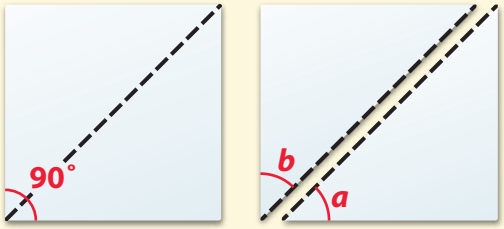
Add and Subtract with Angles

Use What You Know

In Lesson 29, you learned how to use a protractor to measure and draw angles. Now you will learn about adding and subtracting angle measures. Take a look at this problem.

Flora cuts a rectangular sheet of paper into two pieces on the dotted line.



What is the sum of angle *a* and angle *b*?

a. Angle *a* is _____ than 90°. Angle *b* is _____ than 90°.

b. Describe where the 90° angle starts and stops as it turns through the bottom left corner of the uncut sheet of paper. _____

_____

c. Describe where angle *a* starts and stops as it turns through the bottom left corner of the cut sheet of paper. _____

d. Describe where angle *b* starts and stops as it turns through the bottom left corner of the cut sheet of paper. _____

e. Compare where the turning starts and stops for the 90° angle with turning through angle *a* and going on through angle *b*.

_____

_____

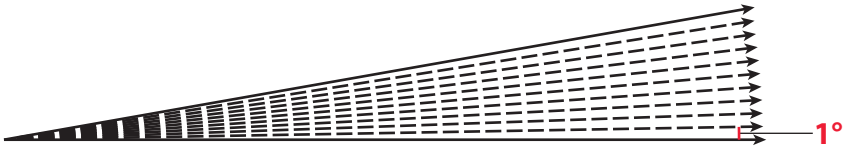
_____

Find Out More

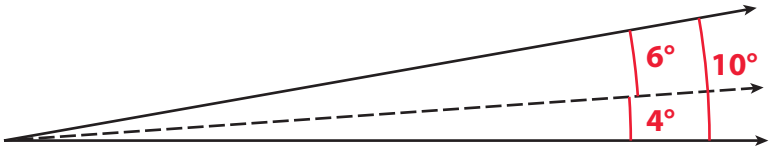
When Flora cut the sheet of paper, she split up a 90° angle into two smaller angles. You can **decompose**, or split up, any angle into smaller angles.

Remember that an angle's measure is the number of one-degree turns it shows. You can think of any angle as a group of one-degree angles with a common vertex.

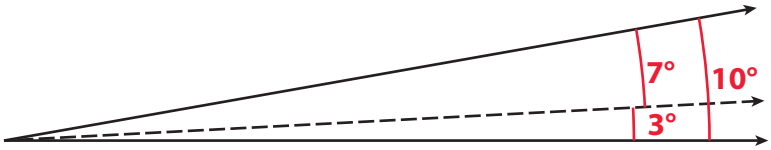
Picture a 10° angle.



You can decompose a 10° angle in many different ways. Here are two possible ways.



$4° + 6° = 10°$



$3° + 7° = 10°$

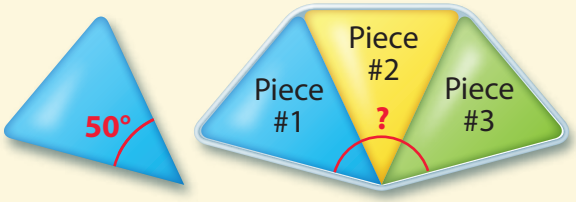
Reflect

1 Is it possible to decompose a 100° angle into two 60° angles? Explain.

Learn About Combining Angles

Read the problem below. Then explore different ways to understand combining smaller angles to form a larger angle.

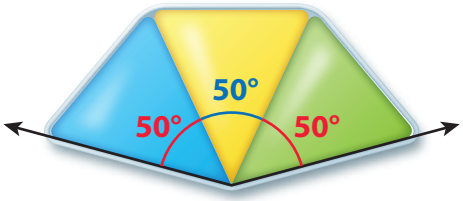
Waylon and Andres play a game where the goal is to fill a tray with three same-size, triangular game pieces. There are no gaps and no overlaps. What is the measure of the bottom angle of the tray?



game piece tray

Picture It You can use a sketch to help understand the problem.

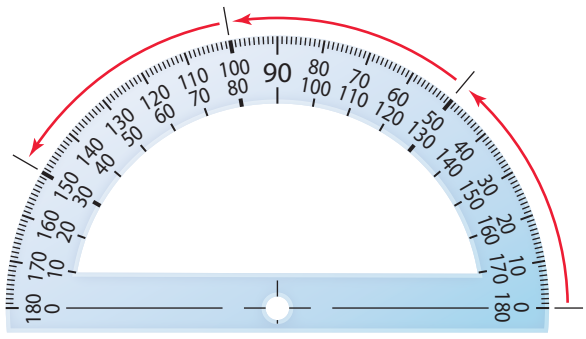
Imagine putting the three pieces together in the tray. The vertices of the 50° angles become the common endpoint of a larger angle. This is the angle at the bottom of the tray.



The three 50° angles **compose**, or combine to form, the larger angle.

Model It You can also use a protractor to help understand the problem.

Look at a protractor. Start at 0°. Count three jumps of 50° each.

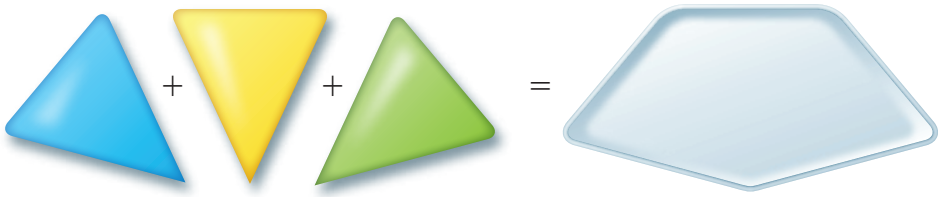


Connect It Now you will solve the problem from the previous page using an equation.

2 How many 50° angles compose the bottom angle of the tray? _____

3 Does addition or subtraction best express putting two or more angles together to make a greater angle? _____

4 You can write an equation to combine the 50° angles to compose the bottom angle of the tray.



The bottom angle of the tray measures _____ degrees.

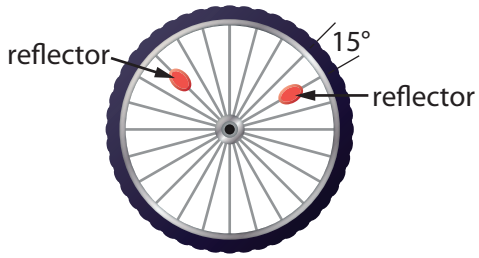
5 Could you compose an angle that measures 150° from three angles with unequal angle measures? If so, give an example.

_____

_____

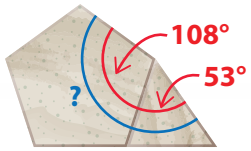
Try It Use what you just learned to solve these problems.

6 The angle between each spoke on a wheel of Sophia's bicycle measures 15°. Sophia puts reflectors on two spokes as shown to the right. What is the measure of the angle between the spokes with the reflectors?



_____

7 Gina sets two floor tiles as shown. What is the measure of the blue angle? _____

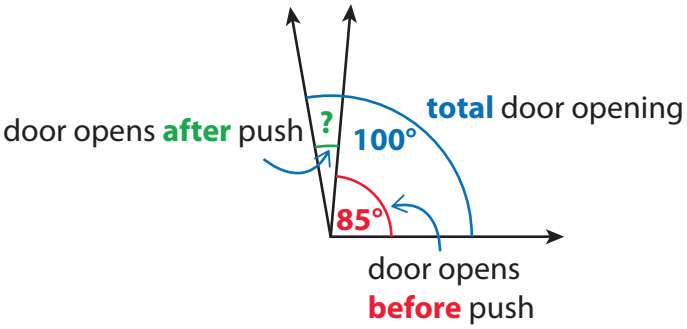


Learn About Finding Unknown Angle Measures

Read the problem below. Then explore different ways to understand using addition and subtraction to find unknown angle measures.

A door swings open 85° and then gets stuck. Randy pushes on the door, and it opens some more. Altogether, the door opens 100°. How many more degrees does the door open after Randy pushes it?

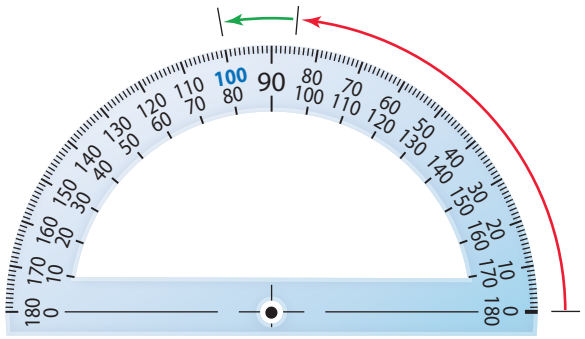
Picture It You can use a sketch to help you understand the problem.



The 100° angle is composed of two smaller angles.
One angle measures 85°, and the other angle measure is unknown.

Model It You can use a protractor to help you understand the problem.

Look at a protractor. Start at 0°. Count on 85°. How many more degrees do you need to count on to get to 100°?



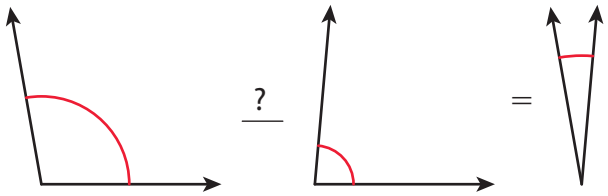
Connect It **Now you will solve the problem from the previous page using an equation.**

8 Write a sentence that describes how the unknown angle measure is related to the 85° and 100° angles. _____

_____

9 Does addition or subtraction best express this relationship? _____

10 Write an equation to describe how the unknown angle measure is related to the 85° and 100° angles.



_____ _____ _____ = _____

11 How would the measure of the unknown angle change if the door opened a total of 120°? _____

_____

12 Imagine an angle that is composed of three smaller angles. If you know the measure of the composed angle and the measures of two of the smaller angles, explain how you could find the measure of the third small angle.

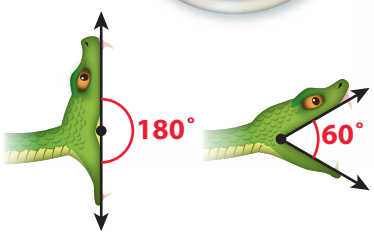
_____

_____

Try It **Use what you just learned to solve these problems.**

13 A game includes an 8-second timer as shown at right. The timer's pointer turns through 135° as it counts down from 8 seconds to 5 seconds. How many more degrees does the pointer have to turn through to count down to 0? _____

14 A snake's mouth opens to form a 180° angle. The snake closes its mouth to form a 60° angle. By how many degrees did the angle formed by the snake's mouth change? _____



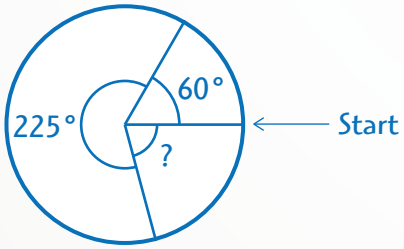
Practice Adding and Subtracting with Angles

Study the example below. Then solve problems 15–17.

Example

Halah turns a jar lid 60° and then 225° more. How many more degrees does Halah need to turn the lid to make one full turn?

Look at how you could show your work using a drawing and an equation.



$$60 + 225 + ? = 360$$
$$285 + ? = 360$$
$$? = 75$$

Solution 75°

One full turn is equal to 360°. So the sum of 60, 225, and the measure of the unknown angle is equal to 360.

Pair/Share
What operation did you use to solve the equation?

15 When the hands of a clock are on 12 and 4, they form a 120° angle. What angle is formed if the hands are moved to 4 and 6?

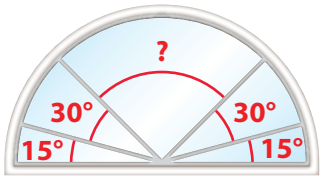
Show your work.

Solution _____

I know the hands make a 180° angle when they are on 12 and 6.

Pair/Share
Once you know the angle from 4 to 6, how could you find the angle from 4 to 5?

16 Tyra's front door has a half-circle window. What is the measure of the angle of the center piece of glass?



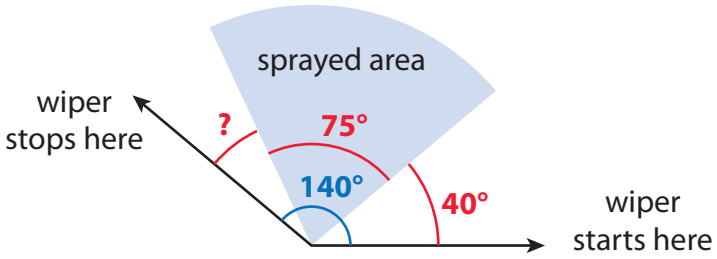
Show your work.

A circle has 360 degrees, so a half-circle has 180 degrees.

Pair/Share
How could you check your answer?

Solution _____

17 A windshield wiper turns through 140°. The window cleaner sprays across 75°. If the wiper turns 40° before it gets to the sprayed area, how many degrees past the sprayed area does the wiper turn? Circle the letter of the correct answer.



The 140° angle is composed of 3 angles: 40°, 75° and ?°. The sum of the measures of these three angles must be 140.

A 25°

B 35°

C 115°

D 255°

Ellen chose **D** as the correct answer. How did she get that answer?

_____

_____

_____

Pair/Share
Does Ellen's answer make sense?

Practice Adding and Subtracting with Angles

Solve the problems.

1 Keith uses a can opener. Every time he twists the knob on the opener, the opener moves 36° around the can's lid. Which best describes how open the can is after 5 twists?

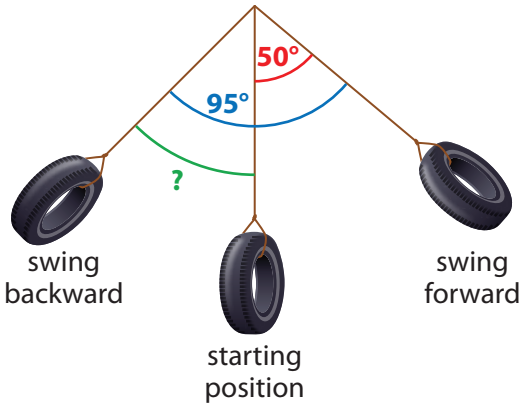
A one-tenth open

B one-fifth open

C half open

D completely open

2 A tire swing hangs straight down. Then a child gets on, swings forward 50°, and swings back 95°. How many degrees forward must the swing go to return to its starting position?



A 5°

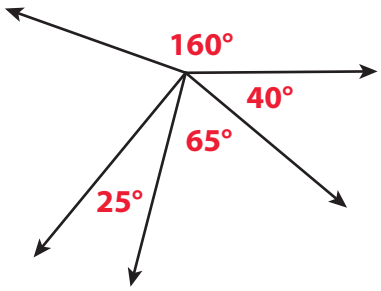
B 45°

C 50°

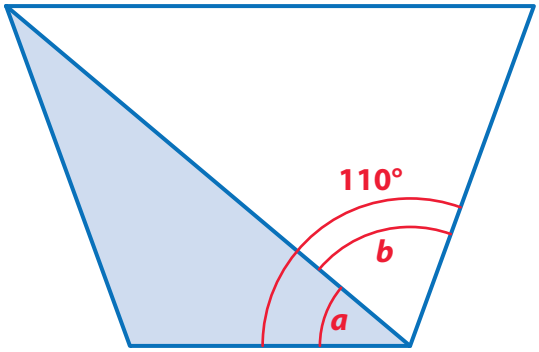
D 95°

3 Choose either *Yes* or *No* to tell whether there is an angle of the given measure shown in the diagram.

a. 225°	☐ Yes	☐ No	
b. 265°	☐ Yes	☐ No	
c. 70°	☐ Yes	☐ No	
d. 320°	☐ Yes	☐ No	
e. 90°	☐ Yes	☐ No	



4 The measure of one angle is given in the figure below.



Use a protractor to measure angle *a*. Use this measure and the given angle measure to find the measure of angle *b*.

_____

5 Lilit opens a pair of scissors 65°. Then she closes the scissors 60° to make a cut. Then she reopens the scissors 100°. How many degrees open are the scissors now?

Show your work.

Answer The scissors are open _____ degrees.

Self Check **Go back and see what you can check off on the Self Check on page 249.**