

Transformations on the Coordinate Plane

Name: _____ Date: _____ Score: _____ / 24

Q Quick Review

On the coordinate plane, every transformation has a tidy rule. A **translation** adds numbers to the coordinates: $(x, y) \rightarrow (x + a, y + b)$. A **reflection over the x -axis** is $(x, y) \rightarrow (x, -y)$; over the y -axis it is $(x, y) \rightarrow (-x, y)$; over $y = x$ it is $(x, y) \rightarrow (y, x)$. A **rotation** about the origin uses: 90° counterclockwise $(x, y) \rightarrow (-y, x)$, 180° $(x, y) \rightarrow (-x, -y)$, and 90° clockwise $(x, y) \rightarrow (y, -x)$. To transform a whole figure, just apply the rule to *each vertex*.

◇ **Example:** Triangle ABC has vertices $A(1, 2)$, $B(4, 2)$, $C(1, 5)$. Reflect it over the y -axis. Find the new vertices.
 ⇒ Reflecting over the y -axis uses the rule $(x, y) \rightarrow (-x, y)$ — the y -value stays put and the x -value flips its sign. Apply it to each vertex: $A(1, 2) \rightarrow A'(-1, 2)$, $B(4, 2) \rightarrow B'(-4, 2)$, and $C(1, 5) \rightarrow C'(-1, 5)$. The triangle is the same size and shape, just mirrored to the other side of the y -axis.

Answer: $A'(-1, 2)$, $B'(-4, 2)$, $C'(-1, 5)$

PRACTICE

Apply the transformation rule to find the image point.

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| 1. $(3, 4) \rightarrow (x + 2, y + 5)$ _____ | 11. Rotate $(5, 2)$ 90° CCW about origin _____ |
| 2. $(6, 1) \rightarrow (x - 4, y - 1)$ _____ | 12. Rotate $(-4, 1)$ 90° CCW about origin _____ |
| 3. $(-2, 5) \rightarrow (x + 7, y - 3)$ _____ | 13. Rotate $(3, 6)$ 180° about origin _____ |
| 4. $(0, -6) \rightarrow (x - 2, y + 9)$ _____ | 14. Rotate $(-7, -2)$ 180° about origin _____ |
| 5. Reflect $(4, 7)$ over x -axis _____ | 15. Rotate $(6, 3)$ 90° CW about origin _____ |
| 6. Reflect $(-5, 3)$ over x -axis _____ | 16. Rotate $(-2, 8)$ 90° CW about origin _____ |
| 7. Reflect $(8, -2)$ over y -axis _____ | 17. Translate $A(2, 3)$ by $(x - 5, y + 5)$ _____ |
| 8. Reflect $(-1, -9)$ over y -axis _____ | 18. Reflect $(0, 5)$ over x -axis _____ |
| 9. Reflect $(2, 6)$ over $y = x$ _____ | 19. Rotate $(1, 1)$ 90° CCW about origin _____ |
| 10. Reflect $(-3, 7)$ over $y = x$ _____ | 20. Reflect $(-6, -6)$ over $y = x$ _____ |

◆ Word Problems

21. A triangle with vertices $A(2, 1)$, $B(5, 1)$, $C(2, 4)$ is translated by the rule $(x, y) \rightarrow (x - 3, y + 2)$. Find the new vertices of the triangle. _____
22. A designer reflects a shape across the x -axis. A corner point at $(7, -3)$ is part of the shape. Where does that corner end up, and is the shape's size changed? _____
23. A square game piece has a corner at $(4, 0)$. The piece is rotated 90° counterclockwise about the origin. Find the new position of that corner. _____
24. A drone flies a path that starts at $(6, 8)$. It is rotated 180° about the origin in a simulation. Where does the starting point move to, and how far from the origin is it now? _____



Answer Keys

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|----------------|---|
| 1. $(5, 9)$ | 13. $(-3, -6)$ |
| 2. $(2, 0)$ | 14. $(7, 2)$ |
| 3. $(5, 2)$ | 15. $(3, -6)$ |
| 4. $(-2, 3)$ | 16. $(8, 2)$ |
| 5. $(4, -7)$ | 17. $(-3, 8)$ |
| 6. $(-5, -3)$ | 18. $(0, -5)$ |
| 7. $(-8, -2)$ | 19. $(-1, 1)$ |
| 8. $(1, -9)$ | 20. $(-6, -6)$ |
| 9. $(6, 2)$ | 21. $A'(-1, 3), B'(2, 3), C'(-1, 6)$ |
| 10. $(7, -3)$ | 22. $(7, 3)$; size is unchanged |
| 11. $(-2, 5)$ | 23. $(0, 4)$ |
| 12. $(-1, -4)$ | 24. $(-6, -8)$; still 10 units from the origin |

Step-by-Step Explanations

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| <p>1. Add 2 to x and 5 to y: $(3 + 2, 4 + 5) = (5, 9)$.</p> <p>2. Subtract 4 from x and 1 from y: $(2, 0)$.</p> <p>3. $-2 + 7 = 5$ and $5 - 3 = 2$, so the image is $(5, 2)$.</p> <p>4. $0 - 2 = -2$ and $-6 + 9 = 3$, so the image is $(-2, 3)$.</p> <p>5. Rule $(x, y) \rightarrow (x, -y)$: keep x, negate y.</p> <p>6. Keep $x = -5$, negate y: $3 \rightarrow -3$.</p> <p>7. Rule $(x, y) \rightarrow (-x, y)$: negate x, keep y.</p> <p>8. Negate x: $-1 \rightarrow 1$; keep $y = -9$.</p> <p>9. Rule $(x, y) \rightarrow (y, x)$: swap the coordinates.</p> <p>10. Swap the coordinates: $(-3, 7) \rightarrow (7, -3)$.</p> <p>11. Rule $(x, y) \rightarrow (-y, x)$: $(5, 2) \rightarrow (-2, 5)$.</p> <p>12. Rule $(x, y) \rightarrow (-y, x)$: $(-4, 1) \rightarrow (-1, -4)$.</p> <p>13. Rule $(x, y) \rightarrow (-x, -y)$: negate both coordinates.</p> <p>14. Negate both: $(-7, -2) \rightarrow (7, 2)$.</p> | <p>15. Rule $(x, y) \rightarrow (y, -x)$: $(6, 3) \rightarrow (3, -6)$.</p> <p>16. Rule $(x, y) \rightarrow (y, -x)$: $(-2, 8) \rightarrow (8, 2)$.</p> <p>17. $2 - 5 = -3$ and $3 + 5 = 8$, so $A' = (-3, 8)$.</p> <p>18. Keep $x = 0$, negate y: $5 \rightarrow -5$.</p> <p>19. Rule $(x, y) \rightarrow (-y, x)$: $(1, 1) \rightarrow (-1, 1)$.</p> <p>20. Swapping equal coordinates leaves the point unchanged.</p> <p>21. Apply the rule to each vertex: $A(2, 1) \rightarrow (-1, 3)$, $B(5, 1) \rightarrow (2, 3)$, $C(2, 4) \rightarrow (-1, 6)$.</p> <p>22. Reflection over the x-axis uses $(x, y) \rightarrow (x, -y)$, so $(7, -3) \rightarrow (7, 3)$. Reflections are rigid, so the size stays the same.</p> <p>23. A 90° counterclockwise rotation about the origin uses $(x, y) \rightarrow (-y, x)$, so $(4, 0) \rightarrow (0, 4)$.</p> <p>24. A 180° rotation gives $(x, y) \rightarrow (-x, -y)$, so $(6, 8) \rightarrow (-6, -8)$. Distance from origin is $\sqrt{6^2 + 8^2} = \sqrt{100} = 10$ units — rotations preserve distance.</p> |
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