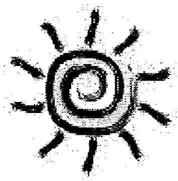
Welcome to Applied Geometry 2021-22

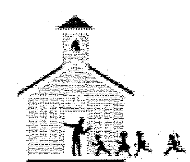


Attached is your summer assignment for next year's course. Please understand that this is not a punishment. In reality, it is an opportunity for you to (1) review selected topics from Geometry you learned in middle school that your next course assumes you are proficient at and (2) to get a jump on some basic geometric terms. The best time to work through your summer assignment is in the second half of the summer so the material will be more fresh in your mind when you return at the end of August.

Your summer assignment:

- Read the lessons and do the worksheets as outlined in the assignment sheet on page 2. Please read carefully and **check the answers to the On Your Own problems so you know that you are on the right track**. For two of the topics, there are websites with videos that can help reteach the material if you need extra assistance after you read through the lesson and sample problems.
- To get a new copy of this packet, go to nwr7.com, click on High School, then Academics, then Summer Assignments. Once you are on that page, find Applied Geometry. You should have a link to all the same items as in this packet.
- Make sure you use pencil for the worksheets; **ink will not be accepted! Show all your work!**
- Your summer assignment with the vocabulary will count for 4 homework checks and will be collected the first day of class.
- The **fourth day (or so…) of school, you will have a test** on the summer assignment material. It should be all review!!! Two class days is not enough time to re-teach the information in the packet. It is your responsibility to come to school on the first day with only the questions that you could not work out on your own.

For the first day of class:



- Have your **summer assignment in order**, stapled, and ready to turn in.
- Solely for Geometry, have a three-ring **binder ready** with 4 dividers, white lined paper and graph paper.
- Bring your **calculator (you cannot use your phone as a calculator!)**. We recommend the TI -84, T1-84 Plus or T1-83 (these are graphing calculators) or the TI 30-X IIS (a less expensive scientific calculator).
- Bring a protractor, a compass, your **pencils** (and one pen for corrections) and a ruler. You might consider purchasing a pouch to hold your tools, as well. We will be emailing a reminder letter with detailed info about supplies in August to help you get the materials you need.

Enjoy your summer, and make time for this important work that will get us off to a great start in August. Email one or both of us if you have any questions (jgallaway@nwr7.org or gmitesser@nwr7.org). We look forward to an awesome, rewarding school year with you!

Mrs. Gallaway and Mr. Mitesser

June, 2021

Area of Rectangles and Triangles (Chapter 4.1-4.3 from Resource Book)

- Read "What You've Learned Before" (no page number) and 4.2 Lesson on pages 160-161. Complete the three Try It Yourself problems (area of rectangles) and the four On Your Own Questions within the lesson as you read.
- Check your answers to the seven Try It Yourself/On Your Own questions with the Selected Answers key at the back of this packet. If they are all correct, proceed to the Exercises. If not, reread the examples in the Lesson and rework the problem(s) you missed.
- If needed, watch the Math Antics Video, Area, at

https://www.youtube.com/watch?v=xCdxURXMdFY&list=PLL1sM9z3kAF7xaKNylmN3RSEeTvWOK8le

- Do the 4.1 Area of Rectangles Worksheet.
- Do the 4.2 Area of Triangles Matching Worksheet.
- Do the 4.2 Area of Triangles Practice Worksheet.
- Do the 4.3 Area of Compound Figures Practice Worksheet.

Area and Perimeter in a Coordinate Plane (Chapter 4.4 from Resource Book)

- Read 4.4 Lesson on pages 176-177. Complete the six On Your Own Questions within the lesson as you read.
- Check your answers to the six On Your Own questions with the Selected Answers key at the back of this packet. If they are all correct, proceed to the Exercises. If not, reread the examples in the Lesson and rework the problem(s) you missed.
- Do the Ch. 4.4 Area and Perimeter in a Coordinate Plane Worksheet.

Pythagorean Theorem (Chapter 14 from Resource Book)

- Read 14.3 Lesson on pages 640-641. Complete the five On Your Own questions within the lesson as you read.
- Check your answers to the five On Your Own questions with the Selected Answers key at the back of this packet. If they are all correct, proceed to the Exercises. If not, reread the examples in the Lesson and rework the problem(s) you missed.
- If needed, watch the Khan Academy video, Pythagorean Theorem Example, at

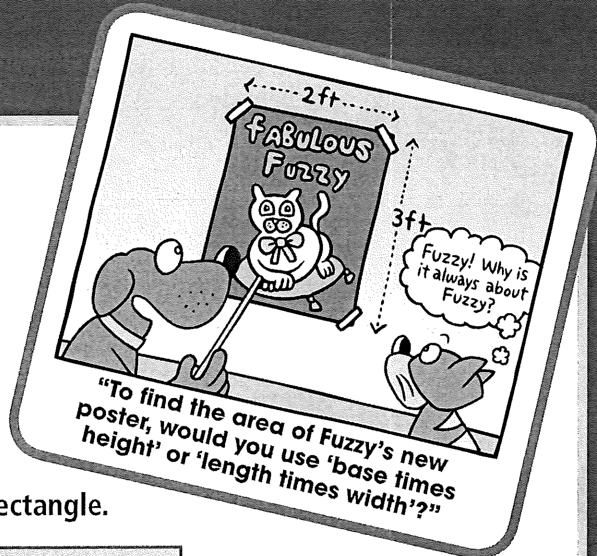
https://www.khanacademy.org/math/cc-eighth-grade-math/cc-8th-geometry/cc-8th-pythagorean-theorem/v/pythagorean-theorem-2

- Do the 14.3 Pythagorean Theorem Practice Worksheet.

Reading Guide 1.1 (Chapter 1 from Discovering Geometry)

- Read Section 1.1 from our text on pages 28-32. Complete Reading Guide 1.1 as you read.
- Read pages 7-8 and look at the examples for how to draw an astrid and an 8-pointed star design. Try to recreate these designs on the templates at the end of Reading Guide 1.1.

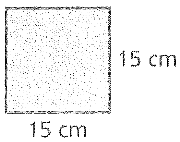
What You Learned Before



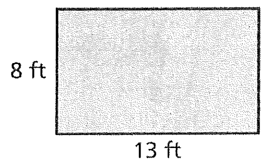
Finding Areas of Squares and Rectangles

Example 1 **Find the area of the square or rectangle.**

a.



b.



$A = s^2$	Write formula.	$A = \ell w$
$= 15^2$	Substitute.	$= 13(8)$
$= 225$	Simplify.	$= 104$

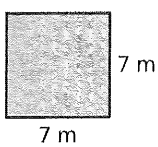
The area of the square is 225 square centimeters.

The area of the rectangle is 104 square feet.

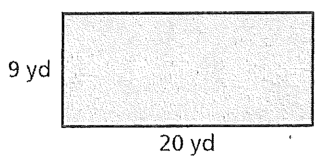
Try It Yourself

Find the area of the square or rectangle.

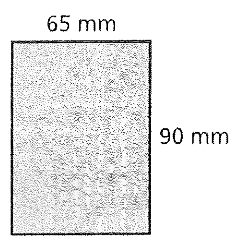
1.



2.



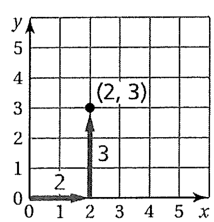
3.



Plotting Ordered Pairs

Example 2 **Plot (2, 3) in a coordinate plane.**

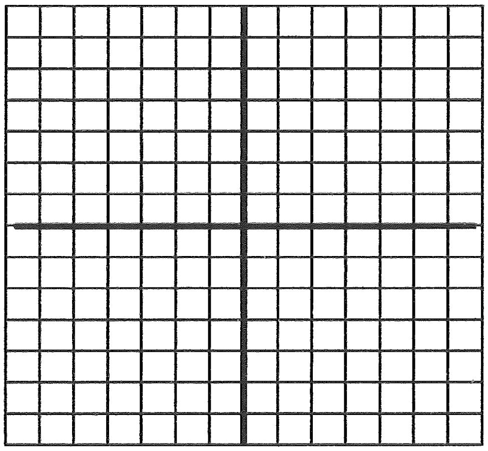
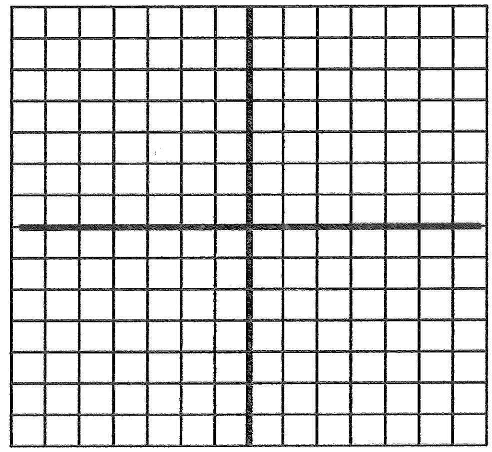
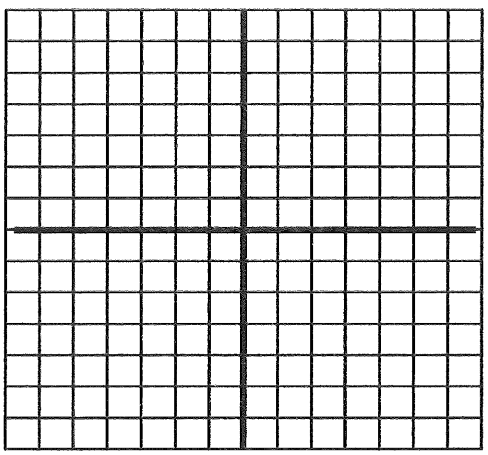
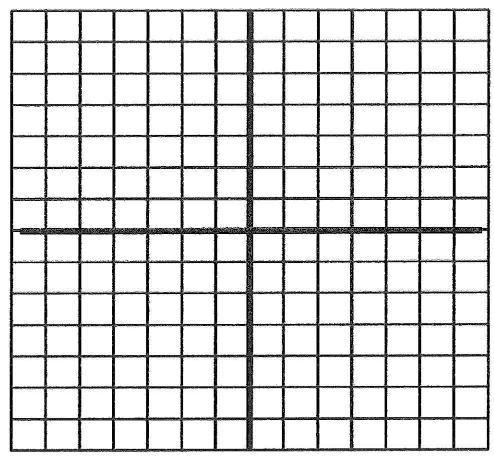
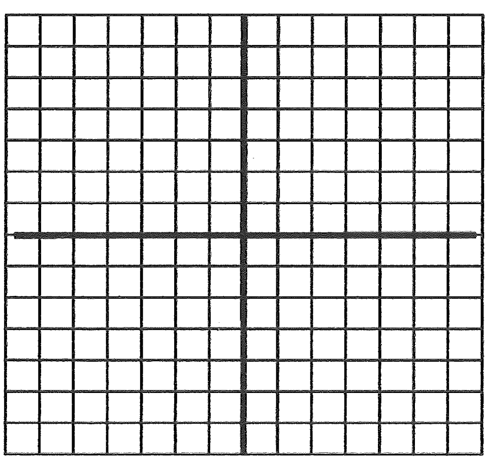
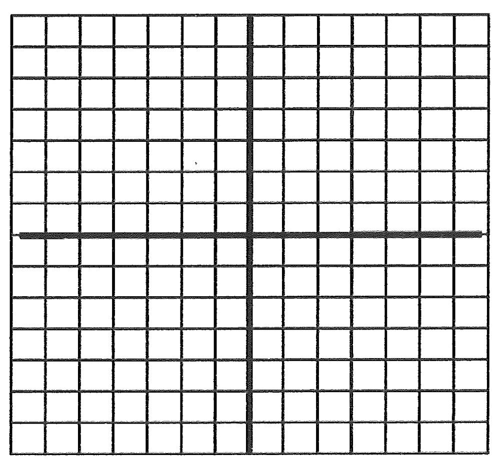
Start at the origin. Move 2 units right and 3 units up. Then plot the point.



Try It Yourself

Plot the ordered pair in a coordinate plane. Use the grids on the back of this page.

4. (1, 4) **5.** (3, 2) **6.** (5, 1)

4.2 Lesson

Check It Out
Lesson Tutorials
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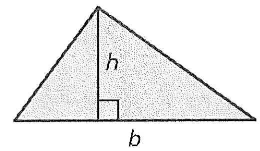
Key Idea

Area of a Triangle

Words The area A of a triangle is one-half the product of its base b and its height h.

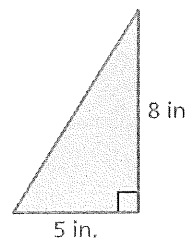
Algebra $A = \frac{1}{2}bh$



EXAMPLE 1 Finding the Area of a Triangle

Find the area of the triangle.

$A = \frac{1}{2}bh$	Write formula.
$= \frac{1}{2}(5)(8)$	Substitute 5 for b and 8 for h.
$= \frac{1}{2}(40)$	Multiply 5 and 8.
$= 20$	Multiply $\frac{1}{2}$ and 40.

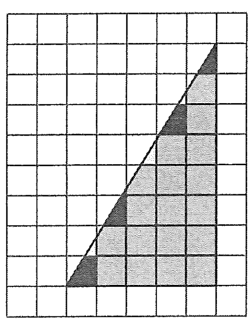


Remember

In Example 1, use the Associative Property of Multiplication to multiply 5 and 8 first.

∴ The area of the triangle is 20 square inches.

Reasonable? Draw the triangle on grid paper and count unit squares. Each square in the grid represents 1 square inch.



Squares full or nearly full: 18

Squares about half full: 4

The area is $18(1) + 4\left(\frac{1}{2}\right) = 20$ square inches.

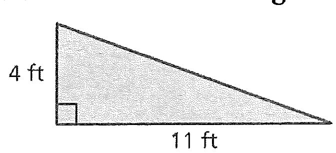
So, the answer is reasonable. ✓

On Your Own

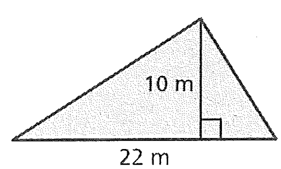
Now You're Ready
Exercises 3–8

Find the area of the triangle.

1.

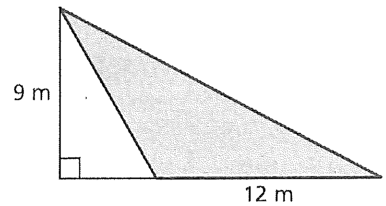


2.



EXAMPLE 2 Finding the Area of a Triangle

Find the area of the triangle.



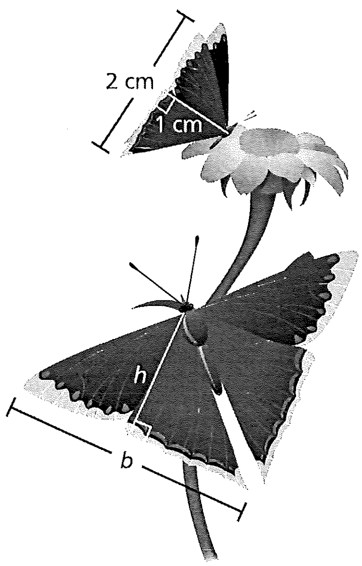
$A = \frac{1}{2}bh$ Write formula.

$= \frac{1}{2}(12)(9)$ Substitute 12 for b and 9 for h.

$= 54$ Multiply.

∴ The area of the triangle is 54 square meters.

EXAMPLE 3 Real-Life Application



The base and height of the red butterfly wing are two times greater than the base and height of the blue butterfly wing. How many times greater is the area of the red wing than the area of the blue wing?

Find the area of the blue wing.

$A = \frac{1}{2}bh$ Write formula.

$= \frac{1}{2}(2)(1)$ Substitute 2 for b and 1 for h.

$= 1 \text{ cm}^2$ Multiply.

The red wing dimensions are 2 times greater, so the base is $2 \times 2 = 4$ cm and the height is $2 \times 1 = 2$ cm. Find the area of the red wing.

$A = \frac{1}{2}bh$ Write formula.

$= \frac{1}{2}(4)(2)$ Substitute 4 for b and 2 for h.

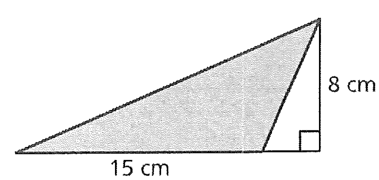
$= 4 \text{ cm}^2$ Multiply.

∴ Because $\frac{4\,\cancel{\text{cm}^2}}{1\,\cancel{\text{cm}^2}} = 4$, the area of the red wing is 4 times greater.

On Your Own

Now You're Ready
Exercises 12–14

3. Find the area of the triangle.



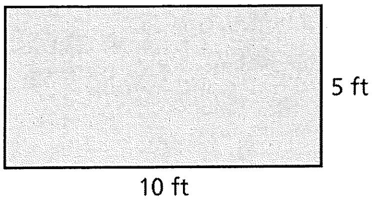
4. **WHAT IF?** In Example 3, the base and the height of the red butterfly wing are three times greater than those of the blue wing. How many times greater is the area of the red wing?

Name ______________________________ Date __________

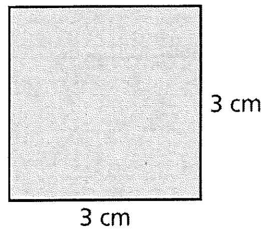
Chapter 4.1 Area of Rectangles

Find the area of each square or rectangle. Show the calculation you used and include appropriate units in your answer.

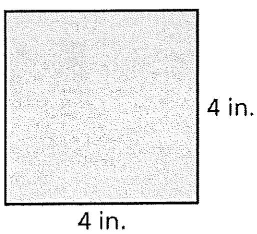
1.



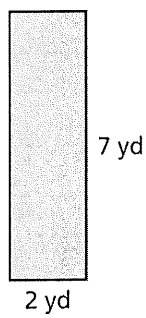
2.



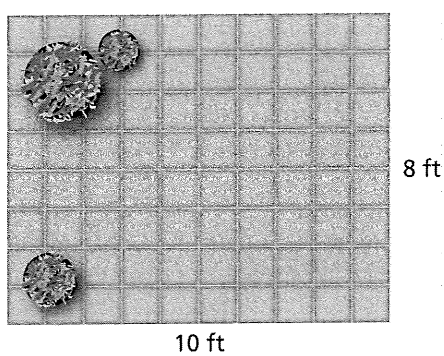
3.



4.



5. Find the area of the patio.



6. Draw and label two different rectangles whose area is 36 square centimeters.

Name ______________________________ Date __________

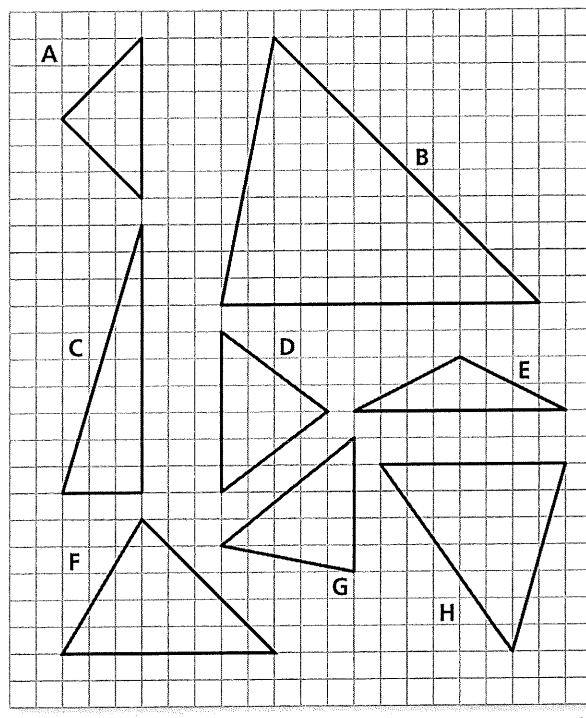
4.2 Areas of Triangles Matching

ACTIVITY: Estimating and Finding the Area of a Triangle

Work with a partner. Each grid square represents 1 square centimeter.

- **Use estimation to match each triangle with its area.**
- **Then check your work by finding the exact area of each triangle.**

	Area	*Estimate Match*	*Exact Match*
a.	15 cm^2	________	________
b.	20 cm^2	________	________
c.	9 cm^2	________	________
d.	12 cm^2	________	________
e.	60 cm^2	________	________
f.	$12\frac{1}{2} \text{ cm}^2$	________	________
g.	$24\frac{1}{2} \text{ cm}^2$	________	________
h.	8 cm^2	________	________



Not drawn to scale

Name ______________________________ Date __________

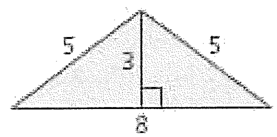
4.2 Area of Triangles Practice
For use after Lesson 4.2

Vocabulary and Concept Check

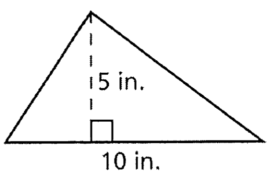
1. **CRITICAL THINKING** Can *any* side of a triangle be labeled as its base? Explain.

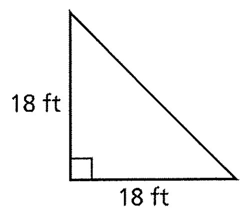
2. **DIFFERENT WORDS, SAME QUESTION** Which is different? Find "both" answers.

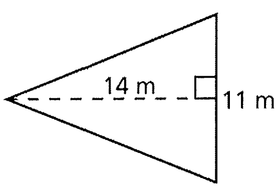
What is the area of the triangle?	What is the distance around the triangle?
How many unit squares fit in the triangle?	What is one-half the product of the base and the height?

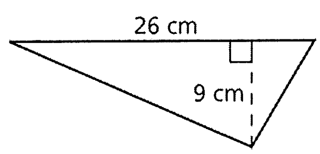


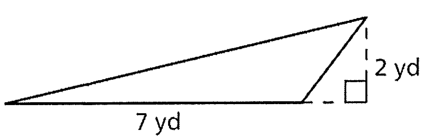
Find the area of each triangle. Show the calculation you used and include appropriate units in your answer.

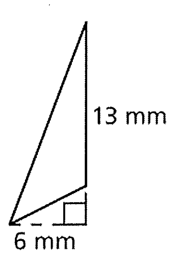
3. 

4. 

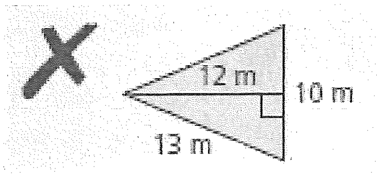
5. 

6. 

7. 

8. 

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

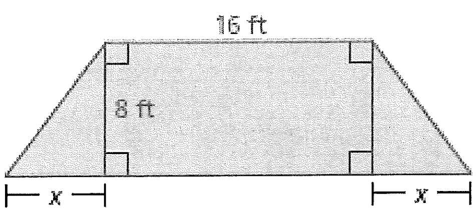


$$A = \frac{1}{2}(10)(13)$$
$$= 65 \text{ m}^2$$

10. Draw and label two different triangles whose area is 24 square cm.

11. **CORNER SHELF** A shelf has the shape of a triangle. The base of the shelf is 36 cm, and the height is 18 cm. Draw a picture to represent the shelf and then find its area.

12. The total area of the polygon is 176 square feet. Find the value of x.

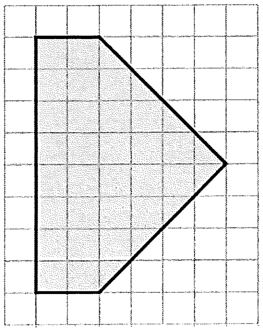


Name ______________________________ Date __________

Extension 4.3 Area of Compound Figures Practice

Find the area of the shaded figure.

1.



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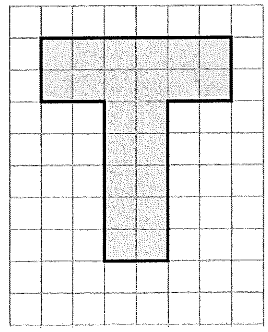

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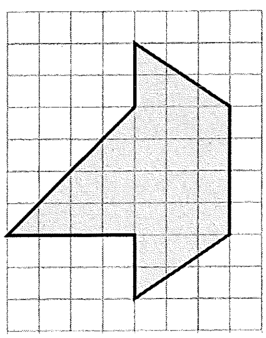

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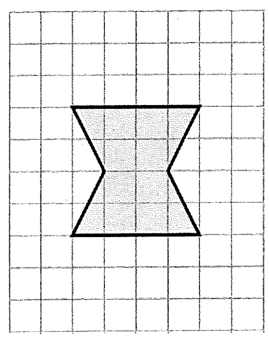
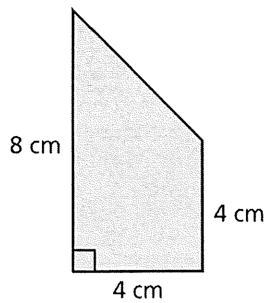
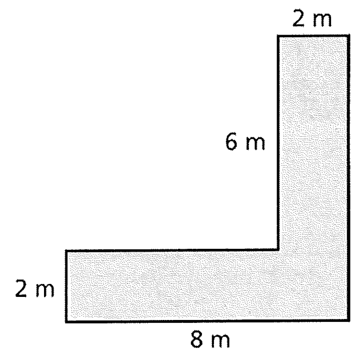


Find the area of each figure. Show your calculations and include appropriate units in your answer.

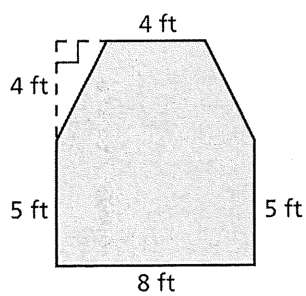
5.



6.



7.



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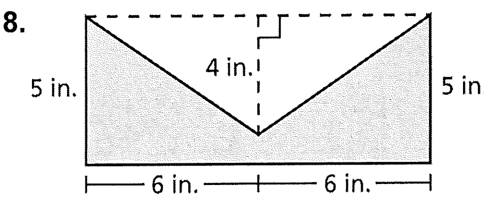


9. You add a 4-foot-by-4-foot section of land to a 6-foot-by-8-foot garden. Find the area of the new garden.

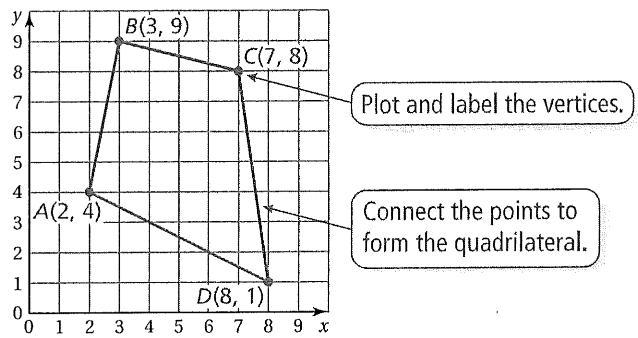
4.4 Lesson

Check It Out
Lesson Tutorials
BigIdeasMath.com

You can use ordered pairs to represent vertices of polygons. To draw a polygon in a coordinate plane, plot and connect the ordered pairs.

EXAMPLE 1 Drawing a Polygon in a Coordinate Plane

The vertices of a quadrilateral are $A(2, 4)$, $B(3, 9)$, $C(7, 8)$, and $D(8, 1)$. Draw the quadrilateral in a coordinate plane.



Study Tip

After you plot the vertices, connect them *in order* to draw the polygon.

On Your Own

Now You're Ready
Exercises 6–11

Draw the polygon with the given vertices in a coordinate plane. Use the grids on the following page.

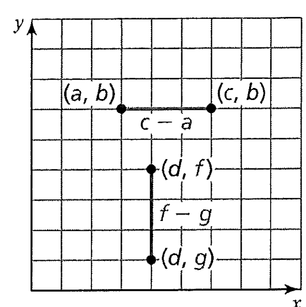
1. $A(0, 0)$, $B(5, 7)$, $C(7, 4)$
2. $W(4, 4)$, $X(7, 4)$, $Y(7, 1)$, $Z(4, 1)$
3. $F(1, 3)$, $G(3, 6)$, $H(5, 6)$, $J(3, 3)$
4. $P(1, 4)$, $Q(3, 5)$, $R(7, 3)$, $S\left(6, \frac{1}{2}\right)$, $T\left(2, \frac{1}{2}\right)$

Key Idea

Finding Distances in the First Quadrant

You can find the length of a horizontal or vertical line segment in a coordinate plane by using the coordinates of the endpoints.

- When the x-coordinates are the same, the vertical distance between the points is the difference of the y-coordinates.
- When the y-coordinates are the same, the horizontal distance between the points is the difference of the x-coordinates.



Be sure to subtract the lesser coordinate from the greater coordinate.

EXAMPLE 2 Finding a Perimeter

The vertices of a rectangle are $F(1, 6)$, $G(7, 6)$, $H(7, 2)$, and $J(1, 2)$. Draw the rectangle in a coordinate plane and find its perimeter.

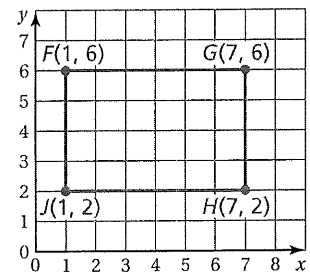
Draw the rectangle and use the vertices to find its dimensions.

Study Tip

You can also find the length using vertices *H* and *J*. You can find the width using vertices *F* and *J*.

The length is the horizontal distance between $F(1, 6)$ and $G(7, 6)$, which is the difference of the x-coordinates.

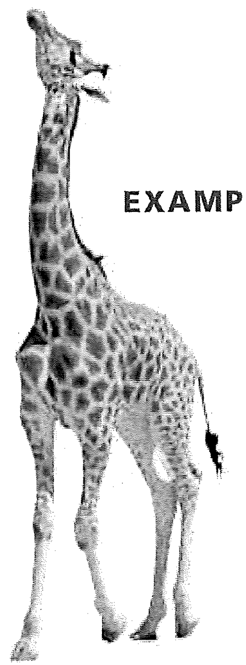
length $= 7 - 1 = 6$ units



The width is the vertical distance between $G(7, 6)$ and $H(7, 2)$, which is the difference of the y-coordinates.

width $= 6 - 2 = 4$ units

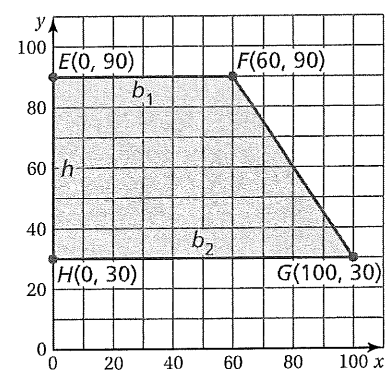
So, the perimeter of the rectangle is $2(6) + 2(4) = 20$ units.



EXAMPLE 3 Real-Life Application

In a grid of the exhibits at a zoo, the vertices of the giraffe exhibit are $E(0, 90)$, $F(60, 90)$, $G(100, 30)$, and $H(0, 30)$. The coordinates are measured in feet. What is the area of the giraffe exhibit?

Plot and connect the vertices using a coordinate grid to form a trapezoid. Use the coordinates to find the lengths of the bases and the height.



$b_1 = 60 - 0 = 60$

$b_2 = 100 - 0 = 100$

$h = 90 - 30 = 60$

Use the formula for the area of a trapezoid.

$$A = \frac{1}{2}(60)(60 + 100)$$

$$= \frac{1}{2}(60)(160) = 4800$$

The area of the giraffe exhibit is 4800 square feet.

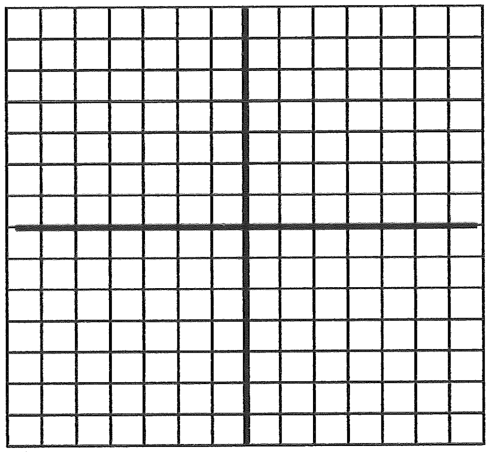
Common Error

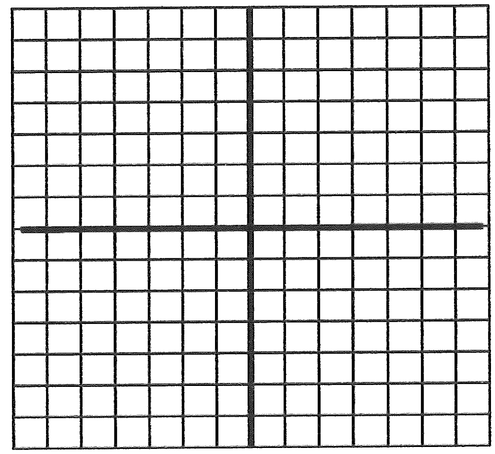
You can count grid lines to find the dimensions, but make sure you consider the scale of the axes.

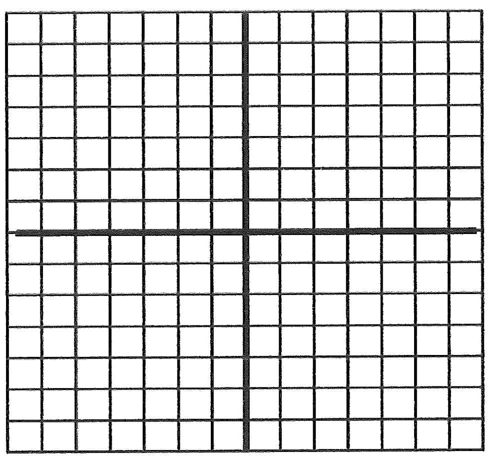
On Your Own

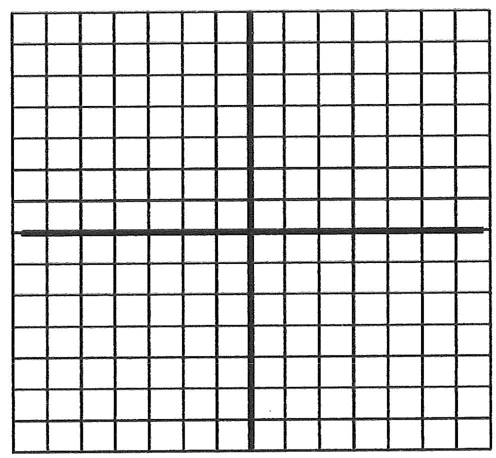
Now You're Ready Exercises 12–15

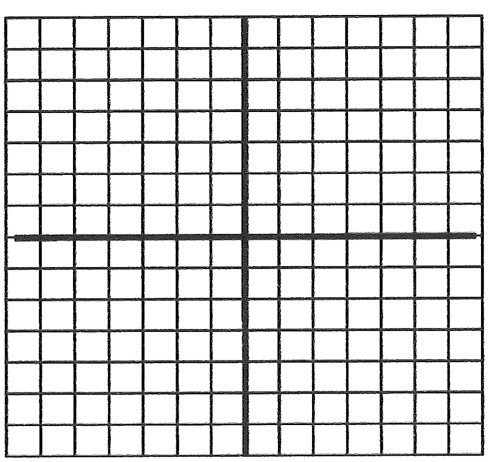
5. The vertices of a rectangle are $J(2, 7)$, $K(4, 7)$, $L(4, 1.5)$, and $M(2, 1.5)$. Find the perimeter and the area of the rectangle. → Use the grid on the following page.
6. **WHAT IF?** In Example 3, the giraffe exhibit is enlarged by moving vertex F to $(80, 90)$. How does this affect the area? Explain.

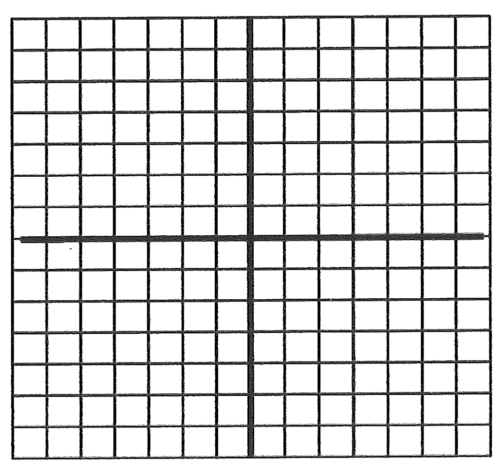












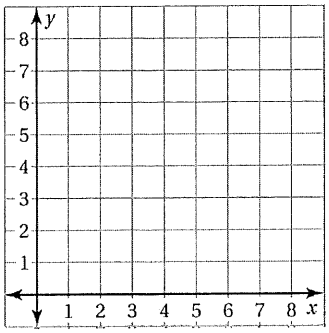
Name ____________________ Date ________

4.4 Area and Perimeter in a Coordinate Plane Practice

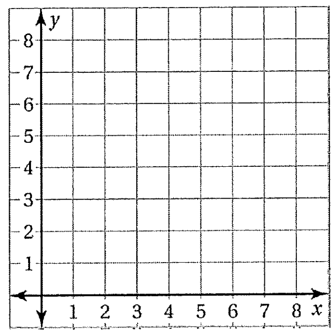
For use after Lesson 4.4

Plot and label each pair of points in the coordinate plane. Find the area of the polygon.

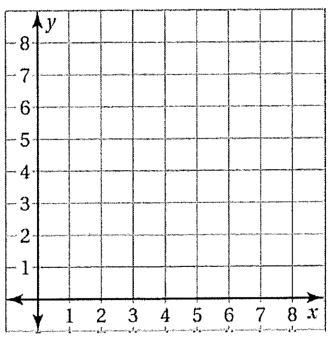
1. $A(2, 2)$, $B(2, 6)$, $C(5, 2)$



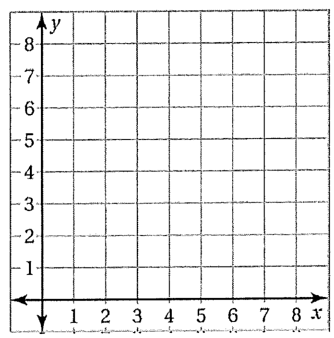
2. $D(3, 2)$, $E(3, 7)$, $F(6, 2)$, $G(6, 7)$



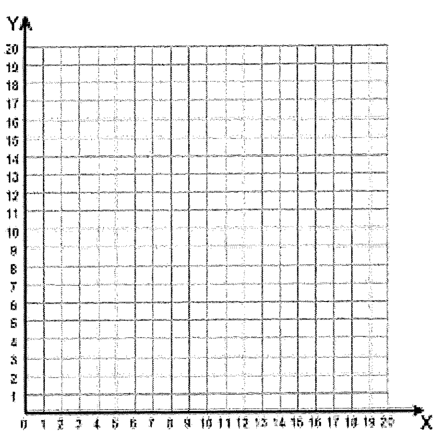
3. $H(3, 3)$, $I(3, 7)$, $J(7, 7)$, $K(7, 3)$



4. $L(1, 2)$, $M(1, 7)$, $N(7, 4)$



5. The vertices of a sandbox are $P(12, 14)$, $Q(12, 17)$, $R(16, 17)$, and $S(16, 14)$. The coordinates are measured in feet. What is the perimeter of the sandbox?
[Can you answer this question without graphing? If not, use the coordinate plane below.]



14.3 Lesson

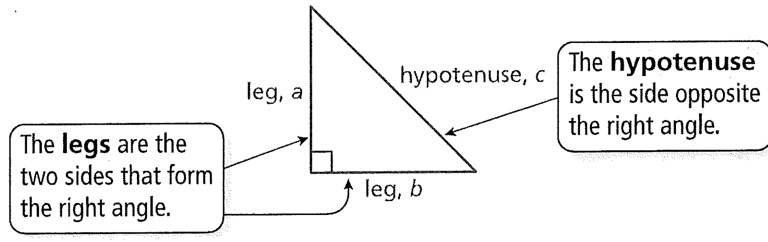
Check It Out
Lesson Tutorials
BigIdeasMath.com

Key Vocabulary
theorem, *p. 638*
legs, *p. 640*
hypotenuse, *p. 640*
Pythagorean Theorem, *p. 640*

Key Ideas

Sides of a Right Triangle

The sides of a right triangle have special names.



Study Tip

In a right triangle, the legs are the shorter sides and the hypotenuse is always the longest side.

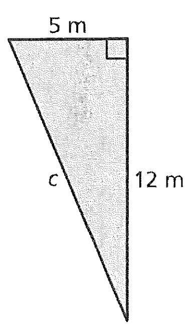
The Pythagorean Theorem

Words In any right triangle, the sum of the squares of the lengths of the legs is equal to the square of the length of the hypotenuse.

Algebra $a^2 + b^2 = c^2$

EXAMPLE 1 Finding the Length of a Hypotenuse

Find the length of the hypotenuse of the triangle.



$a^2 + b^2 = c^2$	Write the Pythagorean Theorem.
$5^2 + 12^2 = c^2$	Substitute 5 for *a* and 12 for *b*.
$25 + 144 = c^2$	Evaluate powers.
$169 = c^2$	Add.
$\sqrt{169} = \sqrt{c^2}$	Take positive square root of each side.
$13 = c$	Simplify.

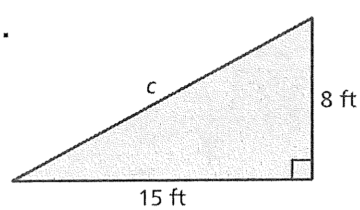
∴ The length of the hypotenuse is 13 meters.

On Your Own

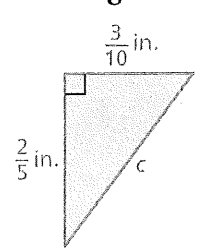
Now You're Ready
Exercises 3 and 4

Find the length of the hypotenuse of the triangle.

1.

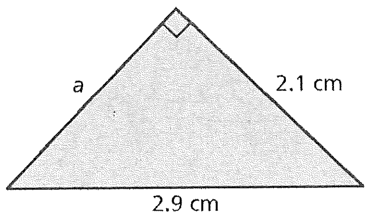


2.



EXAMPLE 2 Finding the Length of a Leg

Find the missing length of the triangle.

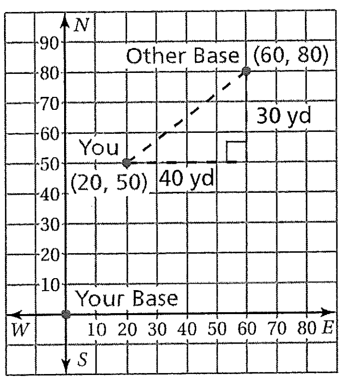


$a^2 + b^2 = c^2$	Write the Pythagorean Theorem.
$a^2 + 2.1^2 = 2.9^2$	Substitute 2.1 for *b* and 2.9 for *c*.
$a^2 + 4.41 = 8.41$	Evaluate powers.
$a^2 = 4$	Subtract 4.41 from each side.
$a = 2$	Take positive square root of each side.

∴ The missing length is 2 centimeters.

EXAMPLE 3 Real-Life Application

You are playing capture the flag. You are 50 yards north and 20 yards east of your team's base. The other team's base is 80 yards north and 60 yards east of your base. How far are you from the other team's base?



Step 1: Draw the situation in a coordinate plane. Let the origin represent your team's base. From the descriptions, you are at (20, 50) and the other team's base is at (60, 80).

Step 2: Draw a right triangle with a hypotenuse that represents the distance between you and the other team's base. The lengths of the legs are 30 yards and 40 yards.

Step 3: Use the Pythagorean Theorem to find the length of the hypotenuse.

$a^2 + b^2 = c^2$	Write the Pythagorean Theorem.
$30^2 + 40^2 = c^2$	Substitute 30 for *a* and 40 for *b*.
$900 + 1600 = c^2$	Evaluate powers.
$2500 = c^2$	Add.
$50 = c$	Take positive square root of each side.

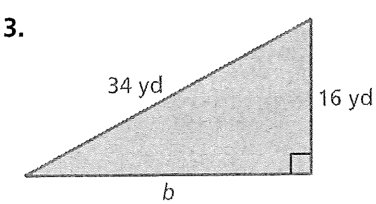
∴ So, you are 50 yards from the other team's base.

On Your Own

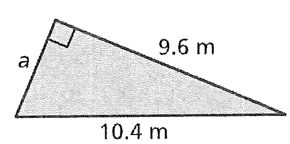
Now You're Ready
Exercises 5–8

Find the missing length of the triangle.

3.



4.



5. In Example 3, what is the distance between the bases?

Name ______________________________ Date __________

14.3 Pythagorean Theorem Practice
For use after Lesson 14.3

1. **VOCABULARY:** In a right triangle, how can you tell which sides are the legs and which side is the hypotenuse?

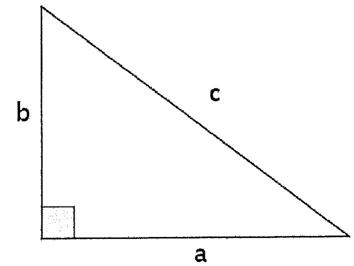
2. **DIFFERENT WORDS, SAME QUESTION:** Which phrase is different? Find "both" answers.

Which side is the hypotenuse?

Which side is the longest?

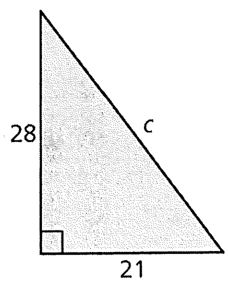
Which side is a leg?

Which side is opposite the 90° angle?

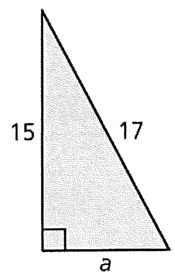


Find the missing length of the triangle. Show all work. You should use a calculator.

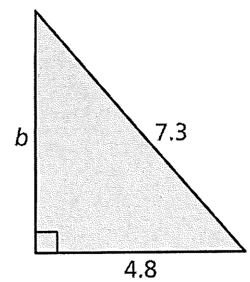
3.



4.

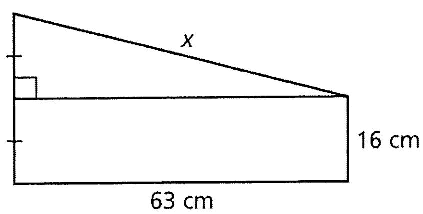


5.

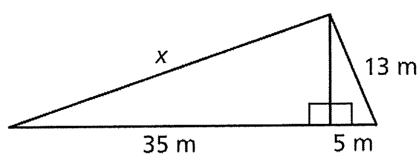


Find the missing length of the figure. Show all work. You should use a calculator.

6.

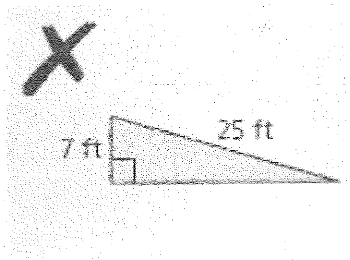


7.



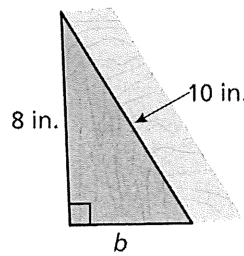
[Hint: You will need to use the Pythagorean Theorem twice!]

8. **ERROR ANALYSIS:** Describe and correct the error in the work shown below.



$$a^2 + b^2 = c^2$$
$$7^2 + 25^2 = c^2$$
$$674 = c^2$$
$$\sqrt{674} = c$$

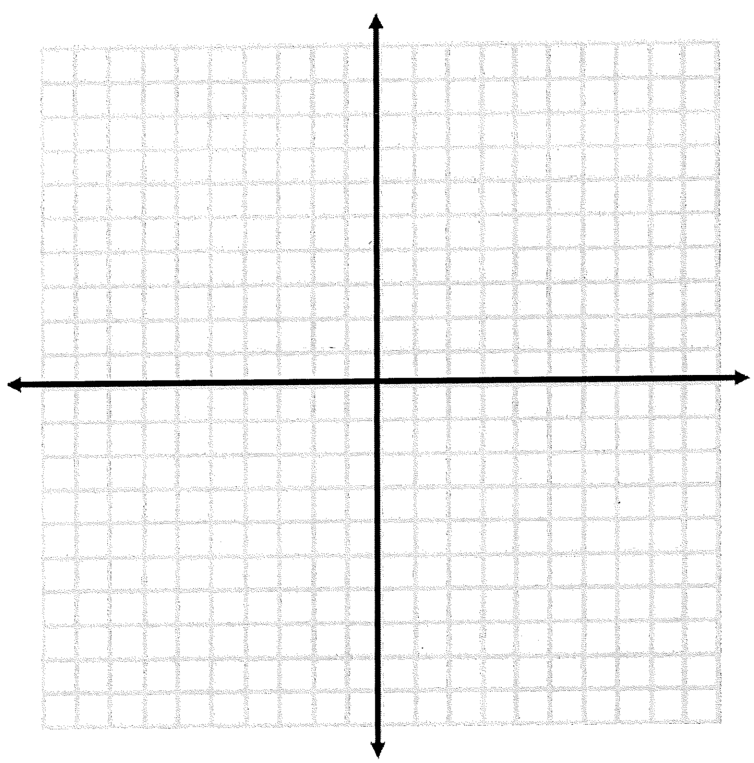
9. In wood shop, you make a bookend that is in the shape of a right triangle. What is the base b of the bookend?



10. SNOWBALLS You and a friend stand back to back. You run 20 feet forward then 15 feet to your right. At the same time, your friend runs 16 feet forward then 12 feet to her right. She stops, turns, and hits you with a snowball.

a. Draw the situation in the coordinate plane at right. [Hint: How might you scale the axes to make the situation fit on the graph?]

b. How far does your friend throw the snowball? Show the work you used to calculate your answer.

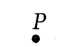


LESSON 1.1

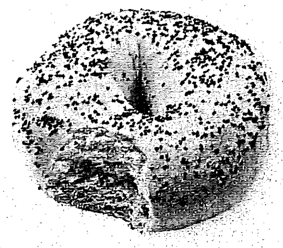
Building Blocks of Geometry

Nature's Great Book is written in mathematical symbols.
GALILEO GALILEI

Three building blocks of geometry are points, lines, and planes. A **point** is the most basic building block of geometry. It has no size. It has only location. You represent a point with a dot, and you name it with a capital letter. The point shown below is called P.

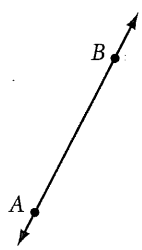


Mathematical model of a point

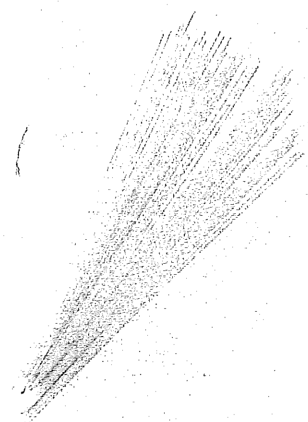


A tiny seed is a physical model of a point.

A **line** is a straight, continuous arrangement of infinitely many points. It has infinite length but no thickness. It extends forever in two directions. You name a line by giving the letter names of any two points on the line and by placing the line symbol above the letters, for example, $\overleftrightarrow{AB}$ or $\overleftrightarrow{BA}$.

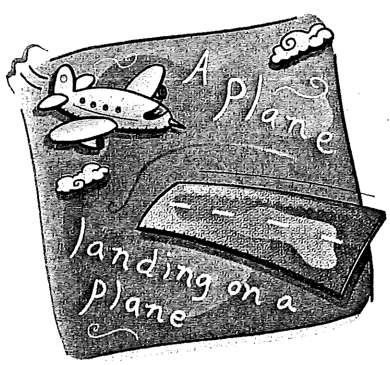


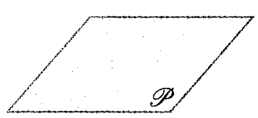
Mathematical model of a line



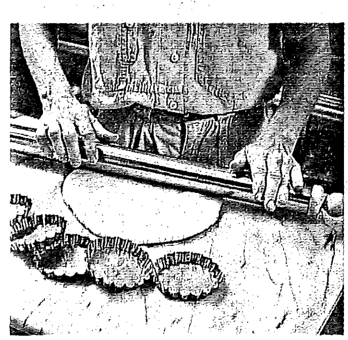
A piece of spaghetti is a physical model of a line. A line, however, is longer, straighter, and thinner than any piece of spaghetti ever made.

A **plane** has length and width but no thickness. It is like a flat surface that extends infinitely along its length and width. You represent a plane with a four-sided figure, like a tilted piece of paper, drawn in perspective. Of course, this actually illustrates only part of a plane. You name a plane with a script capital letter, such as $\mathcal{P}$.



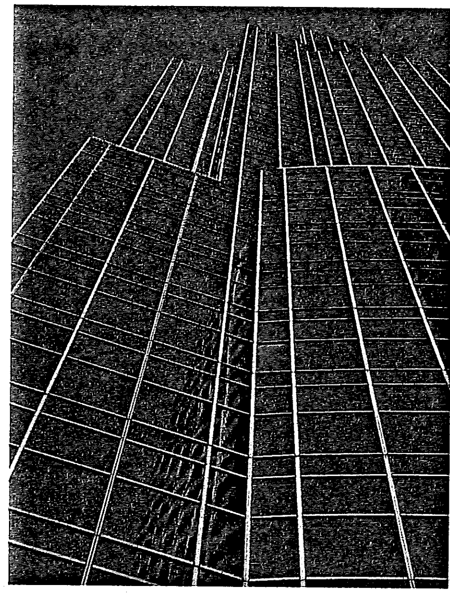


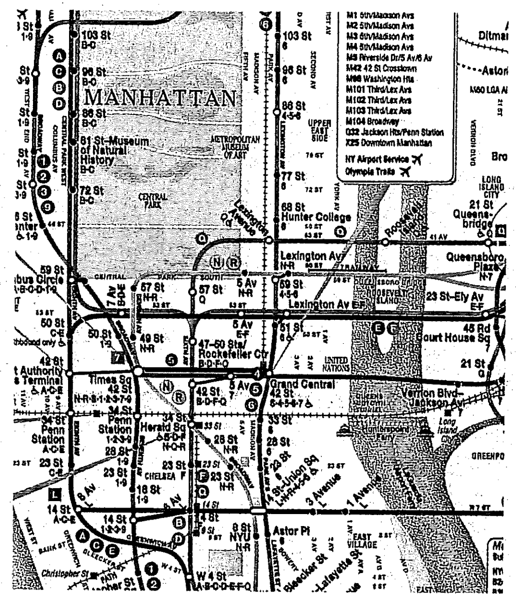
Mathematical model of a plane



A flat piece of rolled-out dough is a model of a plane, but a plane is broader, wider, and thinner than any piece of dough you could roll.

Investigation
Mathematical Models

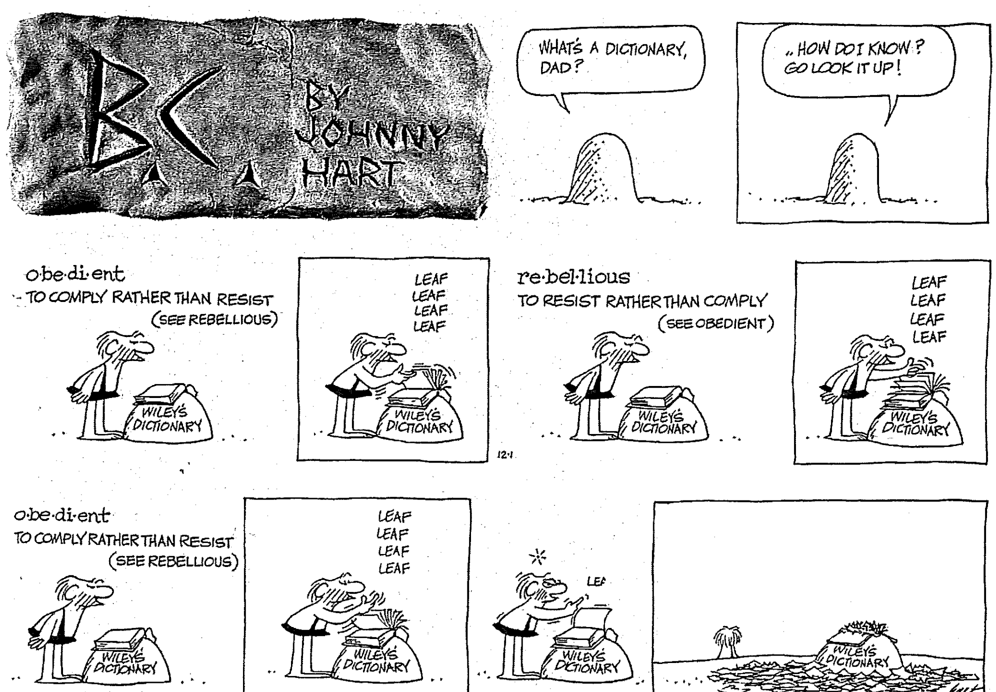




Step 1 | Identify examples of points, lines, and planes in these pictures.

Step 2 | Explain in your own words what point, line, and plane mean.

It can be difficult to explain what points, lines, and planes are. Yet, you probably recognized several models of each in the investigation. Early mathematicians tried to define these terms.



By permission of Johnny Hart and Creators Syndicate, Inc.

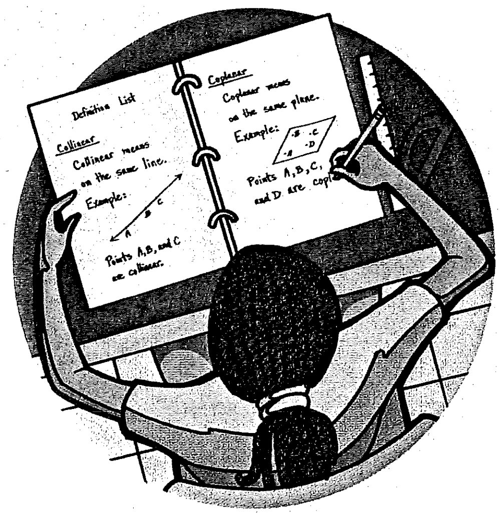
The ancient Greeks said, "A point is that which has no part. A line is breadthless length." The Mohist philosophers of ancient China said, "The line is divided into parts, and that part which has no remaining part is a point." Those definitions don't help much, do they?

A **definition** is a statement that clarifies or explains the meaning of a word or a phrase. However, it is impossible to define point, line, and plane without using words or phrases that themselves need definition. So these terms remain undefined. Yet, they are the basis for all of geometry.

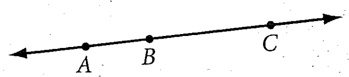
Using the undefined terms *point, line,* and *plane,* you can define all other geometry terms and geometric figures. Many are defined in this book, and others will be defined by you and your classmates.

Keep a definition list in your notebook, and each time you encounter new geometry vocabulary, add the term to your list. Illustrate each definition with a simple sketch.

Here are your first definitions. Begin your list and draw sketches for all definitions.

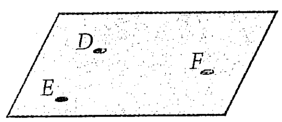


Collinear means on the same line.



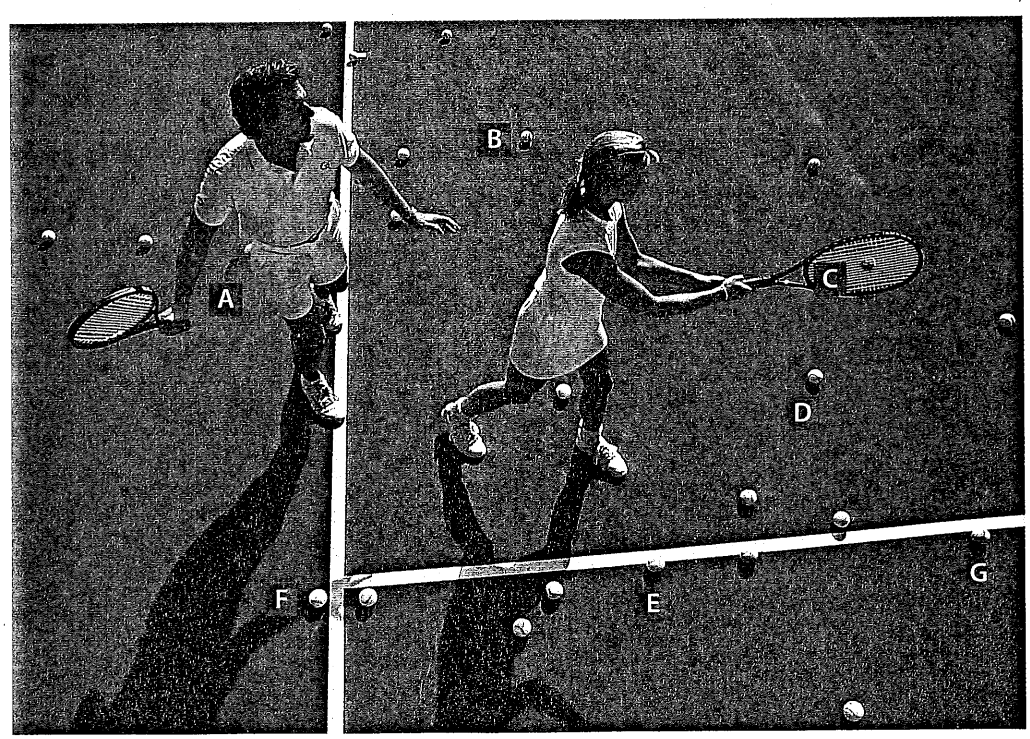
Points A, B, and C are collinear.

Coplanar means on the same plane.

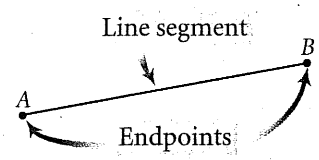


Points D, E, and F are coplanar.

Name three balls that are collinear. Name three balls that are coplanar but not collinear. Name four balls that are not coplanar.

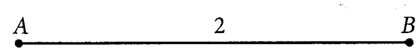


A **line segment** consists of two points called the **endpoints** of the segment and all the points between them that are collinear with the two points.



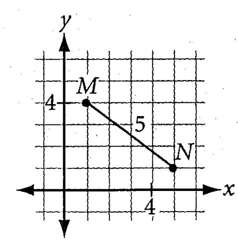
You can write line segment AB, using a segment symbol, as $\overline{AB}$ or $\overline{BA}$. There are two ways to write the length of a segment. You can write $AB = 2$ in., meaning the distance from A to B is 2 inches. You can also use an m for "measure" in front of the segment name, and write the distance as $m\overline{AB} = 2$ in. If no measurement units are used for the length of a segment, it is understood that the choice of units is not important, or is based on the length of the smallest square in the grid.

Figure A



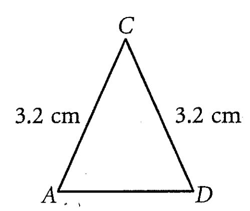
$AB = 2$ in., or $m\overline{AB} = 2$ in.

Figure B



$m\overline{MN} = 5$ units

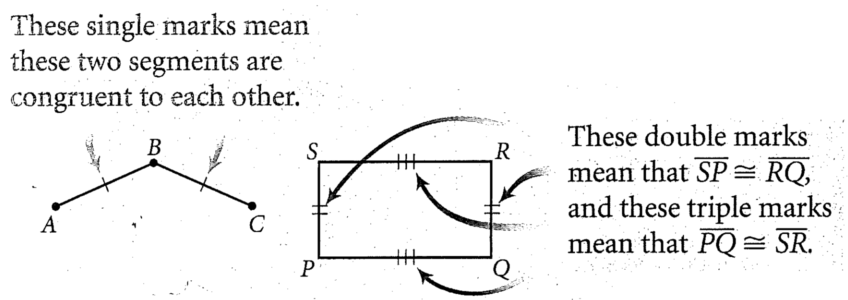
Two segments are **congruent segments** if and only if they have the same measure or length. The symbol for congruence is $\cong$, and you say it as "is congruent to." You use the equals symbol, $=$, between equal numbers and the congruence symbol, $\cong$, between congruent figures.



$AC = DC$

$\overline{AC} \cong \overline{DC}$

When drawing figures, you show congruent segments by making identical markings.



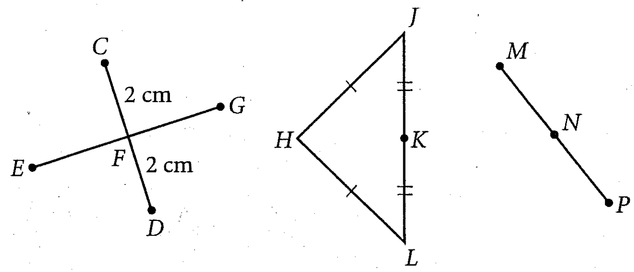
The **midpoint** of a segment is the point on the segment that is the same distance from both endpoints. The midpoint **bisects** the segment, or divides the segment into two congruent segments.

EXAMPLE

Study the diagrams below.

a. Name each midpoint and the segment it bisects.

b. Name all the congruent segments. Use the congruence symbol to write your answers.



▶ Solution

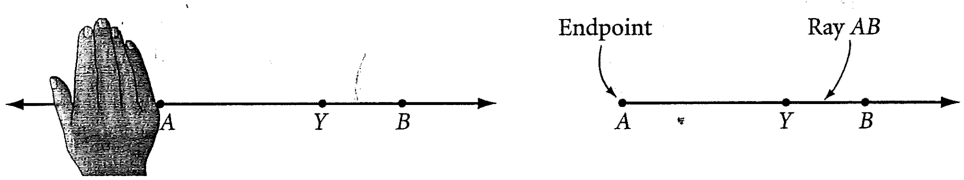
Look carefully at the markings and apply the midpoint definition.

a. $CF \cong FD$, so F is the midpoint of $\overline{CD}$; $\overline{JK} \cong \overline{KL}$, so K is the midpoint of $\overline{JL}$.

b. $\overline{CF} \cong \overline{FD}$, $\overline{HJ} \cong \overline{HL}$, and $\overline{JK} \cong \overline{KL}$.

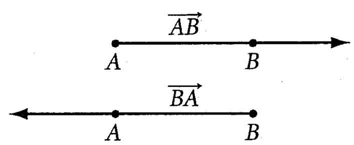
Even though $\overline{EF}$ and $\overline{FG}$ appear to have the same length, you cannot assume they are congruent without the markings. The same is true for $\overline{MN}$ and $\overline{NP}$.

Ray AB is the part of $\overleftrightarrow{AB}$ that contains point A and all the points on $\overleftrightarrow{AB}$ that are on the same side of point A as point B. Imagine cutting off all the points to the left of point A.

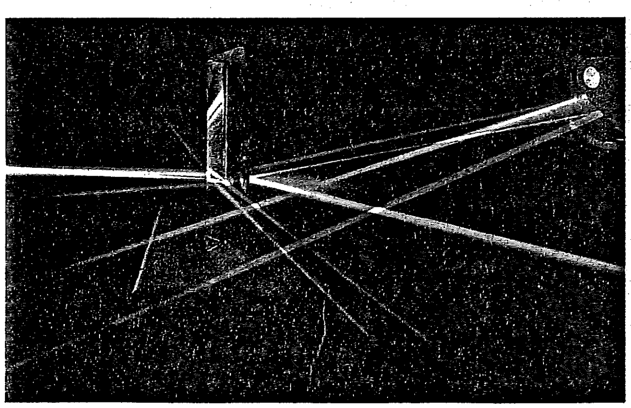


In the figure above, $\overrightarrow{AY}$ and $\overrightarrow{AB}$ are two ways to name the same ray. Note that $\overrightarrow{AB}$ is not the same as $\overrightarrow{BA}$!

A ray begins at a point and extends infinitely in one direction. You need two letters to name a ray. The first letter is the endpoint of the ray, and the second letter is any other point that the ray passes through.



Physical model of a ray: beams of light

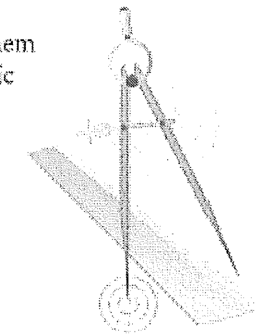


LESSON

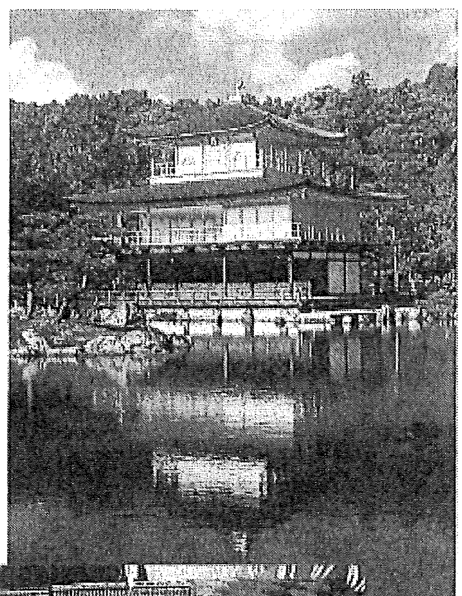
0.2 Line Designs

We especially need imagination in science. It is not all mathematics, nor all logic, but it is somewhat beauty and poetry.
MARIA MITCHELL

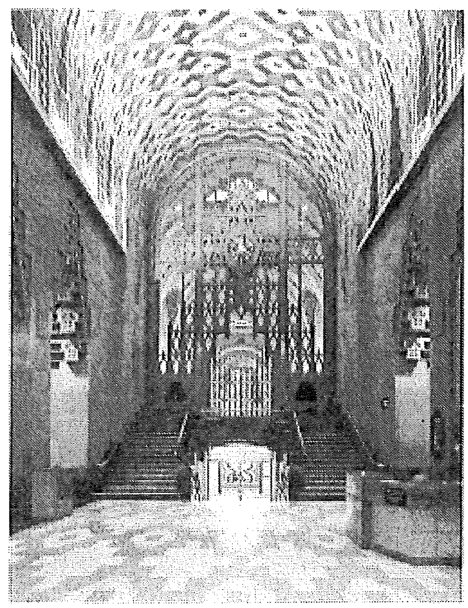
The symmetry and patterns in geometric designs make them very appealing. You can make many designs using the basic tools of geometry—**compass** and **straightedge.**



You'll use a straightedge to construct straight lines and a compass to construct circles and to mark off equal distances. A straightedge is like a ruler but it has no marks. You can use the edge of a ruler as a straightedge. The straightedge and the compass are the classical construction tools used by the ancient Greeks, who laid the foundations of the geometry that you are studying.

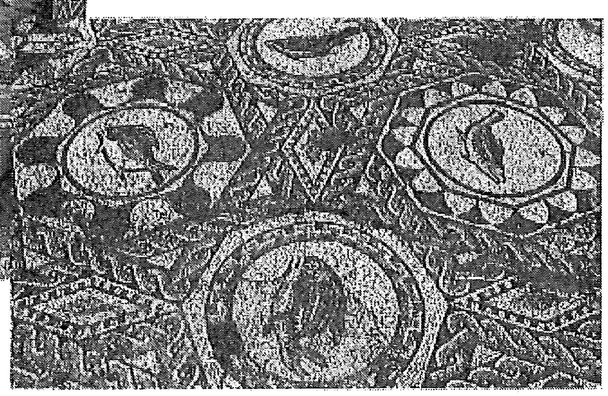


Japanese design is known for its simple, clean lines.



The complementary line designs on the arched ceiling and tile floor make this building lobby look grandiose.

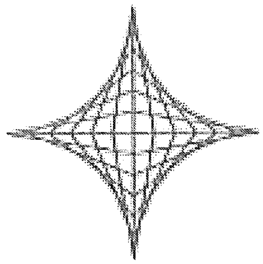
Notice how the patterns of these Guatemalan rugs are a non-uniform and dynamic arrangement of lines.



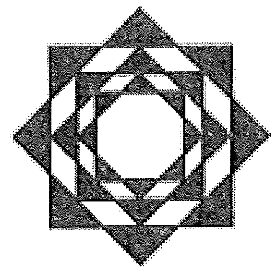
Some of the lines in this mosaic appear to be tied in knots!

You can create many types of designs using only straight lines. Here are two line designs and the steps for creating each one.

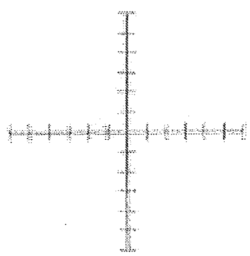
The Astrid



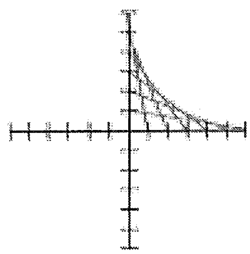
The 8-pointed Star



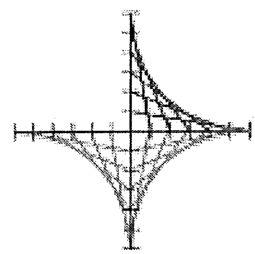
The Astrid



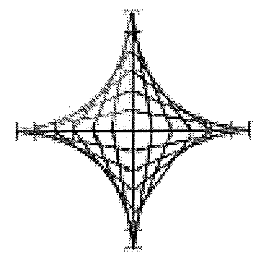
Step 1



Step 2

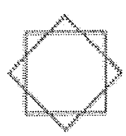


Step 3

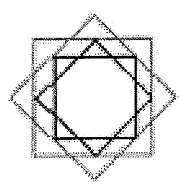


Step 4

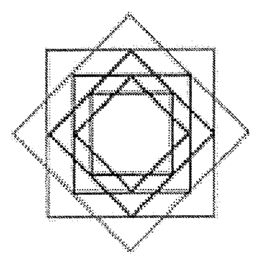
The 8-pointed Star



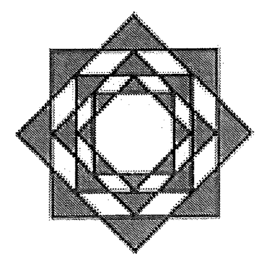
Step 1



Step 2



Step 3



Step 4

Applied Geometry
Reading Guide 1.1

Name________________________________
Date__________________________ Per_____

Please read carefully (pages 28-33) and then complete the following. Be sure to answer questions completely, providing labeled diagrams when needed and including accurate geometric notation.

1. What are the three building blocks of geometry? (Draw a labeled sketch to represent each.)

2. Do lines have endpoints? Explain.

3. Name the line shown two ways. Use the correct notation.

4. Define definition.

5. What are the undefined terms in geometry.

6. Define collinear and draw an example.

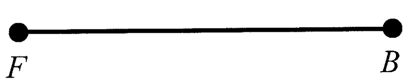
Term	Definition	Picture
collinear		

7. Define coplanar and draw an example.

Term	Definition	Picture
coplanar		

8. What makes a line segment different from a line?

9. Name the line segment shown two ways. Use the correct notation.



10. A definition for a given geometric term must be specific enough that ALL objects which meet the criteria described in the definition actually ARE that term. Based on this notion of definitions and your previous experience, what is wrong with the following definition? [Hint: See if you can find an example that meets this definition but would NOT be considered a midpoint.]

A midpoint is a point that is equal distance from the two endpoints of a line segment.

11. What makes two segments congruent?

12. What is the symbol for congruence?

13. Accurately draw an example that shows $\overline{PS} \cong \overline{TV}$.

14. Explain how you know the segments you drew in #3 are congruent.

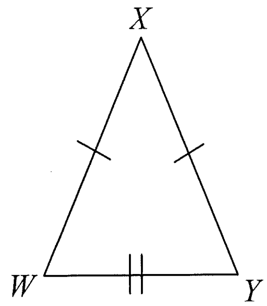
15. Define midpoint of a segment. [It should be more specific than the one given in #10!]

Term	Definition	Picture
midpoint of a segment		

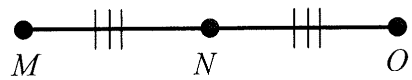
16. Define bisect a segment. (Hint: bisect is a verb.)

Term	Definition	Picture
bisect a segment		

17. What does this diagram tell us?



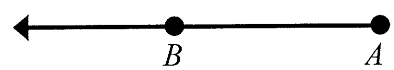
18. What does this diagram tell us about point *N*?



19. Read the book's definition of ray. Try to write a definition of ray that is clear but easier to understand.

Term	**Definition**	**Picture**
ray		

20. Name each ray.

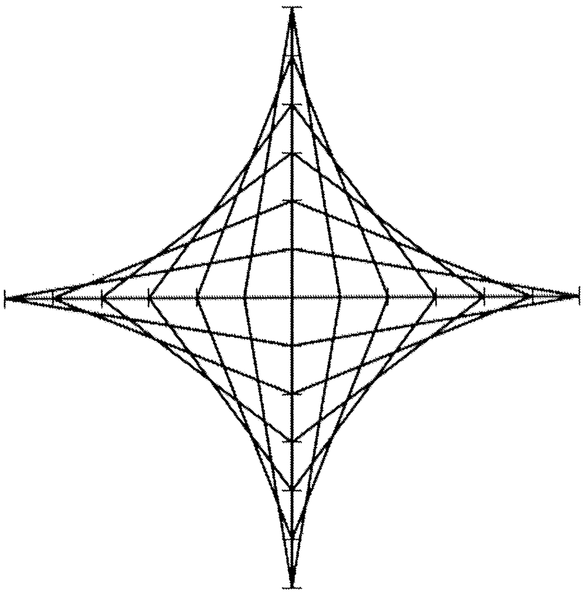


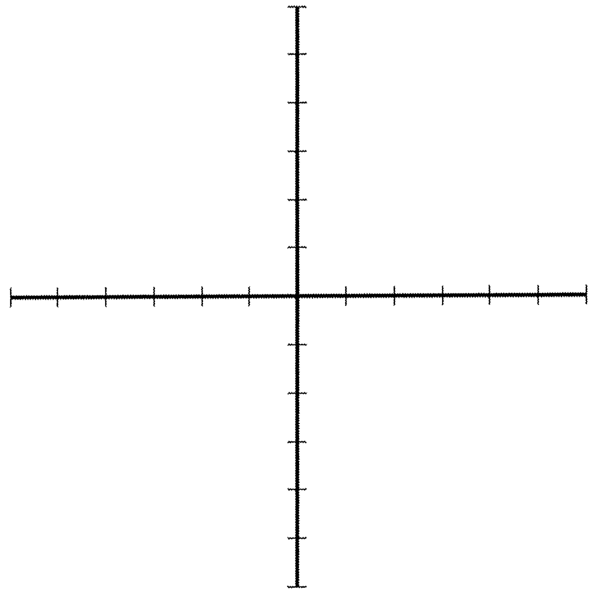
Applied Geometry
Reading Guide 1.1 – Line Designs

Name______________________________
Date_______________________ Per_____

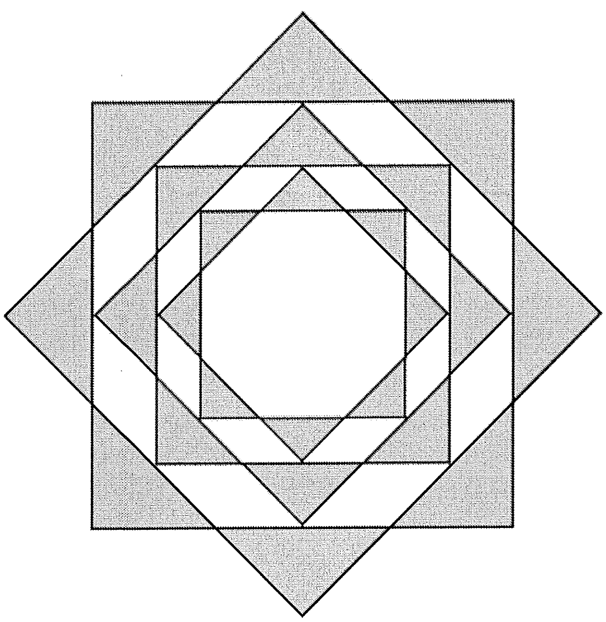
Read p. 7-8 in your book about Line Designs.

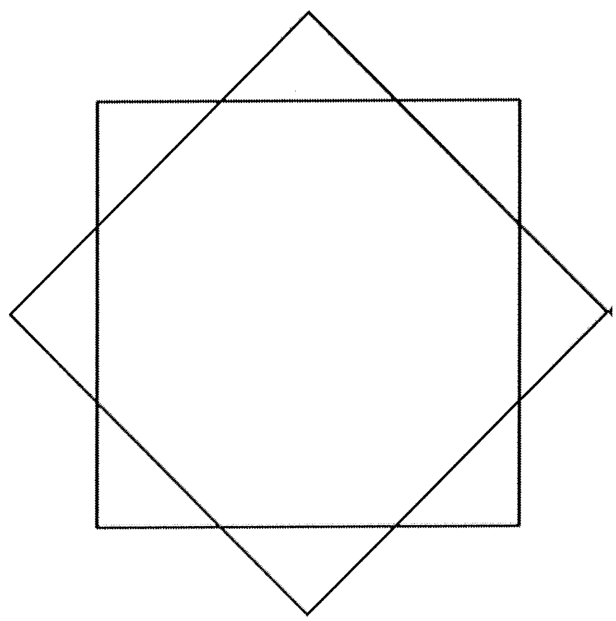
21. Use the grid below and a straight-edge to draw an Astrid.





22. Use the square below to begin an 8-pointed star design. Shade or color your star as shown in the book. Notice that this example begins the construction with the outermost squares. Look carefully at the example on the left to figure out where the corners of the next square should be located.





Selected Answers

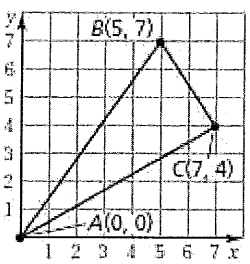
What You've Learned Before – Area of Rectangles

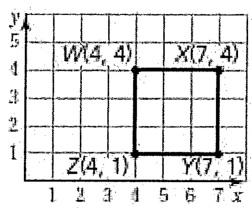
1. A = (7)(7) = 49 m^2
2. A = (9)(20) = 180 yd^2
3. A = (65)(90) = 5850 mm^2

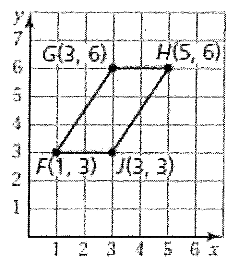
Area of Triangles (Chapter 4.2 from Resource Book)

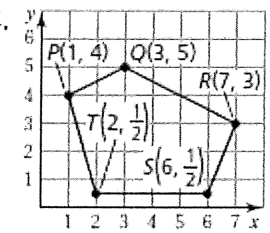
1. A = (½)(11)(4) = 22 ft^2
2. A = (½)(22)(10) = 110 m^2
3. A = (½)(15)(8) = 60 cm^2
4. A = (½)(6)(3) = 9 cm^2, which is 9 times the area of the blue wing

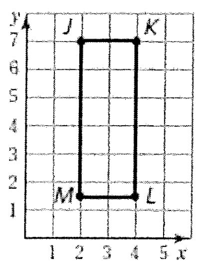
Area and Perimeter in a Coordinate Plane

1.


2.


3.


4.


5.


Length = 4 − 2 = 2 units

Width = 7 − 1.5 = 5.5 units

The perimeter of the rectangle is
2(2) + 2(5.5) = 15 units.

The area of the rectangle is 2(5.5) = 11 square units.

6. The area will increase.

$$b_1 = 80 - 0 = 80$$

$$A = \frac{1}{2}60(80 + 100)$$

$$= \frac{1}{2}60(180)$$

$$= 5400$$

The new area of the giraffe exhibit is 5400 square feet, which is 5400 − 4800 = 600 square feet larger.

Pythagorean Theorem (Chapter 14 from Resource Book)

1.
$$a^2 + b^2 = c^2$$
$$8^2 + 15^2 = c^2$$
$$64 + 225 = c^2$$
$$289 = c^2$$
$$\sqrt{289} = \sqrt{c^2}$$
$$17 = c$$

The length of the hypotenuse is 17 feet.

2.
$$a^2 + b^2 = c^2$$
$$\left(\frac{2}{5}\right)^2 + \left(\frac{3}{10}\right)^2 = c^2$$
$$\frac{4}{25} + \frac{9}{100} = c^2$$
$$\frac{16}{100} + \frac{9}{100} = c^2$$
$$\frac{25}{100} = c^2$$
$$\sqrt{\frac{25}{100}} = \sqrt{c^2}$$
$$\frac{5}{10} = c$$
$$\frac{1}{2} = c$$

The length of the hypotenuse is $\frac{1}{2}$ inch.

[Hint for #2: You also could rewrite each side length as a decimal using your calculator and work the problem using decimal values.]

3.
$$a^2 + b^2 = c^2$$
$$16^2 + b^2 = 34^2$$
$$256 + b^2 = 1156$$
$$b^2 = 900$$
$$\sqrt{b^2} = \sqrt{900}$$
$$b = 30$$

The length of the leg is 30 yards.

4.
$$a^2 + b^2 = c^2$$
$$a^2 + 9.6^2 = 10.4^2$$
$$a^2 + 92.16 = 108.16$$
$$a^2 = 16$$
$$\sqrt{a^2} = \sqrt{16}$$
$$a = 4$$

The length of the leg is 4 meters.

5. Use the graph in the book to find the legs. The lengths of the legs are 60 and 80.

$$a^2 + b^2 = c^2$$
$$60^2 + 80^2 = c^2$$
$$3600 + 6400 = c^2$$
$$10{,}000 = c^2$$
$$\sqrt{10{,}000} = \sqrt{c^2}$$
$$100 = c$$

So, the distance between the two bases is 100 yards.