Points & Lines & Slopes (Oh My!)

ID: 8106

Time required
45 minutes

Activity Overview

In this activity, students are moving a point around the coordinate plane and investigating the coordinates of the point in different quadrants as well as on each axis. They will also look at the relationship between the coordinates of a point and the distance of the point from each axis. Later, they will investigate relationships of lines, slopes, and equations as well as parallel and perpendicular lines and their slope relationships.

Topic: Linear Functions

- *Graph an equation of the form y = mx and describe how the value of m changes as the graph is rotated.*
- *Graph an equation of the form y = mx + b and describe how b changes under vertical translations.*
- *Prove that lines with equal slope are parallel and conversely by showing that they do not intersect.*
- *Graph lines whose slopes are negative reciprocals and measure the angles to verify they are perpendicular.*

Teacher Preparation and Notes

- *This activity is intended to be **teacher-led**. You may use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds, but the majority of the ideas and concepts are only presented in **this** document. Be sure to cover all the material necessary for students' total comprehension.*
- *This activity can review coordinates and then go on to introduce or review the relationships of points, lines, slopes, and equations. The graph could also be divided into different zones by graphing f(x)= x and f(x)= –x and having students generalize the slope for each of these zones.*
- *After graphing lines and looking at relationships, another point could be placed on the plane and students could look at the coordinates of the point with respect to the line. This could be used to introduce inequalities.*
- ***To download the student TI-Nspire documents (.tns files) and student worksheet, go to education.ti.com/exchange and enter "8106" in the quick search box.***

Associated Materials

- *PointsLinesSlopes_Student.doc*
- *PointsLinesSlopes.tns*

Suggested Related Activities

To download any activity listed, go to education.ti.com/exchange and enter the number in the quick search box.

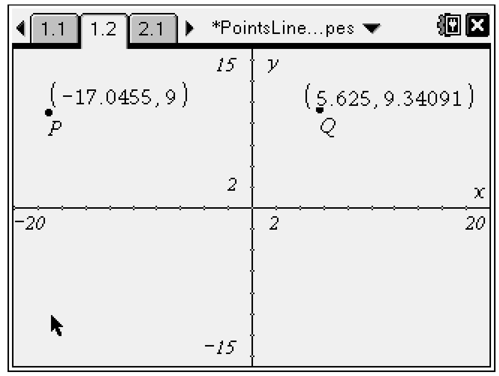
- *Where's the Point? Follow-up (TI-Nspire technology) — 8248*
- *What's the Point – Understanding Coordinate Plane (TI-Nspire technology) — 8999*
- *Points on a Line (TI-Nspire technology) — 10623*
- *Application of Slopes (TI-Nspire technology) — 13443*

Teacher Tip: During the activity, consider posing the following three questions with some student discussion:

1. *What are the relationships of the coordinates of points with various locations in the Cartesian plane?*
2. *What is the relationship of a line with its slope, equation, and y-intercept?*
3. *What is the relationship between the slopes of parallel or perpendicular lines?*

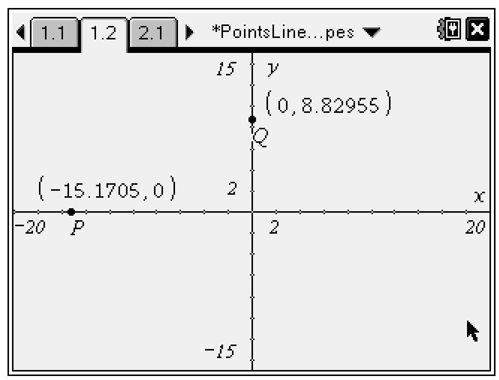
Problem 1 – Investigating the coordinates of points

Step 1: Direct students to open page 1.2, where they will find a *Graphs & Geometry* page with the function entry line hidden. Instruct students to place and label points *P* and *Q* anywhere in the coordinate system using the **Point** tool from the Points & Lines menu. (The labels *P* and *Q* may be typed directly after placing each point.) Then have students label the coordinates of each point, using the **Coordinates and Equations** tool (**MENU > Actions > Coordinates and Equations**).



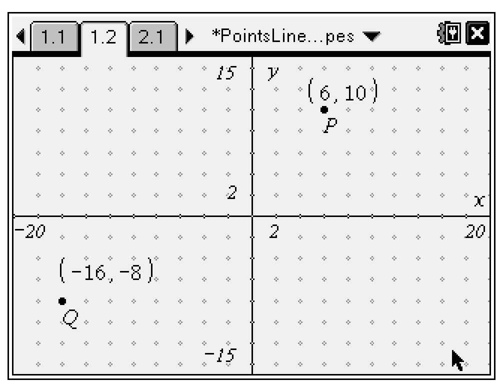
Step 2 : Next have students the **Redefine** tool (**MENU > Actions > Redefine**) point *P* to the *x*-axis and point *Q* to the *y*-axis. (Students should be instructed to **not** redefine to a tick mark on the axis.) Have students now drag point *P* and answer questions from the worksheet about *x*-intercepts. (This foreshadows two important concepts later: *x*-intercepts of graphs and equations of vertical lines.)

Next, have them grab and drag point *Q* and answer questions about *y*-intercepts. (This foreshadows the concept of the *y*-intercept of a graph.)



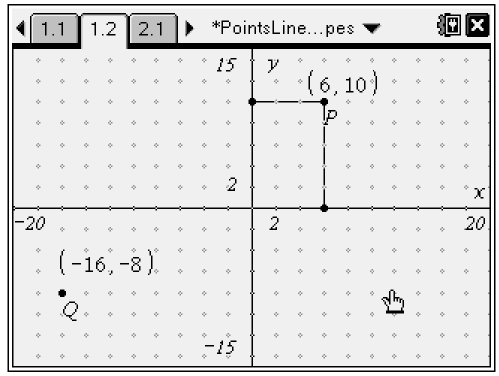
Step 3: After dragging points *P* and *Q*, have students show the grid by selecting **Show Grid** from the View menu. Next, they should again redefine points *P* and *Q*, this time to grid points. The coordinates are now integer values.

Have students once again drag points *P* and *Q* around the plane and answer the questions on their worksheet about the sign of the *x*- and *y*-coordinates in each quadrant.

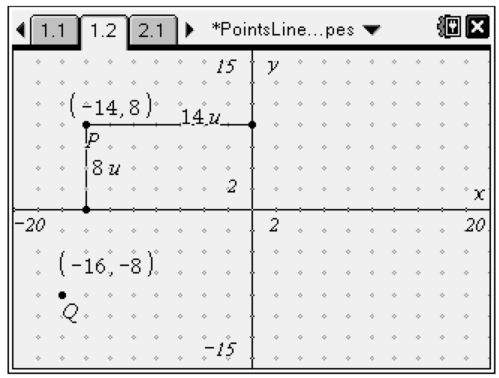


Step 4: Students should now be able to make sense of exactly what the coordinates should be in different quadrants as well as on each axis. Give students the coordinates of a point and ask which quadrant it is in and visa versa. This simple activity is good for students to develop their technology skills and establish sign patterns for the four quadrants.

Step 5: Have students use the **Perpendicular** tool (**MENU > Construction > Perpendicular**) to construct perpendiculars through point *P* to each axis. After the perpendiculars are in place, direct students to construct segments from point *P* to each axis (**MENU > Points & Lines > Segment**) and then hide the “excess” perpendicular lines using the **Hide/Show** tool (**MENU > Actions > Hide/Show**).



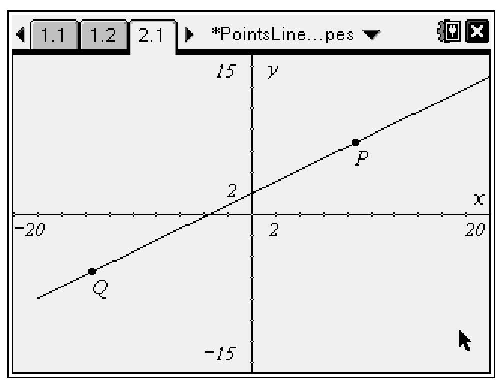
Step 6: Now have students measure the length of each segment using the **Length** tool from the Measurement menu. Drag point *P* and have students conjecture about the distances and the coordinates. (There is a one-to-one correspondence between the distances from *P* to each axis and the absolute value of the coordinates of *P*.)



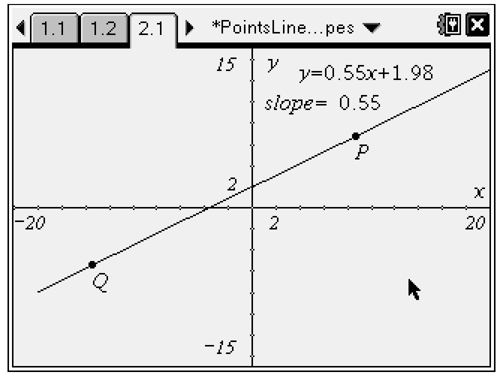
Problem 2 – Investigating lines, equations, and slopes

Step 1: In Problem 2, students are given points *P* and *Q*. (These points are not attached to the grid to allow for more exploration.)

If this is the students’ first introduction to slope, provide a brief description of the concept, including “rise over run.” Ask students to visualize a line between points *P* and *Q* and conjecture as to whether the slope is positive or negative, small or large, etc. Then have them draw a line through points *P* and *Q* using the **Line** tool from the Points & Lines menu.



Step 2: Next, have students find the slope (**MENU > Measurement > Slope**) and equation (**MENU > Actions > Coordinates & Equations**) of the line. Have them label the slope measurement as shown at right by clicking in the text box and typing **slope=**. Also, they can decrease the number of digits of the slope by hovering the cursor over the measurement and pressing −.

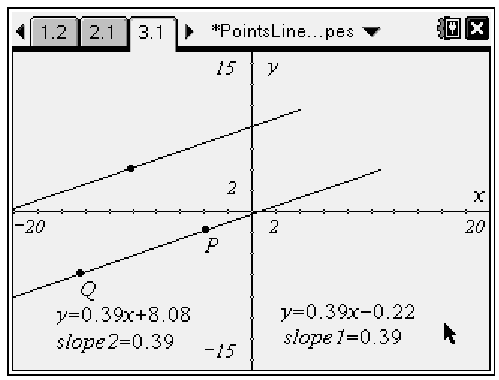


Step 3: Now students can investigate the relationship of the line with its slope and equation. First have students drag point *P* or *Q* and notice what changes and what does not. Next drag by the line itself and observe what changes. Students should also drag point *Q* to the *y*-axis (or redefine it to the *y*-axis) to investigate the relationship between a line's *y*-intercept and its equation.

Problem 3 – Investigating the slopes of parallel and perpendicular lines

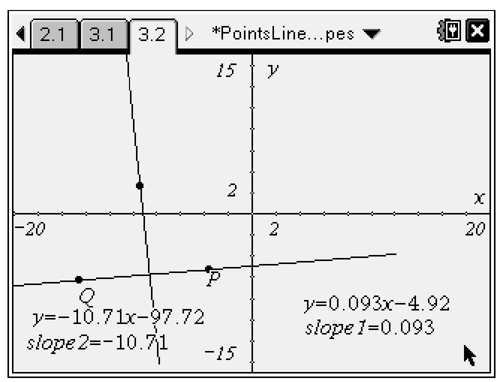
Step 1: On page 3.1, students are given two parallel lines, their equations, and their slopes. (This construction is done for them. An alternative would be for the students to construct the parallel lines, show the slopes, and explore.)

Students should explore the relationships of parallel lines and slopes while they drag the original line by one of its defining points, *P* or *Q*.

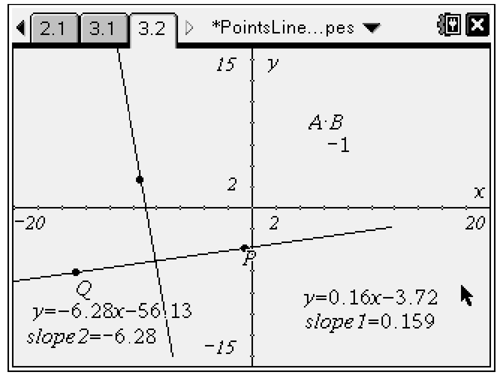


Step 2: On page 3.2, students are shown two perpendicular lines, their equations, and their slopes. Again, students could be led through this construction, if desired.

Encourage students to drag the lines around and try to identify the relationship between their slopes.



Step 3: Another way to look at the relationship of the slopes is to find the product of the two slopes. Have students select **MENU > Actions > Text**, press enter in an open space in the work area, and enter “a*b” (or any other two variables). Next, they should select **MENU > Actions > Calculate**, position the cursor over the newly created text box, and press enter. Moving the cursor off of the text box, students are prompted for the value of the variables. Clicking on each of the measured slopes will produce the product—have students drag it to a convenient location on the screen. Finally, have students drag the line through points *P* or *Q* by grabbing and dragging either point. Encourage them to notice what happens to the product as the lines change.



Extension

As stated in the teacher preparation, there are many extensions to this activity depending on the level of the student. This activity can easily be manipulated to lead students into a deeper study of slopes, parallel lines, and proofs.