

## 4.8 Perform Congruence Transformations

**transformation** - an operation that moves or changes a geometric figure in some way to produce a new figure

**image** - the new figure formed after a transformation has taken place

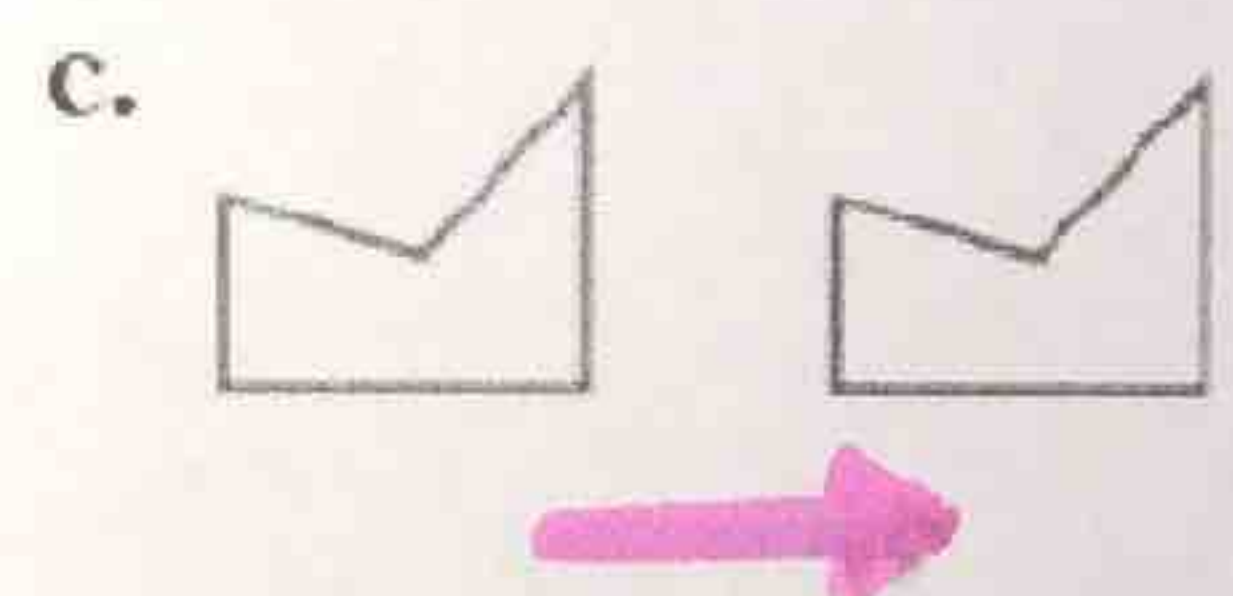
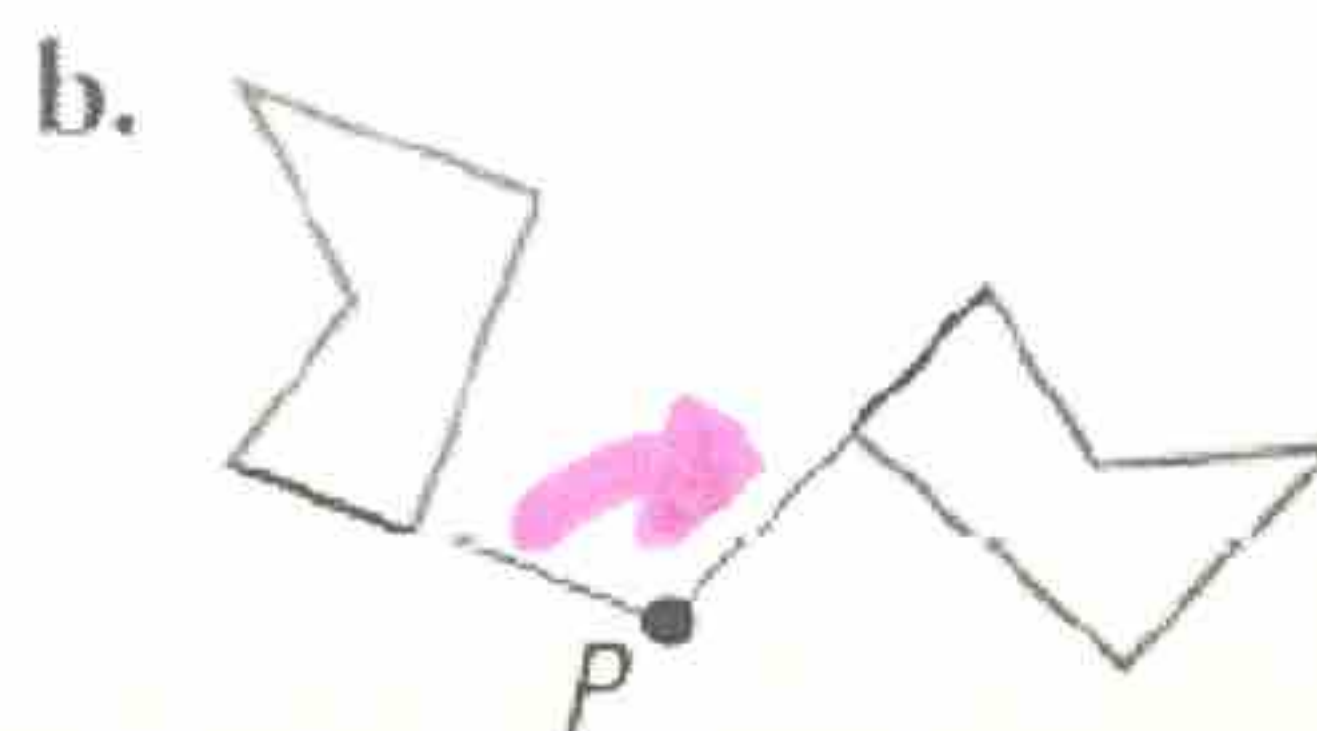
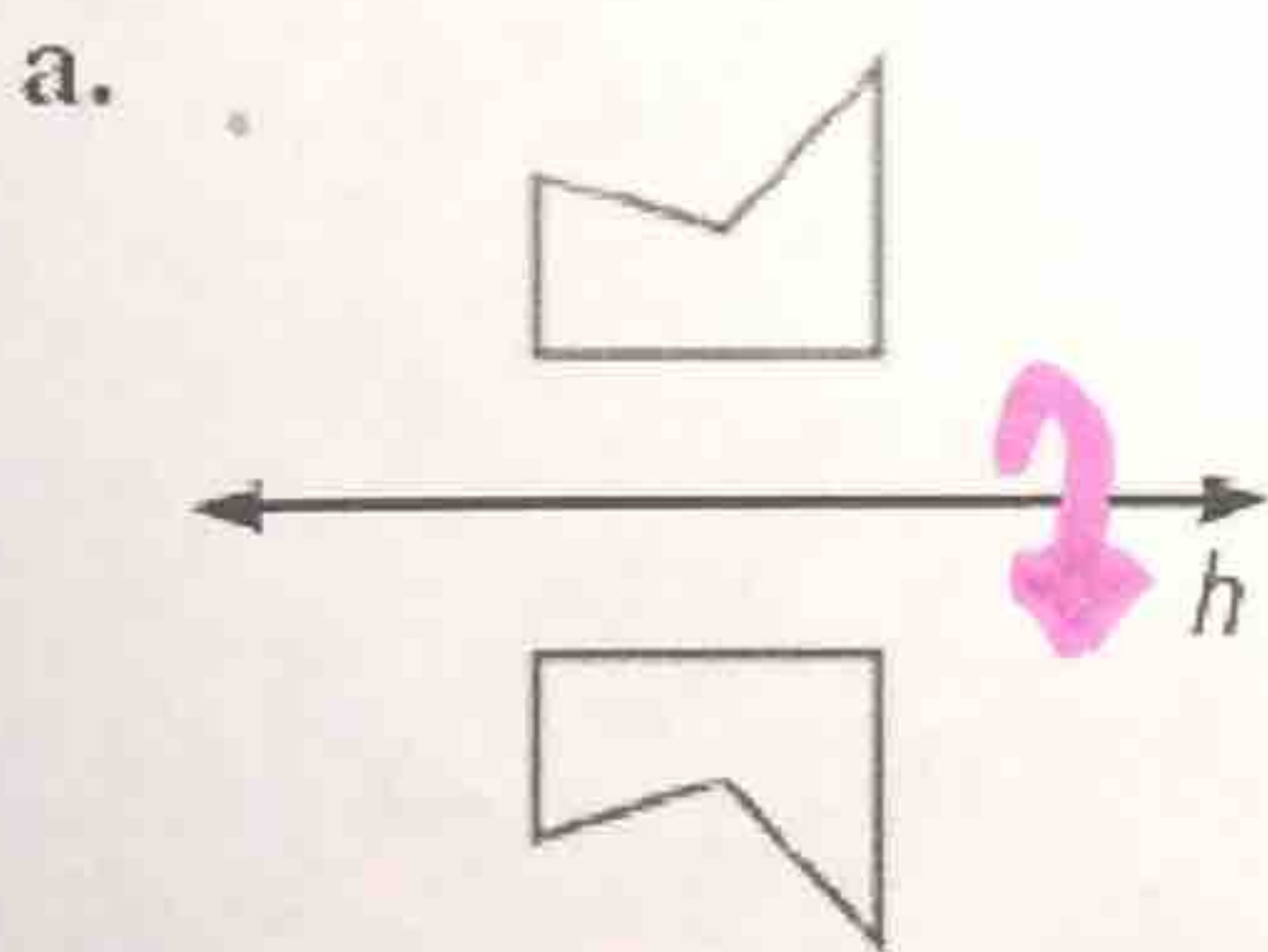
**translation** - moves every point of a figure the same distance in the same direction

**reflection** - uses a *line of reflection* to create a mirror image of the original figure

**rotation** - turns a figure about a fixed point, called the *center of rotation*

**congruence transformation** - changes the position of a figure without changing its size or shape; translations, reflections, and rotations are 3 types

**Ex 1:** Name the type of transformation demonstrated in each picture.



### KEY CONCEPT

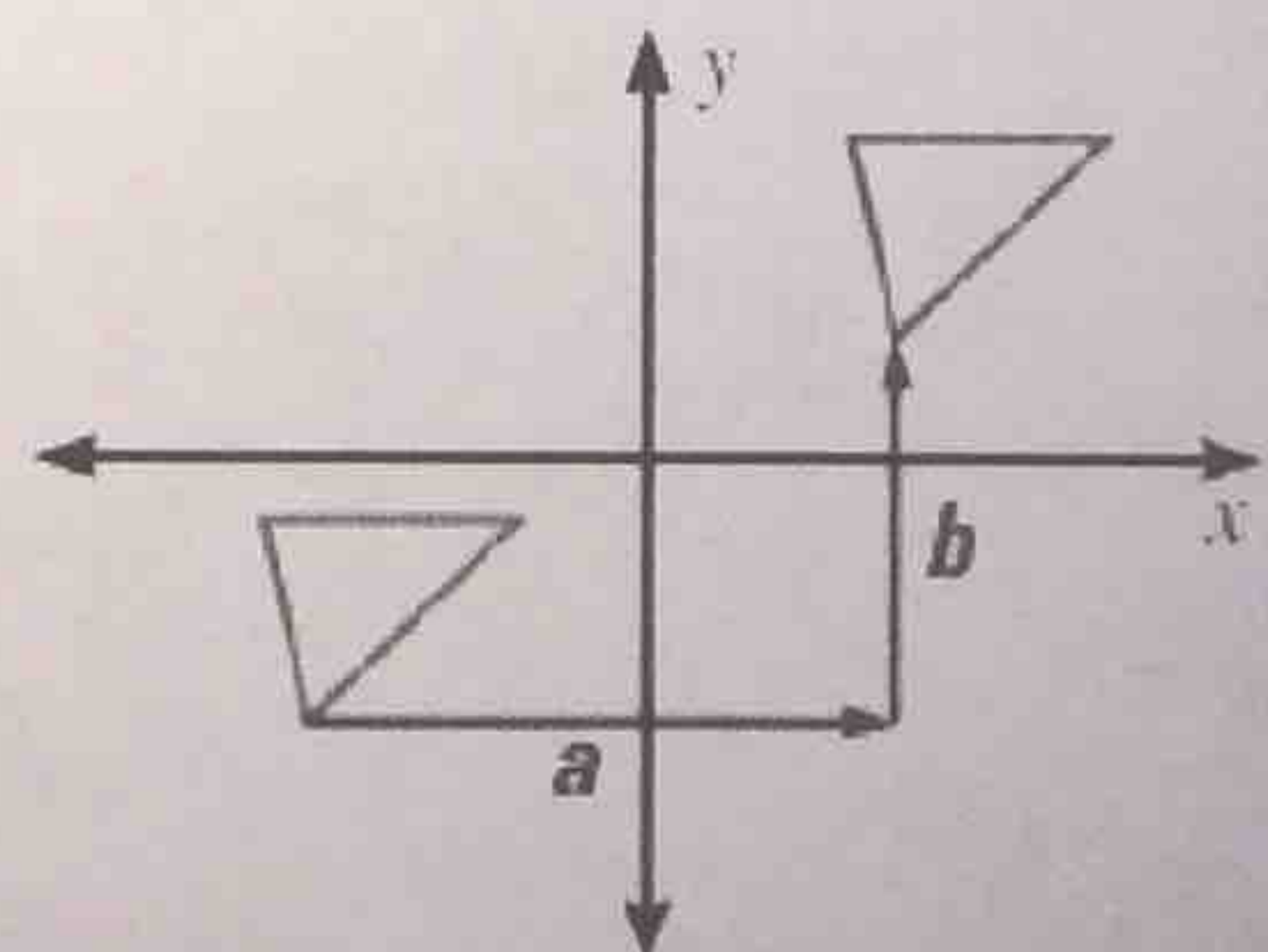
### For Your Notebook

#### Coordinate Notation for a Translation

You can describe a translation by the notation

$$(x, y) \rightarrow (x + a, y + b)$$

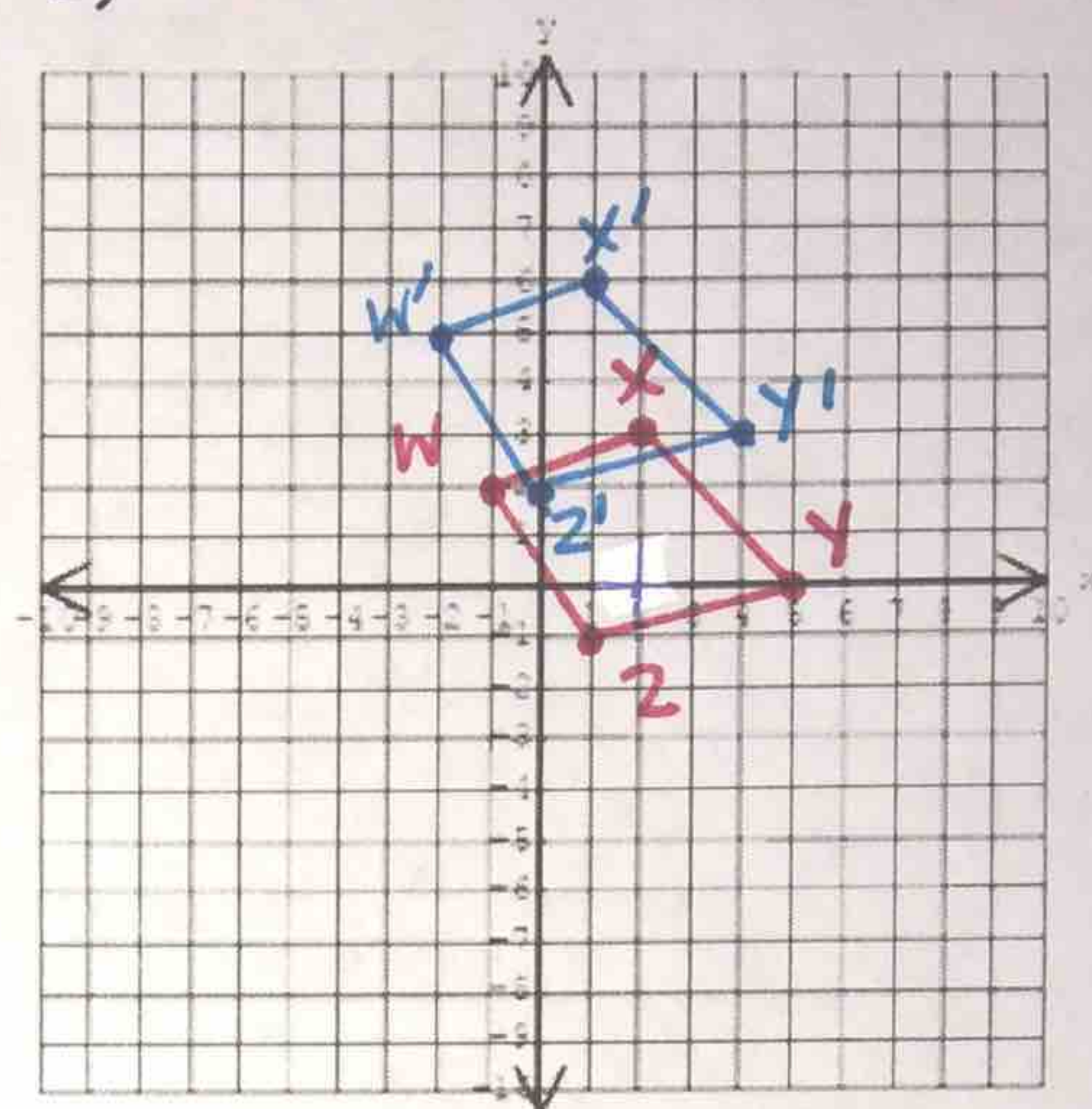
which shows that each point  $(x, y)$  of the blue figure is translated horizontally  $a$  units and vertically  $b$  units.





Ex 2: Figure WXYZ has the vertices  $W(-1, 2)$ ,  $X(2, 3)$ ,  $Y(5, 0)$ , and  $Z(1, -1)$ . Sketch WXYZ and its image  $W'X'Y'Z'$  after the translation:  
 $(x, y) \rightarrow (x - 1, y + 3)$

$$\begin{aligned} W(-1, 2) &\rightarrow W'(-2, 5) \\ X(2, 3) &\rightarrow X'(1, 6) \\ Y(5, 0) &\rightarrow Y'(4, 3) \\ Z(1, -1) &\rightarrow Z'(0, 2) \end{aligned}$$

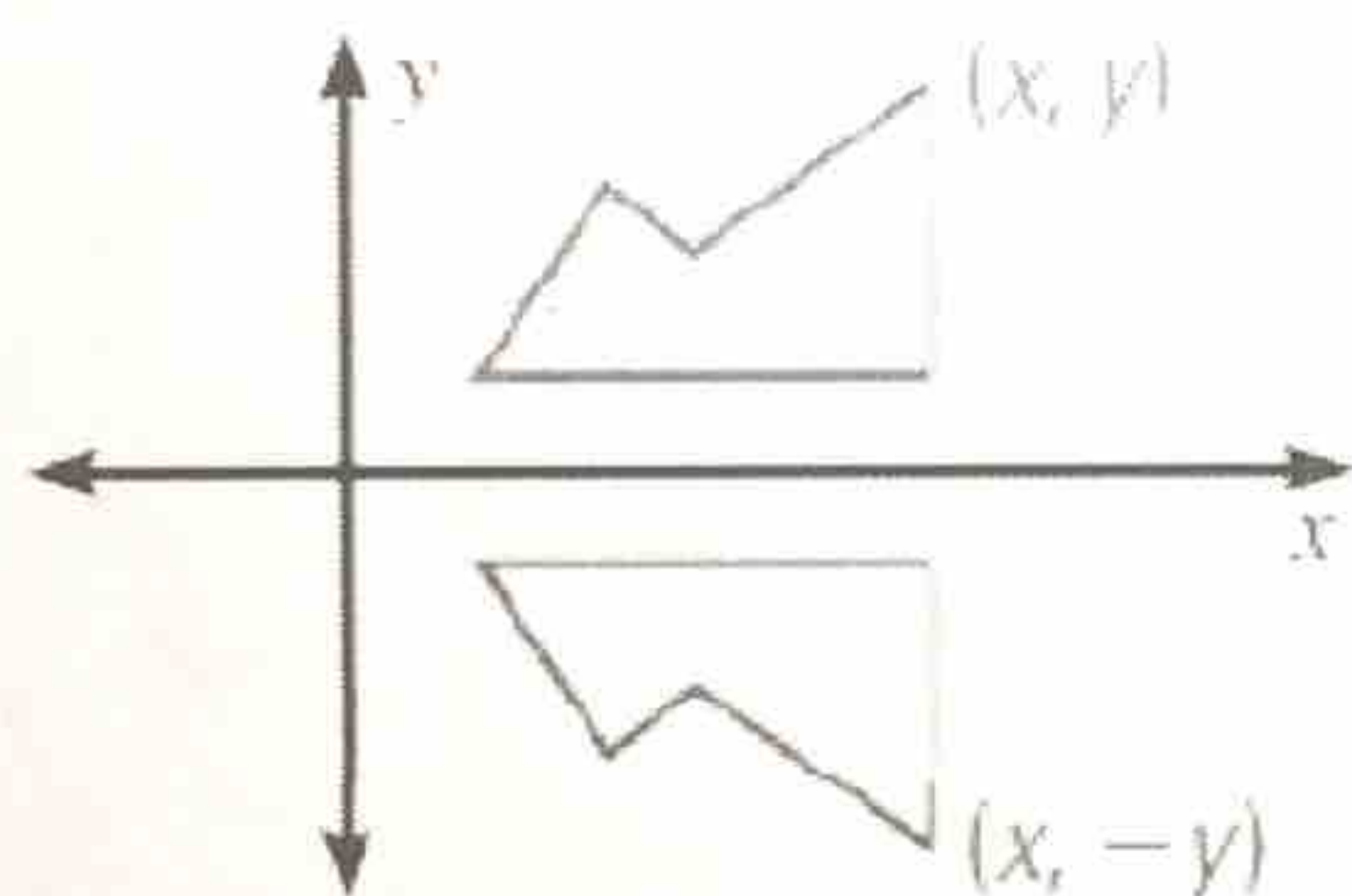


## KEY CONCEPT

## For Your Notebook

### Coordinate Notation for a Reflection

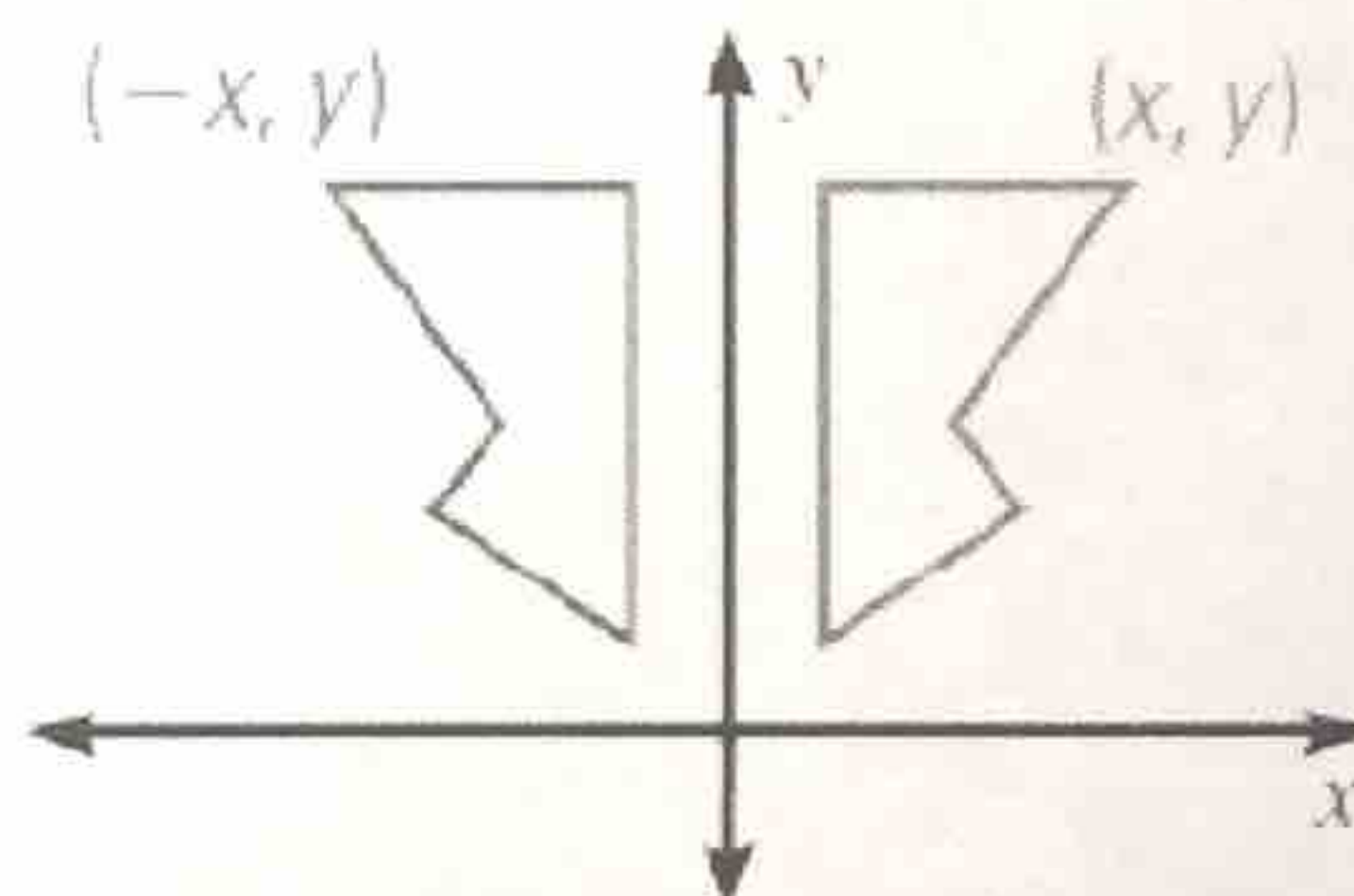
#### Reflection in the x-axis



Multiply the y-coordinate by  $-1$ .

$$(x, y) \rightarrow (x, -y)$$

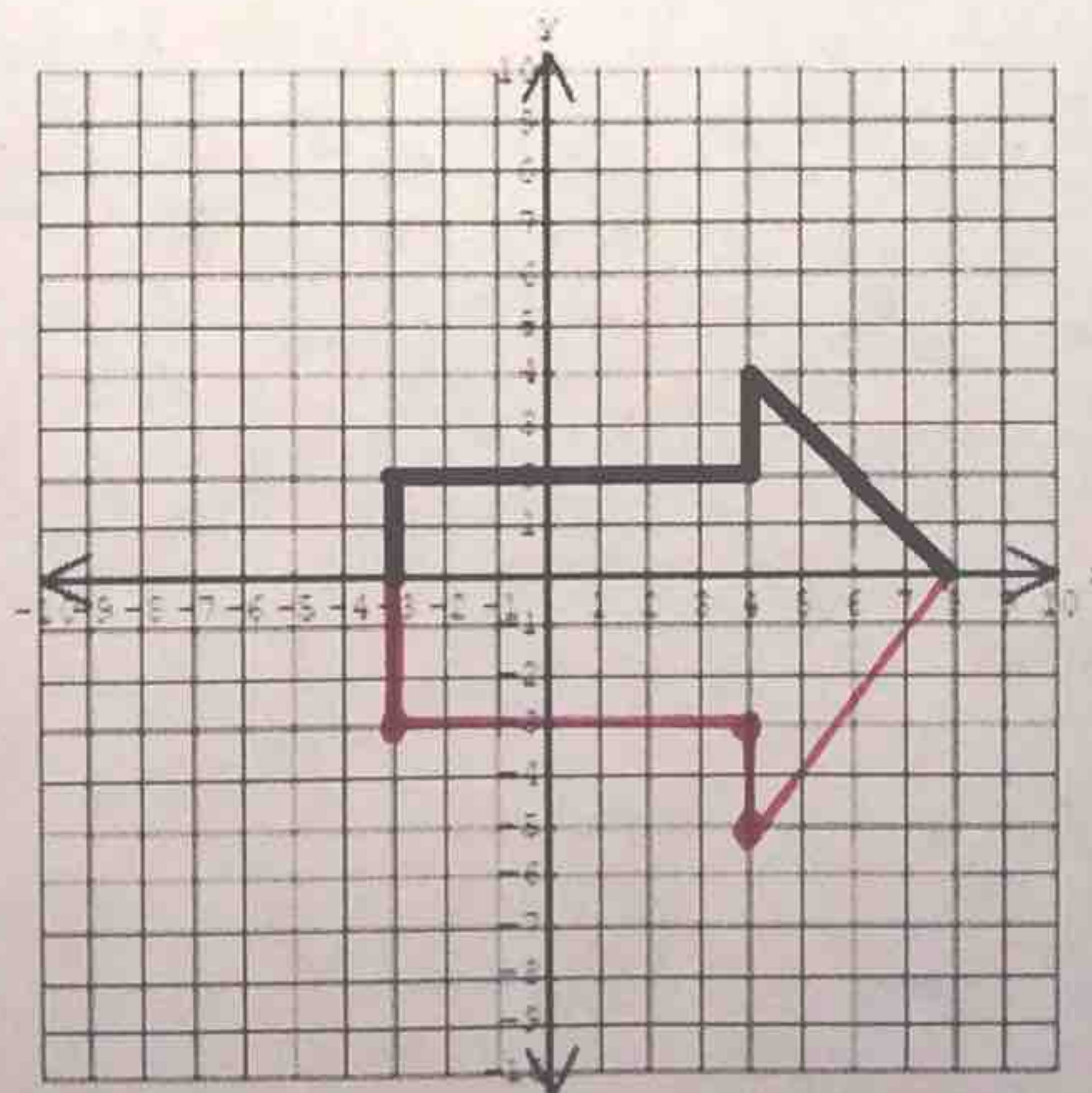
#### Reflection in the y-axis



Multiply the x-coordinate by  $-1$ .

$$(x, y) \rightarrow (-x, y)$$

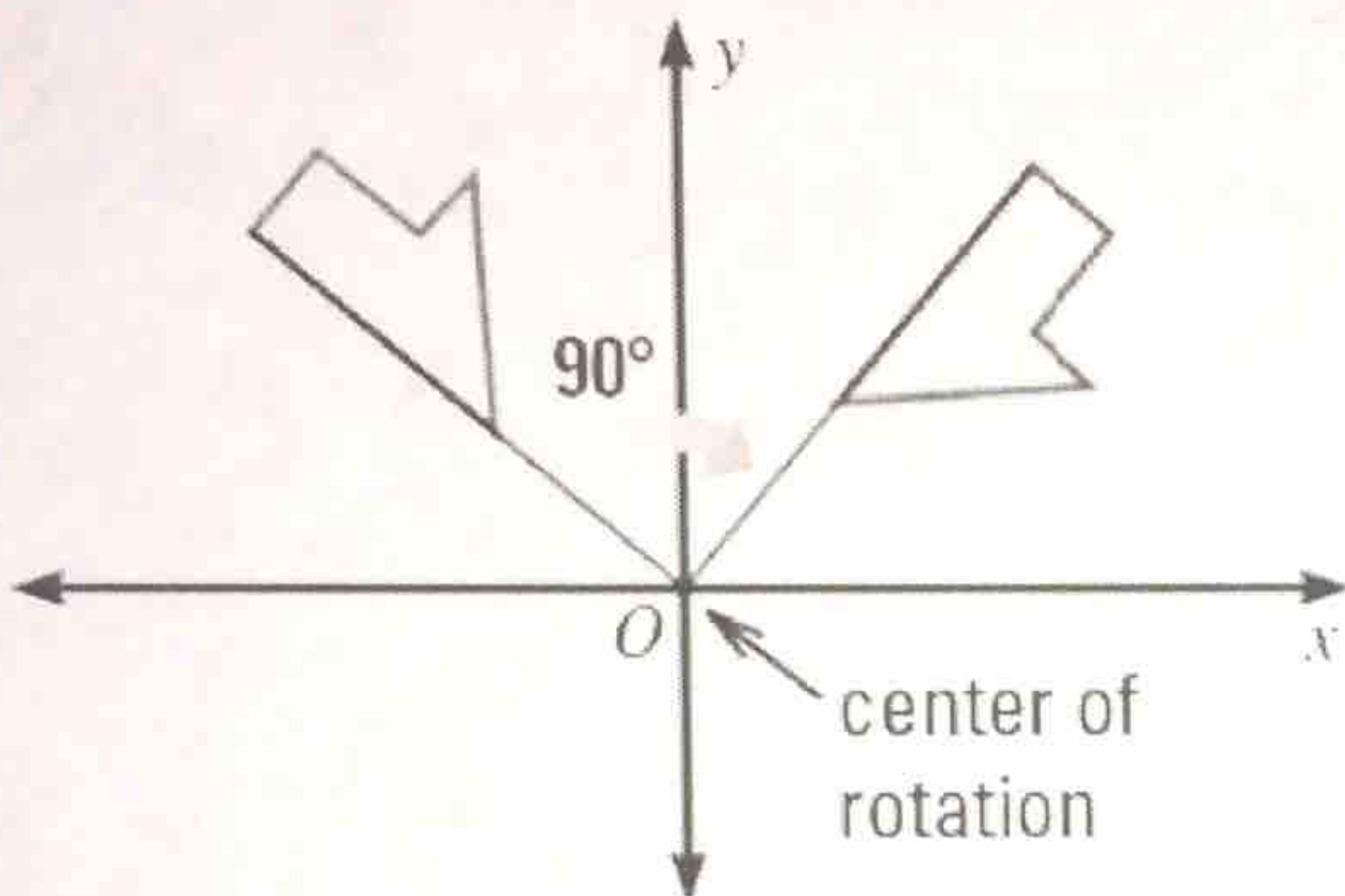
Ex 3: Use reflection in the x-axis to draw the other half of the pattern.



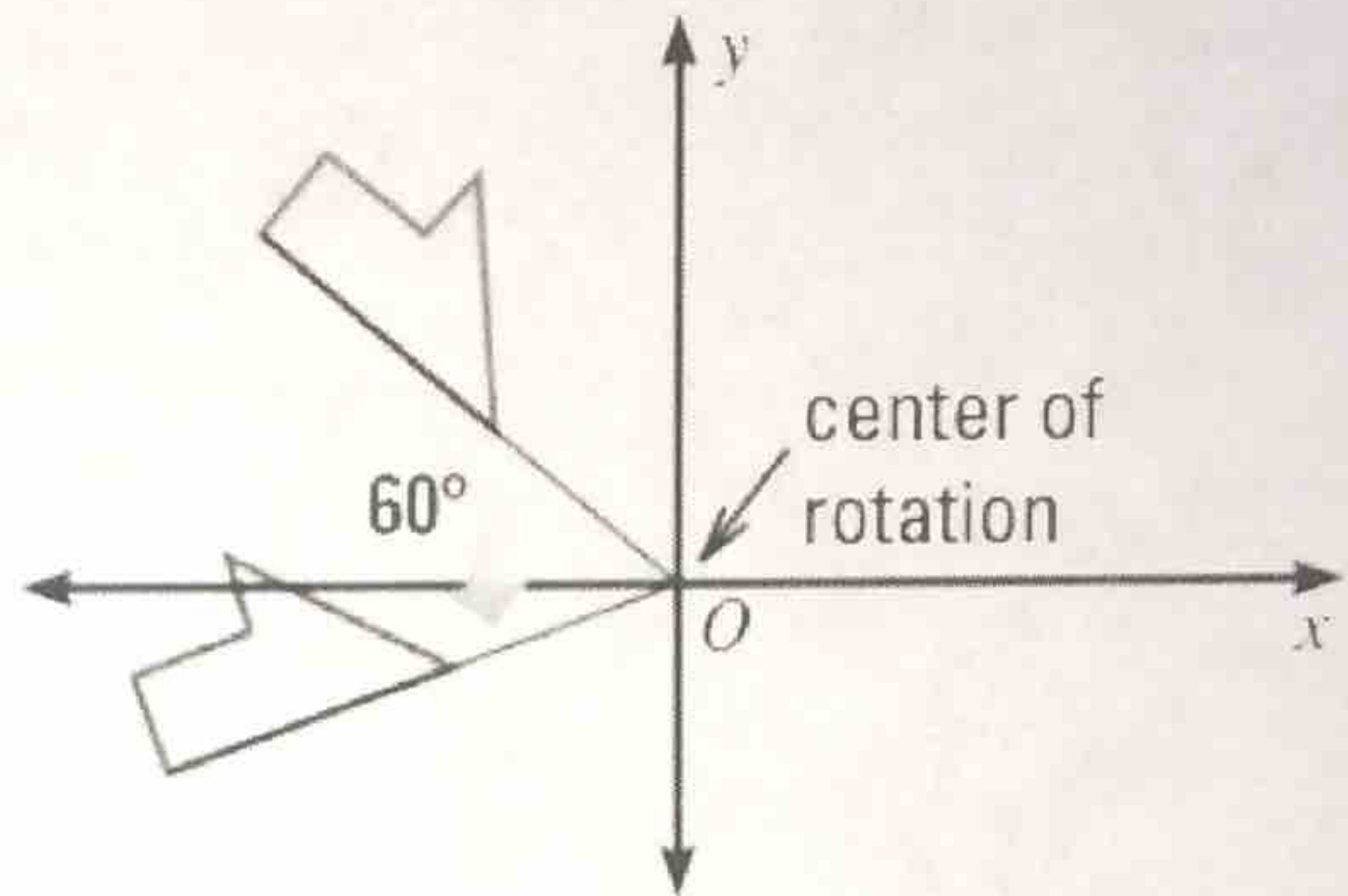


**Rotations** in this lesson will use the origin as the center of rotation. The direction of rotation can either be **clockwise** or **counterclockwise**. The **angle of rotation** is formed by rays drawn from the center of rotation through corresponding points on the original figure and its image.

90° clockwise rotation



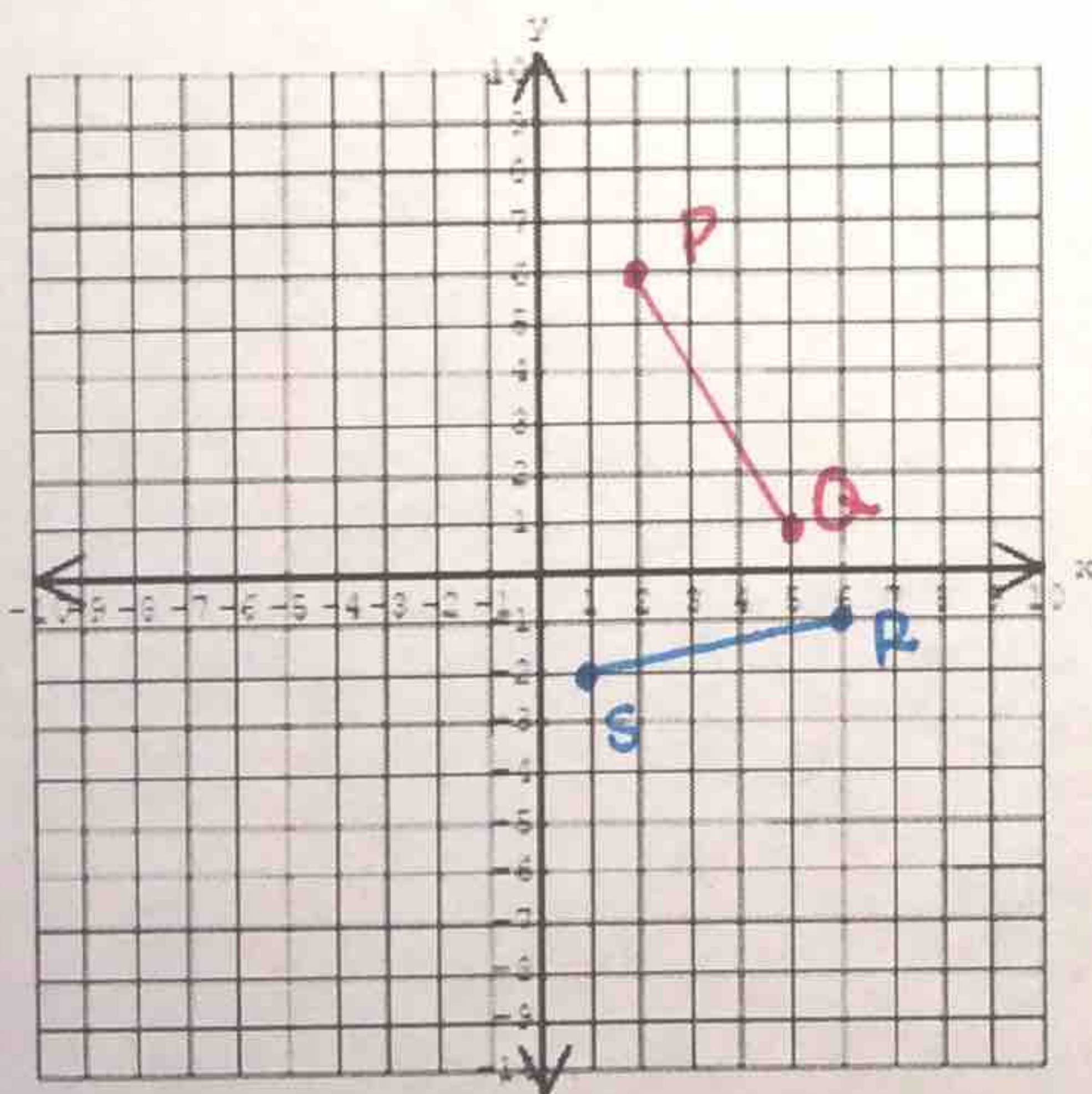
60° counterclockwise rotation



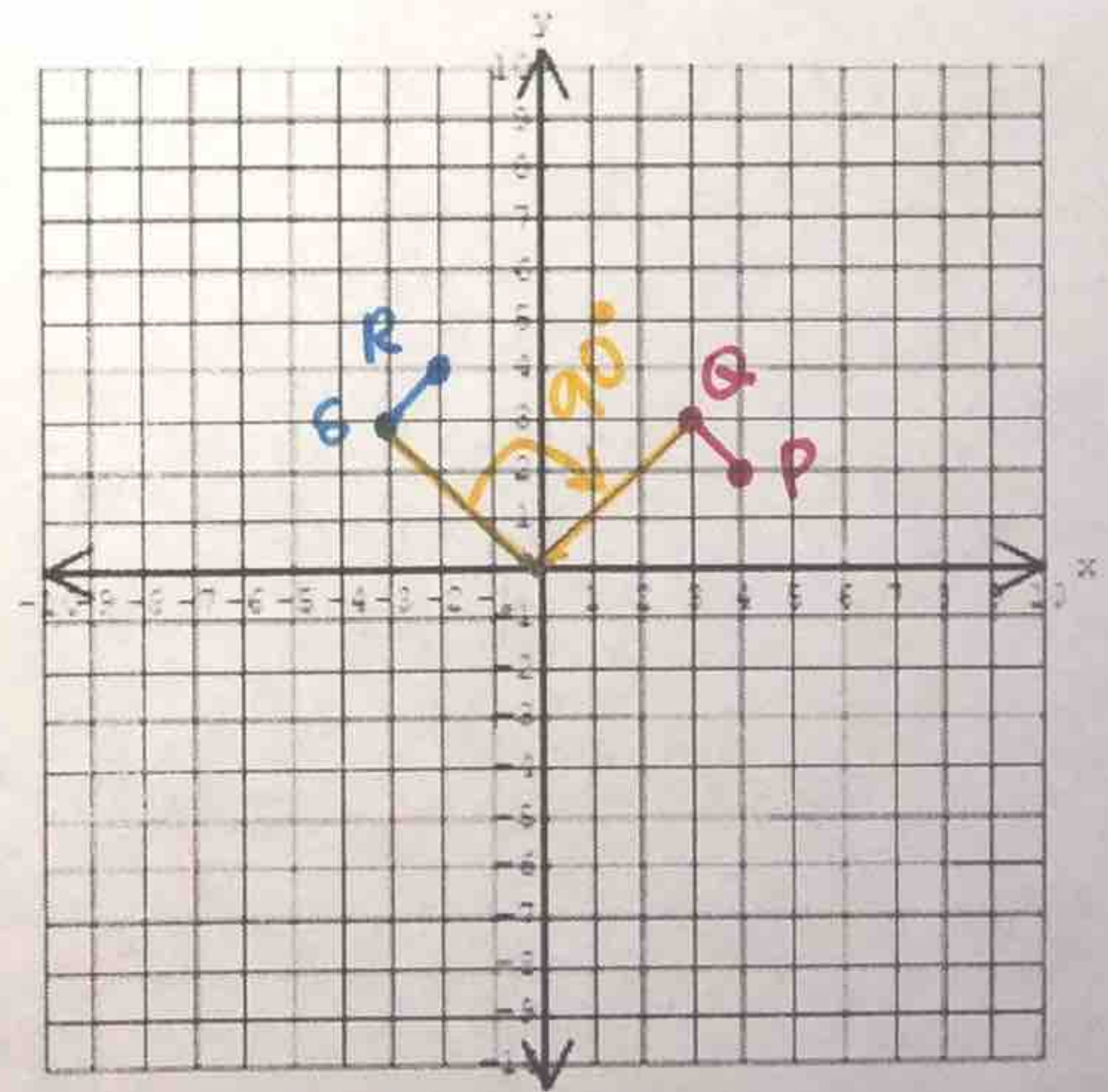
**Ex 4:** Graph  $\overline{PQ}$  and  $\overline{RS}$ . Tell whether  $\overline{RS}$  is a rotation of  $\overline{PQ}$  about the origin. If so, give the angle and direction of the rotation.

(a)  $P(2, 6)$ ,  $Q(5, 1)$ ,  $R(6, -1)$ ,  $S(1, -2)$

(b)  $P(4, 2)$ ,  $Q(3, 3)$ ,  $R(-2, 4)$ ,  $S(-3, 3)$



NOT A ROTATION



ROTATION  
90° Counterclockwise