4.6 Start Thinking

In a coordinate plane, draw any two squares. Label one *ABCD* and the other *EFGH*. Write down the coordinates for each vertex. Using transformations and/or dilations, explain how to find square *EFGH* beginning with square *ABCD*.

4.6 Warm Up

Solve. Round to the nearest tenth, if necessary.

1. $\frac{n}{17} = \frac{14}{25}$

2. $\frac{w}{12} = \frac{3}{2}$

3. $\frac{x}{5} = \frac{31}{35}$

4. $\frac{13}{2} = \frac{y}{19}$

5. $\frac{9}{3} = \frac{c}{4}$

6. $\frac{2}{1} = \frac{n}{17}$

4.6 Cumulative Review Warm Up

Decide whether inductive reasoning or deductive reasoning is used to reach the conclusion. Explain.

1. Each time you go to the store, you spend money. So, the next time you go to the store, you will spend money.

2. Irrational numbers cannot be written as fractions. Rational numbers can be written as fractions. So, 2 is a rational number.

3. All women are human. The first lady is a woman, so the first lady is human.

Name ____ Date _________

4.6 Practice A

In Exercises 1 and 2, graph $\triangle PQR$ with vertices $P(-1, 5)$, $Q(-4, 3)$, and $R(-2, 1)$ and its image after the similarity transformation.

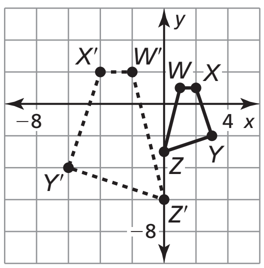
1. **Rotation:** 180° about the origin

Dilation: $(x, y) \rightarrow (2x, 2y)$

2. **Dilation:** $(x, y) \rightarrow \left(\frac{1}{2}x, \frac{1}{2}y\right)$

Reflection: in the x-axis

3. Describe a similarity transformation that maps the black preimage onto the dashed image.



In Exercises 4 and 5, determine whether the polygons with the given vertices are similar. Use transformations to explain your reasoning.

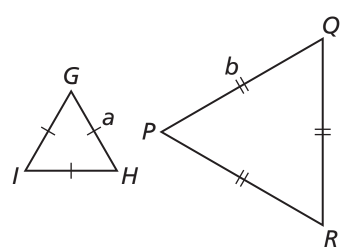
4. $A(-2, 5)$, $B(-2, 2)$, $C(-1, 2)$ and $D(3, 3)$, $E(3, 1)$, $F(2, 1)$

5. $J(-5, -3)$, $K(-3, -1)$, $L(-3, -5)$, $M(-5, -5)$ and $T(3, 3)$, $U(4, 3)$, $V(4, 2)$, $W(3, 1)$

6. Prove that the figures are similar.

Given Equilateral $\triangle GHI$ with side length a, equilateral $\triangle PQR$ with side length b

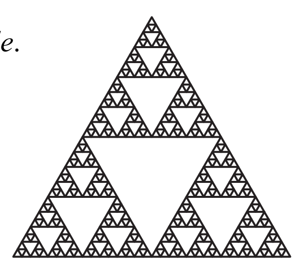
Prove $\triangle GHI$ is similar to $\triangle PQR$.



7. Your friend claims you can use a similarity transformation to turn a square into a rectangle. Is your friend correct? Explain your answer.

8. Is the composition of a dilation and a translation commutative? In other words, do you obtain the same image regardless of the order in which the transformations are performed? Justify your answer.

9. The image shown is known as a *Sierpinski triangle*. It is a common mathematical construct in the area of fractals. What can you say about the similarity transformations used to create the white triangles in this image?



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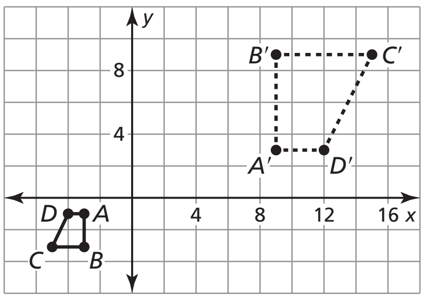
4.6 Practice B

In Exercises 1 and 2, graph $\triangle CDE$ with vertices $C(1, 3)$, $D(5, 3)$, and $E(2, 1)$ and its image after the similarity transformation.

1. **Translation:** $(x, y) \rightarrow (x - 5, y - 2)$
   Dilation: $(x, y) \rightarrow (-0.5x, -0.5y)$

2. **Reflection:** in the x-axis
   Dilation: $(x, y) \rightarrow (2x, 2y)$

3. Describe a similarity transformation that maps the black preimage onto the dashed image.

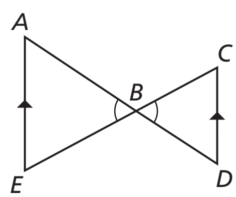


In Exercises 4 and 5, determine whether the polygons with the given vertices are similar. Use transformations to explain your reasoning.

4. $A(-4, 0)$, $B(-4, -2)$, $C(-2, -1)$ and $D(4, 6)$, $E(4, 2)$, $F(8, 2)$

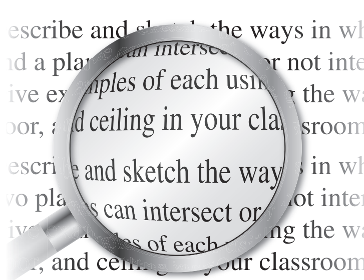
5. $W(0, -1)$, $X(-5, -1)$, $Y(-3, 2)$, $Z(-1, 2)$ and $K(0, -1)$, $L(5, 2)$, $M(3, 4)$, $N(1, 4)$

6. Prove that the figures are similar.
   Given: $\angle ABE \cong \angle DBC$, $\overline{AE} \parallel \overline{CD}$
   Prove: $\triangle ABE$ is similar to $\triangle DBC$.

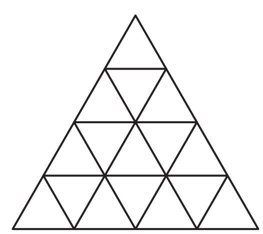


7. Is it possible to draw two circles that are not similar? Explain your reasoning.

8. The image shows what text often looks like when viewed through a magnifying glass. Does this represent a similarity transformation? Explain your reasoning.



9. Your friend draws a sketch of triangles in his notebook like the one shown here. He then claims there are the same number of congruent triangles and similar triangles. Is your friend correct? Explain.



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4.6 Enrichment and Extension

Similarity Through the Origin

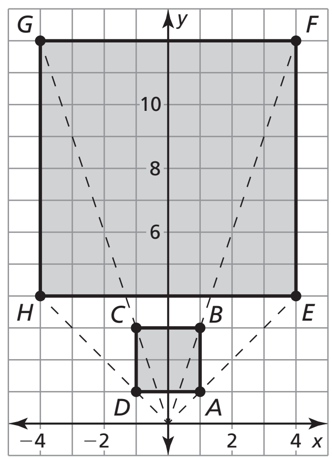
If a figure is scaled by a factor of k about the origin, then the area of the new, similar image changes by a factor of k^2.

Example: A triangle has an area of 10 square units. A new triangle is mapped using $(x, y) \rightarrow (5x, 5y)$. Find the area of the new triangle.

Solution: If the new triangle is dilated by a factor of 5, then $k = 5$, and the new area will increase by a factor of $5^2 = 25$. So, the new area will be $10 \bullet 25 = 250$ square units.

1. A dilated pentagon has an area of 60 square units after being mapped using $(x, y) \rightarrow (2x, 2y)$. What was the original area?

2. In the diagram, square *ABCD* has been enlarged through the origin by a factor of k. The resulting image is *EFGH*. What is the value of k?

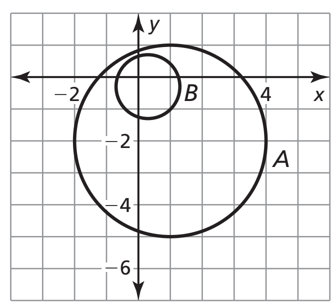


3. Calculate the area of *ABCD*.

4. Calculate the area of *EFGH*.

5. By what factor has the area of *EFGH* increased compared with *ABCD*?

6. In the diagram, Circle A is an enlargement of Circle B by a factor of k. The ratio of the area of Circle A to the area of Circle B is 9. The equations of the circles are as follows.



Circle A: $(x - 1)^2 + (y + 2)^2 = t^2$, where $(1, -2)$ is the center of Circle A and t is the length of the radius.

Circle B: $(x - a)^2 + (y - b) = r^2$, where (a, b) is the center of Circle B and r is the length of the radius.

a. What are the values of k, a, and b?

b. What is the relationship between r and t?

Name____ Date__________

4.6 Puzzle Time

Why Did The Students Do Multiplication Problems On The Floor?

A	B	C	D	E	F
G	H				

Complete each exercise. Find the answer in the answer column. Write the word under the answer in the box containing the exercise letter.

false NOT
not similar AND
not maintain BECAUSE
nay TO
always TABLES
transitional FLOOR
true CUSTODIAN
similarity TOLD

Complete the sentence.

A. Two figures are _______ figures when they have the same shape but not necessarily the same size.

B. _______ transformations preserve length and angle measure.

C. _______ transformations preserve angle measure only.

Determine whether the following are congruent.

D. $A(5, 6)$, $B(3, 3)$, $C(7, 0)$, $D(9, 3)$ and

$R(0, 3)$, $S(-2, 0)$, $T(2, -3)$, $U(4, 0)$

Yes or no?

E. $A(4, 4)$, $B(7, 2)$, $C(5, -2)$, $D(1, 2)$ and

$R(-8, -8)$, $S(14, -4)$, $T(-10, 4)$, $U(2, -4)$

True or false?

F. $A(3, 6)$, $B(6, 3)$, $C(-3, 3)$ and

$R(-1, -2)$, $S(-2, -1)$, $T(1, -1)$

Yea or nay?

Answer the question.

G. If a triangle is transformed by a dilation with a scale factor of -1, will it maintain congruency or not maintain congruency?

H. Do similarity transformations preserve angle measure always or not always?

dilation STAY
congruence TEACHER
not always CLASS
yes THEM
yea GOT
maintain USE
no BAD
similar THE