

# 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

- |  |   |
|--|---|
| <p>1. <input type="text" value="(7, 3)"/></p> <p>2. <input type="text" value="(4, 7)"/></p> <p>3. <input type="text" value="(-5, 2)"/></p> <p>4. <input type="text" value="(5, -7)"/></p> <p>5. <input type="text" value="(7, 2)"/></p> <p>6. <input type="text" value="(2, 1)"/></p> <p>7. <input type="text" value="(3, -5)"/></p> <p>8. <input type="text" value="(-2, -4)"/></p> <p>9. <input type="text" value="(-3, 5)"/></p> <p>10. <input type="text" value="(6, -1)"/></p> <p>11. <input type="text" value="(7, 4)"/></p> <p>12. <input type="text" value="(5, -2)"/></p> | <p>13. <input type="text" value="(0, 1)"/></p> <p>14. <input type="text" value="(-1, 0)"/></p> <p>15. <input type="text" value="(-4, -2)"/></p> <p>16. <input type="text" value="(3, -5)"/></p> <p>17. <input type="text" value="(3, -2)"/></p> <p>18. <input type="text" value="(-1, -5)"/></p> <p>19. <input type="text" value="reflection"/></p> <p>20. <input type="text" value="rotation"/></p> <p>21. <input type="text" value="(3, 7)"/></p> <p>22. <input type="text" value="(6, 2)"/></p> <p>23. <input type="text" value="(4, 0)"/></p> <p>24. <input type="text" value="(3, 3); rotations are rigid motions, so size is unchanged"/></p> |
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### Step-by-Step Explanations

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| <p>1. Right 5 adds 5 to the <math>x</math>-value: <math>2 + 5 = 7</math>, and <math>y</math> stays 3.</p> <p>2. Up 6 adds 6 to the <math>y</math>-value: <math>1 + 6 = 7</math>, and <math>x</math> stays 4.</p> <p>3. Left 2 subtracts 2 from <math>x</math>: <math>-3 - 2 = -5</math>; <math>y</math> stays 2.</p> <p>4. Down 3 subtracts 3 from <math>y</math>: <math>-4 - 3 = -7</math>; <math>x</math> stays 5.</p> <p>5. Add 7 to <math>x</math> and 2 to <math>y</math>: from the origin we reach <math>(7, 2)</math>.</p> <p>6. Subtract 4 from <math>x</math> (<math>6 - 4 = 2</math>) and 5 from <math>y</math> (<math>6 - 5 = 1</math>).</p> <p>7. Reflecting over the <math>x</math>-axis keeps <math>x</math> and negates <math>y</math>: <math>(3, -5)</math>.</p> <p>8. Keep <math>x</math>, flip the sign of <math>y</math>: 4 becomes <math>-4</math>.</p> <p>9. Reflecting over the <math>y</math>-axis keeps <math>y</math> and negates <math>x</math>: <math>(-3, 5)</math>.</p> <p>10. Keep <math>y</math>, flip the sign of <math>x</math>: <math>-6</math> becomes 6.</p> <p>11. Reflecting over <math>y = x</math> swaps the coordinates: <math>(4, 7) \rightarrow (7, 4)</math>.</p> <p>12. Swap the coordinates: <math>(-2, 5) \rightarrow (5, -2)</math>.</p> <p>13. A <math>90^\circ</math> counterclockwise turn sends <math>(x, y) \rightarrow (-y, x)</math>, so <math>(1, 0) \rightarrow (0, 1)</math>.</p> <p>14. Using <math>(x, y) \rightarrow (-y, x)</math>: <math>(0, 1) \rightarrow (-1, 0)</math>.</p> | <p>15. A <math>180^\circ</math> rotation sends <math>(x, y) \rightarrow (-x, -y)</math>: <math>(4, 2) \rightarrow (-4, -2)</math>.</p> <p>16. Negate both coordinates: <math>(-3, 5) \rightarrow (3, -5)</math>.</p> <p>17. A <math>90^\circ</math> clockwise turn sends <math>(x, y) \rightarrow (y, -x)</math>: <math>(2, 3) \rightarrow (3, -2)</math>.</p> <p>18. Using <math>(x, y) \rightarrow (y, -x)</math>: <math>(5, -1) \rightarrow (-1, -5)</math>.</p> <p>19. Flipping across a line is a reflection — the figure is mirrored.</p> <p>20. Turning around a fixed point by an angle is a rotation.</p> <p>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>.</p> <p>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>.</p> <p>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>.</p> <p>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.</p> |
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