Educational Epiphany ™

Districtwide PLC Protocol for **Mathematics**

Teacher/Teacher Team: Mr. Samuel F.
Grade/Course: Geometry
Date: Week of August 28, 2023

#	Planning Question	Teacher/Teacher Team Response	
	Geometry Coherence Tool: Access the foundational standards to make connections to previously taught skills during the lesson introduction.		
1	Which **state standard** is your lesson progression addressing?	**Lesson 1.4 – Perimeter and Area in the Coordinate Plane** **G.GPE.A.3** Understand the relationship between the Pythagorean Theorem and the distance formula and use an efficient method to solve problems on the coordinate plane. **G.MG.A.1** Use geometric shapes, their measures, and their properties to model objects found in a real-world context for the purpose of approximating solutions to problems. ★ **Foundational Standards:** 6.G.A.1, 7.G.B.3, 7.G.B.5, 8.G.C.6	**Lesson 1.5 – Measuring and Constructing Angles** **G.CO.D.11** Perform formal geometric constructions with a variety of tools and methods (compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.). **Foundational Standards:** 7.G.A.2
2	What **mathematical concepts** are embedded in the state standard?	• Explain the relationship between the Pythagorean Theorem and the distance formula. • Choose the most efficient method to find the distance between two points in a coordinate system and use it to solve problems. • Use geometric shapes, their measures, and their properties to describe and approximately model objects in a real-world context. Apply geometric methods to solve real-world problems.	• Bisect an angle using a compass. • Construct perpendicular lines, including the perpendicular bisector of a line segment. • Construct a line parallel to a given line through a point not on the line. • Use the virtual compass and line tool in dynamic geometry software to construct various geometric objects. • Develop methods using a variety of appropriate tools (compass, straightedge, string, reflective device, paper folding, etc.) to perform precise geometric constructions. • Explain informally why and how these construction methods work. Understand the importance of precision in these constructions and attend to precision when performing geometric constructions.
3	What teacher **knowledge, reminders, and misconceptions** are assumed in the standard?	**Knowledge:** • Instruction should allow students to explore using the Pythagorean Theorem to find the distance between two points graphed on the coordinate plane. • It may be easier for students to use numerical coordinates at first. However, to help students generalize the process, the given points can be (x_1, y_1) and (x_2, y_2) . • When applying the Pythagorean Theorem, they should discover that to find a, the length of the horizontal leg, they can subtract the	**Knowledge:** • Students must be allowed to experiment with the construction tools to develop their own method to perform these constructions rather than just be given specific instructions to follow. They will need a basic understanding of the expected outcome. • It is through the process of the construction and particularly discovering the method that students will develop a deeper understanding of the properties of these objects.

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

x coordinates of the endpoints $(x_2 - x_1)$ which are also the x coordinates of each original point. They should also discover that to find b, the length of the vertical leg, they can subtract the y-coordinates of the endpoints $(y_2 - y_1)$ which are also the y coordinates of the original points. When substituting each expression into the Pythagorean Theorem, $a^2 + b^2 = c^2$ becomes $(x_2 - x_1)^2 + (y_2 - y_1)^2 = c^2$, with c representing the hypotenuse which is the distance between the original two points. When isolating c, students will see the distance formula: $c = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$, while in the distance formula, *c* is usually replaced by *d* to represent distance.

- By allowing students to discover this connection between the two formulas, students should be able to flexibly move between these two methods. They can then explore applications for each method such as finding the area of circles or polygons graphed on the coordinate plane. They can also be challenged to solve problems given coordinates that are not graphed. Students should be given the opportunity to choose which method is the most efficient and explain why.
- Students apply geometric concepts learned in this and previous grades to solve real-world geometric application problems
- Throughout the course, students should be exposed to a variety of real-world situations that require the application of geometric concepts to solve. Often, the challenge for students is to identify which concept is needed to address the problem. Therefore, instruction should intentionally provide problems that require students to analyze the context to decide what is needed to solve. Examples may include the need to calculate area, volume, surface area, or verifying parallel lines or angle measures. By modeling the situation with geometric figures, students can more easily recognize an appropriate solution method.

Reminders:

- In grade 8, students were introduced to the Pythagorean Theorem as a method to find a missing side length of a right triangle (8.G.B.4). They also used it to find the distance between two points in a coordinate system (8.G.B.5). In this high school course, students will extend their understanding of the application of Pythagorean Theorem to find a distance and generalize it to find the distance between any two points in a coordinate system and thus discover the distance formula.
- G.MG.A.1 along with G.CO.D.12 addresses the concept of using geometry to visualize a situation for the purpose of solving a problem. As students solve real-world problems that involve two- and three-dimensional objects throughout this course, they should

- Students will want to use a ruler to bisect a line segment or a protractor to bisect an angle, but when performing these formal constructions, students should not use tools that measure. Instead, they need to focus on the properties of the figures in the construction. Likewise, when students are using dynamic geometry software, they should avoid using automatic commands for bisecting and performing other constructions and use the virtual compass and line tool instead.
- Requiring students to perform constructions by hand will help them discover the need for precision, which is essential in performing these constructions or they will not work. For example, a perpendicular bisector construction may not end up exactly in the middle or exactly perpendicular if the student does not use the same holes in the compass during the construction. Dynamic geometry software may help students perform the constructions precisely, particularly for students who struggle with using the tools precisely, but it is important that students also experience performing constructions by hand.
- Developing the process of the methods leads to a deeper understanding of why and how each method works. Therefore, it is important that students be required to show their understanding by informally explaining what their chosen method does and why it works.

Reminders:

- In grade 7 (7.G.A cluster), students begin to experiment with mathematical tools to construct geometric figures and explore their relationships. In this course, students learn to use these and additional tools to perform constructions to explore and demonstrate geometric properties and help students visualize geometric theorems.
- It is important that students understand that constructions serve a purpose. Therefore, pairing this standard with others throughout this course, including G.CO.A.3 and G.CO.D.12, will help students see the why behind these valuable skills.

Misconceptions:

- Students frequently want to resort to using a ruler and protractor. The teacher needs to make the constraints for use of a particular tool clear.
  If students are not precise in a construction, it may not appear to work. The teacher needs to emphasize the importance of precision. Alternatively, using dynamic geometry software could alleviate some of these difficulties.

		recognize that geometric shapes can be used to model real-world objects. **Misconceptions:** • Students often mistakenly assume that they can count a diagonal distance on the coordinate plane like they do with horizontal or vertical distances. To avoid this common misconception, have students measure and compare a side length and diagonal of a square and connect this comparison to the square units on a coordinate plane. They can then calculate the length of the diagonal of one square unit using the Pythagorean Theorem $(1^2 + 1^2 = c^2)$ to see that the length of the diagonal is actually $\sqrt{2}$ which is longer than 1 unit or approximately 1.41 units. Students may be troubled by the fact that in the real world, objects cannot be perfectly modeled by geometric solids. Students should be encouraged to consider that while a geometric model is not perfect, it can provide an approximation that yields useful information.	
4	What **objective(s)** must be taught? In what order? Why?	**PBO:** • **SWBAT** use the Pythagorean Theorem to find a distance between any two points **IOT** solve problems on the coordinate plane. • **SWBAT** generalize the Pythagorean Theorem to the Distance Formula **IOT** use the most efficient method to find the distance between two points. • **SWBAT** use geometric shapes, their measures, and their properties **IOT** describe and model objects in a real-world context. **Lesson objectives:** • I can classify and describe polygons**.** • I can find perimeters of polygons in the coordinate plane. • I can find areas of polygons in the coordinate plane.	**PBO:** • **SWBAT** use a variety of tools and methods (compass, straightedge, string, reflective devices, paper folding, dynamic geometric software, etc.) **IOT** perform formal geometric constructions. **Lesson objectives**: • I can measure and classify angles. • I can construct congruent angles. • I can find angle measures. I can construct an angle bisector.
5	What **academic language** must be taught before the teacher models for students? How will the academic language be **taught and assessed**?	**Academic Language:** • **Use** – take, hold, or apply • **Pythagorean Theorem** – a theorem that states that in a right triangle, the square of the length of the hypotenuse equals the sum of the squares of the lengths of the legs $(a^2 + b^2 = c^2)$ • **Distance** – an amount of space between two things or people • **Solve** – to apply an operation(s) in order to find a value; to find an answer • **Coordinate Plane** – a plane containing the "x" and the "y" axis • **Generalize** – make a broad statement • **Distance Formula** – the distance between any two points $(x1,\ y1)$ and $(x2,\ y2)$ is $d = \sqrt{(x_2 - x_1)^2 + (y_2 - y_1)^2}$ • **Efficient** – to do without wasting time • **Method** – a step of a procedure of an experiment	**Academic Language:** • **Use** – take, hold, or apply • **Variety** – more than one; several • **Method** – a step of a procedure of an experiment • **Compass** – a tool used for drawing and drafting to create arcs, circles or other geometric figures • **Perform** – carry out, accomplish, or fulfill • **Formal** – characterized by precise respect for form • **Geometric** – related to geometry • **Construction** – a geometric figure made with only a straightedge and compass. **Instructional Practice 2:** Strategies used to teach unfamiliar words will include:

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		• **Geometric Shape** – the characteristic surface configuration of an object • **Measure** – the size, amount, or degree of something • **Property** – a mathematical rule; a character or attribute that something has • **Describe** – give an account in words of (someone or something) that includes all the relevant characteristics • **Model** – representation of a concept; to draw, show or explain mathematically • **Real-World** – relating to a concrete setting • **Context** – the surrounding or background information used to determine, specify, or clarify the meaning of an event or other occurrence **Instructional Practice 2:** Strategies used to teach unfamiliar words will include: • 30 – 30 – 30 (common math-related word parts in the text, problem or objective) • Point of Use Annotation of Performance-Based Objective • Universal Language of Literacy • Word-and-Definition Word Walls • Word Parts • Context Clues Point of Use Annotation of the Texts (In Real Time)	• 30 – 30 – 30 (common math-related word parts in the text, problem or objective) • Point of Use Annotation of the Performance Based Objective • Universal Language of Literacy • Word and Definition Walls • Word Parts • Context Clues Point of Use Annotation of the Text (in Real Time)
6	What **activities/practice problems** are you planning to use for **Launch the Lesson, Explore It, Examples & Self-Assessment, and Practice** portions of the lesson? What did you learn from working the problems **in advance** of using them in class with students?	**Technology Integration Suggestions: Big Ideas Platform** • Dynamic Classroom • Resources: Digital Example Videos • Resources: Everyday Connections Video Series • Lesson Example PowerPoints • Resources: Explorations (Dynamic) **For technology integration resources and suggestions, please click here.** **Monday 08/28/2023** • **CFA #1**	**Technology Integration Suggestions: Big Ideas Platform** • Dynamic Classroom • Resources: Digital Example Videos • Resources: Everyday Connections Video Series • Lesson Example PowerPoints • Resources: Explorations (Dynamic) **For technology integration resources and suggestions, please click here.** **Wednesday 08/30/2023**

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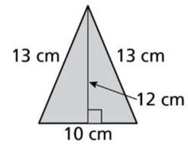
Tuesday 08/29/2023

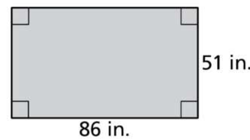
Do Now 08/29/2023 (5 minutes)

Name: ___________________________ Period ___

1. Find the perimeter and area of the polygon.



2. Find the perimeter and area of the polygon.



Agenda

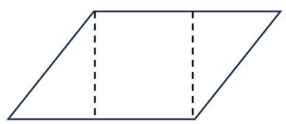
- Classify and describe polygons.
- Find perimeters of polygons in the coordinate plane.
- Find areas of polygons in the coordinate plane.

PBO

- 30 – 30 – 30 (common math-related word parts in the text, problem, or objective)
- Point of Use Annotation of the Performance Based Objective
- Universal Language of Literacy
- Word and Definition Walls

Laurie's Notes

Launch the Lesson



? "How does the area of the parallelogram compare to the areas of the two triangles and rectangle?

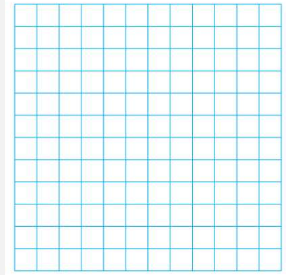
? "Is the perimeter of the parallelogram equal to the sum of the perimeters of the two triangles and rectangle? Explain."

Do Now 08/30/2023 (5 minutes)

Name: ___________________________ Period __

A triangle has vertices at (1, 3), (2, -3) and (-1, -1).

What is the approximate perimeter of the triangle?



Agenda

- Measure Angles
- Construct Angles
- Describe Angles

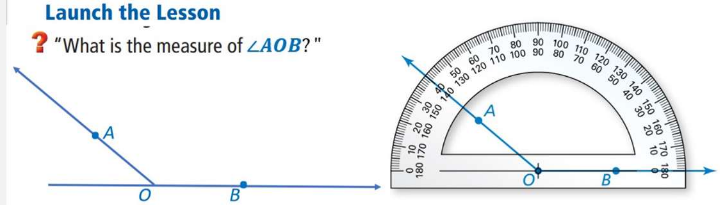
PBO

- 30 – 30 – 30 (common math-related word parts in the text, problem, or objective)
- Point of Use Annotation of the Performance Based Objective
- Universal Language of Literacy
- Word and Definition Walls

Laurie's Notes

Launch the Lesson

? "What is the measure of $\angle AOB$?"



? "How can you find the measure of the angle?" Measure the angle using a protractor.

IMPORTANT How is a protractor used to measure an angle?

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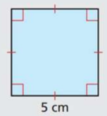
1.4 Perimeter and Area in the Coordinate Plane

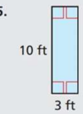
REVIEW & REFRESH

In Exercises 44–47, find the perimeter and area of the figure.

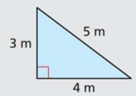
44.



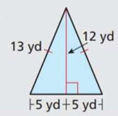
45.



46.



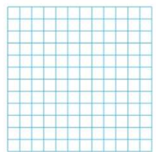
47.



EXPLORE IT! Finding the Perimeter and Area of a Quadrilateral

Work with a partner.

a. Use a piece of graph paper to draw a quadrilateral *ABCD* in a coordinate plane. At most two sides of your quadrilateral can be horizontal or vertical. Plot and label the vertices of *ABCD*.



b. Make several observations about quadrilateral *ABCD*. Can you use any other names to classify your quadrilateral? Explain.

c. Explain how you can find the perimeter of quadrilateral *ABCD*. Then find the perimeter. Compare your method with those of your classmates.

d. Explain how you can find the area of quadrilateral *ABCD*. Then find the area. Compare your method with those of your classmates.

Number of sides	Type of polygon
3	Triangle
4	Quadrilateral
5	Pentagon
6	Hexagon
7	Heptagon
8	Octagon
9	Nonagon
10	Decagon
12	Dodecagon
n	*n*-gon

1.5 Measuring and Constructing Angles

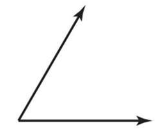
EXPLORE IT! Analyzing a Geometric Figure

? "Look around the room. Where do you see examples of acute angles? right angles? obtuse angles? straight angles?

Work with a partner.

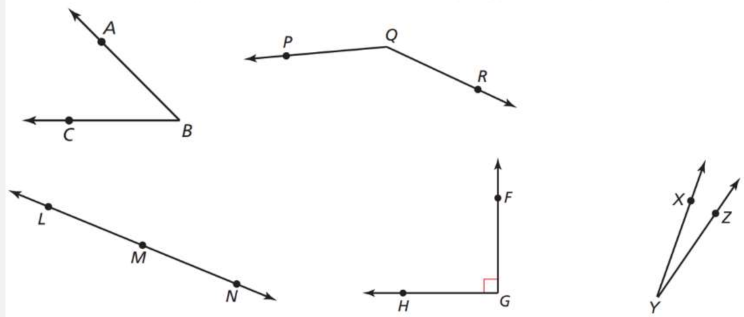
a. Identify the figure shown at the right. Then define it in your own words.

b. Label and name the figure. Then compare your results with those of your classmates.



c. How can you *measure* the figure?

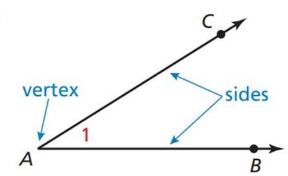
d. Describe each angle below. How would you group these angles? Explain.



Naming Angles

An **angle** is a set of points consisting of two different rays that have the same endpoint, called the **vertex**. The rays are the **sides** of the angle.

You can name an angle in several different ways. The symbol ∠ represents an angle.



- Use its vertex, such as $\angle A$.
- Use a point on each ray and the vertex, such as $\angle BAC$ or $\angle CAB$. Make sure the vertex is the middle letter.
- Use a number, such as $\angle 1$.

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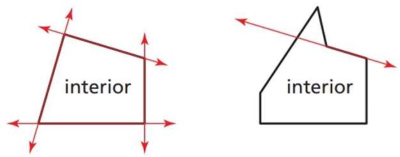
The number of sides determines the type of polygon, as shown in the table. You can also name a polygon using the term *n*-gon, where *n* is the number of sides. For instance, a 14-gon is a polygon with 14 sides.

A polygon is *convex* when no line that contains a side of the polygon contains a point in the interior of the polygon. A polygon that is not convex is *concave*.



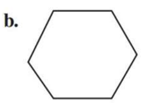
convex polygon　　concave polygon

EXAMPLE 1 **Classifying Polygons** WATCH

Classify each polygon by the number of sides. Tell whether it is *convex* or *concave*.

a.

b.



SOLUTION

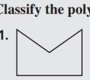
a. The polygon has four sides. So, it is a quadrilateral. The polygon is concave.

b. The polygon has six sides. So, it is a hexagon. The polygon is convex.

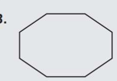
Check for Understanding

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Classify the polygon by the number of sides. Tell whether it is *convex* or *concave*.

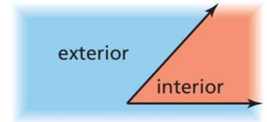
1. 

2. 

3. 

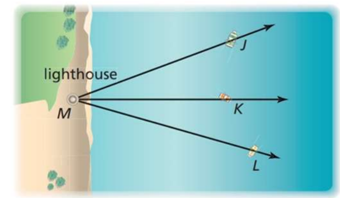
4. MP REASONING Can you draw a concave triangle? If so, draw one. If not, explain why not.

The region that contains all the points between the sides of the angle is the **interior of the angle**. The region that contains all the points outside the angle is the **exterior of the angle**.



EXAMPLE 1 **Naming Angles** WATCH INFO

A lighthouse keeper measures the angles formed by the lighthouse at point *M* and three boats. Name three angles shown in the diagram.



SOLUTION

$\angle JMK$ or $\angle KMJ$

$\angle KML$ or $\angle LMK$

$\angle JML$ or $\angle LMJ$

Measuring and Classifying Angles

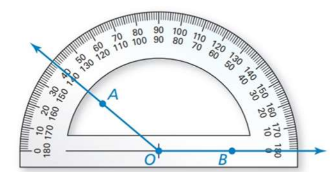
A protractor helps you approximate the *measure* of an angle. The measure is usually given in *degrees*.

POSTULATE

1.3 Protractor Postulate

Consider $\overleftrightarrow{OB}$ and a point *A* on one side of $\overleftrightarrow{OB}$. The rays of the form $\overrightarrow{OA}$ can be matched one to one with the real numbers from 0 to 180.

The **measure** of $\angle AOB$, which can be written as $m\angle AOB$, is equal to the absolute value of the difference between the real numbers matched with $\overrightarrow{OA}$ and $\overrightarrow{OB}$ on a protractor.

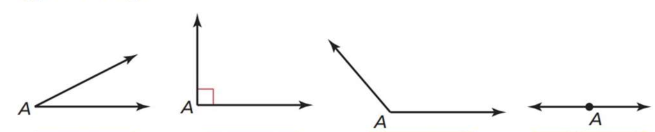


You can classify angles according to their measures.

GO DIGI

KEY IDEA

Types of Angles



acute angle	**right angle**	**obtuse angle**	**straight angle**
Measures greater than 0° and less than 90°	Measures 90°	Measures greater than 90° and less than 180°	Measures 180°

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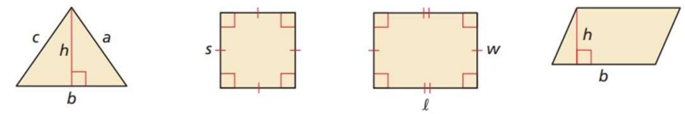
Finding Perimeter and Area in the Coordinate Plane

READING
You can read the notation $\triangle DEF$ as "triangle D E F."

You can use the formulas below and the Distance Formula to find perimeters and areas of polygons in the coordinate plane.

Perimeter and Area



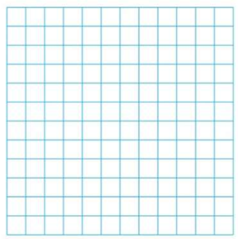
Triangle	Square	Rectangle	Parallelogram
$P = a + b + c$ $A = \frac{1}{2}bh$	$P = 4s$ $A = s^2$	$P = 2\ell + 2w$ $A = \ell w$	$A = bh$

EXAMPLE 2 Finding Perimeter in the Coordinate Plane

Find the perimeter of $\triangle DEF$ with vertices $D(1, 3)$, $E(4, -3)$, and $F(-4, -3)$.

SOLUTION

Step 1 Draw the triangle in a coordinate plane by plotting the vertices and connecting them.



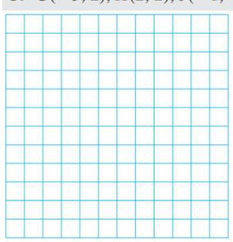
Step 2 Find the length of each side.

Check for Understanding

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Find the perimeter of the polygon with the given vertices.

5. $G(-3, 2)$, $H(2, 2)$, $J(-1, -3)$



EXAMPLE 2 Measuring and Classifying Angles

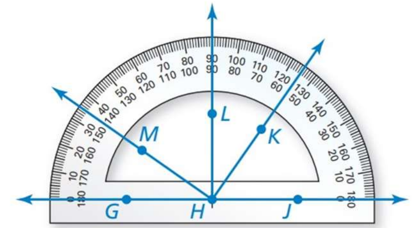
WATCH

Find the measure of each angle. Then classify the angle.

a. $\angle GHK$

b. $\angle JHL$

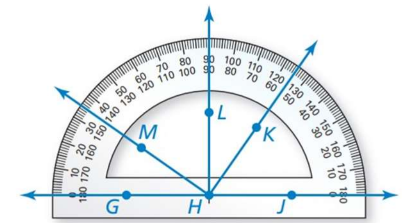
c. $\angle LHK$



SOLUTION

a. $\overrightarrow{HG}$ lines up with 0° on the outer scale of the protractor. $\overrightarrow{HK}$ passes through 125° on the outer scale. So, $m\angle GHK = 125°$. It is an *obtuse* angle.

b. $\overrightarrow{HJ}$ lines up with 0° on the inner scale of the protractor. $\overrightarrow{HL}$ passes through 90°. So, $m\angle JHL = 90°$. It is a *right* angle.

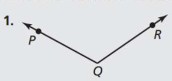


c. $\overrightarrow{HL}$ passes through 90°. $\overrightarrow{HK}$ passes through 55° on the inner scale. So, $m\angle LHK = |90 - 55| = 35°$. It is an *acute* angle.

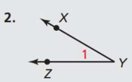
SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Write three names for the angle.

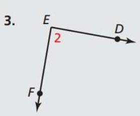
1.



2.

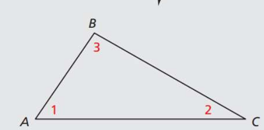


3.



4. WHICH ONE DOESN'T BELONG? Which angle name does *not* belong with the other three? Explain your reasoning.

$\angle BCA$ $\angle BAC$ $\angle 1$ $\angle CAB$



Use the diagram in Example 2 to find the measure of the angle. Then classify the angle.

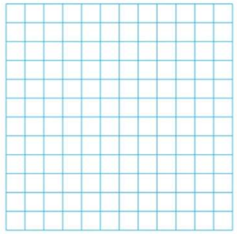
5. $\angle JHM$ **6.** $\angle MHK$ **7.** $\angle MHL$

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Find the perimeter of the polygon with the given vertices.

6. $Q(-4, -1)$, $R(1, 4)$, $S(4, 1)$, $T(-1, -4)$



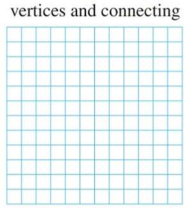
EXAMPLE 3 **Finding Area in the Coordinate Plane**

Find the area of ▱$JKLM$ with vertices $J(-3, 5)$, $K(1, 5)$, $L(2, -1)$, and $M(-2, -1)$.

READING
You can read the notation ▱$JKLM$ as "parallelogram J K L M."

SOLUTION

Step 1 Draw the parallelogram in a coordinate plane by plotting the vertices and connecting them.



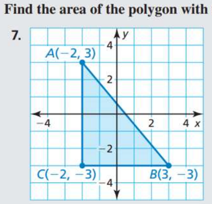
Step 2 Find the length of the base and the height.

Check for Understanding

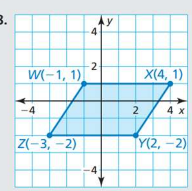
SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

Find the area of the polygon with the given vertices.

7.



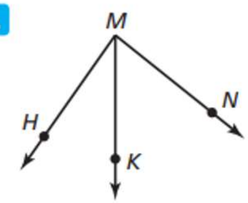
8.



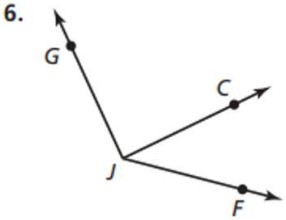
Exit Ticket

In Exercises 5 and 6, name three different angles in the diagram. *Example 1*

5.



6.



Thursday 08/31/2023

Do Now 08/31/2023 (5 minutes)

Name: ______________________________ Period ____

1. Solve the equation.

$$x + 40 = 110$$

2. Solve the equation.

$$y - 55 = 35$$

Agenda

- Identifying congruent angles
- Copying an angle
- Using Angle Addition Postulate
- Finding angle measures

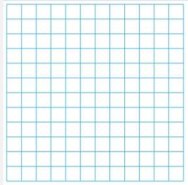
PBO

- 30 – 30 – 30 (common math-related word parts in the text, problem, or objective)
- Point of Use Annotation of the Performance Based Objective
- Universal Language of Literacy
- Word and Definition Walls

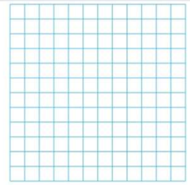
Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

Find the area of the polygon with the given vertices.

9. $N(-1, 1)$, $P(2, 1)$, $Q(2, -2)$, $R(-1, -2)$



10. $K(-3, 3)$, $L(3, 3)$, $M(3, -1)$, $N(-3, -1)$

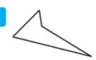


Practice

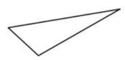
1.4 Practice WITH CalcChat® AND CalcView®

In Exercises 1–4, classify the polygon by the number of sides. Tell whether it is *convex* or *concave*. *Example 1*

1.

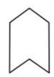


2.



3.

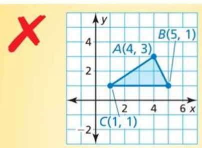
4.



In Exercises 5–10, find the perimeter of the polygon with the given vertices. *Example 2*

Exit Ticket

19. ERROR ANALYSIS Describe and correct the error in finding the area of the triangle.



$b = |5 - 1| = 4$

$h = \sqrt{(5-4)^2 + (1-3)^2} = \sqrt{5}$

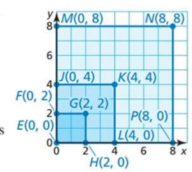
$A = \frac{1}{2}bh = \frac{1}{2}(4)(\sqrt{5}) = 2\sqrt{5}$

The area is $2\sqrt{5}$ square units.

20. MP **REPEATED REASONING** Use the diagram.

a. Find the perimeter and area of each square.

b. What happens to the area of a square when its perimeter increases by a factor of n?



Identifying Congruent Angles

You can use a compass and straightedge to construct an angle that has the same measure as a given angle.

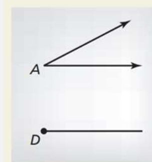
CONSTRUCTION **Copying an Angle** WATCH

Use a compass and straightedge to construct an angle that has the same measure as $\angle A$. In this construction, the *center* of an arc is the point where the compass point rests. The *radius* of an arc is the distance from the center of the arc to a point on the arc drawn by the compass.

Copying $\angle A$.

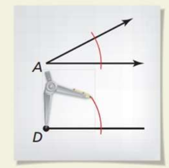
Solution

Step 1



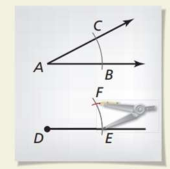
Draw a segment Draw an angle such as $\angle A$, as shown. Then draw a segment. Label point D on the segment.

Step 2



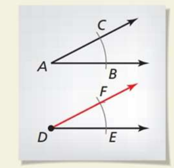
Draw arcs Draw an arc with center A. Using the same radius, draw an arc with center D.

Step 3



Draw an arc Label B, C, and E. Draw an arc with radius BC and center E. Label the intersection F.

Step 4



Draw a ray Draw $\overrightarrow{DF}$. $\angle D$ has the same measure as $\angle A$.

Two angles are **congruent angles** when they have the same measure. In the construction above, $\angle A$ and $\angle D$ are congruent angles. So,

$m\angle A = m\angle D$ The measure of angle *A* is *equal to* the measure of angle *D*.

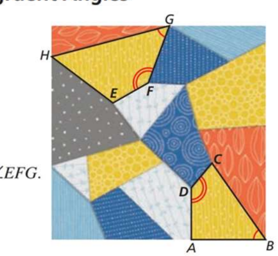
and

$\angle A \cong \angle D$. Angle *A* is *congruent to* angle *D*.

EXAMPLE 3 **Identifying Congruent Angles**

a. Identify the congruent angles labeled in the quilt design.

b. $m\angle ADC = 140°$. What is $m\angle EFG$?



SOLUTION

a. There are two pairs of congruent angles:

$\angle ABC \cong \angle FGH$ and $\angle ADC \cong \angle EFG$.

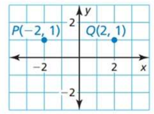
b. Because $\angle ADC \cong \angle EFG$, $m\angle ADC = m\angle EFG$.

So, $m\angle EFG = 140°$.

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

Homework

COLLEGE PREP **In Exercises 21 and 22, use the diagram.**



21. Determine which point is the remaining vertex of a triangle with an area of 4 square units.

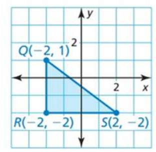
Ⓐ $R(2, 0)$ Ⓑ $S(-2, -1)$
Ⓒ $T(-1, 0)$ Ⓓ $U(2, -2)$

22. Determine which points are the remaining vertices of a rectangle with a perimeter of 14 units.

Ⓐ $A(2, -1)$ and $B(-2, -1)$
Ⓑ $C(-1, -2)$ and $D(1, -2)$
Ⓒ $E(-2, -2)$ and $F(2, -2)$
Ⓓ $G(2, 0)$ and $H(-2, 0)$

28. **CONNECTING CONCEPTS** The lines $y_1 = 2x - 6$, $y_2 = -3x + 4$, and $y_3 = -\frac{1}{2}x + 4$ intersect to form the sides of a right triangle. Find the perimeter and the area of the triangle.

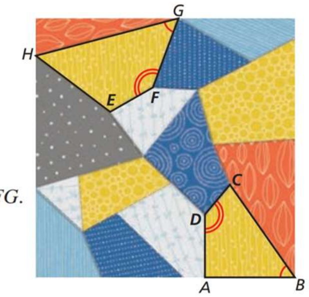
29. **MAKING AN ARGUMENT** Will a rectangle that has the same perimeter as $\triangle QRS$ have the same area as the triangle? Explain your reasoning.



EXAMPLE 3 Identifying Congruent Angles

a. Identify the congruent angles labeled in the quilt design.

b. $m\angle ADC = 140°$. What is $m\angle EFG$?



SOLUTION

a. There are two pairs of congruent angles:

$\angle ABC \cong \angle FGH$ and $\angle ADC \cong \angle EFG$.

b. Because $\angle ADC \cong \angle EFG$, $m\angle ADC = m\angle EFG$.

▶ So, $m\angle EFG = 140°$.

EXAMPLE 4 Finding Angle Measures

Given that $m\angle LKN = 145°$, find $m\angle LKM$ and $m\angle MKN$.

SOLUTION

Step 1 Write and solve an equation to find the value of x.

$m\angle LKN = m\angle LKM + m\angle MKN$	Angle Addition Postulate
$145° = (2x + 10)° + (4x - 3)°$	Substitute angle measures.
$145 = 6x + 7$	Combine like terms.
$138 = 6x$	Subtract 7 from each side.
$23 = x$	Divide each side by 6.

Step 2 Evaluate the given expressions when $x = 23$.

$$m\angle LKM = (2x + 10)° = (2 \cdot 23 + 10)° = 56°$$
$$m\angle MKN = (4x - 3)° = (4 \cdot 23 - 3)° = 89°$$

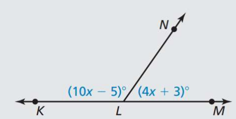
▶ So, $m\angle LKM = 56°$ and $m\angle MKN = 89°$.

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

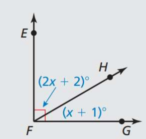
8. Without measuring, determine whether $\angle DAB$ and $\angle FEH$ in Example 3 appear to be congruent. Explain your reasoning. Use a protractor to verify your answer.

Find the indicated angle measures.

9. Given that $\angle KLM$ is a straight angle, find $m\angle KLN$ and $m\angle NLM$.



10. Given that $\angle EFG$ is a right angle, find $m\angle EFH$ and $m\angle HFG$.



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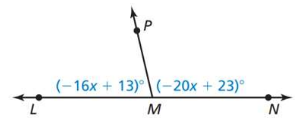
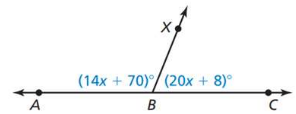
1.5 Practice with CalcChat® and CalcView®

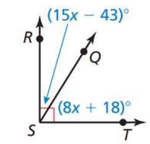
25. $\angle LMN$ is a straight angle. Find $m\angle LMP$ and $m\angle NMP$.



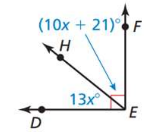
26. $\angle ABC$ is a straight angle. Find $m\angle ABX$ and $m\angle CBX$.



27. Find $m\angle RSQ$ and $m\angle TSQ$.

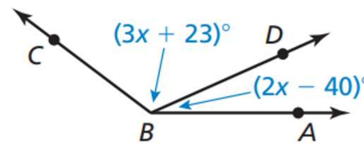


28. Find $m\angle DEH$ and $m\angle FEH$.



Closure

Display the diagram and say, "Given that $m\angle ABC = 143°$, find $m\angle ABD$ and $m\angle DBC$."



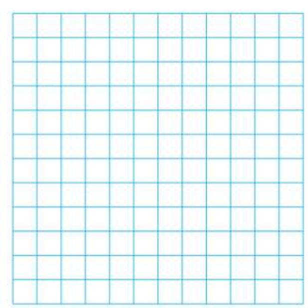
Friday 09/01/2023

Do Now 09/01/2023 **(5 minutes)**

Name: ______________________________ Period __

A right triangle has coordinates $(-3, 4)$, $(3, 6)$, and $(-1, -2)$.

What is the area of the right triangle?



Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

Agenda

- Describing pairs of angles
- Identifying pairs of angles
- Using complementary and supplementary angles

PBO

- 30 – 30 – 30 (common math-related word parts in the text, problem, or objective)
- Point of Use Annotation of the Performance Based Objective
- Universal Language of Literacy
- Word and Definition Walls

1.6 Describing Pairs of Angles

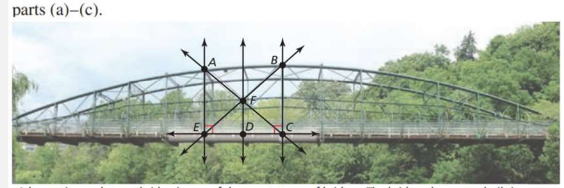
Laurie's Notes

Launch the Lesson **Aerial View of an Airport**

Make a list of pairs of angles and their relationships.

EXPLORE IT! **Identifying Pairs of Angles**

Work with a partner. The Blackfriars Street Bridge in London, Ontario, Canada, is a bowstring arch-truss bridge. Use the diagram to complete parts (a)–(c).



A bowstring arch-truss bridge is one of the rarest types of bridges. The bridge above was built in 1875. There are few bridges of this type remaining today.

Identify a pair of the indicated angles. Do not use the same pair of angles twice.

i. complementary angles

ii. supplementary angles

iii. adjacent angles

iv. vertical angles

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

Using Complementary and Supplementary Angles

Pairs of angles can have special relationships. The measurements of the angles or the positions of the angles in the pair determine the relationship.

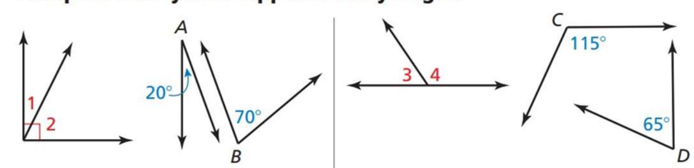
KEY IDEAS

Adjacent Angles

Adjacent angles are two angles that share a common vertex and side, but have no common interior points.

∠5 and ∠6 are adjacent angles. ∠7 and ∠8 are *nonadjacent* angles.

Complementary and Supplementary Angles



∠1 and ∠2 ∠A and ∠B

complementary angles

Complementary angles are two positive angles whose measures have a sum of 90°. Each angle is the *complement* of the other.

∠3 and ∠4 ∠C and ∠D

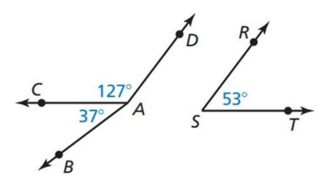
supplementary angles

Supplementary angles are two positive angles whose measures have a sum of 180°. Each angle is the *supplement* of the other.

EXAMPLE 1 Identifying Pairs of Angles

WATCH

In the diagram, name a pair of adjacent angles, a pair of complementary angles, and a pair of supplementary angles.



SOLUTION

∠*BAC* and ∠*CAD* share a common vertex and side, but have no common interior points. So, they are **adjacent angles.**

Because 37° + 53° = 90°, ∠*BAC* and ∠*RST* are **complementary angles.**

Because 127° + 53° = 180°, ∠*CAD* and ∠*RST* are **supplementary angles.**

Additional supporting and prerequisites standards are indicated on the curriculum map. In addition, this is not a comprehensive breakdown of each lesson for this weekly PLC protocol guide.

EXAMPLE 2 Finding Angle Measures

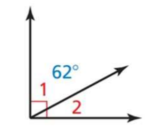
WATCH

a. $\angle 1$ is a complement of $\angle 2$, and $m\angle 1 = 62°$. Find $m\angle 2$.

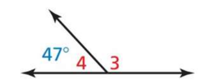
b. $\angle 3$ is a supplement of $\angle 4$, and $m\angle 4 = 47°$. Find $m\angle 3$.

SOLUTION

a. Draw a diagram with complementary adjacent angles to illustrate the relationship.



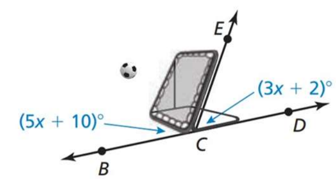
b. Draw a diagram with supplementary adjacent angles to illustrate the relationship.



EXAMPLE 3 Modeling Real Life

WATCH

When viewed from the side, the frame of a ball-return net forms a pair of supplementary angles with the ground. Find $m\angle BCE$ and $m\angle ECD$.



SOLUTION

Step 1 Use the fact that the sum of the measures of supplementary angles is 180°.

$m\angle BCE + m\angle ECD = 180°$ — Write an equation.

$(5x + 10)° + (3x + 2)° = 180°$ — Substitute angle measures.

$8x + 12 = 180$ — Combine like terms.

$x = 21$ — Solve for x.

Step 2 Evaluate the given expressions when $x = 21$.

$$m\angle BCE = (5x + 10)° = (5 \cdot 21 + 10)° = 115°$$

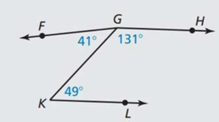
$$m\angle ECD = (3x + 2)° = (3 \cdot 21 + 2)° = 65°$$

▶ So, $m\angle BCE = 115°$ and $m\angle ECD = 65°$.

SELF-ASSESSMENT

1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

In Exercises 1 and 2, use the diagram.



1. Name a pair of adjacent angles, a pair of complementary angles, and a pair of supplementary angles.
2. Are $\angle KGH$ and $\angle LKG$ adjacent angles? Are $\angle FGK$ and $\angle FGH$ adjacent angles? Explain.
3. $\angle 1$ is a complement of $\angle 2$, and $m\angle 2 = 5°$. Find $m\angle 1$.
4. $\angle 3$ is a supplement of $\angle 4$, and $m\angle 3 = 148°$. Find $m\angle 4$.
5. $\angle LMN$ and $\angle PQR$ are complementary angles. Find the measures of the angles when $m\angle LMN = (4x - 2)°$ and $m\angle PQR = (9x + 1)°$.

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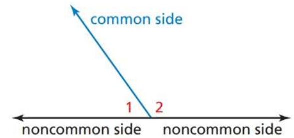
Using Other Angle Pairs

KEY IDEAS

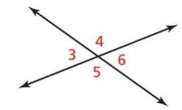
Linear Pairs and Vertical Angles

Two adjacent angles are a **linear pair** when their noncommon sides are opposite rays. The angles in a linear pair are supplementary angles.



∠1 and ∠2 are a linear pair.

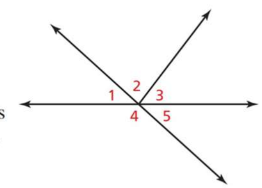
Two angles are **vertical angles** when their sides form two pairs of opposite rays.



∠3 and ∠6 are vertical angles.
∠4 and ∠5 are vertical angles.

EXAMPLE 4 Identifying Angle Pairs

Identify all the linear pairs and all the vertical angles in the diagram.



SOLUTION

To find linear pairs, look for adjacent angles whose noncommon sides are opposite rays.

▶ ∠1 and ∠4 are a linear pair.

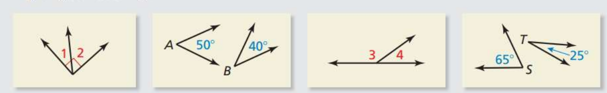
∠4 and ∠5 are also a linear pair.

To find vertical angles, look for pairs of opposite rays.

▶ ∠1 and ∠5 are vertical angles.

SELF-ASSESSMENT 1 I do not understand. 2 I can do it with help. 3 I can do it on my own. 4 I can teach someone else.

6. **WRITING** Explain the difference between adjacent angles and vertical angles.
7. **WHICH ONE DOESN'T BELONG?** Which one does *not* belong with the other three? Explain your reasoning.



Practice & Exit Ticket

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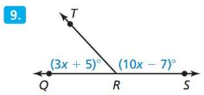
			1.6 Practice WITH CalcChat® AND CalcView® **In Exercises 5–8, find the angle measure.** *Example 2* **5.** $\angle 1$ is a complement of $\angle 2$, and $m\angle 1 = 23°$. Find $m\angle 2$. **6.** $\angle 3$ is a complement of $\angle 4$, and $m\angle 3 = 46°$. Find $m\angle 4$. **7.** $\angle 5$ is a supplement of $\angle 6$, and $m\angle 5 = 78°$. Find $m\angle 6$. **8.** $\angle 7$ is a supplement of $\angle 8$, and $m\angle 7 = 109°$. Find $m\angle 8$. **In Exercises 9–12, find the measure of each angle.** *Example 3* **9.**  **In Exercises 19–24, find the measure of each angle.** *Example 5* **19.** Two angles form a linear pair. The measure of one angle is twice the measure of the other angle. **20.** Two angles form a linear pair. The measure of one angle is $\frac{1}{3}$ the measure of the other angle. **21.** The measure of an angle is $\frac{1}{4}$ the measure of its complement. **22.** The measure of an angle is nine times the measure of its complement. **23.** The ratio of the measure of an angle to the measure of its complement is 4 : 5. **24.** The ratio of the measure of an angle to the measure of its complement is 2 : 7.
7	What **manipulatives** might be integrated into the lesson? What did you learn from using the manipulatives **in advance** of using them in class with students?		Compass and straightedge, string, reflective devices, paper folding, dynamic geometric software, protractor, etc. **Reference:** Interactive Manipulatives • Didax Virtual Manipulatives
8	What **graphic organizer(s)** might support students' conceptual understanding of the process outlined by the performance-based objective(s)?		**Reference:** • Graphic Organizer Templates • Google Drawing Graphic Organizers Teacher Vision

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