sum of the measures of angles A , B , and C is 180° .

What you have learned about translations and half-turn rotations will help you explain why those two geometric properties are true. In this Problem, you will provide reasons for each step in the proofs of these two important properties.

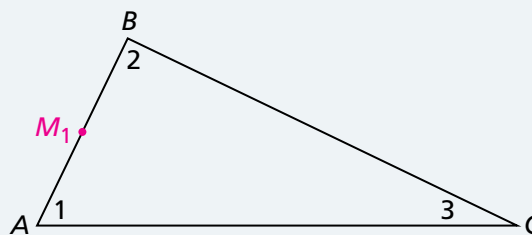
Problem 3.5



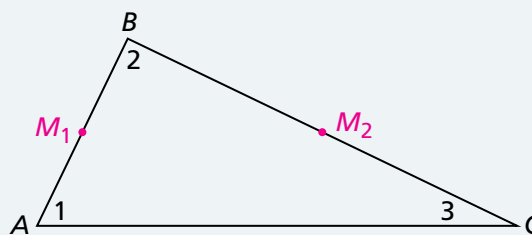
For Questions A and B, use the diagram of the parallel lines and transversal on the previous page.

- A** Complete the following sentences to explain why angles 1, 3, 5, and 7 are congruent.
- Angles 1 and 3 are congruent because . . .
 - Angles 5 and 7 are congruent because . . .
 - What transformation “moves” angle 5 exactly onto angle 1? Explain.
 - Are angles 1, 3, 5, and 7 all congruent? Explain.
- B** Construct an argument of your own to show that angles 2, 4, 6, and 8 are congruent.
- C** Use the transformations described below to explain why the sum of the measures of the interior angles of triangle ABC is 180° .

- Rotate triangle ABC 180° about point M_1 , the midpoint of \overline{AB} . Mark any congruent corresponding angles and sides, and any parallel segments. Justify your claims.



- Rotate triangle ABC 180° about point M_2 , the midpoint of \overline{BC} . Mark any congruent corresponding angles and sides, and any parallel segments. Justify your claims.



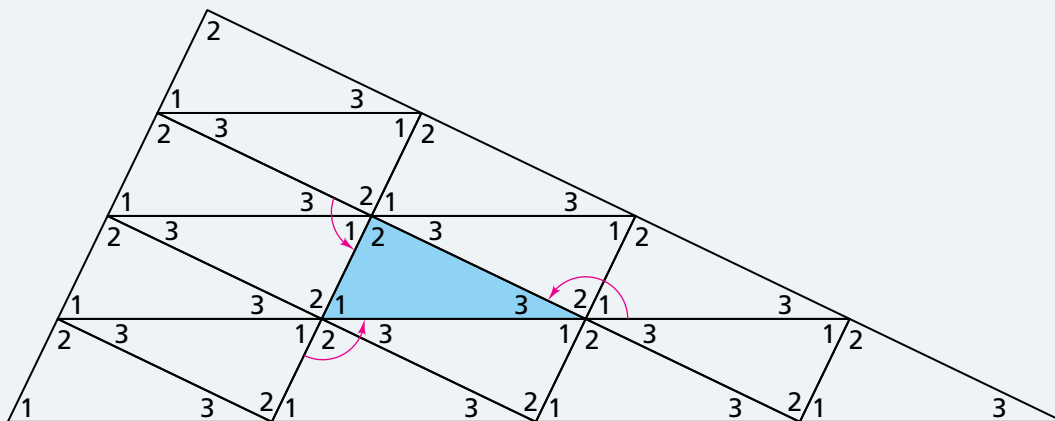
- How can you be sure that you have one straight line through point B , and not two nonparallel segments? Explain.
- How do triangle ABC and its images under 180° rotations about points M_1 and M_2 show that the sum of the measures of angles 1, 2, and 3 is 180° ?
- Do you think this argument would work for any triangle? Explain.

continued on the next page >



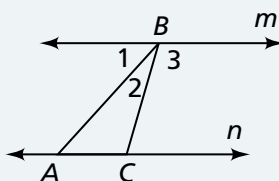
Problem 3.5 *continued*

- D** Erin extended her drawing for Question C by continuing to rotate the images of triangle ABC around the midpoint of every side. The result is shown below.



Erin says that if you know that the sum of the measures of the interior angles of a triangle is 180° , then you can show that the sum of the measures of the exterior angles of a triangle is 360° . How does her diagram support her conclusion?

- E** Another proof of the special angle-sum property of triangles uses a property of parallel lines cut by a transversal: If a transversal cuts two parallel lines, then alternate interior angles are congruent. In the diagram below, the line through point B is parallel to \overline{AC} .



- Which two angles are congruent because they are alternate interior angles formed by two parallel lines and a transversal?
- How can you use this information about congruent angles to show that the sum of the measures of $\angle BAC$, $\angle ACB$, and $\angle ABC$ is 180° ?

A C E Homework starts on page 61.