RIGID TRANSFORMATIONS

Measurements, Rotation Patterns, Lines & Composed Figures

Math 8 • Unit 1 • Lessons 7–10

Goal: use rigid transformations to justify measurements, patterns, and relationships between lines.

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What are we trying to understand?

Four lessons connect preserved measurements with geometric reasoning.

1 VERIFY

Compare side lengths and angle measures before and after a rigid transformation.

2 BUILD

Create patterns with repeated rotations around a fixed center.

3 REASON

Use transformed lines and composed figures to find measurements without a ruler or protractor.

Big idea: rigid transformations preserve distance and angle measure.

Lessons 7–8: measurements and rotation patterns

Students use preserved measurements, then create repeated rotations.

1 LESSON 7

Explain why corresponding side lengths and angle measures remain equal.

2 LESSON 8

Rotate figures 90°, 180°, and 270° around a chosen center.

3 PATTERNS

Recognize how repeated rotations build larger figures and return after a full turn.

A rigid transformation does not bend, stretch, or change scale.

Lessons 9–10: lines and composed figures

Students transform lines and use copies of figures to reason about measures.

1 LESSON 9

Describe what happens to a line and to a pair of parallel lines under rigid transformations.

2 LESSON 10

Use corresponding parts of transformed figures to find unknown lengths and angles.

3 JUSTIFY

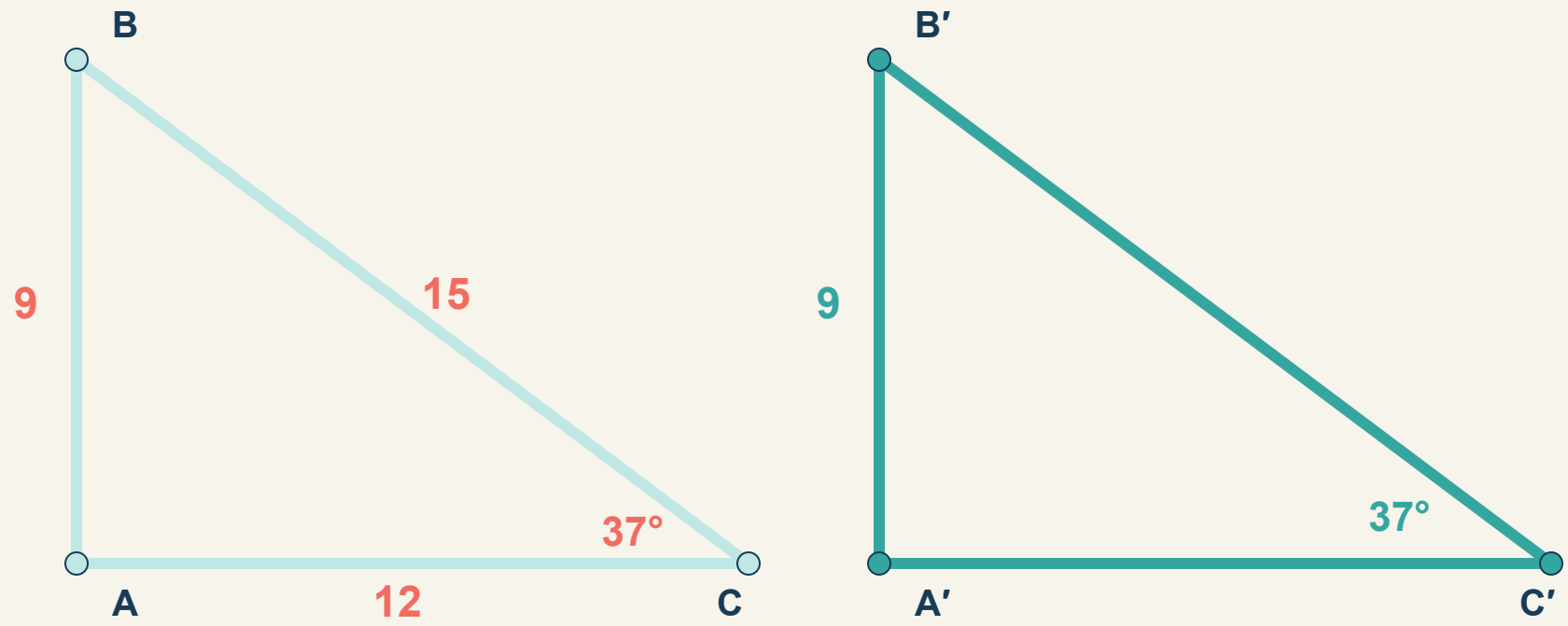
Connect vertical angles, symmetry, and congruent copies to rigid transformations.

Corresponding parts provide evidence for every missing measurement.

Rigid transformations preserve measurements

Corresponding side lengths and angle measures stay equal.

$A \leftrightarrow A'$ $B \leftrightarrow B'$ $C \leftrightarrow C'$



LENGTHS

$AB = A'B'$

ANGLES

$\angle C = \angle C'$

No bending,
No stretching

Corresponding parts carry information

Match vertices in order before transferring a measurement.

1 MATCH

$A \leftrightarrow A'$
$B \leftrightarrow B'$
$C \leftrightarrow C'$

2 NAME

AB corresponds to A′B′

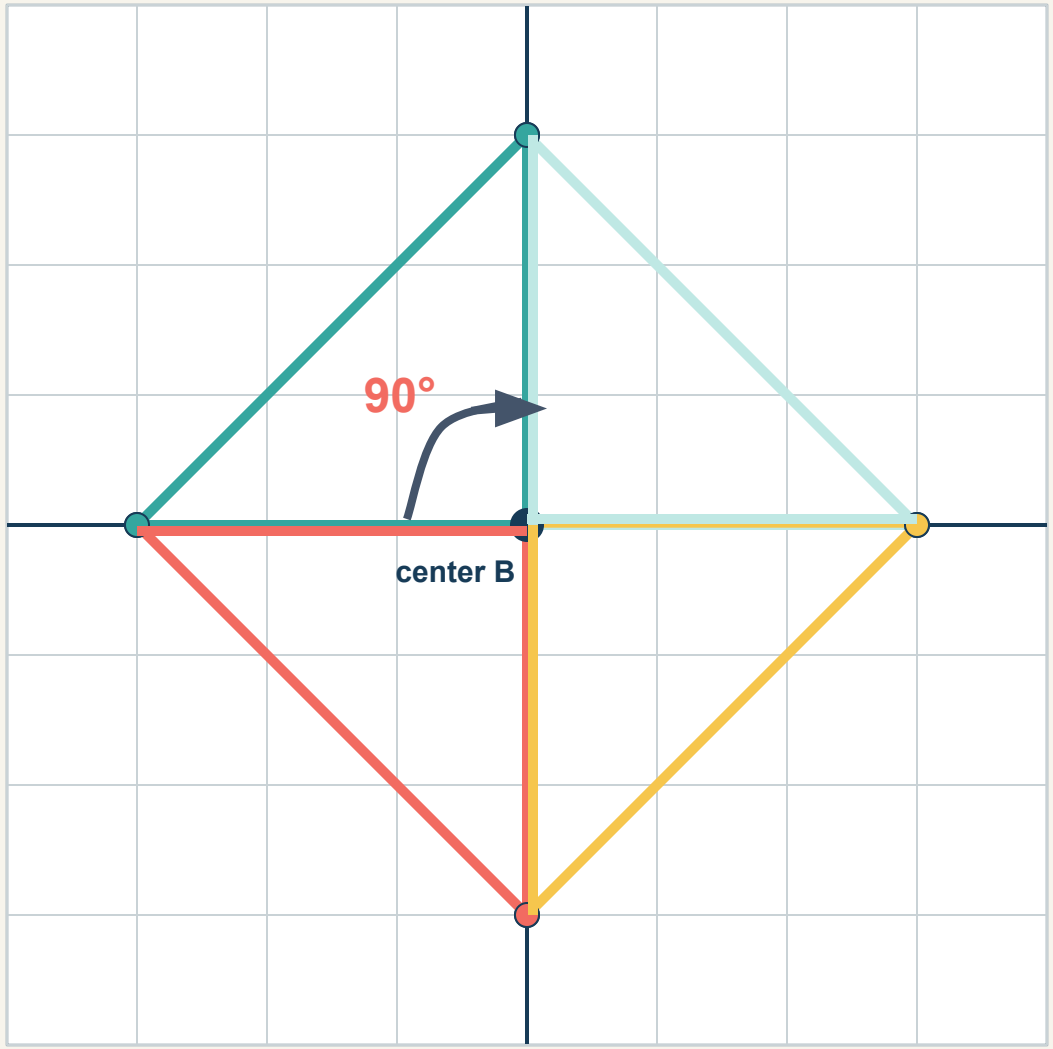
3 TRANSFER

Equal length or equal angle measure

Corresponding order prevents mismatched sides and angles.

Repeated rotations create patterns

The center stays fixed while each point turns through the same angle.



CENTER

B stays fixed

REPEATED TURN

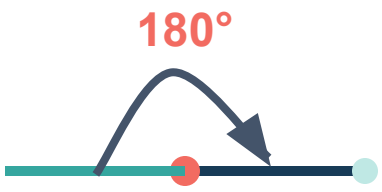
90° clockwise each time

After 4 turns: 4 × 90° = 360°
(which is one full circle)

A half-turn reverses a segment

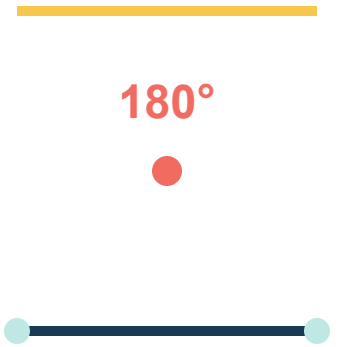
A 180° rotation keeps length and places the image on the opposite side of the center.

CENTER AT A



CENTER AT MIDPOINT

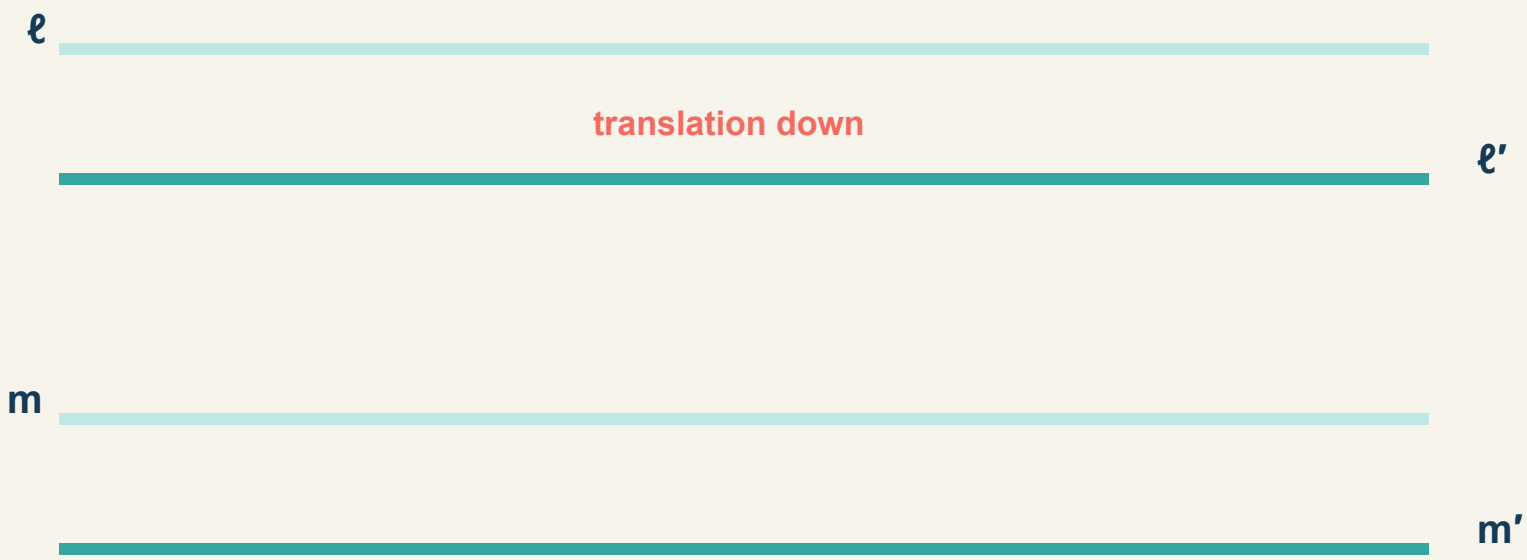
CENTER OFF SEGMENT



Every image segment has the same length as the original.

Rigid transformations send lines to lines

Parallel lines remain parallel and stay the same distance apart.



LINE IMAGE

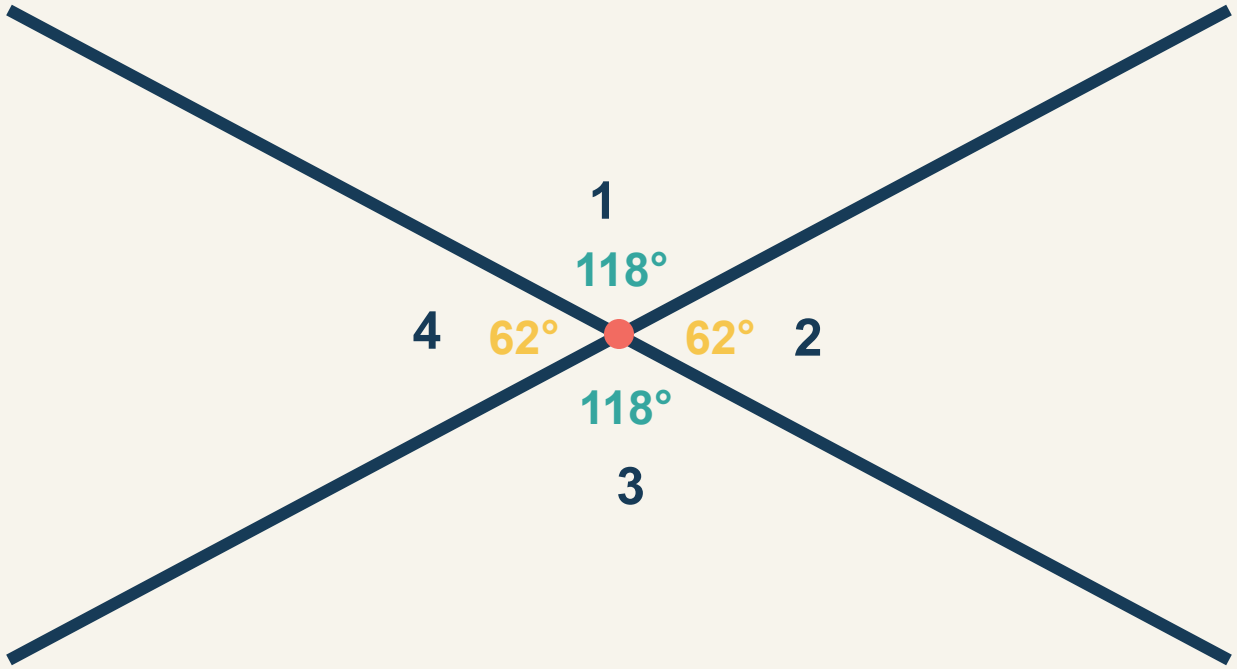
A line maps to a line

PARALLEL PAIR

Parallel lines remain parallel

A half-turn connects vertical angles

A 180° rotation maps each angle to the angle directly opposite it.
This is also called vertical angles.



HALF-TURN

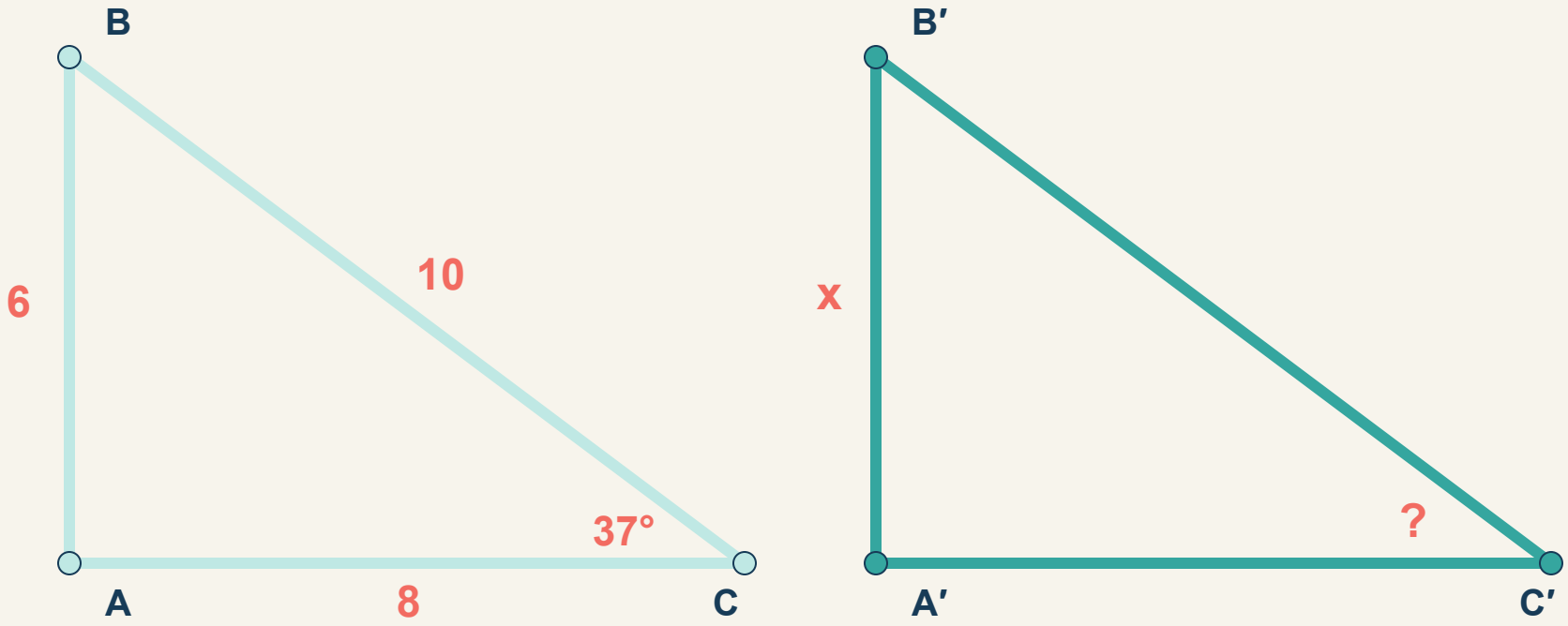
∠1 maps to ∠3

CONCLUSION

Vertical angles have equal measure

Example 1 — Try it first

A rigid transformation maps triangle ABC to triangle A′B′C′.

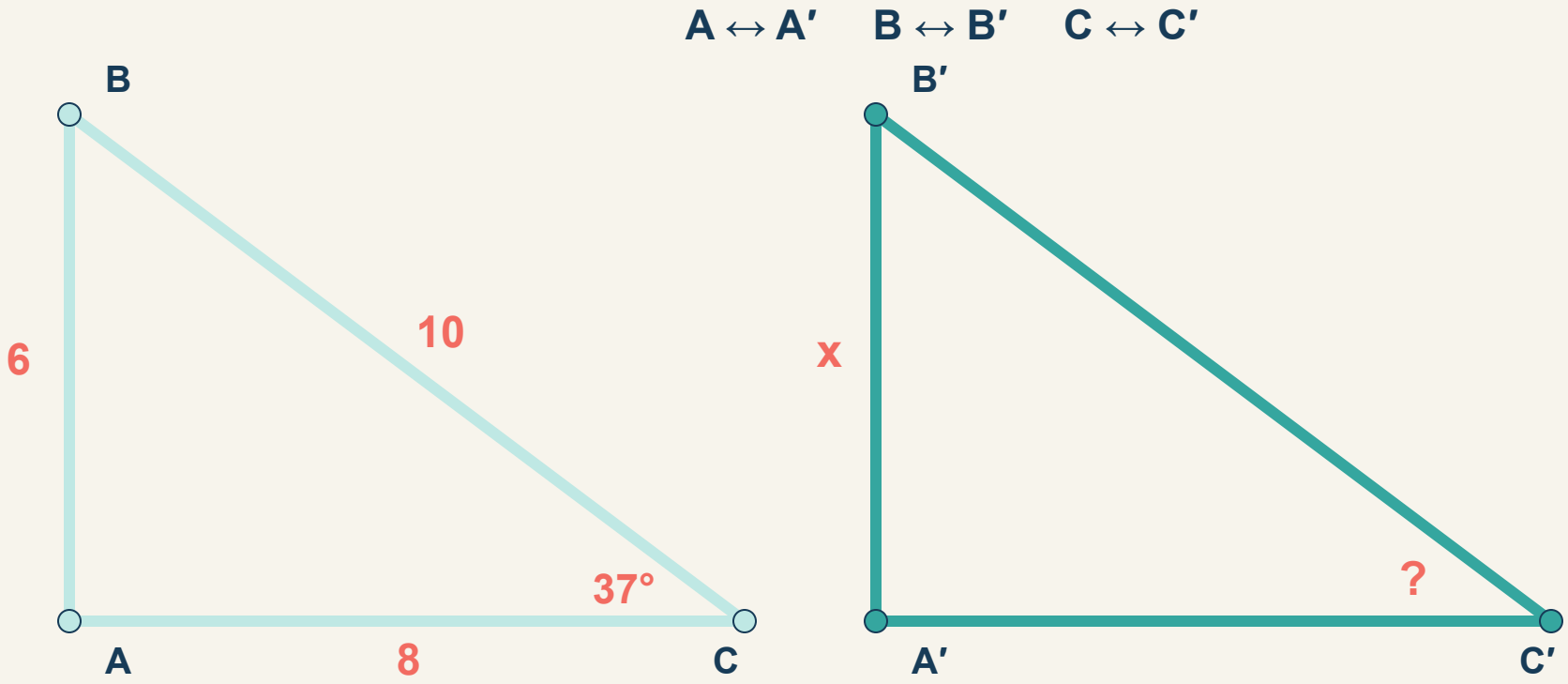


YOUR TURN

Find x and ∠C′.

Example 1 — Step 1: Match vertices

Use the names to identify corresponding points and sides.



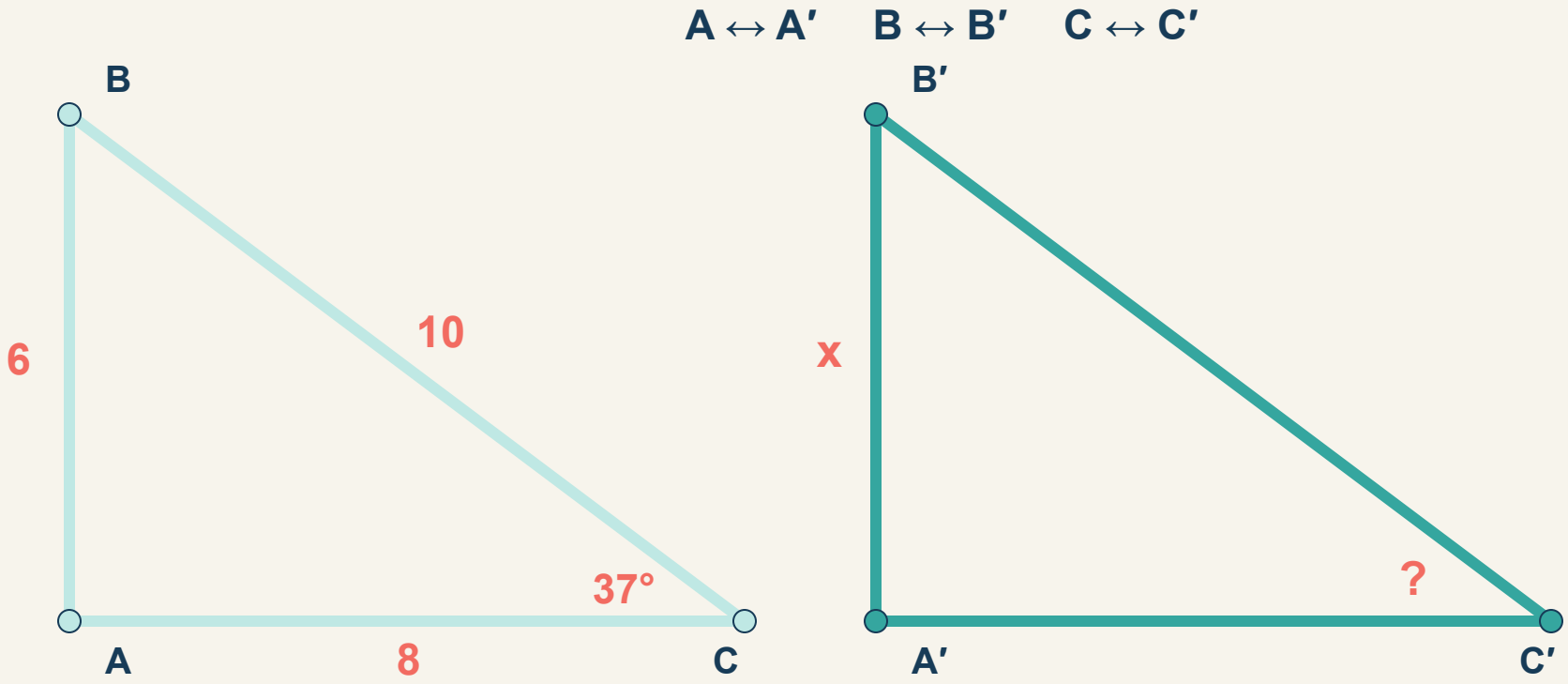
STEP 1

$AB \leftrightarrow A'B'$

$C \leftrightarrow C'$

Example 1 — Step 2: Transfer measures

Rigid transformations preserve every length and angle measure.

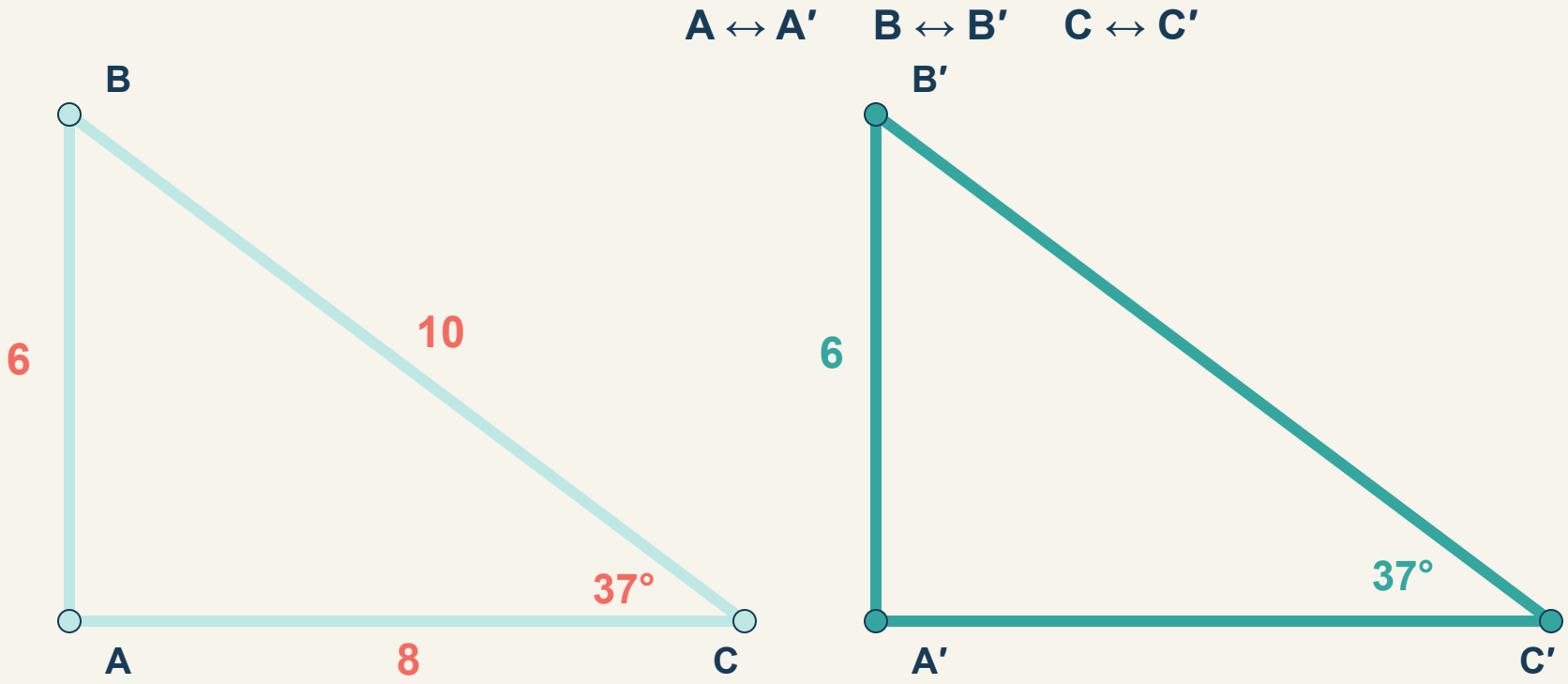


STEP 2

Rigid moves preserve lengths and angles.

Example 1 — Solution

Corresponding parts have equal measures.



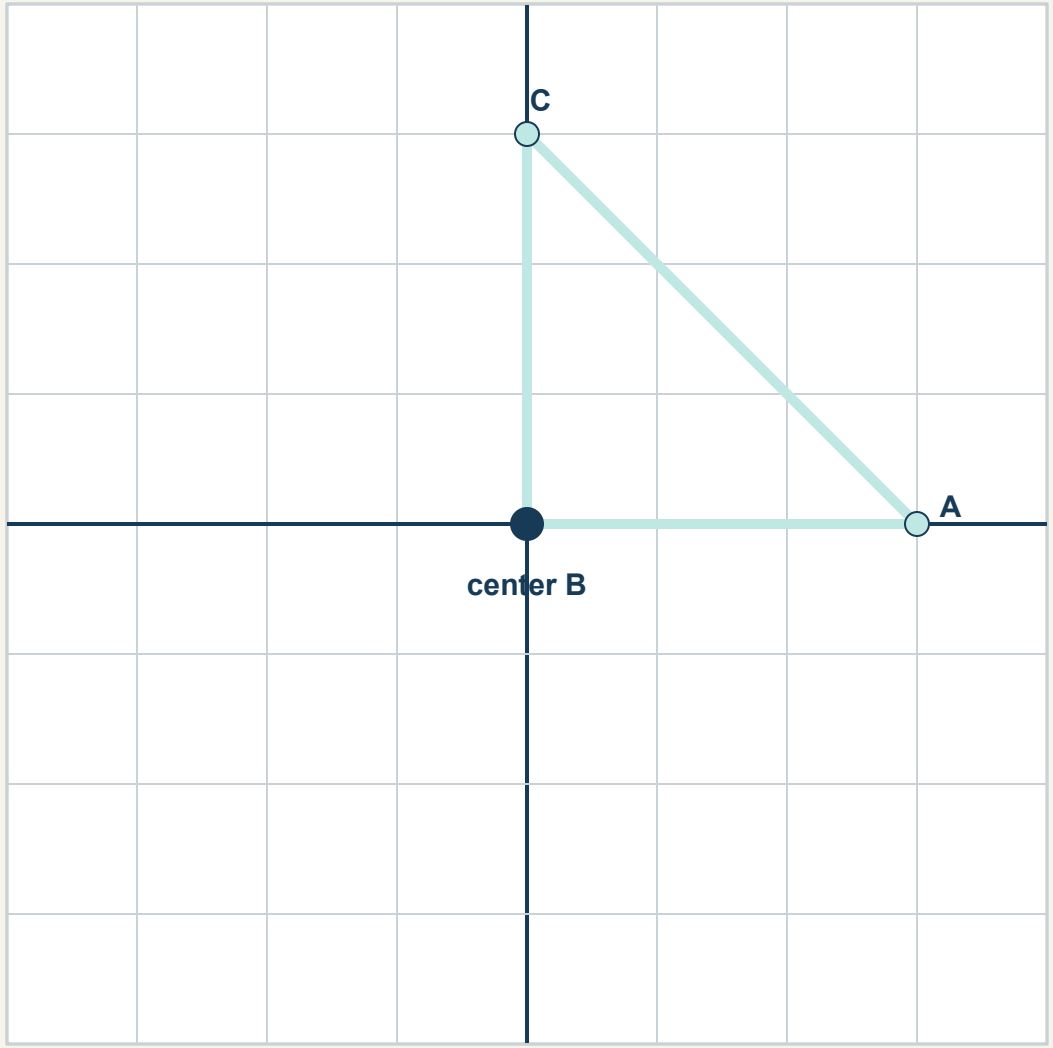
SOLUTION

$x = 6$

$\angle C' = 37°$

Example 2 — Try it first

Rotate the right isosceles triangle 90° clockwise around B.

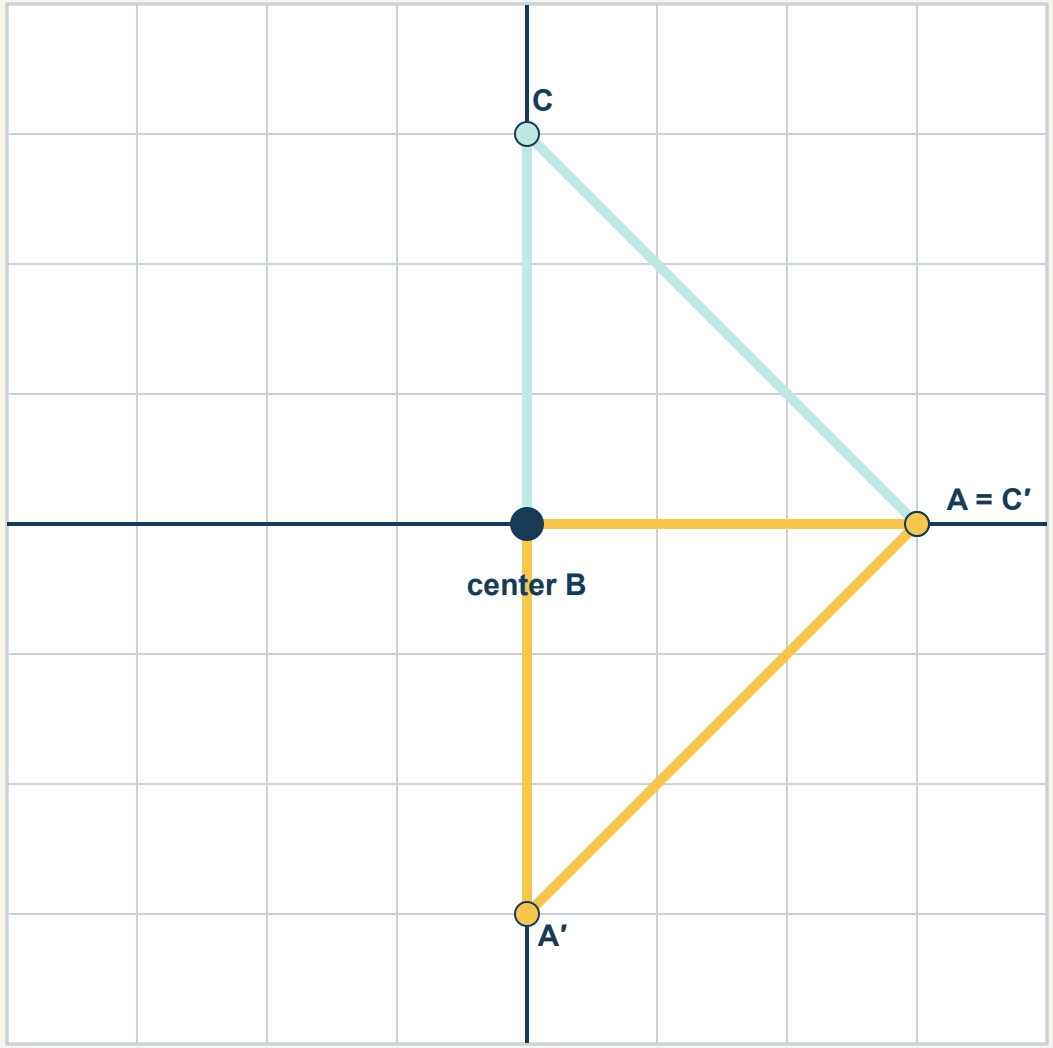


YOUR TURN

Predict A′ and C′ after one quarter-turn clockwise.

Example 2 — Solution

Point B stays in place while A and C move around it.



After 90° clockwise each turn

B stays fixed

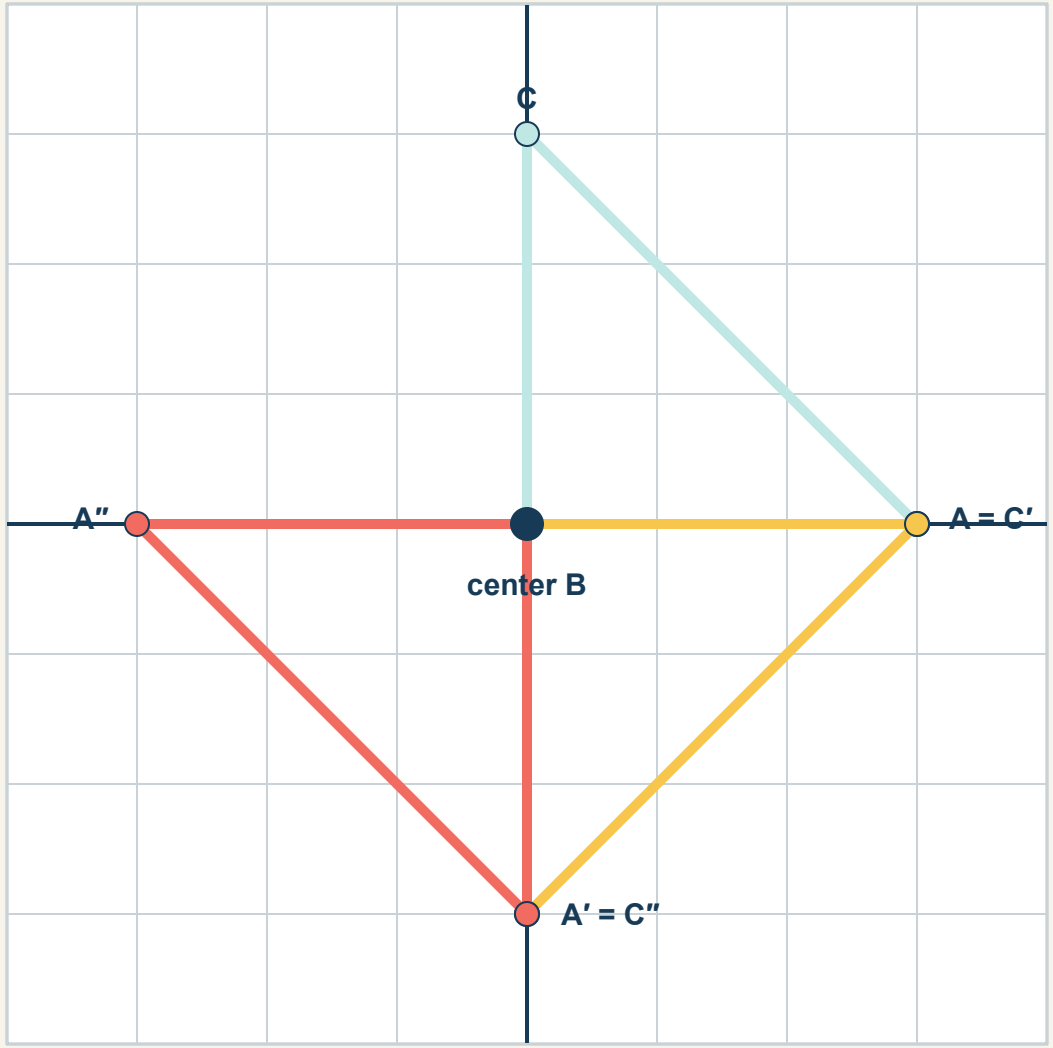
A moves to A′

C moves to C′,
which was the original point A

The new triangle is shown in yellow color

Example 2 — Repeat the turn

Each additional 90° clockwise rotation creates the next copy.

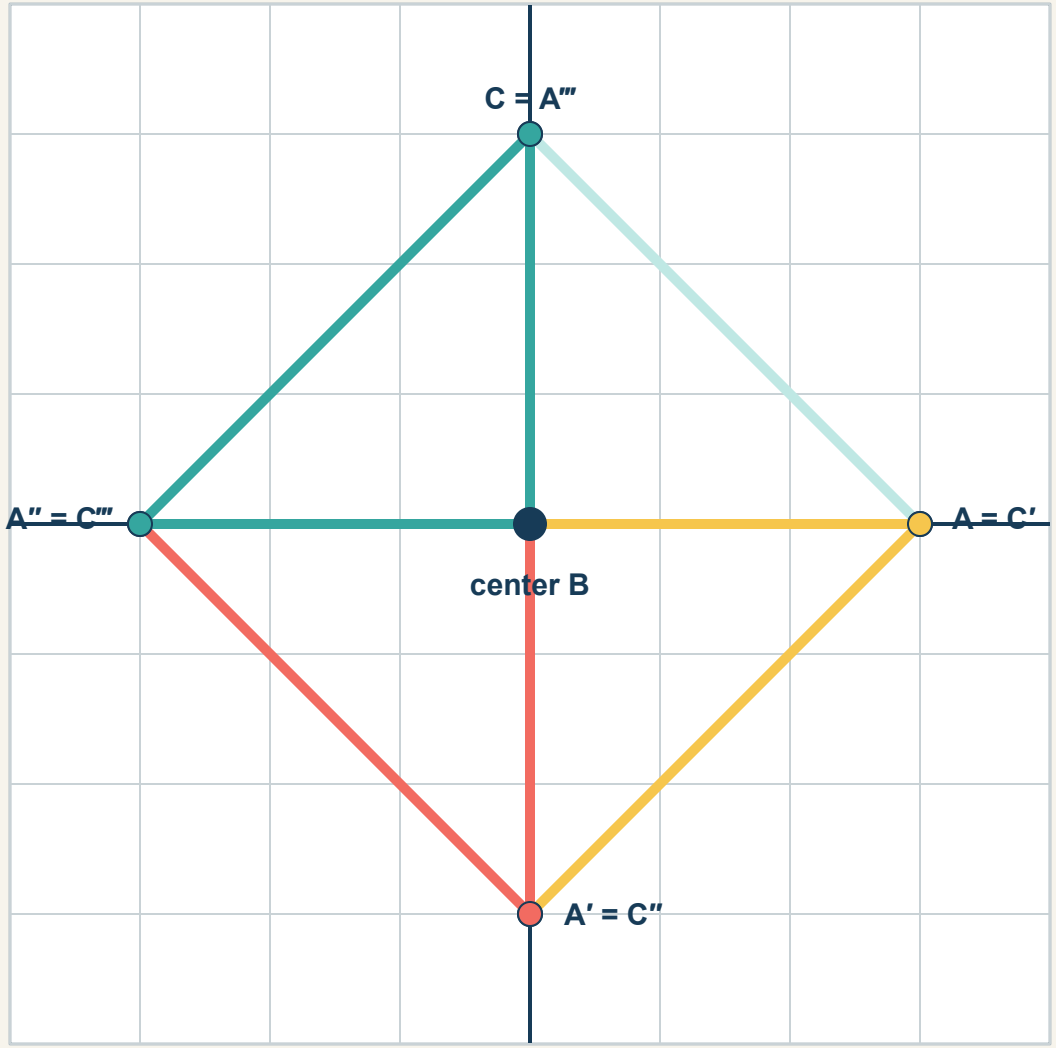


Another 90° clockwise each turn

Repeat the same 90° turn
to create the next copy shown in red

Example 2 — Repeat the turn

Four quarter-turns complete the pattern and return to the original position.



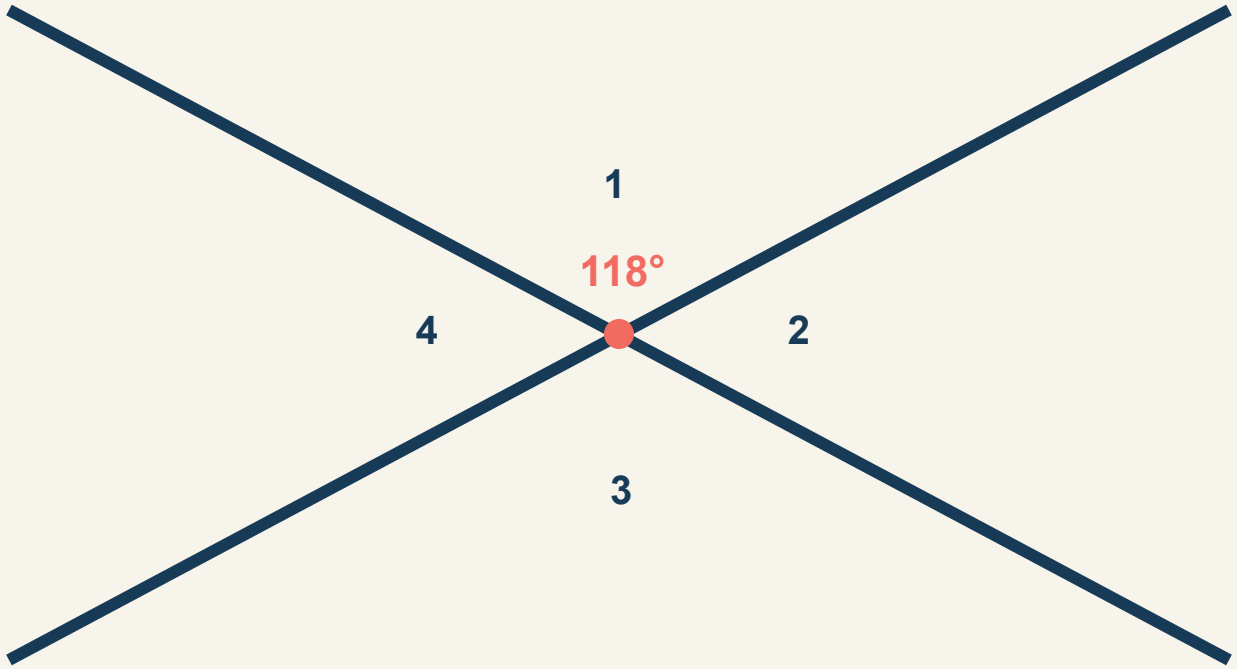
One more 90° clockwise each turn

Again, repeat the same 90° turn to create the next copy shown in dark green

The fourth turn returns to the start. Four copies form a square pattern.

Example 3 — Try it first

Angle 1 measures 118°. Find the other three angle measures.

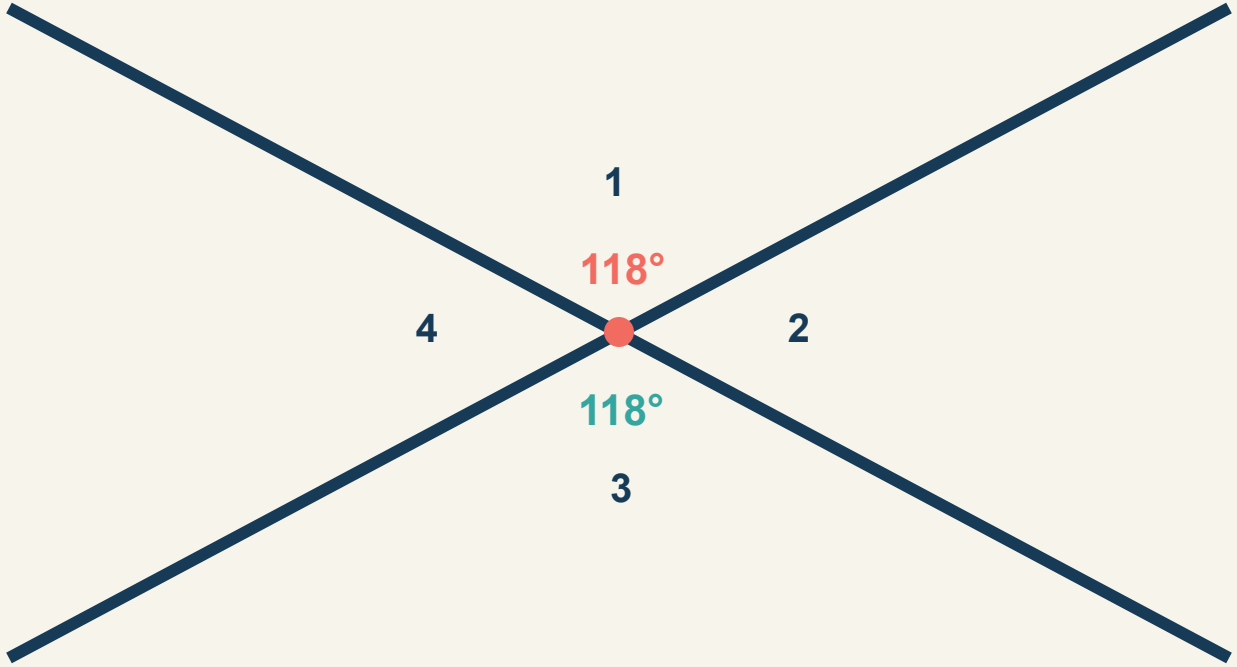


YOUR TURN

Find ∠2, ∠3, and ∠4.

Example 3 — Step 1: Use a half-turn

A 180° rotation maps angle 1 to angle 3.
These two angles are called vertical angles.

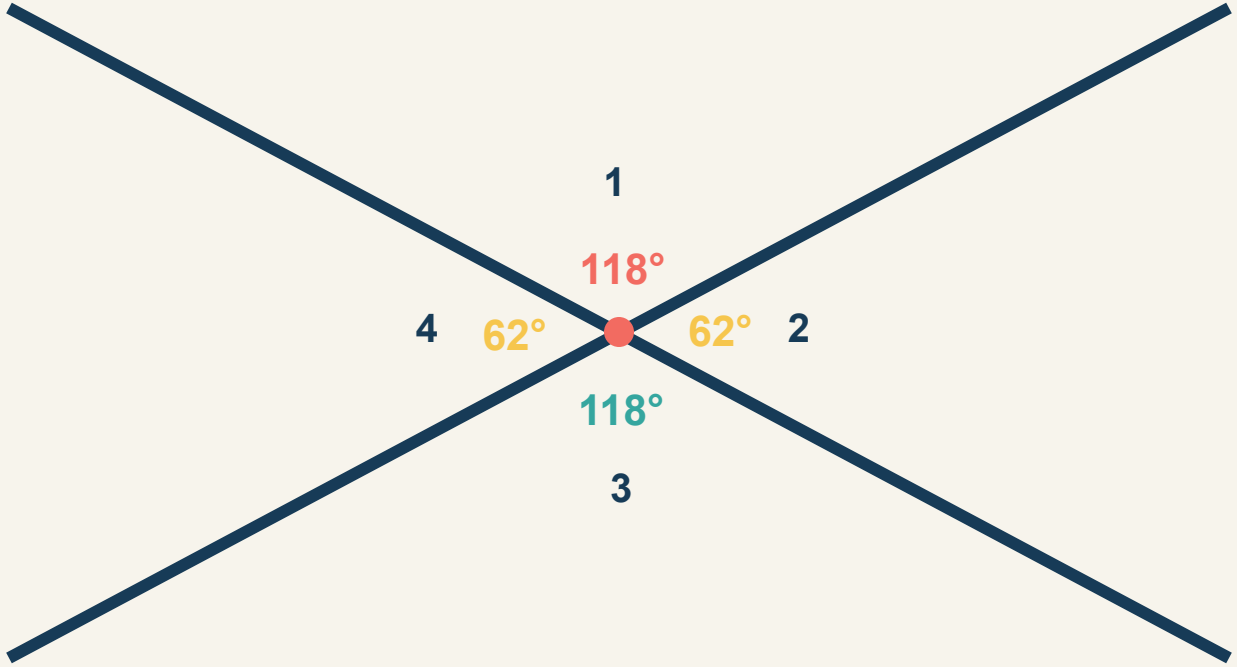


STEP 1

A 180° rotation gives ∠3 = 118°.

Example 3 — Step 2: Use a straight angle

Adjacent angles add to 180°.
These are called supplementary angles.

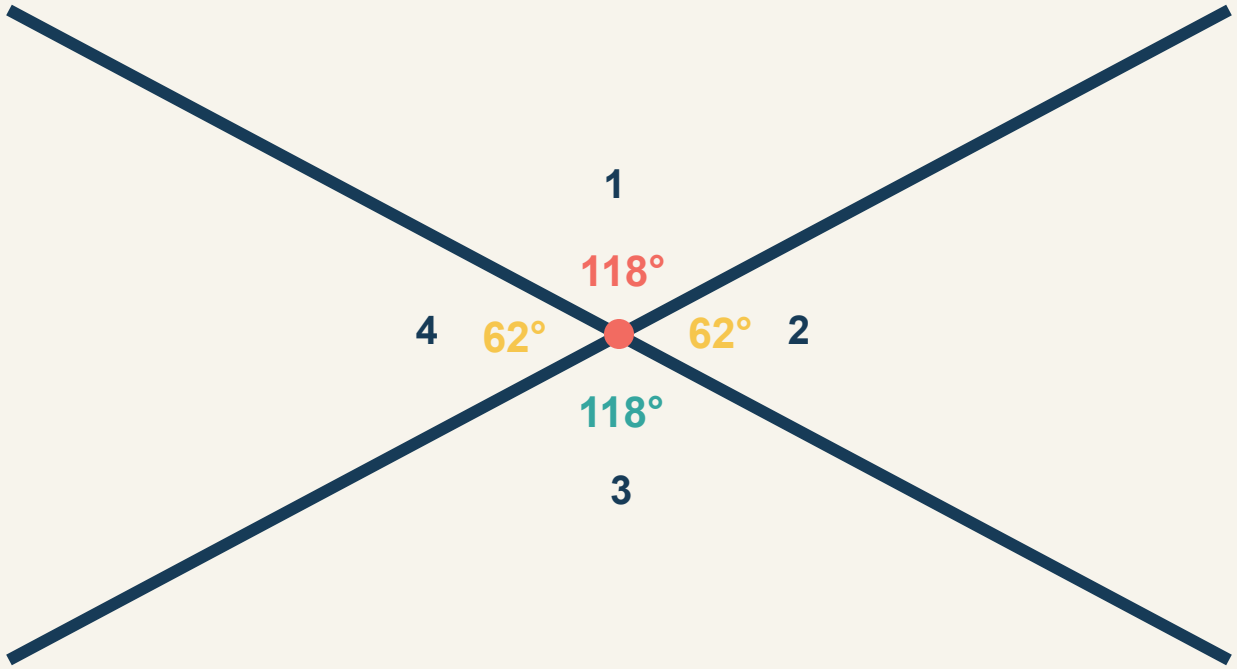


STEP 2

$\angle 2 = 180° - 118°$
$\angle 4 = 180° - 118°$

Example 3 — Solution

Vertical angles match, and adjacent angles are supplementary.

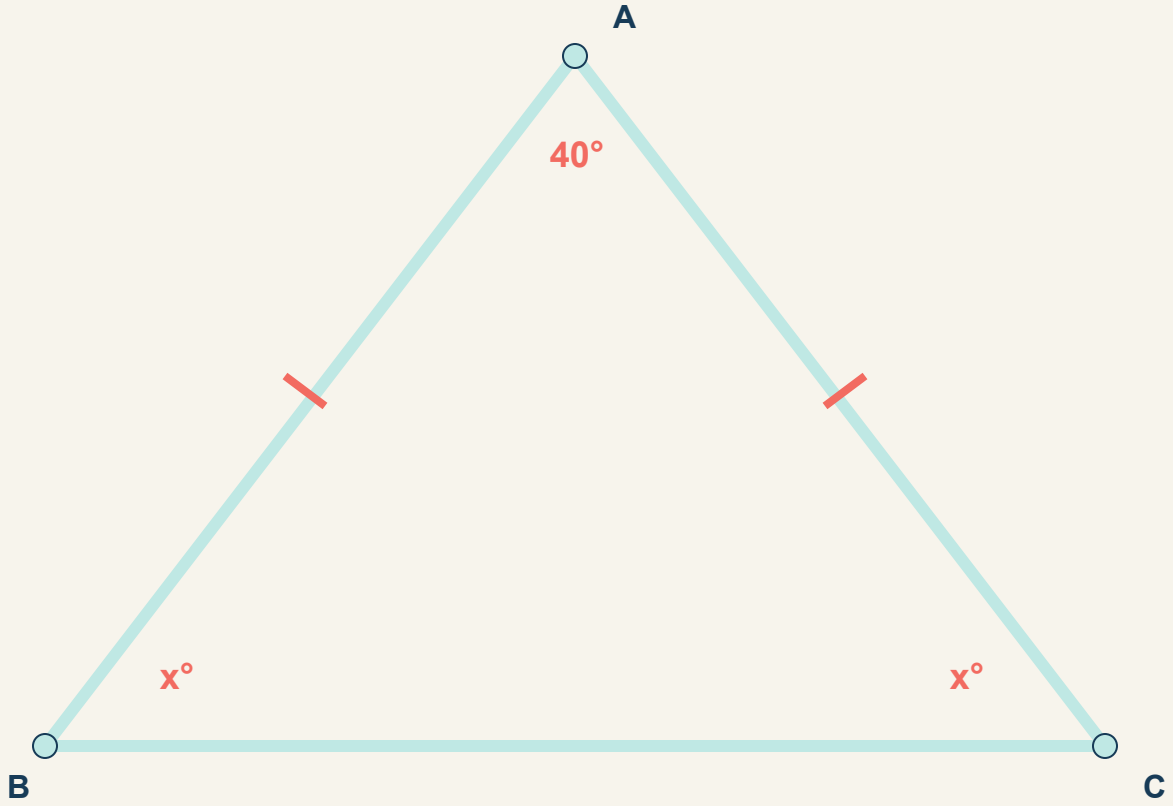


SOLUTION

$\angle 2 = 62°$
$\angle 3 = 118°$
$\angle 4 = 62°$

Example 4 — Try it first

An isosceles triangle has a 40° vertex angle. Find both base angles.

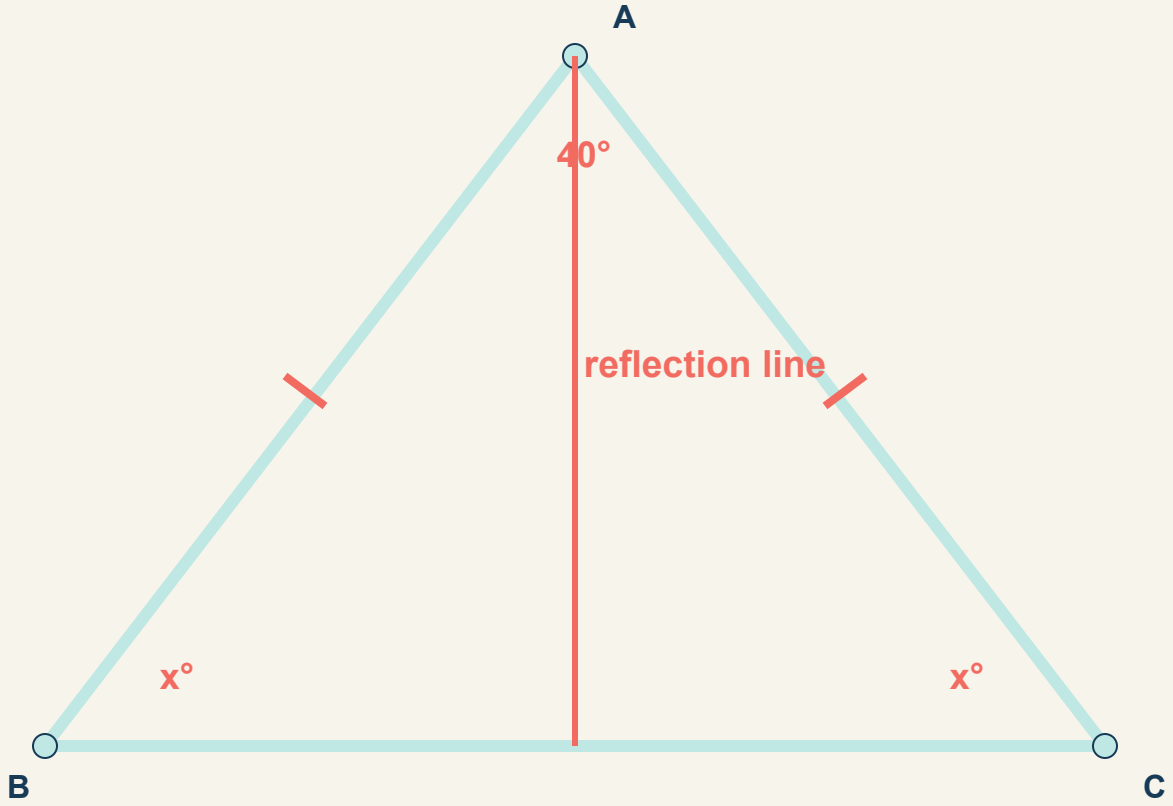


YOUR TURN

Find both base angles.

Example 4 — Step 1: Use symmetry

Reflect across the line from A to the midpoint of BC.

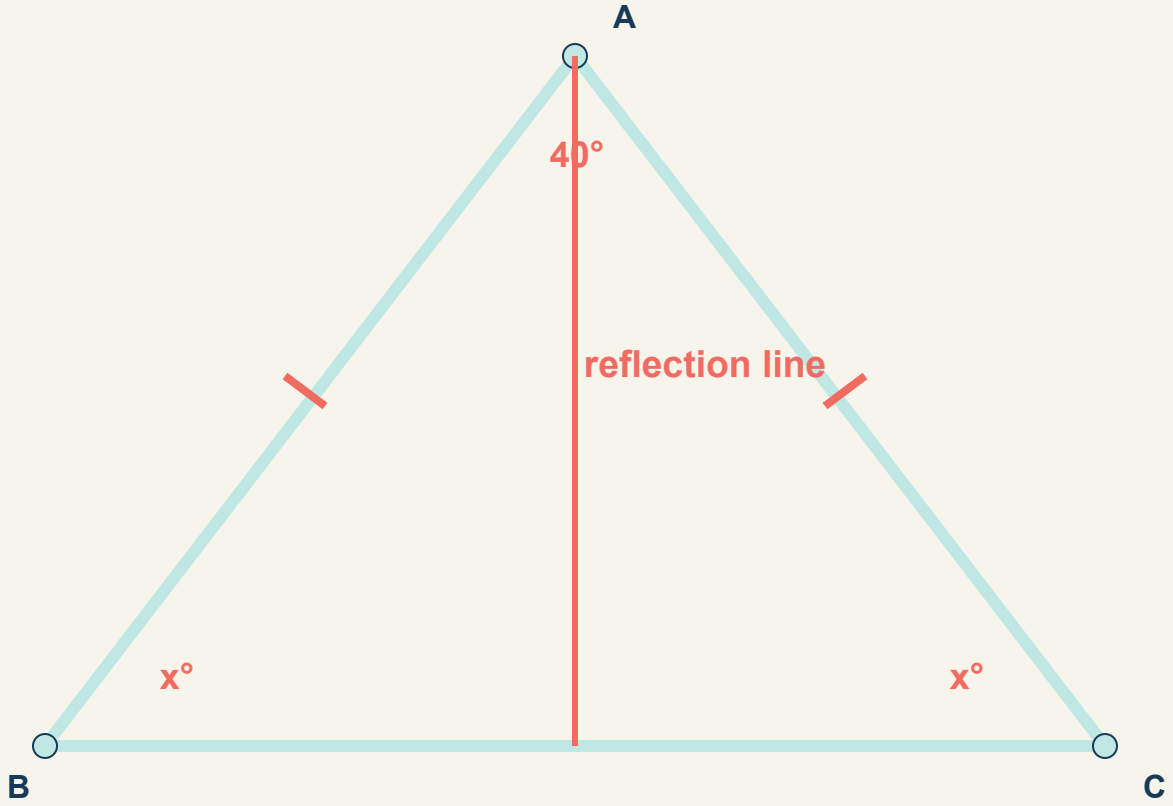


STEP 1

The reflection swaps B and C while A stays fixed.

Example 4 — Step 2: Match the base angles

The reflection maps B to C, so the base angles are equal.



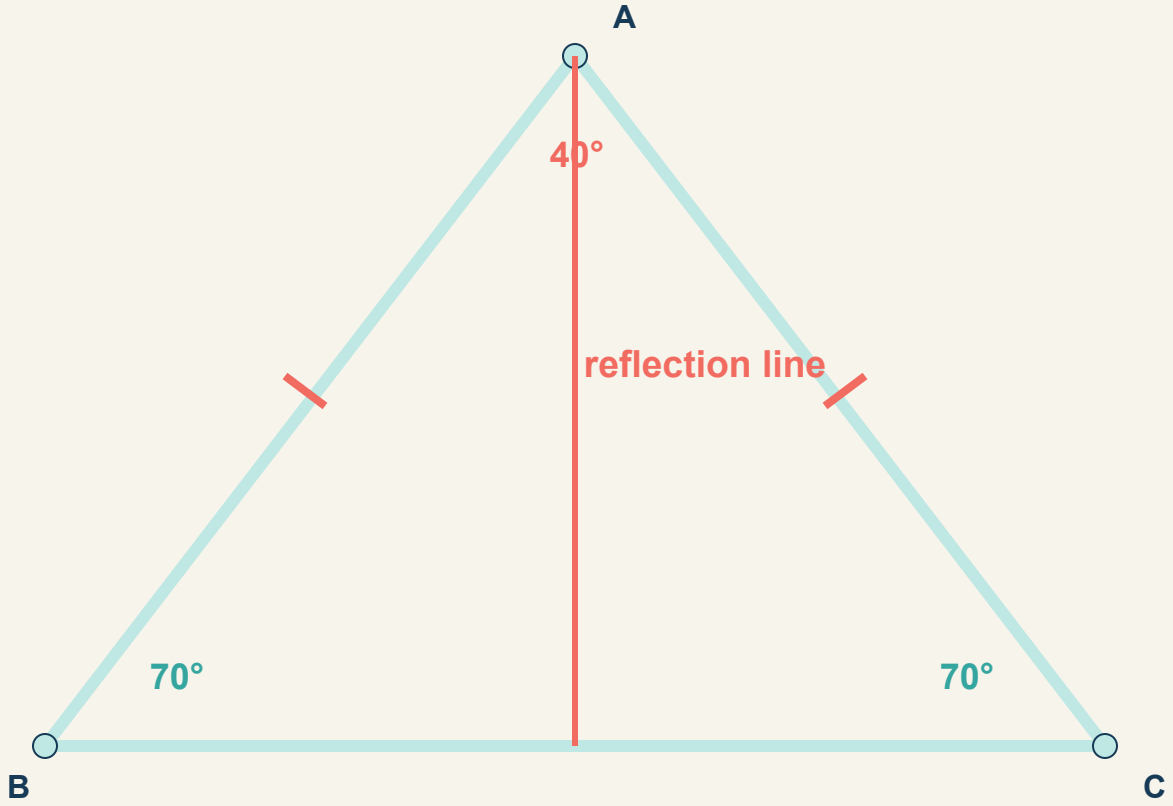
B maps to C, so the base angles have equal measure.

STEP 2

Base angles are equal.
2x + 40 = 180

Example 4 — Solution

The two base angles share the remaining 140°.



B maps to C, so the base angles have equal measure.

SOLUTION

$2x = 140$
$x = 140 * 1/2$
$x = 70°$
Both base angles are 70°

Common mistakes to avoid

Use the transformation and the correspondence as evidence.

A Changing the size

Rigid transformations preserve every length.

B Using the wrong center

Mark the rotation center before turning points.

C Mismatching vertices

Follow the correspondence in the figure names.

D Measuring instead of reasoning

Use preserved lengths and angles as evidence.

Takeaway + exit ticket

Rigid transformations support measurement arguments without direct measuring.

1 **LENGTH**

Segment PQ is 7 units long. What is P′Q′ after any rigid transformation?

2 **ANGLE**

One angle formed by intersecting lines is 124°. What is its vertical angle?

Answers: 7 units and 124°

THANK YOU

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