Transformations on the Coordinate Plane

Name: ____________ Date: ____________ Score: ______ / 24

Quick Review

On the coordinate plane, every transformation has a tidy **rule**. A **translation** adds numbers to the coordinates: $(x, y) \to (x+a,\ y+b)$. A **reflection over the x-axis** is $(x,y) \to (x,-y)$; over the y-axis it is $(x,y) \to (-x,y)$; over $y = x$ it is $(x,y) \to (y,x)$. A **rotation** about the origin uses: 90° counterclockwise $(x,y) \to (-y,x)$, 180° $(x,y) \to (-x,-y)$, and 90° clockwise $(x,y) \to (y,-x)$. 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 $(x,y) \to (-x,y)$ — the y-value stays put and the x-value flips its sign. Apply it to each vertex: $A(1,2) \to A'(-1,2)$, $B(4,2) \to B'(-4,2)$, and $C(1,5) \to C'(-1,5)$. 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.

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

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

Step-by-Step Explanations

1. Add 2 to x and 5 to y: $(3+2,\ 4+5) = (5,9)$.
2. Subtract 4 from x and 1 from y: $(2,0)$.
3. $-2+7=5$ and $5-3=2$, so the image is $(5,2)$.
4. $0-2=-2$ and $-6+9=3$, so the image is $(-2,3)$.
5. Rule $(x,y)\to(x,-y)$: keep x, negate y.
6. Keep $x=-5$, negate y: $3\to-3$.
7. Rule $(x,y)\to(-x,y)$: negate x, keep y.
8. Negate x: $-1\to1$; keep $y=-9$.
9. Rule $(x,y)\to(y,x)$: swap the coordinates.
10. Swap the coordinates: $(-3,7)\to(7,-3)$.
11. Rule $(x,y)\to(-y,x)$: $(5,2)\to(-2,5)$.
12. Rule $(x,y)\to(-y,x)$: $(-4,1)\to(-1,-4)$.
13. Rule $(x,y)\to(-x,-y)$: negate both coordinates.
14. Negate both: $(-7,-2)\to(7,2)$.
15. Rule $(x,y)\to(y,-x)$: $(6,3)\to(3,-6)$.
16. Rule $(x,y)\to(y,-x)$: $(-2,8)\to(8,2)$.
17. $2-5=-3$ and $3+5=8$, so $A'=(-3,8)$.
18. Keep $x=0$, negate y: $5\to-5$.
19. Rule $(x,y)\to(-y,x)$: $(1,1)\to(-1,1)$.
20. Swapping equal coordinates leaves the point unchanged.
21. Apply the rule to each vertex: $A(2,1)\to(-1,3)$, $B(5,1)\to(2,3)$, $C(2,4)\to(-1,6)$.
22. Reflection over the x-axis uses $(x,y)\to(x,-y)$, so $(7,-3)\to(7,3)$. Reflections are rigid, so the size stays the same.
23. A 90° counterclockwise rotation about the origin uses $(x,y)\to(-y,x)$, so $(4,0)\to(0,4)$.
24. A 180° rotation gives $(x,y)\to(-x,-y)$, so $(6,8)\to(-6,-8)$. Distance from origin is $\sqrt{6^2+8^2}=\sqrt{100}=10$ units — rotations preserve distance.

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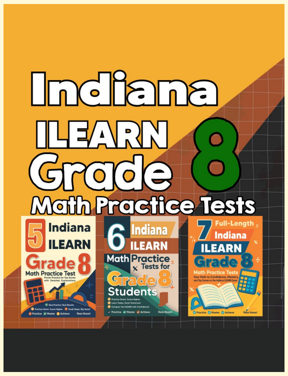

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