Bell Ringer

Wednesday 2/12

Solve each system of equations using a matrix.

$2y - 3x = 4$

$3y - 5x = 5$

$4x + 8y = 20$

$-4x + 2y = -30$

Polygons can be represented in matrix form, we simply place all of the coordinates of the vertices into one matrix. This is called a vertex matrix.

$$\begin{bmatrix} x \\ y \end{bmatrix}$$

A square has its vertexes in the following coordinates (1,1), (-1,1), (-1,-1) and (1,-1). If we want to create our vertex matrix we plug each ordered pair into each column of a 4 column matrix:

$$\begin{bmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \end{bmatrix} = \begin{bmatrix} 1 & -1 & -1 & 1 \\ 1 & 1 & -1 & -1 \end{bmatrix}$$

We can use matrices to translate our figure, if we want to translate the figure x+3 and y+2 we simply add 3 to each x-coordinate and 2 to each y-coordinate.

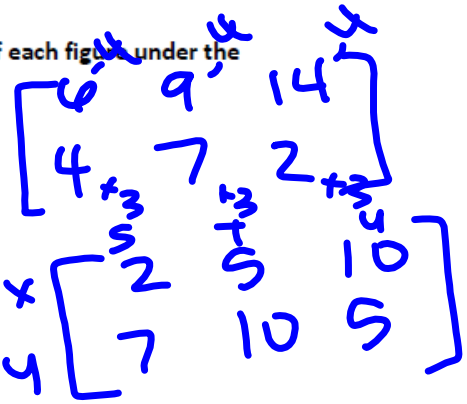
$$\begin{bmatrix} x_1 + 3 & x_2 + 3 & x_3 + 3 & x_4 + 3 \\ y_1 + 2 & y_2 + 2 & y_2 + 2 & y_2 + 2 \end{bmatrix}$$

Feb 12-11:12 AM

Transformations with Matrices

Use a matrix to find the coordinates of the vertices of the image of each figure under the given translations.

1. ΔSTU with S(6, 4), T(9, 7) and U(14, 2); (x, y) → (x – 4, y + 3)



2. ΔGHI with G(-5, 0), H(-3, 6) and I(-2, 1); (x, y) → (x + 2, y + 6)

3. ΔKLM with K(-7, -3), L(4, 9) and M(9, -6); (x, y) → (x – 7, y + 2)

4. parallelogram ABCD with A(-4, 3), B(-2, 8), C(3, 10), and D(1, 5); (x, y) → (x + 3, y - 9)

Use scalar multiplication to find the coordinates of the vertices of each figure for a dilation centered at the origin with the given scale factor.

5. ΔDEF with D(2, 1), E(5, 4) and F(7, 2); r = 4

6. quadrilateral WXYZ with W(-9, 6), X(-6, 3), Y(3, 12) and Z(-6, 15); $r = \frac{1}{3}$

7. quadrilateral HIJK with H(-2, 3), I(2, 6), J(8, 3) and K(3, -4); $r = -\frac{1}{3}$

8. pentagon DEFGH with D(-8, -4), E(-8, 2), F(2, 6), G(8, 0) and H(4, -6); $r = \frac{5}{4}$

Use a matrix to find the coordinates of the vertices of the image of each figure under the given reflection.

9. ΔMNO with M(-5, 1), N(-2, 3) and O(2, 0); y -axis

10. quadrilateral ABCD with A(3, 1), B(6, -2), C(5, -5), and D(1, -6); x-axis

If we want to dilate a figure we simply multiply each x- and y-coordinate with the scale factor we want to dilate with.

$$3 \cdot \begin{bmatrix} x_1 & x_2 & x_3 & x_4 \\ y_1 & y_2 & y_3 & y_4 \end{bmatrix}$$

Transformations with Matrices

Use a matrix to find the coordinates of the vertices of the image of each figure under the given translations.

1. ΔSTU with S(6, 4), T(9, 7) and U(14, 2); $(x, y) \rightarrow (x - 4, y + 3)$

2. ΔGHI with G(-5, 0), H(-3, 6) and I(-2, 1); $(x, y) \rightarrow (x + 2, y + 6)$

3. ΔKLM with K(-7, -3), L(4, 9) and M(9, -6); $(x, y) \rightarrow (x - 7, y + 2)$

4. parallelogram ABCD with A(-4, 3), B(-2, 8), C(3, 10), and D(1, 5); $(x, y) \rightarrow (x + 3, y - 9)$

Use scalar multiplication to find the coordinates of the vertices of each figure for a dilation centered at the origin with the given scale factor.

5. ΔDEF with D(2, 1), E(5, 4) and F(7, 2); r = 4

6. quadrilateral WXYZ with W(-9, 6), X(-6, 3), Y(3, 12) and Z(-6, 15); $r = \frac{1}{3}$

7. quadrilateral HIJK with H(-2, 3), I(2, 6), J(8, 3) and K(3, -4); $r = -\frac{1}{3}$

8. pentagon DEFGH with D(-8, -4), E(-8, 2), F(2, 6), G(8, 0) and H(4, -6); $r = \frac{5}{4}$

$$\frac{1}{3} \cdot \begin{bmatrix} -9 & -6 & 3 & -6 \\ 6 & 3 & 12 & 15 \end{bmatrix}$$

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

Use a matrix to find the coordinates of the vertices of the image of each figure under the given reflection.

9. ΔMNO with M(-5, 1), N(-2, 3) and O(2, 0); y -axis

10. quadrilateral ABCD with A(3, 1), B(6, -2), C(5, -5), and D(1, -6); x-axis

When we want to create a reflection image we multiply the vertex matrix of our figure with what is called a reflection matrix. The most common reflection matrices are:

for a reflection in the x-axis

$$\begin{bmatrix} 1 & 0 \\ 0 & -1 \end{bmatrix}$$

for a reflection in the origin

$$\begin{bmatrix} -1 & 0 \\ 0 & -1 \end{bmatrix}$$

for a reflection in the y-axis

$$\begin{bmatrix} -1 & 0 \\ 0 & 1 \end{bmatrix}$$

for a reflection in the line y=x

$$\begin{bmatrix} 0 & 1 \\ 1 & 0 \end{bmatrix}$$

Transformations with Matrices

Use a matrix to find the coordinates of the vertices of the image of each figure under the given translations.

1. ΔSTU with S(6, 4), T(9, 7) and U(14, 2); $(x, y) \rightarrow (x - 4, y + 3)$

2. ΔGHI with G(-5, 0), H(-3, 6) and I(-2, 1); $(x, y) \rightarrow (x + 2, y + 6)$

3. ΔKLM with K(-7, -3), L(4, 9) and M(9, -6); $(x, y) \rightarrow (x - 7, y + 2)$

4. parallelogram ABCD with A(-4, 3), B(-2, 8), C(3, 10), and D(1, 5); $(x, y) \rightarrow (x + 3, y - 9)$

Use scalar multiplication to find the coordinates of the vertices of each figure for a dilation centered at the origin with the given scale factor.

5. ΔDEF with D(2, 1), E(5, 4) and F(7, 2); r = 4

6. quadrilateral WXYZ with W(-9, 6), X(-6, 3), Y(3, 12) and Z(-6, 15); $r = \frac{1}{3}$

7. quadrilateral HIJK with H(-2, 3), I(2, 6), J(8, 3) and K(3, -4); $r = -\frac{1}{3}$

8. pentagon DEFGH with D(-8, -4), E(-8, 2), F(2, 6), G(8, 0) and H(4, -6); $r = \frac{5}{4}$

Use a matrix to find the coordinates of the vertices of the image of each figure under the given reflection.

9. ΔMNO with M(-5, 1), N(-2, 3) and O(2, 0); y-axis

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

2x2 2x3

0 + 1

10. quadrilateral ABCD with A(3, 1), B(6, -2), C(5, -5), and D(1, -6); x-axis

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

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

11. ΔQRS with Q(-5, -4), R(-1, -1) and S(2, -6); x -axis

12. quadrilateral VXYZ with V(-4, -2), X(-3, 4), Y(2, 1) and Z(4, -3); y = x

Use a matrix to find the coordinates of the vertices of the image of each figure under the given rotation.

13. ΔRST with R(-2, -2), S(-3, 3) and T(2, 2); 90° counterclockwise

14. parallelogram LMNP with L(3, 4), M(7, 4), N(9, -3), and P(5, -3); 180° counterclockwise

15. parallelogram EFGH with E(-5, -4), F(-3, -1), G(5, -1) and H(3, -4); 90° counterclockwise

16. quadrilateral PSTU with P(-3, 5), S(2, 6), T(8, 1) and U(-6, -4); 270° counterclockwise

17. **Forestry** A research botanist mapped a section of forested land on a coordinate grid to keep track of endangered plants in the region. The vertices of the map are A(-2, 6), B(9, 8), C(14, 4) and D(1, -1). After a month, the botanist has decided to decrease the research area to $\frac{3}{4}$ of its original size. If the center for the reduction is O(0, 0), what are the coordinates of the new research area?

If we want to rotate a figure we operate similar to when we create a reflection. If we want to rotate a figure 90° counterclockwise we multiply the vertex matrix with:

$$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix}$$

If we want to rotate a figure 180° counterclockwise we multiply the vertex matrix with:

$$\begin{bmatrix} 0 & -1 \\ -1 & 0 \end{bmatrix}$$

If we want to rotate a figure 270° counterclockwise, or rotate a figure 90° clockwise, we multiply the vertex matrix with:

$$\begin{bmatrix} 0 & 1 \\ -1 & 0 \end{bmatrix}$$

Transformations with Matrices

Use a matrix to find the coordinates of the vertices of the image of each figure under the given translations.

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8. pentagon DEFGH with D(-8, -4), E(-8, 2), F(2, 6), G(8, 0) and H(4, -6); $r = \frac{5}{4}$

Use a matrix to find the coordinates of the vertices of the image of each figure under the given reflection.

9. ΔMNO with M(-5, 1), N(-2, 3) and O(2, 0); y -axis

10. quadrilateral ABCD with A(3, 1), B(6, -2), C(5, -5), and D(1, -6); x-axis

11. ΔQRS with Q(-5, -4), R(-1, -1) and S(2, -6); x -axis

12. quadrilateral VXYZ with V(-4, -2), X(-3, 4), Y(2, 1) and Z(4, -3); y = x

Use a matrix to find the coordinates of the vertices of the image of each figure under the given rotation.

13. ΔRST with R(-2, -2), S(-3, 3) and T(2, 2); 90° counterclockwise

14. parallelogram LMNP with L(3, 4), M(7, 4), N(9, -3), and P(5, -3); 180° counterclockwise

15. parallelogram EFGH with E(-5, -4), F(-3, -1), G(5, -1) and H(3, -4); 90° counterclockwise

16. quadrilateral PSTU with P(-3, 5), S(2, 6), T(8, 1) and U(-6, -4); 270° counterclockwise

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