

Introducing the Coordinate Plane

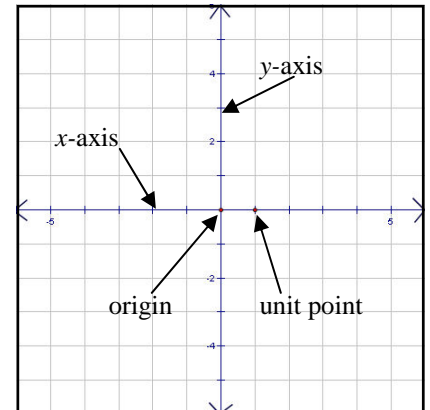


As the story goes, philosopher and mathematician René Descartes was gazing upward at the ceiling, deep in thought, when he saw a fly walking on the ceiling. It occurred to Descartes that the fly's position on the ceiling could be described by two numbers: its distance from each of two walls. Thus was born the coordinate plane, also called the Cartesian coordinate systems after Descartes. In this activity, you'll investigate how to describe the locations of points in the coordinate plane.

1: Sketch and Investigate

First: Set up your Cartesian plane:

- Graph > Show Grid (drag the unit point to enlarge the grid so the y-axis has 6 near the top of your screen)
- Edit > Preferences > Other (Slope, Ratio, ...) Precision > Units > OK
- Graph > Snap Points



Second: Mark one point anywhere on the sketch except on the axes (Use the point tool; point should locate exactly where any two gridlines intersect)

Third: Label coordinates (right-click > Coordinates)

The coordinates of the point form an ordered pair: the two numbers that describe the point's location. The order of the two numbers is important!

Fourth: Use the selection arrow to drag point A – be sure to drag it to the left and right of the y-axis, and above/below the x-axis. Observe the coordinates and look for the relationship between these numbers and the point's position.

2: Explore and Find Patterns

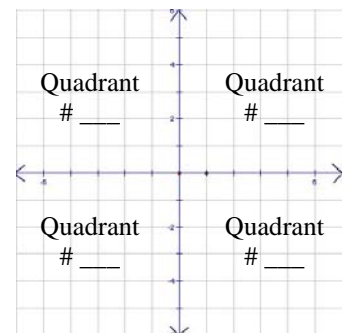
Q1

The first coordinate in an ordered pair (x,y) is called the x-coordinate of the point, and the second number is called the y-coordinate. What do each of these numbers represent?

Q2

The x- and y-axes divide the plane into four regions called quadrants, numbered I, II, III, and IV. Using the following facts, label the diagram with the correct Roman numerals.

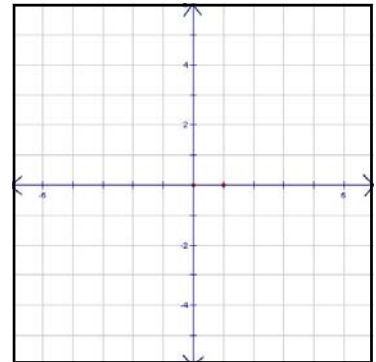
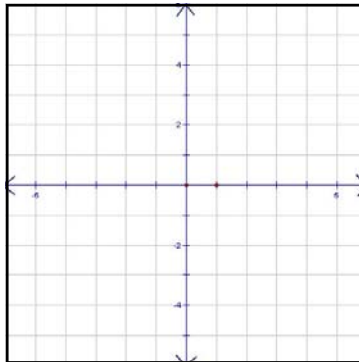
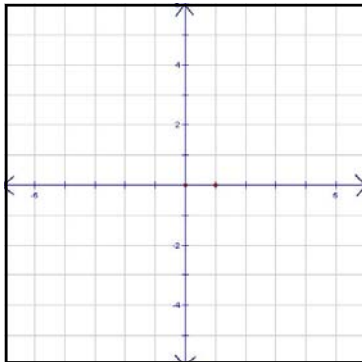
- In quadrant I, both coordinates are positive
- In quadrant II, the x-coordinate is negative and the y-coordinate is positive
- In quadrant III, both coordinates are negative
- In quadrant IV, the x-coordinate is positive and the y-coordinate is negative



Q3

For each problem, mark 4 points that satisfy the given conditions. Do this first on the GSP screen, by moving point A around, then copy points on the screen to these planes.

- The x-coordinate of point A equals the y-coordinate
- The y-coordinate of Point A is equal to 4
- The x-coordinate of point A is equal to -3

**Q4**

Find several locations where the x-coordinate of point A is 0. Where must a point lie if its x-coordinate is zero?

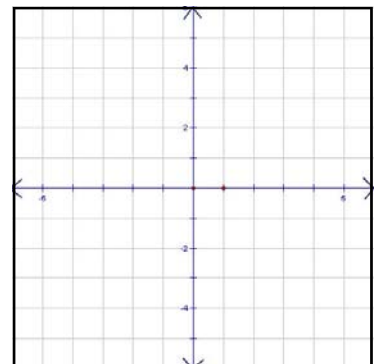
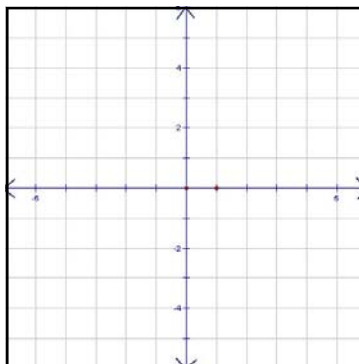
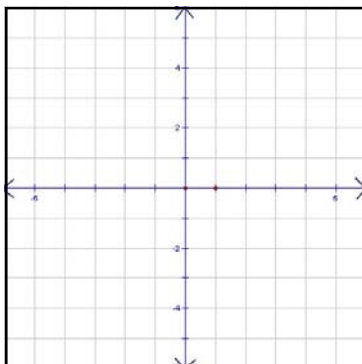
Q5

Find several locations where the y-coordinate of point A is 0. Where must a point lie if its y-coordinate is zero?

Q6

Draw a new point B and measure its coordinates. For each problem, mark and label 4 pairs of points (A_1, B_1 through A_4, B_4) satisfying the given conditions:

- Points A and B have the same coordinates but in reverse order; e.g., A (2,3) and B (3,2).
- Points A and B have the same x-coordinates but the y-coordinates are opposite; e.g., A (2,3) and B (2,-3).
- Points A and B have the same y-coordinates but the x-coordinates are opposite.



3: A Message

In the next steps, you'll move point A in the coordinate plane. If a meaningful message appears, you'll know that you correctly identified the locations and coordinates.

- Move point A to $(-3,3)$. With this point still selected, choose Display > Trace Point.
- Choose Graph > Snap Points to turn it off.
- Carefully move point A to the following coordinates in order (work left to right, row by row, turning tracing off and on as directed in the order. When you're done, the trace should spell something familiar.

$(-6,3)$, $(-6,-3)$, $(-3,-3)$, $(-3,0)$, $(-4,0)$, $(-2,0)$, turn off tracing, $(3,3)$, turn on tracing, $(0,3)$, $(0,0)$, $(3,0)$, $(3,-3)$, $(0,-3)$, turn off tracing, $(5,-3)$, turn on tracing, $(5,3)$, $(8,3)$, $(8,0)$, $(5,0)$

4: Explore More

List the coordinates of your initials, including instructions to turn tracing on and off, as in the directions above. Then have someone else test your list.

5: Reflecting Upon Your Learning

- Using symbols and/or words, show the patterns of various points on this Cartesian grid. Show one point in each quadrant, as well as one point on each side of each axis.
- Use general terms, e.g. $(x, -y)$ rather than a specific point, so that you describe all points in a group.
- Write about any patterns you have observed.

