

Scale Shift Lab

Draw, measure and test what dilation changes.

HIGH SCHOOL • HSG-SRT.A.1

CCSS.Math.Content.HSG-SRT.A.1 "Verify experimentally the properties of dilations given by a center and a scale factor:"

NAME _____

DATE _____

Materials and setup

Pencil, ruler and straightedge; a graphing tool may be used to repeat the experiments. Plot image points on the provided grids, label them with primes, and draw image segments or lines with dashes. Each grid interval is 1 coordinate unit. Compare coordinate lengths as well as measured lengths.

THE BIG IDEA

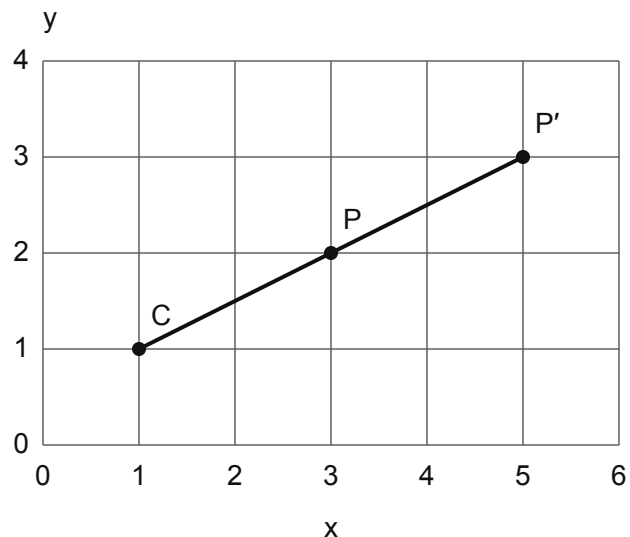
A dilation with center C and positive scale factor k sends P to $C+k(P-C)$. Points move along rays from C ; distances from C scale by k . Experimentally test two predictions: a line through C maps onto itself, while a line not through C maps to a distinct parallel line when $k \neq 1$. For $k=1$, every point stays fixed. Segment lengths scale by k . Measurements test examples, while a general argument explains why.

WORKED EXAMPLE

The figure shows $C(1,1)$, $P(3,2)$ and its image P' under scale factor 2. Verify the image using a vector from C .

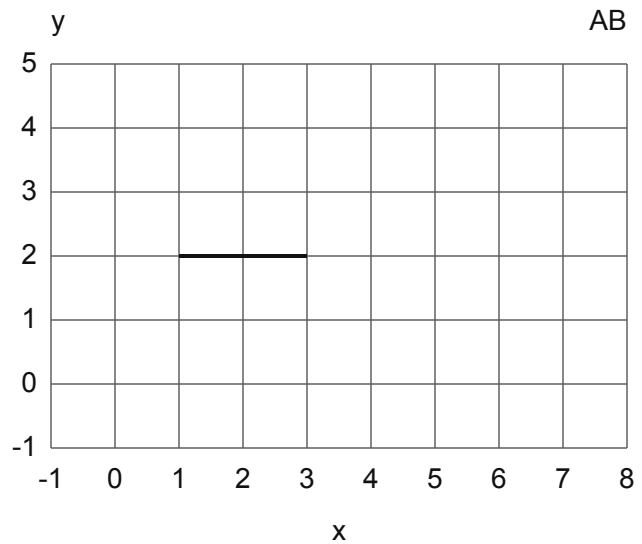
1. $P-C=(2,1)$. Doubling gives $(4,2)$.
2. Add C to get $P'=(5,3)$.
3. The vectors $C \rightarrow P$ and $C \rightarrow P'$ point in the same direction; the second is twice as long.

Answer: $P'=(5,3)$, and $CP'=2CP$.

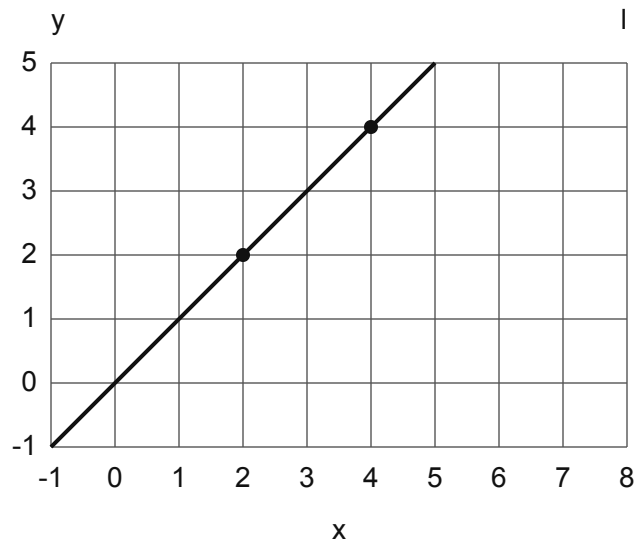


PRACTICE 4 problems

- 1** On the grid, $A=(1,2)$ and $B=(3,2)$. Dilate segment AB about $O=(0,0)$ with $k=2$. Draw $A'B'$. Measure both segments, compare their lengths, and extend both lines to compare their directions.

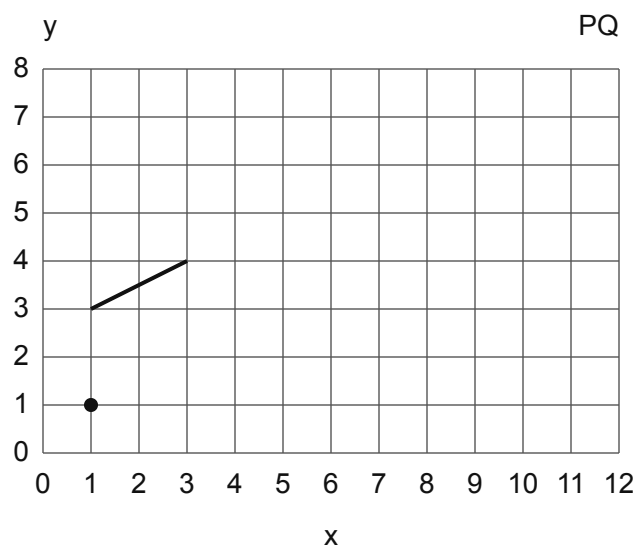


- 2** Line l is $y=x$ through center $O=(0,0)$. Dilate $A=(2,2)$ and $B=(4,4)$ with $k=1/2$. Plot their images and draw the image line. Check whether the line changes; compare segment lengths.



- 3** A student claims a dilation preserves segment length because a line through its center stays unchanged. Use Practice 2 to explain why the whole-line statement does not imply the segment statement.

- 4** Use center $C=(1,1)$ and $k=2$. Dilate $P=(1,3)$, $Q=(3,4)$, and draw the image segment on the grid. Compare slopes and lengths. Why does this test a line not through C ?



APPLY IT Show your work

- 1** Repeat one experiment with a different positive $k \neq 1$ using graph paper or a graphing tool. Draw an oblique segment whose line misses the center and a segment whose line passes through it. Record k , both pairs of endpoints, slopes and image/original length ratios.

- 2** A logo line lies on $y=4$. It is dilated about $C=(0,1)$ with $k=1/2$. Find the image line, explain why it is parallel, and state what happens to a 6-unit segment on it.

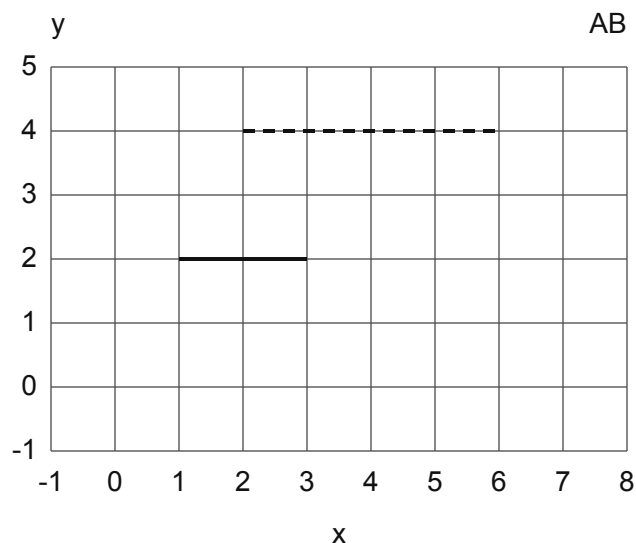
CHALLENGE One step up

For endpoints P and Q , the dilation rule gives $P'=C+k(P-C)$ and $Q'=C+k(Q-C)$. Subtract to find $Q'-P'$. Explain how this gives both the segment-length ratio and the direction of the image line, for $k>0$.

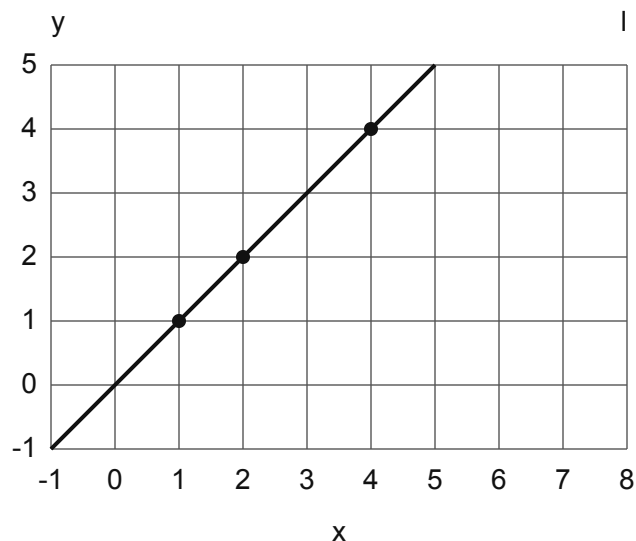
Require plotted images and observations, not coordinates alone. Accept measured ratios within normal ruler tolerance, supported by exact coordinate checks. For Practice 2, B' coincides with original A . The worked graph labels C , P and P' at the stated coordinates. Experiment results support examples; the challenge supplies a general vector argument.

PRACTICE 1

$A'=(2,4)$, $B'=(6,4)$. $AB=2$, $A'B'=4$; the ratio is 2. Their horizontal lines $y=2$ and $y=4$ are distinct and parallel.

**PRACTICE 2**

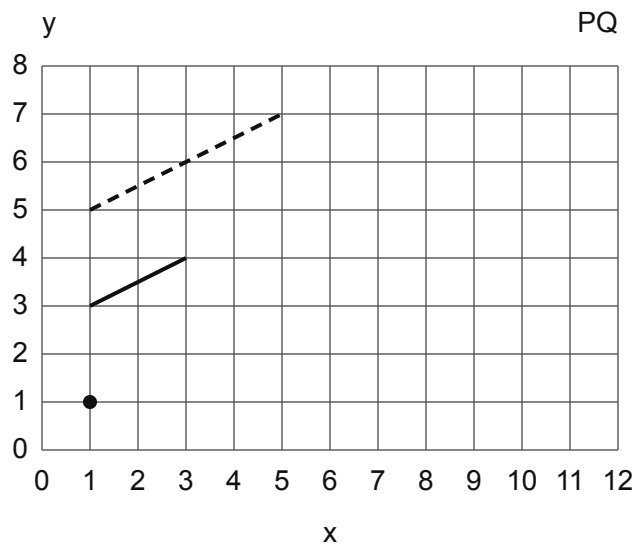
$A'=(1,1)$, $B'=(2,2)$. The image line is still $y=x$. $AB=2\sqrt{2}$ and $A'B'=\sqrt{2}$, so the segment length is halved even though the whole line is unchanged.

**PRACTICE 3**

A whole line contains infinitely many points and maps onto itself. Its individual points usually move. Practice 2 maps segment endpoints $(2,2)$, $(4,4)$ to $(1,1)$, $(2,2)$, producing a shorter segment on the same line.

PRACTICE 4

$P'=(1,5)$, $Q'=(5,7)$. Both slopes are $1/2$; lengths are $\sqrt{5}$ and $2\sqrt{5}$. C is not on line PQ (at $x=1$, PQ has $y=3$), so its distinct image line is parallel.

**APPLY IT 1**

Answers vary; both ratios should be k . The first pair of lines is parallel; the line through the center is unchanged.

Example with center O and $k=3$: $(1,1),(2,3)$ become $(3,3),(6,9)$, slopes 2 and ratio 3; the distinct lines miss O . $(1,2),(2,4)$ become $(3,6),(6,12)$, slopes 2 and ratio 3 on the same line $y=2x$.

APPLY IT 2

The image line is $y=2.5$; a 6-unit segment becomes 3 units.

The original line is 3 units above C ; its image is 1.5 units above C . Both are horizontal and distinct. Every segment length is multiplied by $1/2$.

CHALLENGE

$Q'-P'=k(Q-P)$. Multiplication by positive k preserves direction and multiplies vector length by k . Thus every segment-length ratio is k . The image line has the same direction: it is the original line if it passes through C or $k=1$, and a distinct parallel line otherwise.