

## Teacher Notes

### Student Data Sheet Key:

#### Problem 1:

1. Either A or C
2. For A we need some set of graphs that shows how A causes the graph to widen and that as A changes from positive to negative the graph changes from having a minimum to having a maximum.  
For C we need as set of graphs showing the y-intercept is the value of C.

#### Problem 2:

1. What number did you use for the RandSeed?  
**Answers will vary**
2. What values did you get for A: **Answers will vary** and C: **Answers will vary**?  
**All should be integers between -10 and 10 inclusive. You may test these by using their seed number.**
3. List the 7 values you got for B. **Answers will vary**
4. In the table below list the 4 values of B you selected and the variable names used. **Answers will vary**

Variable Name	Value

5. As you see the four Quadratics with B being changed, how would you describe the effect of B on the graph?  
**Student should see several things. That the curve stays the same width (A is the same) and the y-intercept is locked in (C is the same). In addition we have some sense that the graph is moving to the right and down until it starts moving up.**

6. What is happening to the maximum or minimum on the graph?
7. Fill in the table with the max/min values you got for the four values of B. Indicate if we have a maximum or minimum.

B	Xmax/min	Ymax/min

**Look for the indication of max or min (the value of A) and nice numbers (fractions). Answers will vary.**

8. Why did you get maximums or minimums?

**The value of A (negative A gives maximums).**

9. What model type did you select for the pattern between the Xmax and Ymax (Xmin and Ymin) values? When you round the constants, what values do you get for the function?

**This should be a Quadratic. The function should be  $-Ax^2 + C$**

10. How is this function related to B and to the core quadratic in  $f_1(x)$ ?

**B is not involved and the A is just the opposite of the A used in the core function while C is the same.**

11. What happened to the pattern on max/min points as you change B? Explain.

**The function remains the same since B is not involved in the quadratic the models the pattern in the max/min points.**

12. Collect the data indicated in the table below from 3 other groups.  
**Answers will vary but look to see if the regression values were rounded.**

Team	A	C	Function that models the max/min (Rounded)
My Team			

13. What pattern do you see now? Explain.  
**The same pattern shown before, that A is now  $-A$ , B is not involved, and C is the same. In addition, we should all have Quadratics.**
14. What function type do you think you have that relates B and  $X_{\max/\min}$ ? Give the exact values. How is this function related to your Quadratics?  
**Linear**  
 $y = -2Ax$   
**This is from  $X_{\max/\min} = -B/(2A)$  to define the minimum.**

**Problem 3:**

1. Look for a labeled sketch with the object at least 15 cm away from the CBR2 at the start. Since B is the initial velocity, look for information in the sketch showing some push or pull to start.
2. What value of B do you think you will get from the data? Why?  
**Answers will vary**
3. What value did you get for B? Were you close in your prediction? Explain.  
**Answers will vary**
4. With a unit analysis, determine the units of A, B, and C in your Quadratic from the CBR2 experiment.  
**A = m/sec – acceleration;**

**B = m/s – velocity, and  
C = m – initial position.**

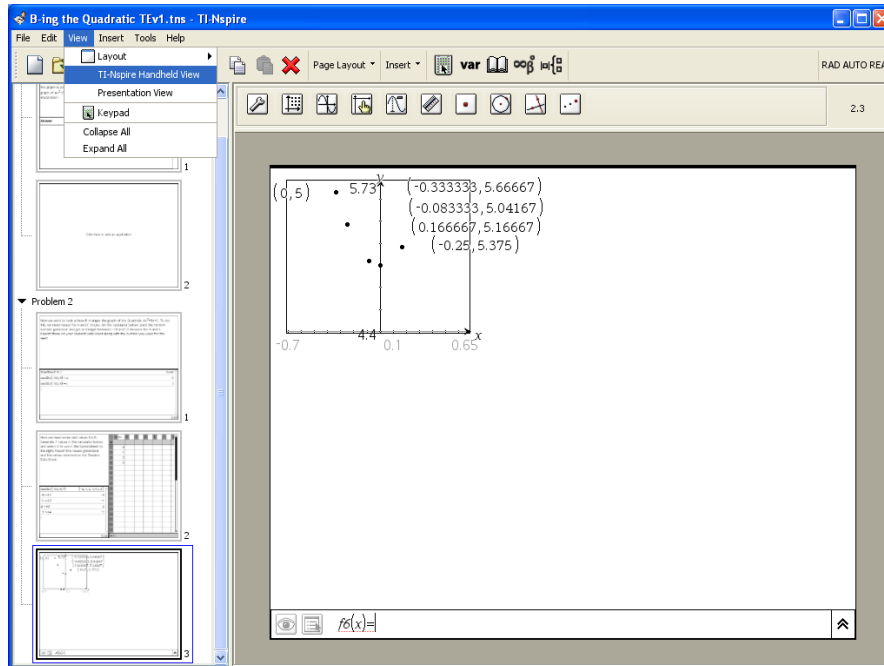
5. How would you modify the event to increase the value of B in from your data? decrease the value of B from your data?  
**give a greater initial velocity to increase B,  
give a smaller initial velocity to decrease B.**

**Prerequisites:**

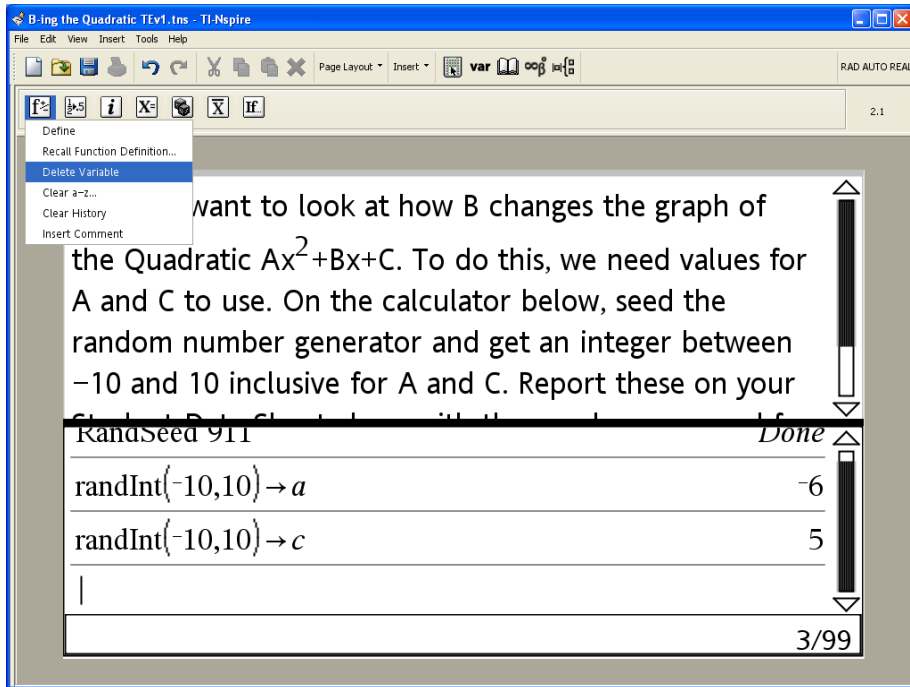
Students should have been exploring the constants A and C in the Quadratic. At this time they should have determined the meaning of these two constants as they relate to the graph of the function.

**Stating:**

- The students need to get the file B-ing the Quadratic on their handheld. The file B-ing the Quadratic TE has a sample solution set for your use.
- The Document Settings might need to be modified so that when you do the regressions the answers are more effective (that is 9.7534734E-21 becomes 0 and 4.99999999999 becomes 5).
- As you work with the software on the tns files, make sure you look at the Handheld view. This will help you position items so that they can be viewed correctly on the handheld. Notice in the image below how the graph is in the upper left of the image. It might just be best to work on the whole document in that view, if the problem will be done on the handheld.

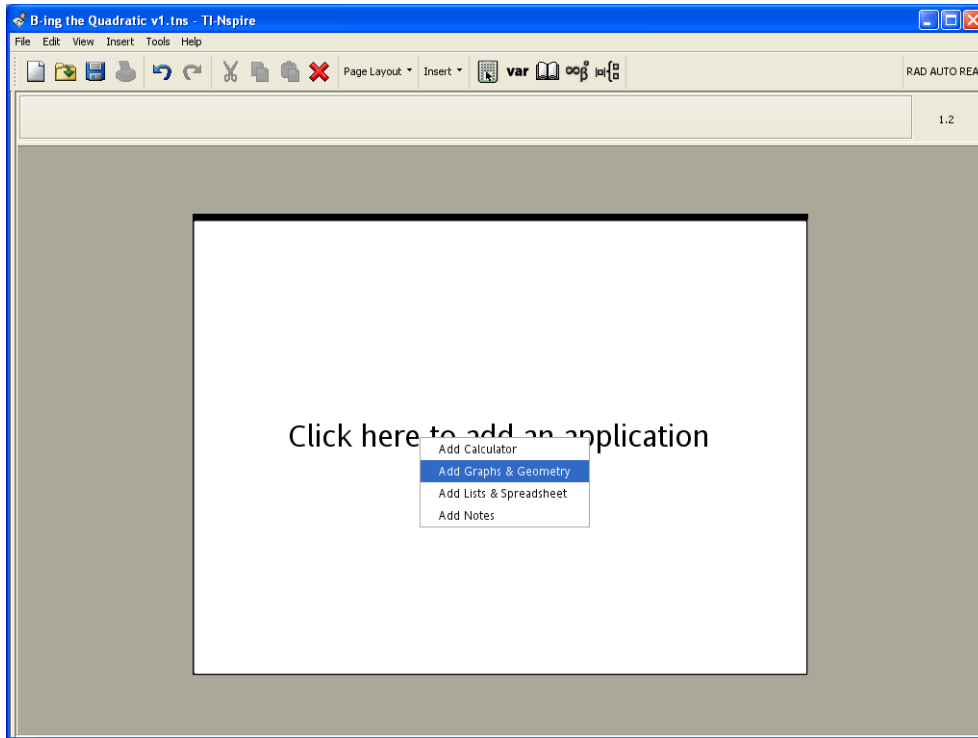



- The placement of the cursor in the document might be critical as well as you prepare the tns. The cursor will start on the document where you left it, so you might have the students starting on the third paragraph of the writing, if that is where it was left when you wrote it.
- The scope of a variable is the whole document and is understood on all pages in all problems. If on Problem 2 you define the value of A, then it will be understood in Problem 1 all though the first definition of a variable carries until it is reassigned later in the document. That new definition will hold for the rest of the document moving forward. This will work to your advantage most of the time, but might require you to reassign a variable value or clear one. Do this by by using the Function Key from the tabs and shown below.

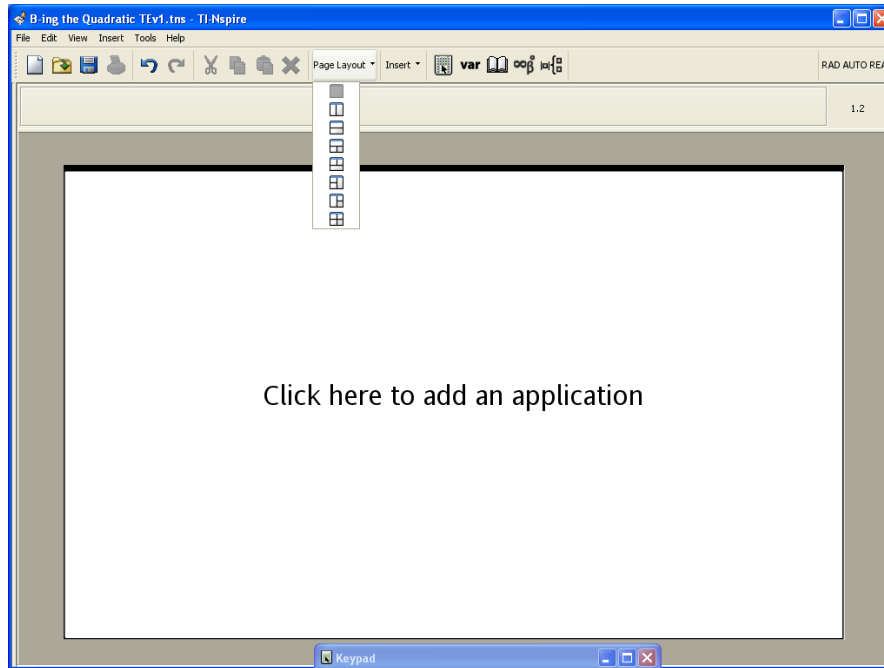


**Problem 1:**

- Students will need to provide multiple graphs to help explain the control that variable A or C have on the graph of the quadratic. This may require multiple functions on the Graphs and Geometry page, but they may want to add multiple pages. In the tns document they get to choose what type to make the next page.



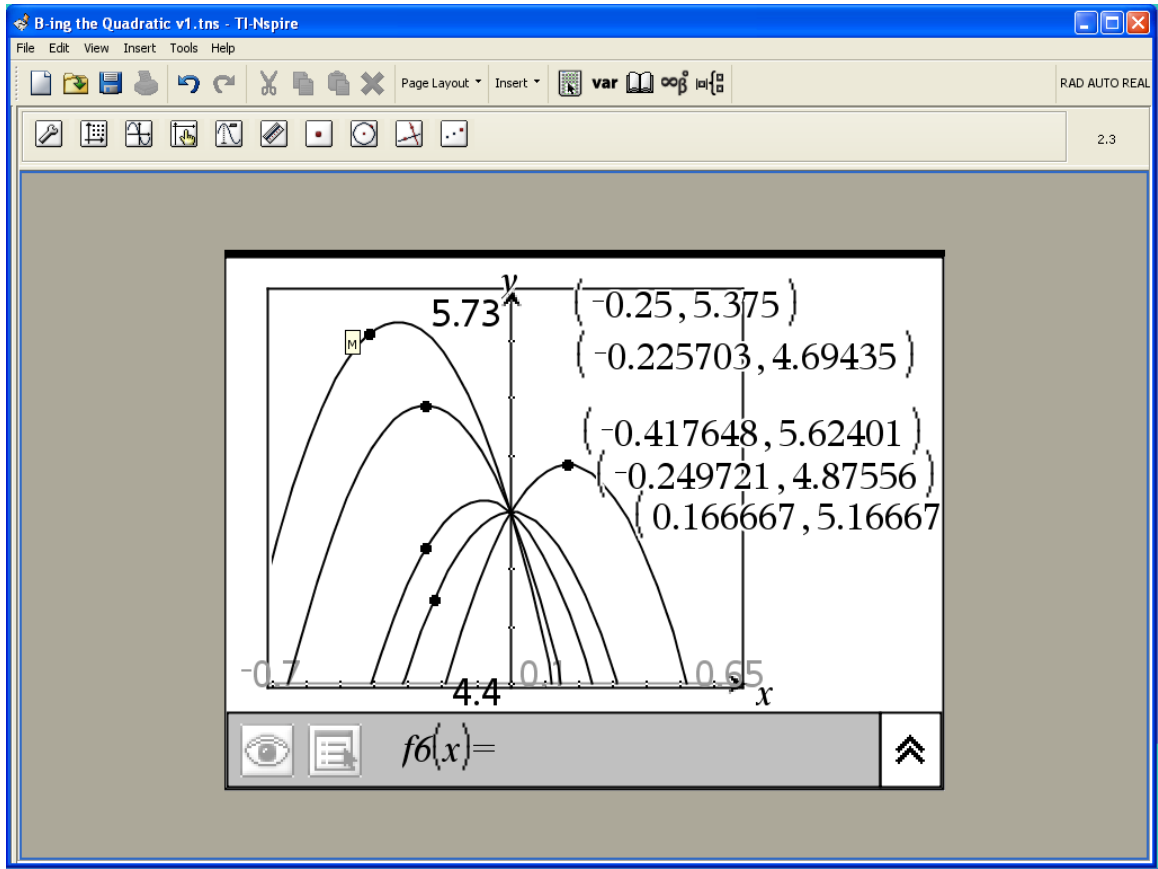
- To add additional pages, have the students press the Home key [&#9671;] and then select the type of page they need.
- Students may also want to modify the layout so they can have multiple pages at one viewing. See the selections available below.



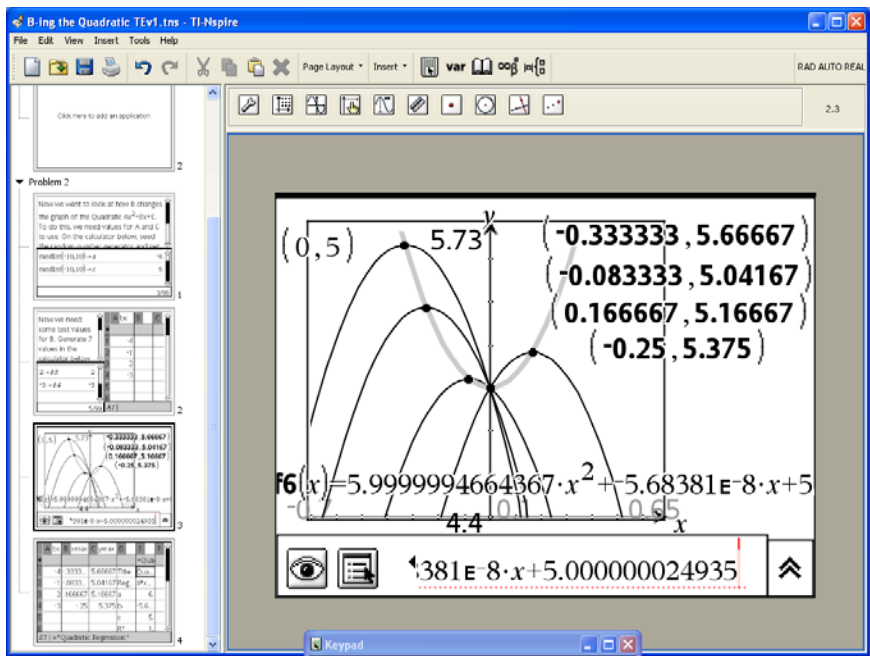
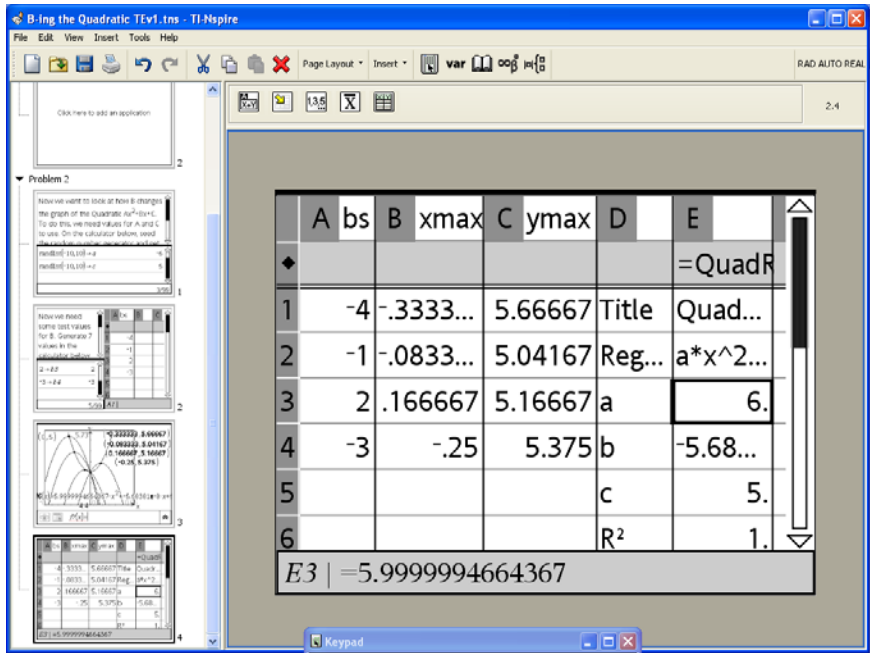
## **Problem 2:**

- To seed the random number generator use *RandSeed SomeNumber* like *RandSeed 911*
- When the students generate the random integers for A and C, some may be problematic in getting a good window on the Graphs and Geometry page.
- You will be able to test their work if they give you the *RandSeed* number.
- It might help the kids if they order the values of B so that they can find the plots and associate them with the  $b_1$ ,  $b_2$ ,  $b_3$  values.
- As you move the trace point to the max or min you will see the M box indicating that you have the max or min coordinates.





- As they set up the spreadsheet, we need a column for the B values and the associated Xmax and Ymax values. In some cases the students will need to change the column name to Xmin and Ymin.
- The regression should be Quadratic and the pattern will be as shown below. Notice A is the opposite of the original A value but C is the same and B is effectively zero.



- Now if you modify the values of B (b1, b2, etc. the regression changes, and when the points are placed back at the max, the function remains the same.

B-ing the Quadratic TEv1.Ins - TI-Nspire

File Edit View Insert Tools Help

Page Layout Insert var RAD AUTO REAL

2.2

Click here to add an application

Problem 2

Now we want to look at how B changes the graph of the Quadratic  $Ax^2+Bx+C$ . To do this, we need values for A and C to use. On the calculator below, used

rad(10,10)→a  
rad(10,10)→c

Now we need some test values for B. Generate 7 values in the calculator below

$-3 \rightarrow b4$      $-3$   
 $-2.5 \rightarrow b4$      $-2.5$

	A	bs	B	C
1		-4		
2		-1		
3		2		
4		-2.5		
5				
6				

6/99 A1 | =b1

Keypad

B-ing the Quadratic TEv1.Ins - TI-Nspire

File Edit View Insert Tools Help

Page Layout Insert var RAD AUTO REAL

2.3

Click here to add an application

Problem 2

Now we want to look at how B changes the graph of the Quadratic  $Ax^2+Bx+C$ . To do this, we need values for A and C to use. On the calculator below, used

rad(10,10)→a  
rad(10,10)→c

Now we need some test values for B. Generate 7 values in the calculator below

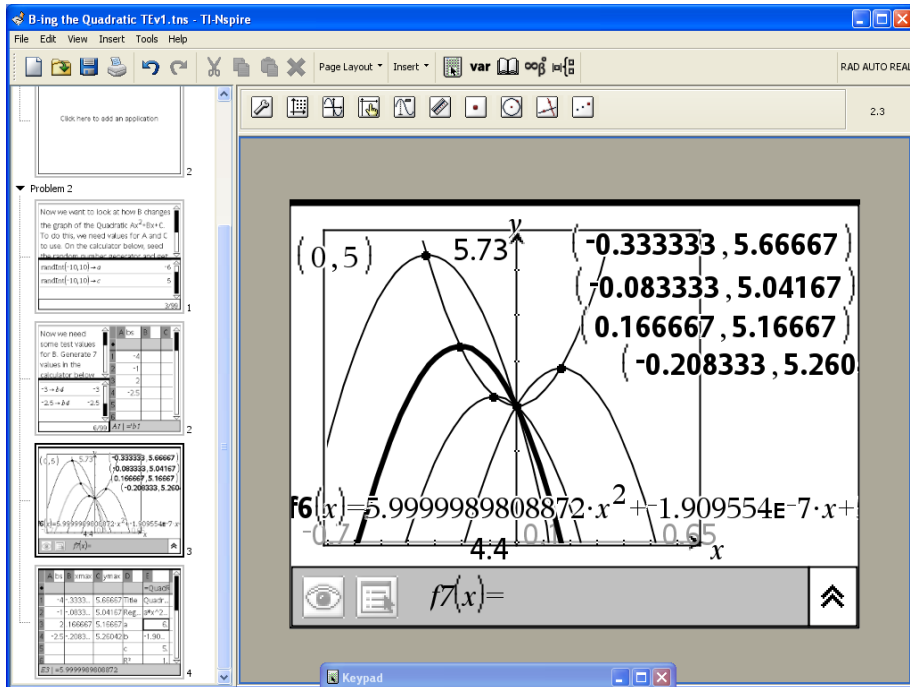
$-3 \rightarrow b4$      $-3$   
 $-2.5 \rightarrow b4$      $-2.5$

$(0, 5)$      $5.73$      $(-0.333333, 5.66667)$   
 $(-0.083333, 5.04167)$   
 $(0.166667, 5.16667)$   
 $(-0.29632, 5.2139)$

$f_6(x) = -5.7389892612314 \cdot x^2 + 2.698059697992 \cdot x + 5$

$f_7(x) =$

Keypad



- When you get the Navigator working with the Nspire handhelds, collecting the values of A, C, and the functions that model the movement of the max/min will be better facilitated. In addition collecting the functions that model the B vs. Xmax/min will be revealing as well with the Navigator Activity Center.
- The students may be ready to understand that the max/min point occurs when the slope is zero. The slope is the 1<sup>st</sup> derivative of the function so set it to zero and solve to get  $x_{\max/\min} = -B/(2A)$ .

### Problem 3:

- Use the Data Collection option on the Graphs and Geometry window with the USB links and the CBR2.

