

Points Lining Up in the Plane

If you've seen marching bands perform at football games, you've probably seen band members wandering in seemingly random directions suddenly spell a word or form a cool picture. Can you describe these patterns mathematically? In this activity you'll start to answer this question by exploring simple patterns of dots in the x - y plane.

SKETCH AND INVESTIGATE

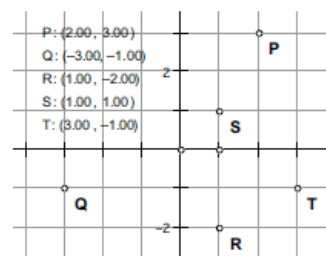
Holding down the Shift key keeps all five points selected.

To measure the coordinates, choose **Measure | Coordinates**.

To hide objects, select them and choose **Display | Hide**.

The absolute value of a number is its "positive value." The absolute value of both 5 and -5 is 5.

1. In a new sketch, choose the **Point** tool from the Toolbox.
2. While holding down the Shift key, construct five points.
3. With all points selected, choose **Display | Label Points**. Set the label of the first point to P and click OK.



4. Measure the coordinates of the five selected points.

A coordinate system appears, and the coordinates of the five points are displayed.

5. Hide the point at the origin $(0, 0)$, and the unit point $(1, 0)$.
6. To make dragged points land only on locations with integer coordinates, choose **Graph | Snap Points**.

Q1 For each part a–h below, drag the five points to five different locations that satisfy the rule. Then copy your solutions onto the grids on the next page. Remember to fill in the coordinates of each point.

- a. The y -coordinate equals the x -coordinate.
- b. The y -coordinate is one greater than the x -coordinate.
- c. The y -coordinate is twice the x -coordinate.
- d. The y -coordinate is one greater than twice the x -coordinate.
- e. The y -coordinate is the opposite of the x -coordinate.
- f. The sum of the x - and y -coordinates is 5.
- g. The y -coordinate is the absolute value of the x -coordinate.
- h. The y -coordinate is the square of the x -coordinate.

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continued

a. The y -coordinate equals the x -coordinate.

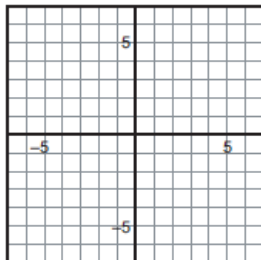
P: ()

Q: ()

R: ()

S: ()

T: ()



b. The y -coordinate is one greater than the x -coordinate.

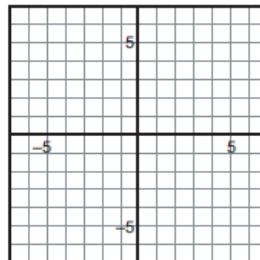
P: ()

Q: ()

R: ()

S: ()

T: ()



c. The y -coordinate is twice the x -coordinate.

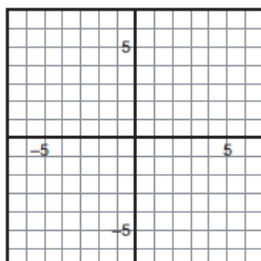
P: ()

Q: ()

R: ()

S: ()

T: ()



d. The y -coordinate is one greater than twice the x -coordinate.

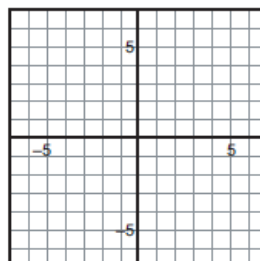
P: ()

Q: ()

R: ()

S: ()

T: ()



e. The y -coordinate is the opposite of the x -coordinate.

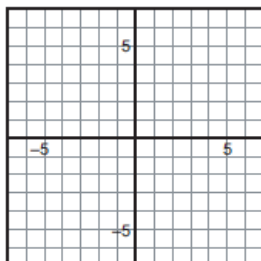
P: ()

Q: ()

R: ()

S: ()

T: ()



f. The sum of the x - and y -coordinates is 5.

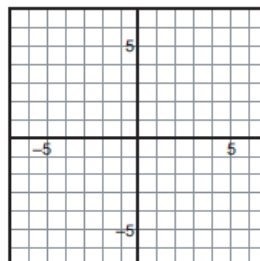
P: ()

Q: ()

R: ()

S: ()

T: ()



g. The y -coordinate is the absolute value of the x -coordinate.

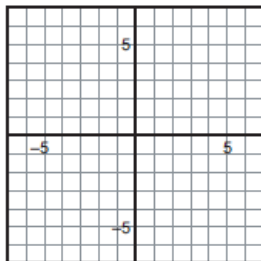
P: ()

Q: ()

R: ()

S: ()

T: ()



h. The y -coordinate is the square of the x -coordinate.

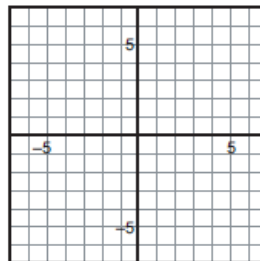
P: ()

Q: ()

R: ()

S: ()

T: ()



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continued

BACKWARD THINKING

In Q1, you moved points around to make them fit a certain rule. Here you'll reverse the process and be the detective. Your clues will be the given point positions, and your task will be to figure out the rule.

7. Open **Points Line Up.gsp**. You'll see a coordinate system with eight points (P – W), their coordinate measurements, and eight action buttons (a – h).

Q2 Press each action button in the sketch. Like the members of a marching band, the points will move about until they form a pattern. Study the coordinates of the points in each pattern, and then write a rule (like the ones in Q1) for each of the action buttons a – h .

EXPLORE MORE

Q3 Each rule in this activity can be written as an equation. For example, the rule for part b of Q1 ("The y -coordinate is one greater than the x -coordinate.") can be written as $y = x + 1$. Write an equation for each description in Q1 and Q2.

Q4 Add your own action buttons to those in **Points Line Up.gsp**, and ask your classmates to come up with descriptions or equations for your patterns. (Instructions on how to do this are on page 2 of the sketch.)

Q5 Go back to your first sketch. Turn off **Graph | Snap Points**. Drag each of your five points to a new location that satisfies the rule without using integer coordinates. Add your new points to grids a – h , and write their coordinates down on your paper.