RIGID TRANSFORMATIONS

Translations, Rotations, Reflections & Sequences

Math 8 • Unit 1 • Lessons 1–6

Goal: describe, perform, and sequence rigid transformations on grids and the coordinate plane.

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What are we trying to understand?

Six lessons connect movement, precision, and coordinates.

1 RECOGNIZE

Identify translations, rotations, and reflections from how a figure moves.

2 PERFORM

Move every point using a vector, center and angle, or mirror line.

3 DESCRIBE

Use coordinates and ordered steps to communicate a transformation precisely.

Big idea: rigid transformations move figures without changing side lengths or angle measures.

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Lessons 1–3: name and perform the moves

Students build precise language before using coordinate rules.

1 LESSON 1

Describe how a figure slides or turns from one position to another.

2 LESSON 2

Name translations, rotations, reflections, images, and corresponding points.

3 LESSON 3

Carry out rigid transformations on square and isometric grids.

Every point follows the same transformation.

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Lessons 4–6: make, coordinate, and sequence

Students specify each move and reason about order.

1 LESSON 4

Use vectors, rotation centers and angles, and reflection lines precisely.

2 LESSON 5

Track how translations, axis reflections, and 90° rotations change coordinates.

3 LESSON 6

Describe sequences and explain why the order of transformations matters.

A complete description tells what moves, how far, around what, and in what order.

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Three moves preserve shape and size

A rigid transformation moves every point without bending or stretching.

1

TRANSLATION

slide

same distance
same direction

2

ROTATION

turn

same angle
around one center

3

REFLECTION

flip

equal distance
across one line

All three are rigid: corresponding lengths and angles remain equal.

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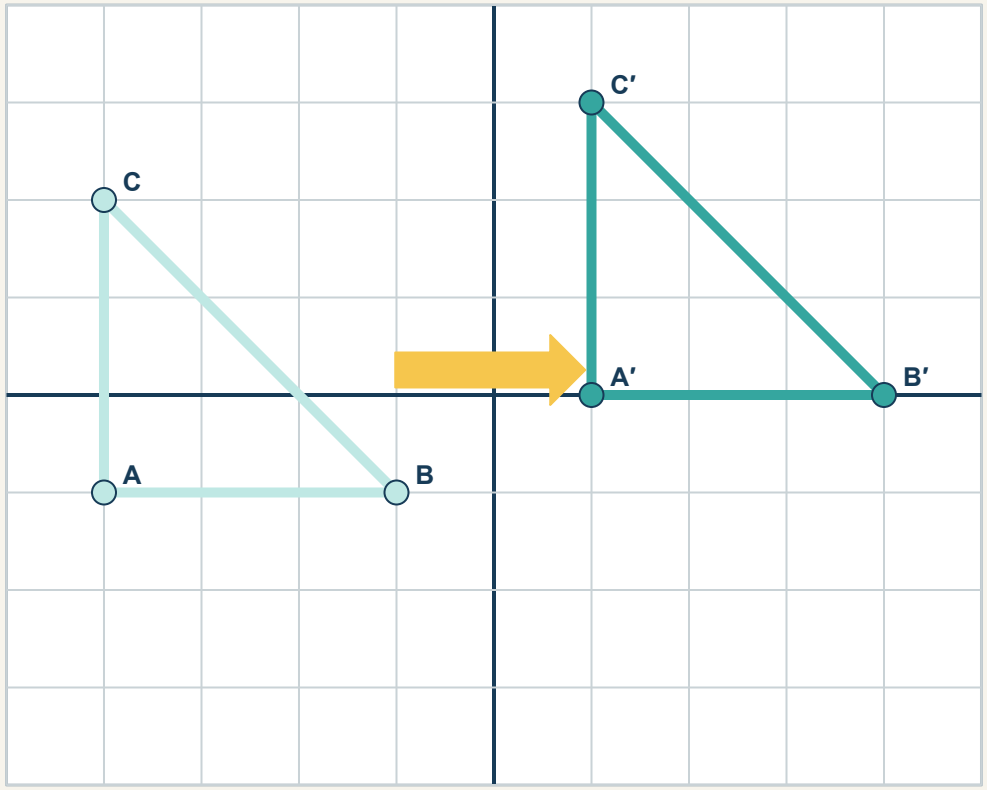
Original points correspond to image points

Prime marks label the image: A maps to A′, B maps to B′, and so on.



VOCABULARY

Original → image

CORRESPONDENCE

A ↔ A′
B ↔ B′
C ↔ C′

The same move maps every original point to exactly one image point.

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A precise description includes the defining information

Name the move and the information that determines it.

TRANSLATE

vector: direction + distance

Example

A → A′

ROTATE

center + angle + direction

Example

90° CCW about O
(counter-clock-wise)

REFLECT

line of reflection

Example

across y-axis

If a description is missing defining information, more than one image may be possible.

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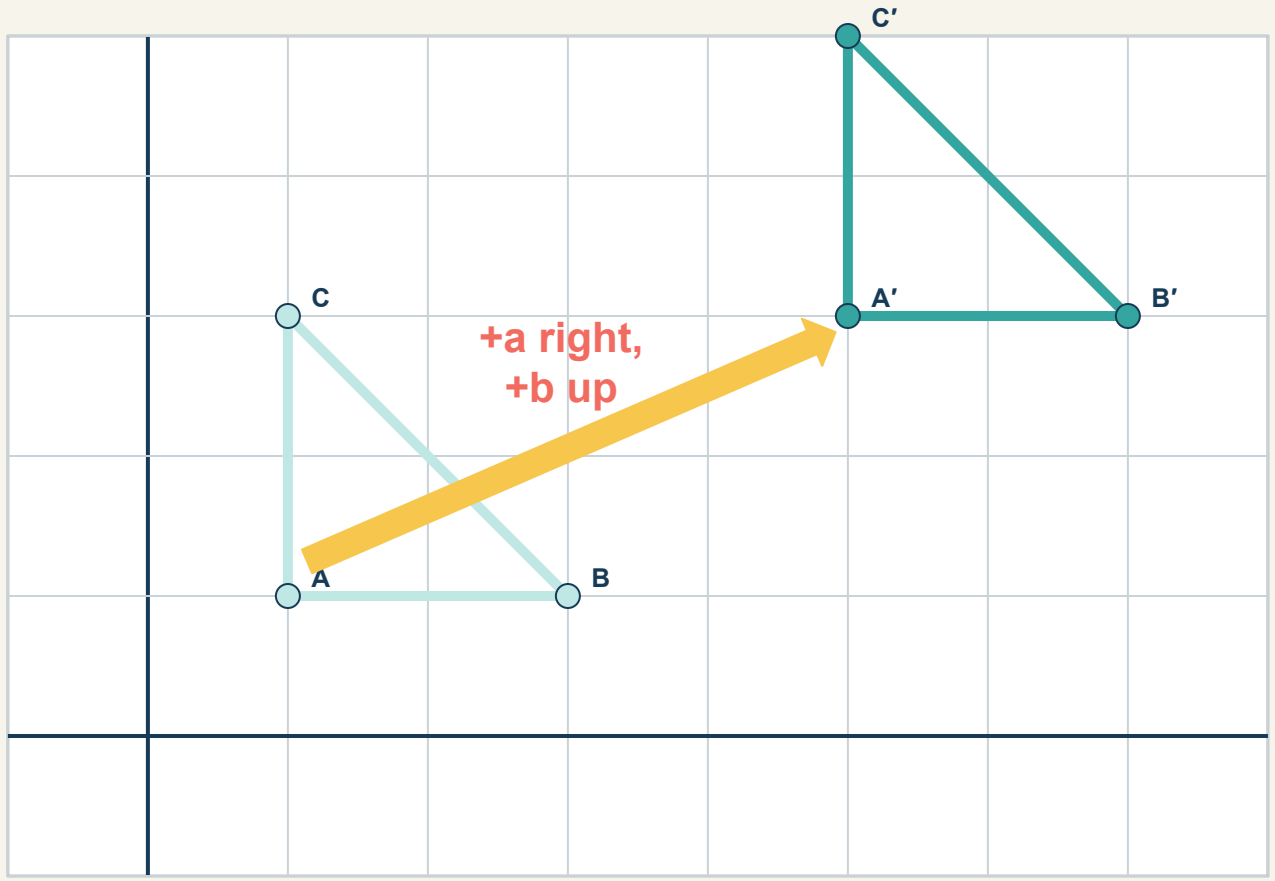
A translation uses one vector for every point

Add the same horizontal and vertical changes to each coordinate.



COORDINATE RULE

$$(x, y) \rightarrow (x + a, y + b)$$

Same vector for every vertex

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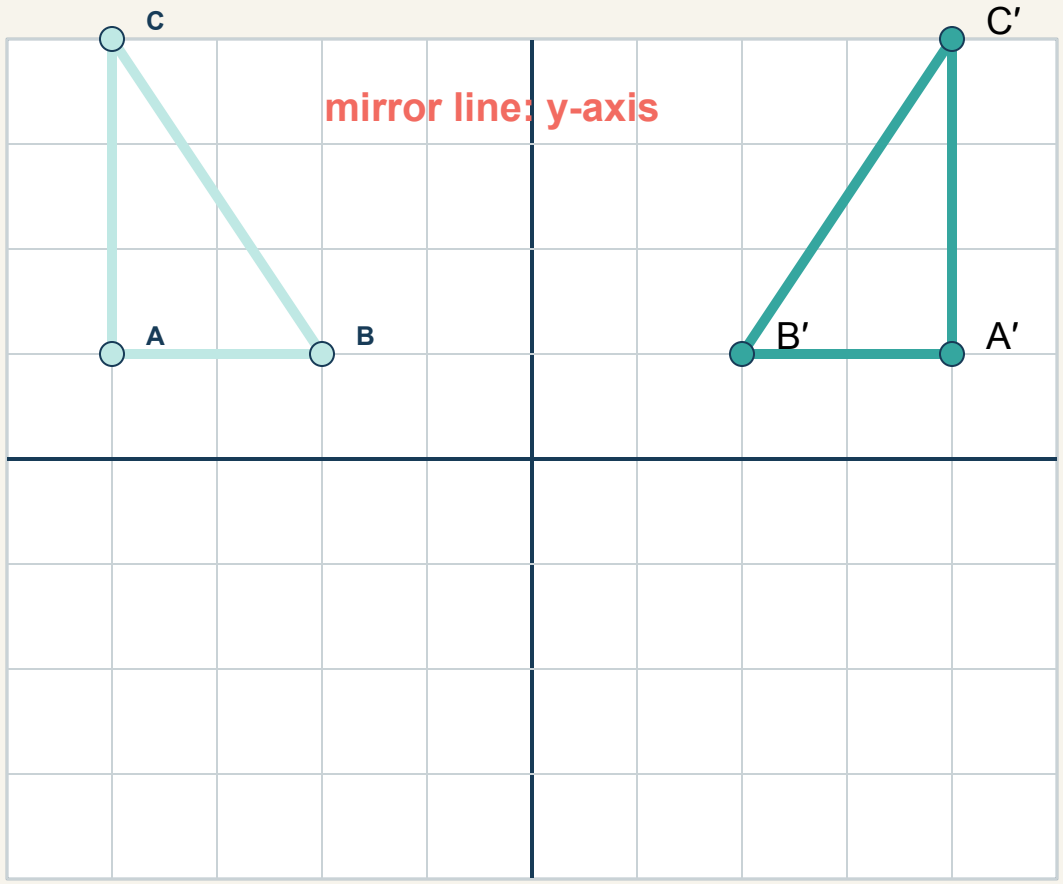
A reflection mirrors equal distances across a line

Across an axis, one coordinate changes sign and the other stays fixed.



ACROSS Y-AXIS

$(x, y) \rightarrow (-x, y)$

ACROSS X-AXIS

$(x, y) \rightarrow (x, -y)$

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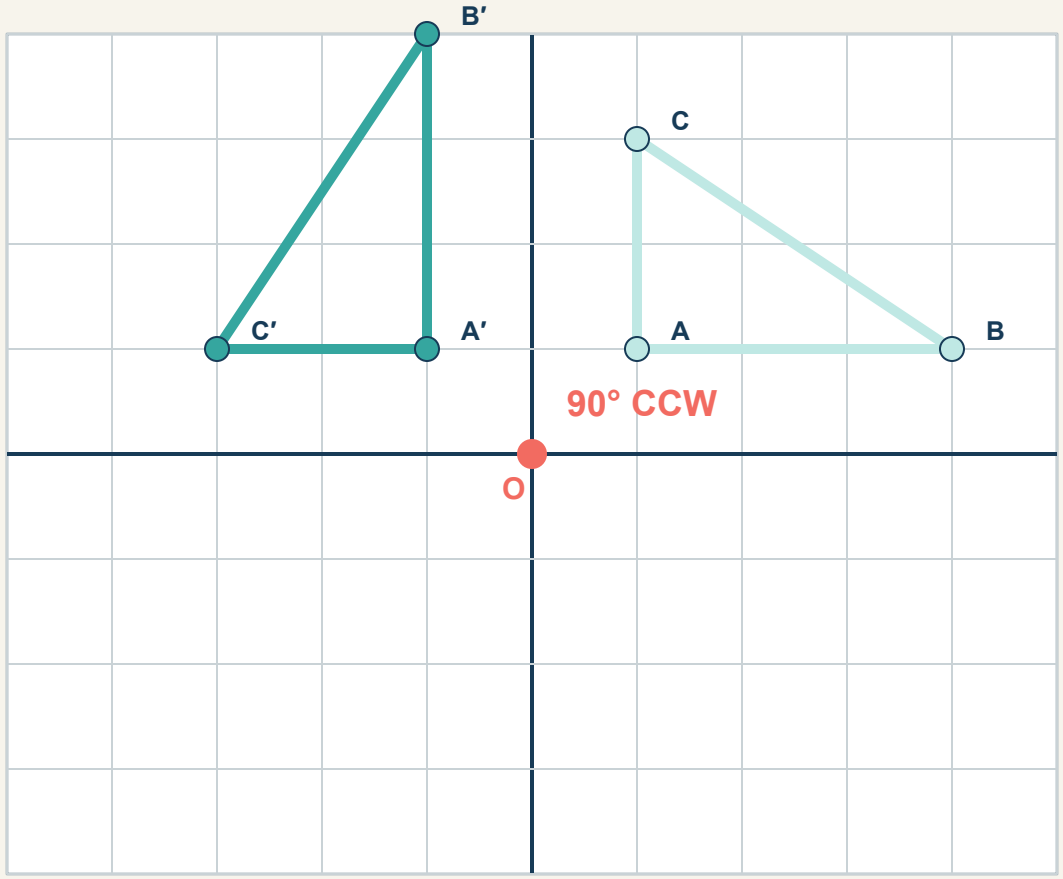
A rotation needs a center, angle, and direction

For 90° turns about the origin, coordinate patterns help check the image.



90° COUNTERCLOCKWISE

$(x, y) \rightarrow (-y, x)$

90° CLOCKWISE

$(x, y) \rightarrow (y, -x)$

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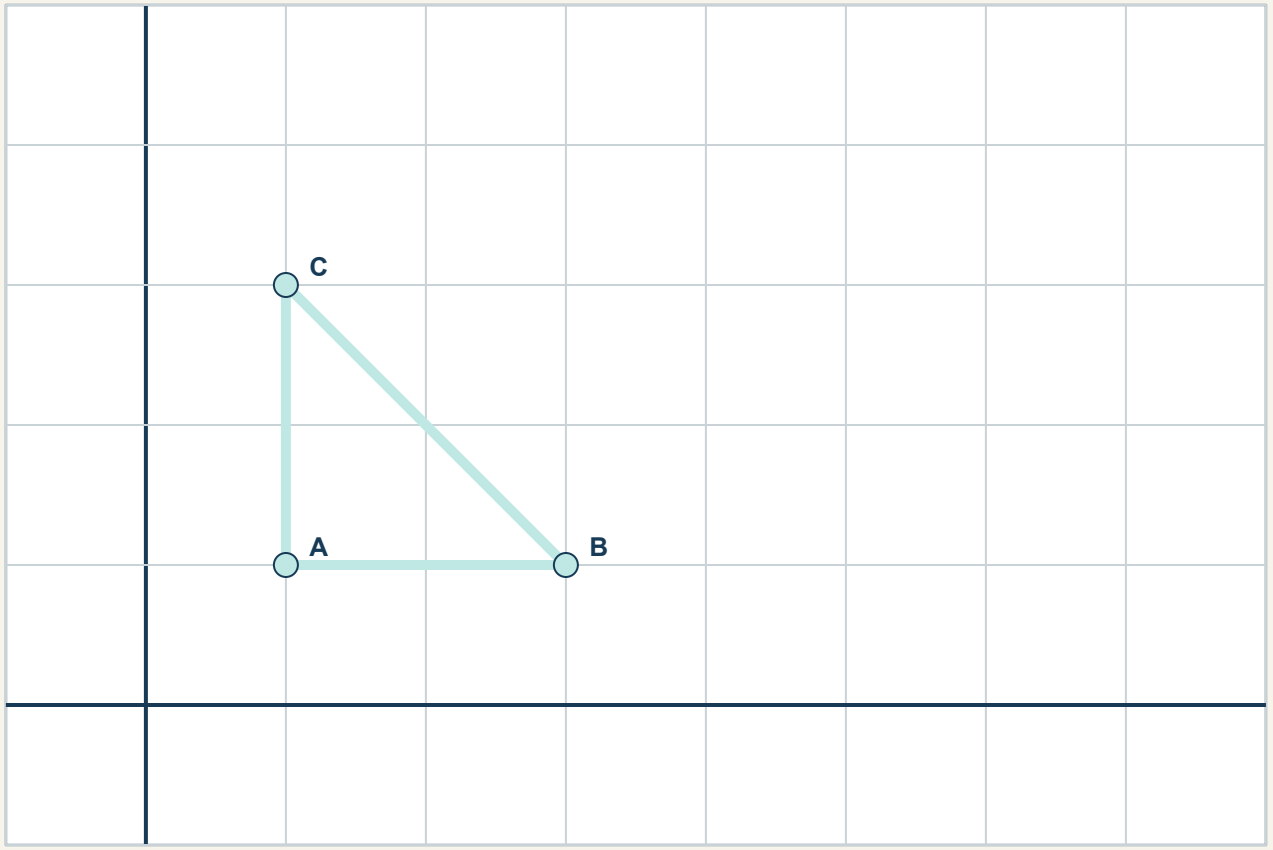
Example 1 — Try it first

Translate triangle ABC 4 units right and 2 units up.



YOUR TURN

Predict A′, B′, and C′.

What stays the same?

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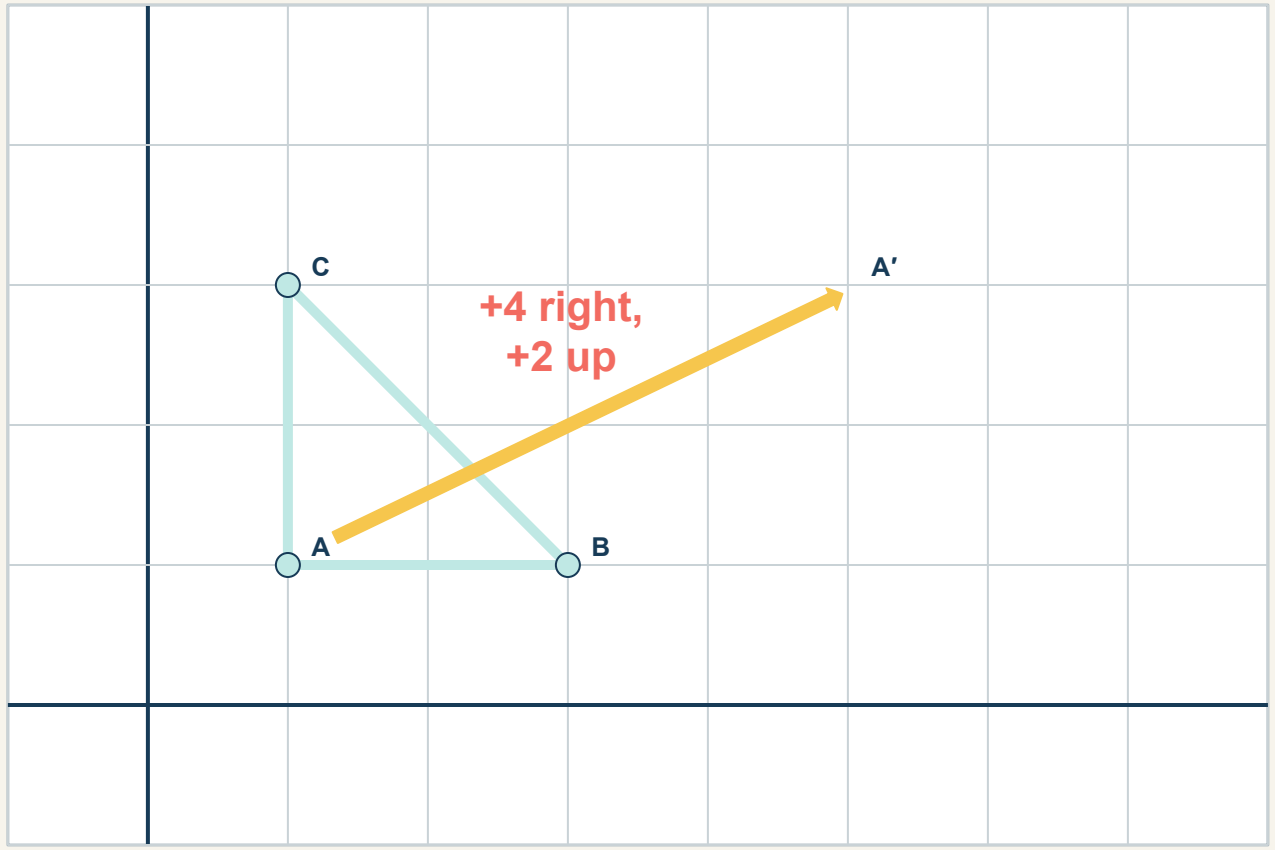
Example 1 — Step 1: Find the vector

Compare A with A′ to identify the horizontal and vertical changes.



STEP 1

A(1,1) → A′(5,3)
right 4, up 2

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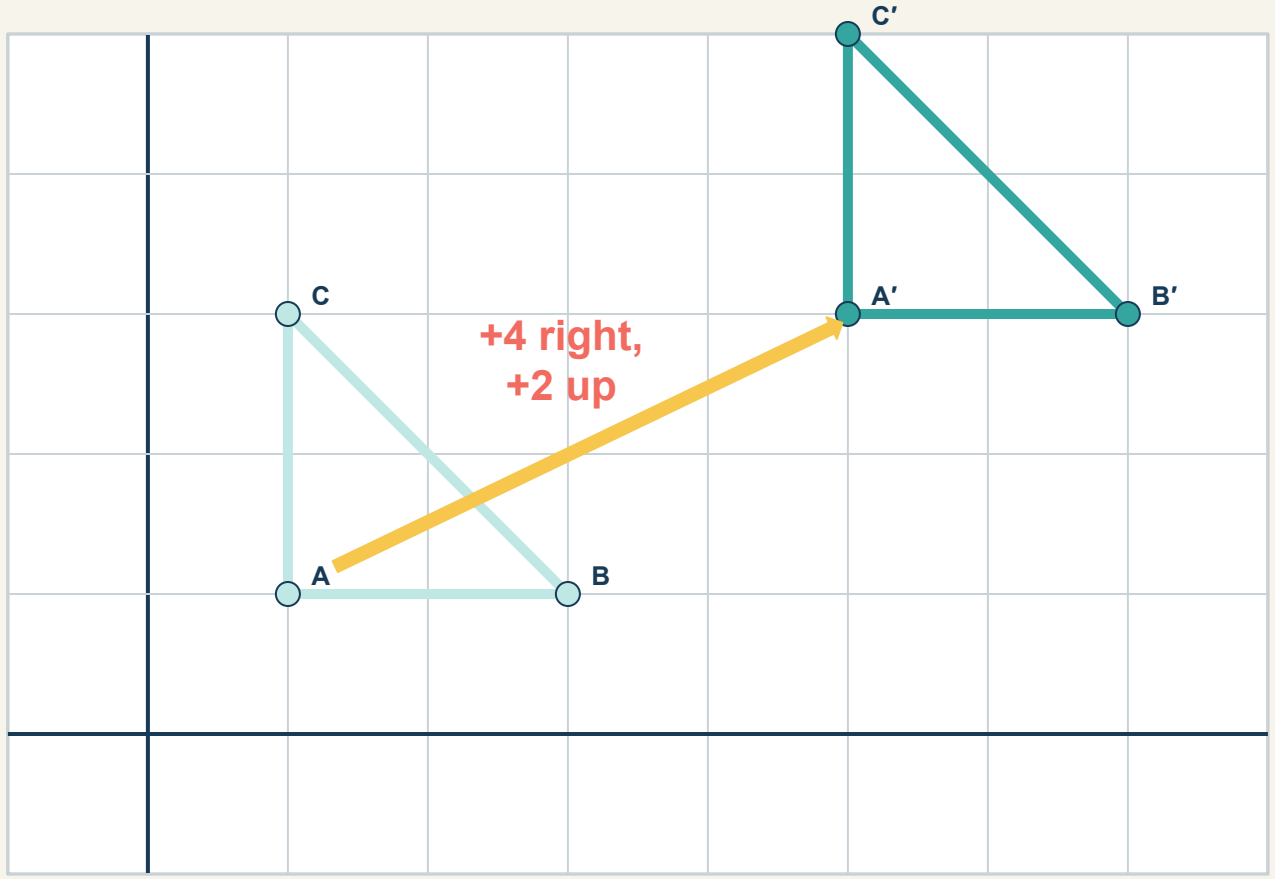
Example 1 — Step 2: Move every vertex

Apply the same vector to A, B, and C.



STEP 2

B(3,1) → B′(7,3)

C(1,3) → C′(5,5)

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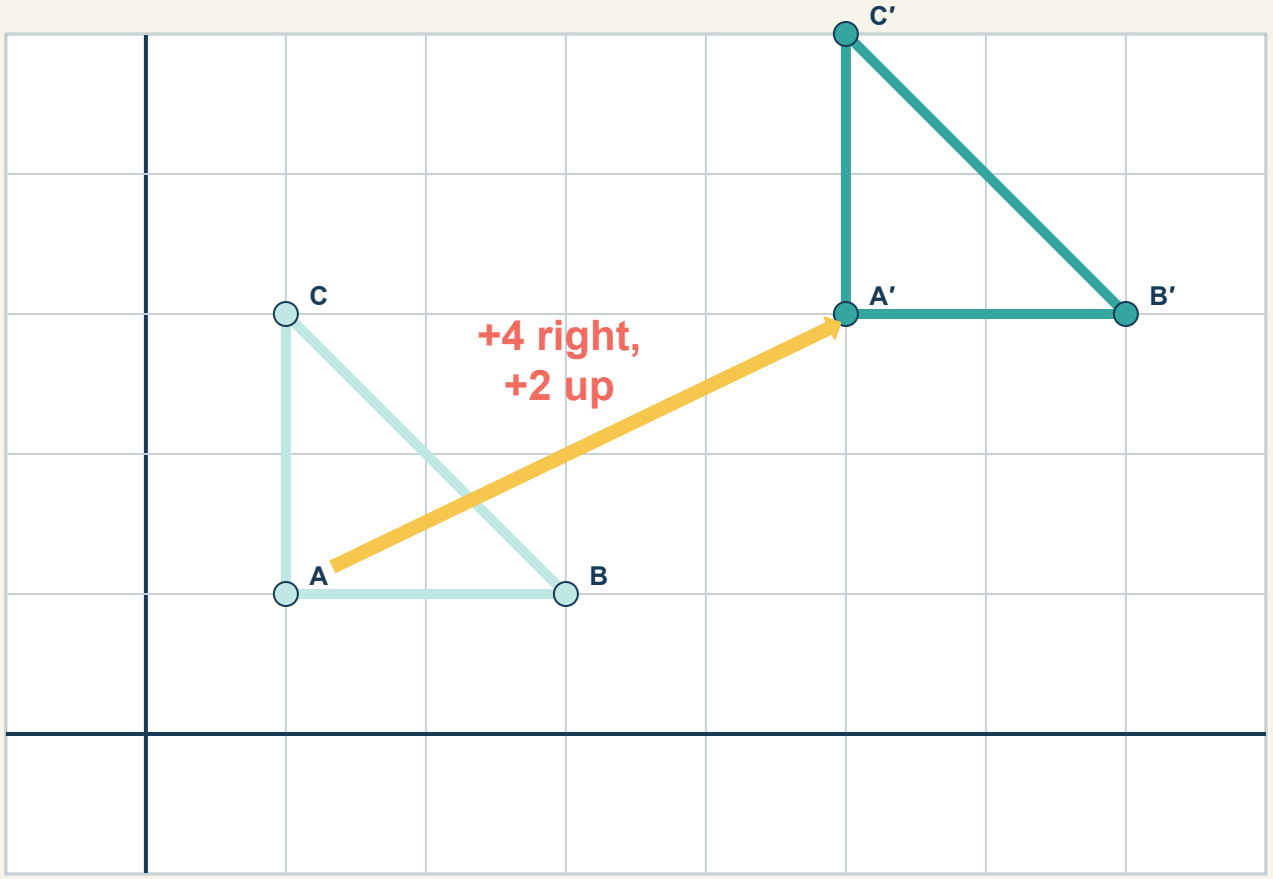
Example 1 — Solution

The translation rule is (x, y) → (x + 4, y + 2).



SOLUTION

A′ (5,3),
B′ (7,3),
C′ (5,5)

Rule: +4, +2

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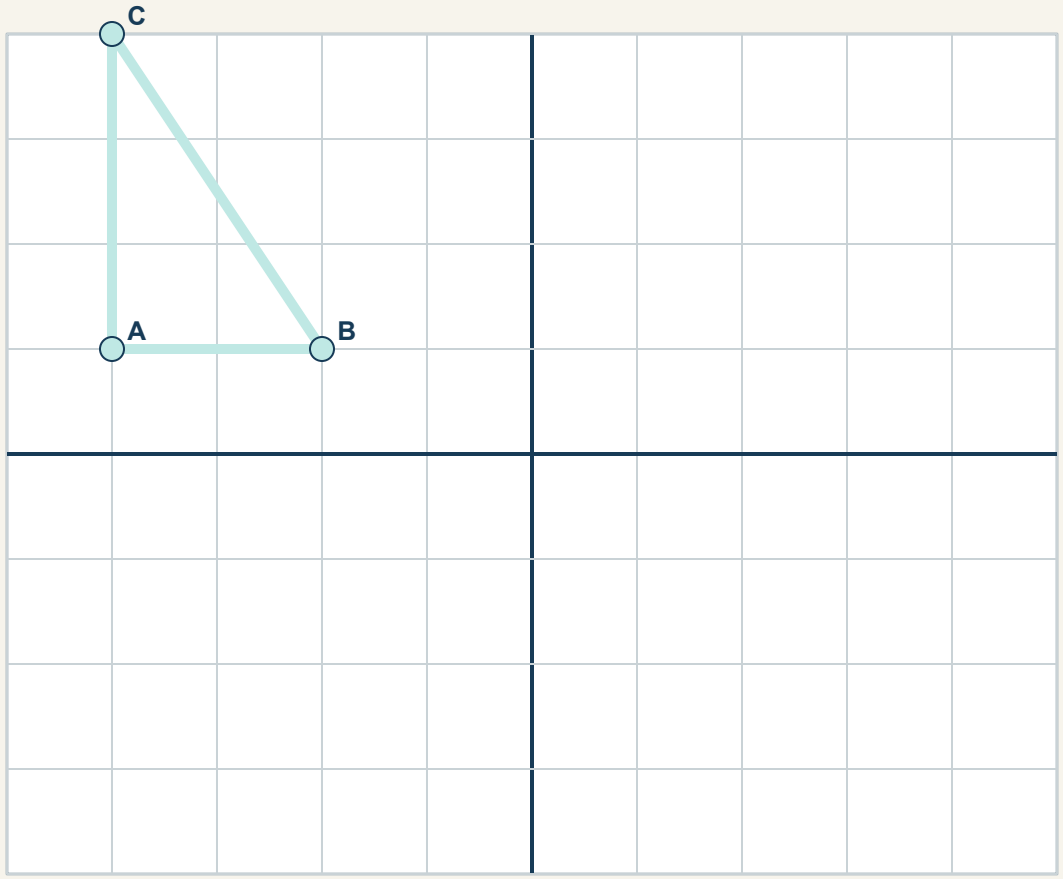
Example 2 — Try it first

Reflect triangle ABC across the y-axis.



YOUR TURN

Sketch the mirror image.

Label A′, B′, C′.

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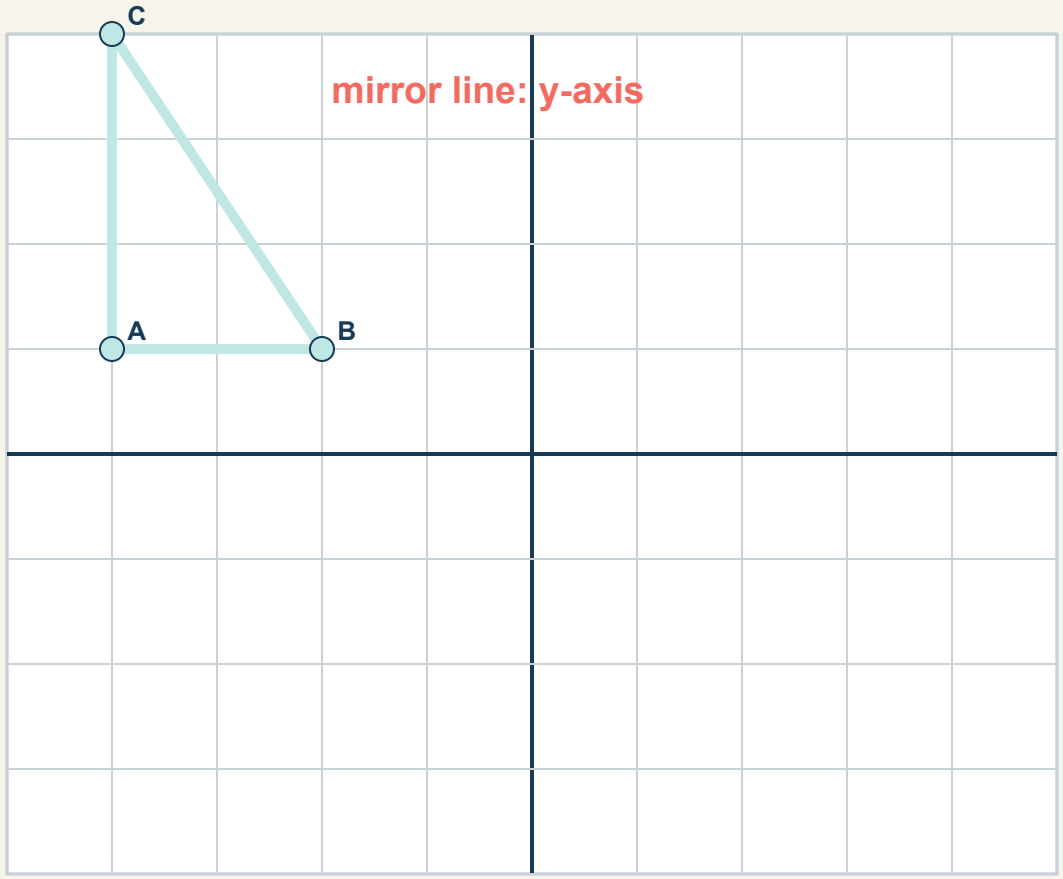
Example 2 — Step 1: Measure from the mirror

Each image point is the same distance from the y-axis.



STEP 1

A is 4 units left of the y-axis.

A′ must be 4 units right.

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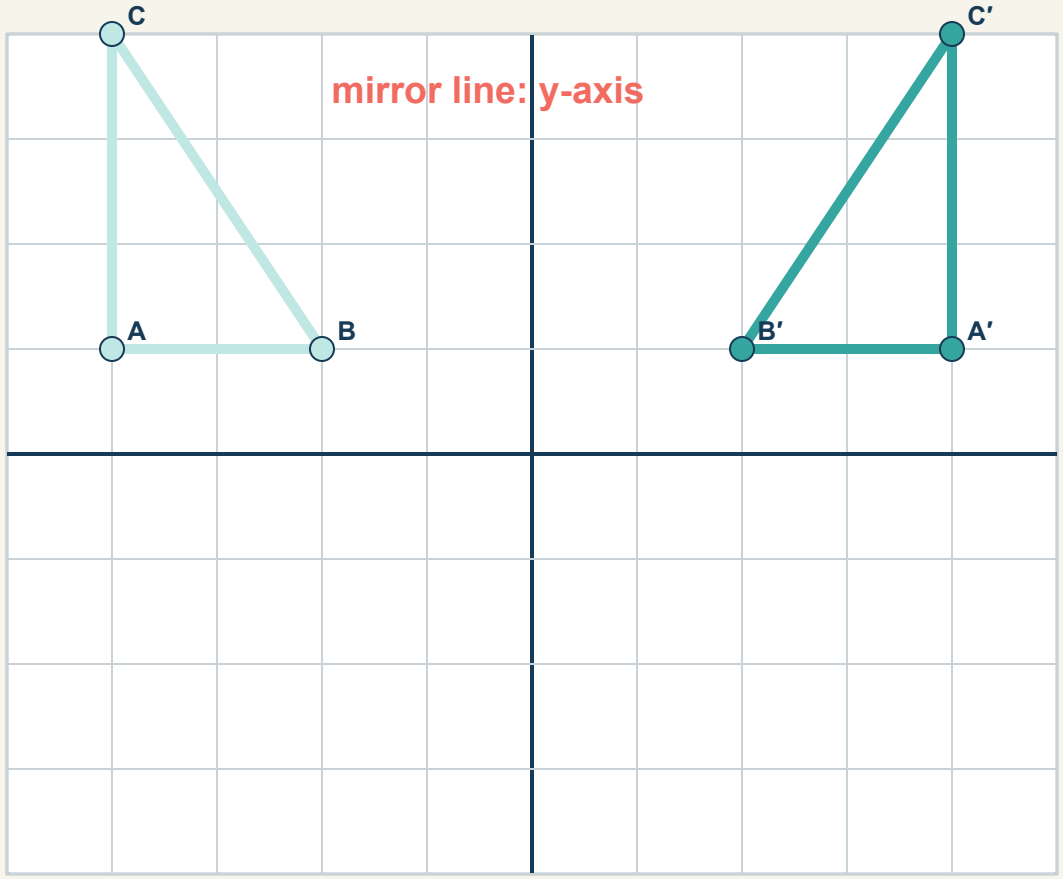
Example 2 — Step 2: Plot the image

Change the sign of x; keep y unchanged.



STEP 2

A′(4,1)
B′(2,1)
C′(4,4)

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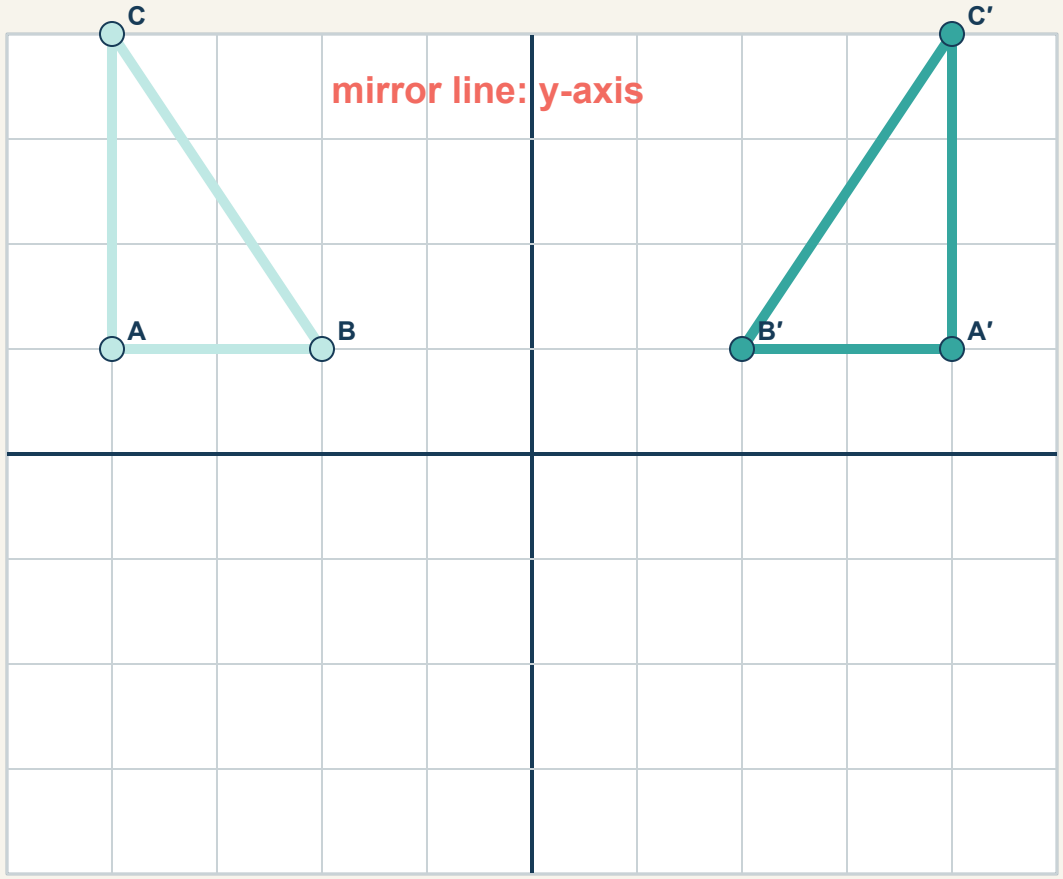
Example 2 — Solution

Reflection across the y-axis follows (x, y) → (−x, y).



SOLUTION

Rule: (x,y) → (−x,y)

Only x changes sign.

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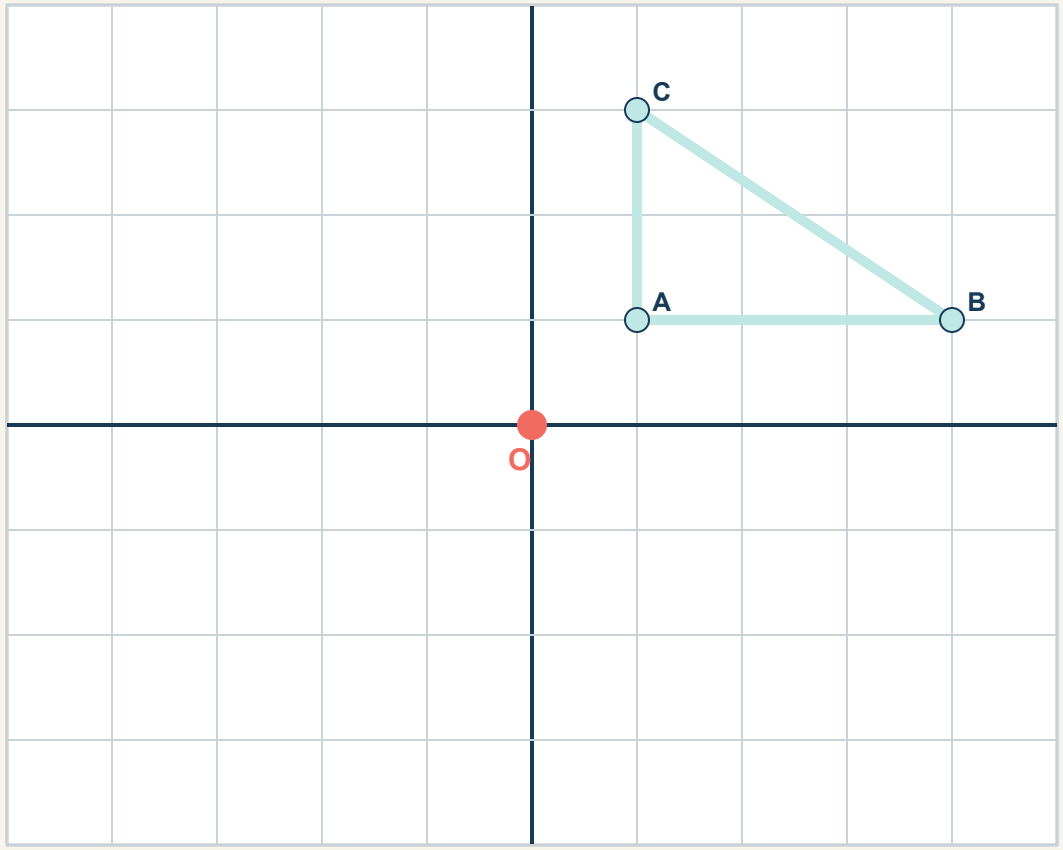
Example 3 — Try it first

Rotate triangle ABC 90° counterclockwise about the origin.



YOUR TURN

Predict the image after a quarter-turn counterclockwise.

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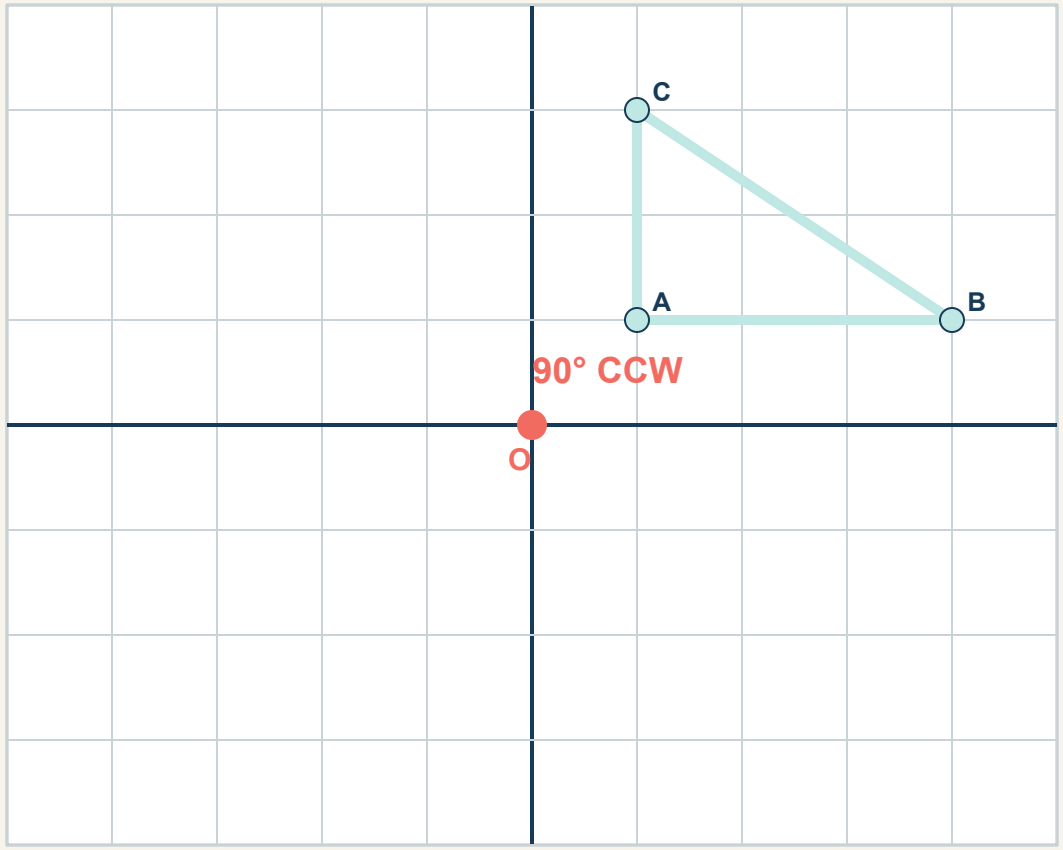
Example 3 — Step 1: Identify the turn

The origin is fixed; every point turns one quarter-turn counterclockwise.



STEP 1

Center: O(0,0)
Angle: 90°
Direction: CCW

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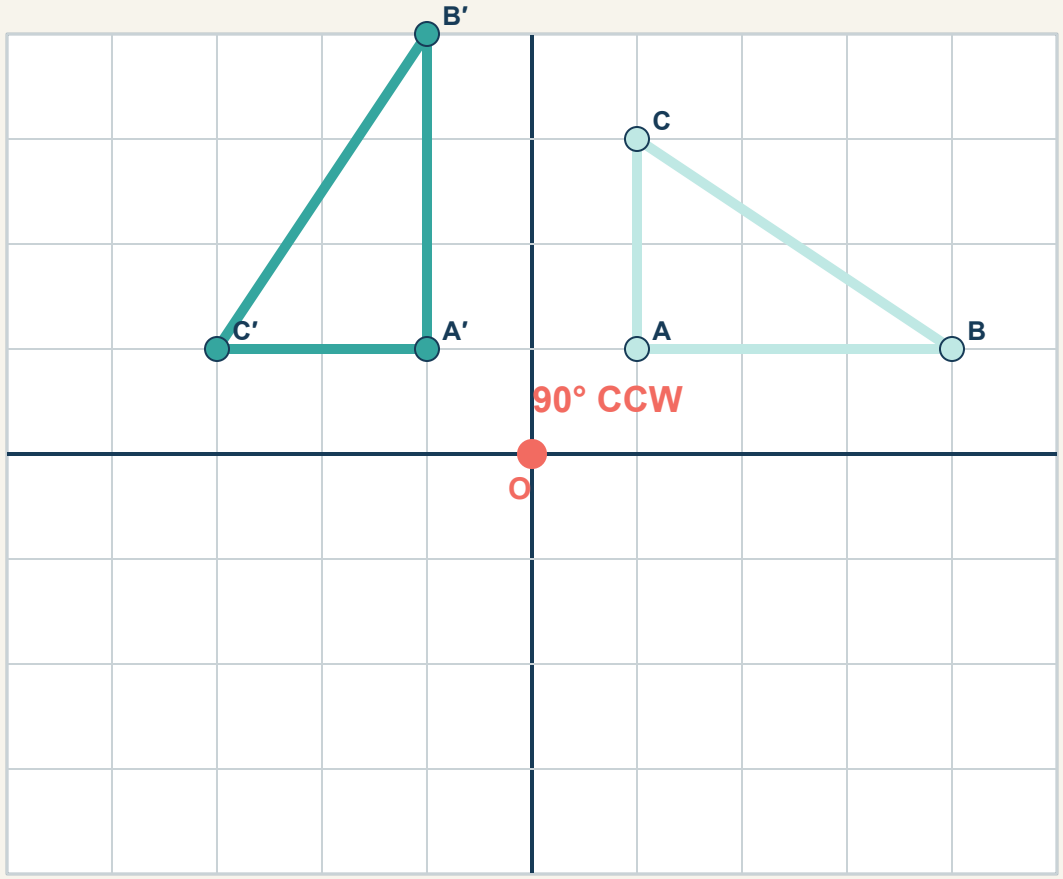
Example 3 — Step 2: Rotate each vertex

For this turn, (x, y) → (−y, x).



STEP 2

A(1,1) → A′(−1,1)

B(4,1) → B′(−1,4)

C(1,3) → C′(−3,1)

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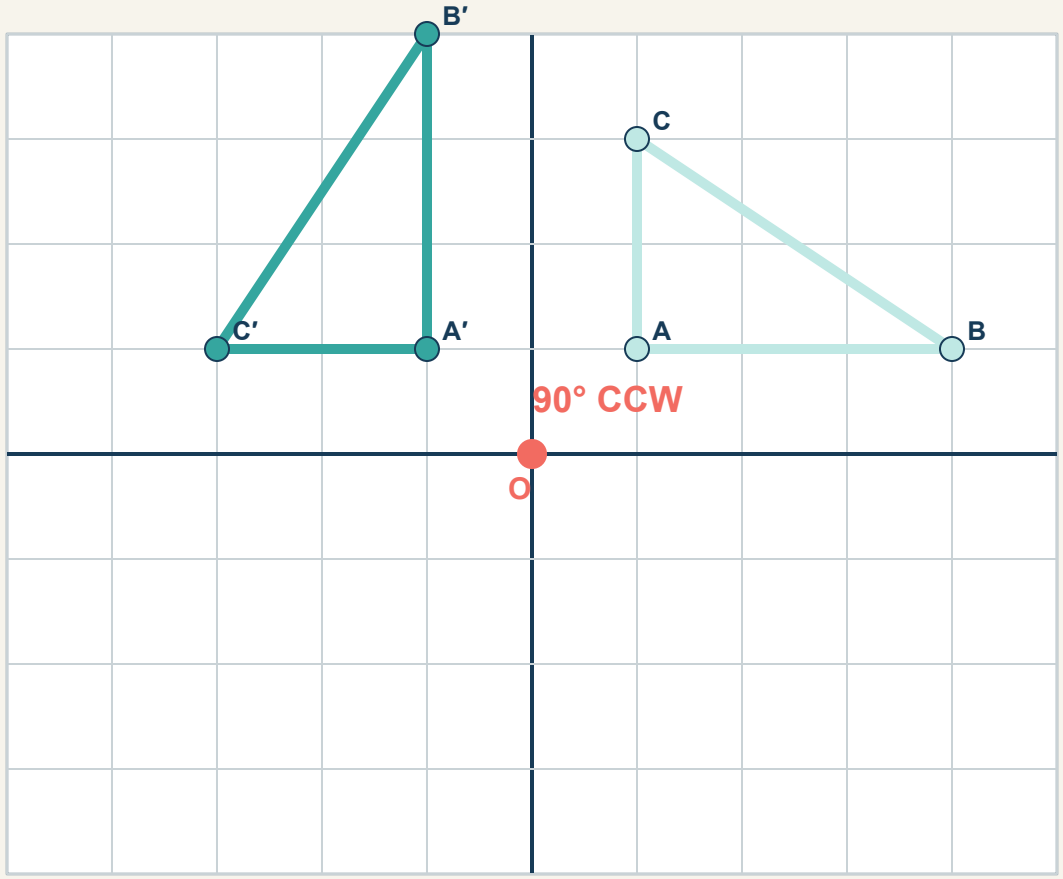
Example 3 — Solution

The image is A′(−1,1), B′(−1,4), C′(−3,1).



SOLUTION

Rule: (x,y) → (−y,x)

The origin stays fixed.

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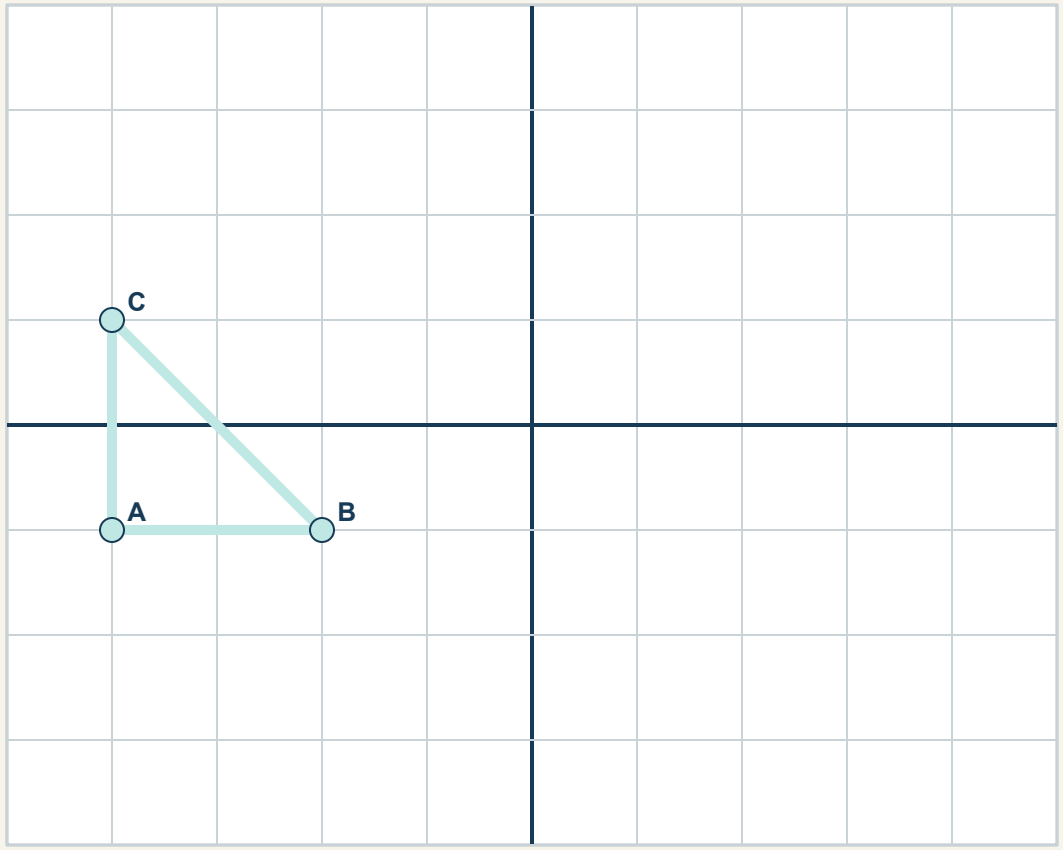
Example 4 — Try it first

Translate triangle ABC 5 units right, then reflect it across the x-axis.



YOUR TURN

Do the moves in order.
Where will A end?

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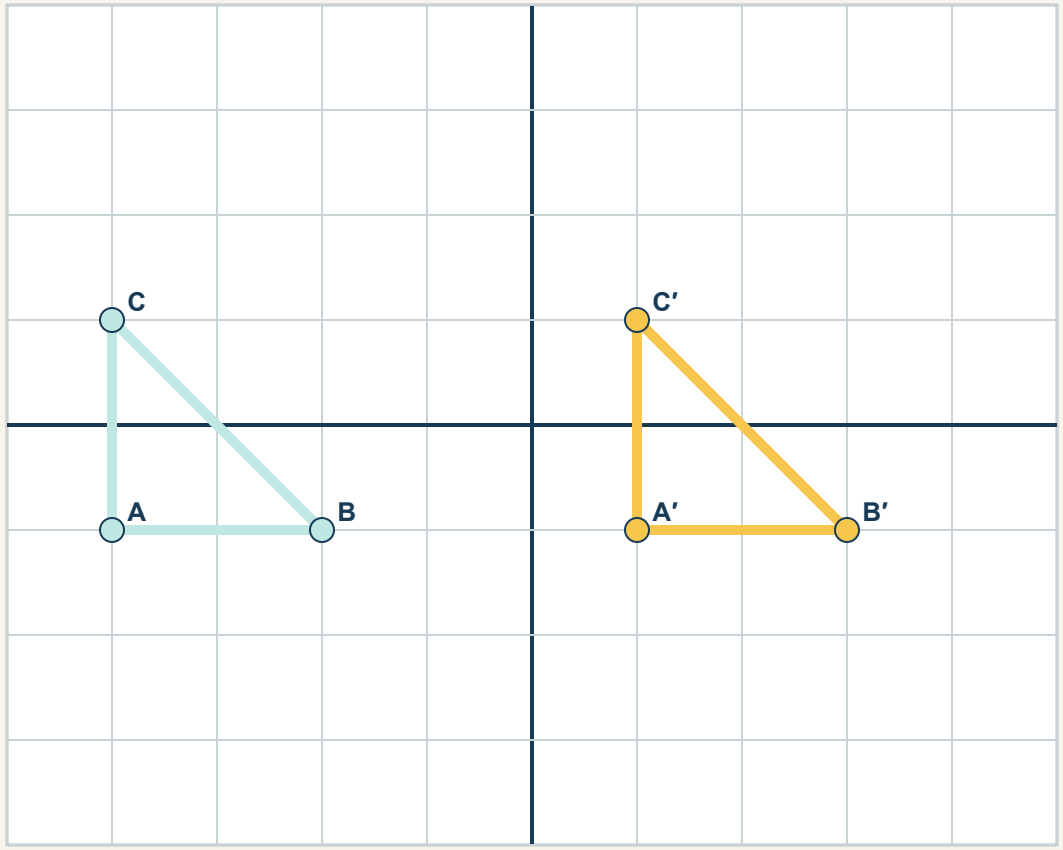
Example 4 — Step 1: Translate

First apply (x, y) → (x + 5, y).



STEP 1

Translate right 5:

A′(1,−1), B′(3,−1), C′(1,1)

See yellow line

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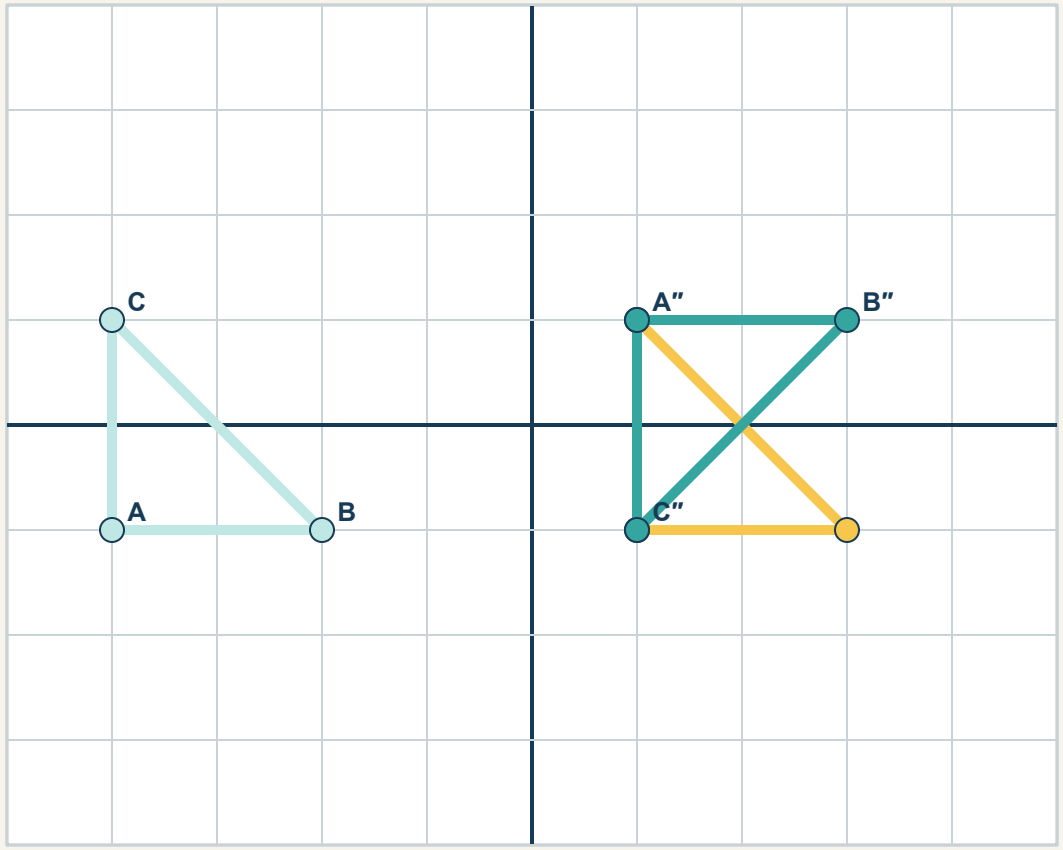
Example 4 — Step 2: Reflect

Then apply (x, y) → (x, −y) to the translated image.



STEP 2

Reflect across x-axis:

A″(1,1), B″(3,1), C″(1,−1)

See dark teal line

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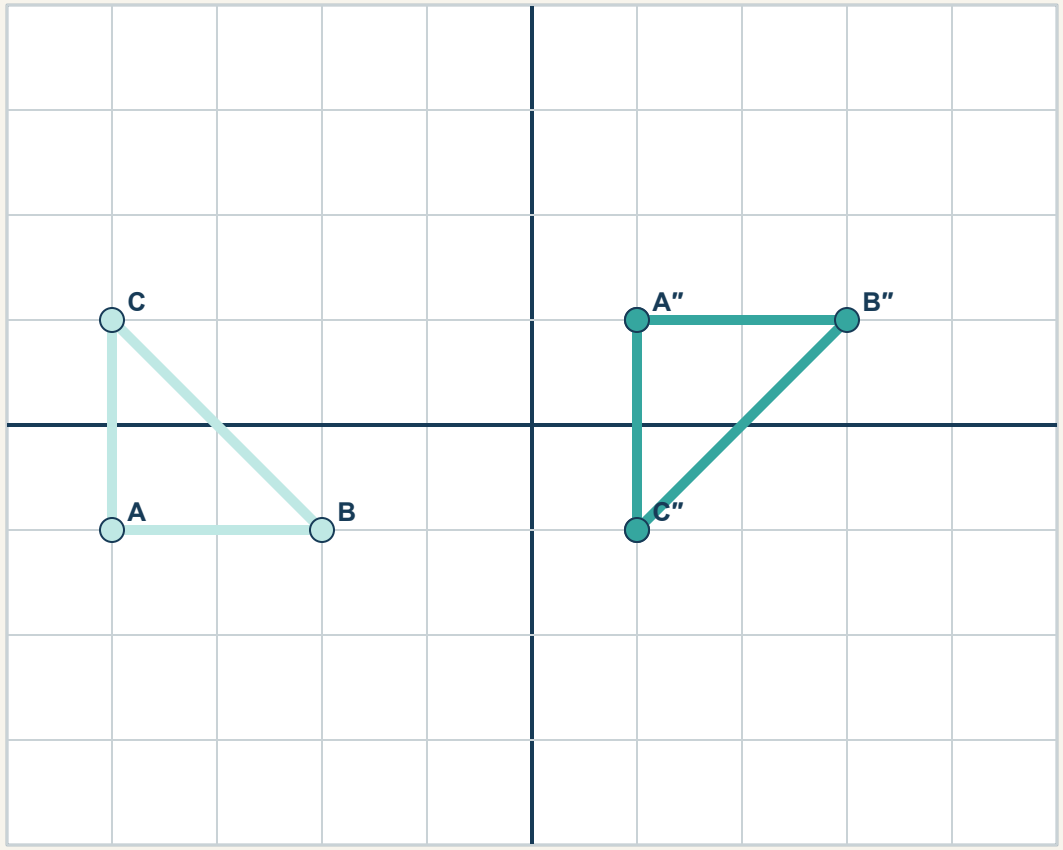
Example 4 — Solution

The ordered sequence ends at A″(1,1), B″(3,1), C″(1,−1).



SOLUTION

Translation, then reflection.

Reversing the order gives a different image.

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Common mistakes to avoid

Check the defining information before drawing the image.

A Clockwise vs. counterclockwise

Trace the top of the figure:
right is clockwise; left is counterclockwise.

B Moving only one point

Every vertex follows the same transformation.

C Unequal reflection distances

Original and image points must be equally far from the mirror line.

D Ignoring sequence order

Complete the first move before starting the second.

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Takeaway + exit ticket

Rigid moves preserve shape and size; coordinates make each move precise.

1 NAME

translation, rotation, or reflection

2 DEFINE

vector; center + angle + direction; or mirror line

3 APPLY

move every point and label the image

EXIT TICKET

Point P(2,−1) rotates 90° counterclockwise about the origin, then reflects across the y-axis. Find P″ and explain why the order matters.

Answer: P′(1,2), then P″(−1,2).

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