

Printing Books

By – Stephanie Amato and Monica Mowery

Activity Overview

1. In this activity, students will create functions based on real-life scenarios, fill out a table of values, and critically analyze characteristics of graphs.
2. At the sixth grade level, this activity can be used to identify patterns and help students visualize a function on a graph.
3. At the seventh and eighth grade levels, student can formulate a function and critically analyze the function in three ways: graphically, in a table, and as an equation.

Teacher Note

This activity includes sixth grade standards, however it may prove to be advanced for a standard sixth grade class. Therefore, this program may be best utilized in an advanced sixth grade class.

Concepts

Tennessee State Standards:

Grade Six

Grade Level Expectation:

GLE 0606.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

GLE 0606.3.5 Use multiple representations including symbolic algebra to model and/or solve contextual problems that involve linear relationships.

Checks for Understanding:

0606.1.7 Formulate questions, design studies, and collect real world data.

0606.3.6 Use equations to describe simple relationships shown in a table or graph.

0606.3.7 Move fluently between different representations (such as verbal, tabular, numerical, algebraic, and graphical) of equations and expressions.

0606.3.8 Represent patterns using words, graphs, and simple symbolic notation.

0606.3.9 Write a contextual story modeled by a given graph.

State Performance Indicators:

SPI 0606.1.1 Make conjectures and predictions based on data.

SPI 0606.3.3 Write equations that correspond to given situations or represent a given mathematical relationship.

SPI 0606.3.5 Translate between verbal expressions/sentences and algebraic expressions/equations.

SPI 0606.3.6 Solve two-step linear equations using number sense, properties, and inverse operations.

Grade Seven

Grade Level Expectation:

GLE 0706.1.5 Use mathematical ideas and processes in different settings to formulate patterns, analyze graphs, set up and solve problems and interpret solutions.

GLE 0706.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

GLE 0706.3.6 Conceptualize the meanings of slope using various interpretations, representations, and contexts.

GLE 0706.3.7 Use mathematical models involving linear equations to analyze real-world phenomena.

Checks for Understanding:

0706.1.6 Develop meaning of intercept and rate of change in contextual problems.

0706.3.11 Relate the features of a linear equation to a table and/or graph of the equation.

0706.3.12 Use linear equations to solve problems and interpret the meaning of slope, m , and the y -intercept, b , in $f(x) = mx + b$ in terms of the context.

State Performance Indicators:

SPI 0706.1.2 Generalize a variety of patterns to a symbolic rule from tables, graphs, or words.

SPI 0706.3.7 Translate between verbal and symbolic representations of real-world phenomena involving linear equations.

SPI 0706.3.8 Solve contextual problems involving two-step linear equations.

Grade Eight

Grade Level Expectation:

GLE 0806.1.3 Develop independent reasoning to communicate mathematical ideas and derive algorithms and/or formulas.

GLE 0806.1.8 Use technologies/manipulatives appropriately to develop understanding of mathematical algorithms, to facilitate problem solving, and to create accurate and reliable models of mathematical concepts.

GLE 0806.3.4 Translate among verbal, tabular, graphical and algebraic representations of linear functions.

GLE 0806.3.5 Use slope to analyze situations and solve problems.

Checks for Understanding:

0806.1.2 Draw qualitative graphs (trend graphs) of functions and describe their general shape/trend.

0806.3.6 Identify x - and y -intercepts and slope of linear equations from an equation, graph or table.

State Performance Indicators:

SPI 0806.3.5 Determine the slope of a line from an equation, two given points, a table or a graph.

SPI 0806.3.6 Analyze the graph of a linear function to find solutions and intercepts.

Teacher Preparation

Before the activity, the teacher should pre-load the activity file Printing Book.tns on to the student handheld devices. This can be done via Connect-to-Class software, TI-Nspire computer link software, or by using link cables with the handhelds.

Classroom Management Tips

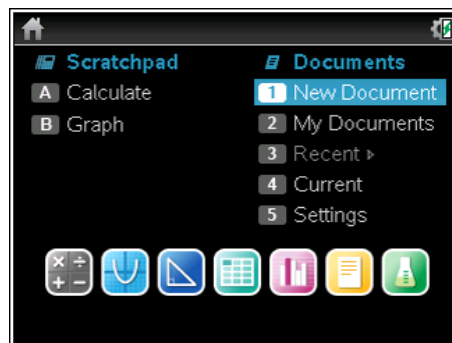
1. This activity can be done by the students using the pre-made document file or by them creating various parts of the file as chosen by the teacher.
2. This activity is intended to be student-centered with the students working in small cooperative groups.

TI-Nspire Applications

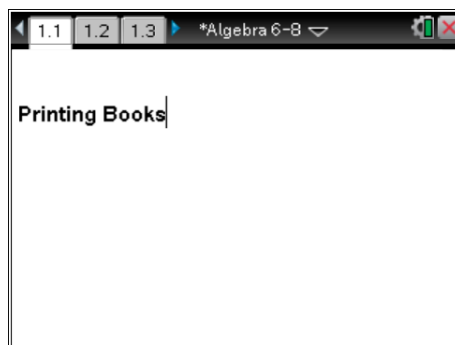
- Notes
- Lists & Spreadsheets
- Data & Statistics
- Calculator Page

Step-by-Step Directions

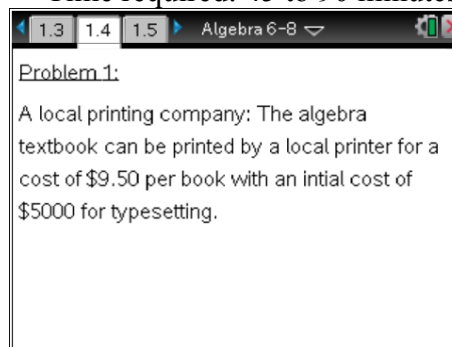
1. From the home screen, choose My Documents and navigate to the appropriate folder containing the .tns file Printing Books. Highlight the file and press \bullet . Choose whether or not to save changes to any previous document.



2. Page 1.1 is the title page for this activity. Press \swarrow and \searrow to navigate through the document. Pressing \swarrow will give you a thumbnail view of all pages in the document. Page 1.2 lists standards addressed in the activity.



3. Based on the story in 1.3, 1.4 introduces the first of three problems. Students are presented with these problems and prompted to create a function on the following pages.

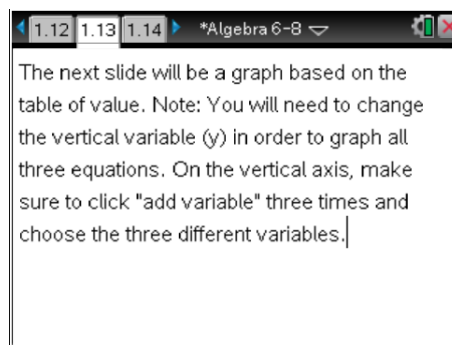


4. After creating the functions, students are prompted to complete the table of values on the next page. Students may complete the spreadsheet one cell at a time or use the gray formula cells.

The screenshot shows a spreadsheet window titled "Algebra 6-8" with tabs for 1.9, 1.10, and 1.11. The spreadsheet has columns labeled "no_books", "printing_co", "copy_ctr", and "school". The "printing_co" column contains the formula $=9.5 \times x[] + 5000$. The "no_books" column has values 0, 25, 50, 75, and 100. The "copy_ctr" column has a formula $=9.5 \times x[] + 5000$. The "school" column is empty.

	no_books	printing_co	copy_ctr	school
1	0	$=9.5 \times x[] + 5000$		
2	25			
3	50			
4	75			
5	100			

5. 1.13 prompts the students on how to graph the table of values in the following page.

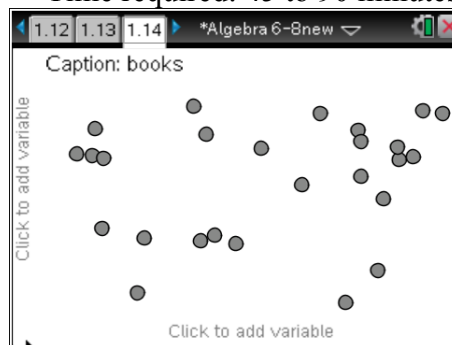


Grade level: 6-8

Subject: Mathematics

Time required: 45 to 90 minutes

- Click in the areas at the bottom and left portions of the screen to add the variables in the relationship that you wish to graph. To add additional y-variables, go to Plot Properties and Add Y-Variable.



- In the next three slides, students will refer back to 1.5, 1.7, 1.9, and 1.14 to answer questions about slope.

Question

Looking at the function on slide 1.5, what is the slope? How does slope affect the cost of books? (Hint-refer to your graph.)

Answer ▾

- In the next three slides, students will refer back to 1.5, 1.7, 1.9, and 1.14 to answer questions about the y-intercept.

Question

Looking at the function in slide 1.5, what is the y-intercept?(Hint: plug in x=0 or 0 amount of books.) Check your answer by looking at the graph. What does the y-intercept represent?

Answer ▾

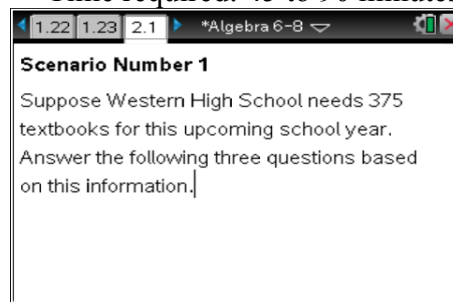
- In the next three slides, students will be asked to determine points of intersection by examining the table of values, computationally, and graphically.

Question

Using the table of values, where do the points of intersection lie in respect to the printing company function and the copy center function? What does this mean?

Answer ▾

10. In the next slide, students are given a scenario and asked to determine the best deal based on the equations, table of values, and the graph. If time allows, students should proceed to Scenario 2 and 3 using similar strategies from Scenario 1.



Assessment & Evaluation

Problem 1:

A local printing company: The algebra textbook can be printed by a local printer for a cost of \$9.50 per book with an initial cost of \$5000 for typesetting.

Q: Write a function for the scenario from 1.4.

A: $y = 9.5x + 5000$ or cost = \$9.5(number of books) + \$5000

Problem 2:

A local company center: The algebra textbook can be duplicated at a local copying center for \$0.05 per page plus \$2.00 per book for binding.

Q: Write a function for the scenario from 1.6.

A: $y = 0.05 * 325 + 2x = 18.25x$ or cost = 18.25 (number of books)

Problem 3:

The school district: The school district's own copying center can reproduce the text book at a cost of \$0.035 per page plus an up-front cost of \$3000.

Q: Write a function for the scenario from 1.8.

A: $y = 0.035 * 325x + 3000 = 11.375x + 3000$ or cost = 11.375 (number of books) + \$3000

Q: Looking at the function on slide 1.5, what is the slope? How does slope affect the cost of books? (Hint-refer to your graph.)

A: The slope is 9.5. This means the cost per book is \$9.50 and the steeper the slope, the faster the cost rises.

Q: Looking at the function on slide 1.7, what is the slope? How does slope affect the cost of books? (Hint-refer to your graph.)

A: The slope is 18.25. This means that the cost per book is \$18.25 and the steeper the slope, the faster the cost rises.

Q: Looking at the function on slide 1.9, what is the slope? How does slope affect the cost of books? (Hint-refer to your graph.)

A: The slope is 11.375. This means that the cost per book is \$11.38 and the steeper the slope, the faster the cost rises.

Q: Looking at the function in slide 1.5, what is the y-intercept? (Hint: plug in $x=0$ or 0 amount of books.) Check your answer by looking at the graph. What does the y-intercept represent?

A: $y = 9.5 * 0 + 5000 = 5000$. The y-intercept is 5000, which means there is an initial cost of \$5000 before any books are purchased.

Q: Looking at the function in slide 1.7, what is the y-intercept? Check your answer with the graph. What does the y-intercept represent?

A: $y = 18.25 * 0 = 0$. The y-intercept is 0 and thus, there is no initial cost for the books.

Q: Looking at the function in 1.9, what is the y-intercept? Again, check your answer with the graph. What does the y-intercept represent?

A: $y = 11.375 * 0 + 3000 = 3000$. The y-intercept is 3000 which means there is an initial cost of \$3000.

Q: Using the table of values, where do the points of intersection lie in respect to the printing company function and the copy center function? What does this mean?

A: The points of intersection lie somewhere around 575 books. This means that the cost of about 575 books is the same for the printing company and the copy center.

Q: Using the functions found in slides 1.5 and 1.7, set the equations equal to each other and find their points of intersection. Is this value about the same as the value found in the table?

A: $9.5x + 5000 = 18.25x$

$$5000 = 8.75x$$

$$x = 571$$

Yes, it is about the same because the point of intersections fell around 575 in the table.

Q: Using the table of values, where do the points of intersection lie in respect to the copy center function and the school district? What does this mean?

A: The points of intersection lie somewhere between 425-450 books. This means that the cost of between 425 to 450 books is the same for the copy center and the school district.

Q: Using the equations found in slides 1.7 and 1.9, set them equal to each other and find their points of intersection. Is this value about the same as the value found in the table?

A: $18.25x = 11.375x + 3000$

$$6.875x = 3000$$

$$x = 436$$

Yes, 436 books fell in between the range of 425 to 450 books.

Scenario Number 1

Suppose Western High School needs 375 textbooks for this upcoming school year. Answer the following three questions based on this information.

Q: Based on the graph, what option would be the best deal for Western High School? Describe specific features of the graph that determine what the best option would be.

A: The copy center would be the best deal. When you look at the x-axis at 375 books and go up the y-axis, the copy center line is the line that is the lowest on the graph at that x value.

Q: Based on the table of values, what option is the best deal for Western? How do you determine this from the table?

A: When looking at the values at 375 books, the copy center has the lowest cost at \$6843.75.

Q: Based on the functions in slides 1.5, 1.7, and 1.9, plug in the number of books and determine the best deal based on the output.

A: Printing Company

Copy Center

School District

$$y = 9.5 * 375 + 5000$$

$$y = 18.25 * 375$$

$$y = 11.375 * 375 + 3000$$

$$y = \$5187.50$$

$$y = \$6843.75$$

$$y = \$7265.63$$

The best deal is the copy center.

Scenario 2

Eastern High School needs 500 books this school year. Answer the following questions:

Q: Based on the graph, what option would be the best deal for Eastern High School? Describe specific features of the graph that would determine what the best option would be.

A: The school district would be the best deal. When you look at the x-axis at 500 books and go up the y-axis, the school district's line is the line that is the lowest on the graph at that x value.

Q: Based on the table on slide 1.11, what option is the best deal for Eastern High School? How did you determine this?

A: When looking at the values at 500 books, the school district has the lowest cost at \$8687.50.

Q: Based on the functions in slide 1.5, 1.7, and 1.9, plug in the number of books needed and determine the best deal based on the output.

A: Printing Center

Copy Center

School District

$$y = 9.5 * 500 + 5000$$

$$y = 18.25 * 500$$

$$y = 11.375 * 500 + 3000$$

$$y = \$9750$$

$$y = \$9125$$

$$y = \$8687.50$$

The best deal is the school district.

Scenario Number 3

Suppose Northern High School need 600 books for this upcoming school year. Answer the following three questions based on this information.

Q: Based on the graph, what option would be the best deal Northern High School? Describe specific features of the graph that would determine what the best option would be.

A: The school district would be the best deal. When you look at the x-axis at 600 books and go up the y-axis the school district's line is the line that is the lowest on the graph at that x value.

Q: Based on the table of values, what option is the best deal for Northern? How do you determine this from the table?

A: When looking at the values at 600 books, the school district has the lowest cost at \$9825.

Q: Based on the functions in slides 1.5, 1.7, and 1.9, plug in the number of books and determine the best deal based on the output.

A: Printing Center

Copy Center

School District

$$y = 9.5 * 600 + 5000$$

$$y = 18.25 * 600$$

$$y = 11.375 * 600 + 3000$$

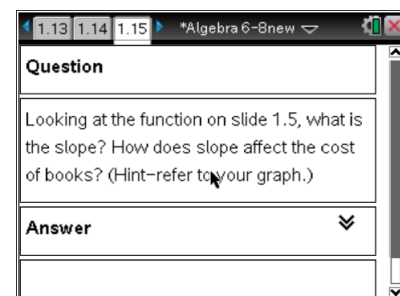
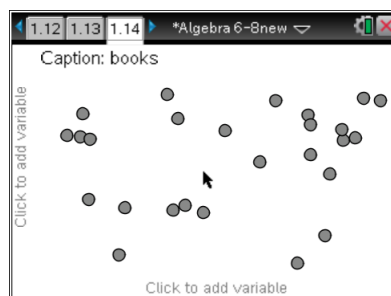
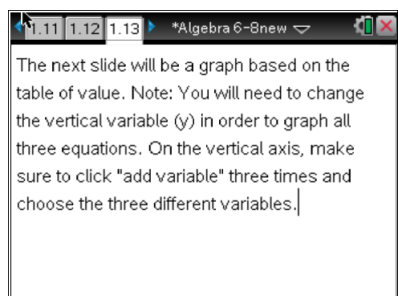
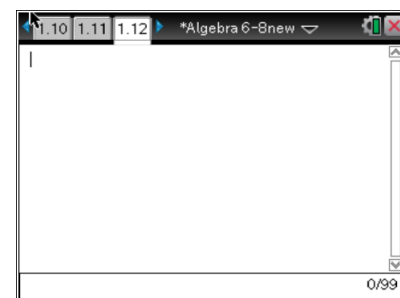
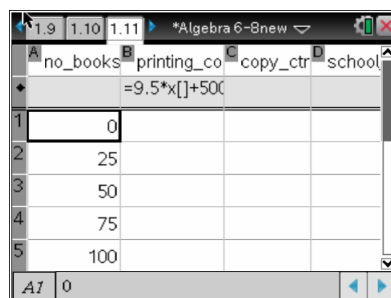
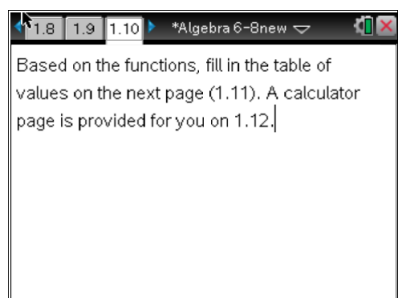
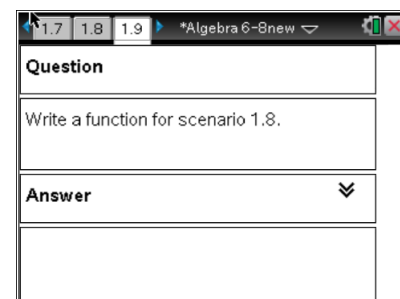
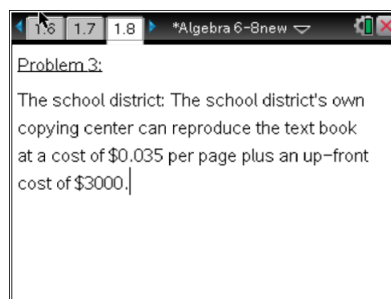
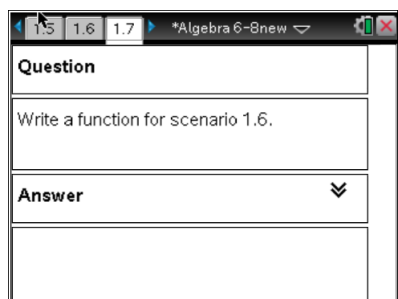
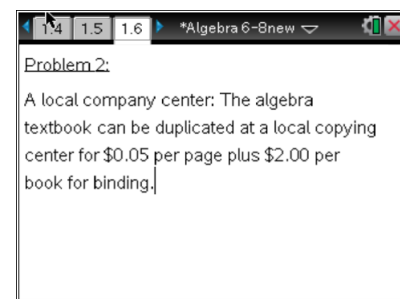
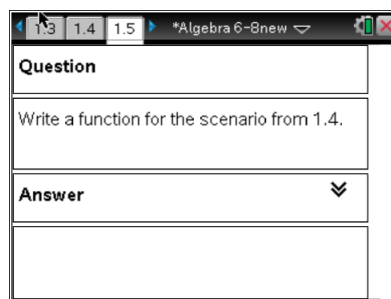
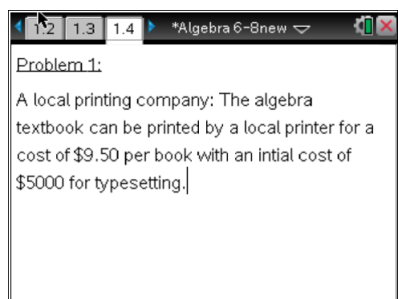
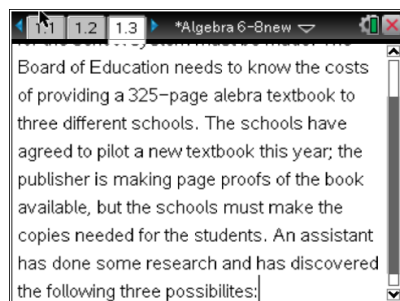
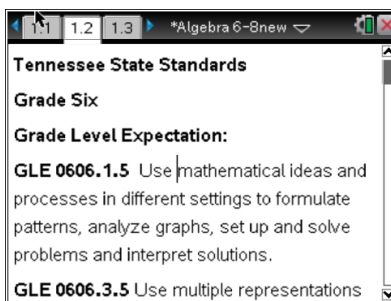
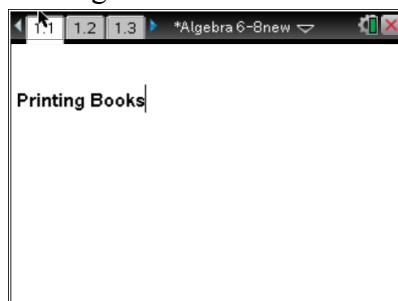
$$y = \$10700$$

$$y = \$10950$$

$$y = \$9825$$

The school district is the best deal.

Student TI-Nspire Document Printing Books.tns



Grade level: 6-8
 Subject: Mathematics
 Time required: 45 to 90 minutes

1.14 1.15 1.16 *Algebra 6-8new

Question

Looking at the function on slide 1.7, what is the slope? How does slope affect the cost of books? (Hint—refer to your graph.)

Answer

1.15 1.16 1.17 *Algebra 6-8new

Question

Looking at the function on slide 1.9, what is the slope? How does slope affect the cost of books? (Hint—refer to your graph.)

Answer

1.16 1.17 1.18 *Algebra 6-8new

Question

Looking at the function in slide 1.5, what is the y-intercept? (Hint: plug in $x=0$ or 0 amount of books.) Check your answer by looking at the graph. What does the y-intercept represent?

Answer

1.17 1.18 1.19 *Algebra 6-8new

Question

Looking at the function in slide 1.7, what is the y-intercept? Check your answer with the graph. What does the y-intercept represent?

Answer

1.18 1.19 1.20 *Algebra 6-8new

Question

Looking at the function in 1.9, what is the y-intercept? Again, check your answer with the graph. What does the y-intercept represent?

Answer

1.19 1.20 1.21 *Algebra 6-8new

Question

Using the table of values, where do the points of intersection lie in respect to the printing company function and the copy center function? What does this mean?

Answer

1.20 1.21 1.22 *Algebra 6-8new

Question

Using the functions found in slides 1.5 and 1.7, set the equations equal to each other and find their points of intersection. Is this value about the same as the value found in the table?

Answer

1.21 1.22 1.23 *Algebra 6-8new

Question

Using the table of values, where do the points of intersection lie in respect to the copy center function and the school district? What does this mean?

Answer

1.22 1.23 1.24 *Algebra 6-8new

Question

Using the equations found in slides 1.7 and 1.9, set them equal to each other and find their points of intersection. Is this value about the same as the value found in the table?

Answer

1.23 1.24 2.1 *Algebra 6-8new

Scenario Number 1

Suppose Western High School needs 375 textbooks for this upcoming school year. Answer the following three questions based on this information.

1.24 2.1 2.2 *Algebra 6-8new

Question

Based on the graph, what option would be the best deal for Western High School? Describe specific features of the graph that determine what the best option would be.

Answer

2.1 2.2 2.3 *Algebra 6-8new

Question

Based on the table of values, what option is the best deal for Western? How do you determine this from the table?

Answer

2.2 2.3 2.4 *Algebra 6-8new

Question

Based on the functions in slides 1.5, 1.7, and 1.9, plug in the number of books and determine the best deal based on the output.

Answer

2.3 2.4 3.1 *Algebra 6-8new

Scenario 2

Eastern High School needs 500 books this school year. Answer the following questions:

2.4 3.1 3.2 *Algebra 6-8new

Question

Based on the graph, what option would be the best deal for Eastern High School? Describe specific features of the graph that would determine what the best option would be.

Answer

Grade level: 6-8

Subject: Mathematics

Time required: 45 to 90 minutes

3.1 3.2 3.3 *Algebra 6-8new

Question

Based on the table on slide 1.11, what option is the best deal for Eastern High School? How did you determine this?

Answer

3.2 3.3 3.4 *Algebra 6-8new

Question

Based on the functions in slide 1.5, 1.7, and 1.9, plug in the number of books needed and determine the best deal based on the output.

Answer

3.3 3.4 4.1 *Algebra 6-8new

Scenario Number 3

Suppose Northern High School need 600 books for this upcoming school year. Answer the following three questions based on this information.

4.1 4.2 4.3 *Algebra 6-8new

Question

Based on the table of values, what option is the best deal for Northern? How do you determine this from the table?

Answer

3.4 4.1 4.2 *Algebra 6-8new

Question

Based on the graph, what option would be the best deal Northern High School? Describe specific features of the graph that would determine what the best option would be.

Answer

4.2 4.3 4.4 *Algebra 6-8new

Question

Based on the functions in slides 1.5, 1.7, and 1.9, plug in the number of books and determine the best deal based on the output.

Answer

4.3 4.4 4.5 *Algebra 6-8new

This activity was adapted from *Navigating through Algebra in Grades 6-8*, a publication from the National Council of Teachers of Mathematics Navigation Series.

This activity was adapted from *Navigating through Algebra in Grades 6-8*, a publication from the National Council of Teachers of Mathematics Navigation Series.