

## Objective

Use the properties of parallel lines cut by a transversal to find the measure of unknown angles.

## Common Core State Standards

- **8.G.5** Use informal arguments to establish facts about the angle sum and exterior angle of triangles, about the angles created when parallel lines are cut by a transversal, and the angle-angle criterion for similarity of triangles. *For example, arrange three copies of the same triangle so that the sum of the three angles appears to form a line, and give an argument in terms of transversals why this is so.*

## Geometry

# Parallel Lines Intersected by a Transversal

As students investigate parallel lines that are intersected by a transversal, they discover the relationships between the corresponding angles that are formed. These relationships then can be used to find the measures of unknown angles when given the measure of one of these angles.

**Try It!** Perform the Try It! activity on the next page.

## Talk About It

- **Ask:** Which of the angles are the same? What is the measure of these angles? Angles A, C, E, G, I, and K =  $60^\circ$ . B, D, F, H, J, and L =  $120^\circ$ .
- **Say:** Look at a parallelogram formed by the handrail, the baserail, and two balusters. **Ask:** What is the relationship between the angles that have the same measure (E and G, for example)? Elicit that they are opposite (in opposite corners from) each other.
- **Say:** Look at all three parallelograms. **Ask:** What do angles A, E, and I have in common? Elicit that they are in corresponding positions in the parallelograms. Have students find other examples.
- **Say:** Look at angles E and B. They are formed by the handrail and a baluster. **Ask:** What is the sum of their angles? **Say:** Find other examples.
- **Say:** Look at angles J and L. Think of them as alternate interior angles. **Ask:** What is their relationship? **Say:** Find other examples.

## Solve It

Reread the problem with students. Have students explain in writing how to find all of the angles formed by a transversal line that crosses parallel lines when the measure of only one of the angles is given.

## More Ideas

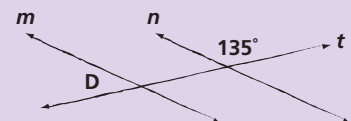
For other ways to teach about parallel lines intersected by a transversal—

- Use AngLegs® pieces to construct other configurations that have parallel lines intersected by a transversal.
- Have students look for examples of parallel lines intersected by a transversal in architecture and art.

## Formative Assessment

Have students try the following problem.

Lines  $m$  and  $n$  are parallel. What is the measure of angle  $D$ ?

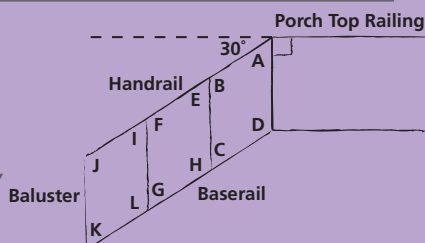


- A.  $40^\circ$       B.  $45^\circ$       C.  $90^\circ$       D.  $135^\circ$

# Try It! 30 minutes | Pairs

Here is a problem about parallel lines intersected by a transversal.

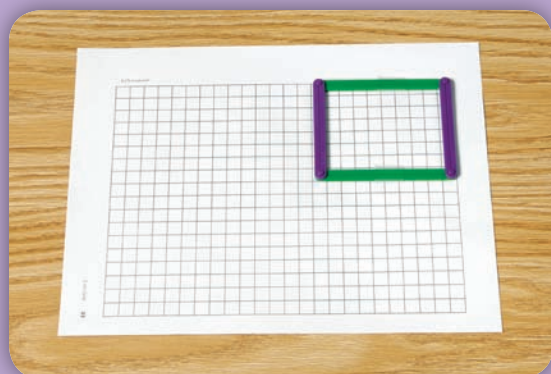
Adam is drawing plans to build a handrail for the stairs to the back porch. He knows that the handrail should slant down  $30^\circ$  from the top railing of the porch. What angles will the balusters form with the new handrail and with the baserail?



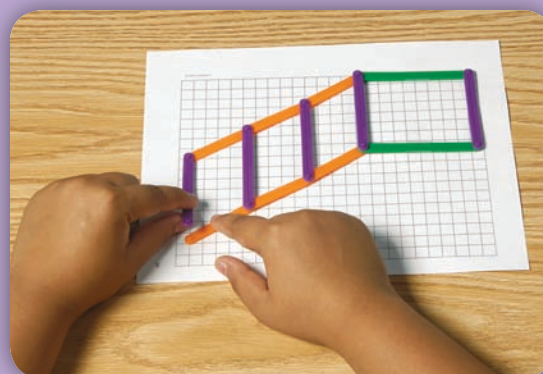
Introduce the problem. The have students do the activity to solve the problem. Sketch the diagram from the story problem on the board. Distribute the materials. Remind students to measure from the groove down the middle of the AngLegs piece to get the correct reading.

## Materials

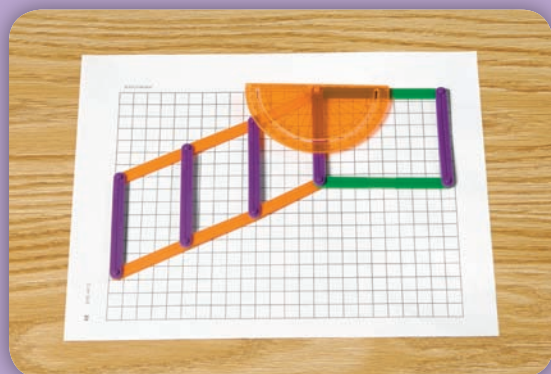
- AngLegs® (6 orange, 5 purple, and 2 green)
- Centimeter Grid Paper (BLM 9; 1 per pair)
- tape
- paper
- ruler or straightedge



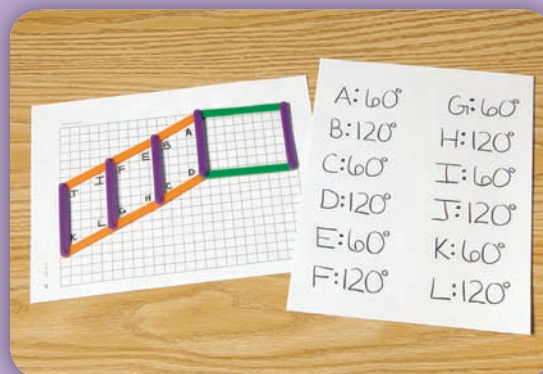
1. Have students construct the porch model with two green and two purple AngLegs pieces as shown. Place the model in the upper right-hand corner of the graph paper. Use the grid to make sure that the corners are square ( $90^\circ$ ) and tape the figure in place.



2. Have students use three orange AngLegs pieces to make the top rail (handrail) and three to make the bottom (baserail). Have them use purple AngLegs pieces for the balusters.

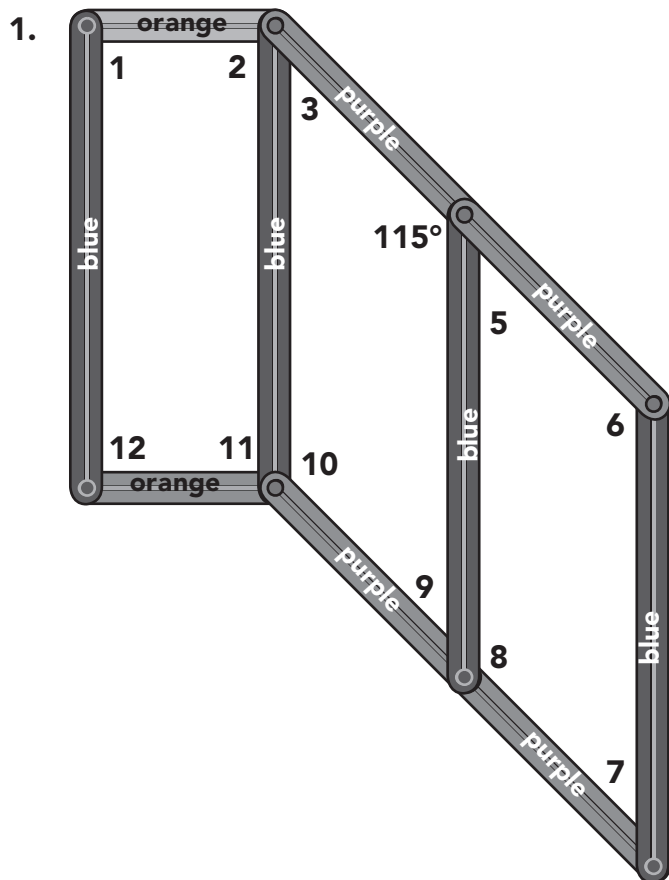


3. Have students use a protractor to set the handrail assembly at a  $30^\circ$  angle from the top porch railing. The purple balusters should be set at  $90^\circ$  (vertical). Students should secure the model to the grid paper with tape as needed.



4. Have students examine their model and measure each angle that is labeled in the drawing that accompanies the story problem. Have them record their answers on a separate piece of paper.

Use AngLegs to build the model shown. Use the AngLegs protractor to measure each angle. Which angles are congruent? (Check students' work.)



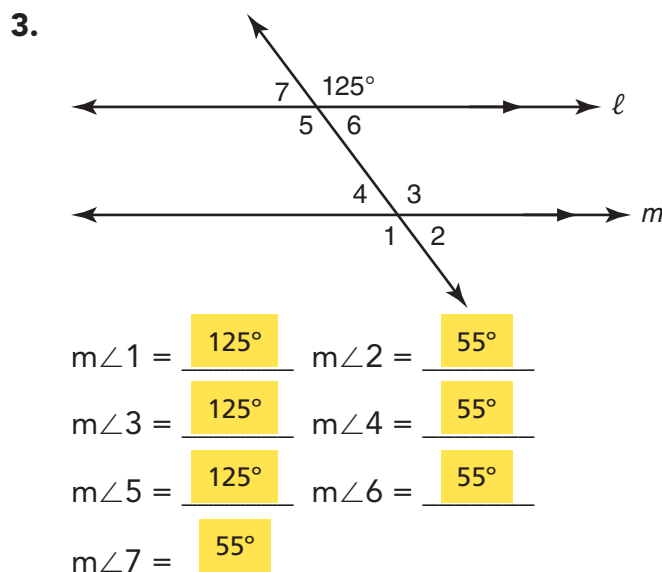
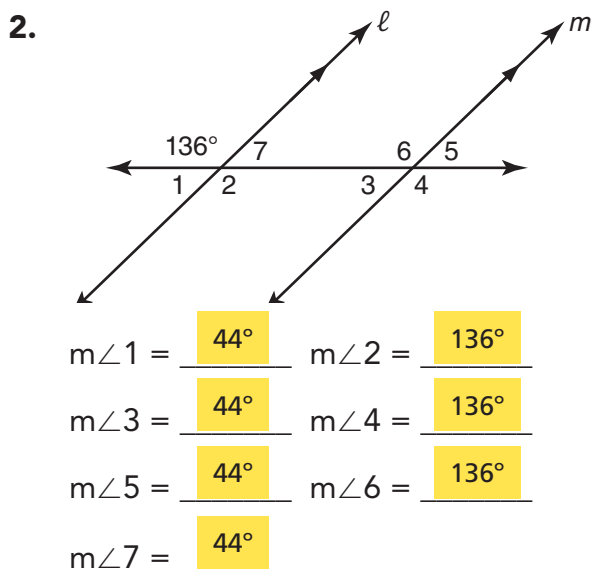
$$\begin{aligned} m\angle 1 &= 90^\circ \\ m\angle 2 &= 90^\circ \\ m\angle 3 &= 65^\circ \\ m\angle 4 &= 115^\circ \\ m\angle 5 &= 65^\circ \\ m\angle 6 &= 115^\circ \\ m\angle 7 &= 65^\circ \\ m\angle 8 &= 115^\circ \\ m\angle 9 &= 65^\circ \\ m\angle 10 &= 115^\circ \\ m\angle 11 &= 90^\circ \\ m\angle 12 &= 90^\circ \end{aligned}$$

Angles congruent to  $\angle 1$ : 2, 11, and 12

Angles congruent to  $\angle 3$ : 5, 7, and 9

Angles congruent to  $\angle 4$ : 6, 8, and 10

Use the measure given to find the measures of the other angles.  $\ell \parallel m$ .



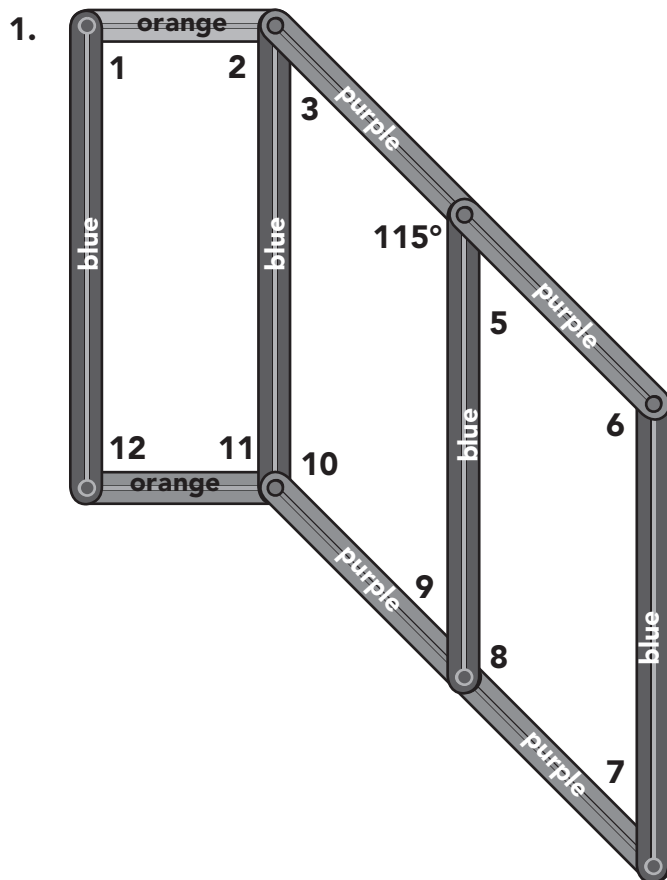
## Answer Key

**Challenge!** When given two parallel lines cut by a transversal, if you are given the measure of one angle, how do you find the measures of the other seven angles? Draw a diagram to help.

Challenge: (Sample) There are three angles congruent to the given angle. The other four angles are supplementary to the given angle.

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Use AngLegs to build the model shown. Use the AngLegs protractor to measure each angle. Which angles are congruent?



$m\angle 1 =$  \_\_\_\_\_

$m\angle 2 =$  \_\_\_\_\_

$m\angle 3 =$  \_\_\_\_\_

$m\angle 4 = 115^\circ$

$m\angle 5 =$  \_\_\_\_\_

$m\angle 6 =$  \_\_\_\_\_

$m\angle 7 =$  \_\_\_\_\_

$m\angle 8 =$  \_\_\_\_\_

$m\angle 9 =$  \_\_\_\_\_

$m\angle 10 =$  \_\_\_\_\_

$m\angle 11 =$  \_\_\_\_\_

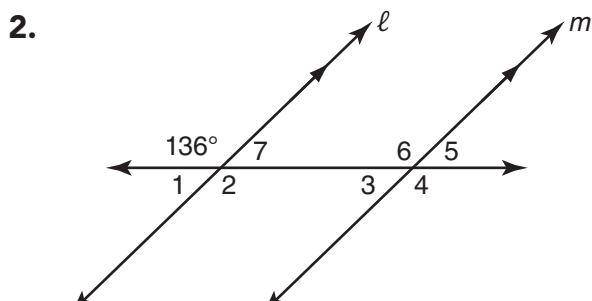
$m\angle 12 =$  \_\_\_\_\_

Angles congruent to  $\angle 1$ : \_\_\_\_\_

Angles congruent to  $\angle 3$ : \_\_\_\_\_

Angles congruent to  $\angle 4$ : \_\_\_\_\_

Use the measure given to find the measures of the other angles.  $\ell \parallel m$ .

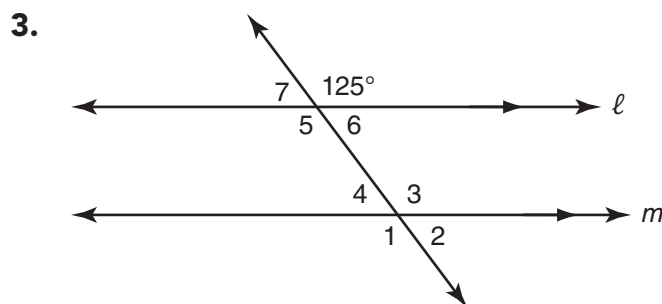


$m\angle 1 =$  \_\_\_\_\_  $m\angle 2 =$  \_\_\_\_\_

$m\angle 3 =$  \_\_\_\_\_  $m\angle 4 =$  \_\_\_\_\_

$m\angle 5 =$  \_\_\_\_\_  $m\angle 6 =$  \_\_\_\_\_

$m\angle 7 =$  \_\_\_\_\_



$m\angle 1 =$  \_\_\_\_\_  $m\angle 2 =$  \_\_\_\_\_

$m\angle 3 =$  \_\_\_\_\_  $m\angle 4 =$  \_\_\_\_\_

$m\angle 5 =$  \_\_\_\_\_  $m\angle 6 =$  \_\_\_\_\_

$m\angle 7 =$  \_\_\_\_\_

**Challenge!** When given two parallel lines cut by a transversal, if you are given the measure of one angle, how do you find the measures of the other seven angles? Draw a diagram to help.

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Name \_\_\_\_\_

