# Transformations on the Coordinate Plane

Apply the skill to decisions and designs

**Name** _____ **Date** _____ **Score** _____ / 6

**QUICK REVIEW**

Translation adds a fixed coordinate change. Reflections use $(x, y) \to (x, -y)$ across the $x$-axis or $(-x, y)$ across the $y$-axis. About the origin, a $90°$ counterclockwise rotation uses $(-y, x)$ and $180°$ uses $(-x, -y)$. For $(2, 3)$ these images are $(-3, 2)$ and $(-2, -3)$. Rigid motions preserve length.

**Worked example**

Translate $(1, -2)$ by $(3, 1)$.

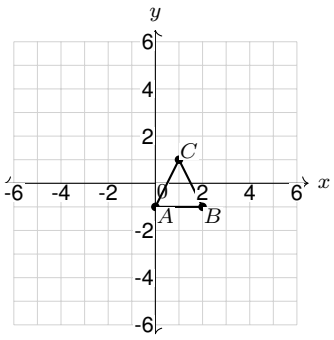
**1.** New $x = 1 + 3 = 4$.
**2.** New $y = -2 + 1 = -1$.
**3.** The image is $(4, -1)$; reverse change $(4 - 3, -1 - 1) = (1, -2)$.
**Answer:** $(4, -1)$.

## Practice Problems

Show your thinking.

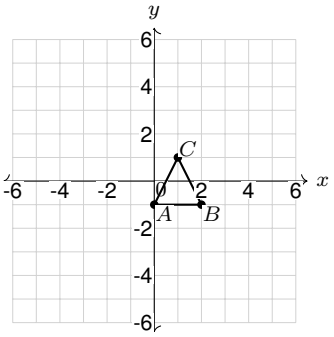
**1.** A tile has $A = (0, -1), B = (2, -1), C = (1, 1)$. Apply the rule: translate $(3, -2)$. Give the new vertices and check that side $AB$ keeps its length.

**2.** A tile has $A = (0, -1), B = (2, -1), C = (1, 1)$. Apply the rule: reflect across the $x$-axis. Give the new vertices and check that side $AB$ keeps its length. Plot the image triangle and label the vertices.



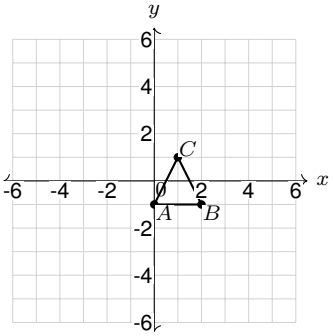

**3.** A tile has $A = (0, -1), B = (2, -1), C = (1, 1)$. Apply the rule: reflect across the $y$-axis. Give the new vertices and check that side $AB$ keeps its length.

**4.** A tile has $A = (0, -1), B = (2, -1), C = (1, 1)$. Apply the rule: rotate $90°$ counterclockwise about the origin. Give the new vertices and check that side $AB$ keeps its length. Plot the image triangle and label the vertices.




**5.** A tile has $A = (0, -1), B = (2, -1), C = (1, 1)$. Apply the rule: rotate $180°$ about the origin. Give the new vertices and check that side $AB$ keeps its length.

**6.** A tile has $A = (0, -1), B = (2, -1), C = (1, 1)$. Apply the rule: translate $(-1, 2)$. Give the new vertices and check that side $AB$ keeps its length. Plot the image triangle and label the vertices.



# Answer Key

**1.** $A\prime = (3, -3), B\prime = (5, -3), C\prime = (4, -1)$. Side $AB$ remains $2$ grid units long.
**2.** $A\prime = (0, 1), B\prime = (2, 1), C\prime = (1, -1)$. Side $AB$ remains $2$ grid units long.
**3.** $A\prime = (0, -1), B\prime = (-2, -1), C\prime = (-1, 1)$. Side $AB$ remains $2$ grid units long.
**4.** $A\prime = (1, 0), B\prime = (1, 2), C\prime = (-1, 1)$. Side $AB$ remains $2$ grid units long.
**5.** $A\prime = (0, 1), B\prime = (-2, 1), C\prime = (-1, -1)$. Side $AB$ remains $2$ grid units long.
**6.** $A\prime = (-1, 1), B\prime = (1, 1), C\prime = (0, 3)$. Side $AB$ remains $2$ grid units long.

## Step-by-Step Solutions

Follow each calculation, then check your own work.

### Problem 1

**1.** For $(0, -1)$: $x\prime = 0 + 3 = 3$; $y\prime = -1 - 2 = -3$. Image $(3, -3)$.
**2.** For $(2, -1)$: $x\prime = 2 + 3 = 5$; $y\prime = -1 - 2 = -3$. Image $(5, -3)$.
**3.** For $(1, 1)$: $x\prime = 1 + 3 = 4$; $y\prime = 1 - 2 = -1$. Image $(4, -1)$.
**4.** Original side $AB$ is $|2 - (0)| = 2$ units. The image side changes along only one axis, with length $|5 - (3)| = 2$ units.

### Problem 2

**1.** For $(0, -1)$: $x\prime = 0$; $y\prime = -(-1) = 1$. Image $(0, 1)$.
**2.** For $(2, -1)$: $x\prime = 2$; $y\prime = -(-1) = 1$. Image $(2, 1)$.
**3.** For $(1, 1)$: $x\prime = 1$; $y\prime = -(1) = -1$. Image $(1, -1)$.
**4.** Original side $AB$ is $|2 - (0)| = 2$ units. The image side changes along only one axis, with length $|2 - (0)| = 2$ units.

### Problem 3

**1.** For $(0, -1)$: $x\prime = -(0) = 0$; $y\prime = -1$. Image $(0, -1)$.
**2.** For $(2, -1)$: $x\prime = -(2) = -2$; $y\prime = -1$. Image $(-2, -1)$.
**3.** For $(1, 1)$: $x\prime = -(1) = -1$; $y\prime = 1$. Image $(-1, 1)$.
**4.** Original side $AB$ is $|2 - (0)| = 2$ units. The image side changes along only one axis, with length $|-2 - (0)| = 2$ units.

### Problem 4

**1.** For $(0, -1)$: $x\prime = -(-1) = 1$; $y\prime = 0 = 0$. Image $(1, 0)$.
**2.** For $(2, -1)$: $x\prime = -(-1) = 1$; $y\prime = 2 = 2$. Image $(1, 2)$.
**3.** For $(1, 1)$: $x\prime = -(1) = -1$; $y\prime = 1 = 1$. Image $(-1, 1)$.
**4.** Original side $AB$ is $|2 - (0)| = 2$ units. The image side changes along only one axis, with length $|2 - (0)| = 2$ units.

### Problem 5

**1.** For $(0, -1)$: $x\prime = -(0) = 0$; $y\prime = -(-1) = 1$. Image $(0, 1)$.
**2.** For $(2, -1)$: $x\prime = -(2) = -2$; $y\prime = -(-1) = 1$. Image $(-2, 1)$.
**3.** For $(1, 1)$: $x\prime = -(1) = -1$; $y\prime = -(1) = -1$. Image $(-1, -1)$.
**4.** Original side $AB$ is $|2 - (0)| = 2$ units. The image side changes along only one axis, with length $|-2 - (0)| = 2$ units.

### Problem 6

**1.** For $(0, -1)$: $x\prime = 0 - 1 = -1$; $y\prime = -1 + 2 = 1$. Image $(-1, 1)$.
**2.** For $(2, -1)$: $x\prime = 2 - 1 = 1$; $y\prime = -1 + 2 = 1$. Image $(1, 1)$.
**3.** For $(1, 1)$: $x\prime = 1 - 1 = 0$; $y\prime = 1 + 2 = 3$. Image $(0, 3)$.
**4.** Original side $AB$ is $|2 - (0)| = 2$ units. The image side changes along only one axis, with length $|1 - (-1)| = 2$ units.

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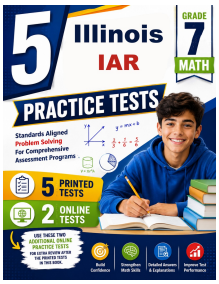


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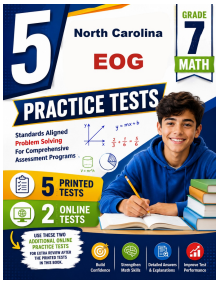


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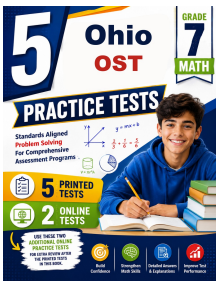


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