Modeling Geometric Figures

MODULE 8

CALIFORNIA

ESSENTIAL QUESTION

How can you use proportions to solve real-world geometry problems?

Real-World Video

my.hrw.com

Architects make blueprints and models of their designs to show clients and contractors. These scale drawings and scale models have measurements in proportion to those of the project when built.

GO DIGITAL
my.hrw.com

my.hrw.com
Go digital with your write-in student edition, accessible on any device.

Math On the Spot
Scan with your smart phone to jump directly to the online edition, video tutor, and more.

Animated Math
Interactively explore key concepts to see how math works.

Personal Math Trainer
Get immediate feedback and help as you work through practice sets.

Are YOU Ready?

Complete these exercises to review skills you will need for this module.

Personal Math Trainer
Online Practice and Help
my.hrw.com

Solve Two-Step Equations

EXAMPLE

$$5x + 3 = -7$$

$$5x + 3 - 3 = -7 - 3 \quad \text{Subtract 3 from both sides.}$$

$$5x = -10 \quad \text{Simplify.}$$

$$\frac{5x}{5} = \frac{-10}{5} \quad \text{Divide both sides by 5.}$$

$$x = -2$$

Solve.

1. $3x + 4 = 10$ ________
2. $5x - 11 = 34$ ________
3. $-2x + 5 = -9$ ________
4. $-11 = 8x + 13$ ________
5. $4x - 7 = -27$ ________
6. $\frac{1}{2}x + 16 = 39$ ________
7. $12 = 2x - 16$ ________
8. $5x - 15 = -65$ ________

Solve Proportions

EXAMPLE

$$\frac{a}{4} = \frac{27}{18}$$

$$a \times 18 = 4 \times 27 \quad \text{Write the cross products.}$$

$$18a = 108 \quad \text{Simplify.}$$

$$\frac{18a}{18} = \frac{108}{18} \quad \text{Divide both sides by 18.}$$

$$a = 6$$

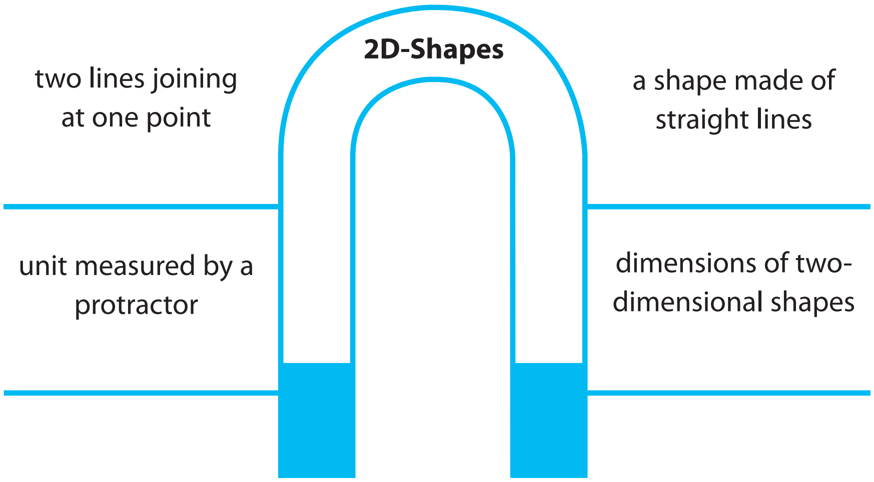
Solve for *x*.

9. $\frac{x}{5} = \frac{18}{30}$ ________
10. $\frac{x}{12} = \frac{24}{36}$ ________
11. $\frac{3}{9} = \frac{x}{3}$ ________
12. $\frac{14}{15} = \frac{x}{75}$ ________
13. $\frac{8}{x} = \frac{14}{7}$ ________
14. $\frac{14}{x} = \frac{2}{5}$ ________
15. $\frac{5}{6} = \frac{x}{15}$ ________
16. $\frac{81}{33} = \frac{x}{5.5}$ ________

Reading Start-Up

Visualize Vocabulary

Use the ✔ words to complete the graphic. You may put more than one word on each line.



Understand Vocabulary

Complete each sentence using a preview word.

1. What is a proportional two-dimensional drawing of an object?

   ____

2. _________________________ are angles that have the same measure.

3. ______________________________ are angles whose measures have a sum of 90°.

Vocabulary

Review Words

✔ angle *(ángulo)*
✔ degree *(grado)*
dimension *(dimensión)*
✔ length *(longitud)*
proportion *(proporción)*
✔ polygon *(polígono)*
ratio *(razón)*
✔ width *(ancho)*

Preview Words

adjacent angles *(ángulos adyacentes)*
complementary angles *(ángulos complementarios)*
congruent angles *(ángulos congruentes)*
cross section *(sección transversal)*
intersection *(intersección)*
scale *(escala)*
scale drawing *(dibujo a escala)*
supplementary angles *(ángulos suplementarios)*
vertical angles *(ángulos verticales)*

Active Reading

Key-Term Fold Before beginning the module, create a key-term fold to help you learn the vocabulary in this module. Write each highlighted vocabulary word on one side of a flap. Write the definition for each word on the other side of the flap. Use the key-term fold to quiz yourself on the definitions in this module.

GETTING READY FOR

Modeling Geometric Figures

Understanding the standards and the vocabulary terms in the standards will help you know exactly what you are expected to learn in this module.

CA CC 7.G.1

Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.

Key Vocabulary

scale *(escala)*
The ratio between two sets of measurements.

What It Means to You

You will learn how to calculate actual measurements from a scale drawing.

EXAMPLE 7.G.1

A photograph of a painting has dimensions 5.4 cm and 4 cm. The scale factor is $\frac{1}{15}$. Find the length and width of the actual painting.

$$\frac{1}{15} = \frac{5.4}{\ell} \qquad \frac{1}{15} = \frac{4}{w}$$

$$\frac{1 \times 5.4}{15 \times 5.4} = \frac{5.4}{\ell} \qquad \frac{1 \times 4}{15 \times 4} = \frac{4}{w}$$

$$15 \times 5.4 = \ell \qquad 15 \times 4 = w$$

$$81 = \ell \qquad 60 = w$$

The painting is 81 cm long and 60 cm wide.

CA CC 7.G.5

Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

Key Vocabulary

supplementary angles
(ángulos suplementarios)
Two angles whose measures have a sum of 180°.

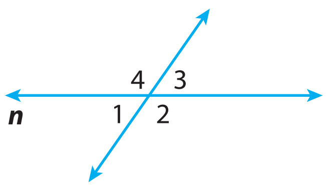
What It Means to You

You will learn about supplementary, complementary, vertical, and adjacent angles. You will solve simple equations to find the measure of an unknown angle in a figure.

EXAMPLE 7.G.5

Suppose $m\angle 1 = 55°$.

Adjacent angles formed by two intersecting lines are supplementary.



$$m\angle 1 + m\angle 2 = 180°$$

$$55° + m\angle 2 = 180° \qquad \text{Substitute.}$$

$$m\angle 2 = 180° - 55°$$

$$= 125°$$

Visit **my.hrw.com** to see all **CA Common Core Standards** explained.

my.hrw.com

LESSON 8.1

Similar Shapes and Scale Drawings

CA CC 7.G.1

Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale. *Also 7.RP.1, 7.RP.2b*

ESSENTIAL QUESTION

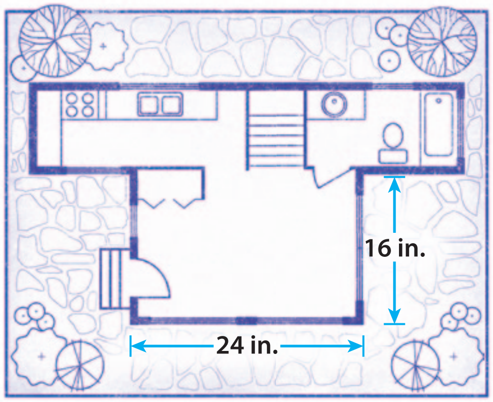
How can you use scale drawings to solve problems?

EXPLORE ACTIVITY 1 Real World

CA CC 7.G.1

Finding Dimensions

Scale drawings and scale models are used in mapmaking, construction, and other trades.



A blueprint is a technical drawing that usually displays architectural plans. Pete's blueprint shows a layout of a house. Every 4 inches in the blueprint represents 3 feet of the actual house. One of the walls in the blueprint is 24 inches long. What is the actual length of the wall?

A Complete the table to find the actual length of the wall.

Blueprint length (in.)	4	8	12	16	20	24
Actual length (ft)	3	6				

Reflect

1. In Pete's blueprint the length of a side wall is 16 inches. Find the actual length of the wall.

2. The back wall of the house is 33 feet long. What is the length of the back wall in the blueprint?

3. **Check for Reasonableness** How do you know your answer to **2** is reasonable?

Math On the Spot
my.hrw.com

Using a Scale Drawing to Find Area

Similar shapes are proportional figures that have the same shape but not necessarily the same size.

A **scale drawing** is a proportional two-dimensional drawing that is *similar* to an actual object. Scale drawings can represent objects that are smaller or larger than the actual object.

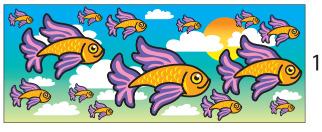
A **scale** is a ratio between 2 sets of measurements. It shows how a dimension in a scale drawing is related to the actual object. Scales are usually shown as two numbers separated by a colon such as 1:20 or 1 cm:1 m. Scales can be shown in the same unit or in different units.

My Notes

EXAMPLE 1 Real World

CA CC 7.G.1, 7.RP.1

The art class is planning to paint a mural on an outside wall. This figure is a scale drawing of the wall. What is the area of the actual wall?



STEP 1 Find the number of feet represented by 1 inch in the drawing.

$$\frac{2\text{ in.} \div 2}{3\text{ ft} \div 2} = \frac{1\text{ in.}}{1.5\text{ ft}}$$

The scale 2 in.:3 ft can be represented by the ratio $\frac{2\text{ in.}}{3\text{ ft}}$

1 inch in this drawing equals 1.5 feet on the actual wall.

STEP 2 Find the height of the actual wall labeled 11 inches in the drawing.

$$\frac{1\text{ in.} \times 11}{1.5\text{ ft} \times 11} = \frac{11\text{ in.}}{16.5\text{ ft}}$$

The height of the actual wall is 16.5 ft.

STEP 3 Find the length of the actual wall labeled 28 inches in the drawing.

$$\frac{1\text{ in.} \times 28}{1.5\text{ ft} \times 28} = \frac{28\text{ in.}}{42\text{ ft}}$$

The length of the actual wall is 42 ft.

STEP 4 Since area is length times width, the area of the actual wall is $16.5\text{ ft} \times 42\text{ ft} = 693\text{ ft}^2$.

Math Talk
Mathematical Practices

How could you solve the example without having to determine the number of feet represented by 1 inch?

Reflect

4. **Analyze Relationships** Write the scale in Example 1 as a unit rate. Show that this unit rate is equal to the ratio of the height of the drawing to the actual height.

5. **Analyze Relationships** Write the ratio of the area of the drawing to the area of the actual mural. Write your answer as a unit rate. Show that this unit rate is equal to the square of the unit rate in **4**.

YOUR TURN

6. The drawing plan for an art studio shows a rectangle that is 13.2 inches by 6 inches. The scale in the plan is 3 in.:5 ft. Find the length and width of the actual studio. Then find the area of the actual studio.

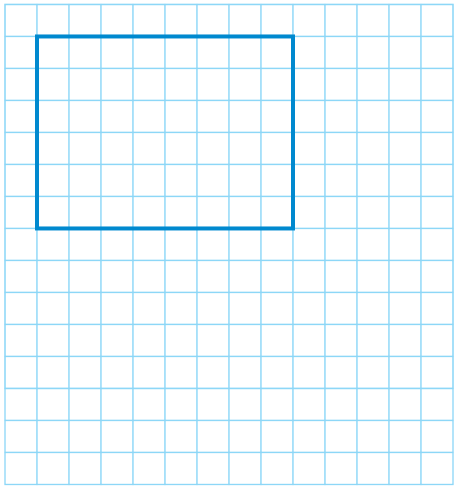
____

Personal Math Trainer
Online Practice and Help
my.hrw.com

EXPLORE ACTIVITY 2 Real World

CA CC 7.G.1, 7.RP.2b

Drawing in Different Scales



A A scale drawing of a meeting hall is drawn on centimeter grid paper as shown. The scale is 1 cm:3 m.

Suppose you redraw the rectangle on centimeter grid paper using a scale of 1 cm:6 m. In the new scale, 1 cm represents **more than/less than** 1 cm in the old scale.

The measurement of each side of the new drawing will be **twice/half** as long as the measurement of the original drawing.

B Draw the rectangle for the new scale 1 cm:6 m.

Reflect

7. Find the actual length and width of the hall using the original scale. Then find the actual length and width of the hall using the new scale. How do you know your answers are correct?

____

____

____

____

8. Explain how you know that there is a proportional relationship between the first and second drawings.

____

____

____

Guided Practice

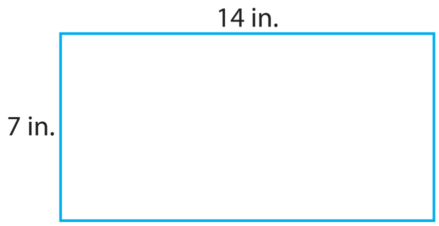
1. The scale of a room in a blueprint is 3 in.:5 ft. A wall in the same blueprint is 18 in. Complete the table. (Explore Activity 1)

Blueprint length (in.)	3					
Actual length (ft)						

a. How long is the actual wall? ______________________

b. A window in the room has an actual width of 2.5 feet. Find the width of the window in the blueprint. ________

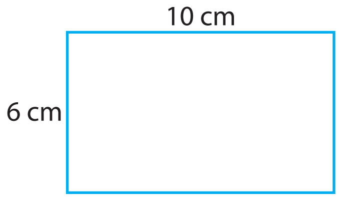
2. The scale in the drawing is 2 in.:4 ft. What are the length and width of the actual room? Find the area of the actual room. (Example 1)



____

____

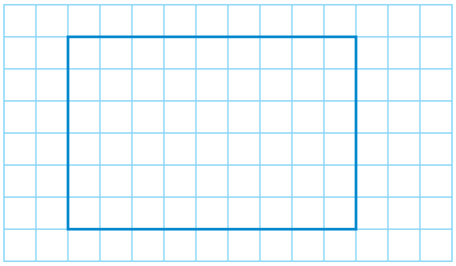
3. The scale in the drawing is 2 cm:5 m. What are the length and width of the actual room? Find the area of the actual room. (Example 1)

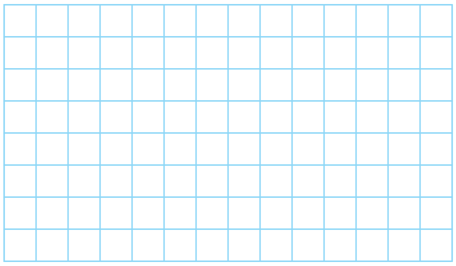


____

4. A scale drawing of a cafeteria is drawn on centimeter grid paper as shown. The scale is 1 cm:4 m. (Explore Activity 2)

a. Redraw the rectangle on centimeter grid paper using a scale of 1 cm:6 m.





b. What is the actual length and width of the cafeteria using the original scale? What are the actual dimensions of the cafeteria using the new scale?

____

ESSENTIAL QUESTION CHECK-IN

5. If you have an accurate, complete scale drawing and the scale, which measurements of the object of the drawing can you find?

____

____

Name ______________________ Class ______________ Date ______________

8.1 Independent Practice

CA CC 7.G.1, 7.RP.1, 7.RP.2b

Personal Math Trainer

my.hrw.com

Online Practice and Help

6. **Art** Marie has a small copy of Rene Magritte's famous painting, *The Schoolmaster*. Her copy has dimensions 2 inches by 1.5 inches. The scale of the copy is 1 in.:40 cm.

a. Find the dimensions of the original painting.

____

b. Find the area of the original painting.

____

c. Since 1 inch is 2.54 centimeters, find the dimensions of the original painting in inches.

____

d. Find the area of the original painting in square inches.

____

7. A game room has a floor that is 120 feet by 75 feet. A scale drawing of the floor on grid paper uses a scale of 1 unit:5 feet. What are the dimensions of the scale drawing?

____

8. **Multiple Representations** The length of a table is 6 feet. On a scale drawing, the length is 2 inches. Write three possible scales for the drawing.

____

9. **Analyze Relationships** A scale for a scale drawing is 10 cm:1 mm. Which is larger, the actual object or the scale drawing? Explain.

____

____

10. **Architecture** The scale model of a building is 5.4 feet tall.

a. If the original building is 810 meters tall, what was the scale used to make the model?

____

b. If the model is made out of tiny bricks each measuring 0.4 inch in height, how many bricks tall is the model?

____

11. You have been asked to build a scale model of your school out of toothpicks. Imagine your school is 30 feet tall. Your scale is 1 ft:1.26 cm.

a. If a toothpick is 6.3 cm tall, how many toothpicks tall will your model be?

____

b. Your mother is out of toothpicks, and suggests you use cotton swabs instead. You measure them, and they are 7.6 cm tall. How many cotton swabs tall will your model be?

____

H.O.T. FOCUS ON HIGHER ORDER THINKING

12. **Draw Conclusions** The area of a square floor on a scale drawing is 100 square centimeters, and the scale of the drawing is 1 cm:2 ft. What is the area of the actual floor? What is the ratio of the area in the drawing to the actual area?

____

13. **Multiple Representations** Describe how to redraw a scale drawing with a new scale.

____

____

____

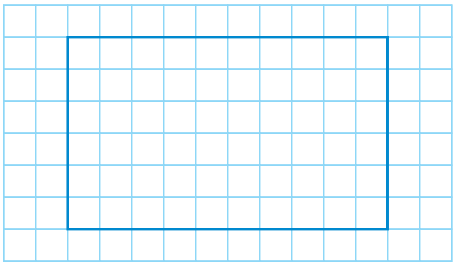
____

____

____

14. The scale drawing of a room is drawn on a grid that represents quarter-inch grid paper. The scale is $\frac{1}{4}$ in.:4 ft. Redraw the scale drawing of the same room using a different scale. What scale did you use? What is the length and width of the actual room? What is the area of the actual room?

____



Work Area

LESSON

8.2 Geometric Drawings

CA CC 7.G.2

Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle.

ESSENTIAL QUESTION

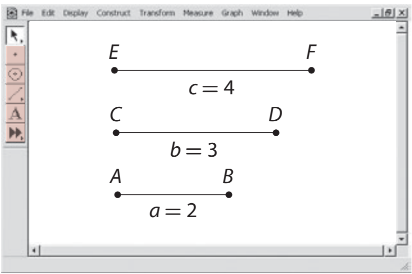
How can you draw shapes that satisfy given conditions?

EXPLORE ACTIVITY 1 CA CC 7.G.2

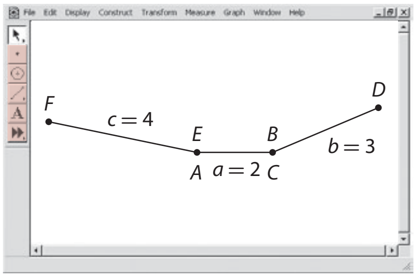
Drawing Three Sides

Use geometry software to draw a triangle whose sides have the following lengths: 2 units, 3 units, and 4 units.

A Draw the segments.

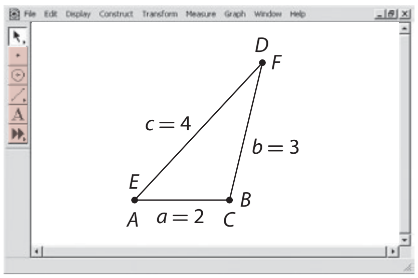


B Let $\overline{AB}$ be the base of the triangle. Place point *C* on top of point *B* and point *E* on top of point *A*.



C Using the points *C* and *E* as fixed vertices, rotate points *F* and *D* to see if they will meet in a single point.

Note that the line segments form a triangle.



D Repeat **A** and **B**, but use a different segment as the base. Do the segments form a triangle? If so, is it the same as the original triangle?

____

E Use geometry software to draw a triangle with sides of length 2, 3, and 6 units, and one with sides of length 2, 3, and 5 units. Do the line segments form triangles? How does the sum of the lengths of the two shorter sides of each triangle compare to the length of the third side?

____

Animated Math
my.hrw.com

Reflect

1. **Conjecture** Do two segments of lengths *a* and *b* units and a longer segment of length *c* units form one triangle, more than one, or none?

____

EXPLORE ACTIVITY 2 CA CC 7.G.2

Two Angles and Their Included Side

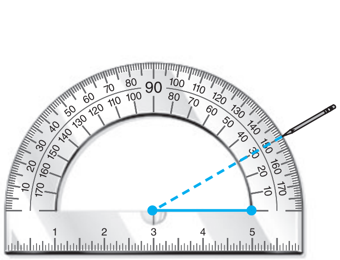
Use a ruler and a protractor to draw each triangle.

Triangle 1	Triangle 2
Angles: 30° and 80°	Angles: 55° and 50°
Length of included side: 2 inches	Length of included side: 1 inch

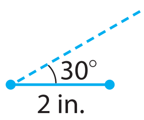
A Draw Triangle 1.

STEP 1 Use a ruler to draw a line that is 2 inches long. This will be the included side.

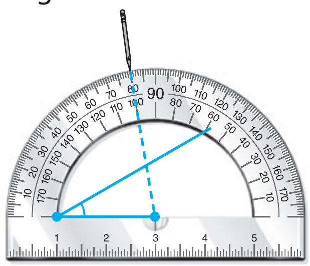
STEP 2 Place the center of the protractor on the left end of the 2-in. line. Then make a 30°-angle mark.



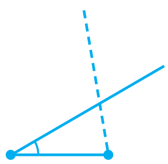
STEP 3 Draw a line connecting the left side of the 2-in. line and the 30°-angle mark. This will be the 30° angle.



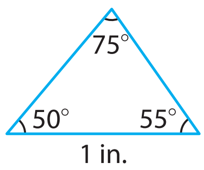
STEP 4 Repeat Step 2 on the right side of the triangle to construct the 80° angle.



STEP 5 The side of the 80° angle and the side of the 30° angle will intersect. This is Triangle 1 with angles of 30° and 80° and an included side of 2 inches.



B Use the steps in A to draw Triangle 2.



Reflect

2. Will a triangle be unique if you know all three angle measures but no side lengths? Make a sketch and explain your answer.

____

____

____

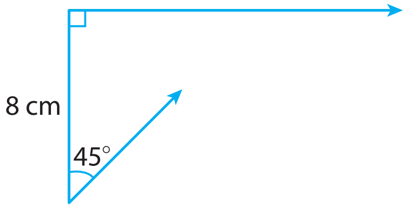
Math Talk
Mathematical Practices
Are Triangle 1 and Triangle 2 unique? Explain.

Name ____________________ Class ____________ Date ____________

Guided Practice

Tell whether each figure creates the conditions to form a unique triangle, more than one triangle, or no triangle. (Explore Activities 1 and 2)

1.

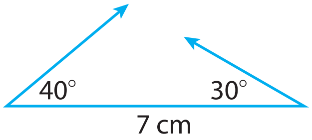


____

2.

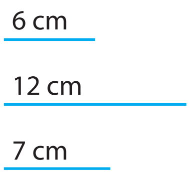
____

3.



____

4.



____

ESSENTIAL QUESTION CHECK-IN

5. Describe lengths of three segments that could **not** be used to form a triangle.

____

8.2 Independent Practice

CA CC 7.G.2

Personal Math Trainer
my.hrw.com
Online Practice and Help

6. On a separate piece of paper, try to draw a triangle with side lengths of 3 centimeters and 6 centimeters, and an included angle of 120°. Determine whether the given segments and angle produce a unique triangle, more than one triangle, or no triangle.

____

7. A landscape architect submitted a design for a triangle-shaped flower garden with side lengths of 21 feet, 37 feet, and 15 feet to a customer. Explain why the architect was not hired to create the flower garden.

____

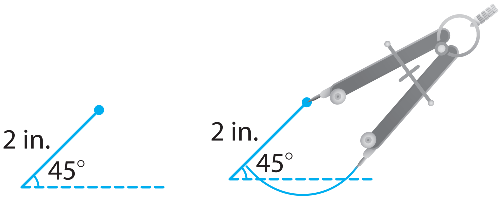
____

8. **Make a Conjecture** The angles in an actual triangle-shaped traffic sign all have measures of 60°. The angles in a scale drawing of the sign all have measures of 60°. Explain how you can use this information to decide whether three given angle measures can be used to form a unique triangle or more than one triangle.

Work Area

H.O.T. FOCUS ON HIGHER ORDER THINKING

9. **Communicate Mathematical Ideas** The figure on the left shows a line segment 2 inches long forming a 45° angle with a dashed line whose length is not given. The figure on the right shows a compass set at a width of $1\frac{1}{2}$ inches with its point on the top end of the 2-inch segment. An arc is drawn intersecting the dashed line twice.



Explain how you can use this figure to decide whether two sides and an angle **not** included between them can be used to form a unique triangle, more than one triangle, or no triangle.

10. **Critical Thinking** Two sides of an isosceles triangle have lengths of 6 inches and 15 inches, respectively. Find the length of the third side. Explain your reasoning.

LESSON

8.3 Cross Sections

CA CC 7.G.3

Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.

ESSENTIAL QUESTION

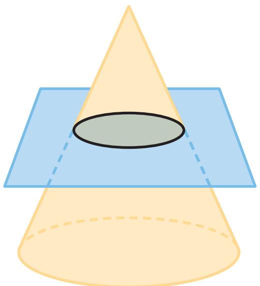
How can you describe cross sections of three-dimensional figures?

EXPLORE ACTIVITY 1

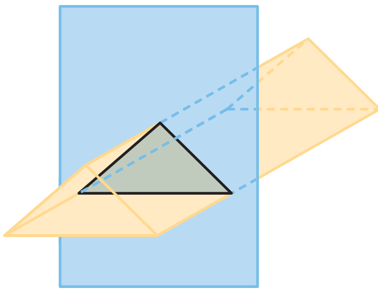
CA CC 7.G.3

Cross Sections of a Right Rectangular Prism

An **intersection** is a point or set of points common to two or more geometric figures. A **plane** is a flat surface that extends forever in all directions. A **cross section** is the intersection of a three-dimensional figure and a plane. Imagine a plane slicing through the pyramid shown, or through a cone or a prism.



This figure shows the intersection of a cone and a plane. The cross section is a circle.



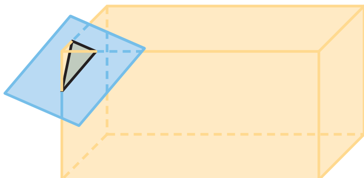
This figure shows the intersection of a triangular prism and a plane. The cross section is a triangle.

A three-dimensional figure can have several different cross sections depending on the position and the direction of the slice. For example, if the intersection of the plane and cone were vertical, the cross section would form a triangle.

Describe each cross section of the right rectangular prism with the name of its shape.

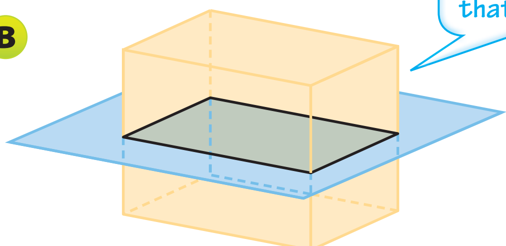
A right rectangular prism has six faces that are rectangles.

A



____

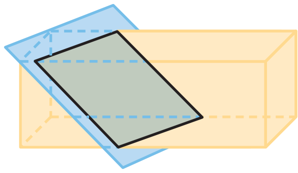
B



____

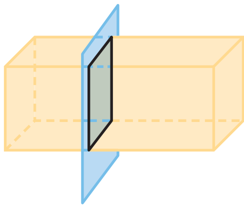
EXPLORE ACTIVITY 1 *(cont'd)*

C



____

D



____

Reflect

1. **Conjecture** Is it possible to have a circular cross section in a right rectangular prism?

____

EXPLORE ACTIVITY 2 CA CC 7.G.3

Describing Cross Sections

A right rectangular pyramid with a non-square base is shown. (In a *right* pyramid, the point where the triangular sides meet is centered over the base.)

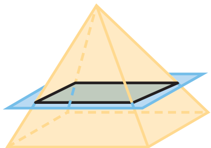
A The shape of the base is a ______________________.

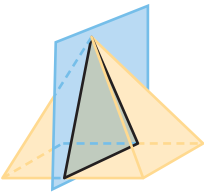
The shape of each side is a ______________________.

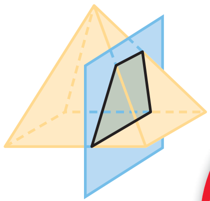
B Is it possible for a cross section of the pyramid to have each shape?

square ______ rectangle ______ triangle ______ circle ______ trapezoid ______

C Sketch the cross sections of the right rectangular pyramid below.







Reflect

2. **What If?** Suppose the figure in **B** had a square base. Would your answers in **B** be the same? Explain.

____

____

Math Talk
Mathematical Practices

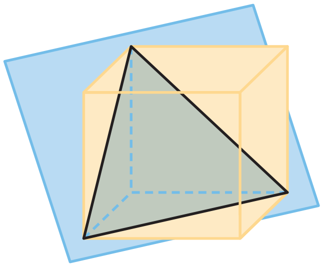
Describe and compare the cross sections created when two horizontal planes intersect a right rectangular pyramid.

Name ______________________ Class ______________ Date ____________

Guided Practice

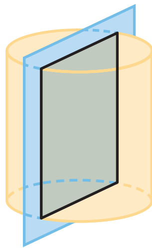
Describe the cross section of each given figure with the name of its shape.

1. cube (Explore Activity 1)



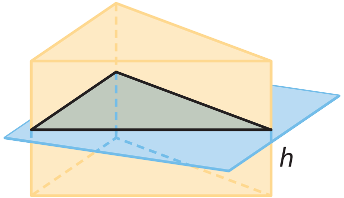
____

2. cylinder (Explore Activity 2)



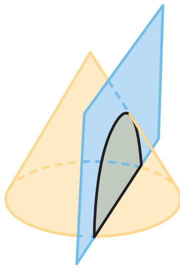
____

3. triangular prism (Explore Activity 2)



____

4. cone (Explore Activity 2)



____

ESSENTIAL QUESTION CHECK-IN

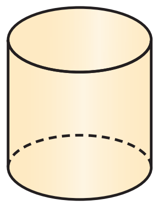
5. What is the first step in describing what figure results when a given plane intersects a given three-dimensional figure?

____

8.3 Independent Practice

CA CC 7.G.3

6. Describe different ways in which a plane might intersect the cylinder and the cross section that results.



____

____

____

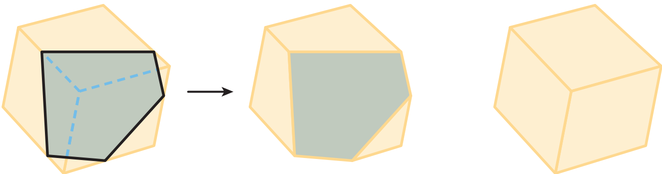
7. **Make a Conjecture** What cross sections might you see when a plane intersects a cone that you would **not** see when a plane intersects a

pyramid or a prism? ______________________________

Work Area

H.O.T. FOCUS ON HIGHER ORDER THINKING

8. **Critical Thinking** The two figures on the left below show that you can form a cross section of a cube that is a pentagon. Think of a plane cutting the cube at an angle in such a way as to slice through five of the cube's six faces. Draw dotted lines on the third cube to show how to form a cross section that is a hexagon.



9. **Analyze Relationships** A sphere has a radius of 12 inches. A horizontal plane passes through the center of the sphere.

   a. Describe the cross section formed by the plane and the sphere.

   ____

   b. Describe the cross sections formed as the plane intersects the interior of the sphere but moves away from the center.

   ____

   ____

   ____

10. **Communicate Mathematical Ideas** A right rectangular prism is intersected by a horizontal plane and a vertical plane. The cross section formed by the horizontal plane and the prism is a rectangle with dimensions 8 in. and 12 in. The cross section formed by the vertical plane and the prism is a rectangle with dimensions 5 in. and 8 in. Describe the faces of the prism, including their dimensions. Then find its volume.

    ____

    ____

11. **Represent Real-World Problems** Describe a real-world situation that could be represented by planes slicing a three-dimensional figure to form cross sections.

    ____

    ____

    ____

LESSON

8.4 Angle Relationships

CA CC 7.G.5

Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.

ESSENTIAL QUESTION

How can you use angle relationships to solve problems?

EXPLORE ACTIVITY CA CC Prep. for 7.G.5

Measuring Angles

It is useful to work with pairs of angles and to understand how pairs of angles relate to each other. **Congruent angles** are angles that have the same measure.

STEP 1 Using a ruler, draw a pair of intersecting lines. Label each angle from 1 to 4.

STEP 2 Use a protractor to help you complete the chart.

Angle	Measure of Angle
$m\angle 1$	
$m\angle 2$	
$m\angle 3$	
$m\angle 4$	
$m\angle 1 + m\angle 2$	
$m\angle 2 + m\angle 3$	
$m\angle 3 + m\angle 4$	
$m\angle 4 + m\angle 1$	

Reflect

1. **Make a Conjecture** Share your results with other students. Make a conjecture about pairs of angles that are opposite each other.

____

____

2. **Make a Conjecture** When two lines intersect to form two angles, what conjecture can you make about the pairs of angles that are next to each other?

____

Math On the Spot
my.hrw.com

Angle Pairs and One-Step Equations

Vertical angles are the opposite angles formed by two intersecting lines. Vertical angles are congruent because the angles have the same measure.

Adjacent angles are pairs of angles that share a vertex and one side but do not overlap.

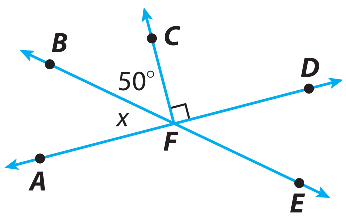
Complementary angles are two angles whose measures have a sum of 90°.

Supplementary angles are two angles whose measures have a sum of 180°. You discovered in the Explore Activity that adjacent angles formed by two intersecting lines are supplementary.

EXAMPLE 1

CA CC 7.G.5

Use the diagram.



A **Name a pair of vertical angles.**

Vertical angles are opposite angles formed by intersecting lines.

∠*AFB* and ∠*DFE* are vertical angles.

Math Talk
Mathematical Practices
Are ∠*BFD* and ∠*AFE* vertical angles? Why or why not?

B **Name a pair of adjacent angles.**

Adjacent angles share a vertex and a side but do not overlap.

∠*AFB* and ∠*BFD* are adjacent angles.

C **Name a pair of supplementary angles.**

Adjacent angles formed by intersecting lines are supplementary.

∠*AFB* and ∠*BFD* are supplementary angles.

D **Name two pairs of supplementary angles that include ∠*DFE*.**

Any angle that forms a line with ∠*DFE* is a supplementary angle to ∠*DFE*.

∠*DFE* and ∠*EFA* are supplementary angles, as are ∠*DFE* and ∠*DFB*.

E **Find the measure of ∠*AFB*.**

Use the fact that ∠*AFB* and ∠*BFD* in the diagram are supplementary angles to find m∠*AFB*.

$$\begin{aligned} m\angle AFB + m\angle BFD &= 180^\circ && \text{They are supplementary angles.} \\ x + 140^\circ &= 180^\circ && m\angle BFD = 50^\circ + 90^\circ = 140^\circ \\ \underline{-140^\circ} \quad & \underline{-140^\circ} && \text{Subtract } 140^\circ \text{ from both sides.} \\ x &= 40^\circ \end{aligned}$$

The measure of ∠*AFB* is 40°.

Reflect

3. **Analyze Relationships** What is the relationship between ∠*AFB* and ∠*BFC*? Explain.

____

____

____

4. **Draw Conclusions** Are ∠*AFC* and ∠*BFC* adjacent angles? Why or why not?

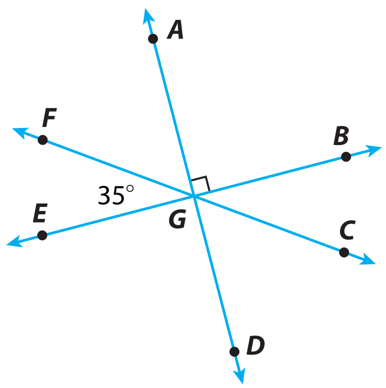
____

____

____

YOUR TURN

Use the diagram.



5. Name a pair of supplementary angles.

____

6. Name a pair of vertical angles.

____

7. Name a pair of adjacent angles.

____

8. Name a pair of complementary angles.

____

9. Find the measure of ∠*CGD*. ______________________________

My Notes

Personal Math Trainer
Online Practice and Help
my.hrw.com

Math On the Spot
my.hrw.com

My Notes

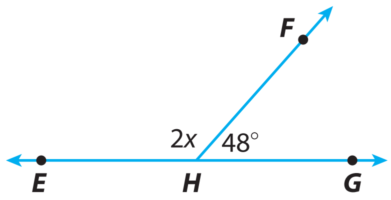
Angle Pairs and Two-Step Equations

Sometimes solving an equation is only the first step in using an angle relationship to solve a problem.

EXAMPLE 2

CA CC 7.G.5

A **Find the measure of $\angle EHF$.**



$\angle EHF$ and $\angle FHG$ form a straight line.

STEP 1 Identify the relationship between $\angle EHF$ and $\angle FHG$.

Since angles $\angle EHF$ and $\angle FHG$ form a straight line, the sum of the measures of the angles is 180°.

$\angle EHF$ and $\angle FHG$ are supplementary angles.

STEP 2 Write and solve an equation to find x.

$m\angle EHF + m\angle FHG = 180°$ — The sum of the measures of supplementary angles is 180°.

$$2x + 48° = 180°$$

$$\underline{-48°} \quad \underline{-48°}$$ — Subtract 48° from both sides.

$$2x = 132°$$ — Divide both sides by 2.

$$x = 66°$$

STEP 3 Find the measure of $\angle EHF$.

$m\angle EHF = 2x$

$= 2(66°)$ — Substitute 66° for x.

$= 132°$ — Multiply.

The measure of $\angle EHF$ is 132°.

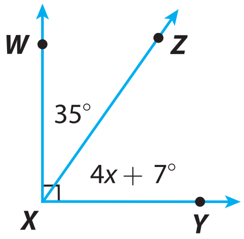
Check Confirm that $\angle EHF$ and $\angle FHG$ are supplementary.

$$m\angle EHF + m\angle FHG \stackrel{?}{=} 180°$$

$$132° + 48° \stackrel{?}{=} 180°$$

$$180° = 180°$$

B **Find the measure of $\angle ZXY$.**



STEP 1 Identify the relationship between $\angle WXZ$ and $\angle ZXY$.

$\angle WXZ$ and $\angle ZXY$ are complementary angles.

STEP 2 Write and solve an equation to find x.

$m\angle WXZ + m\angle ZXY = 90°$ — *The sum of the measures of complementary angles is 90°.*

$4x + 7° + 35° = 90°$ — *Substitute the values.*

$4x + 42° = 90°$ — *Combine like terms.*

$\underline{-42°} \quad \underline{-42°}$ — *Subtract 42° from both sides.*

$4x = 48°$ — *Divide both sides by 4.*

$x = 12°$

STEP 3 Find the measure of $\angle ZXY$.

$m\angle ZXY = 4x + 7°$

$= 4(12°) + 7°$ — *Substitute 12° for x.*

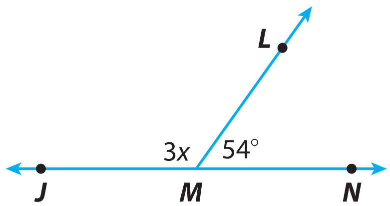
$= 55°$ — *Use the Order of Operations.*

The measure of $\angle ZXY$ is 55°.

Math Talk
Mathematical Practices
How can you check that your answer is reasonable?

YOUR TURN

10. Write and solve an equation to find the measure of $\angle JML$.



11. **Critique Reasoning** Cory says that to find $m\angle JML$ above, you can stop when you get to the solution step $3x = 126°$. Explain why this works.

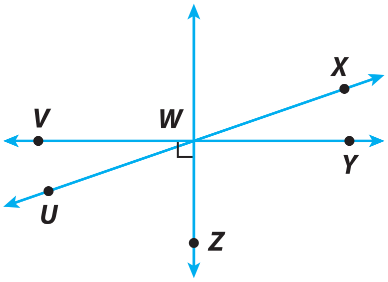
____

____

____

Guided Practice

For 1–2, use the figure. (Example 1)



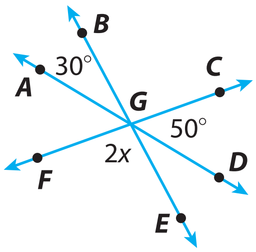
1. **Vocabulary** The sum of the measures of $\angle UWV$ and $\angle UWZ$ is 90°, so $\angle UWV$ and $\angle UWZ$ are

__________________ angles.

2. **Vocabulary** $\angle UWV$ and $\angle VWX$ share a vertex and one side. They do not overlap, so $\angle UWV$ and $\angle VWX$ are

__________________ angles.

For 3–4, use the figure.



3. $\angle AGB$ and $\angle DGE$ are __________________ angles,

so $m\angle DGE =$ __________________. (Example 1)

4. Find the measure of $\angle EGF$. (Example 2)

$m\angle CGD + m\angle DGE + m\angle EGF = 180^\circ$

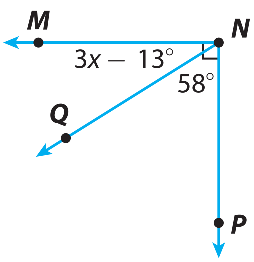
_______ + _______ + _______ $= 180^\circ$

_______ $+ 2x = 180^\circ$

$2x =$ ________

$m\angle EGF = 2x =$ ________

5. Find the value of x and the measure of $\angle MNQ$. (Example 2)



$m\angle MNQ + m\angle QNP = 90^\circ$

__________ + _______ $= 90^\circ$, so $3x +$ _______ $= 90^\circ$.

Then $3x =$ _______, and $x =$ _______.

$m\angle MNQ = 3x - 13^\circ = 3($_______$) - 13^\circ$

$=$ _______ $- 13^\circ$

$=$ _______

ESSENTIAL QUESTION CHECK-IN

6. Suppose that you know that $\angle T$ and $\angle S$ are supplementary, and that $m\angle T = 3(m\angle S)$. How can you find $m\angle T$?

____

____

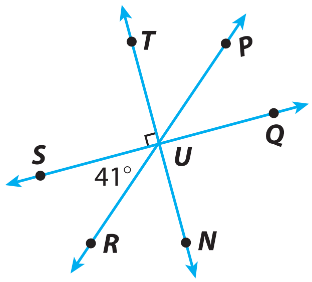
Name ______________________ Class ______________ Date ______________

8.4 Independent Practice

CA CC 7.G.5

Personal Math Trainer
Online Practice and Help
my.hrw.com

For 7–11, use the figure.



7. Name a pair of adjacent angles. Explain why they are adjacent.

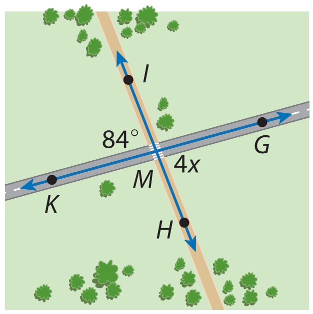
8. Name a pair of acute vertical angles.

9. Name a pair of supplementary angles.

10. **Justify Reasoning** Find m∠*QUR*. Justify your answer.

11. **Draw Conclusions** Which is greater, m∠*TUR* or m∠*RUQ*? Explain.

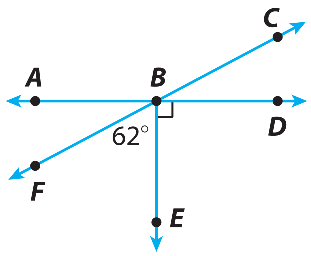
For 12–13, use the figure. A bike path crosses a road as shown. Solve for each indicated angle measure or variable.



12. x ______

13. m∠*KMH* ______

For 14–16, use the figure. Solve for each indicated angle measure.



14. m∠*CBE* ______

15. m∠*ABF* ______

16. m∠*CBA* ______

17. The measure of ∠*A* is 4° greater than the measure of ∠*B*. The two angles are complementary. Find the measure of each angle.

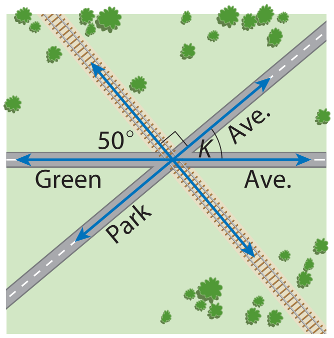
18. The measure of ∠*D* is 5 times the measure of ∠*E*. The two angles are supplementary. Find the measure of each angle.

19. **Astronomy** Astronomers sometimes use angle measures divided into degrees, minutes, and seconds. One degree is equal to 60 minutes, and one minute is equal to 60 seconds. Suppose that $\angle J$ and $\angle K$ are complementary, and that the measure of $\angle J$ is 48 degrees, 26 minutes, 8 seconds. What is the measure of $\angle K$?

____

H.O.T. FOCUS ON HIGHER ORDER THINKING

20. **Represent Real-World Problems** The railroad tracks meet the road as shown. The town will allow a parking lot at angle K if the measure of angle K is greater than 38°. Can a parking lot be built at angle K? Why or why not?



____

____

21. **Justify Reasoning** Kendra says that she can draw $\angle A$ and $\angle B$ so that $m\angle A$ is 119° and $\angle A$ and $\angle B$ are complementary angles. Do you agree or disagree? Explain your reasoning.

____

____

____

____

22. **Draw Conclusions** If two angles are complementary, each angle is called a *complement* of the other. If two angles are supplementary, each angle is called a *supplement* of the other.

a. Suppose $m\angle A = 77°$. What is the measure of a complement of a complement of $\angle A$? Explain.

____

____

____

b. What conclusion can you draw about a complement of a complement of an angle? Explain.

____

____

____

____

____

Work Area

MODULE QUIZ

Ready to Go On?

Personal Math Trainer
Online Practice and Help
my.hrw.com

8.1 Similar Shapes and Scale Drawings

1. A house blueprint has a scale of 1 in.:4 ft. The length and width of each room in the actual house are shown in the table. Complete the table by finding the length and width of each room on the blueprint.

	Living room	Kitchen	Office	Bedroom	Bedroom	Bathroom
Actual $\ell \times w$ **(ft)**	16×20	12×12	8×12	20×12	12×12	6×8
Blueprint $\ell \times w$ **(in.)**						

8.2 Geometric Drawings

2. Can a triangle be formed with the side lengths of 8 cm, 4 cm, and 12 cm? _______

3. A triangle has side lengths of 11 cm and 9 cm. Which could be the value of the third side, 20 cm or 15 cm? _______________________________

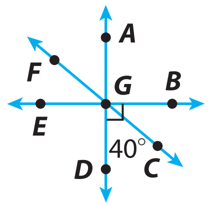
8.3 Cross Sections

4. Name one possible cross section of a sphere. _______________

5. Name at least two shapes that are cross sections of a cylinder.

____

8.4 Angle Relationships



6. $\angle BGC$ and $\angle FGE$ are _________ angles, so $m\angle FGE =$ _________.

7. Suppose you know that $\angle S$ and $\angle Y$ are complementary, and that $m\angle S = 2(m\angle Y) - 30°$. Find $m\angle Y$. ___________

ESSENTIAL QUESTION

8. How can you model geometry figures to solve real-world problems?

____

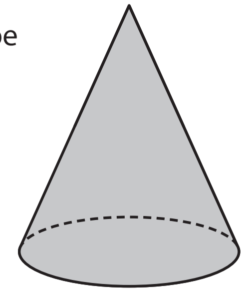
____

MODULE 8
MIXED REVIEW

Assessment Readiness

Personal Math Trainer
Online Practice and Help
my.hrw.com

1. Consider each figure named below. Could the figure be a cross section of the cone as seen at right?



Select Yes or No for A–C.

A. triangle ◯ Yes ◯ No
B. circle ◯ Yes ◯ No
C. rectangle ◯ Yes ◯ No

2. The temperature at 7 p.m. at a weather station in Minnesota was $-5\ ^\circ$F. The temperature began changing at a rate of $-2.5\ ^\circ$F per hour.

Choose True or False for each statement.

A. At 10 p.m. the temperature was $-7.5\ ^\circ$F. ◯ True ◯ False
B. At midnight the temperature was $-12.5\ ^\circ$F. ◯ True ◯ False
C. At 9 p.m. the temperature was $-10\ ^\circ$F. ◯ True ◯ False

3. The floor of the entryway to an office building will be triangular. Two angles of the triangle will measure 40°, and the side between them will have a length of 8 meters. Make a scale drawing of the entryway using a scale of 1 cm : 2 m. Explain how you made your drawing.

4. The diagram shows a portion of a wooden support for the roof of a house. A construction worker says that $\angle BDA$ measures 30° more than $\angle DAC$. Is the worker correct? Use angle relationships and equations to justify your answer.