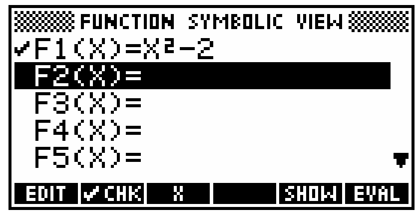
Gradient at a point as the limit of the slope of a chord

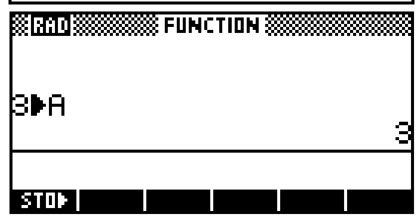
The true gradient at a point is available in a number of ways. For example, via the **FCN** *Slope* tool in the PLOT view or via the δ differentiation operator. For students first being introduced to calculus a common task is to investigate the slope of the chord joining two points as the length of the chord tends towards zero.

ie. $$\lim_{h\to 0}\left(\frac{f(x+h)-f(x)}{h}\right)$$

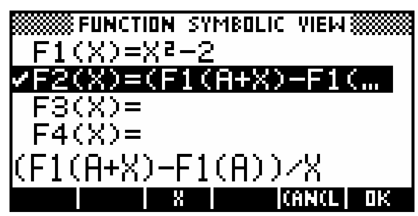
This can be effectively introduced via the Function aplet.



Begin by entering the function being studied into F1(X) as shown.



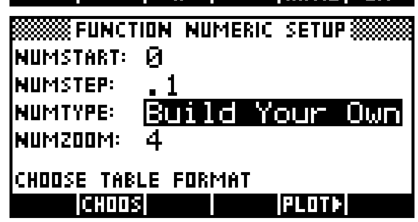
To examine the gradient at x=3, store 3 into memory **A** in the HOME view as shown right.



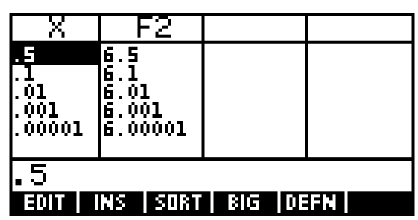
Return to the SYMB view, un-**✔CHK** the function F1(X) and enter the expression:

F2(X)=(F1(A+X)-F1(A))/X in F2(X).

This is the basic differentiation formula quoted above with X taking the role of *h* and A being the point of evaluation, in this case with A = 3.

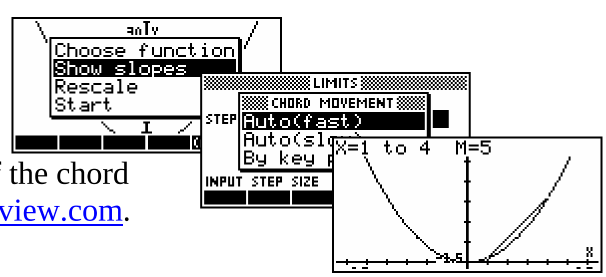


Change to the NUM SETUP view and change the NumType to “Build Your Own”. By entering successively smaller values for X you can now investigate the limit as *h* tends towards zero.



In this case it is clear that the limit for x=3 is the value 6.

To investigate the gradient at a different point simply change back to the HOME view, enter a new value into A and then return to the NUM view.



The disadvantage of the previous method is that it is not very visual. An alternative is to use an aplet downloaded from the web. An aplet that will automate the process and provide a visual display of the chord diminishing in length can be found at www.hphomeview.com.