Lesson Title 1.5.3 Transforming Matrices **Algebra 2** **Date** _____

Translation:

Shifting or sliding a matrix up, down, left or right.

When you translate an original matrix you add or subtract the movements to the original using a translation matrix. Remember the matrices MUST have the same dimension. X values go on top and Y values go on the bottom row of the matrix, which means each column would represent the coordinates you are shifting or sliding.

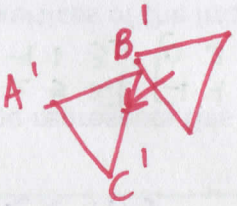
TASK 1: Translate ΔABC with coordinates $A(-2, 1)$, $B(3, 2)$, and $C(0, -3)$, 3 units left and 1 units down.

a) Write the matrix equation the represents this transformation.

$$\begin{bmatrix} -2 & 3 & 0 \\ 1 & 2 & -3 \end{bmatrix} + \begin{bmatrix} -3 & -3 & -3 \\ -1 & -1 & -1 \end{bmatrix} = \begin{bmatrix} -5 & 0 & -3 \\ 0 & 1 & -4 \end{bmatrix}$$

b) Find the coordinates of the new vertices of the image and graph both figures. *After a transformation has occurred you would change A to A′ (A prime) and B to B′ and so on.*

$A'(-5, 0)$
$B'(0, 1)$
$C'(-3, -4)$



Dilation:

Enlarging or Reducing the size of a figure using matrices.

When you dilate an original matrix you use scalar multiplication (similar to distributing into parentheses) to the original using a scalar multiplier. The scalar determines if the dilation is an enlargement or a reduction. Numbers larger than 1 enlarge a figure and numbers between 0 and 1, reduce the figure.

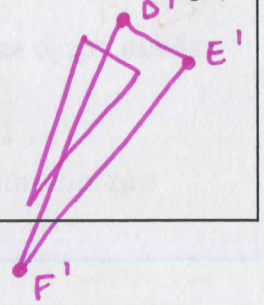
TASK 2: Enlarge ΔDEF with coordinates $D(2, 3)$, $E(5, 1)$, and $F(-2, -7)$, a factor of $\frac{4}{3}$.

a) Write the matrix equation that represents this transformation.

$$\frac{4}{3}\begin{bmatrix} 2 & 5 & -2 \\ 3 & -1 & -7 \end{bmatrix} = \begin{bmatrix} \frac{8}{30} & \frac{20}{3} & -\frac{8}{3} \\ 4 & \frac{4}{3} & -\frac{28}{3} \end{bmatrix}$$

b) Find the coordinates of the new vertices of the image, and graph both figures.

$D'\left(\frac{8}{3}, 4\right)$
$E'\left(\frac{20}{3}, \frac{4}{3}\right)$
$F'\left(-\frac{8}{3}, -\frac{28}{3}\right)$



Reflection:

Mirror image across an axis (x or y).

When you reflect an original matrix you use multiplication with a specific matrix in a specific order. The reflection matrices below always go in front of the original matrix when you multiply.

- x-axis $\begin{bmatrix}1 & 0\\0 & -1\end{bmatrix}$ - y-axis $\begin{bmatrix}-1 & 0\\0 & 1\end{bmatrix}$

TASK 3: Reflect ΔJKL with coordinates $J(3, 4)$, $K(4, 2)$, and $L(1, -2)$

TASK 4: Reflect ΔPQR with coordinates $P(2, 2)$, $Q(2, -1)$, and $R(4, 3)$

TASK 3: across the *x*-axis.

a) Write the matrix equation the represents this transformation.

$\begin{bmatrix}1 & 0\\0 & -1\end{bmatrix}\begin{bmatrix}3 & 4 & 1\\4 & 2 & -2\end{bmatrix}=\begin{bmatrix}3 & 4 & 1\\-4 & -2 & 2\end{bmatrix}$

b) Find the coordinates of the vertices of the image and graph both triangles.

$J'(3,-4)$ $K'(4,-2)$ $L'(1,2)$

TASK 4: across the *y*-axis.

a) Write the matrix equation the represents this transformation.

$\begin{bmatrix}-1 & 0\\0 & 1\end{bmatrix}\begin{bmatrix}2 & 2 & 4\\2 & -1 & 3\end{bmatrix}=\begin{bmatrix}-2 & -2 & -4\\2 & -1 & 3\end{bmatrix}$

b) Find the coordinates of the vertices of the image and graph both triangles.

$P'(-2,2)$ $Q'(-2,-1)$ $R'(-4,3)$

Rotation:

Turning a figure about the origin (0, 0).

When you turn an object about the origin, you are given a direction and a degree amount that tells you which matrix you will multiply by the original matrix. You will use multiplication with a specific matrix in a specific order. The rotation matrices below always go in front of the original matrix when you multiply.

- 90° counterclockwise $\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}$ - 90° clockwise $\begin{bmatrix}0 & 1\\-1 & 0\end{bmatrix}$ - 180° $\begin{bmatrix}-1 & 0\\0 & -1\end{bmatrix}$

Use each matrix to rotate polygon *ABCD* with coordinates $A(0, 1)$, $B(2, -4)$, $C(5, 1)$, and $D(2, 3)$ about the origin.

TASK 5: 90° Counter clockwise (CCW)

a) Write the matrix equation the represents this transformation.

$\begin{bmatrix}0 & -1\\1 & 0\end{bmatrix}\begin{bmatrix}0 & 2 & 5 & 2\\1 & -4 & 1 & 3\end{bmatrix}=\begin{bmatrix}-1 & 4 & -1 & -3\\0 & 2 & 5 & 2\end{bmatrix}$

b) Find the coordinates of the vertices of the image and graph both triangles.

$A'(-1,0)$; $B'(4,2)$; $C'(-1,5)$; $D'(-3,2)$

TASK 6: 90° Clockwise (CW)

a) Write the matrix equation the represents this transformation.

$\begin{bmatrix}0 & 1\\-1 & 0\end{bmatrix}\begin{bmatrix}0 & 2 & 5 & 2\\1 & -4 & 1 & 3\end{bmatrix}=\begin{bmatrix}1 & -4 & 1 & 3\\0 & -2 & -5 & -2\end{bmatrix}$

b) Find the coordinates of the vertices of the image and graph both triangles.

$A'(1,0)$; $B'(-4,-2)$; $C'(1,-5)$; $D'(3,-2)$

Still need help with: