## Overview

The purpose of the .tns file described in this document is to utilize parametric equations to enable students to see the graph of an object's height as a function of time, in addition to seeing the actual path of the object.

Materials

• *TI-Nspire™ handheld or Computer Software*

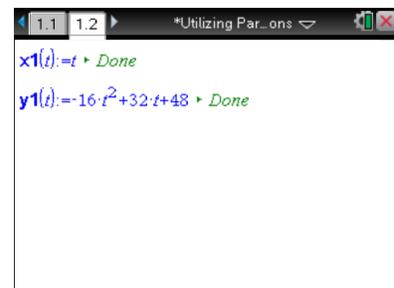## Step 1—Preparing the document

1. Open a new document on the handheld by pressing `⌂ on` > **New Document**. Open a new document in the Teacher Software by clicking **File > New TI-Nspire Document**.
2. Select **Add Notes.**
3. Create a title page for the activity.
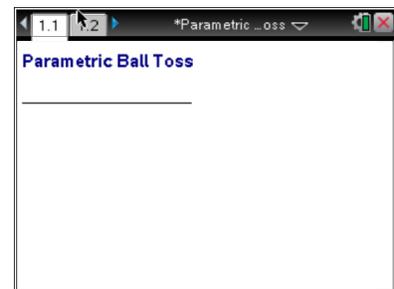
From this point on, directions for the Computer Software and the Handheld will be notated separately where appropriate.

4. Handheld: Add another Notes page by selecting `ctrl` `doc▾` > **Add Notes** (or `ctrl` `I` > **Add Notes**).
   Computer Software: Add another Notes page by clicking **Insert > Notes**.
5. Handheld: Select **MENU > Insert > Math Box** (or press `ctrl` `M`) to add a Math Box.
   Computer Software: Select **Document Tools > Insert > Math Box** (or press Ctrl+M).

6. Add separate Math Boxes for each of the following parametric function definitions and press `enter` after each function:
   • x1(t) := t (On the handheld, you can press `ctrl` `▨{▤` to obtain `:=`.)
   • y1(t) := -16t^2+32t+48
Note: If you do not want to see the > *Done* message at the end of each entry, select `ctrl` **MENU > Math Box Attributes**, and change the **Input & Output** to **Hide Output**.
7. Handheld: Select `doc▾` > **Page Layout > Select Layout**, and select the option to split the whole page in half vertically, with the left side also split in half horizontally (resulting in three work areas).
   Computer Software: Select **Edit > Page Layout > Select Layout**, and choose the appropriate icon to split the page in half vertically, with the left side also split in half horizontally (resulting in three work areas).

8. Add a Notes page to the lower left work area, and add a Graphs page to the right work area. The upper left work area is the Notes page you have already created and modified.
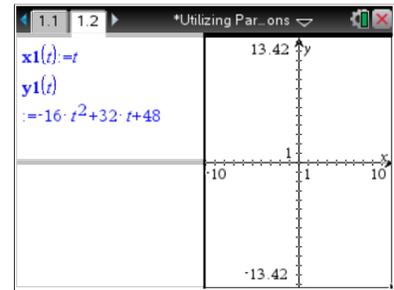
9. In the Graphs work area, change the window settings to [-1.5,3,5] x [-5,75] by selecting **MENU > Window/Zoom > Window Settings**.

    Computer Software: Select **Document Tools > Window/Zoom > Window Settings**.

10. If necessary,

    Handheld: To hide the function entry line, press ⌈ctrl⌉ ⌈G⌉ or click on the chevron, «.

    Computer Software: To hide the function entry line, click on the chevron, «.

Step 2—Add a Slider

11. Handheld: While still in the graphing work area, select **MENU > Actions > Insert Slider**. Position the slider in the left portion of the graph screen. Rename the slider variable *n*.

    Computer Software: Select **Document Tools > Actions > Insert Slider**.

12. Handheld: Select ⌈ctrl⌉ **> MENU > Settings**, change the slider settings as indicated in the screens to the right, and click OK.

    Computer Software: Right-click in the slider box, select **Settings**, change the slider settings as indicated in the screens to the right, and click OK
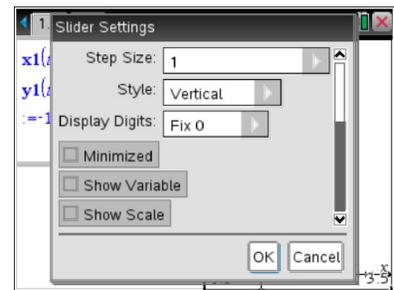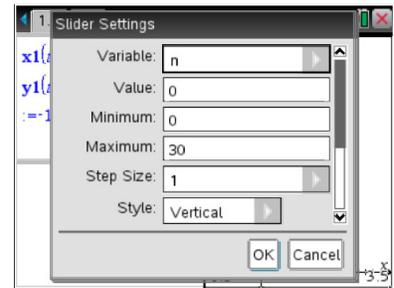
The figure to the right shows the slider created with the settings given above.
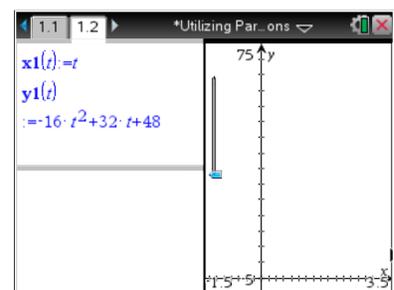
Step 3—Setting up the Other Notes Pane

13. In the bottom Notes work area, insert the following Math Boxes. (Remember to press ⌊enter⌋ after each one.)

- To make it easier to change functions, add:
 - ○ tstep := 0.1
  - ○ tmin := 0

- For the parametric plot, add:
  - ○ x1plot := seq(x1(t*tstep),t,tmin,n)
  - ○ y1plot := seq(y1(t*tstep),t,tmin,n)

- To see the path of the ball, add:
  - ○ x2plot := {-1,x1(n*tstep)}
  - ○ y2plot := {y1(n*tstep),y1(n*tstep)}

- (Optional) Change Math Box Attribute: Hide output.

The figure to the right shows the set-up of the bottom Notes work area.

Note: If you change the parametric function definitions, x1(t) and y1(t), it might be necessary to adjust the graph window, slider range, tstep, and tmin.
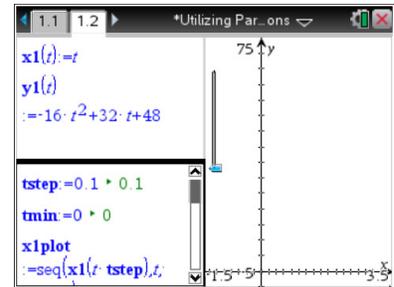

Step 4— Complete the Set-Up of the Graphs Work Area

14. Handheld: In the Graph work area, select **MENU > Graph Entry/Edit > Scatter Plot**. For scatter plot s1, press ⌊var⌋, select **x1plot** for the x-value and **y1plot** for the y-value, and press ⌊enter⌋.

    Computer Software: Select **Document Tools > Graph Entry/Edit > Scatter Plot**. For scatter plot s1, click on the round "var" button at the top of the screen, select **x1plot** for the x-value and **y1plot** for the y-value, and press Enter.
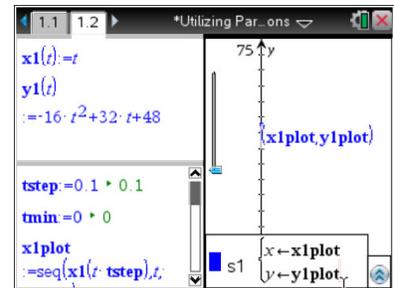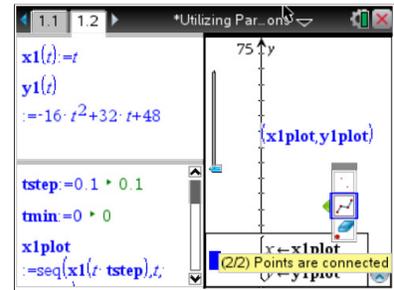

15. Handheld: Press ⌊ctrl⌋ ⌊G⌋ to re-open the entry line. Move up using the arrows to s1(x, y), and select ⌊ctrl⌋ **MENU > Attributes**.

    Computer Software: Right-click on s1(x, y), and select **Attributes**.
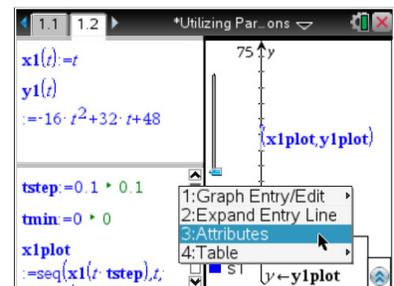
16. Choose the *thin point* and the *connected graph* from the
    Attributes menu.

17. The following is a list of the coordinates and attributes for the three scatter plots:
   - Scatter plot s1: (x1plot,y1plot); Attributes: thin point, connected graph.
    - Scatter plot s2: (x2plot,y2plot); Attributes: large solid point, connected graph.

18. Handheld: To join the two points with a dotted segment, select **MENU > Geometry > Points and
    Lines > Segment**, and click on each of the two plotted points to form the line segment.
    Computer Software: Select **Document Tools > Geometry > Points and Lines > Segment**, and
    click on each of the endpoints to make a line segment.

19. Handheld: Move your cursor over the line segment, select ctrl
    > MENU > Attributes, and choose thin line and dotted.
    Computer Software: Right-click on the line segment, select
   **Attributes**, and choose thin line and dotted.
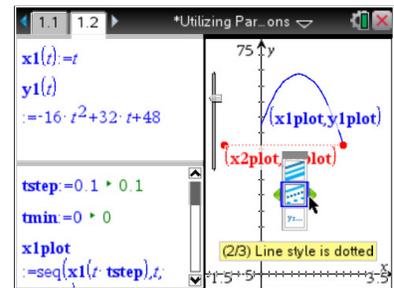
20. Handheld: Hide the endpoints of the line segment by moving your cursor over each of the two
    endpoints and selecting ctrl **> MENU > Hide**.
    Computer Software: Hide the two endpoints by right-clicking on each of them and selecting **Hide**.

21. Handheld: Hide the labels of the scatterplots by moving your
    cursor over each label and selecting ctrl **> MENU > Hide**.

    Computer Software: Hide the labels of the scatterplots by right-
    clicking on each label and selecting **Hide.**
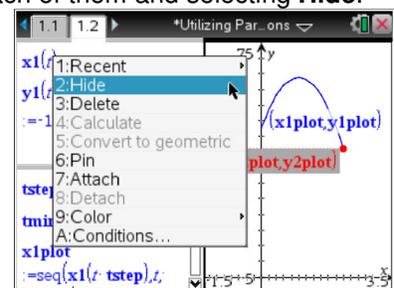
Note: You might want to adjust your screen so the graph on the right is larger.
    Handheld: Select doc▾ **> Page Layout > Custom Split.** You will see a wheel in the center of
    the page; press the arrows (◀▶) to move the column to the desired location and press enter to
    set the column in place.
    Computer Software: Position your cursor on the vertical line separating the two vertical panes.
    When you see the double-sided arrow, click and move the column to the desired location and
   release to set the column in place.

Note: You might also want to slide the lower left quarter pane out
of sight completely.

Handheld: Select [doc▾] **> Page Layout > Custom Split.**
You will see a wheel in the center of the page; press the
arrows (▲▼) to move the pane to the desired location and
press [enter] to slide the pane out of sight.

Computer Software: Position your cursor on the horizontal
line separating the two horizontal panes. When you see the
double-sided arrow, click to slide the pane out of site and
release.
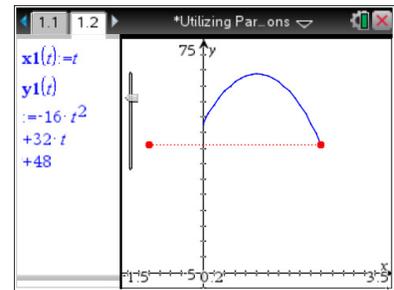
As you move your slider, your screen should look like the one to the
right.

Note: Handheld: To eliminate the need to grab and drag the slider, you can animate it. To do so, click
on the slider, and select [ctrl] **MENU > Animate**. To stop the animation, press [ctrl] **MENU >
Stop Animate**.

Computer Software: Right-click on the slider, and select **Animate**. To stop the animation, right-
click on the slider, and select **Stop Animate**.