TI-nspire™

Grade level: 9-12
Subject: Algebra II
Time required: 45 minutes

Quadratic Connections

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Activity overview

Students will investigate how the parameters a, b, and c for the function $f(x) = ax^2 + bx + c$ change its graph. In addition, first and second differences and their relationships to the values of a, b, and c is explored.

Concepts

- Deriving an equation for a quadratic given its first and second differences.
- Deriving a shortcut for finding the coordinates of the vertex of the parabola.
- Explain the value of each parameter to the resulting graph of $f(x) = ax^2 + bx + c$.

Teacher preparation

Students need to understand how to read the cells of a spreadsheet.
Students need to understand how to enter a formula to a cell of a spreadsheet and fill it down.

The screenshots on pages 2-4 demonstrate expected student results. Refer to the screenshots on page 5-6 for a preview of the student .tns file.

Classroom management tips

This activity is designed to be student-centered with the teacher acting as a facilitator while students work cooperatively. The student worksheet is provided for students to record their answers to the questions asked in the activity.

You may have students share their methods to solve the problem on page 1.16 with the whole class to summarize and develop what was gained from the activity.

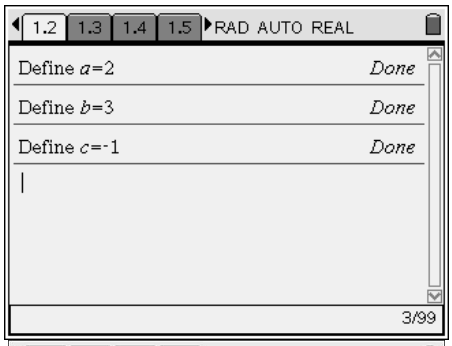
TI-Nspire Applications

Graphs & Geometry, Notes, Calculator, Lists & Spreadsheet

What is the value of a? **2**

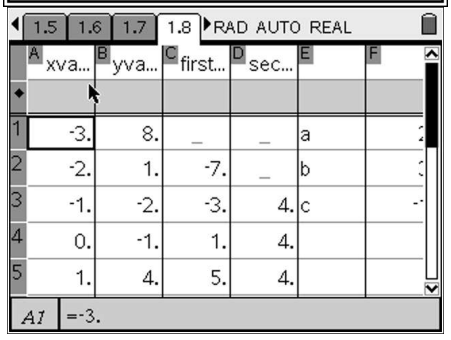
What is the value of b? **3**

What is the value of c? **-1**



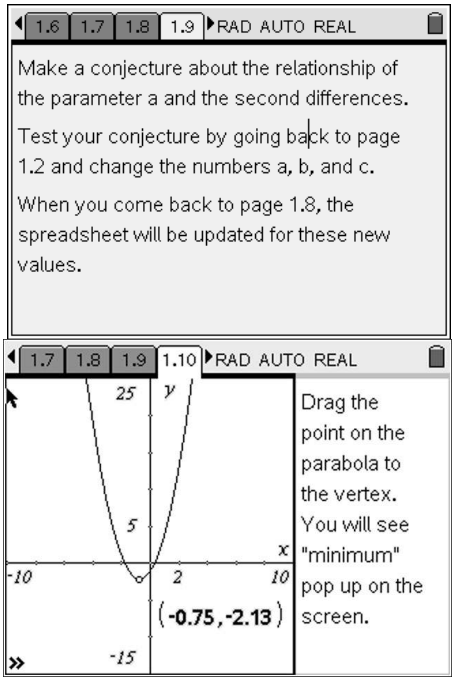
Students may need to be directed to the entry line at the bottom of the screen for the cell formula. Also, point out that the increment for the x-values is 1.

The first differences are the differences of successive y-values in the table.
The second differences are the differences of successive first differences.



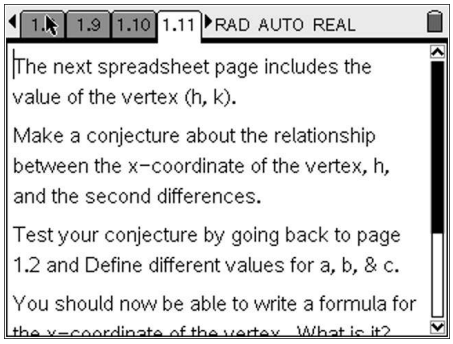
The second difference = 2a.

In order to change the values of "a" the students need to up arrow and highlight one of the Define statements, enter to bring it to a new line, and change the value.

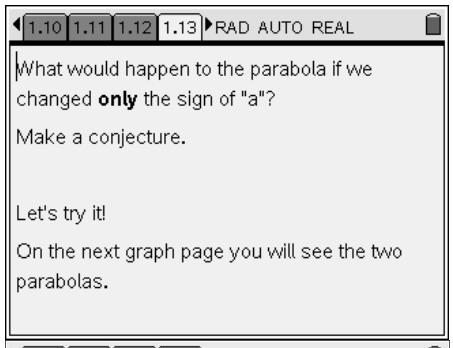


$$h = -\frac{b}{2nd\ diff} = -\frac{b}{2a}$$

To find the y-coordinate, plug this value into the equation for x.

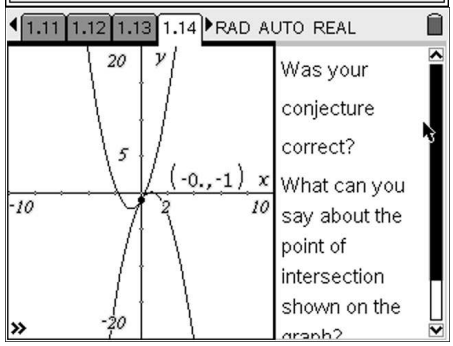


.
Don't correct student responses at this point. Many might say it will flip the parabola over, and not think about the role of "a" in moving the vertex at this point.



Changing "a" flipped the parabola and moved the vertex.

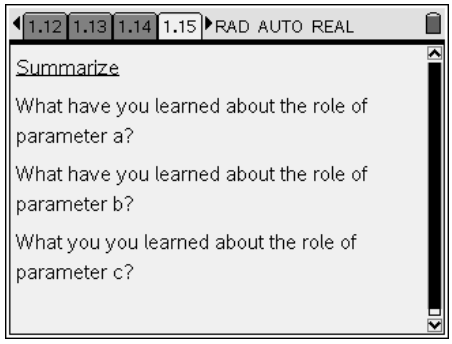
The point of intersection is the y-intercept of BOTH parabolas, and this is the value of "c".



.
Possible answers:
"a" : Makes the parabola switch direction of opening and affects the x-value of the vertex.

"b" : It affects where the vertex lies.

"c" : It is the y-intercept.



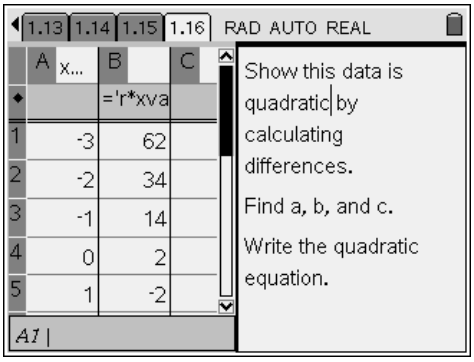
The second difference is 8. Therefore, a = 4.
It can be seen from the table c = 2, however a more general approach uses two points, along with a = 4 and solve the 2 x 2 system of equations to find b and c.

$$y = ax^2 + bx + c$$

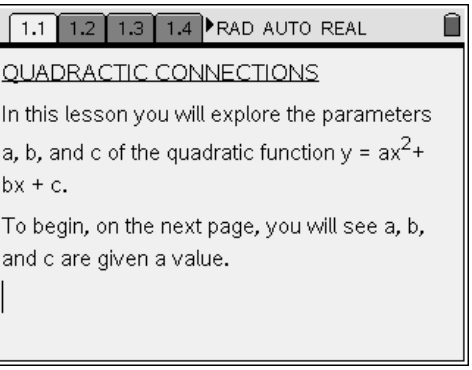
$$14 = 4(3)^2 + b(3) + c \quad \text{--->} \quad -22 = 3b + c \quad \text{--->} \quad 2b = -16$$

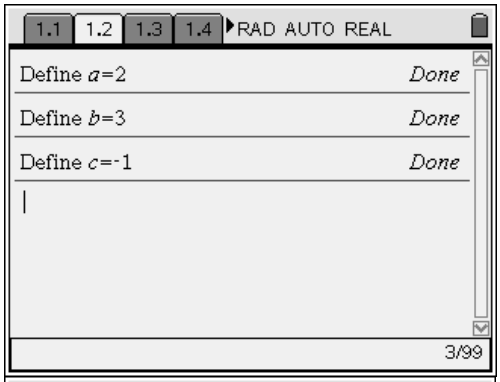
$$-2 = 4(1)^2 + b(1) + c \qquad\qquad -6 = b + c \qquad\qquad b = -8, c = 2$$

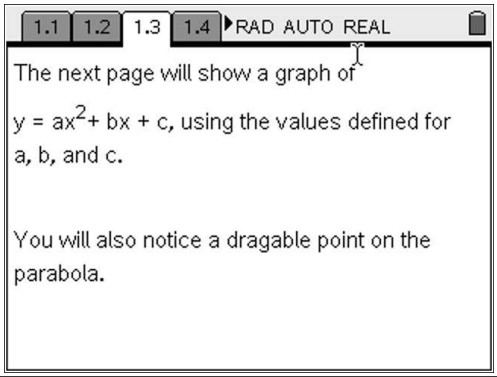
Thus, the equation is $y = 4x^2 - 8x + 2$.

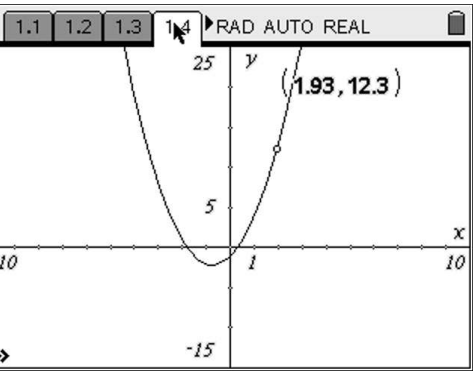


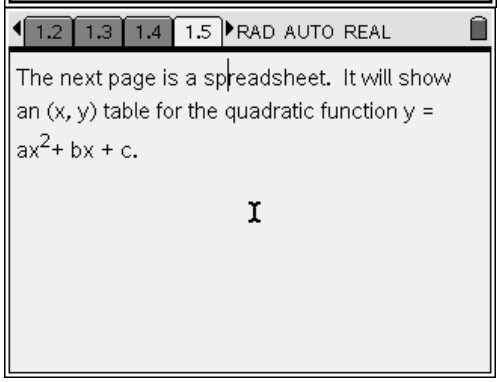
Student TI-Nspire Document
quadratic_connections.tns

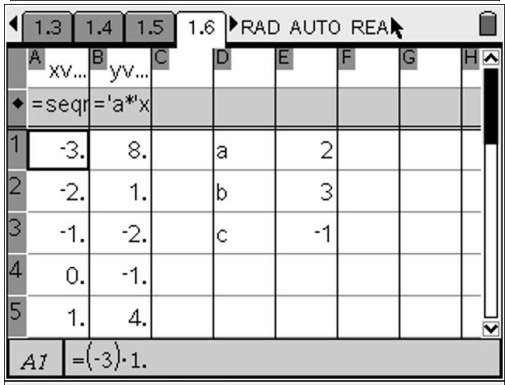


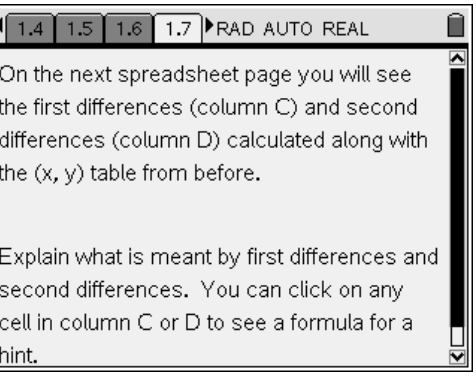


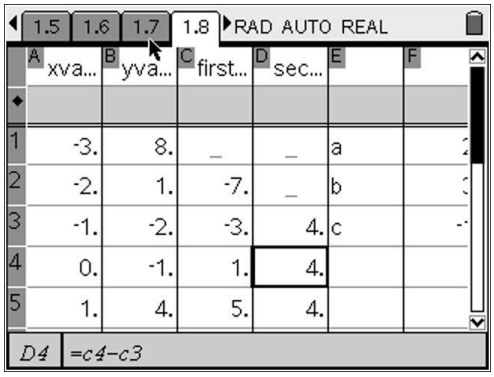


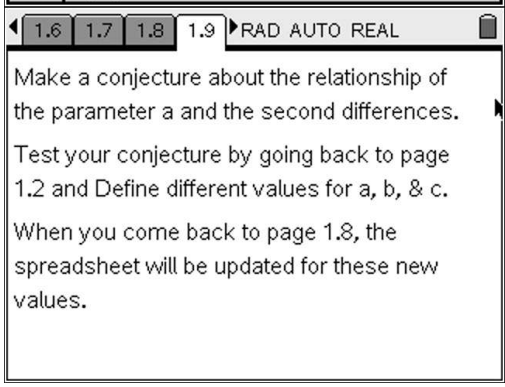


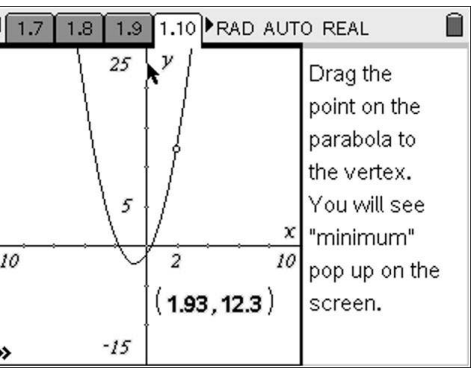


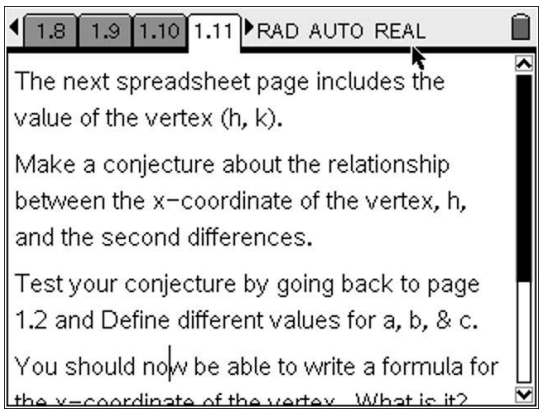


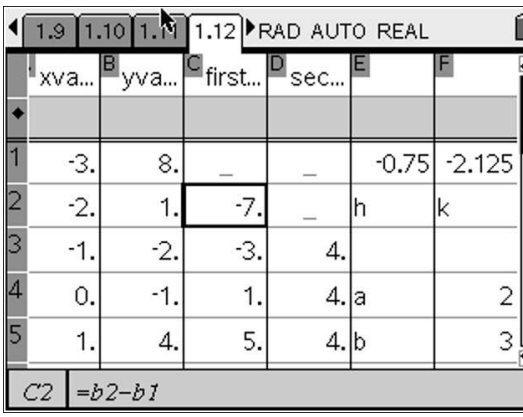


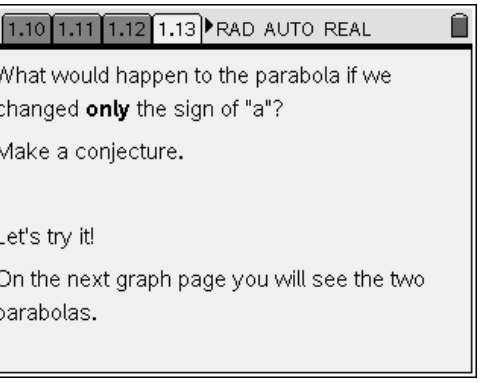


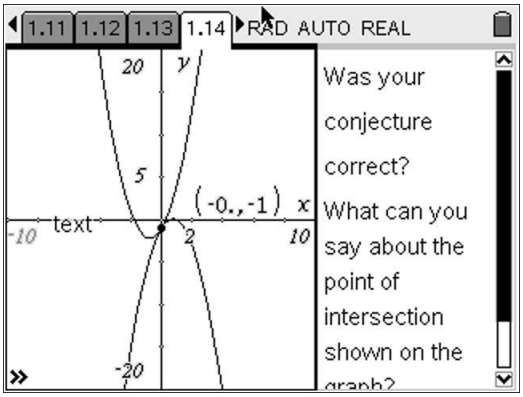


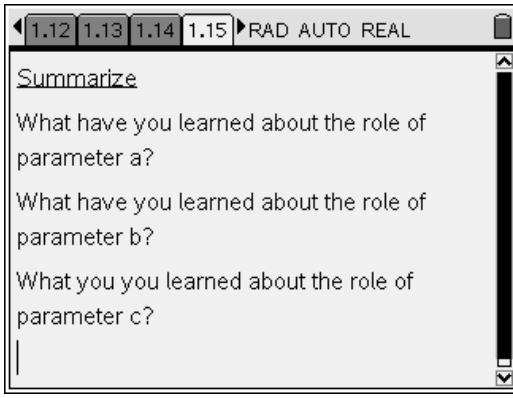

1.7 1.8 1.9 1.10 RAD AUTO REAL
25
y
5
x
10
2
10
(1.93, 12.3)
-15
Drag the point on the parabola to the vertex. You will see "minimum" pop up on the screen.

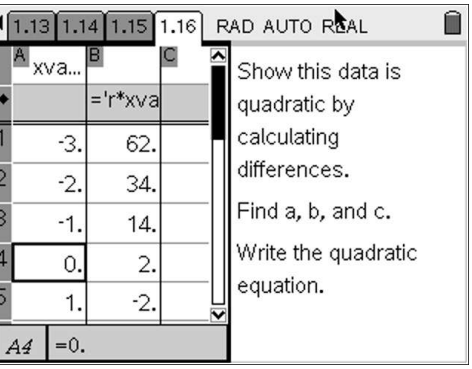

1.8 1.9 1.10 1.11 RAD AUTO REAL
The next spreadsheet page includes the value of the vertex (h, k).
Make a conjecture about the relationship between the x−coordinate of the vertex, h, and the second differences.
Test your conjecture by going back to page 1.2 and Define different values for a, b, & c.
You should now be able to write a formula for


1.9 1.10 1.11 1.12 RAD AUTO REAL
xva... yva... first... sec... E F
-3. 8. _ _ -0.75 -2.125
-2. 1. -7. _ h k
-1. -2. -3. 4.
0. -1. 1. 4. a 2
1. 4. 5. 4. b 3
C2 =b2−b1


1.10 1.11 1.12 1.13 RAD AUTO REAL
What would happen to the parabola if we changed **only** the sign of "a"?
Make a conjecture.
Let's try it!
On the next graph page you will see the two parabolas.


1.11 1.12 1.13 1.14 RAD AUTO REAL
20
y
5
(-0., -1)
x
-10
text
2
10
-20
Was your conjecture correct?
What can you say about the point of intersection shown on the


1.12 1.13 1.14 1.15 RAD AUTO REAL
Summarize
What have you learned about the role of parameter a?
What have you learned about the role of parameter b?
What you you learned about the role of parameter c?


1.13 1.14 1.15 1.16 RAD AUTO REAL
A xva... B ='r*xva C
-3. 62.
-2. 34.
-1. 14.
0. 2.
1. -2.
A4 =0.
Show this data is quadratic by calculating differences.
Find a, b, and c.
Write the quadratic equation.