Graphs of Linear Functions

ID: 8872

Time required
45 minutes

Activity Overview

In this activity, students will investigate the connections between the points on a line and the equation of the line written in slope-intercept form. They practice graphing linear functions and check their work using the TI-Nspire handheld. Next, they explore the slopes of lines that are parallel or perpendicular to a given line and graph a function given a point and the equation of a line parallel or perpendicular to it.

Topic: Functions & Relations

- *Graph a linear function defined as an algebraic equation in the form of f(x) = mx + b.*
- *Given two points on a line, calculate the slope and write the equation of the line.*

Teacher Preparation and Notes

This activity is designed to be used in a middle school or high school Algebra 1 classroom.

- *Students should already be familiar with the meaning of slope and how to find the slope of a line given two points on the line (the ratio: difference of y-values and difference of x-values).*
- *This activity is intended to be mainly **teacher-led**, with breaks for individual student work. Use the following pages to present the material to the class and encourage discussion. Students will follow along using their handhelds.*
- *Information for an optional extension is provided at the end of this activity, both on the student worksheet and in the student .tns file. Should you not wish students to complete the extension, you may delete the extension from the student .tns file and have students disregard that portion of the student worksheet.*
- *Notes for using the TI-Nspire™ Navigator™ System are included throughout the activity. The use of the Navigator System is not necessary for completion of this activity.*
- ***To download the student .tns file and student worksheet, go to education.ti.com/exchange and enter "8872" in the keyword search box.***

Suggested Related Activities

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

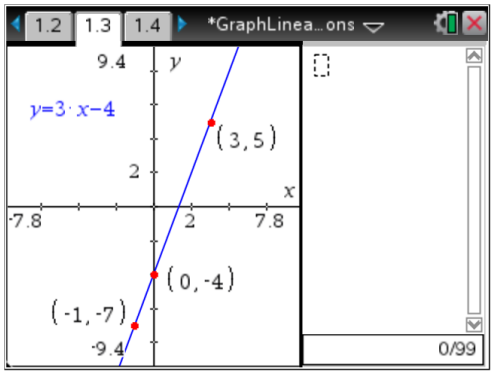
- *Theatre-Goers (TI-Nspire™ Technology) — 9638*
- *Linear Equation Investigation (TI-Nspire™ Technology) — 9592*
- *Any 2 Points Make a Line (TI-Nspire™ Technology) — 9002*

Problem 1 – Slope-intercept form of a line

On page 1.3, students first find the coordinates of the points using the **Coordinates and Equations** tool from the Actions menu.

To do so, select the tool and then arrow over to one of the points. The coordinates will lightly appear. Click once to choose the point, move the label to the desired location, and click again to place it there.

Next, students can move to the *Calculator* application (ctrl + tab) to calculate the slope of the line and use the slope formula with any pair of points shown.

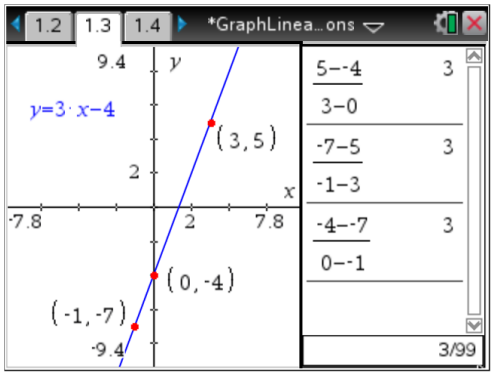


TI-Nspire Navigator Opportunity: *Live Presenter*

See Note 1 at the end of this lesson.

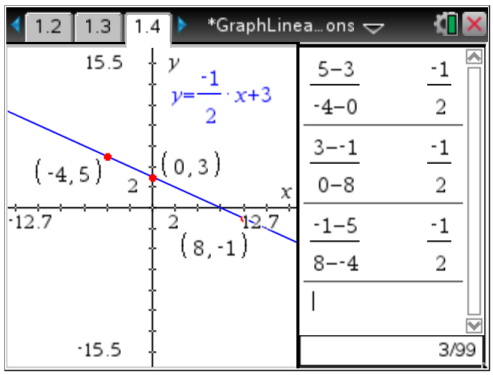
The fraction template may be accessed by pressing (ctrl + ÷). **Note**: If students choose to not use the fraction template, they must use parentheses to indicate the correct numerator and denominator of the fraction.

Remind students that the *y*-intercept is where the line crosses the *y*-axis. This is one of the points for which they found the coordinates. They should record both the slope and *y*-intercept on their worksheet.

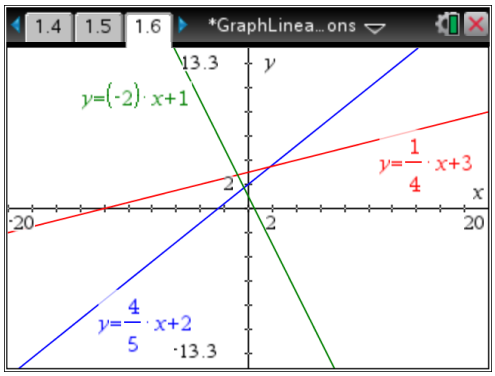


On page 1.4, students can work individually to find the coordinates of the points on the line, followed by its slope and *y*-intercept as before.

Ask students to compare their answers for pages 1.3 and 1.4 to the equations of the lines. Have a discussion about what they observe. Depending on the students' background, you should review or introduce the slope-intercept form of a line: $y = mx + b$.

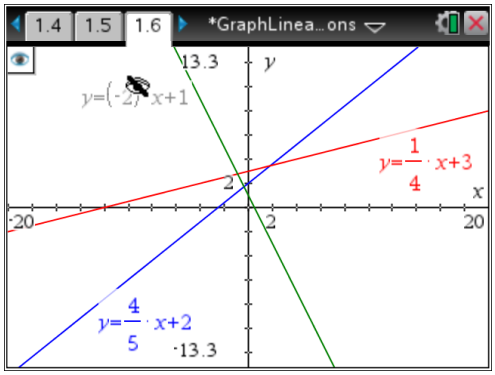


Students are asked to use that relationship to sketch three lines on their worksheet *only* (for the third example, they first need to solve the equation for *y*). If needed, tell them to plot the *y*-intercept before applying the slope to find another point on the line.



They are then invited to graph each line on page 1.6 to check their work. With the equations solved for *y*, students should use the Linear Equation Template by pressing **Menu > Graph Entry/Edit > Equation > Line > y=mx•b**.

If time permits, let students experiment with the equations and lines on this page. For example, they can change either the slope or *y*-intercept of an equation and watch how the line changes. To reduce distractions and clutter, they can use the **Hide/Show** tool (also from the Actions menu) to hide two of the equations and experiment with one line at a time.



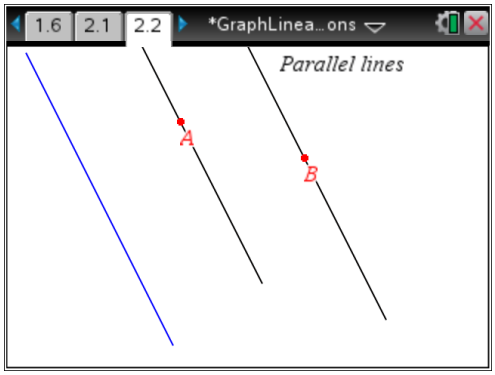
TI-Nspire Navigator Opportunity: *Class Capture*

See Note 2 at the end of this lesson.

Problem 2 – Parallel and perpendicular lines

On page 2.2, students are to construct two lines parallel to the given line, one through point *A* and the other through point *B*. To accomplish this, they should select **MENU > Geometry > Construction > Parallel**, click on the given line, and click point *A*. Repeat for point *B*.

Next, students should find the slopes of the three lines by choosing **Slope** from the Measurement menu and clicking on each line. Press enter to place the slope at the desired location.



Encourage students to observe that these three slopes are equal. (You may also wish to ask why the slopes are negative). Students can grab and rotate the original line and watch how the slopes of all the lines remain equal. If desired, this may also be a good time to investigate when the slope changes from negative to positive, and when it is undefined.

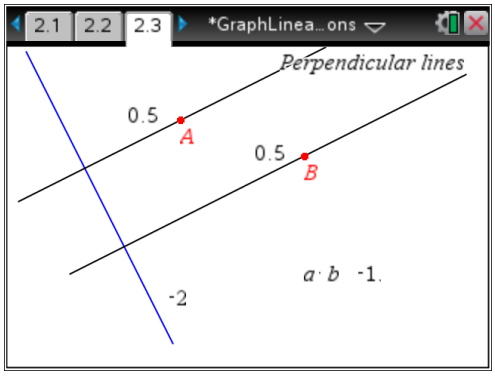
TI-Nspire Navigator Opportunity: *Quick Poll*

See Note 3 at the end of this lesson.

On page 2.3, students will use the **Perpendicular** tool (**MENU > Geometry > Construction > Perpendicular**) to draw two lines perpendicular to the given line, one passing through the each of the points *A* and *B*. Then, they should measure the slopes of each of the lines as before.

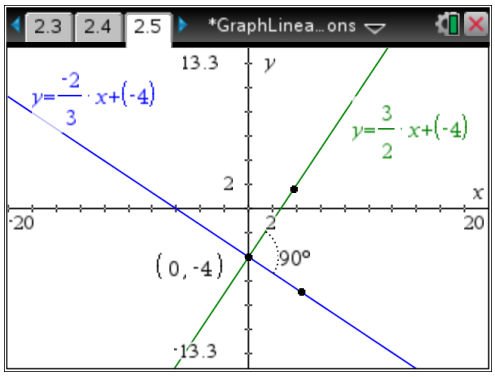
If students do not recognize the relationship between the slopes, have them use the **Text** tool to display the expression ***a* · *b***. They can then use the **Calculate** tool (Actions menu) to evaluate the product of the slope of the original line and the slope of a line perpendicular to it, obtaining –1.

Students should rotate the original line and see that the product of the slopes is always –1. That is, they are "opposite reciprocals."



Advancing to page 2.5, students are directed to graph the line that passes through (0, –4) and is *parallel* to $y = -\frac{2}{3}x + 1$.

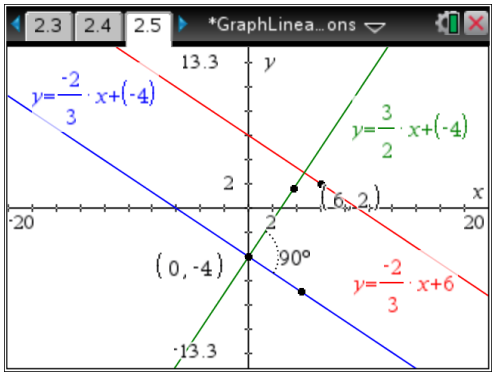
On the same page, they then graph the line that passes through (0, –4) and is *perpendicular* to $y = -\frac{2}{3}x + 1$. You can confirm that they are perpendicular by using the **Angle** tool and pressing **Menu > Geometry > Measurement > Angle**.



For the two lines just graphed, the given point was the *y*-intercept. Now, students are asked to graph the line that passes through (6, 2) and is parallel to $y = -\frac{2}{3}x + 1$.

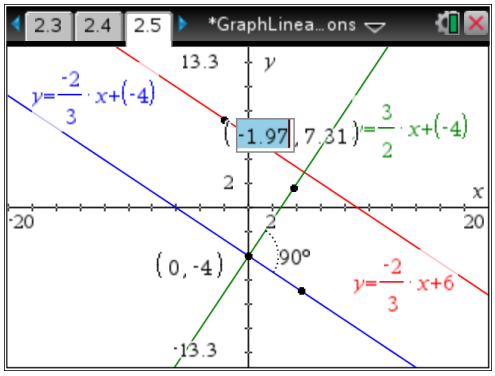
The lines are parallel, so their slopes are equal—only the *y*-intercept needs to change. But what should it be?

Here, students should write the standard equation of a line in slope-intercept form, then substitute the known slope for *m* and the coordinates of the given point for *x* and *y*. Last, they can simply solve for *b*, the *y*-intercept.



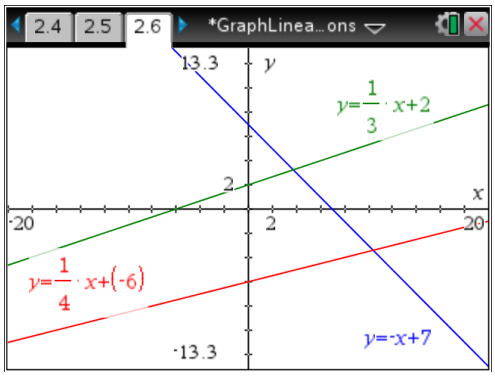
Students may check that their line passes through (6, 2) by using the **Point On** tool from the Points & Lines menu. After placing a point on the line, the coordinates automatically appear.

Press esc to close out of the **Point On** tool and click on the *x*-coordinate of the point, change it to 6, and press enter. The *y*-value will be updated according to the equation; in this case, 2.



Next, students are asked to complete a similar exercise—first graphing three lines on their worksheet and then graphing the lines again on page 2.6.

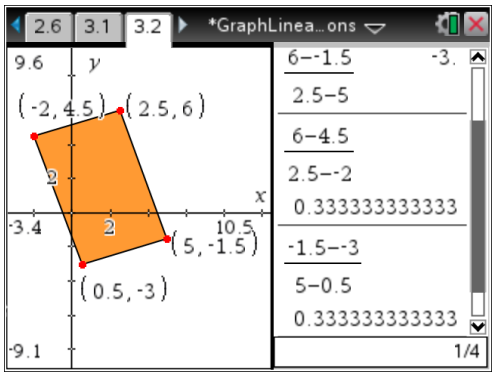
The skills they have obtained throughout the lesson will be used in many of their future mathematical endeavors, so be sure to provide assistance to any students having difficulty.



Extension

Students should use the coordinates of the vertices and the *Calculator* application on the right side of the screen to prove that the quadrilateral is a parallelogram, (by calculating slopes: a parallelogram has two pairs of parallel sides).

Then, students will prove that in addition to being a parallelogram, the figure is in fact a rectangle (by proving that the sides are perpendicular).



TI-Nspire™ Navigator™ Opportunities

Note 1
Question 1, *Live Presenter*
Use Live Presenter to demonstrate how to calculate the coordinates of each point as well as how to find the *Calculator* application to find slope.

Note 2
Question 1, *Class Capture*
Use Class Capture to monitor student progress as they work through page 1.6, offering help where necessary. If time permits, have students experiment with the equations and lines on this page. For example, they can change either the slope or *y*-intercept of an equation and watch how the line changes. Use Live Presenter to have students make predictions on the graph of an equation based on the typed equation.

Note 3
Question 2, *Quick Poll*
Send individual Quick Poll's for the following questions:

- What is the slope of a vertical line?
- What is the slope of a horizontal line?