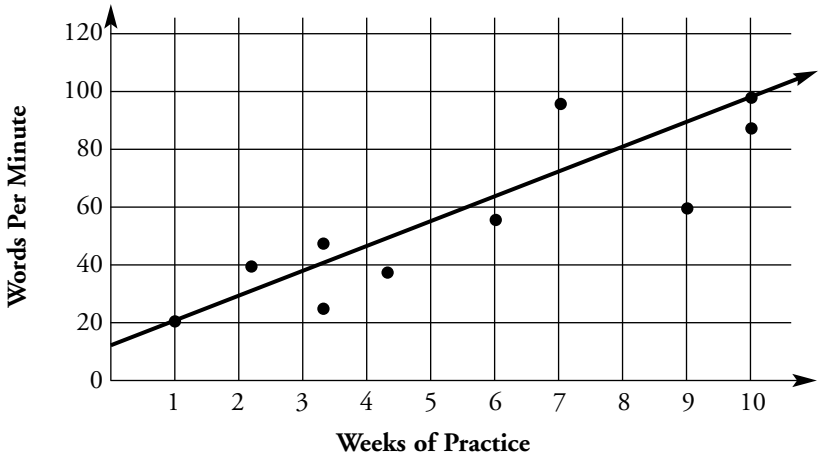
Learning Project 7 The Coordinate Plane, Intercepts and Slopes

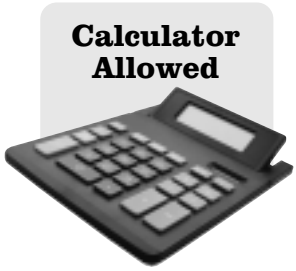
Inquiry Activity 7–4: A Line of Best Fit/Slope

(Note: Italicized portions should be directed to students.)

1. Identifying the Problem (Item #6, PA) Calculator allowed.

Read the question carefully, as you would if taking the actual test.





Partners for Excellence offers its employees training classes to improve their typing skills. The graph above shows the typing speed results of 10 employees, as well as the line of best fit showing typing speed based on these results. The line of best fit can be used to make predictions for future employees who wish to take the classes.

6. The slope of the line of best fit represents the increase in words per minute for each additional week of practice. Based on the slope of the line, by how many words per minute can an employee expect to increase her or his speed for each additional week of practice?

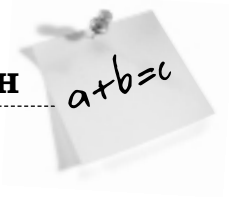
(1) 8
(2) 20
(3) 25
(4) 80
(5) 100

Here are some problem clarification questions you may want to consider when reading test questions.

What words and/or symbols might be important to understand to answer this problem and what are they telling you?

Cannot know what words the learner will choose. The following represents a possible, though non-exclusive, list: line of best fit, additional week of practice, words per minute, slope, increase.

What words and/or symbols are unfamiliar and what do you think they mean?



2. Becoming Familiar with the Problem

Ask yourself questions like these about the problem, taking note of the ones that were especially helpful so that you can remember to use them when you take the test.

Reread the question. What are you being asked to find?

What do you know about this?

What information in the graph is relevant to what you need to solve the problem?

3. Planning, Assigning and Performing Tasks.

Try to answer the test question any way you can, even if you have to guess, but try to be aware of the reasoning and operations that you are using. The following questions can be helpful.

In your own words, determine what to look for in the graph.

By how much does the line go up each week?

Estimate an answer.

Eliminate answer choices that are not reasonable.

Again, only the correct answer, 8, is reasonable

Choose an answer. Be ready to explain how you found it.

4. Sharing with Others

Telling other people what you know helps you to understand the material better. So take this opportunity not only to share your knowledge, but also to learn it more completely.

Small Groups: *Compare your answer to others in the group and explain why you think yours is correct.*

Agree on the correct answer, the steps you would recommend to find it, and the reasoning that supports it.

The critical underlying task is to translate the question into what it means on the graph – how much does the line go up each week? A close inspection shows that the line rises less than half a space each week. Since each space represents 20 wpm, 8 is the only answer choice that fits. Be prepared for students to take a variety of steps for a variety of reasons here. The formal definition of 'slope' will be discussed in the reflection step later.

Use the overhead transparency of the graphic in the item to help the students refer to specific points when they are reporting to the whole class.

Whole class: *Report your group's answer to this question, the steps that you recommend to find it, and the reasoning that supports them.*

Take notes on the different ways that others used to find the answer.

5. Reflecting, Extending and Evaluating

Reflecting: Think about what you learned. (A group activity or instructor led.)

Here are some questions to start you thinking about the experience you just had. Thinking about what you have learned and experienced is part of the learning process. When the focus is only on the answer, you don't get much time to think about what was learned.

What general ideas were present in all the solution methods that the groups presented?

Most of them would have used a method that involved inspecting the graph and counting the number of squares. These visual, graphical concepts underlying the idea of slope are the most critical to emphasize at this level.

The slope of a line indicates the rate of change. Mathematically speaking, *t* is the ratio of vertical change to horizontal change or rise over run. Practically speaking, in this case, it refers to the increase in typing speed per week of practice.

It doesn't matter where they looked on the line to determine the slope; the change per week is the same each week, when you are dealing with a straight line.

Find some problems to practice finding the slope of a line from its graph.

The graph in this item is not ideal for this purpose because of the estimating required. Unfortunately, most traditional algebra textbooks immediately emphasize calculating the slope with the formula, without providing the graphical understanding first. There are some good exercises in Lesson 24 of the *Problem Solver* and on page 214 of *Smart Solutions: Comprehensive Math Review.*

Extending: Extend what you learned to new situations.

In extending, you are being asked to transfer the information presented in the Practice Test question to other information or situations you already know and maybe make new connections to other information.

The following questions about the slope formula are placed in the Extending section because the formula is not necessary to answer this question. However, by studying the formula, students will confront the mystery of subscripts and gain in their ability to understand what a complex formula instructs them to do.

Look on the formulas page of the Practice Test to find the mathematical formula that summarizes in mathematical language the process to use when finding the slope of a line. In your own words, explain what the formula tells you to do.

It says to find the difference between the y-values of two points and then divide (or compare in a ratio) that number by the difference between the x-values of the points. The subscripts are necessary so that the same order is maintained in both subtractions.

How is your method of finding the answer similar to the mathematical way?

Noticing how much change there was in the position of the line from week to week is the same as subtracting the y-values. The difference in the x-values is just 1, so no division had to be done.

In the previous activities, you have talked about two points on this line, (0,17) and (8,80). Use these two points and the formula to find the slope.

It doesn't matter which point is assigned as (x_1, y_1). $\frac{80 - 17}{8 - 0}$ ∪8, and $\frac{17 - 80}{0 - 8} = \frac{-63}{-8}$ ∪8.

Find some problems in your math books to use for practice finding the slope of a line using the formula.

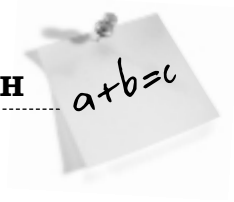
These will be easier to find.

Next, you should refer back to a previous Learning Project and emphasize (again) that the slope of the line indicates the rate of change.

Connect what you have learned about slope of a line in this activity to what you learned before in Inquiry Activity 1-4.

Explain a major difference between the slope of a straight line and the slope of a curved line.

The slope of a straight line does not change while the slope of a curved line does.



Compare your experience in learning to type (or learning some other skill) to the story told by the slope of the graph. Would you say that the rate of increase was the same in the early weeks as it was in the later weeks? Make a sketch of how your experience would be pictured or graphed.

Ask this question as a Just-in-Time assessment of whether students understood the idea that a steeper line will picture the greater rate of change.

Learning some tasks goes faster in the first stages and then slows down during the last stages. To picture this, start with a steep line (or curve) for the first weeks and follow it by a shallower line. Other tasks are very difficult at first, but once you catch on, progress is rapid. To picture this, a shallow slope for the first weeks will be followed by a steeper curve for the remaining time.

Noting that the slope of the line in the graph in this item is a positive number, what would you guess the slope of the curve in Activity 1-4 would be? Write a sentence that connects the two ideas of the sign of the slope and the overall story of the graph.

A positive slope tells a story of a value that increases while a negative slope tells a story of a decreasing value.

What story does a graph of a horizontal line tell?

A horizontal line tells a story of no change over time.

Finally, you may also want to connect the ideas of slope and rate of change with the equation of a straight line, $y = mx + b$ where m is the slope and b is the y-intercept. This connection is empowering for the student even though it may be a little academic for the GED test. For additional practice, look in algebra books for questions that involve a story rather than just naked numbers.

Connect what you have learned about slope of a line in this activity to the equation that was the answer for item #19 (IA3-1).

In the function, $T = 2x + 300$, how much does T (total cost) change when x (number of people attending) increases by 1? (As an example, you may want to use some easy numbers like 10 and 11 for x.)

The total cost increases by $2 with each additional person who attends.

Does this rate of change remain the same or does it change?

It remains the same.

Will the graph of this function be a straight line or a curve? What is its slope?

It will be a straight line with a slope of 2. Practically speaking, the slope in this case refers to the number of dollars per person.

Where do you see the slope (2) in the equation?

It is the number being multiplied by x.

Evaluating: Assess what you learned and how you learned it.

In this last step, you get a chance to review the content of what you learned and the methods used to learn. There are no right or wrong answers to these questions; it is your chance to look more closely at your learning style and the opportunity to state how you benefited or didn't benefit from the content and/or the methods to help you pass the GED test.

Write a few sentences that describe the progress toward your learning goals that you have made in this Learning Project.

Tell about how you think you can use the new knowledge and skills in your everyday life.

On which topics do you want more practice?