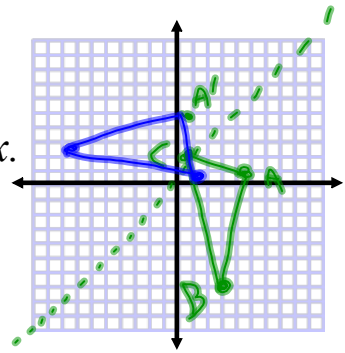


## Warm Up

1. Graph  $\triangle ABC$  and reflect it in the line  $y = x$ .  
 $A(5, 1)$     $B(3, -7)$     $C(1, 2)$

$$A'(1, 5)$$



2. Given the points  $M(3, 5)$ ,  $N(-5, 3)$  and  $O(0, 0)$ , find  $MO$ ,  $NO$ , and  $m\angle MON$

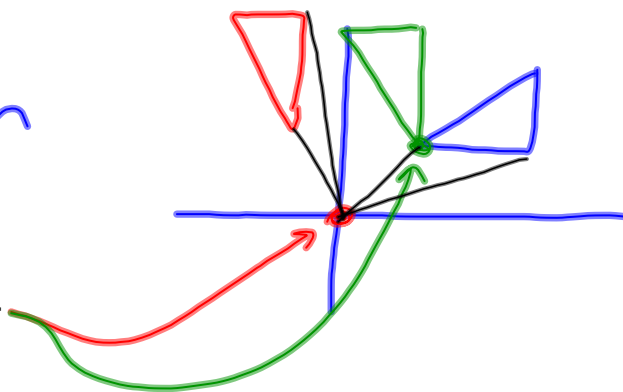
3. Multiply  $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \begin{bmatrix} 2 & 3 \\ 5 & -7 \end{bmatrix} \begin{bmatrix} 5 & -7 \\ -2 & 3 \end{bmatrix}$

## 9-4 Rotations

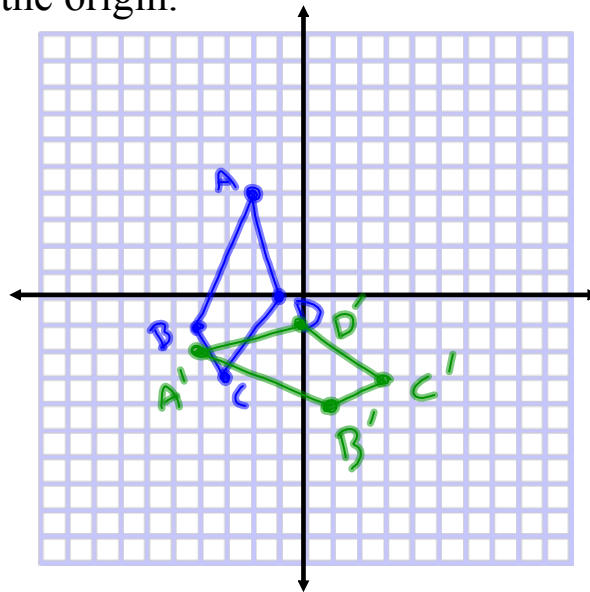
Rotation - *turn*

Center of rotation -

Angle of rotation - *amount of "spin"*



- Ex 1 Graph quadrilateral  $ABCD$  with vertices  $A(-2, 4)$ ,  $B(-4, -1)$ ,  $C(-3, -3)$ , and  $D(-1, 0)$ . Then rotate the quadrilateral  $90^\circ$  counterclockwise about the origin.



- Ex 2 Graph quadrilateral  $ABCD$  with vertices  $A(3, 1)$ ,  $B(5, 1)$ ,  $C(5, -3)$ , and  $D(2, -1)$ . Then rotate the quadrilateral  $90^\circ$  counterclockwise about the origin.

$$A(3, 1)$$

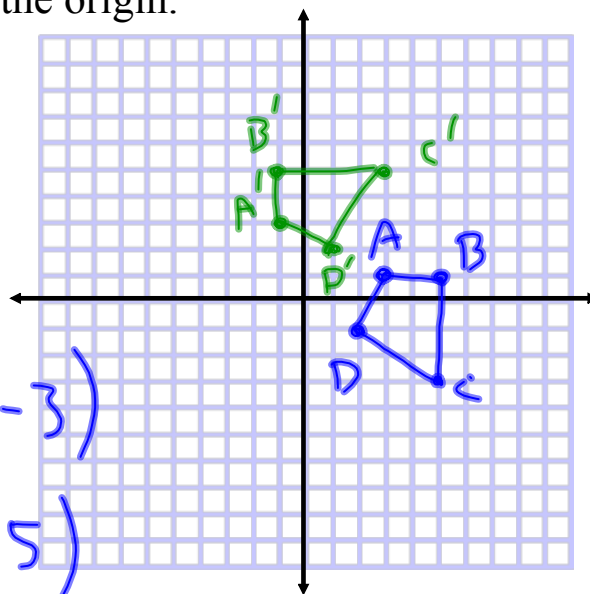
$$A'(-1, 3)$$

$$B(5, 1)$$

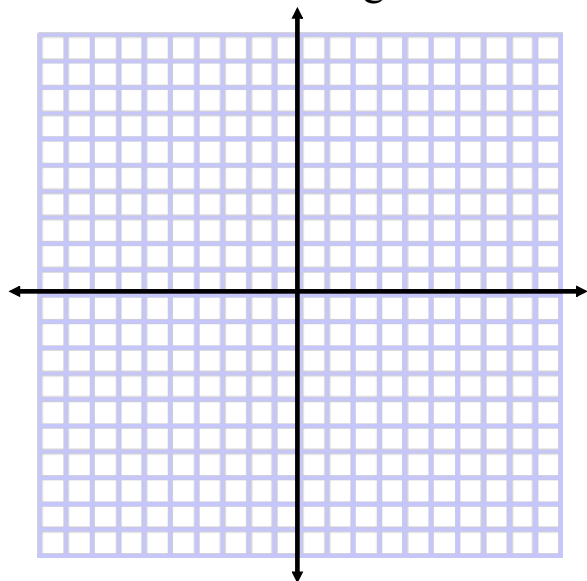
$$B'(-1, 5)$$

$$C(5, -3)$$

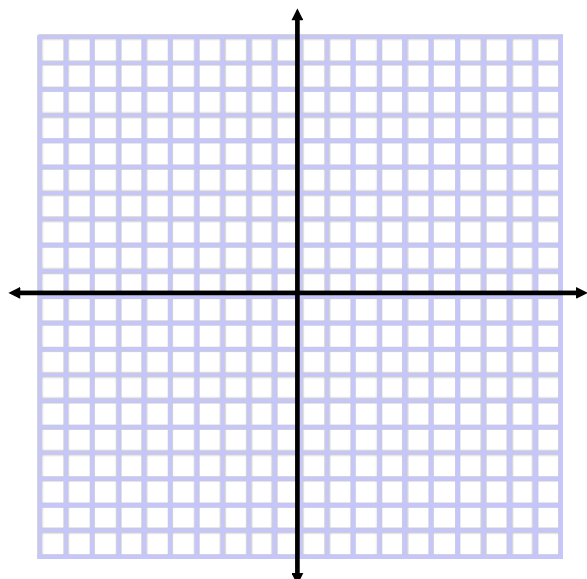
$$C'(3, 5)$$



Ex 3 Graph triangle  $ABC$  with vertices  $A(-2, 1)$ ,  $B(4, 2)$ , and  $C(1, 0)$ . Then rotate the triangle  $270^\circ$  counterclockwise about the origin.



Ex 4 Graph triangle  $ABC$  with vertices  $A(3, 7)$ ,  $B(2, 1)$ , and  $C(5, 2)$ . Then rotate the triangle  $180^\circ$  counterclockwise about the origin.



## Reflection and Rotation Matrices

Reflect across the  $x$ -axis: multiply by  $\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$

Reflect across the  $y$ -axis: multiply by  $\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$

Rotate 90 degrees: multiply by  $\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$

Rotate 180 degrees: multiply by  $\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$

Rotate 270 degrees: multiply by  $\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$

Rotate 360 degrees: multiply by  $\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix}$

Ex 5 Trapezoid  $PQRS$  has vertices  $P(2, 5)$ ,  $Q(4, 4)$ ,  $R(4, -1)$ , and  $S(2, -2)$ . Find the image matrix for a  $270^\circ$  rotation about the origin. Graph  $PQRS$  and  $P'Q'R'S'$ .

$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix} \quad \begin{bmatrix} 2 & 4 & 4 & 2 \\ 5 & 4 & -1 & -2 \end{bmatrix}$$

$2 \times 2$        $2 \times 4$

$$\begin{bmatrix} 5 & 4 & -1 & -2 \\ -2 & -4 & -4 & -2 \end{bmatrix}$$

Ex 6 Triangle  $QRS$  has vertices  $Q(1, 4)$ ,  $R(2, 1)$ , and  $S(4, 3)$ .  
Find the image matrix for a  $180^\circ$  rotation about the origin.  
Graph  $QRS$  and  $Q'R'S'$ .

