

Symmetry Signal

Find flips, turns, and slides that preserve a figure.

HIGH SCHOOL • MA.912.GR.2.4

MA.912.GR.2.4 "Determine symmetries of reflection, symmetries of rotation and symmetries of translation of a geometric figure."

NAME _____

DATE _____

WHEN A MOVE IS A SYMMETRY

A symmetry moves a figure so it matches itself exactly. A reflection flips across a line, a rotation turns around a center, and a translation slides every point the same distance and direction. For coordinates about the origin, a 90-degree clockwise rotation sends (x, y) to $(y, -x)$.

WORKED EXAMPLE

Reflect point $M(13, -17)$ across the x-axis.

1. Use the x-axis rule: (x, y) becomes $(x, -y)$.
2. Keep the x-coordinate, 13.
3. Change the y-coordinate from -17 to 17.

Answer: $M'(13, 17)$

PRACTICE 6 problems

- 1** A square has vertices $(-3, -3)$, $(3, -3)$, $(3, 3)$, and $(-3, 3)$. List all lines of reflection symmetry and all rotational symmetries about the origin with angles less than 360 degrees.

ANSWER _____

- 2** A rectangle has vertices $(-5, -2)$, $(5, -2)$, $(5, 2)$, and $(-5, 2)$. List all lines of reflection symmetry and all rotational symmetries about the origin with angles less than 360 degrees.

ANSWER _____

- 3** An isosceles triangle has vertices $(-4, 0)$, $(4, 0)$, and $(0, 6)$. What line of reflection symmetry does it have? Does it have a rotational symmetry with an angle less than 360 degrees?

ANSWER _____

- 4** Reflect point $P(-7, 4)$ across the line $y = x$.

ANSWER _____

- 5** Rotate point $Q(-2, 9)$ 90 degrees clockwise about the origin.

ANSWER _____

- 6** A repeating mural has a translation symmetry of $\langle 6, 3 \rangle$. A triangle vertex is at $(1, -5)$. What are the coordinates of the matching vertex after one translation?

ANSWER _____

APPLY IT Show your work

- 1** A student designs a square social-media icon with four identical camera symbols centered at $(0, 4)$, $(4, 0)$, $(0, -4)$, and $(-4, 0)$. Each camera symbol faces the center of the icon. Which rotations about the origin, with angles less than 360 degrees, map the whole icon onto itself?

WORK SPACE

ANSWER _____

- 2** A sneaker designer creates a repeating lightning-bolt pattern. Moving the whole pattern by $\langle 5, -2 \rangle$ maps every bolt onto the next matching bolt. Does the translation $\langle 10, -4 \rangle$ also preserve the pattern? Explain.

WORK SPACE

ANSWER _____

CHALLENGE One step up

CHALLENGE

A hexagon has vertices $(0, 2)$, $(2, 3)$, $(4, 2)$, $(4, 0)$, $(2, -1)$, and $(0, 0)$. Determine all lines of reflection symmetry and all rotational symmetries with angles less than 360 degrees. The center is $(2, 1)$. Explain how corresponding vertices match for one reflection and one rotation.

PART 1 • PRACTICE

#	PROBLEM	ANSWER
1	A square has vertices $(-3, -3)$, $(3, -3)$, $(3, 3)$, and $(-3, 3)$. List all lines of reflection symmetry and all rotational symmetries about the origin with angles less than 360 degrees.	Reflection lines: x-axis, y-axis, $y = x$, and $y = -x$. Rotational symmetries: 90 degrees, 180 degrees, and 270 degrees.
2	A rectangle has vertices $(-5, -2)$, $(5, -2)$, $(5, 2)$, and $(-5, 2)$. List all lines of reflection symmetry and all rotational symmetries about the origin with angles less than 360 degrees.	Reflection lines: x-axis and y-axis. Rotational symmetry: 180 degrees.
3	An isosceles triangle has vertices $(-4, 0)$, $(4, 0)$, and $(0, 6)$. What line of reflection symmetry does it have? Does it have a rotational symmetry with an angle less than 360 degrees?	Line of reflection symmetry: y-axis. No rotational symmetry with an angle less than 360 degrees.
4	Reflect point $P(-7, 4)$ across the line $y = x$.	$P'(4, -7)$
5	Rotate point $Q(-2, 9)$ 90 degrees clockwise about the origin.	$Q'(9, 2)$
6	A repeating mural has a translation symmetry of $\langle 6, 3 \rangle$. A triangle vertex is at $(1, -5)$. What are the coordinates of the matching vertex after one translation?	$(7, -2)$

PART 2 • APPLY IT

- 90 degrees, 180 degrees, and 270 degrees** The four symbols are equally spaced around the origin and turn with the icon. A quarter-turn, half-turn, or three-quarter-turn places every symbol onto a matching symbol.
- Yes. The translation $\langle 10, -4 \rangle$ preserves the pattern.** $\langle 10, -4 \rangle$ is two copies of $\langle 5, -2 \rangle$. Applying a translation symmetry twice still maps the pattern onto itself.

CHALLENGE

Reflection lines: $x = 2$ and $y = 1$. Rotational symmetry: 180 degrees about $(2, 1)$. For reflection across $x = 2$, $(0, 2)$ matches $(4, 2)$. For a 180-degree rotation, $(0, 2)$ matches $(4, 0)$.

Accept equivalent descriptions such as “the vertical line through $x = 2$ ” for $x = 2$. For symmetry lists, students must include all and only the valid reflection lines or rotation angles.