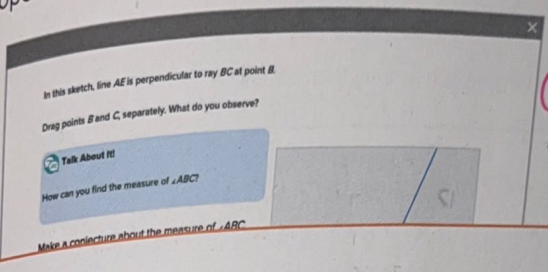
Complementary and Supplementary Angles

I Can... identify complementary and supplementary angles, and use them to write and solve equations to find unknown angle measures.

What Vocabulary Will You Learn?
complementary angles
supplementary angles

Explore Complementary and Supplementary Angle Pairs

Online Activity You will use Web Sketchpad to explore the properties of complementary and supplementary angle pairs.

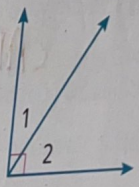


complementary
= 90
supplementary
180

Learn Identify Complementary Angles

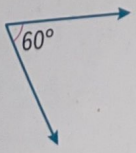
Two angles are **complementary angles** if the sum of their measures is 90°.

Words	The measure of angle 1 plus the measure of angle 2 equals 90 degrees.
Symbols	$m\angle 1 + m\angle 2 = 90°$



Example 1 Identify Complementary Angles

Give the measure of the angle that is complementary to the given angle.



Complementary angles have a sum of 90°.

The equation $60 + x = 90$ can be used to find the measure of the angle that is complementary to the given angle.

Because $x = 30$, the measure of the angle complementary to the 60 degree angle is complementary = 30°

Talk About It!
Trevor stated that all complementary angles are adjacent. Draw a diagram that supports his claim. Then draw a diagram that illustrates a counterexample. Is Trevor correct?

Not, correct
Not every pair of complementary angles are adjacent

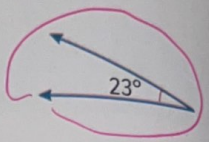
Your Notes

Math History Minute

German mathematician and astronomer **August Ferdinand Möbius (1790–1868)** created the Möbius strip which has fascinated mathematicians worldwide since. It is created by twisting a strip of paper one time and then joining the two ends. The Möbius strip only has one edge and one side. You can take a pencil and draw a single line in a continuous loop without ever crossing an edge.

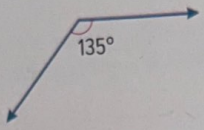
Check

Select the angle that is complementary to the given angle.



23+67=90°

Ⓐ



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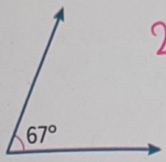

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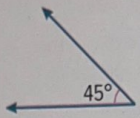

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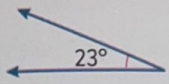


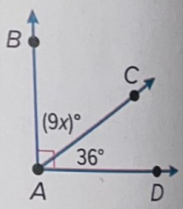
Go Online You can complete an Extra Example online.

Learn Use Complementary Angles to Find Missing Values

Go Online Watch the animation to see how to use complementary angles to find a missing value.

Step 1 Identify the complementary angles.

$\angle BAC$ and $\angle CAD$ are complementary and have a sum of 90°.



Step 2 Write the relationship between the angles.

$m\angle BAC + m\angle CAD = 90°$

Step 3 Write an equation by substituting for each angle measure.

$(9x) + 36 = 90$

Step 4 Solve the equation.

$9x + 36 = 90$ Write the equation.

$-36 \quad -36$ Subtract 36 from each side.

$9x = 54$ Simplify.

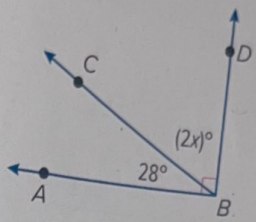
$\frac{9x}{9} = \frac{54}{9}$ Divide each side by 9.

$x = 6$ Simplify.

So, the value of x is 6.

Example 2 Use Complementary Angles to Find Missing Values

Write and solve an equation to find the value of *x*.



Part A Write an equation.

Because $m\angle ABC$ and $m\angle CBD$ have a sum of 90°, write an equation showing that the sum of the two angle measures is 90°.

$2x + 28 = 90$

Part B Solve the equation.

$2x + 28 = 90$ Write the equation.

$-28 \quad -28$ Subtract 28 from each side.

$2x = 62$ Simplify.

$\frac{2x}{2} = \frac{62}{2}$ Divide each side by 2.

$x = 31$ Divide by 2.

So, $x = 31$.

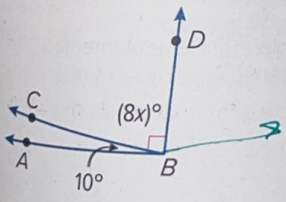
Think About It!
What is the relationship between the two angles shown?

They have a sum of 90°

اجيال المستقبل التعليمية
Mrs/Aya

Check

Write and solve an equation to find the value of *x*.



complementary

Part A Write an equation. $8x + 10 = 90$

Part B Solve the equation. Show your work here

$-10 \quad -10$

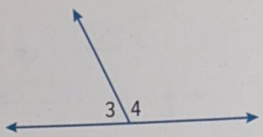
$\frac{8x}{8} = \frac{80}{8}$

$x = 10$

Go Online You can complete an Extra Example online.

Learn Identify Supplementary Angles

Two angles are **supplementary angles** if the sum of their measures is 180°.



Words	The measure of angle 3 plus the measure of angle 4 equals 180 degrees.
Symbols	$m\angle 3 + m\angle 4 = 180°$

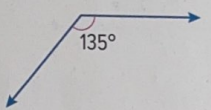
Think About It!

What do you know about two supplementary angles?

They have a sum of 180°

Example 3 Identify Supplementary Angles

What is the measure of the angle that is supplementary to the given angle?



What is sum of the angle measures of supplementary angles?

180

Let x represent the measure of the angle that is supplementary to the given angle. The equation $135 + x = 180$ can be used to represent this situation.

Solve the equation for x.

$135 + x = 180$ Write the equation.

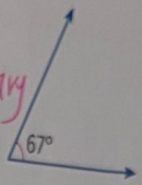
$-135 \quad -135$ Subtract 135 from each side.

$x = 45$ Simplify.

So, the measure of the angle that is supplementary to the given angle is 45°.

Check

What is the angle measure of the angle that is supplementary to the given angle?



sum of supplementary = 180

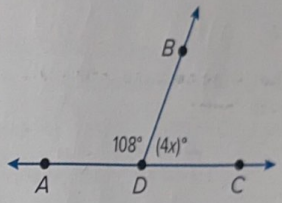
180 − 67 = 113°

Go Online You can complete an Extra Example online.

Learn Use Supplementary Angles to Find Missing Values

You can use the properties of supplementary angles to find missing measures.

Go Online Watch the animation to see how to use supplementary angles to find a missing value.



Step 1 Identify the supplementary angles.

$\angle ADB$ and $\angle BDC$

Step 2 Write the relationship between the angles. Because supplementary angles have measures with a sum of 180°, set the sum of the angle measures equal to 180°.

$m\angle ADB + m\angle BDC = 180°$

Step 3 Write an equation by substituting for each angle measure.

$108 + 4x = 180$

Step 4 Solve the equation.

$108 + 4x = 180$	Write the equation.
$-108 \quad -108$	Subtract 108 from each side.
$4x = 72$	Simplify.
$\frac{4x}{4} = \frac{72}{4}$	Divide each side by 4.
$x = 18$	Simplify.

Think About It!

What is the relationship between the two angles shown?

sum of angles = 180°

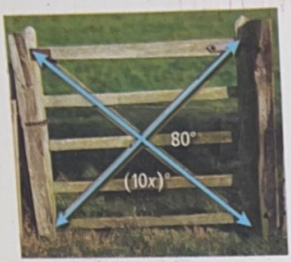
Talk About It!

Why were the expressions for the angle measures not set equal to each other (10x = 80)?

Supplementary angles are not necessarly congurent. the sum of their angles measure is 180° So the sum of the expressions is equal to 180°

Example 4 Use Supplementary Angles to Find Missing Values

Write and solve an equation to find the value of *x*.



Part A Write an equation.

Because the angles are supplementary angles, set the sum of the two angle measures equal to 180°.

$10x + 80 = 180$

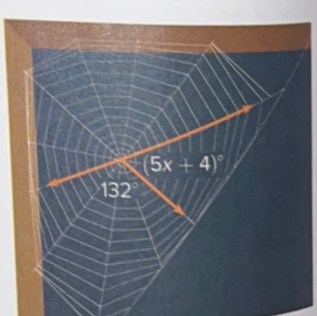
Part B Solve the equation.

$10x + 80 = 180$	Write the equation.
$-80 \quad -80$	Subtract 80 from each side.
$10x = 100$	Simplify.
$\frac{10x}{10} = \frac{100}{10}$	Divide each side by 10.
$x = 10$	Simplify.

So, $x = 10$.

Check

Write and solve an equation to find the value of x.



Part A Write an equation.

Part B Solve the equation.

$x =$ _____

5x + 4 + 132 = 180

5x + 136 = 180

−136 −136

$\frac{5x}{5} = \frac{44}{5}$

x = 8.8

Go Online You can complete an Extra Example online.

Apply Engineering

A space shuttle scaffold has the angles shown. Engineers determined that the measure of angle x needs to be about 7% less to be more supportive. What is the measure of the new angle?

1 What is the task?

Make sure you understand exactly what question to answer or problem to solve. You may want to read the problem three times. Discuss these questions with a partner.

First Time Describe the context of the problem, in your own words.
Second Time What mathematics do you see in the problem?
Third Time What are you wondering about?

2 How can you approach the task? What strategies can you use?

Record your observations here

$35 + x = 180$
$-35 \quad -35$
$x = 145$

3 What is your solution?

Use your strategy to solve the problem.

Show your work here

$\angle x$ is 7% less

So, $\frac{145 \times 7}{100} = 10.15$

$145 - 10.15 = 134.85$

4 How can you show your solution is reasonable?

Write About It! Write an argument that can be used to defend your solution.

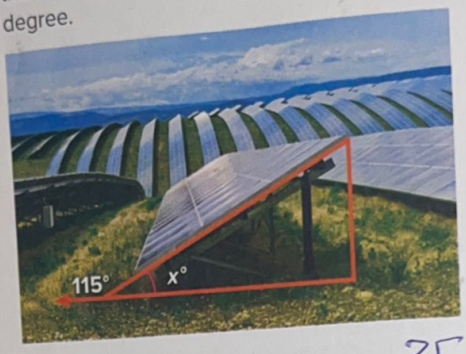
Talk About It!

How do you calculate the 7% decrease in the measure of the angle labeled $x°$?

Find 7% of the ~~angles~~ angle measure then subtract it's value from the angle

Check

In the winter, a solar panel is set with the angles shown. In the summer, the measure of angle x is reduced by about 46.2%. What is the new measure of the angle in the summer? Round to the nearest degree.



The new measure of angle x is about 35.

Show your work here

$115 + x = 180$

$-115 \quad -115$

$x = 65$

x is reduced by about 46.2%

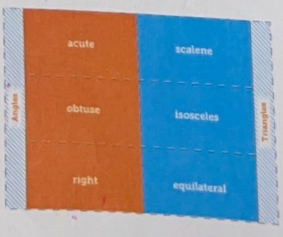
$\frac{46.2}{100} = 0.462$

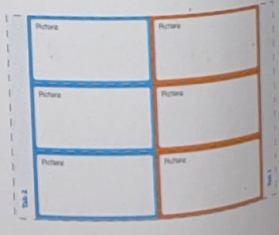
$65 \times 0.462 = 30$

$65 - 30 = 35$

Go Online You can complete an Extra Example online.

Foldables It's time to update your Foldable, located in the Module Review, based on what you learned in this lesson. If you haven't already assembled your Foldable, you can find the instructions on page FL1.





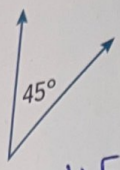
Name Mrs. Ayat Hamed

Period 6R7 Date 2514

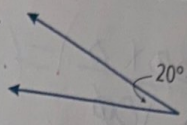
Practice

Go Online You can complete your homework online.

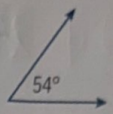
Give the measure of the angle that is complementary to the given angle. (Example 1)

1. 

90-45=45

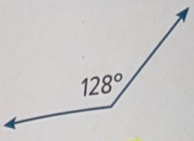
2. 

90-20=70

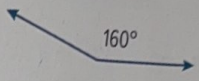
3. 

90-54=36

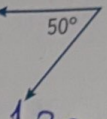
Give the measure of the angle that is supplementary to the given angle. (Example 3)

4. 

180-128=52

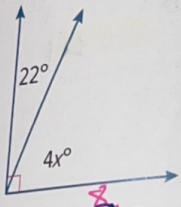
5. 

180-160=20°

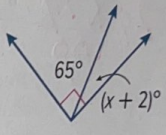
6. 

180-50=130

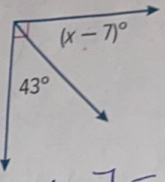
Write and solve an equation to find the value of x in each figure. (Examples 2 and 4)

7. 

22+4x=90
-22 -22
4x=68
4 4
x=17

8. 

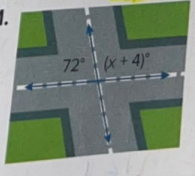
65+x+2=90
-67 -67
x=23

9. 

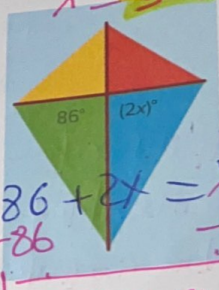
43+x-7=90
36+x=90
-36 -36
x=54

10. 

110+7x=180
-110 -110
7x=70
7 7
x=10

11. 

72+x+4=180
76+x=180
-76 -76
x=104

12. 

86+2x=180
-86 -86
2x=94
2 2
x=47

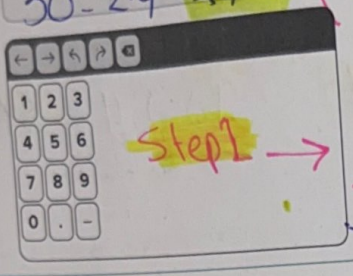
Test Practice

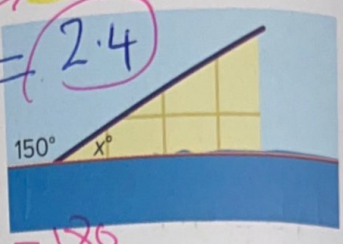
13. Equation Editor An adjustable water ski ramp is set at the angles shown. An instructor wants to decrease angle x by 8%. What is the new measure of the angle, to the nearest tenth of a degree?

30 − 2.4 = 27.6

30 × 8 / 100 = 2.4

Step 2





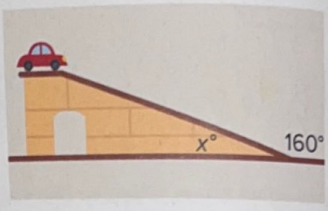
Step 1 → 150 + x = 180

−150 −150

x = 30

Apply

14. Truman's father is designing a toy car ramp for him. His dad determined that the measure of angle x needs to be increased by 20%. What is the measure of the new angle?

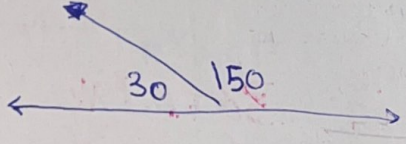


160 + x = 180

−160 −160

Step 1 → x = 20 Step 2 → 20 × 20 / 100 = 4 Answer 20 + 4 = 24

15. Draw a pair of supplementary, adjacent angles. Label the measures of the angles.



16. MP **Persevere with Problems** Find the measure of angle A and angle B for the given situation.

complementary angles A and B, where $m\angle A = (y - 16)°$ and $m\angle B = (y + 4)°$

∠A + ∠B = 90

y − 16 + y + 4 = 90

2y − 12 = 90

+12 +12

2y / 2 = 102 / 2

y = 51

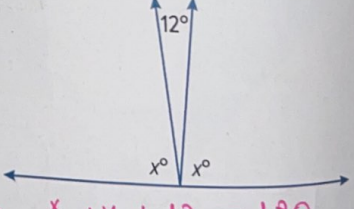
m∠A: (51) − 16 = 35

m∠B: (51) + 4 = 55

17. MP **Justify Conclusions** A student said that a pair of complementary angles cannot also be adjacent angles. Is the student correct? Explain. Support your answer with a drawing.

No, a pair of complementary must be equal 90, and can be adjacent

18. What is the value of x? Write an argument that can be used to defend your solution.



x + x + 12 = 180

2x + 12 = 180

−12 −12

2x / 2 = 168 / 2

x = 84