Lesson 23

Polygons in the Coordinate Plane

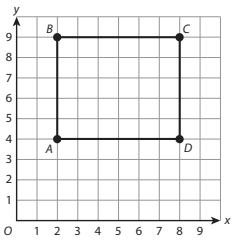
Name: _____

Prerequisite: Find Distance on a Coordinate Plane

Study the example showing how to solve a measurement problem using a shape on a coordinate plane. Then solve problems 1–9.

Example

Mr. Hiroshi plans to tile the floor of his family room. He draws a rectangle on the coordinate plane to represent the floor. What is the area of the floor in square units?



The area of a rectangle is length × width. You can count units to find the length and the width.

The length of $\overline{AB}$ is 5 units. The length of $\overline{BC}$ is 6 units. The area of rectangle *ABCD* is 5 × 6, or 30 square units.

You can also use ordered pairs to find the horizontal distance and the vertical distance between points on the coordinate plane.

B 1 Write the ordered pair for each point.

A (2, 4) *B*(2, 9) *C*(8, 9) *D*(8, 4)

M 2 Explain how to use the *x*-coordinates of point *A* and point *D* to find the distance between the two points.

Subtract the *x*-coordinates of the ordered pairs.

M 3 Explain how to use the *y*-coordinates of point *C* and point *D* to find the distance between the two points.

Subtract the *y*-coordinates of the ordered pairs.

B 4 Find the lengths of these sides using the coordinates of their endpoints.

$\overline{AD}$ 6 units $\overline{CD}$ 5 units

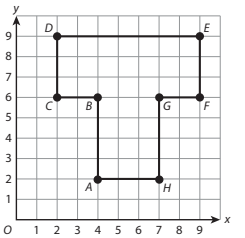
B 5 What is the perimeter of rectangle *ABCD*? Explain how you found the perimeter.

22 units; Possible explanation: I added the lengths of the four sides of the rectangle.

5 + 6 + 5 + 6 = 22

Solve.

Use the shape on the coordinate plane to solve problems 6–8.



M 6 What are the coordinates of each point on the shape?

A(4, 2) *B*(4, 6) *C*(2, 6) *D*(2, 9)

E(9, 9) *F*(9, 6) *G*(7, 6) *H*(7, 2)

M 7 Find the area of the shape. Explain how you found your answer.

Show your work.

Possible work: I can draw a line connecting points *B* and *G*. The area of the shape is the sum of the areas of rectangles *ABGH* and *CDEF*. I can count units to find the length and width of each rectangle. Then I multiply length × width to find the areas. The area of rectangle *ABGH* is 3 × 4, or 12, square units. The area of rectangle *CDEF* is 7 × 3, or 21, square units. 12 + 21 = 33

Solution: The area of the shape is 33 square units.

M 8 Find the perimeter of the shape.

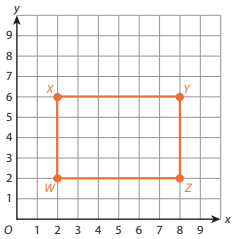
Show your work.

The perimeter of the shape is the sum of the lengths of the sides of the shape. I can count units or subtract coordinates to find the lengths of the sides of the shape.

4 + 2 + 3 + 7 + 3 + 2 + 4 + 3 = 28

Solution: The perimeter of the shape is 28 units.

C 9 Use the coordinate plane to draw a rectangle with an area of 24 square units. Label the corners of the rectangle *W*, *X*, *Y*, and *Z*. Explain how you know that the area of the rectangle is 24 square units.



Rectangles will vary. Possible rectangle is shown. Possible explanation: The coordinates of the rectangle are *W*(2, 2), *X*(2, 6), *Y*(8, 6), and *Z*(8, 2). Subtract the *x*-coordinates to find the length of $\overline{WZ}$: 8 − 2 = 6. Subtract the *y*-coordinates to find the length of $\overline{WX}$: 6 − 2 = 4. The area of rectangle *WXYZ* is 6 × 4, or 24, square units.

Key		
B Basic	**M** Medium	**C** Challenge

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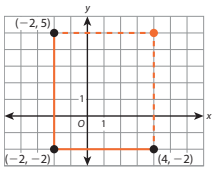
Find Missing Coordinates and Dimensions

Study the example problem showing how to find missing coordinates and dimensions of a rectangle. Then solve problems 1–9.

Example

Ms. Issa is planning to build a rectangular fishpond in her garden. A drawing shows three corners of the pond with coordinates (4, −2), (−2, −2), and (−2, 5). Where is the fourth corner?

You can graph the information given and then sketch the rectangle.



B 1 What are the coordinates of the fourth corner?

(4, 5)

M 2 How did you locate the fourth corner to sketch the rectangle?

Possible answer: I drew a horizontal line through the corner at (−2, 5) and a vertical line through the corner at (4, −2). The point where these lines intersect is the fourth corner.

B 3 Explain how to use counting to find the distance between (−2, −2) and (4, −2).

I can count the units between the points. There are 6 units.

M 4 Explain how to use absolute value to find the distance between (−2, −2) and (−2, 5).

Possible answer: The distance from −2 to the *x*-axis is |−2| or 2. The distance from 5 to the *x*-axis is |5| or 5. The distance between the two points is 2 + 5, or 7, units.

M 5 Explain how to find the area of the pond.

The area of a rectangle is length × width. 6 × 7 = 42; so the area of the pond is 42 square units.

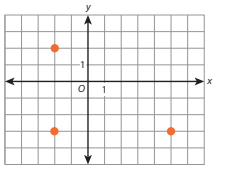
Solve.

Use the following situation to solve problems 6–8.

Mrs. Rockwell is buying a rectangular lot on which to build a new home. Three corners of the lot are at (5, −3), (−2, −3), and (−2, 2) on the coordinate plane.

B 6 Graph the three corners on the coordinate plane. What is the ordered pair for the fourth corner of the lot?

(5, 2)



M 7 What is the perimeter of the lot?

Show your work.

The distance from (−2, −3) to (5, −3) is 7 units.

The distance from (−2, −3) to (−2, 2) is 5 units.

7 + 5 + 7 + 5 = 24

Solution: The perimeter is 24 units.

M 8 Mr. Brown bought a lot that is half as long and twice as wide as Mrs. Rockwell's lot. How does the area of his lot compare to the area of Mrs. Rockwell's lot? Explain how you know.

The two lots have the same area.

Possible explanation: The area of Mrs. Rockwell's lot is 7 × 5 = 35 square units.

$\frac{1}{2} \times 7 = 3\frac{1}{2}$ and 2 × 5 = 10, so the area of Mr. Brown's lot is $3\frac{1}{2} \times 10 = 35$ square units.

C 9 Nadim wants to build a square pen for his rabbits. He plots two corners on a coordinate plane at (3, −3) and (−3, 3). Abe says that he should plot another corner at (3, 3). Does this make sense? Explain why or why not.

Yes; Possible explanation: All sides of a square are equal in length. I can use absolute value to find the distance between two points on the same side of a square. The distance from (3, −3) to (3, 3) is 6 units, and the distance from (−3, 3) to (3, 3) is 6 units. So plotting a corner of the square at (3, 3) makes sense.

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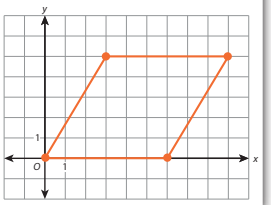
Find Area on a Coordinate Plane

Study the example problem showing how to find the area of a polygon on a coordinate plane. Then solve problems 1–7.

Example

A floor plan for a building shows corners of the building at (0, 0), (6, 0), (9, 5), and (3, 5). What is the shape of the floor of the building? How can you find the area of the floor?



You can graph the information given and connect the points to find the shape of the floor. The connected points form a parallelogram, so the floor is a parallelogram.

You can find the area of the floor by multiplying its base times its height since it is a parallelogram.

B 1 What is the base length of the parallelogram in the example? How did you find the base length?

6 units; Possible answer: I counted units.

B 2 What is the height of the parallelogram in the example? How did you find the height?

5 units; Possible answer: I counted units.

M 3 Find the area.

$A = 6 \times 5 = 30$; the area is 30 square units.

M 4 Katerine divided the parallelogram into two congruent triangles and a rectangle in order to find its area. Does her method work? If so, show that it works. If not, explain why not.

Yes; Possible explanation: I can divide the figure into two triangles, each with a base length of 3 and a height of 5, and a rectangle that has a base of 3 and a height of 5 as well.

Area of triangle: $A = \frac{1}{2} \times 3 \times 5 = 7\frac{1}{2}$ square units

Area of rectangle: $A = 3 \times 5 = 15$ square units

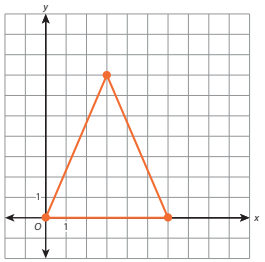
The total area is $7\frac{1}{2} + 7\frac{1}{2} + 15 = 30$ square units.

Solve.

Use the following situation to solve problems 5–6.

Madeline plotted these points to represent the corners of a vegetable garden: (0, 0), (6, 0), (3, 7).

M 5 Draw the shape on the coordinate plane. What shape is the garden? Find the area of the garden.



Show your work.

The garden is a triangle.

The area of the triangle is $A = \frac{1}{2} \times$ base $\times$ height

$= \frac{1}{2} \times 6 \times 7$

$= \frac{1}{2} \times 42$

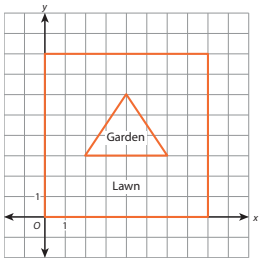
$= 21$

Solution: The area of the vegetable garden is 21 square units.

M 6 Suppose Madeline uses (6, 7) rather than (3, 7) as the third corner for her garden. How will that change the shape of the garden? How will the areas of the two gardens compare?

The shape of the garden will still be a triangle, but it will be a right triangle. The areas will be the same because the base and the height of the two triangles are the same.

C 7 A flower garden and the lawn around it are shown on the coordinate plane. What is the area of the lawn?



Show your work.

Area of lawn = area of square − area of triangle

square: $A = bh$ triangle: $A = \frac{1}{2}bh$

$= 8 \times 8$ $= \frac{1}{2} \times 4 \times 3$

$= 64$ $= 6$

area of square − area of triangle $= 64 - 6 = 58$

Solution: The area of the lawn is 58 square units.

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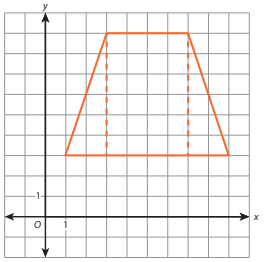
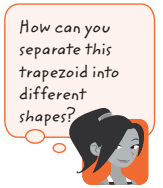
Solve the problems.

M

1 Find the area of the trapezoid.





Show your work.

Possible work:

Area of rectangle:
$A = 6(4) = 24$

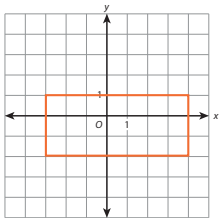
Area of one triangle:
$A = \frac{1}{2}bh$
$= \frac{1}{2}(2)(6)$
$= 6$

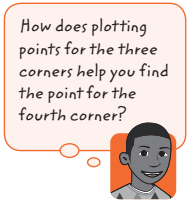
Area of trapezoid:
$A = 24 + 6 + 6$
$= 36$

Solution: **The area of the trapezoid is 36 square units.**

B

2 Three corners of a rectangular park are located at (−3, 1), (4, 1), and (4, −2).





Part A

What are the coordinates of the fourth corner?

(−3, −2)

Part B

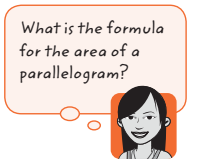
What is the perimeter of the park? Explain how you found your answer.

20 units; I plotted the fourth point and then counted units to find the width and length. Then I added two times the width to two times the length.

Solve.

C

3 Keaton drew a parallelogram on a coordinate plane. Two vertices of the parallelogram were located at (1, 1) and (1, 7). The area of the parallelogram is 18 square units. Tell whether each statement is *True* or *False*.



a. The *x*-coordinate of the other two vertices of the parallelogram could be −2. ☒ True ☐ False

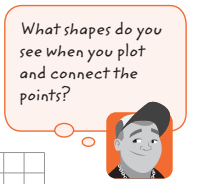
b. The *x*-coordinate of the other two vertices of the parallelogram could be 4. ☒ True ☐ False

c. The parallelogram must be a square. ☐ True ☒ False

d. The perimeter of this parallelogram could be 18 units. ☒ True ☐ False

M

4 Gianna plotted these points and then connected the points in order from *J* to *N* and then back to *J* to show the shape of her room. Draw the room on the coordinate plane. What is the area of Gianna's room?



J(1, 0) *K*(1, 6) *L*(9, 6) *M*(9, 3) *N*(6, 3)

Show your work.

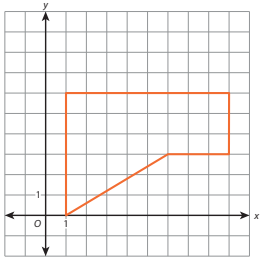
Possible student work:

A = area of rectangle + area of triangle

$= 8(3) + \left(\frac{1}{2}\right)(3)(5)$

$= 24 + 7\frac{1}{2}$

$= 31\frac{1}{2}$



Solution: **The area of Gianna's room is $31\frac{1}{2}$ square units.**