Name Key Class Date

Dilations

4-4

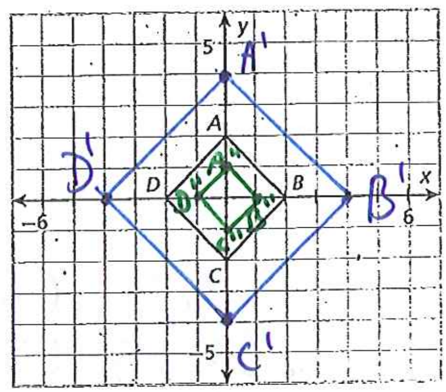
COMMON CORE CC.8.G.3

Essential question: *How can you use coordinates to describe the result of a dilation?*

A dilation is a transformation that changes the size, but not the shape, of a geometric figure. The center of the figure is known as the center of dilation. When dilating in the coordinate plane, the center of dilation is usually the origin.

1 EXPLORE Applying Dilations

The square is the preimage (input). The center of dilation is the origin.



A List the coordinates of the vertices of the square.

A: (0, 2) C: (0, -2)

B: (2, 0) D: (-2, 0)

B Multiply each coordinate by 2. List the resulting ordered pairs.

A′: (0, 4) C′: (0, -4)

B′: (4, 0) D′: (-4, 0)

C Sketch the image of the dilation. Label each vertex of the image.

D How does multiplying the coordinates of the preimage by 2 affect the image?

Same shape but different size.
Scale factor is 2 (twice as big)

E Multiply each coordinate from the preimage by $\frac{1}{2}$. List the resulting ordered pairs.

A″: (0, 1) C″: (0, -1)

B″: (1, 0) D″: (-1, 0)

F Sketch the image of the dilation. Label each vertex of the image. Green image

G How does multiplying the coordinates of the preimage by $\frac{1}{2}$ affect the image?

Same shape but different size
Scale factor is $\frac{1}{2}$ (half as big)

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A scale factor describes how much larger or smaller the image of a dilation is than the preimage.

Rule for Dilation

For a dilation centered at the origin with scale factor k, the image of point $P(x, y)$ is found by multiplying each coordinate by k.

$$(x, y) \rightarrow (kx, ky)$$

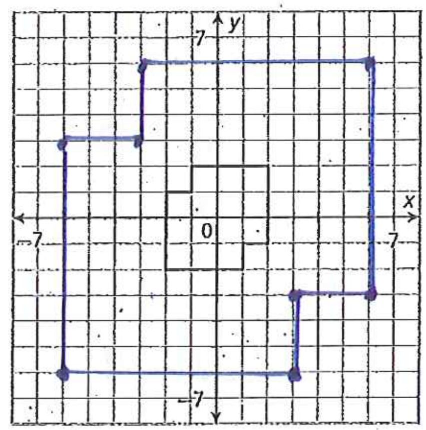
- If $k > 1$, then the image is larger than the preimage.
- If $0 < k < 1$, then the image is smaller than the preimage.

2 EXAMPLE Enlargements

The figure is the preimage. The center of dilation is the origin.

A List the coordinates of the vertices of the preimage in the first column of the table.

Preimage	Image
(2, 2)	(6, 6)
(2, -1)	(6, -3)
(1, -1)	(3, -3)
(1, -2)	(3, -6)
(-2, -2)	(-6, -6)
(-2, 1)	(-6, 3)
(-1, 1)	(-3, 3)
(-1, 2)	(-3, 6)



B What is the scale factor for the dilation $(x, y) \rightarrow (3x, 3y)$? 3

C Apply the dilation to the preimage and write the coordinates of the vertices of the image in the second column of the table.

D Sketch the image under the dilation on the coordinate grid.

REFLECT

2a. How does the dilation affect the length of line segments?

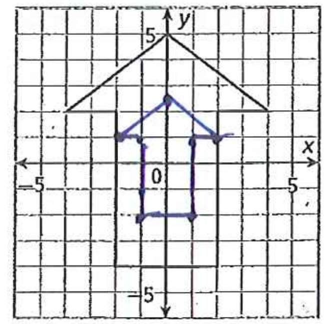
The are 3 times the length.

2b. How does the dilation affect angle measures?

$\angle$ measures do not change.

3 EXAMPLE Reductions

The arrow is the preimage. The center of dilation is the origin.



A List the coordinates of the vertices of the preimage in the first column of the table.

Preimage	Image
(4, 2)	(2, 1)
(0, 5)	(0, 2.5)
(-4, 2)	(-2, 1)
(-2, 2)	(-1, 1)
(-2, -4)	(-1, -2)
(2, -4)	(1, -2)
(2, 2)	(1, 1)

B What is the scale factor for the dilation $(x, y) \rightarrow \left(\frac{1}{2}x, \frac{1}{2}y\right)$? $\frac{1}{2}$

C Apply the dilation to the preimage and write the coordinates of the vertices of the image in the second column of the table.

D Sketch the image under the dilation on the coordinate grid.

REFLECT

3a. How does the dilation affect the length of line segments?

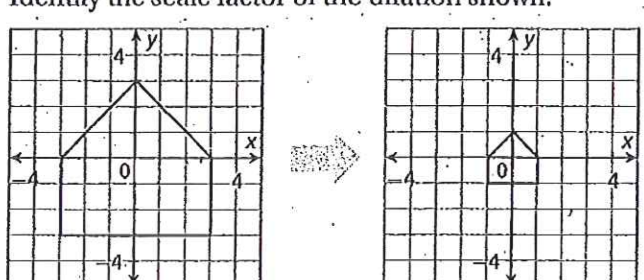
Length is half is big

3b. How would a dilation with scale factor 1 affect the preimage?

There would be no change.

TRY THIS!

3c. Identify the scale factor of the dilation shown.

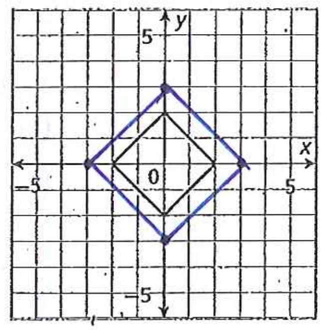


Scale factor → $\frac{1}{3}$

PRACTICE

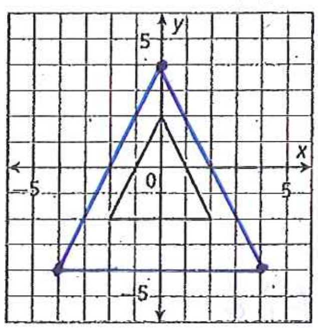
1. The square is the preimage. The center of dilation is the origin. Write the coordinates of the vertices of the preimage in the first column of the table. Then apply the dilation $(x, y) \rightarrow \left(\frac{3}{2}x, \frac{3}{2}y\right)$ and write the coordinates of the vertices of the image in the second column. Sketch the image of the figure under the dilation.

Preimage	Image
(2, 0)	(3, 0)
(0, 2)	(0, 3)
(-2, 0)	(-3, 0)
(0, -2)	(0, -3)

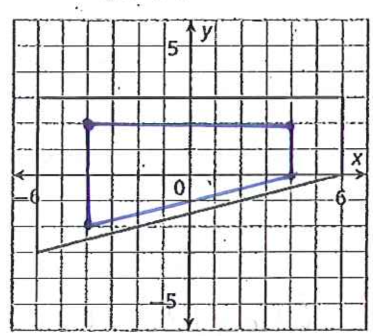


Sketch the image of the figure under the given dilation.

2. $(x, y) \rightarrow (2x, 2y)$

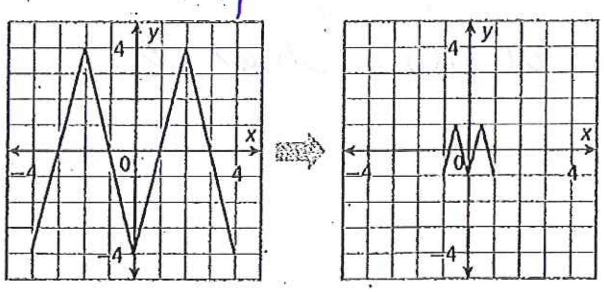


3. $(x, y) \rightarrow \left(\frac{2}{3}x, \frac{2}{3}y\right)$



Identify the scale factor of the dilation shown.

4. scale factor = $\frac{1}{4}$



5. scale factor = $\frac{1}{2}$