

## Linear Functions: Slope Using Coordinates

## Student Worksheet

### Overview

The **Overview** introduces the topics covered in **Observations** and **Activities**. Scroll through the **Overview** using  $\blacktriangleright$  ( $\blacktriangleleft$  to review, if necessary). Read each screen carefully. Look for new terms, definitions, and concepts.

### Observations

The **Observations** illustrate mathematical concepts relating to finding the slope using graph coordinates. Scroll through the **Observations** using  $\blacktriangleright$  ( $\blacktriangleleft$  to review, if necessary). Read each screen carefully. When you come to a **Write an Observation** screen, stop and write the answers to the questions on your worksheet.

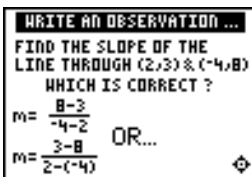


Is every set of three coordinate points collinear? Write your thoughts below.

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Which is the correct way to calculate the given slope? Write your thoughts below.

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### Activities

The **Activities** section helps you practice finding a slope using graph coordinates. You can select from two activities—**Screen Cross** or **Linked Graphing Calculators Screen Cross**. Follow these steps to play the activity and complete your worksheet.

1. Make sure you are in the **Activities** for this section.
2. Highlight an activity using  $\blacktriangleup$  or  $\blacktriangledown$ , and press  $\boxed{\text{ENTER}}$ .

**Note:** TI-84 Plus family calculators cannot use the USB unit-to-unit cable (Mini-A to Mini-B USB Cable) for the **Linked Graphing Calculators Screen Cross** game. All calculators must be linked using the I/O unit-to-unit cable in the I/O port.

### Activities (continued)



**Scoring:** You get two attempts to solve each problem. You earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

You can earn up to 10 points.

#### Screen Cross

This activity is similar to the Screen Cross in the Slope with Grid section. There is no grid displayed, but the endpoints are given.

1. Read the directions on the screen, and then press any key to continue.

**Note:** Repeat steps 2 and 3 for line segments 2 through 5.

2. Calculate the slope between the two points. Record your work below.
3. Press  $\uparrow$  or  $\downarrow$  to view the choices for the slope (**UNDEF** = undefined slope). When you think the correct slope is displayed, press **[ENTER]**.

	point 1 ( $x_1, y_1$ )	point 2 ( $x_2, y_2$ )	slope
segment #1	_____	_____	_____
segment #2	_____	_____	_____
segment #3	_____	_____	_____
segment #4	_____	_____	_____
segment #5	_____	_____	_____

4. What was your score? \_\_\_\_\_



**Scoring:** There are no points awarded in the linked version. You must answer correctly before the next line segment is shown.

The player who reaches the right side of the grid first wins.

#### Linked Graphing Calculators Screen Cross

Play Screen Cross against another student. Race another student across the screen by calculating the slopes more quickly than your opponent.

1. Connect two similar graphing calculators using a unit-to-unit cable.
2. Use the grid to help determine as quickly as possible the slope of the line segment.
3. Select the slope as you did in Screen Cross.
4. The player who reaches the right side of the grid first wins.
5. Who won? \_\_\_\_\_


**Note:** TI-84 Plus family calculators cannot use the USB unit-to-unit cable (Mini-A to Mini-B USB Cable) for this game. All calculators must be linked using the I/O unit-to-unit cable in the I/O port.

 **Try-It!™ on Your TI-83 Plus or TI-73**

Use the graphing calculator to find the slope of a line through the points (2,6) and (7,4).

The slope is:  $m = \frac{6 - 4}{2 - 7}$

To Do This on the TI-83 Plus	Press	Display (TI-83 Plus shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	<b>2nd</b> [QUIT] <b>&lt;EXIT&gt;</b> [CLEAR]	
2. Calculate the slope.	[ <b>6</b> ] [ <b>-</b> ] [ <b>4</b> ] [ <b>÷</b> ] [ <b>2</b> ] [ <b>-</b> ] [ <b>7</b> ] [ <b>]</b> [ENTER]	$(6-4)/(2-7) \quad -.4$
3. Change the fraction to a decimal. Use the <b>►Frac</b> function on the [MATH] MATH menu.	[MATH] <b>1►Frac</b> [ENTER]	$(6-4)/(2-7) \quad -.4$ Ans►Frac $-2/5$

To Do This on the TI-73	Press	Display (TI-73 shown)
1. Exit the Topics in Algebra 1 application and clear the Home screen.	<b>2nd</b> [QUIT] <b>&lt;EXIT&gt;</b> [CLEAR]	
2. Calculate the slope.	[ <b>6</b> ] [ <b>-</b> ] [ <b>4</b> ] [ <b>÷</b> ] [ <b>2</b> ] [ <b>-</b> ] [ <b>7</b> ] [ <b>]</b> [ENTER]	$(6-4)/(2-7) \quad -.4$
3. Change the decimal to a fraction.	[ <b>F◀D</b> ] [ENTER]	$(6-4)/(2-7) \quad -.4$ $-.4 \rightarrow F \leftrightarrow D$ min:2
4. Simplify the fraction. <b>Note:</b> The mode setting <b>ManSimp</b> must be selected first. For more information, see  Tip 2: <i>Adjusting Your Graphing Calculator Settings.</i>	[MODE] <b>▼</b> <b>▼</b> <b>▼</b> <b>▼</b> <b>►</b> to <b>ManSimp</b> [ENTER] [SIMP] [ENTER]	$(6-4)/(2-7) \quad -.4$ $-.4 \rightarrow F \leftrightarrow D$ $-\frac{4}{10} \rightarrow \text{SIMP} \quad \text{Fac}=2 \quad \text{min:2}$
5. Use [ <b>b/c</b> ] to enter the problem.	[ <b>b/c</b> ] <b>6</b> [ <b>-</b> ] <b>4</b> [ <b>b/c</b> ] <b>2</b> [ <b>-</b> ] <b>7</b> [ENTER]	$\frac{6-4}{2-7} \quad \text{min:2}$

 **Try-It!™ on Your TI-83 Plus or TI-73 (continued)**

**Additional Problems**

1. Calculate the same problem,  $m = \frac{6 - 4}{2 - 7}$ , on the graphing calculator from the Home screen, using the following keystrokes:

6  $\square$  - 4  $\square$   $\div$  2  $\square$  - 7  $\square$  ENTER

Did you get the same answer? If not, why not? Which answer is correct?

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2. Find the slope of the line containing the given points using the graphing calculator. Who can do these problems faster, the graphing calculator or you? You can also pair with another student and challenge each other to see who is faster at the calculations. Write your calculations and answers.
- a. (3,-4) and (-2,8)
- b. (-12,17) and (5,-6)
- c. (36,6) and (-25,6)
- d. (1.36,2.54) and (1.36,5.72)

## Linear Functions: Slope Using Coordinates

## Teacher Notes

### Objectives

- To introduce slope as a ratio as the change in  $y$  to the change in  $x$ .
- To find the slope of a line using the slope formula.
- To illustrate the characteristics of lines with positive, zero, negative, or undefined slope.
- To associate *increasing*, *horizontal*, *decreasing*, or *vertical* with the appropriate slope.

### Math Highlights

This section again highlights a review of slope as the steepness of a line. The section opens with a bike riding along a piecewise linear path. Students see the definition of slope as a ratio.

$$\text{Slope} = m = \frac{\text{rise}}{\text{run}} = \frac{\text{change in } y}{\text{change in } x} = \frac{y_2 - y_1}{x_2 - x_1}$$

Several examples of the calculations are shown. Next, the characteristics of lines with positive, zero, negative and undefined slopes are summarized.


### Common Student Errors

- Many students are concerned that they have to know which point is  $(x_1, y_1)$  and which point is  $(x_2, y_2)$ . Show that both calculations give the same answer. In the second example below, some students are confused when they see division with two negative numbers results in a positive slope. Discuss this. For the line containing the points  $(0,0)$  and  $(10,2)$ , the slope is calculated by:

$$\frac{2 - 0}{10 - 0} = \frac{1}{5} \quad \text{or} \quad \frac{0 - 2}{0 - 10} = \frac{-1}{-5} = \frac{1}{5}$$

- Watch for an incorrect substitution where students switch the order in the numerator or denominator. For the example above,

$$\text{Incorrect: } \frac{0 - 2}{10 - 0} \quad \text{or} \quad \frac{2 - 0}{0 - 10}$$

- This is a good opportunity to open a discussion on different representations of the same number. Students might write a graphing calculator answer without thinking about whether or not the representation is the best for the problem. Ask when it is most useful to have the slope represented in decimal form versus in fraction form.
- Remind students that they need to use the Order of Operations rules.
- In the  Try-It!™ section, the correct calculation is  $(6 - 4) \div (2 - 7)$ , not  $6 - 4 \div 2 - 7$  (where division would be performed before subtraction).

## Student Worksheet Notes with Answers

### Overview

Tell students:

1. How to find the **Overview**, or tell them to review the instructions on the worksheet.
2. How to navigate the application, if they are not yet familiar with the application.
3. To scroll through the **Overview** on the graphing calculator. Point out new terms, definitions, and concepts, and tell students to look for them as they go through the **Overview**.

### Observations

The **Observations** help students understand mathematical concepts relating to finding the slope using graph coordinates.

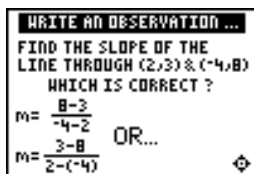
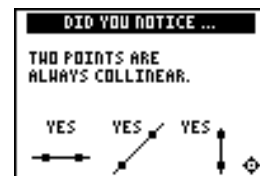
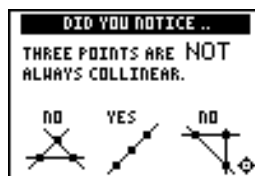
If necessary, tell students how to find the **Observations** for this section.



#### Observation 1

Is any set of three points collinear?

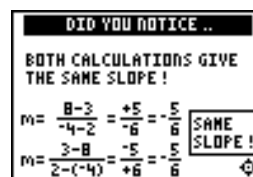
*Three points may be collinear, but are not necessarily collinear.*



#### Observation 2

Find the slope of the line through (2,3) and (-4,8).

*Students can pick either point as  $(x_1, y_1)$  and  $(x_2, y_2)$  to compute the slope using the formula.*



## Activities



**Scoring:** Students get two attempts to solve each problem. They earn 2 points for a correct answer on the first try, 1 point for a correct answer on the second try.

Students can earn up to 10 points.

### Screen Cross

Tell students to:

1. Read the directions on the screen, and then press any key to continue.  
**Note:** Repeat steps 2 and 3 for line segments 2 through 5.
2. Calculate the slope between the two points. Record their work.
3. Press  $\uparrow$  or  $\downarrow$  to view the choices for the slope (**UNDEF** = undefined slope). When they think the correct slope is displayed, press **[ENTER]**. Record the endpoints and slopes for each segment. The segments are different on each graphing calculator and each time the game is played.
4. Record their final score.



**Scoring:** There are no points awarded in the linked version. Students must answer correctly before the next line segment is shown.

The player who reaches the right side of the screen first wins.

### Linked Graphing Calculators Screen Cross

Tell students to:

1. Connect two similar graphing calculator s using a unit-to-unit cable.
2. Try to determine as quickly as possible the slope of the line segment.
3. Select the slope as they did in Screen Cross.
4. The player who reaches the right side of the screen first wins.

**Note:** TI-84 Plus family calculators cannot use the USB unit-to-unit cable (Mini-A to Mini-B USB Cable) for this game. All calculators must be linked using the I/O unit-to-unit cable in the I/O port.

 **Try-It!™ on Your TI-83 Plus or TI-73**

Students investigate how to input the calculation for slope on the Home screen. See the Student Worksheet for instructions.

Warn students about the correct use of parentheses. They need to be reminded of the Order of Operations rules. Notice that the TI-73 has stacked fraction capabilities; therefore, the calculation is performed correctly without parentheses.

**Additional Problems**

1. Students input  $6-4/2-7$  in the graphing calculator. The graphing calculator computes  $6 - (4 \div 2) - 7 = -3$  since division is performed before subtraction according to the Order of Operation rules. This is *not* the correct answer. Students need to be aware that parentheses, such as  $(6 - 4) \div (2 - 7)$ , override the Order of Operation rules.
2. Students practice calculating the slope using the graphing calculator, but remind students that they can compute these answers faster than the graphing calculator can! Pair students and challenge them to try to beat the graphing calculator.

a.  $(3,-4)$  and  $(-2,8)$   $\text{slope} = -\frac{12}{5}$

b.  $(-12,17)$  and  $(5,-6)$   $\text{slope} = -\frac{23}{17}$

c.  $(36,6)$  and  $(-25,6)$   $\text{slope} = 0$

d.  $(1.36,2.54)$  and  $(1.36,5.72)$   $\text{slope} = \text{undefined}$