

4.5 Start Thinking

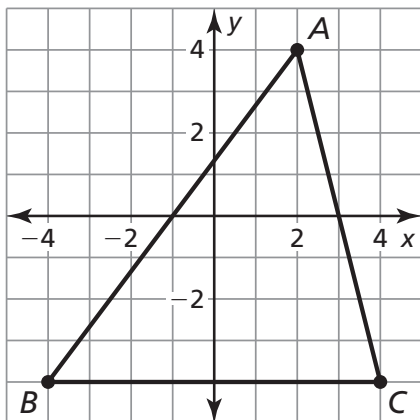
Shine a flashlight at a wall 6 feet away in a dimly lit room. Measure the diameter of the circle of light created on the wall. Move the flashlight 3 feet away from the wall and measure the new diameter. Move the flashlight 1.5 feet away from the wall and measure the diameter.

Is there a pattern? Explain what happens to the diameter of the circle of light as the flashlight is moved closer to the wall.

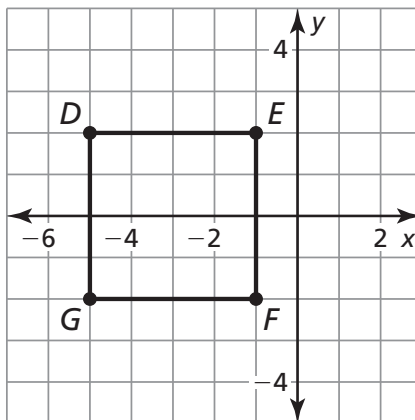
4.5 Warm Up

Use the graph to find the indicated length.

1. Find the length of \overline{BC} .



2. Find the length of \overline{DE} .



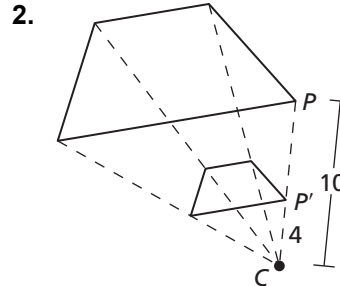
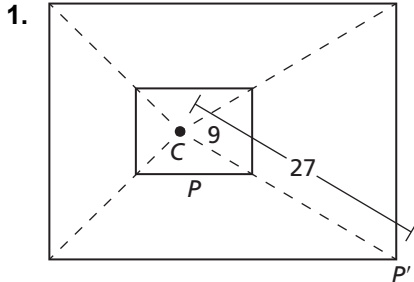
4.5 Cumulative Review Warm Up

Plot the points in a coordinate plane. Then determine whether \overline{AB} and \overline{CD} are congruent.

1. $A(-3, 4)$, $B(-3, 7)$, $C(3, -4)$, $D(3, -1)$
2. $A(7, -2)$, $B(2, -2)$, $C(3, -4)$, $D(5, -4)$
3. $A(9, 2)$, $B(0, 2)$, $C(6, 9)$, $D(6, 2)$
4. $A(7, -9)$, $B(7, 0)$, $C(8, -3)$, $D(-1, -3)$

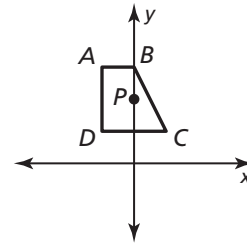
4.5 Practice A

In Exercises 1 and 2, find the scale factor of the dilation. Then tell whether the dilation is a *reduction* or an *enlargement*.



In Exercises 3–5, copy the diagram. Then use a compass and straightedge to construct a dilation of quadrilateral $ABCD$ with the given center and scale factor k .

- Center B , $k = 3$
- Center P , $k = \frac{1}{2}$
- Center C , $k = 75\%$

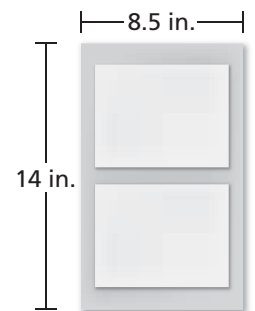


In Exercises 6 and 7, graph the polygon and its image after a dilation with a scale factor k .

- $P(1, 2)$, $Q(2, 2)$, $R(4, -2)$, $S(-1, -3)$; $k = 2$
- $A(-4, 4)$, $B(-2, 6)$, $C(1, -1)$, $D(-2, -4)$; $k = -75\%$

8. A standard piece of paper is 8.5 inches by 11 inches. A piece of legal-size paper is 8.5 inches by 14 inches. By what scale factor k would you need to dilate the standard paper so that you could fit two pages on a single piece of legal paper?

9. The old film-style cameras created photos that were best printed at 3.5 inches by 5 inches. Today's new digital cameras create photos that are best printed at 4 inches by 6 inches. Neither size picture will scale perfectly to fit in an 11-inch by 14-inch frame. Which type of camera will you minimize the loss of the edges of your picture?

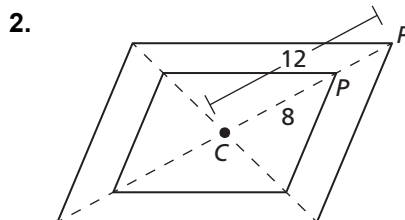
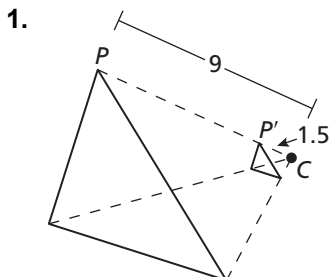


- Your friend claims that if you dilate a rectangle by a certain scale factor, then the area of the object also increases or decreases by the same amount. Is your friend correct? Explain your reasoning.
- Would it make sense to state "A dilation has a scale factor of 1?" Explain your reasoning.

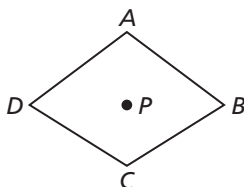
4.5

Practice B

In Exercises 1 and 2, find the scale factor of the dilation. Then tell whether the dilation is a *reduction* or an *enlargement*.



In Exercises 3 and 4, copy the diagram. Then use a compass and straightedge to construct a dilation with the given center and scale factor k .



3. Center B , $k = 2$
4. Center P , $k = 75\%$

In Exercises 5 and 6, graph the polygon and its image after a dilation with a scale factor k .

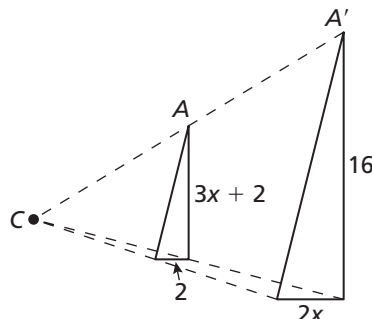
5. $J(-3, 4)$, $K(2, 1)$, $L(3, -2)$, $M(-5, -4)$; $k = 50\%$
6. $V(1, 1)$, $W(-1, 0)$, $X(-4, 2)$, $Y(-3, 4)$, $Z(0, 3)$; $k = -3$

7. You look up at the sky at night and see the moon. It looks like it is about 2 millimeters across. If you then look at the moon through a telescope that has a magnification of 40 times, how big will it look to you through the telescope?

8. What would it mean for an object to be dilated with a scale factor of $k = 0$?

9. Your friend claims that if you dilate a rectangle by a certain scale factor, then the perimeter of the object also increases or decreases by the same factor. Is your friend correct? Explain your reasoning.

10. The image shows an object that has been dilated with an unknown scale factor. Use the given measures to determine the scale factor and solve for the value of x .



4.5 Enrichment and Extension

Perimeter, Area, and Dilation

Points $A(0, 0)$, $B(0, 2)$, $C(4, 0)$, and $D(4, 2)$ form a rectangle on the x - y coordinate plane.

- Plot points A , B , C , and D in a coordinate plane. Find the length, width, perimeter, and area of the rectangle, and then fill in the first row in the chart below.

	Length	Width	Perimeter	Area
1. Points A , B , C , and D				
2. Points A' , B' , C' , and D'				
3. Points D , E , F , and G				

Points A , B , C , and D are transformed under the operation $(x, y) \rightarrow (2x, 2y)$ to generate points A' , B' , C' , and D' . Plot the new rectangle. Then find the new length, width, perimeter, and area, and fill in the second row in the chart above.

Points A' , B' , C' , and D' are transformed under the operation $(x, y) \rightarrow (2x, 2y)$ to generate the points D , E , F , and G . Plot the new rectangle. Then find the new length, width, perimeter, and area, and fill in the last row in the chart above.

- How does the transformation $(x, y) \rightarrow (2x, 2y)$ affect the length and width? perimeter? area?
- A right triangle has vertices $A(0, 0)$, $B(10, 0)$, and $C(10, 24)$. How will the perimeter and area of the triangle change under the transformation $(x, y) \rightarrow (4x, 4y)$?
- Write a general rule for the change in perimeter and area under the transformation $(x, y) \rightarrow a(x, y)$ or $(x, y) \rightarrow (ax, ay)$.
- Rectangle $RSTU$ is defined by vertices $R(0, 0)$, $S(3, 0)$, $T(3, 5)$, and $U(0, 5)$. Write the transformation notation for $RSTU \rightarrow R'S'T'U'$ if the image has an area of 60 square units.
- A microscope increases the side lengths of objects eight times. Calculate how big the area of a square will appear that has a side length of 0.6 millimeter.



Puzzle Time

What Side Of A House Gets The Most Rain?

Circle the letter of each correct answer in the boxes below. The circled letters will spell out the answer to the riddle.

Complete the sentence or solve the problem.

1. A _____ is a transformation in which a figure is enlarged or reduced with respect to a fixed point C , called the *center*, and a scale factor k , which is the ratio of the lengths of the corresponding sides of the image and the preimage.
2. When the scale factor $k > 1$, a dilation is a(n) _____.
3. When $0 < k < 1$, a dilation is a(n) _____.
4. When a transformation changes the shape or size of a figure, the transformation is _____.
5. You want to reduce a picture that is 10 inches by 12 inches to a picture that is 2.5 inches by 3 inches. What is the scale factor k ?
6. A magnifying glass shows the image of an object that is 10 times the object's actual size. Determine the length of the image of the object if the actual length of the object is 8 millimeters.
7. A magnifying glass shows the image of an object that is 6 times the object's actual size. Determine the actual length of the object if the image is 120 millimeters.

Find the coordinates of the vertices after a dilation centered at the origin with scale factor $k = -\frac{1}{3}$.

8. $A(3, 6)$

9. $B(3, 3)$

10. $C(9, 0)$

R (-3, -6)	T 80 mm	K (-9, 0)	L 40	Q expansion	H dilation	E (-1, -1)	M alteration	A shrink	O reduction
G 8	I 4	U (-3, 0)	T 20 mm	P (1, 1)	S enlargement	I $\frac{1}{4}$	N rigid	D (-1, -2)	E nonrigid