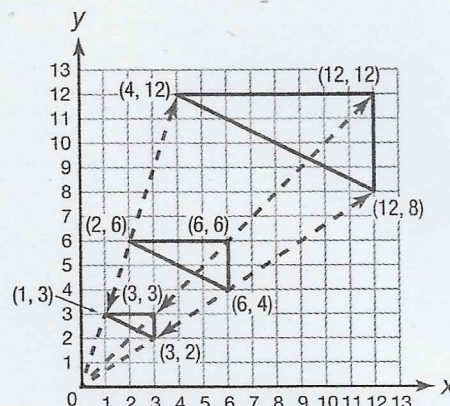


Dilations as Functions

UNDERSTAND The scale factor describes how the length of a line segment changes during a dilation. It also describes how the distance from the center of dilation to a given point changes during that dilation. The graph on the right shows the blue triangle dilated by a scale factor of 0.5 and a scale factor of 2 with the center of dilation at the origin. Notice that each vertex of the larger green triangle is twice as far from the origin as the corresponding vertex on the blue triangle, and each vertex of the smaller green triangle is half as far from the origin.



A dilation on the coordinate plane can be written as a function. The input of this function is a point on the coordinate plane, (x, y) . When you apply the function to a point, the output of the function will be the coordinates of the dilated image of that point.

To dilate a point on a figure (x, y) by a scale factor k with the center of dilation at (a, b) , use the following rule:

$$D_k(x, y) = (a + k(x - a), b + k(y - b))$$

When the center of dilation is the origin, $a = 0$ and $b = 0$, so this rule simplifies to:

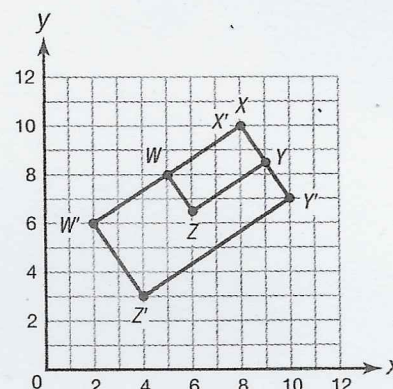
$$D_k(x, y) = (kx, ky)$$

The graph to the right shows a dilation of rectangle $WXYZ$ with the center of dilation at $X(8, 10)$ and a scale factor of 2. The function that represents this transformation is

$$D_2(x, y) = (8 + 2(x - 8), 10 + 2(y - 10)) = (8 + 2x - 16, 10 + 2y - 20) = (2x - 8, 2y - 10)$$

Point W has coordinates $(5, 8)$. Substitute these coordinates into the function to find W' .

$$D_2(5, 8) = (8 + 2(5 - 8), 10 + 2(8 - 10)) = (8 + 2(-3), 10 + 2(-2)) = (8 - 6, 10 - 4) = (2, 6)$$



UNDERSTAND When the size of a figure changes in only one dimension, the transformation is called a stretch or a shrink. A vertical stretch pulls the points of a figure away from a horizontal line, such as the x -axis, and a vertical shrink pushes the points of the figure toward a horizontal line. A horizontal stretch pulls the points of a figure away from a vertical line, such as the y -axis, and a horizontal shrink pushes the points of the figure toward a vertical line. The lengths of line segments and the measure of angles usually change during a stretch or a shrink.

