Similarity and Dilations

Models and mappings

Name _____ **Date** _____ **Score** _____ / 6

QUICK REVIEW

A dilation centered at the origin uses $(x, y) \mapsto (kx, ky)$ with $k > 0$. Corresponding lengths have ratio k, perimeters scale by k, and areas by k^2. Similar figures have equal corresponding angles and proportional corresponding sides; they are congruent only when $k = 1$. A reduction has $0 < k < 1$. Compute image length divided by original length, using the same correspondence throughout.

Worked example

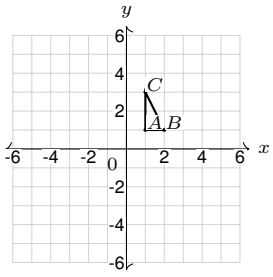
Dilate $E(-2, 1)$ by $k = 2$ about the origin. Find the image and its inverse scale factor.

1. Multiply both coordinates by 2: $(2(-2), 2(1)) = (-4, 2)$.
2. The inverse dilation uses $1/2$, since $(\frac{1}{2}(-4), \frac{1}{2}(2)) = (-2, 1)$.
3. Plot $E\prime = (-4, 2)$ on the same ray from the origin. Its distance from the center is twice the original.
Answer: $E\prime = (-4, 2)$; inverse factor $\frac{1}{2}$.

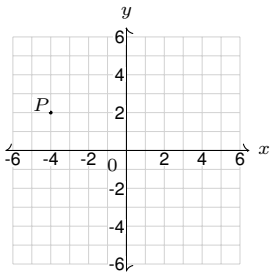
Practice Problems

Show your thinking.

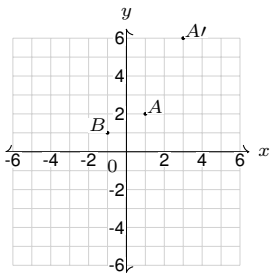
1. Dilate triangle ABC by $k = 2$ about the origin. List and plot its image.



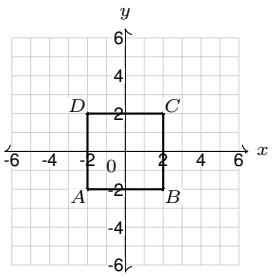
2. Reduce $P(-4, 2)$ with origin-centered scale factor $\frac{1}{2}$. Plot its image.



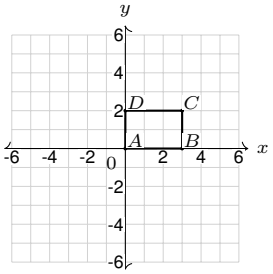
3. $A(1, 2)$ dilates to $A\prime(3, 6)$ about the origin. Find k and the image of $B(-1, 1)$.



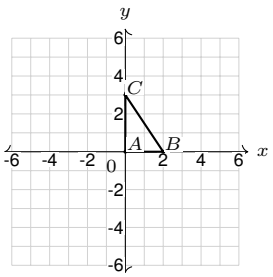
4. The shown square is dilated by $k = \frac{1}{2}$. Find its original and image perimeters.



5. The shown rectangle is dilated by $k = 2$. Find both areas and their ratio.



6. A similar triangle has corresponding legs 6 and 9. The plotted triangle has legs 2 and 3. Find k and decide congruence.



Answer Key

1. $(2,2), (4,2), (2,6)$
2. $(-2,1)$
3. $k = 3$; $B\prime = (-3,3)$.
4. 16 and 8 units.
5. 6 and 24 square units; ratio 4.
6. $k = 3$; similar, not congruent.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Multiply $A(1,1)$ and $B(2,1)$ by 2 to obtain $A\prime = (2,2)$ and $B\prime = (4,2)$.

2. For $C(1,3)$, $(2(1), 2(3)) = (2,6)$. The base grows from 1 to 2 units.

3. Join the image vertices. Every corresponding length doubles while the right angle stays $90°$.

Problem 2

1. Multiply both coordinates by $\frac{1}{2}$: $(\frac{1}{2}(-4), \frac{1}{2}(2)) = (-2,1)$.

2. The squared distances are $(-4)^2 + 2^2 = 20$ and $(-2)^2 + 1^2 = 5 = 20/4$.

3. The distance, rather than its square, is halved. Plot the reduced point $P\prime = (-2,1)$ between P and the origin.

Problem 3

1. The coordinate ratios are $3/1 = 3$ and $6/2 = 3$, so the common scale factor is $k = 3$.

2. Apply it to B: $(3(-1), 3(1)) = (-3,3)$.

3. Plot $B\prime = (-3,3)$. Both coordinate ratios agree for A, which is necessary for this origin-centered dilation.

Problem 4

1. The square side is $2 - (-2) = 4$ units, so the original perimeter is $4(4) = 16$.

2. The image side is $\frac{1}{2}(4) = 2$, giving image perimeter $4(2) = 8$.

3. Perimeter scales by k, not k^2: $\frac{1}{2}(16) = 8$. The reduction preserves the square's shape, not its size.

Problem 5

1. The original width is 3 and height is 2, so $A = 3(2) = 6$.

2. The image dimensions are $2(3) = 6$ and $2(2) = 4$, so $A\prime = 6(4) = 24$.

3. The area ratio is $24/6 = 4 = 2^2$. Doubling lengths quadruples area rather than merely doubling it.

Problem 6

1. The plotted legs are $2 - 0 = 2$ and $3 - 0 = 3$. The corresponding ratios are $6/2 = 3$ and $9/3 = 3$.

2. Thus a dilation with $k = 3$ matches both legs and preserves their included $90°$ angle.

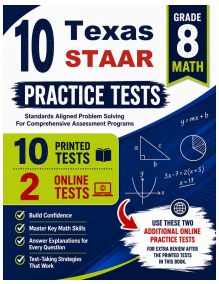
3. The triangles are similar but not congruent because $k = 3 \neq 1$, so corresponding lengths differ.

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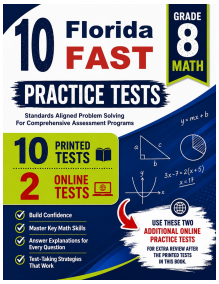
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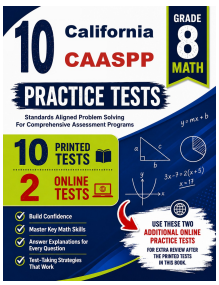
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