Dilations

Similarity Transformations

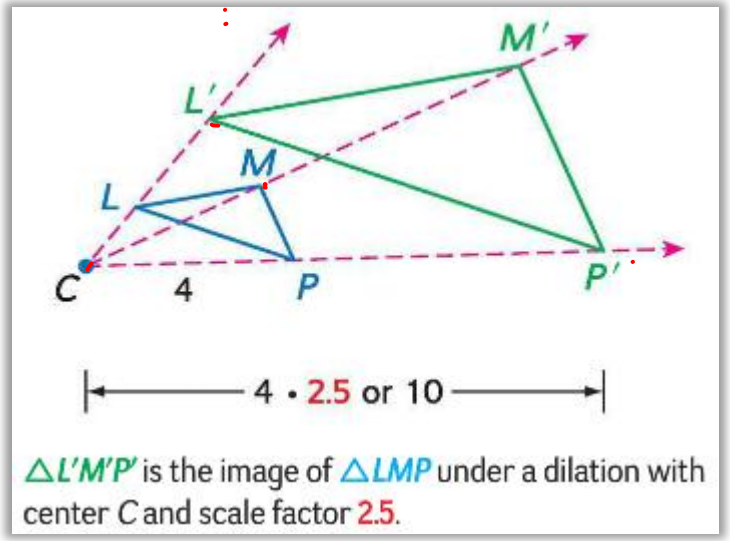
$|r| \rightarrow |\ominus 2| = 2$

- A dilation or scaling is a similarity transformation that enlarges or reduces a figure proportionally with respect to a center point and a scale factor.
- The scale factor of a dilation describes the extent of the dilation and is the ratio of a length

If $|r| > 1$, the dilation is an enlargement.

If $0 < |r| < 1$, the dilation is a reduction.

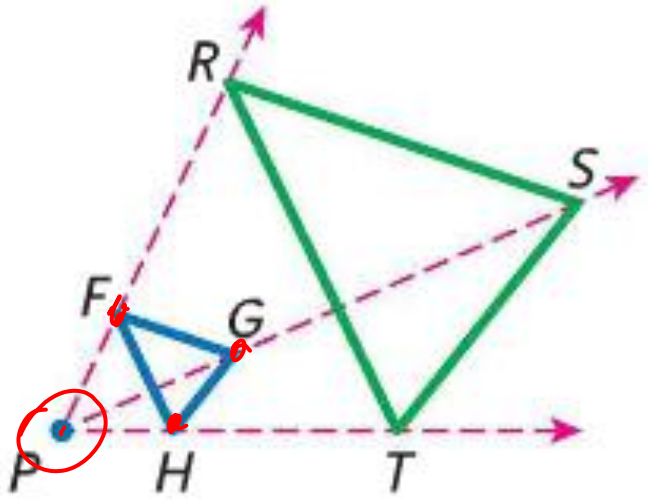
If $|r| = 1$, the dilation is a congruence transformation.



△L′M′P′ is the image of △LMP under a dilation with center C and scale factor 2.5.

Enlargement

- A dilation with a scale factor greater than 1 produces an enlargement, or an image that is larger than the original figure.

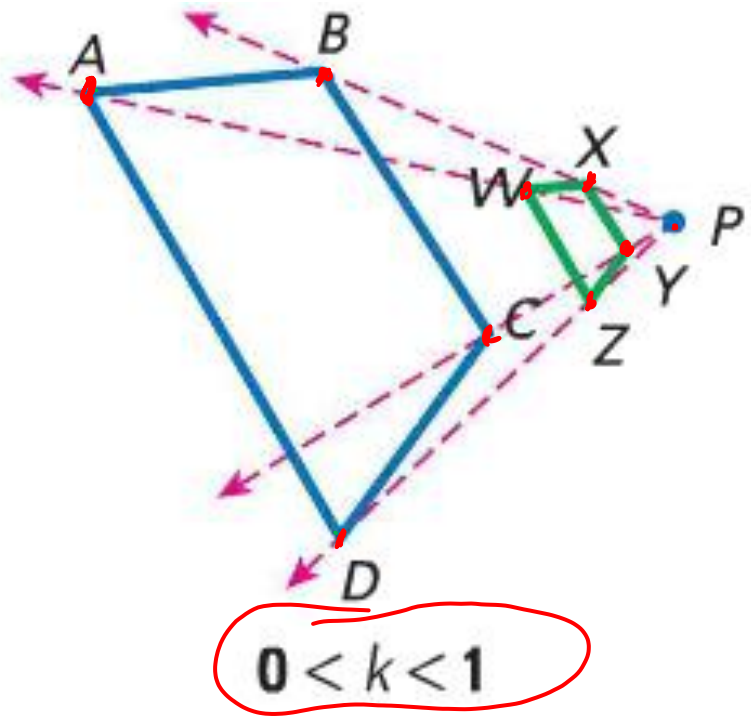


$k > 1$

$\triangle FGH$ is dilated by a scale factor of 3 to produce $\triangle RST$. Since $3 > 1$, $\triangle RST$ is an enlargement of $\triangle FGH$.

Reduction

- A dilation with a scale factor between 0 and 1 produces a reduction, an image that is smaller than the original figure.



ABCD is dilated by a scale factor of $\frac{1}{4}$ to produce *WXYZ*. Since $0 < \frac{1}{4} < 1$, *WXYZ* is a reduction of *ABCD*.

Congruence Transformation

- A dilations with a scale factor of 1 produces a congruence transformation. In other words, it is an exact replica of the original.

Dilations

- When the scale factor is negative, the image falls on the opposite side of the center than the preimage.

KEY CONCEPT — **Dilations**

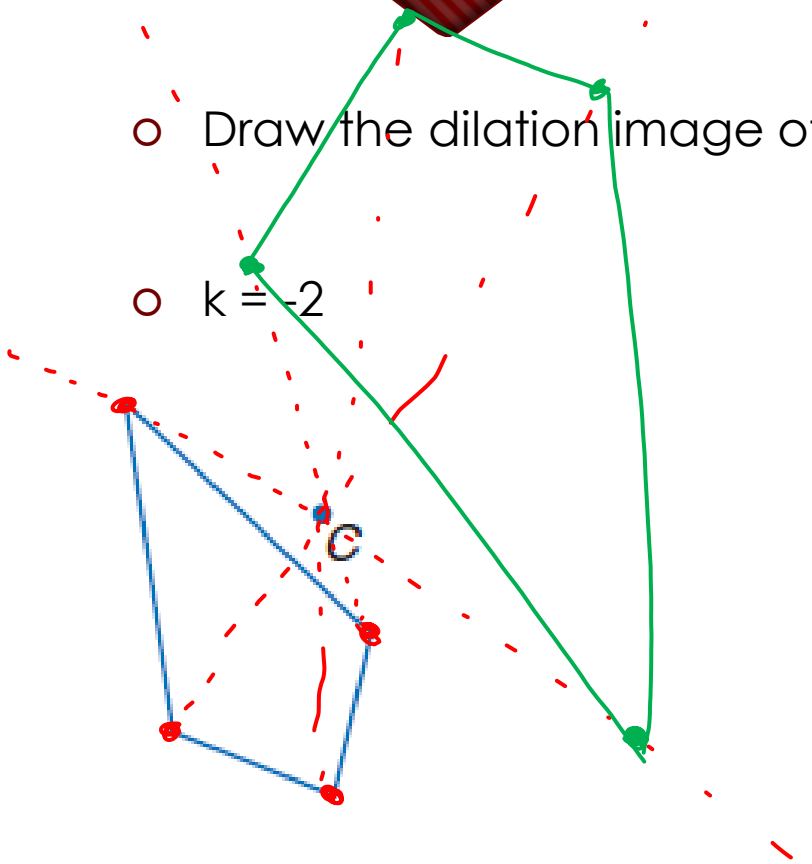
If $r > 0$, P' lies on $\overrightarrow{CP}$, and $CP' = r \cdot CP$.

If $r < 0$, P' lies on $\overrightarrow{CP'}$ the ray opposite $\overrightarrow{CP}$, and $CP' = |r| \cdot CP$.

The center of a dilation is always its own image.

Examples

- Draw the dilation image of the figure with center C and the given scale factor.
- k = -2

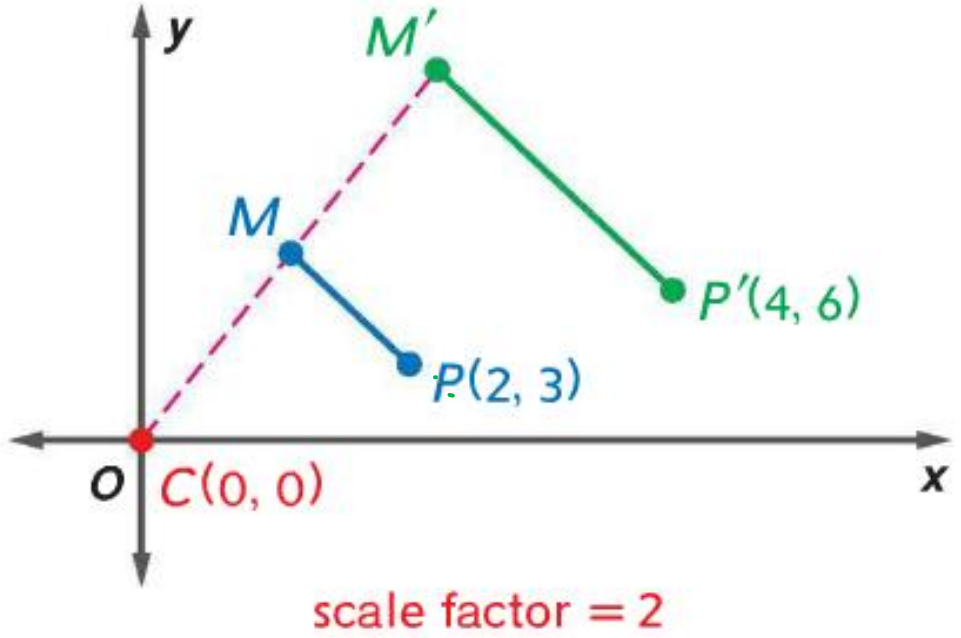


Verify Similarity

- You can verify that a dilation produces a similar figure by comparing corresponding sides and angles.

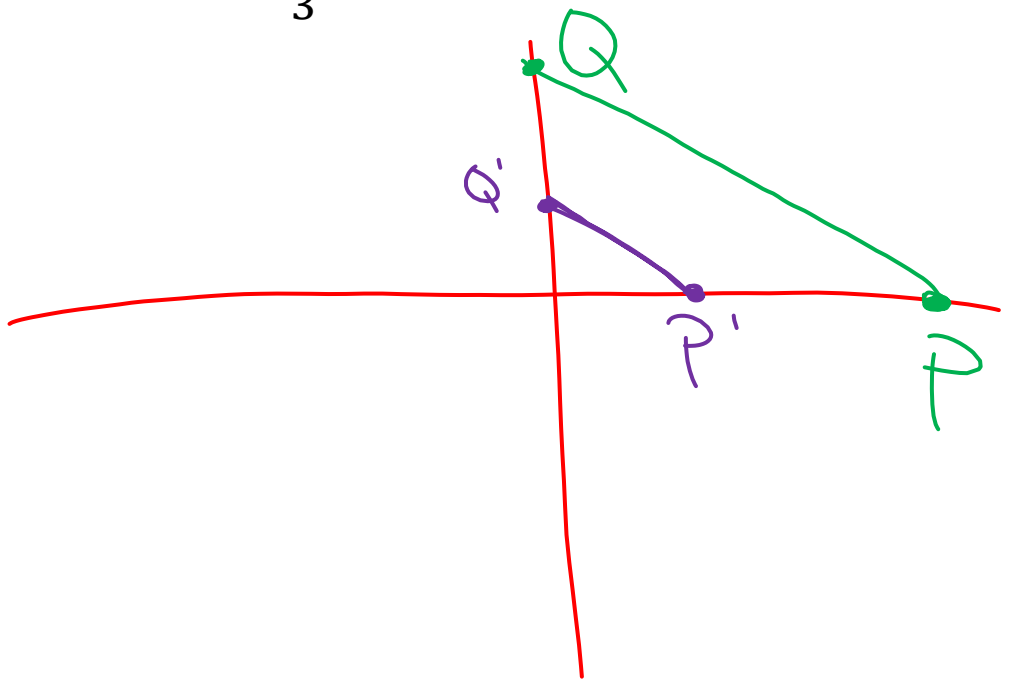
Dilations in the Coordinate Plane

- To find the coordinates of an image after a dilation centered at the origin, multiply the x- and y-coordinates of each point on the preimage by the scale factor of the dilation, k.



Examples

- $\overline{PQ}$ has endpoints P(9, 0) and Q(0, 6). Find the image of after a dilation centered at the origin with a scale factor of k = $\frac{1}{3}$. Sketch the preimage and the image.



Composition of Dilations

- A composition of dilations is a dilation of a dilation. In other words, you will have a secondary dilation after you perform the first one.

Scale Drawings and Models

- A scale model or scale drawing is an object or drawing with lengths proportional to the object it represents.
- The scale is the ratio of a length on the model to the actual length of the object being modeled.

Examples

- The scale on the map of New Mexico is 2 centimeters = 160 miles. The width of New Mexico through Albuquerque on the map is 4.1 centimeters. How long would it take to drive across New Mexico if you drove at an average of 60 miles per hour?

5 hrs 28 min

5 hrs 36 min

5 hrs 20 min

5 hrs 30 min

$\frac{2\text{ cm}}{160\text{ mi}} = \frac{4.1\text{ cm}}{x\text{ mi}}$

$\frac{656}{2} = \frac{2x}{2}$

$328\text{ mi} = x$

$\frac{328}{60}$

547

Questions

- Where can we use dilations in the real world?