LESSON MAKER PRO

Transformation Moves

Use geometric facts to describe plane transformations.

HIGH SCHOOL · GEO-G.CO.4

GEO-G.CO.4 "Develop definitions of rotations, reflections, and translations in terms of points, angles, circles, perpendicular lines, parallel lines, and line segments."

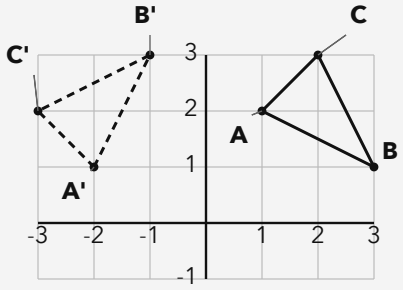
NAME _____ DATE _____

DEFINE THE MOVE

In a translation, directed segments from each point to its image are parallel, equal in length, and point the same way. In a reflection, the mirror line is the perpendicular bisector of each segment joining a point to its image. In a rotation, points stay on circles centered at the rotation center and turn through the same directed angle. Points on a reflection line stay fixed; the rotation center stays fixed. A zero translation fixes every point; its zero-length point-image segments have no direction.

WORKED EXAMPLE

The solid triangle maps to the dashed triangle. Name the transformation.



1. Use the counterclockwise quarter-turn rule: (x, y) maps to (-y, x).
2. A(1, 2) maps to A'(-2, 1).
3. B and C also map to the matching dashed vertices.
4. Draw OA and OA′. Both have length $\sqrt{5}$ and the directed angle AOA′is90°; repeat for the other vertices.
5. These equal-radius quarter-turns define the rotation; the origin itself remains fixed.

Answer: A counterclockwise quarter-turn rotation about the origin.

PRACTICE 4 problems

1 Point P(9, -8) is translated by vector <-4, 12>. Find P'. Draw the point-image arrow; compare its components with the given vector and describe the defining property of a translation.

ANSWER _____

2 Reflect Q(-7, 5) across the y-axis. Find Q'.

ANSWER _____

3 A translation maps A to A' and B to B'. Write two facts about directed segments AA' and BB'.

ANSWER _____

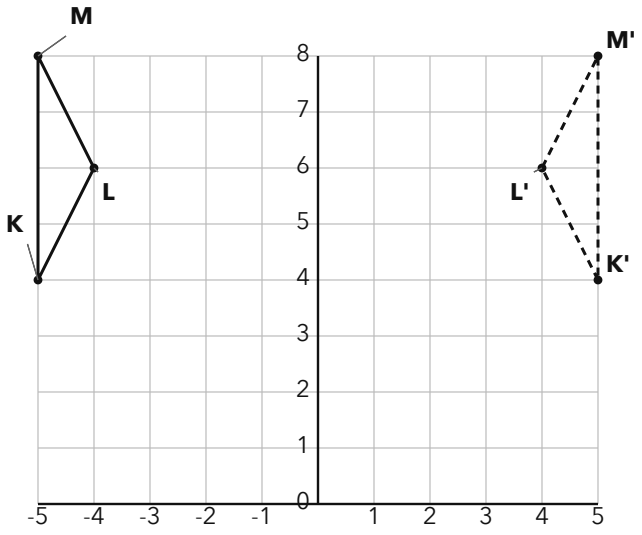
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4 R and R' lie on a circle centered at O with radius 10. Directed angle ROR' is 120° counterclockwise. Name the transformation that maps R to R'.

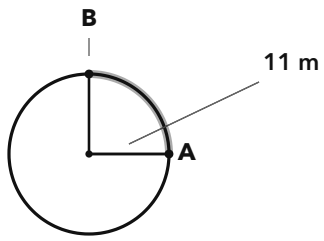
ANSWER _____

APPLY IT Show your work

1 A game club copies a logo on the coordinate grid. The solid logo becomes the dashed logo. What transformation was used?



2 At a music festival, a spotlight moves from A to B around a circular stage. It travels 90° counterclockwise around center O. Name the transformation.



CHALLENGE One step up

A transformation maps A(12, 5) to A'(16, 5), B(12, 9) to B'(16, 9), and C(15, 7) to C'(13, 7). Name the transformation and explain using midpoints and perpendicular lines. Draw each point-image segment on graph paper and mark its midpoint and the mirror line. What happens to a point already on the mirror line? Use your observations to state a general definition of reflection.

ANSWER KEY

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PART 1 · PRACTICE

#	PROBLEM	ANSWER
1	Point P(9, -8) is translated by vector <-4, 12>. Find P'. Draw the point-image arrow; compare its components with the given vector and describe the defining property of a translation.	**P'(5, 4) Arrow components(−4,12), identical for every point under this translation.**
2	Reflect Q(-7, 5) across the y-axis. Find Q'.	**Q'(7, 5)**
3	A translation maps A to A' and B to B'. Write two facts about directed segments AA' and BB'.	**They are parallel and point in the same direction. They have equal length.**
4	R and R' lie on a circle centered at O with radius 10. Directed angle ROR' is 120° counterclockwise. Name the transformation that maps R to R'.	**A 120° counterclockwise rotation about O.**

PART 2 · APPLY IT

1. **Reflection across the y-axis.** Each image point has the opposite x-coordinate and the same y-coordinate as its original point. The y-axis is the perpendicular bisector of each joining segment.
2. **A 90° counterclockwise rotation about O.** Both positions are on the circle centered at O, so they stay the same distance from O. The stated turn gives the rotation angle and direction.

CHALLENGE

It is a reflection across x = 14. Each pair's midpoint lies on x = 14, and each horizontal segment joining a point to its image is perpendicular to x = 14. Midpoints(14,5),(14,9),(14,7)lie on x=14; each joining segment is horizontal. A point on x=14 stays fixed. For every other point the mirror line perpendicularly bisects the point-image segment.

Accept "reflection over the y-axis" for "across the y-axis." For the challenge, accept any correct explanation that identifies x = 14 as the perpendicular bisector of all three point-image segments.