## Lesson 4: Coordinate Moves

Let’s transform some figures and see what happens to the coordinates of points.

### 4.1: Translating Coordinates

Select all of the translations that take Triangle T to Triangle U. There may be more than one correct answer.



1. Translate $\left(-3,0\right)$ to $\left(1,2\right)$.
2. Translate $\left(2,1\right)$ to $\left(-2,-1\right)$.
3. Translate $\left(-4,-3\right)$ to $\left(0,-1\right)$.
4. Translate $\left(1,2\right)$ to $\left(2,1\right)$.

### 4.2: Reflecting Points on the Coordinate Plane



1. Here is a list of points $\begin{matrix}A&=\left(0.5,4\right)&B&=\left(-4,5\right)&C&=\left(7,-2\right)&D&=\left(6,0\right)&E&=\left(0,-3\right)\\&&&&&&&&&\end{matrix}$ On the **coordinate plane**:
	1. Plot each point and label each with its coordinates.
	2. Using the $x$-axis as the line of reflection, plot the image of each point.
	3. Label the image of each point with its coordinates.
	4. Include a label using a letter. For example, the image of point $A$ should be labeled $A^{′}$.
2. If the point $\left(13,10\right)$ were reflected using the $x$-axis as the line of reflection, what would be the coordinates of the image? What about $\left(13,-20\right)$? $\left(13,570\right)$? Explain how you know.
3. The point $R$ has coordinates $\left(3,2\right)$.
	1. Without graphing, predict the coordinates of the image of point $R$ if point $R$ were reflected using the $y$-axis as the line of reflection.
	2. Check your answer by finding the image of $R$ on the graph.
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	1. Label the image of point $R$ as $R^{′}$.
	2. What are the coordinates of $R^{′}$?
4. Suppose you reflect a point using the $y$-axis as line of reflection. How would you describe its image?

### 4.3: Transformations of a Segment



Apply each of the following transformations to segment $AB$.

1. Rotate segment $AB$ 90 degrees counterclockwise around center $B$. Label the image of $A$ as $C$. What are the coordinates of $C$?
2. Rotate segment $AB$ 90 degrees counterclockwise around center $A$. Label the image of $B$ as $D$. What are the coordinates of $D$?
3. Rotate segment $AB$ 90 degrees clockwise around $\left(0,0\right)$. Label the image of $A$ as $E$ and the image of $B$ as $F$. What are the coordinates of $E$ and $F$?
4. Compare the two 90-degree counterclockwise rotations of segment $AB$. What is the same about the images of these rotations? What is different?

#### Are you ready for more?

Suppose $EF$ and $GH$ are line segments of the same length.  Describe a sequence of transformations that moves $EF$ to $GH$.

### Lesson 4 Summary

We can use coordinates to describe points and find patterns in the coordinates of transformed points.

We can describe a translation by expressing it as a sequence of horizontal and vertical translations.  For example, segment $AB$ is translated right 3 and down 2.



Reflecting a point across an axis changes the sign of one coordinate. For example, reflecting the point $A$ whose coordinates are $\left(2,-1\right)$ across the $x$-axis changes the sign of the $y$-coordinate, making its image the point $A^{′}$ whose coordinates are $\left(2,1\right)$. Reflecting the point $A$ across the $y$-axis changes the sign of the $x$-coordinate, making the image the point $A^{″}$ whose coordinates are $\left(-2,-1\right)$.



Reflections across other lines are more complex to describe.

We don’t have the tools yet to describe rotations in terms of coordinates in general. Here is an example of a $90^{∘}$ rotation with center $\left(0,0\right)$ in a counterclockwise direction.



Point $A$ has coordinates $\left(0,0\right)$. Segment $AB$ was rotated $90^{∘}$ counterclockwise around $A$. Point $B$ with coordinates $\left(2,3\right)$ rotates to point $B^{′}$ whose coordinates are $\left(-3,2\right)$.



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