Similarity and Dilations

Applications and design

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

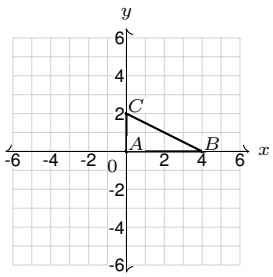
Dilate $E(-2, 1)$ by $k = 2$ about the origin. Find the image and its inverse scale factor.

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 $\frac{1}{2}$.

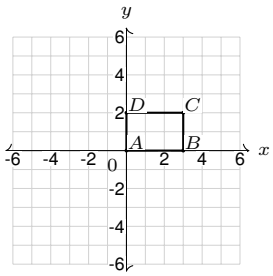
Practice Problems

Show your thinking.

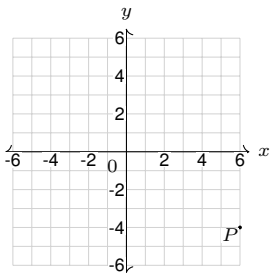
1. A logo triangle is enlarged by $k = \frac{3}{2}$ about the origin. Give the image vertices for the printer.



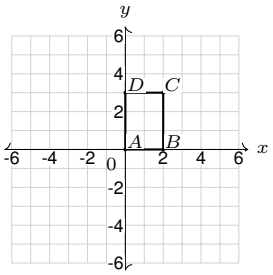
2. A map rectangle spans 3 by 2 grid units. Each unit is 4 m in the park. Find real perimeter and area.



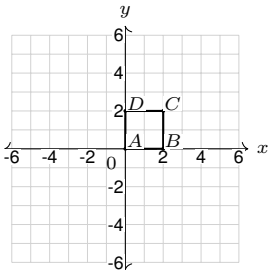
3. A game designer reduces point $P(6, -4)$ so that its image has $x = 3$, using an origin-centered dilation. Find k and $y\prime$.



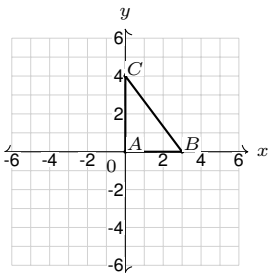
4. A 2 by 3 photo is represented on the grid. It must fit a 4 by 5 opening without distortion. Can it fill the opening exactly?



5. A square tile of side 2 grid units is enlarged to side 3. Find k and the area of 8 enlarged tiles without overlap.



6. A model triangle has legs 3 and 4 cm on the grid. Design a similar triangle with perimeter 24 cm; use its hypotenuse 5 cm. Find all sides.



Answer Key

1. $(0,0), (6,0), (0,3)$
2. 40 m; 96 m^2.
3. $k = \frac{1}{2}$; $y\prime = -2$.
4. No; width factor 2 would require height 6.
5. $k = \frac{3}{2}$; 72 square units.
6. $6, 8, 10$ cm.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The origin stays $(0,0)$ because multiplying either zero coordinate by $3/2$ still gives zero.

2. The other vertices become $B\prime = ((3/2)4, 0) = (6,0)$ and $C\prime = (0, (3/2)2) = (0,3)$.

3. The base and height both increase by factor 1.5, so the printer receives a similar, not congruent, logo.

Problem 2

1. The real dimensions are $3(4) = 12$ m and $2(4) = 8$ m.

2. The perimeter is $2(12 + 8) = 40$ m, while area is $12(8) = 96$ m^2.

3. The map area 6 scales by $4^2 = 16$, giving $6(16) = 96$; length and area use different scale multipliers.

Problem 3

1. The desired horizontal coordinate requires $6k = 3$, hence $k = 3/6 = 1/2$.

2. Apply the same factor vertically: $y\prime = (1/2)(-4) = -2$.

3. The image is $(3, -2)$. This reduction keeps the point on its original ray rather than moving it horizontally alone.

Problem 4

1. To reach width 4 from 2, the scale factor must be $4/2 = 2$.

2. The corresponding height would then be $2(3) = 6$, exceeding the opening height 5.

3. No single factor produces both 4 and 5. Filling exactly would require cropping or distortion, not an undistorted dilation.

Problem 5

1. The side multiplier is $k = 3/2$. The original tile area is $2^2 = 4$.

2. Each enlarged tile has area $4(3/2)^2 = 4(9/4) = 9$ square units.

3. Eight tiles cover $8(9) = 72$ square units. Using $8(4)(3/2)$ would incorrectly scale area as length.

Problem 6

1. The model perimeter is $3 + 4 + 5 = 12$ cm, so the required scale is $24/12 = 2$.

2. Multiply all sides by 2: $3(2) = 6$, $4(2) = 8$, and $5(2) = 10$ cm.

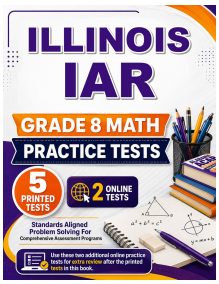
3. The new perimeter is $6 + 8 + 10 = 24$ cm. All side ratios equal 2, so the design is similar.

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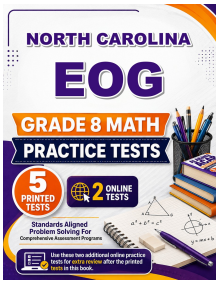
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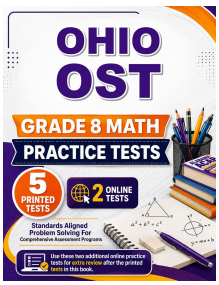
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