LESSON
14.2 Polygons in the Coordinate Plane

COMMON CORE 6.G.3

Draw polygons in the coordinate plane;…find the length of a side… in the context of solving… problems.

ESSENTIAL QUESTION

How can you solve problems by drawing polygons in the coordinate plane?

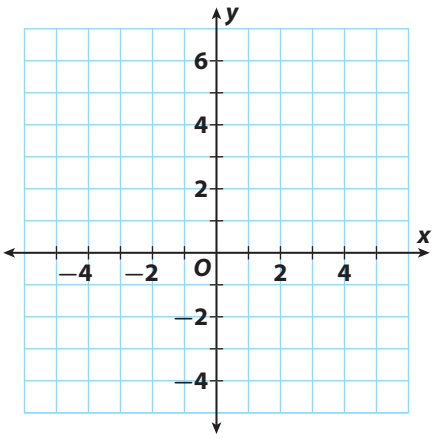
EXPLORE ACTIVITY Real World

COMMON CORE 6.G.3

Polygons in the Coordinate Plane

A **polygon** is a closed plane figure formed by three or more line segments that meet only at their endpoints. A **vertex** is the point where two sides of a polygon meet. The *vertices* of a polygon can be represented as ordered pairs, and the polygon can then be drawn in the coordinate plane.

Sheila wants to make a pattern of two different tile shapes on a floor. She first graphs the shapes on a coordinate plane.



A Plot these points to form one of the tile shapes:

$A(3, 5)$, $B(4, 6)$, $C(5, 5)$, $D(4, 4)$

Connect the points in order.

The polygon formed is a(n) _____.

B Plot these points to form the other tile shape:

$P(-5, 2)$, $Q(-4, 3)$, $R(0, 3)$, $S(1, 2)$,

$T(1, -2)$, $U(0, -3)$, $V(-4, -3)$, $W(-5, -2)$

Connect the points in order.

The polygon formed is a(n) _____.

Reflect

1. How is the number of vertices related to the number of sides of the polygon and to the type of polygon? Give two examples.

_____

_____

_____

_____

Math On the Spot
my.hrw.com

Finding Perimeter in the Coordinate Plane

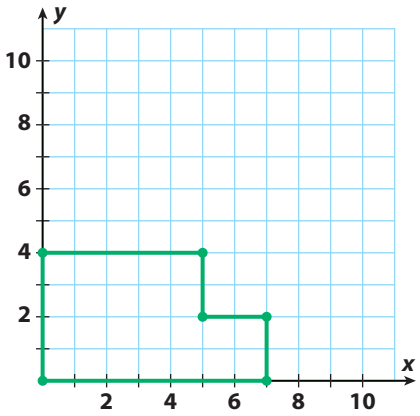
You can use what you know about finding lengths in the coordinate plane to find the perimeter of a polygon.

EXAMPLE 1

Real World

COMMON CORE 6.G.3

The grid shows the path Tommy followed when he walked from his home at (0, 0) to various locations and back home again. If each grid square represents one block, how many blocks did he walk?



Home (0, 0)

Library (0, 4)

Park (5, 4)

Friend's house (5, 2)

Pond (7, 2)

Store (7, 0)

Math Talk
Mathematical Practices
How do you find the distance between two points in the same quadrant that have the same *x*-coordinate?

STEP 1 Find each distance. Each grid unit represents one block.

Tommy's home (0, 0) to the library (0, 4) is $|4| - 0 = 4 - 0 = 4$ blocks.

The library (0, 4) to the park (5, 4) is $|5| - 0 = 5 - 0 = 5$ blocks.

The park (5, 4) to Tommy's friend's house (5, 2) is $|4| - |2| = 4 - 2 = 2$ blocks.

Tommy's friend's house (5, 2) to the pond (7, 2) is $|7| - |5| = 7 - 5 = 2$ blocks.

The pond (7, 2) to the store (7, 0) is $|2| - 0 = 2 - 0 = 2$ blocks.

The store (7, 0) to Tommy's home (0, 0) is $|7| - 0 = 7 - 0 = 7$ blocks.

STEP 2 Find the sum of the distances.

Tommy walked $4 + 5 + 2 + 2 + 2 + 7 = 22$ blocks.

Animated Math
my.hrw.com

Personal Math Trainer
Online Assessment and Intervention
my.hrw.com

YOUR TURN

2. Suppose the next day Tommy walks from his home to the mall at (0, 8), and then walks to a movie theater at (7, 8). After leaving the theater Tommy walks to the store at (7, 0) before returning home.

How far does he walk? _____ blocks

Finding Area in the Coordinate Plane

You can use familiar area formulas to find areas of polygons in the coordinate plane.

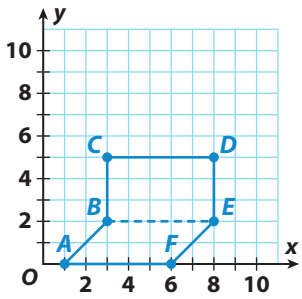
Math On the Spot
my.hrw.com

EXAMPLE 2

Real World

COMMON CORE 6.G.3

Caleb is planning a new deck for his house. He graphs the deck as polygon *ABCDEF* on a coordinate plane in which each grid unit represents one foot. The vertices of the polygon are *A*(1, 0), *B*(3, 2), *C*(3, 5), *D*(8, 5), *E*(8, 2), and *F*(6, 0). What is the area of Caleb's deck?



STEP 1 Graph the vertices, and connect them in order.

Draw a horizontal dashed line segment to divide the polygon into two quadrilaterals—a rectangle and a parallelogram.

STEP 2 Find the area of the rectangle using the length of segment *BE* as the base *b* and the length of segment *BC* as the height *h*.

$b = |8| - |3| = 5$ feet $\qquad h = |5| - |2| = 3$ feet

$A = bh = 5 \cdot 3 = 15$ square feet

STEP 3 Find the area of the parallelogram using the length of segment *AF* as the base. Use the length of a segment from *F*(6, 0) to the point (6, 2) as the height *h*.

$b = |6| - |1| = 5$ feet $\qquad h = |2| - 0 = 2$ feet

$A = bh = 5 \cdot 2 = 10$ square feet

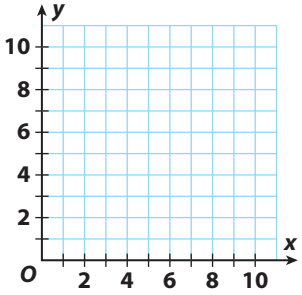
STEP 4 Add the areas to find the total area of the deck.

$A = 15 + 10 = 25$ square feet

YOUR TURN

3. The vertices of a polygon are *L*(1, 2), *M*(1, 6), *N*(7, 6), *O*(7, 2), *P*(5, 0), and *Q*(3, 0). Graph the polygon. Then find its area.

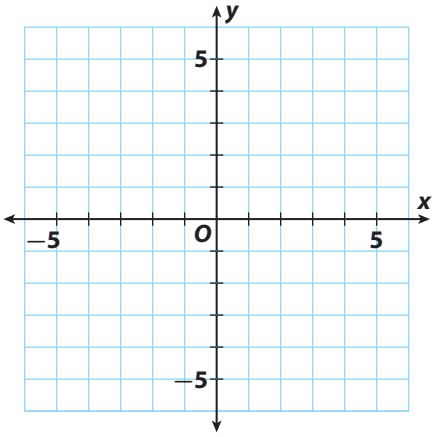
$A =$ _____ square units



Personal Math Trainer
Online Assessment and Intervention
my.hrw.com

Guided Practice

A gardener uses a coordinate grid to design a new garden. The gardener uses polygon *WXYZ* on the grid to represent the garden. The vertices of this polygon are *W*(3, 3), *X*(−3, 3), *Y*(−3, −3), and *Z*(3, −3). Each grid unit represents one yard.



1. Graph the points, and connect them in order. What is the shape of the garden? (Explore Activity)

_____

2. How much fencing will the gardener need to enclose the garden? (Example 1)

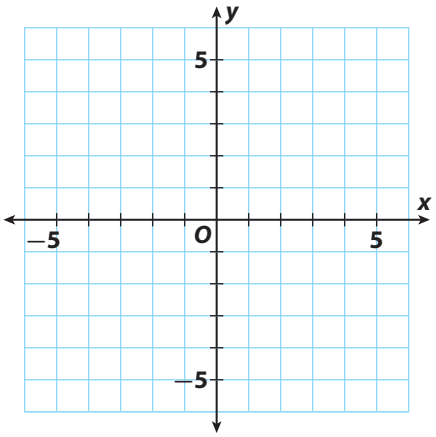
Each side of the garden is _____ yards in length.

The gardener will need _____ yards of fencing to enclose the garden.

3. What is the area of the garden? (Example 2)

_____

4. A clothing designer makes letters for varsity jackets by graphing the letters as polygons on a coordinate plane. One of the letters is polygon *ABCDEF*. The vertices of this polygon are *A*(3, −2), *B*(3, −4), *C*(−3, −4), *D*(−3, 4), *E*(−1, 4), and *F*(−1, −2). Each grid unit represents one inch. Graph the points on the coordinate plane, and connect them in order. Identify the letter formed. Then find its area. (Example 2)



_____

ESSENTIAL QUESTION CHECK-IN

5. How can you use a coordinate plane to solve perimeter and area problems?

_____

_____

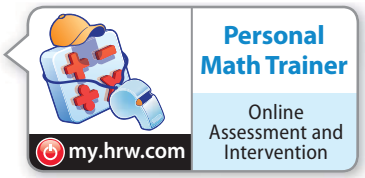
_____

_____

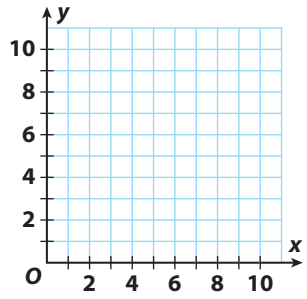
Name _____ Class _____ Date _____

14.2 Independent Practice

COMMON CORE 6.G.3



6. A graphic designer creates letters for wall art by first graphing the letters as polygons on a coordinate plane. One of the letters is polygon *MNOPQRSTUV* with vertices *M*(2, 1), *N*(2, 9), *O*(7, 9), *P*(7, 7), *Q*(4, 7), *R*(4, 6), *S*(6, 6), *T*(6, 4), *U*(4, 4), and *V*(4, 1). Each grid unit represents one inch.



a. Graph the points on the coordinate plane, and connect them in order. What letter is formed? _____

b. The designer will use decorative tape to paint the outline of the letter on a wall. How many inches of tape are needed? _____

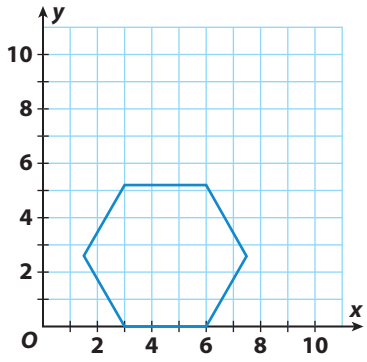
c. How much space does the letter cover on the wall? _____

d. How did you find your answer to c? Use the name(s) of shapes in your answer.

_____

_____

7. **Vocabulary** The polygon shown is a regular polygon since all sides have equal length and all angles have equal measure.



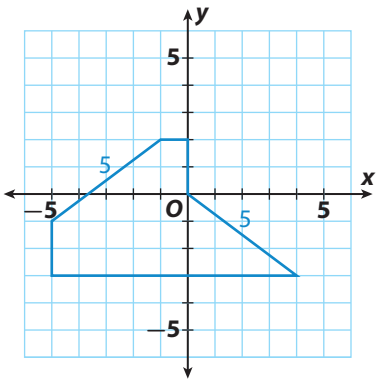
a. The polygon is a regular _____.

b. What is the perimeter of the polygon? _____

c. A line can divide the figure into two identical four-sided polygons. Each polygon has two bases, and one base is twice the length of the other base. Identify the polygon, and give its perimeter.

_____

8. Jean wants to put furniture in her clubhouse. She drew a floor plan of the clubhouse, as shown. Each grid unit represents one foot.



a. Which polygon names the shape of the floor?

_____

b. How many feet of baseboard are needed to go around the entire clubhouse?

_____

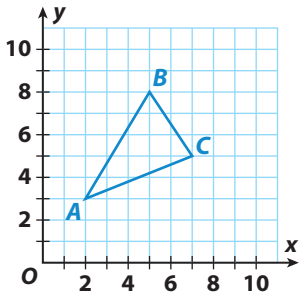
c. How much carpet is needed for the clubhouse floor?

_____

H.O.T. FOCUS ON HIGHER ORDER THINKING

Work Area

9. **Persevere in Problem Solving** To find the area of triangle *ABC*, Jen first drew a square around the figure. Two sides of the square passed through the points *B* and *C*. The other two sides met at point *A*. Draw Jen's square, and explain how you can use it to find the area of triangle *ABC*.



10. **Communicate Mathematical Ideas** The coordinates $A(5, -2)$, $B(3, -1)$, $C(-4, -4)$, $D(-3, 8)$, and $E(-1, 4)$ form the vertices of a polygon when they are connected in order from *A* through *E*. Classify the polygon without plotting the points. Explain your answer.

11. **Explain the Error** Josh's teacher draws a regular octagon on a coordinate plane. One side has endpoints at (1, 5) and (4, 5). Josh says he can't find the perimeter of the octagon because he can only find lengths of horizontal and vertical segments. He says he can't find the lengths of the slanted sides of the octagon. What mistake is Josh making? What is the perimeter of the octagon?

12. **Critical Thinking** Give coordinates for the vertices of a triangle that could have an area of 35 square units. Prove that your triangle fits the description by finding its area.