9 CHAPTER SUMMARY

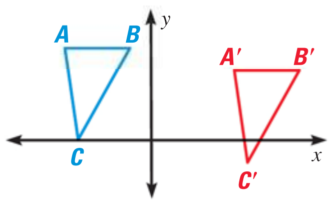
BIG IDEAS — For Your Notebook

Big Idea 1

Performing Congruence and Similarity Transformations

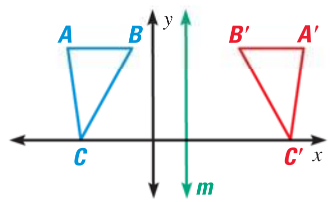
Translation

Translate a figure right or left, up or down.



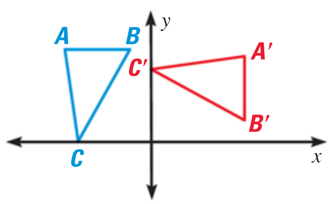
Reflection

Reflect a figure in a line.



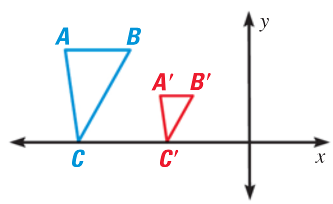
Rotation

Rotate a figure about a point.



Dilation

Dilate a figure to change the size but not the shape.

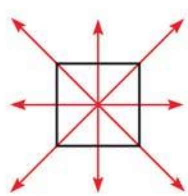


You can combine congruence and similarity transformations to make a composition of transformations, such as a glide reflection.

Big Idea 2

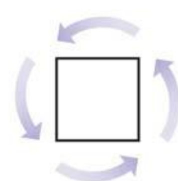
Making Real-World Connections to Symmetry and Tessellations

Line symmetry



4 lines of symmetry

Rotational symmetry



90° rotational symmetry

Big Idea 3

Applying Matrices and Vectors in Geometry

You can use matrices to represent points and polygons in the coordinate plane. Then you can use matrix addition to represent translations, matrix multiplication to represent reflections and rotations, and scalar multiplication to represent dilations. You can also use vectors to represent translations.

9 CHAPTER REVIEW

@HomeTutor
classzone.com
• Multi-Language Glossary
• Vocabulary practice

REVIEW KEY VOCABULARY

For a list of postulates and theorems, see pp. 926–931.

- image, *p. 572*
- preimage, *p. 572*
- isometry, *p. 573*
- vector, *p. 574*
  initial point, terminal point, horizontal component, vertical component
- component form, *p. 574*
- matrix, *p. 580*
- element, *p. 580*
- dimensions, *p. 580*
- line of reflection, *p. 589*
- center of rotation, *p. 598*
- angle of rotation, *p. 598*
- glide reflection, *p. 608*
- composition of transformations, *p. 609*
- line symmetry, *p. 619*
- line of symmetry, *p. 619*
- rotational symmetry, *p. 620*
- center of symmetry, *p. 620*
- scalar multiplication, *p. 627*

VOCABULARY EXERCISES

1. Copy and complete: A(n) _?_ is a transformation that preserves lengths.

2. Draw a figure with exactly one line of symmetry.

3. **WRITING** *Explain* how to identify the dimensions of a matrix. Include an example with your explanation.

Match the point with the appropriate name on the vector.

4. T **A.** Initial point

5. H **B.** Terminal point

REVIEW EXAMPLES AND EXERCISES

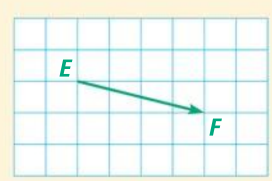
Use the review examples and exercises below to check your understanding of the concepts you have learned in each lesson of Chapter 9.

9.1 Translate Figures and Use Vectors *pp. 572–579*

EXAMPLE

Name the vector and write its component form.

The vector is $\overrightarrow{EF}$. From initial point E to terminal point F, you move 4 units right and 1 unit down. So, the component form is $\langle 4, 1\rangle$.



EXERCISES

EXAMPLES 1 and 4 on pp. 572, 574 for Exs. 6–7

6. The vertices of $\triangle ABC$ are $A(2, 3)$, $B(1, 0)$, and $C(-2, 4)$. Graph the image of $\triangle ABC$ after the translation $(x, y) \to (x + 3, y - 2)$.

7. The vertices of $\triangle DEF$ are $D(-6, 7)$, $E(-5, 5)$, and $F(-8, 4)$. Graph the image of $\triangle DEF$ after the translation using the vector $\langle -1, 6\rangle$.

@HomeTutor
classzone.com
Chapter Review Practice

9.2 Use Properties of Matrices *pp. 580–587*

EXAMPLE

Add $\begin{bmatrix} -9 & 12 \\ 5 & -4 \end{bmatrix} + \begin{bmatrix} 20 & 18 \\ 11 & 25 \end{bmatrix}$.

These two matrices have the same dimensions, so you can perform the addition. To add matrices, you add corresponding elements.

$$\begin{bmatrix} -9 & 12 \\ 5 & -4 \end{bmatrix} + \begin{bmatrix} 20 & 18 \\ 11 & 25 \end{bmatrix} = \begin{bmatrix} -9+20 & 12+18 \\ 5+11 & -4+25 \end{bmatrix} = \begin{bmatrix} 11 & 30 \\ 16 & 21 \end{bmatrix}$$

EXERCISES

EXAMPLE 3 on p. 581 for Exs. 8–9

Find the image matrix that represents the translation of the polygon. Then graph the polygon and its image.

8. $\begin{array}{c} \begin{matrix} A & B & C \end{matrix} \\ \begin{bmatrix} 2 & 8 & 1 \\ 4 & 3 & 2 \end{bmatrix} \end{array}$; 5 units up and 3 units left

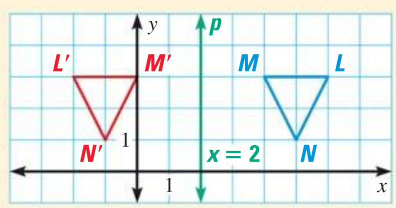
9. $\begin{array}{c} \begin{matrix} D & E & F & G \end{matrix} \\ \begin{bmatrix} -2 & 3 & 4 & -1 \\ 3 & 6 & 4 & -1 \end{bmatrix} \end{array}$; 2 units down

9.3 Perform Reflections *pp. 589–596*

EXAMPLE

The vertices of $\triangle MLN$ are $M(4, 3)$, $L(6, 3)$, and $N(5, 1)$. Graph the reflection of $\triangle MLN$ in the line p with equation $x = 2$.

Point M is 2 units to the right of p, so its reflection M' is 2 units to the left of p at $(0, 3)$. Similarly, L' is 4 units to the left of p at $(-2, 3)$ and N' is 3 units to the left of p at $(-1, 1)$.

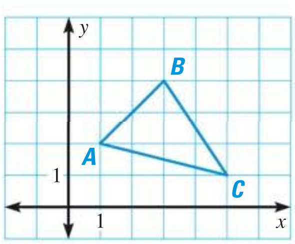


EXERCISES

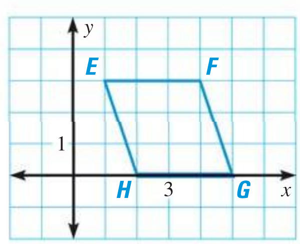
EXAMPLES 1 and 2 on pp. 589–590 for Exs. 10–12

Graph the reflection of the polygon in the given line.

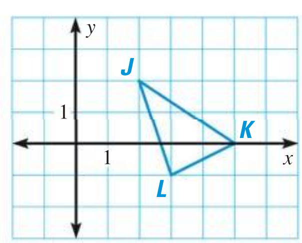
10. $x = 4$



11. $y = 3$



12. $y = x$

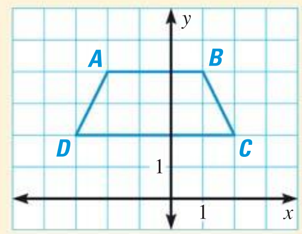


9.4 Perform Rotations

pp. 598–605

EXAMPLE

Find the image matrix that represents the 90° rotation of *ABCD* about the origin.



The polygon matrix for *ABCD* is $\begin{bmatrix} -2 & 1 & 2 & -3 \\ 4 & 4 & 2 & 2 \end{bmatrix}$.

Multiply by the matrix for a 90° rotation.

$$\begin{bmatrix} 0 & -1 \\ 1 & 0 \end{bmatrix} \begin{array}{c} \begin{array}{cccc} A & B & C & D \end{array} \\ \begin{bmatrix} -2 & 1 & 2 & -3 \\ 4 & 4 & 2 & 2 \end{bmatrix} \end{array} = \begin{array}{c} \begin{array}{cccc} A' & B' & C' & D' \end{array} \\ \begin{bmatrix} -4 & -4 & -2 & -2 \\ -2 & 1 & 2 & -3 \end{bmatrix} \end{array}$$

EXERCISES

EXAMPLE 3 on p. 600 for Exs. 13–14

Find the image matrix that represents the given rotation of the polygon about the origin. Then graph the polygon and its image.

13. $\begin{array}{c} \begin{array}{ccc} Q & R & S \end{array} \\ \begin{bmatrix} 3 & 4 & 1 \\ 0 & 5 & -2 \end{bmatrix} \end{array}$; 180°

14. $\begin{array}{c} \begin{array}{cccc} L & M & N & P \end{array} \\ \begin{bmatrix} -1 & 3 & 5 & -2 \\ 6 & 5 & 0 & -3 \end{bmatrix} \end{array}$; 270°

9.5 Apply Compositions of Transformations

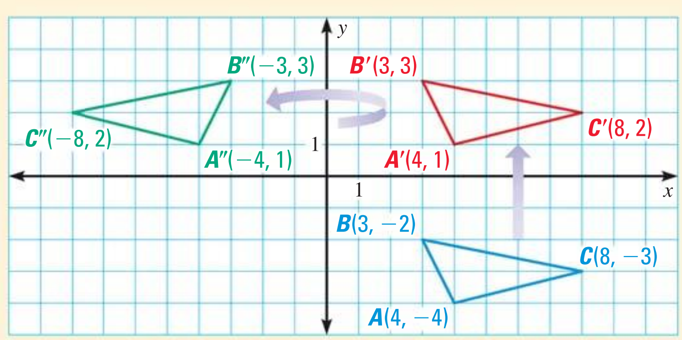
pp. 608–615

EXAMPLE

The vertices of △*ABC* are *A*(4, −4), *B*(3, −2), and *C*(8, −3). Graph the image of △*ABC* after the glide reflection.

Translation: $(x, y) \to (x, y + 5)$
Reflection: in the *y*-axis

Begin by graphing △*ABC*. Then graph the image △*A′B′C′* after a translation of 5 units up. Finally, graph the image △*A″B″C″* after a reflection in the *y*-axis.



EXERCISES

EXAMPLE 1 on p. 608 for Exs. 15–16

Graph the image of *H*(−4, 5) after the glide reflection.

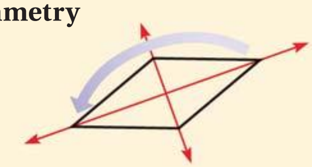
15. Translation: $(x, y) \to (x + 6, y - 2)$
Reflection: in $x = 3$

16. Translation: $(x, y) \to (x - 4, y - 5)$
Reflection: in $y = x$

9.6 Identify Symmetry *pp. 619–624*

EXAMPLE

Determine whether the rhombus has *line symmetry* and/or *rotational symmetry*. Identify the number of lines of symmetry and/or the rotations that map the figure onto itself.



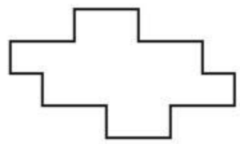
The rhombus has two lines of symmetry. It also has rotational symmetry, because a 180° rotation maps the rhombus onto itself.

EXERCISES

EXAMPLES 1 and 2 on pp. 619–620 for Exs. 17–19

Determine whether the figure has *line symmetry* and/or *rotational symmetry*. Identify the number of lines of symmetry and/or the rotations that map the figure onto itself.

17.


18.


19.


9.7 Identify and Perform Dilations *pp. 626–632*

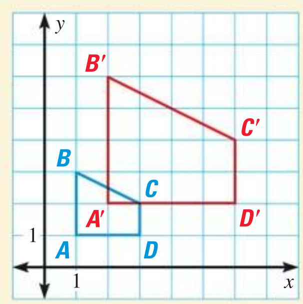
EXAMPLE

Quadrilateral *ABCD* has vertices $A(0, 0)$, $B(0, 3)$, $C(2, 2)$, and $D(2, 0)$. Use scalar multiplication to find the image of *ABCD* after a dilation with its center at the origin and a scale factor of 2. Graph *ABCD* and its image.

To find the image matrix, multiply each element of the polygon matrix by the scale factor.

$$2\begin{array}{c} \begin{matrix} A & B & C & D \end{matrix} \\ \begin{bmatrix} 1 & 1 & 3 & 3 \\ 1 & 3 & 2 & 1 \end{bmatrix} \end{array} = \begin{array}{c} \begin{matrix} A' & B' & C' & D' \end{matrix} \\ \begin{bmatrix} 2 & 2 & 6 & 6 \\ 2 & 6 & 4 & 2 \end{bmatrix} \end{array}$$

Scale factor **Polygon matrix** **Image matrix**



EXERCISES

EXAMPLE 4 on p. 628 for Exs. 20–21

Find the image matrix that represents a dilation of the polygon centered at the origin with the given scale factor. Then graph the polygon and its image.

20. $\begin{array}{c} \begin{matrix} Q & R & S \end{matrix} \\ \begin{bmatrix} 2 & 4 & 8 \\ 2 & 4 & 2 \end{bmatrix} \end{array}; k = \frac{1}{4}$

21. $\begin{array}{c} \begin{matrix} L & M & N \end{matrix} \\ \begin{bmatrix} -1 & 1 & 2 \\ -2 & 3 & 4 \end{bmatrix} \end{array}; k = 3$