

Moving Shapes with Translations, Reflections, Rotations

Grade 8 math · Lesson · Standards: 8.G.A.1, 8.G.A.3

Quick answer: A rigid motion moves a figure without changing its size or shape. A translation slides it, a reflection flips it across a line, and a rotation turns it about a point. Each motion keeps side lengths, angle measures, and parallelism the same, and each has a simple coordinate rule.

Standards: 8.G.A.1, 8.G.A.3 · **Level:** Grade 8

What is a rigid motion?

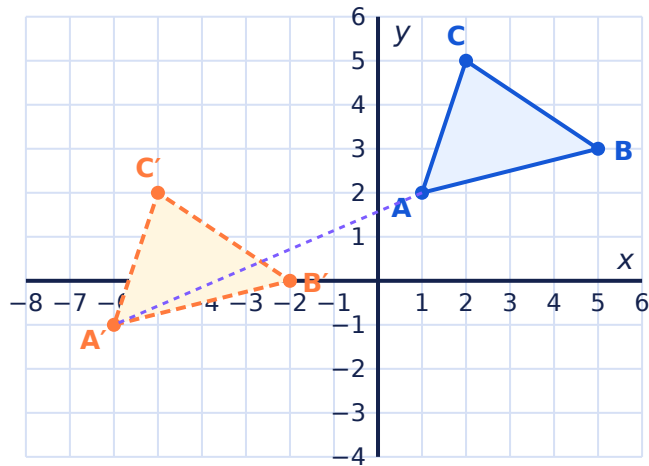
Rigid motion

A rigid motion moves a figure without changing its size or shape. Translations, reflections, and rotations are the three rigid motions studied in Grade 8. The original figure is the *pre-image*; the moved figure is the *image*, and its vertices are named with a prime mark, such as A' .

Every rigid motion sends lines to lines and line segments to segments of the same length. Angle measures stay the same, and parallel lines stay parallel. Only the position, and sometimes the orientation, changes.

How does a translation change coordinates?

A translation slides every point the same distance in the same direction. Add the same horizontal change to every x-coordinate and the same vertical change to every y-coordinate.



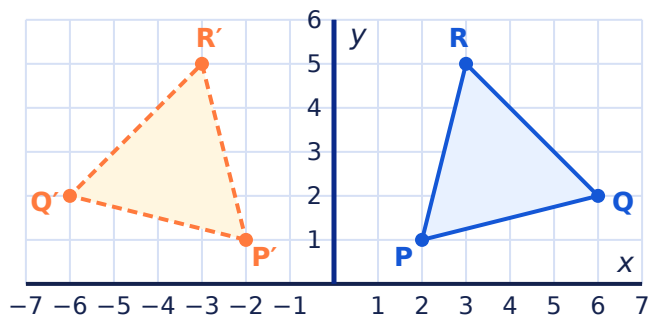
Translation: every point moves 7 units left and 3 units down.

How do reflections and rotations change coordinates?

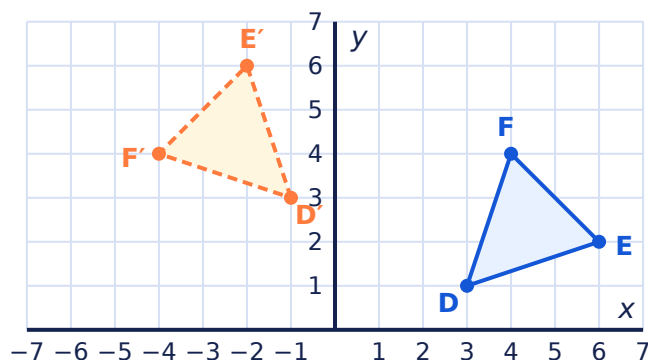
A reflection flips a figure across a line, like a mirror. A rotation turns a figure around a fixed point, here the origin, by a stated angle. Rotations are counterclockwise unless the problem says clockwise, and a 90° clockwise turn equals a 270° counterclockwise turn.

Coordinate rules

Motion	Rule for (x, y)	Example with $(3, 2)$
Translation a right, b up	$(x + a, y + b)$	$a = 4, b = -1$ gives $(7, 1)$
Reflection across the x -axis	$(x, -y)$	$(3, -2)$
Reflection across the y -axis	$(-x, y)$	$(-3, 2)$
Rotation 90° counterclockwise	$(-y, x)$	$(-2, 3)$
Rotation 180°	$(-x, -y)$	$(-3, -2)$
Rotation 270° counterclockwise	$(y, -x)$	$(2, -3)$



Reflection across the y -axis: each x -coordinate changes sign.



Rotation of 90° counterclockwise about the origin: $(x, y) \rightarrow (-y, x)$.

How do you find the image of a figure?

Method

1. Write down the coordinates of every vertex.
2. Choose the rule for the motion from the table.
3. Apply the rule to each vertex, one at a time.
4. Plot the new vertices and join them in the same order.
5. Check that side lengths and angles match the pre-image.

Worked example

Rotate the segment from $G(5, -2)$ to $H(1, -6)$ by 180° about the origin. The rule is $(x, y) \rightarrow (-x, -y)$, so $G' = (-5, 2)$ and $H' = (-1, 6)$. Both segments have length $4\sqrt{2} \approx 5.66$ units, so the length is preserved.

Common mistake

Reflecting across the x -axis changes the sign of y , not x . Many students swap the two axes. Picture which axis is the mirror: points keep their distance along the mirror line.

Mathbot's tip

For a 90° counterclockwise turn, swap the coordinates first, then negate the new x . Test the rule on $(1, 0)$: it should land on $(0, 1)$.

Key points to remember

- Translations, reflections, and rotations keep lengths, angles, and parallel lines unchanged.
- A translation adds the same numbers to every x and y .
- Reflection across the x -axis: $(x, y) \rightarrow (x, -y)$; across the y -axis: $(x, y) \rightarrow (-x, y)$.
- Rotation 90° counterclockwise about the origin: $(x, y) \rightarrow (-y, x)$.

- The moved figure is the image; its labels carry a prime mark.

Moving Shapes with Translations, Reflections, Rotations: frequently asked questions

Does a reflection change the size of a figure?

No. A reflection is a rigid motion, so every side length and angle measure stays the same. Only the position and the orientation (clockwise or counterclockwise order of the vertices) change.

What is the difference between a clockwise and a counterclockwise rotation?

Counterclockwise turns the opposite way from clock hands. A 90° clockwise rotation about the origin gives $(y, -x)$, which is the same result as a 270° counterclockwise rotation.

How do you reflect a point across the y-axis?

Change the sign of the x-coordinate and keep the y-coordinate. For example, $(7, -3)$ becomes $(-7, -3)$. The point stays at the same height but lands on the other side of the y-axis.

Do parallel lines stay parallel after a rotation?

Yes. Rigid motions map parallel lines to parallel lines, because slopes change together and the distance between the lines is preserved. Perpendicular lines also stay perpendicular.

What does the prime mark in A' mean?

The prime mark shows that A' is the image of the point A after a transformation. Corresponding vertices keep the same letter, so the vertex order of the image matches the pre-image.