

Parallel Lines and Transversals

5.4

NEW SKILLS: WORKING WITH ANGLES FORMED BY PARALLEL LINES INTERSECTED BY A TRANSVERSAL

If two parallel lines are intersected by a transversal:

- the alternate interior angles are equal;
- the corresponding angles are equal; and
- the interior angles on the same side of the transversal are supplementary.

If you know that, given two lines cut by a transversal:

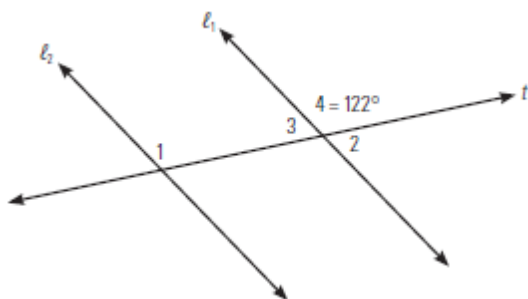
- alternate interior angles are equal; or
- corresponding angles are equal; or
- interior angles on the same side of the transversal are supplementary;

then you can conclude that the lines are parallel.

For more details, see page 209 of *MathWorks 10*.

Example 1

Consider the diagram below, in which ℓ_1 is parallel to ℓ_2 . What are the measures of the three indicated angles? Explain how you reached your answers.

**SOLUTION**

$\angle 1$ measures _____ $^\circ$ because it corresponds to $\angle 4$.

$\angle 2$ measures _____ $^\circ$ because it forms a straight angle with $\angle 4$.

$\angle 3$ measures _____ $^\circ$ because it is vertically opposite $\angle 2$.

The order in which you find the angle measures is important in explaining your reasoning.

ALTERNATIVE SOLUTION

There may be more than one reason for stating why two angles are equal.

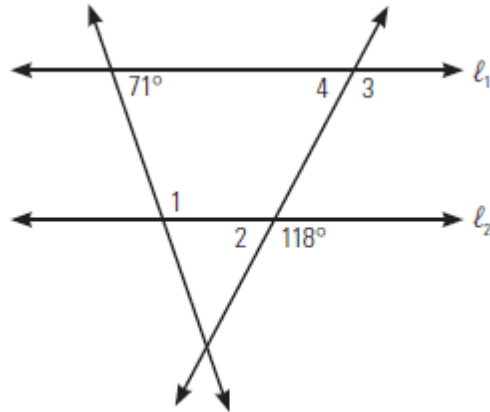
$\angle 3$ is 58° because it forms a straight angle with $\angle 4$.

$\angle 2$ is 58° because it is vertically opposite $\angle 3$.

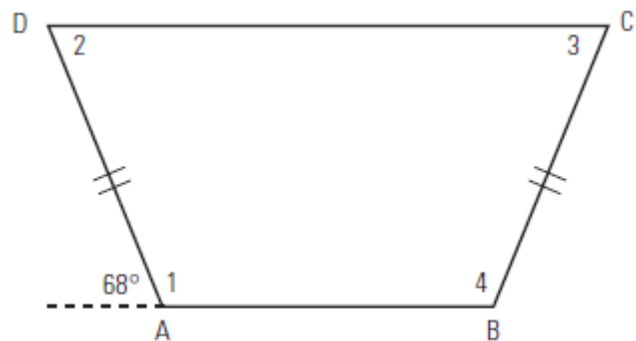
$\angle 1$ is 122° because it is an interior angle on the same side of a transversal as $\angle 3$.

BUILD YOUR SKILLS

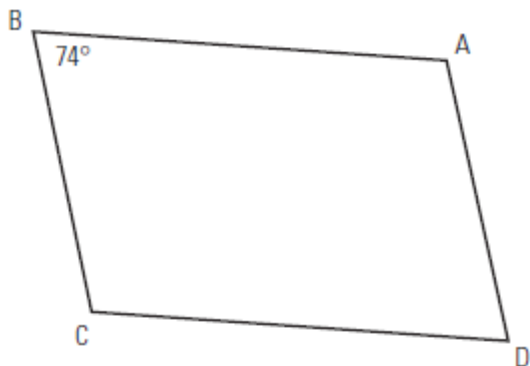
1. In the diagram below, ℓ_1 is parallel to ℓ_2 . State the measures of the indicated angles and explain your reasoning.



2. What are the measures of the interior angles in the trapezoid shown below? (Hint: Be careful of the order in which you calculate the angles.)

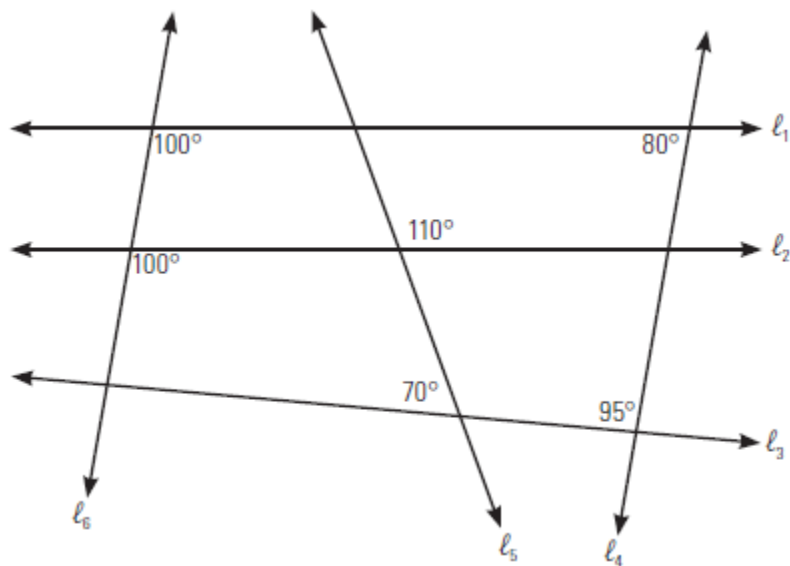


3. Quadrilateral ABCD is a parallelogram in which $\angle B$ measures 74° . Determine the measures of the other angles and state your reasons.



Example 2

Given the diagram below, identify all the pairs of parallel lines and explain your selection.



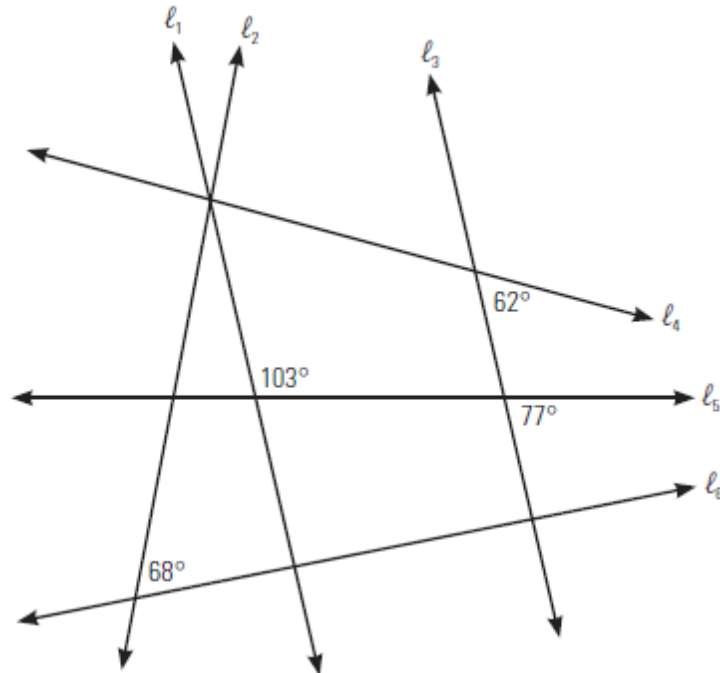
SOLUTION

l_6 is parallel to l_4 . If you consider l_1 to be a transversal, 100° and 80° are interior angles on _____ of the transversal.

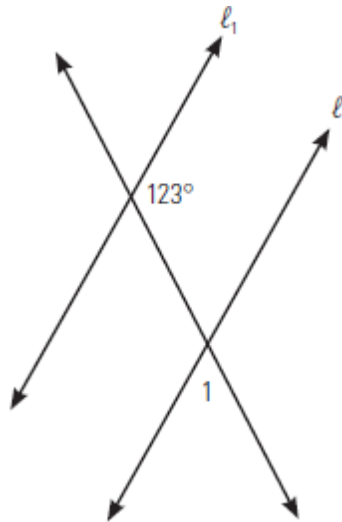
l_1 is parallel to l_2 . If l_6 is a transversal, the two 100° angles are _____ angles.

BUILD YOUR SKILL

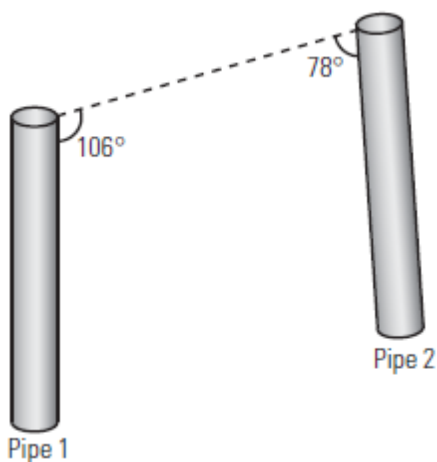
4. Find a pair of parallel lines in the following diagram. On the diagram, mark all the angles necessary to determine this.



5. What size must $\angle 1$ be if l_1 is parallel to l_2 ?

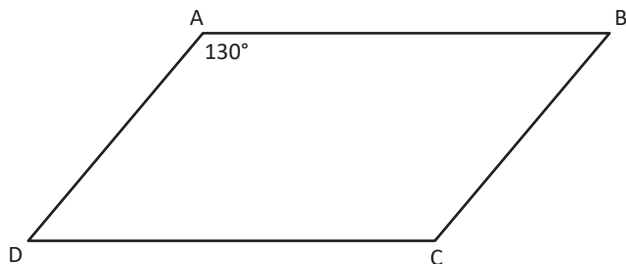


6. The two vertical pipes in the diagram need to be moved to be parallel to each other. By what angle must the plumber move the second pipe?



Example 3

Given parallelogram $ABCD$, determine the values of $\angle B$, $\angle C$, and $\angle D$ in that order, stating your reason for each measure.



SOLUTION

In a parallelogram, opposite sides are parallel. AD is parallel to _____, and they are intersected by transversal AB . $\angle B$ is an interior angle on the same side of the transversal as $\angle A$. Therefore, it is _____ to $\angle A$.

$$180^\circ - \underline{\hspace{2cm}}^\circ = \underline{\hspace{2cm}}^\circ \qquad \angle B \text{ is } \underline{\hspace{2cm}}^\circ.$$

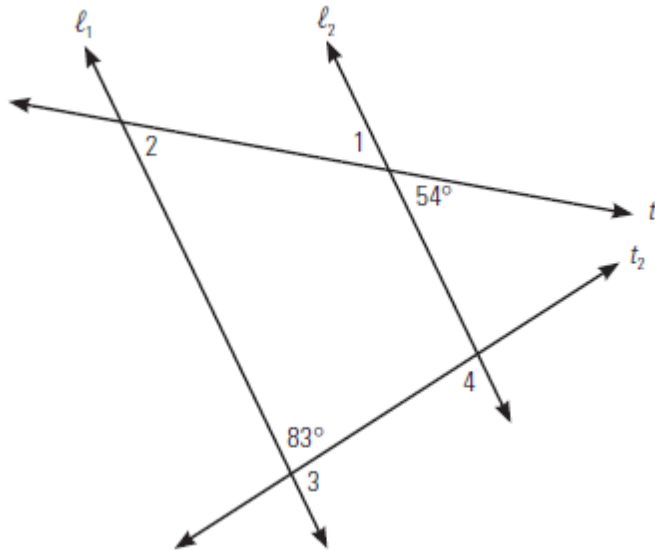
AB is parallel to DC , and they are intersected by transversal BC . You know that $\angle B$ is 50° . $\angle C$ is an interior angle on the same side of the transversal as $\angle B$, so they are complementary. $\angle C$ measures 130° .

AB is parallel to DC , and they are intersected by transversal AD . You know that $\angle A$ measures 130° and is complementary to $\angle D$. Therefore, $\angle D$ measures 50° .

You can use the notation $AD \parallel BC$ to indicate that AD and BC are parallel.

BUILD YOUR SKILLS

7. If ℓ_1 and ℓ_2 are parallel and are intersected by transversals t_1 and t_2 , what are the measures of the indicated angles? Solve for the measures in the given order, stating your reasoning.

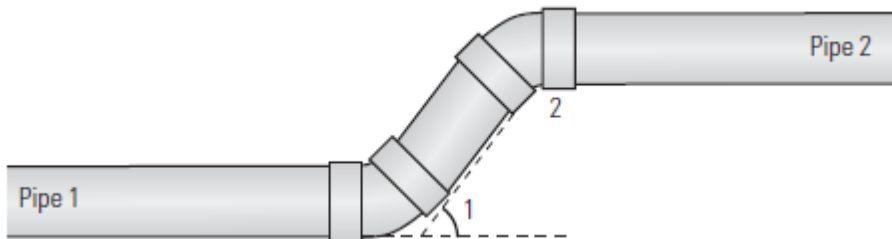


SOLVING ANGLE MEASURES	
Angle Measure	Reason
$\angle 1 =$	
$\angle 2 =$	
$\angle 3 =$	
$\angle 4 =$	

8. In the diagram below, if the side of the house and the side of the shed are parallel, what are the measures of $\angle 1$ and $\angle 2$?

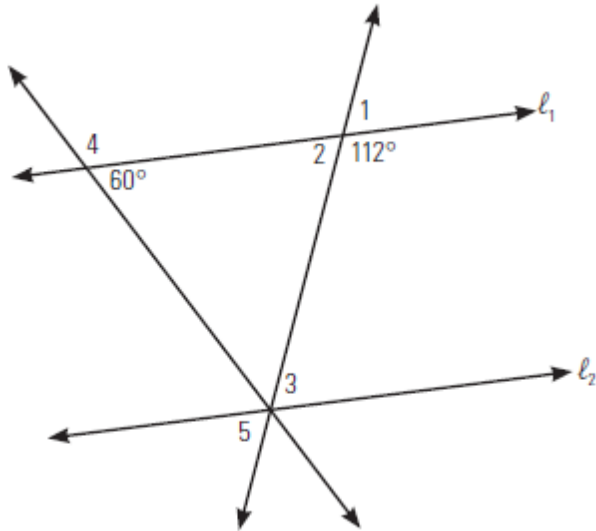


9. A plumber must install pipe 2 parallel to pipe 1. He knows that $\angle 1$ is 53° . What is the measure of $\angle 2$?

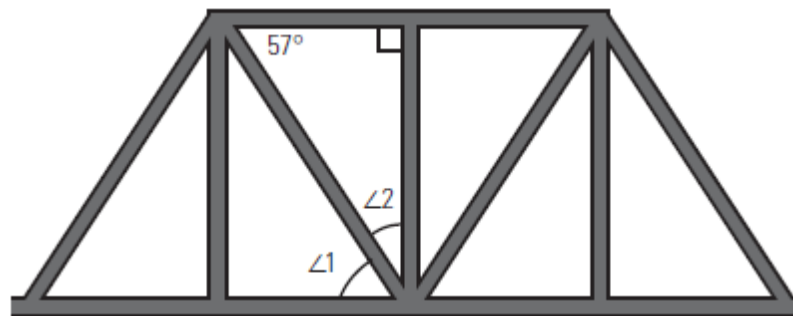


PRACTISE YOUR NEW SKILLS

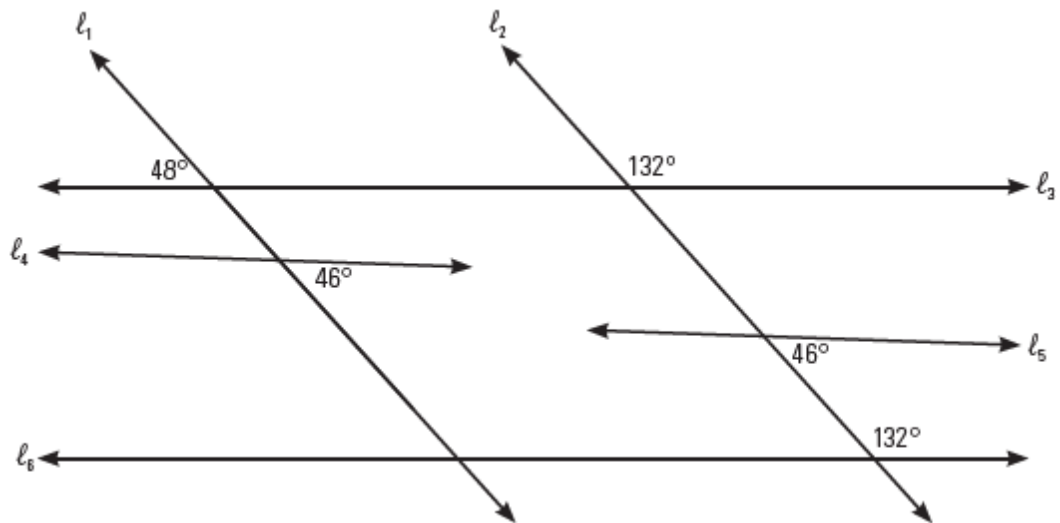
1. Given the diagram below, where l_1 is parallel to l_2 , find the measures of the indicated angles and state your reasons.



2. In the diagram below, the top of the bridge is parallel to the deck, and the brace in the middle is vertical, perpendicular to the deck, determine the size of $\angle 1$ and $\angle 2$.



3. Identify the pairs of parallel lines in the following diagram. (Hint: The lines can be extended.)



4. Examine the following diagram. By how many degrees do the studs need to be moved in order to be parallel to each other? What direction do they need to move in? (The studs are indicated by the capital letters.)

