

# Rotations, Reflections, and Translations

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Score: \_\_\_\_\_ / 24

## Q Quick Review

A **transformation** moves a figure without bending or breaking it. A **translation** slides every point the same distance in the same direction. A **reflection** flips the figure across a line, like a mirror. A **rotation** turns the figure around a fixed point by some angle. All three are **rigid motions**: they keep every *length* and every *angle* exactly the same, so the new figure is the same size and shape as the original — just in a new spot.

◇ **Example:** Point  $P(3, 5)$  is translated 4 units left and 2 units down. Find its new location.

⇒ A translation just shifts the point, so we handle the  $x$  and  $y$  separately. “4 units left” means subtract 4 from the  $x$ -value:  $3 - 4 = -1$ . “2 units down” means subtract 2 from the  $y$ -value:  $5 - 2 = 3$ . So the point lands at  $(-1, 3)$ . Notice the figure didn’t shrink or turn — it only slid.

**Answer:**  $P' = (-1, 3)$

## PRACTICE

Identify the transformation or find the new location of the point.

- Translate  $(2, 3)$  right 5 \_\_\_\_\_
- Translate  $(4, 1)$  up 6 \_\_\_\_\_
- Translate  $(-3, 2)$  left 2 \_\_\_\_\_
- Translate  $(5, -4)$  down 3 \_\_\_\_\_
- Translate  $(0, 0)$  right 7 up 2 \_\_\_\_\_
- Translate  $(6, 6)$  left 4 down 5 \_\_\_\_\_
- Reflect  $(3, 5)$  over the  $x$ -axis \_\_\_\_\_
- Reflect  $(-2, 4)$  over the  $x$ -axis \_\_\_\_\_
- Reflect  $(3, 5)$  over the  $y$ -axis \_\_\_\_\_
- Reflect  $(-6, -1)$  over the  $y$ -axis \_\_\_\_\_
- Reflect  $(4, 7)$  over the line  $y = x$  \_\_\_\_\_
- Reflect  $(-2, 5)$  over the line  $y = x$  \_\_\_\_\_
- Rotate  $(1, 0)$   $90^\circ$  counterclockwise about origin \_\_\_\_\_
- Rotate  $(0, 1)$   $90^\circ$  counterclockwise about origin \_\_\_\_\_
- Rotate  $(4, 2)$   $180^\circ$  about origin \_\_\_\_\_
- Rotate  $(-3, 5)$   $180^\circ$  about origin \_\_\_\_\_
- Rotate  $(2, 3)$   $90^\circ$  clockwise about origin \_\_\_\_\_
- Rotate  $(5, -1)$   $90^\circ$  clockwise about origin \_\_\_\_\_
- A figure flips across a vertical mirror line. Name it. \_\_\_\_\_
- A figure turns  $45^\circ$  around a point. Name it. \_\_\_\_\_

## ◆ Word Problems

- On a video game grid, a player at  $(8, 3)$  moves 5 squares left and 4 squares up to reach a coin. What are the coin’s coordinates?  
\_\_\_\_\_
- A graphic designer reflects a logo placed at  $(6, -2)$  across the  $x$ -axis to make a mirrored copy. Where is the copy? \_\_\_\_\_
- A clock’s hour hand tip is at  $(0, 4)$ . The hand rotates  $90^\circ$  clockwise about the center at the origin. Where is the tip now?  
\_\_\_\_\_
- A robot at  $(-3, -3)$  is rotated  $180^\circ$  about the origin during a test. Explain why the robot is still the same size, and give its new position. \_\_\_\_\_



## Answer Keys

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| <ol style="list-style-type: none"> <li>1. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(7, 3)</span></li> <li>2. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(4, 7)</span></li> <li>3. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(-5, 2)</span></li> <li>4. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(5, -7)</span></li> <li>5. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(7, 2)</span></li> <li>6. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(2, 1)</span></li> <li>7. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(3, -5)</span></li> <li>8. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(-2, -4)</span></li> <li>9. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(-3, 5)</span></li> <li>10. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(6, -1)</span></li> <li>11. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(7, 4)</span></li> <li>12. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(5, -2)</span></li> </ol> | <ol style="list-style-type: none"> <li>13. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(0, 1)</span></li> <li>14. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(-1, 0)</span></li> <li>15. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(-4, -2)</span></li> <li>16. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(3, -5)</span></li> <li>17. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(3, -2)</span></li> <li>18. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(-1, -5)</span></li> <li>19. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">reflection</span></li> <li>20. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">rotation</span></li> <li>21. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(3, 7)</span></li> <li>22. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(6, 2)</span></li> <li>23. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(4, 0)</span></li> <li>24. <span style="border: 1px solid black; border-radius: 5px; padding: 2px;">(3, 3); rotations are rigid motions, so size is unchanged</span></li> </ol> |
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### Step-by-Step Explanations

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| <ol style="list-style-type: none"> <li>1. Right 5 adds 5 to the <math>x</math>-value: <math>2 + 5 = 7</math>, and <math>y</math> stays 3.</li> <li>2. Up 6 adds 6 to the <math>y</math>-value: <math>1 + 6 = 7</math>, and <math>x</math> stays 4.</li> <li>3. Left 2 subtracts 2 from <math>x</math>: <math>-3 - 2 = -5</math>; <math>y</math> stays 2.</li> <li>4. Down 3 subtracts 3 from <math>y</math>: <math>-4 - 3 = -7</math>; <math>x</math> stays 5.</li> <li>5. Add 7 to <math>x</math> and 2 to <math>y</math>: from the origin we reach <math>(7, 2)</math>.</li> <li>6. Subtract 4 from <math>x</math> (<math>6 - 4 = 2</math>) and 5 from <math>y</math> (<math>6 - 5 = 1</math>).</li> <li>7. Reflecting over the <math>x</math>-axis keeps <math>x</math> and negates <math>y</math>: <math>(3, -5)</math>.</li> <li>8. Keep <math>x</math>, flip the sign of <math>y</math>: 4 becomes <math>-4</math>.</li> <li>9. Reflecting over the <math>y</math>-axis keeps <math>y</math> and negates <math>x</math>: <math>(-3, 5)</math>.</li> <li>10. Keep <math>y</math>, flip the sign of <math>x</math>: <math>-6</math> becomes 6.</li> <li>11. Reflecting over <math>y = x</math> swaps the coordinates: <math>(4, 7) \rightarrow (7, 4)</math>.</li> <li>12. Swap the coordinates: <math>(-2, 5) \rightarrow (5, -2)</math>.</li> <li>13. A <math>90^\circ</math> counterclockwise turn sends <math>(x, y) \rightarrow (-y, x)</math>, so <math>(1, 0) \rightarrow (0, 1)</math>.</li> <li>14. Using <math>(x, y) \rightarrow (-y, x)</math>: <math>(0, 1) \rightarrow (-1, 0)</math>.</li> </ol> | <ol style="list-style-type: none"> <li>15. A <math>180^\circ</math> rotation sends <math>(x, y) \rightarrow (-x, -y)</math>: <math>(4, 2) \rightarrow (-4, -2)</math>.</li> <li>16. Negate both coordinates: <math>(-3, 5) \rightarrow (3, -5)</math>.</li> <li>17. A <math>90^\circ</math> clockwise turn sends <math>(x, y) \rightarrow (y, -x)</math>: <math>(2, 3) \rightarrow (3, -2)</math>.</li> <li>18. Using <math>(x, y) \rightarrow (y, -x)</math>: <math>(5, -1) \rightarrow (-1, -5)</math>.</li> <li>19. Flipping across a line is a reflection — the figure is mirrored.</li> <li>20. Turning around a fixed point by an angle is a rotation.</li> <li>21. Moving left 5 gives <math>8 - 5 = 3</math> for the <math>x</math>-value, and up 4 gives <math>3 + 4 = 7</math> for the <math>y</math>-value, so the coin is at <math>(3, 7)</math>.</li> <li>22. A reflection over the <math>x</math>-axis keeps the <math>x</math>-coordinate and flips the sign of <math>y</math>, so <math>(6, -2)</math> becomes <math>(6, 2)</math>.</li> <li>23. A <math>90^\circ</math> clockwise rotation about the origin sends <math>(x, y) \rightarrow (y, -x)</math>, so <math>(0, 4) \rightarrow (4, 0)</math>.</li> <li>24. A <math>180^\circ</math> rotation sends <math>(x, y) \rightarrow (-x, -y)</math>, so <math>(-3, -3) \rightarrow (3, 3)</math>. Rotations are rigid motions: they keep all lengths and angles, so the robot is unchanged in size.</li> </ol> |
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