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Enrichment

1.7 Other Reflections on the Coordinate Plane

There are infinitely many lines in a coordinate plane, and you can reflect a point across any of them. The relationships between the coordinates of the preimage and image points can give rise to some interesting patterns.

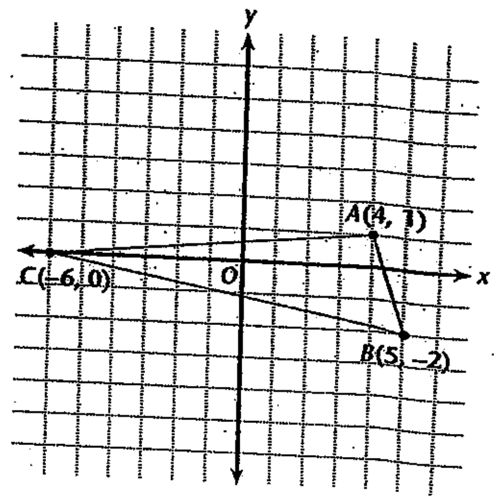
1. Use the figure at right and $P(x, y) = (x, -y + 2)$.

a. Draw the image of $\triangle ABC$ under this transformation. Write the coordinates of A', B', and C'.

____

b. Draw the line of reflection. Then write an equation for it. Recall that the equation of any horizontal line can be written in the form $y = k$, where k is a constant.

____



Using a separate sheet of graph paper, repeat parts a and b of Exercise 1 for each transformation.

2. $Q(x, y) = (x, -y + 6)$

3. $S(x, y) = (x, -y + (-4))$

4. $T(x, y) = (x, -y + (-6))$

5. Write a rule for reflecting a point across any line $y = k$, where k is a constant.

$K(x, y) =$ ____________

6. Explain how you can apply your rule from Exercise 5 to a reflection across the x-axis.

____

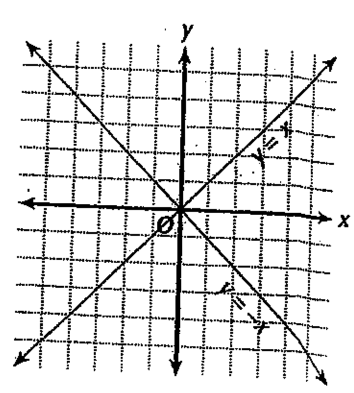
7. Recall that the equation of any vertical line can be written in the form $x = j$, where j is a constant. Based on your work in Exercises 1 through 6, make a conjecture about a rule for reflecting a point across a vertical line. Verify your conjecture by testing several specific cases.

$J(x, y) =$ ____________

8. Two other lines that are often used as lines of reflection are $y = x$ and $y = -x$. They are graphed on the coordinate plane at right. Investigate several reflections across these lines. Then write a rule for each reflection.

a. reflection across $y = x$: $F(x, y) =$ ____________

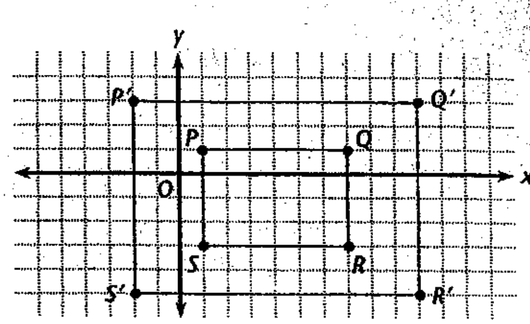
b. reflection across $y = -x$: $G(x, y) =$ ____________



Enrichment

8.1 Exploring Centers of Dilation Other than the Origin

On a coordinate plane, the dilation defined by the rule $D(x, y) = (nx, ny)$ has scale factor n, and its center is at the origin. The investigation that follows will help you to define a dilation whose center is at a point other than the origin.



1. In the figure at right, rectangle $P'Q'R'S'$ is the image of rectangle $PQRS$ under a dilation.

a. What is the scale factor, n, of the dilation? ______________

b. What are the coordinates of the center, C, of the dilation? ______________

c. Write a rule for the translation that would move the center of dilation to the origin. ______________

d. Write the coordinates that result when the coordinates from part **c** are transformed by a dilation centered at the origin with the scale factor n from part **a.** ______________

e. Write a rule for the translation that would move the center of dilation back to point C. ______________

f. Write the coordinates that result when the coordinates from part **d** are transformed by the translation from part **e.** ______________

g. The expressions for the coordinates in part **f** should define the dilation that transforms rectangle $PQRS$ into rectangle $P'Q'R'S'$. Verify this by substituting the x- and y-coordinates of points P, Q, R, and S into the corresponding expressions. Show your work in the space below.

Write a rule for the dilation, D, that transforms the rectangle with vertices at points J, K, L, and M into the rectangle with vertices at points J', K', L', and M'.

2. $J(-7, 6)$ $J'(-9, 7)$
$K(1, 6)$ $K'(3, 7)$
$L(1, 2)$ $L'(3, 1)$
$M(-7, 2)$ $M'(9, 1)$

$D(x, y) =$ ______________

3. $J(-2, 14)$ $J'(1, 8)$
$K(8, 14)$ $K'(5, 8)$
$L(8, -6)$ $L'(5, 0)$
$M(-2, -6)$ $M'(1, 0)$

$D(x, y) =$ ______________

4. $J(-5, 1)$ $J'(-11, 10)$
$K(0, 0)$ $K'(9, 6)$
$L(-1, -5)$ $L'(5, -14)$
$M(-6, -4)$ $M'(-15, -10)$

$D(x, y) =$ ______________

5. Refer to your work in Exercises 1–4. Write a rule that can be used to define any dilation, D, with scale factor $n > 0$ and center of dilation (a, b). ______________

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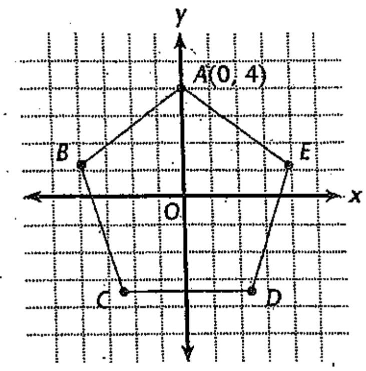
10.7 Rotations and Regular Polygons

In the figure at right, *ABCDE* is a regular pentagon with its center at the origin of a coordinate plane. One vertex is at the point $A(0, 4)$. Given just this information, it may seem nearly impossible to identify the coordinates of the other vertices. However, it is fairly easy to do this by using fundamental facts about regular polygons and rotations.



For Exercises 1–3, refer to the figure at right.

1. Draw $\overline{OB}$. What is the measure of $\angle AOB$? __________

2. Assume that point *B* is the image of point *A* under a rotation *R*.

a. Describe the magnitude and direction of *R*.

____

b. Write a set of transformation equations for *R*.

____

c. What are the coordinates of point *B*? Round to the nearest tenth. __________

3. Use the technique of Exercise 2 to find the coordinates of:

a. point *C* __________ **b.** point *D* __________ **c.** point *E* __________

Find the coordinates of all vertices of the polygon that is described.

4. a regular nonagon with center at the origin and one vertex at $(0, 8)$

____

5. a regular decagon with center at the origin and one vertex at $(-6, 0)$

____

6. a regular hexagon with center at the origin and one vertex at $(-4, 2)$

____

7. a regular pentagon with center at $(2, -3)$ and one vertex at $(1, 6)$ (Hint: Start with a translation.)

____

8. On a separate sheet of paper, describe a method for finding the coordinates of all vertices of a regular *n*-gon with center at (a, b) and one vertex at (x, y).