Rotations, Reflections, and Translations

Applications and design

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

QUICK REVIEW

Translations use $(x, y) \mapsto (x + a, y + b)$. Reflections in the x- and y-axes use $(x, -y)$ and $(-x, y)$. About the origin, rotations of 90° counterclockwise, 90° clockwise, and 180° use $(-y, x)$, $(y, -x)$, and $(-x, -y)$. These rigid motions preserve lengths and angles; a reflection reverses orientation. Apply rules to every vertex.

Worked example

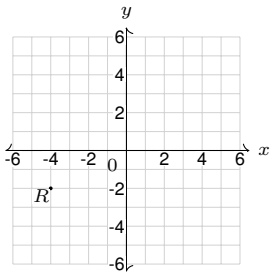
Reflect $E(-3, 2)$ across the x-axis, then translate 2 units right. Find the final point.

1. The reflection keeps $x = -3$ and changes the sign of y: $(-3, 2) \mapsto (-3, -2)$.
2. The translation adds 2 only to the first coordinate: $(-3 + 2, -2) = (-1, -2)$.
3. Thus $E'' = (-1, -2)$; the second move does not change its distance below the x-axis.
Answer: $E'' = (-1, -2)$

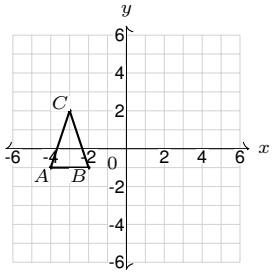
Practice Problems

Show your thinking.

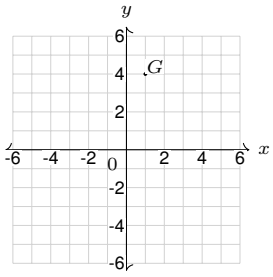
1. A robot starts at $R(-4, -2)$. It moves right 5, then up 4. Plot its destination and give one translation rule.



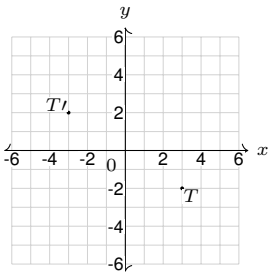
2. A logo uses triangle ABC. Reflect it in the y-axis to make the matching right-hand panel. List all new vertices.



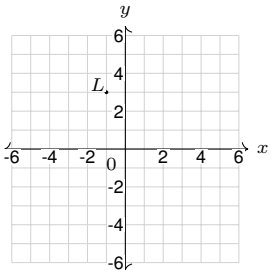
3. A game piece at $G(1, 4)$ turns 90° clockwise about the origin, then slides left 2. Plot its final location.



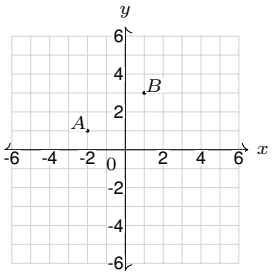
4. A tile at $T(3, -2)$ must reach $T\prime(-3, 2)$ using one rotation about the origin. Choose the turn and check it.



5. A light at $L(-1, 3)$ is reflected in the x-axis and then in the y-axis. Find the final point and an equivalent rotation.



6. Design the translated copy of AB with $A\prime = (2, -3)$. Find the common vector and $B\prime$.



Answer Key

1. $R\prime = (1, 2)$; $(x, y) \mapsto (x + 5, y + 4)$.
2. $A\prime = (4, -1)$, $B\prime = (2, -1)$, $C\prime = (3, 2)$
3. $G'' = (2, -1)$
4. $180°$
5. $(1, -3)$; $180°$ about the origin.
6. Vector $(4, -4)$; $B\prime = (5, -1)$.

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. The horizontal destination is $-4 + 5 = 1$ and the vertical destination is $-2 + 4 = 2$.

2. The combined move is $(x, y) \mapsto (x + 5, y + 4)$, so $(-4, -2) \mapsto (1, 2)$.

3. Plot the robot at $(1, 2)$. The two component moves can be combined because neither changes the other coordinate.

Problem 2

1. For $A(-4, -1)$ and $B(-2, -1)$, negating x gives $(4, -1)$ and $(2, -1)$.

2. For $C(-3, 2)$, the reflection is $(3, 2)$. Each matching pair is 3, 2, or 4 units from the axis.

3. Join $(4, -1), (2, -1), (3, 2)$ to make the mirrored panel, not a translated panel with the same orientation.

Problem 3

1. The turn uses $(x, y) \mapsto (y, -x)$, giving $(1, 4) \mapsto (4, -1)$.

2. The slide then gives $(4 - 2, -1) = (2, -1)$. It changes only the first coordinate.

3. The final location is $(2, -1)$. Performing the slide before the rotation would give a different result.

Problem 4

1. A half-turn gives $(3, -2) \mapsto (-3, 2)$ by negating both coordinates.

2. A counterclockwise quarter-turn would give $(2, 3)$, and a clockwise quarter-turn would give $(-2, -3)$.

3. Only the $180°$ turn reaches the target among these rotations. Plot the two opposite points to check the center.

Problem 5

1. The first mirror gives $(-1, 3) \mapsto (-1, -3)$, changing only the vertical coordinate.

2. The second gives $(-1, -3) \mapsto (1, -3)$. Together both original signs changed.

3. This is exactly the half-turn rule $(x, y) \mapsto (-x, -y)$, so a $180°$ rotation gives the same final point.

Problem 6

1. From $A(-2, 1)$ to $(2, -3)$, the vector is $(2 - (-2), -3 - 1) = (4, -4)$.

2. Apply it to $B(1, 3)$: $(1 + 4, 3 - 4) = (5, -1)$.

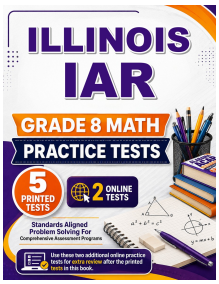
3. Plot $(2, -3)$ and $(5, -1)$. Both endpoints use vector $(4, -4)$, preserving the original segment length.

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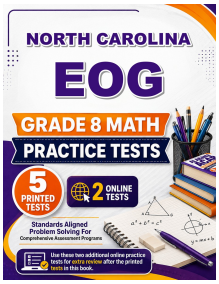
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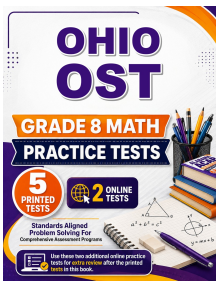
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