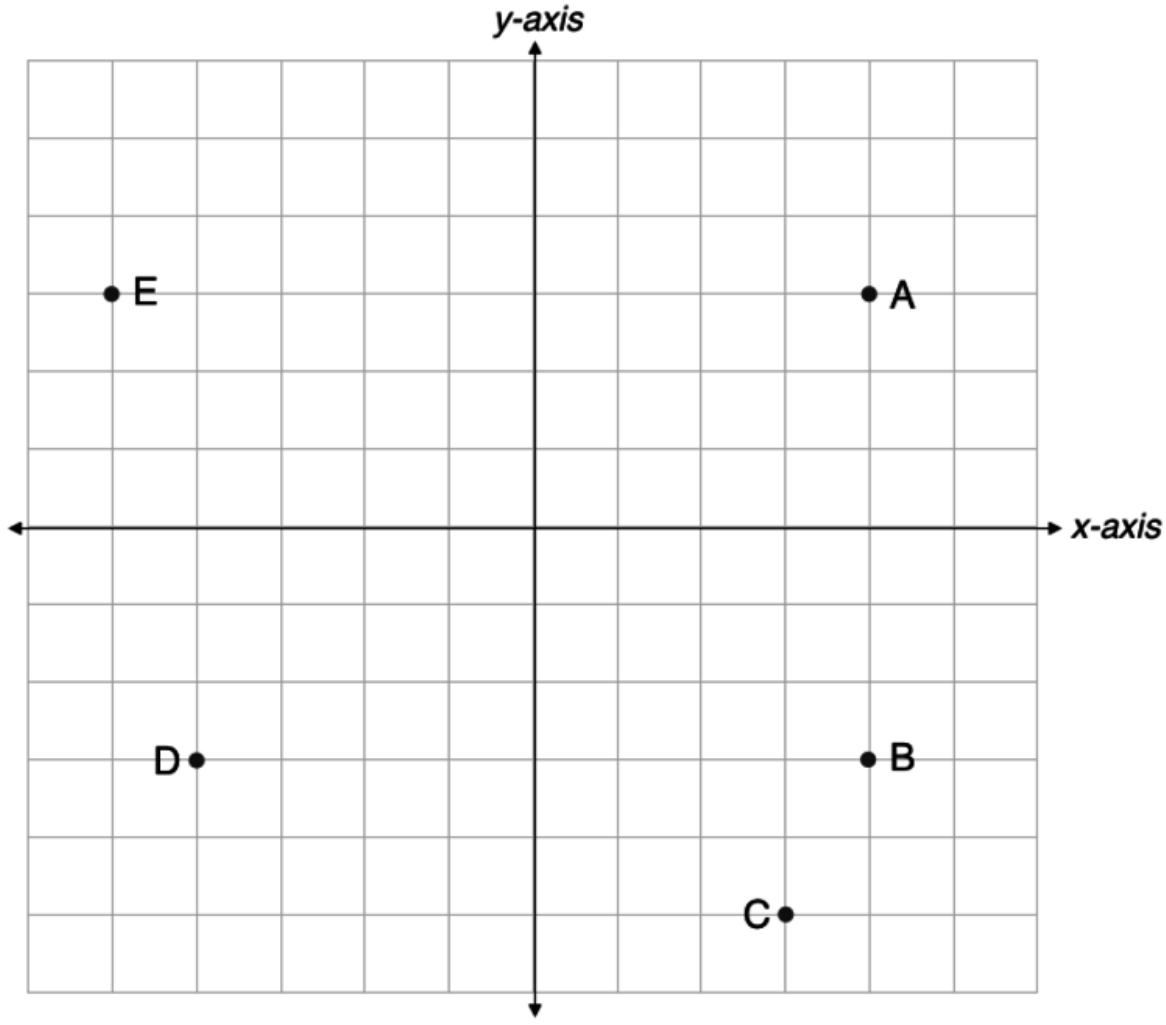
6.NS Locations in the Coordinate Plane

Alignments to Content Standards: 6.NS.C.6

Task

Some points are located on a square-unit grid, and coordinate axes are drawn:



Note: *x* and *y* are on the same scale.The scale is 1 unit.

a) Choose any two points. Consider their locations in the plane. How are they the same? How are they different? Write down at least three things you notice.

b) Name the coordinates for each point:

- A (,)
- B (,)
- C (,)
- D (,)
- E (,)

c) Make some observations relating coordinates to locations in the plane. (Here is an example: "When the first coordinate is positive, that point is located to the right of the

y-axis.") Write down at least three things you notice.

d) Consider the rule, "When the first coordinate is positive, that point is located to the right of the y-axis." Will that always be true or only happen sometimes? Explain your reasoning.

e) Choose one of the things you noticed from part (c) and explain why it will always be true or only happen sometimes.

IM Commentary

The goal of this task is to introduce students to the relationships between the locations and coordinates of points graphed in all four quadrants of the coordinate plane. When describing the things they notice about the point locations and coordinates, the teacher should encourage students to use terms such as quadrant, distance, origin, sign, axis, and coordinate. This precision in language will be helpful to students when they later discuss opposites and reflections as described in the content standards, and attending to language is a good example of students engaging in MP6.

The solution names the quadrants I, II, III, and IV, which is a convention. If students have learned this convention before beginning this task, they might be expected to use the quadrant names in their observations. If they have not yet learned this convention, they may instead use positional language (such as "upper left") to refer to areas in the plane. Students should start using the conventional language in grade 6, so it is recommend that this task be used after the convention is learned; however, it could be used to introduce this convention as well.

As students name the points, they may begin to notice many other things. While more detailed explanations are available in the solution, teachers should explictly listen for things students notice about the distance of a point from each axis and the ways in which the signs of the numbers relate to the quadrant location of a point.

While the goal of this task centers on naming points and relating the locations of these points, students may notice things related to absolute value. Students may notice, for example, that (-4,-3) and (-5,3) are each the same distance from the x-axis. Teachers might highlight these observations and use the discussions as a formative assessment of student language and thinking around standard 6.NS.C.7c.

Asking students to explain whether the things they notice will always happen or only sometimes happen pushes students to extend their thinking beyond the points given in the task. For example, students may notice that (4,3) and (4,-3) are each the same distance from the y-axis and the x-axis, but they are on the same side of the y-axis and on opposite sides of the x-axis. In explaining why this will always happen, students can reason about integers and rational numbers which they could physically put on the grid, as well as numbers outside the region of the graph. It also allows students to engage in MP3.

Suggestions for classroom use: After students have had a chance to look at the coordinate plane, give them a few minutes to individually write down things they notice. During this time, the teacher should observe the student work. Knowing what students are seeing visually as well as the vocabulary they are using will help the teacher better understand where students are in their thinking. After the individual work time, have students take a couple of minutes to share the things they noticed with a partner or small group. Students can then complete part (b) as a group or individually; however, it is important for students to have the correct coordinates written down before moving forward in the task. After students have worked on parts (c) and (d) individually, they should discuss the things they notice with a partner or small group. Given the variety of things students may notice for part (d) and possible reasonings behind their answer in part (e), sharing as a whole class with the teacher recording their work publicly will give all students more exposure to various approaches to part (e) and provide examples of justification. The teacher may want to collect the things students noticed and/or conjectures from part (e) to use later in discussions around definitions of key vocabulary, developing claims, and/or proving a mathematical idea.

Edit this solution

Solution

a) In this initial question, the things the students notice may focus on the location of the points and, therefore, be more visual in nature. While there are many things to notice, these are possible observations related to the locations of pairs of points in the plane:

- Points B and C are in the same quadrant.
- Points A and E lie on the same horizontal line.
- Points A and B lie on the same vertical line.
- Points A and B are on the same location on the *x*-axis but opposite directions on the

y-axis.
- Points A and B are symmetrical over the *x*-axis.
- Points B and D are in the same location on the *y*-axis but opposite directions on the x-axis.
- Points B and D are equally distant from but on opposite sides of the *y*-axis.
- Points A and D connect through the origin.

b) **A** (4,3); **B** (4,-3); **C** (3,-5); **D** (-4,-3); **E** (-5,3)

c) The students should relate the coordinates of a point to its location in the plane. Depending on prior exposure to the names of the quadrants, student descriptions may be positional language, such as "above the *x*-axis and to the right of the *y*-axis." Students may notice the changes in the point's location as the *x*- and *y*-coordinates change. It is important in these cases to be clear as to the increase or decrease of the integer itself or its absolute value. For example, a student who looks at B and C may notice, "As the *x*-coordinate gets smaller, the closer the point is to the *y*-axis," but this observation would only be correct for positive values of *x*. While there are many things students may notice, here are some possibilities:

- A point with positive *x*- and *y*-coordinates falls in Quadrant I. [A]
- A point with a negative *x*-coordinate and postive *y*-coordinate falls in Quadrant II. [E]
- A point with negative *x*- and *y*-coordinates falls in Quadrant III. [D]
- A point with a positive *x*-coordinate and a negative *y*-coordinate falls in Quadrant IV. [B,C]
- A point with a positive *x*-coordinate is to the right of the *y*-axis. [A,B,C]
- A point with a negative *x*-coordinate is to the left of the *y*-axis. [D,E]
- A point with a positive *y*-coordinate is above the *x*-axis. [A,E]
- A point with a negative *y*-coordinate is below the *x*-axis. [B,C,D]
- Points with the same *y*-coordinate lie on the same horizontal line. [A,E]
- Points with the same *x*-coordinate lie on the same vertical line. [A,B]
- Points with opposite *x*-coordinates are the same distance from the *y*-axis [B,D]
- Points with opposite *y*-coordinates are the same distance from the *x*-axis. [D,E]
- Points with the same *x*-coordinate and opposite *y*-coordinates are the same distance but opposite directions from the *x*-axis and are the same distance from both axes.[A,B]
- Points with the same *y*-coordinate and opposite *x*-coordinates are the same distance but opposite directions from the *y*-axis and are the same distance from both axes. [B,D]
- If you have two points with opposite *x*- and *y*-coordinates, the line segment joining them will pass through the origin. [A,D]
- When you change the order of the coordinates the points have a diagonal line of symmetry through the origin. [C,E]

d) Students may have a variety of ways to explain why the observation will always

happen. For example, they may say "The first coordinate tells you to go right," which should be refined to say something more precise like, "The sign of the first coordinate tells you whether to plot the point to the left or right of the origin along the horizontal axis." Addressing the content standards, it will be important to highlight reasonings centered on the horizontal and vertical number lines as well as their intersection at the origin in a coordinate plane.

e) Answers will vary. Possiblities:

- When a point has a negative x-coordinate, it will be always be to the left of the y-axis. This will always happen because in the coordinate plane, the y-axis goes through zero on the horizontal number line and negative numbers are to the left of zero.
- When a point has a positive y-coordinate it will be always be above the x-axis. This will always happen because in the coordinate plane, the x-axis goes through zero on a vertical number line and positive numbers fall above zero.
- A point with positive x- and y-coordinates will always fall in Quadrant I because points with a positive x-coordinate will always be to the right of the y-axis and points with a positive y-coordinate will always be above the x-axis.
- Points that have the same x-coordinate and opposite y-coordinates will always be the same distance but on opposite sides of the x-axis because having the same x-coordinate means they will be the same distance along the x-axis, and having opposite y-coordinates means they will be on opposite sides of $y = 0$.