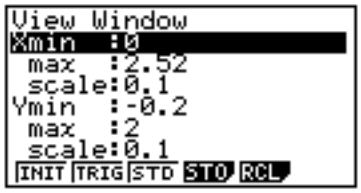
UNIT III: Slope of Tangent With CASIO Calculator

After performing the incline lab (unit III), the students obtain a graph whose equation is x = kt^2. Here's a way to help students get the concept that one could determine the instantaneous velocity at a given time by finding the slope of the tangent to the curve, using a CASIO CFX-9650G calculator.

1. From the main menu, select [Graph]. Enter the equation in y1 =. Press the [F6: Draw] key to sketch the curve. You will need to re-size the view window. To do so, press the [F3] key. Then, to make the tracing function choose "nice" (i.e., easier to read) values of x, use the following guideline when choosing Xmax and Xmin values under the [View Window] menu:

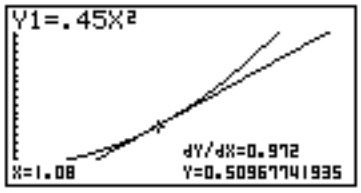
   (Xmax - Xmin)/126 = the increment value you would like.



   If you choose Xmax to be 2.52, you will see that as you trace along the curve, x is incremented by 0.02. You can set y values to whatever you'd like to show the top-opening parabola. However, if you set the y-min to -0.2, then the x-axis is far enough above the bottom of the screen to not interfere with the values displayed when you trace along the curve.

2. Once you have set your View Window parameters, press the [Exit] key to return to the Graph Func screen. Now press [Set Up] (by pressing [Shift] & [Menu] keys) and scroll down to derivative; press [F1] to turn derivative on. Press the [Exit] key to return to the Graph Func screen.

3. Press [F6: Draw] to get the calculator to draw the graph. Now press [F4: Sketch], then [F2: Tang] to activate the tangent drawing function. Use the left and right arrow keys to move the cursor to the desired x-value. Note that the x and y coordinates are displayed as well as the value of dy/dx.



   When you press [EXE], the calculator draws a tangent line and gives you the value of dy/dx, which is the instantaneous velocity at the specified time. For those students who have not yet seen this notation, you might suggest that one can consider it to be $\frac{\Delta y}{\Delta x}$ for a tiny interval.

4. One can obtain the values of dy/dx at different spots on the curve by simply using the left and right arrow keys. However, to draw additional tangent lines, you must press [F4: Sketch], then [F2: Tang], scroll to the desired x value, then press [EXE] as you did in the previous step.

5. You can draw as many as 6 tangent lines before the screen gets cluttered. To clear the tangent lines, press [Exit] to return to the Graph Func screen and press [F6: Draw]. This re-draws the curve withou the tangent lines.

6. Next, use these values for a plot of v vs t using Graphical Analysis (unless, of course, you are a CASI junkie). After you have defined the slope of the v vs t graph to be acceleration, note the value (and units) of a. Then, revisit the equation of the straight-line graph from the lab (the one they used for the y= function on the calculator). Students should notice that the slope of that equation is 1/2 of the acceleration. This nicely sets the stage for the derivation for the kinematic equation $\Delta x = 1/2\ at^2$.