

Lines Under Dilation

Track what happens to lines when a figure is scaled.

HIGH SCHOOL • HSG-SRT.A.1a

CCSS.Math.Content.HSG-SRT.A.1a "A dilation takes a line not passing through the center of the dilation to a parallel line, and leaves a line passing through the center unchanged."

NAME _____

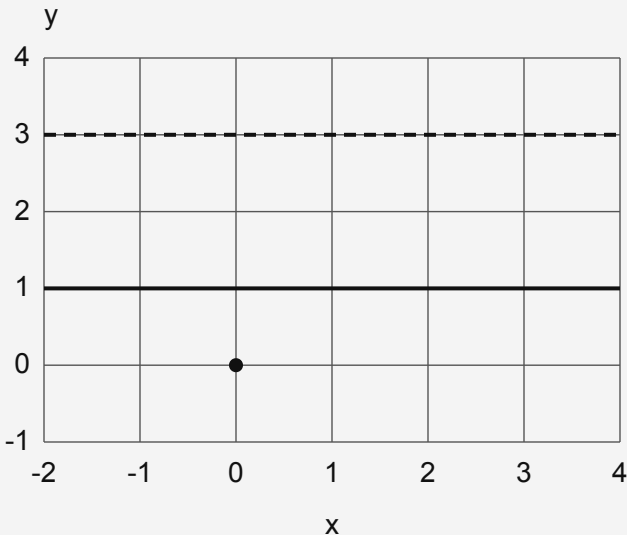
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THE BIG IDEA

For a dilation with nonzero scale factor k , a line through the center stays the same set of points, though its individual points may move. Other lines map to parallel lines (the same line if $k = 1$). With center $C(a,b)$, $x = d$ maps to $x = a + k(d - a)$, and $y = e$ maps to $y = b + k(e - b)$. Multiply the signed offset; distance is multiplied by $|k|$. A negative k places an off-center line on the opposite side.

WORKED EXAMPLE

The solid line is $y = 1$. A dilation centered at $C(0,0)$ with $k = 3$ maps it to the dashed line. Use the diagram to explain the image.



1. The original line does not pass through C .
2. Its signed vertical offset is $+1$; multiplying by 3 gives $+3$.
3. The image is horizontal and parallel to the original.

Answer: $y = 3$. Every point on the original line maps to a point on this parallel line.

PRACTICE 4 problems

- 1** A dilation centered at $(0,0)$ has scale factor 3. What is the image of $y = 4$? Is it parallel to or the same line as the original?

ANSWER _____

- 2** A dilation centered at $(0,0)$ has scale factor -5. What is the image of $y = -x$?

ANSWER _____

- 3** The center is $(6,-1)$, and the scale factor is 4. What is the image of $x = 6$?

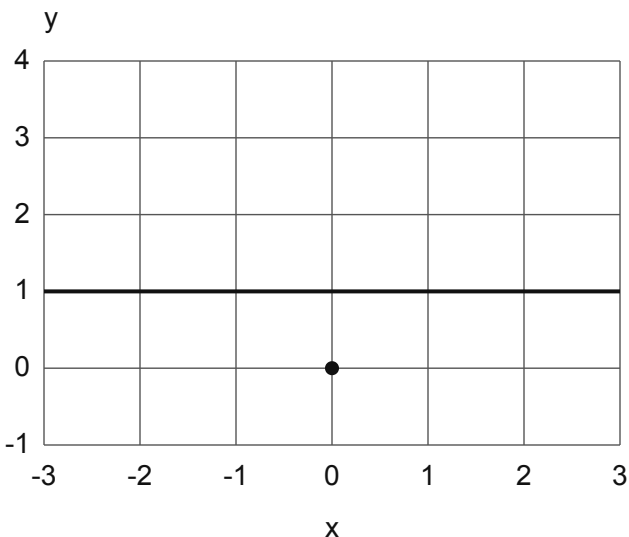
ANSWER _____

- 4** The center is $(-3,5)$ and $k = -2$. What is the image of $y = 1$? Show the signed-offset calculation and compare the lines.

ANSWER _____

APPLY IT Show your work

- 1** A poster stripe is the solid line l . The marked point is center $C(0,0)$. A dilation uses $k = 2$. Add the image line to the grid. Give its equation and explain its relationship to l .



ANSWER _____

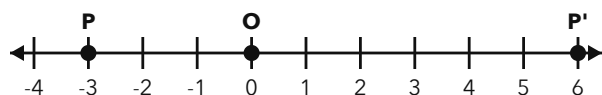
- 2** A game designer shrinks a route line $x = 4$ by a scale factor of $1/3$ about $C(4,-6)$. What is the image of the route line?

WORK SPACE

ANSWER _____

CHALLENGE One step up

The figure shows P mapped to P' under a dilation centered at O . Explain why the number line is unchanged even though P moves.



WORK SPACE AND ANSWER

PRACTICE 1

A dilation centered at (0,0) has scale factor 3. What is the image of $y = 4$? Is it parallel to or the same line as the original?

$y = 12$; a distinct parallel line.

PRACTICE 2

A dilation centered at (0,0) has scale factor -5. What is the image of $y = -x$?

$y = -x$

PRACTICE 3

The center is (6,-1), and the scale factor is 4. What is the image of $x = 6$?

$x = 6$

PRACTICE 4

The center is (-3,5) and $k = -2$. What is the image of $y = 1$? Show the signed-offset calculation and compare the lines.

$y = 5 + (-2)(1 - 5) = 13$. The image is parallel and on the opposite side of the center.

APPLY IT 2

$x = 4$

The line $x = 4$ passes through C because C has x-coordinate 4. A line through the dilation center is unchanged.

CHALLENGE

The number line passes through O. A dilation leaves every line through its center unchanged, so P moves to another point on the same number line. Here $k = -2$, so P moves from -3 to 6 on the opposite side of O. The image of the whole line is still the whole line.

All tasks use nonzero factors. Distinguish an unchanged line as a set from a fixed individual point. For $k = 1$ all lines are unchanged; for $k = 0$ the plane collapses to the center, so the stated line theorem does not apply. Negative factors multiply signed offsets; distances use the absolute value of the factor.

APPLY IT 1

$y = 2$; parallel to l .

The signed offset $+1$ becomes $+2$. Draw the horizontal image two units above C .

