Transformations on the Coordinate Plane

Models and mappings

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

QUICK REVIEW

Apply a sequence in its stated order. Translation by (a, b) gives $(x + a, y + b)$; reflection in $y = x$ swaps coordinates to (y, x). About the origin, $90°$ counterclockwise gives $(-y, x)$, clockwise gives $(y, -x)$, and $180°$ gives $(-x, -y)$. Reflection in $x = c$ gives $(2c - x, y)$. An inverse sequence reverses both the order and each operation.

Worked example

First translate $E(1, -2)$ by $(2, 1)$, then reflect in $y = x$. Find the result.

1. Translate first: $(1 + 2, -2 + 1) = (3, -1)$. The intermediate point is $E\prime = (3, -1)$.

2. Reflecting in $y = x$ swaps the intermediate coordinates, giving $(3, -1) \mapsto (-1, 3)$.

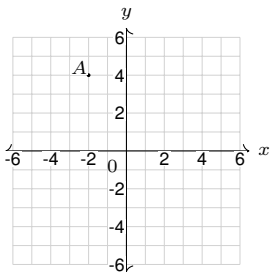
3. The final point is $(-1, 3)$. Swapping the original coordinates before translating would follow a different sequence.

Answer: $E'' = (-1, 3)$

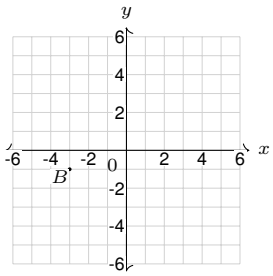
Practice Problems

Show your thinking.

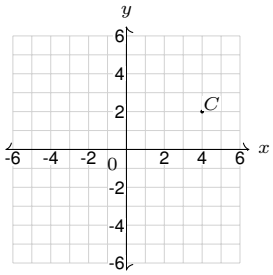
1. Reflect $A(-2, 4)$ in $y = x$. Plot the image.



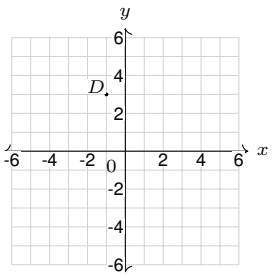
2. Translate $B(-3, -1)$ by $(4, 2)$, then rotate $180°$. Plot the final point.



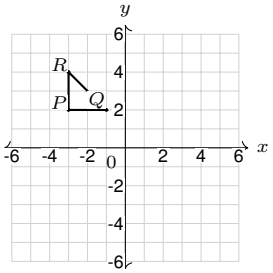
3. Reflect $C(4, 2)$ across the vertical line $x = 1$. Plot its image.



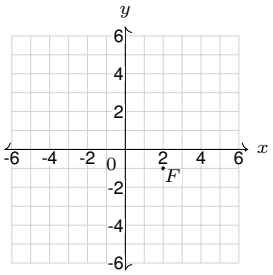
4. Rotate $D(-1, 3)$ $90°$ clockwise, then reflect in the x-axis. Plot the final point.



5. Translate triangle PQR by $(1, -2)$ and then reflect in the y-axis. List final vertices.



6. Reflect $F(2, -1)$ in the horizontal line $y = 1$. Plot the image.



Answer Key

1. $(4, -2)$
2. $(-1, -1)$
3. $(-2, 2)$
4. $(3, -1)$
5. $P'' = (2, 0), Q'' = (0, 0), R'' = (2, 2)$
6. $(2, 3)$

Step-by-Step Solutions

Follow each calculation, then check your own work.

Problem 1

1. Swap x and y: $(-2, 4) \mapsto (4, -2)$ using $(x, y) \mapsto (y, x)$.
2. The midpoint is $((-2 + 4)/2, (4 - 2)/2) = (1, 1)$, on the mirror line $y = x$.
3. Plot $A\prime = (4, -2)$. This is a reflection, not the clockwise turn $(4, 2)$.

Problem 2

1. The translation gives $(-3 + 4, -1 + 2) = (1, 1)$.
2. The half-turn then negates both coordinates: $(1, 1) \mapsto (-1, -1)$.
3. Thus $B'' = (-1, -1)$. The net rule is $(-x - 4, -y - 2)$, which also gives this result.

Problem 3

1. The point is $4 - 1 = 3$ units to the right of the mirror line.
2. The image must be 3 units left of it: $x\prime = 1 - 3 = -2$, while $y\prime = 2$.
3. Thus $C\prime = (-2, 2)$; equivalently, substitute into $x\prime = 2(1) - 4 = -2$.

Problem 4

1. The clockwise rule $(y, -x)$ gives $(-1, 3) \mapsto (3, 1)$.
2. Reflection in the x-axis then gives $(3, 1) \mapsto (3, -1)$.
3. The final point is $(3, -1)$. Here the combined rule is (y, x), matching a reflection in $y = x$.

Problem 5

1. Translation gives $P\prime = (-2, 0)$, $Q\prime = (0, 0)$, $R\prime = (-2, 2)$ by adding $(1, -2)$.
2. Reflect these intermediate points with $(-x, y)$ to obtain $(2, 0)$, $(0, 0)$, and $(2, 2)$.
3. Join the final vertices. Both operations preserve the original leg lengths 2 and 2.

Problem 6

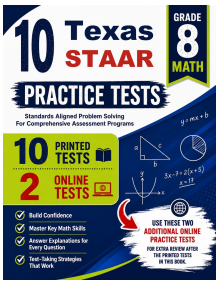
1. The original point lies $1 - (-1) = 2$ units below the horizontal mirror line.
2. The image lies 2 units above it: $y\prime = 1 + 2 = 3$ and $x\prime = 2$.
3. Plot $F\prime = (2, 3)$. The midpoint $(2, 1)$ lies on the mirror, confirming equal perpendicular distances.

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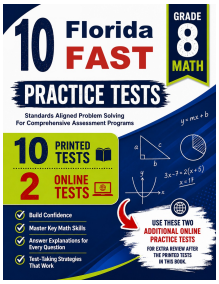
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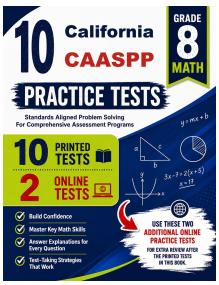
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