Transformation Functions on the Coordinate Plane

Use coordinate rules and compare distances and angles after transformations

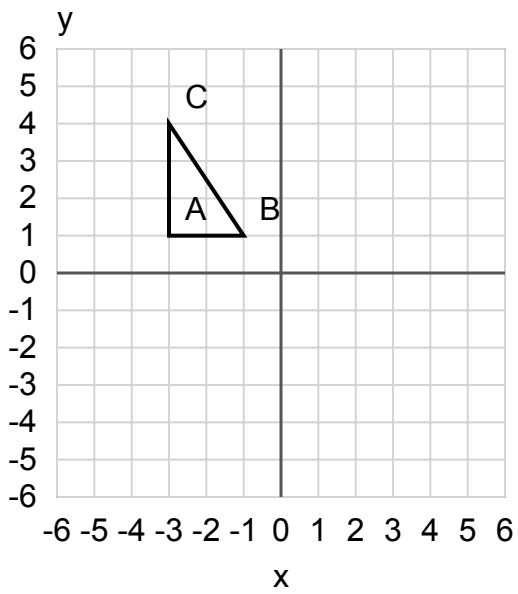
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Part 1 - Translation as a Function

Input figure: Triangle ABC has A(-3, 1), B(-1, 1), and C(-3, 4). A translation is a function: each input point has one output point.

Task: Translate ABC 4 units right and 2 units down. Write the rule, find each output coordinate, and plot A', B', and C'. Connect the image points.

Input point	Output point after T
A(-3, 1)	
B(-1, 1)	
C(-3, 4)	



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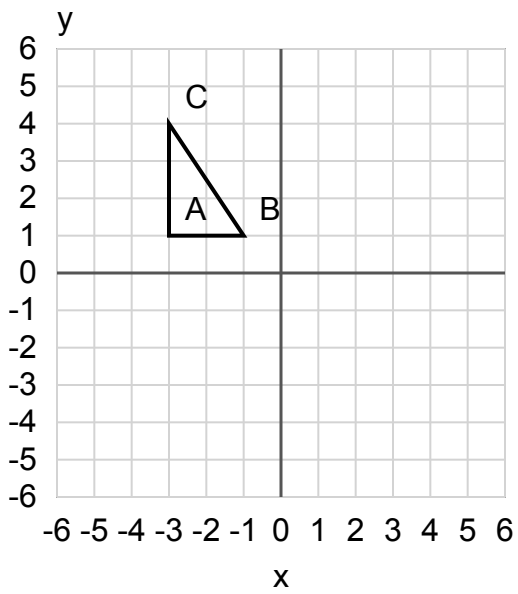
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Part 2 - Reflection as a Function

Use the same input triangle ABC. Reflect it across the y-axis. A reflection sends each input point to exactly one output point.

Task: Write the reflection rule. Find each output coordinate, then plot A", B", and C" and connect them. Use double-prime labels so this image is different from Part 1.

Input point	Output point after R
A(-3, 1)	
B(-1, 1)	
C(-3, 4)	



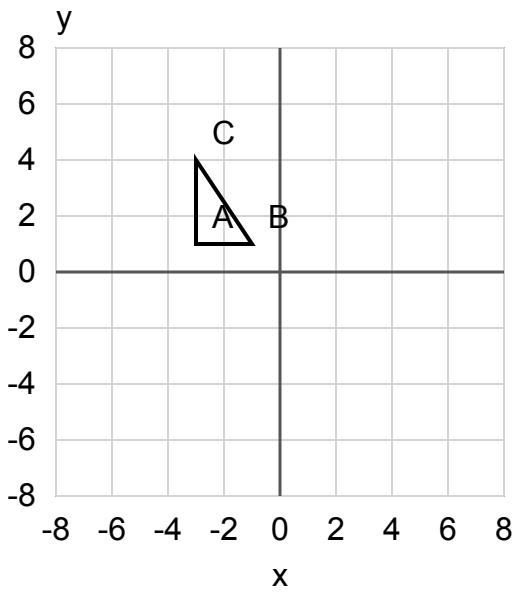
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Part 3 - Dilation and What Is Preserved

Use the same input triangle ABC. Dilate it from the origin with positive scale factor 2. Write the rule, find A‴, B‴, and C‴, and plot the image.



Compare using exact values. Find the side lengths from coordinate differences. For example, a horizontal or vertical side has length equal to its coordinate change. The angle at A is a right angle because AB is horizontal and AC is vertical.

Measure	Original ABC	Translation	Reflection	Dilation, k = 2
AB				
AC				
BC				
angle A and its image angle				

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Part 3 - Dilation and What Is Preserved (continued)

For these transformations, which preserve distance? Which preserve the angle measure? State a conclusion specifically about the dilation with positive scale factor 2.

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Answer Key - Coordinates and Plots

1. Translation: Rule: T(x, y) = (x + 4, y - 2). A' = (1, -1), B' = (3, -1), C' = (1, 2). The plotted image is a congruent triangle shifted right 4 and down 2.

2. Reflection: Rule: R(x, y) = (-x, y). A'' = (3, 1), B'' = (1, 1), C'' = (3, 4). The plotted image is a mirror image across the y-axis.

3. Dilation coordinates: For a dilation centered at the origin with k = 2, D(x, y) = (2x, 2y). A''' = (-6, 2), B''' = (-2, 2), C''' = (-6, 8). The Part 3 grid includes y = 8, so students can plot all three image points and connect the complete triangle.

Plot rubric for 1-3: Award credit when the student uses the correct rule, gives all three correct ordered pairs, and places and connects image points accurately. A minor graphing slip may receive partial credit when the coordinate table and rule are correct.

Supplied materials: three coordinate grids, input triangle coordinates, coordinate tables, and measurement comparison table. **Additionally needed:** pencils and straightedges.

Source credit: New York Next Generation Mathematics Learning Standards, GEO-G.CO.2, https://lessonmakerpro.com/standards/ny-nextgen-math/geo-g-co-2

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Answer Key - Comparison and Teaching Notes

4. Exact measurements:

Measure	Original	Translation	Reflection	Dilation, k = 2
AB	2	2	2	4
AC	3	3	3	6
BC	sqrt(13)	sqrt(13)	sqrt(13)	2sqrt(13)
angle A and image angle	90 degrees	90 degrees	90 degrees	90 degrees

5. Conclusion: The translation and reflection preserve the listed distances and the right angle. The dilation with positive scale factor 2 preserves angle measure but doubles every distance, so it does not preserve distance. Accept equivalent wording that is restricted to k = 2 or to a positive scale factor other than 1. Do not accept an unqualified claim that every dilation fails to preserve distance or that every scale factor has the same effect.

Exact setup: Print and supply all student pages, keeping teacher-key pages separate. Give each student a pencil and straightedge. Tell students to complete Parts 1 and 2 before using the comparison table in Part 3. Students may use the provided grids only; the Part 3 grid extends from -8 to 8 on both axes and includes C'''(-6, 8).

Teaching script: “A transformation can be described as a function: a point is the input, and its image point is the output. Keep each ordered pair matched to its labeled point. Today we will compare what happens to side lengths and to a right angle. Our dilation has positive scale factor 2, so make conclusions about that stated scale factor.”

Observation method: While students work, inspect one row from each coordinate table before they graph. Listen for students naming the input and output coordinates. In Part 3, check whether students calculate BC with the distance formula or recognize coordinate changes of 2 and 3. Record whether each student distinguishes “angle preserved” from “distance preserved.”