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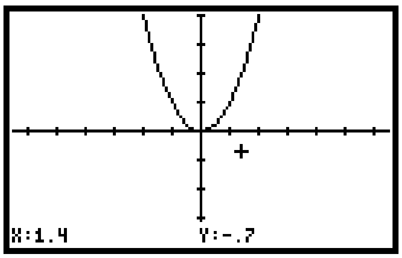
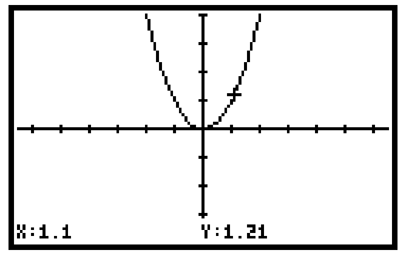
Calculator Lesson 4

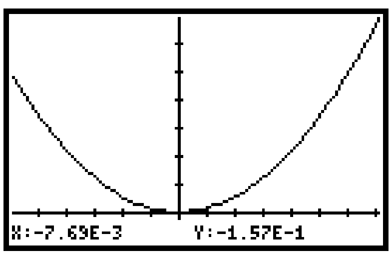
More Graphing: Choosing the Graph Window

Plot the function $y = x^2$ in the default window. Now press F2-(X, Y) and press the arrow keys several times. As you do, watch the x and y co-ordinates at the bottom of the screen. Notice that as the cursor moves one pixel the appropriate co-ordinate changes by .1. The figure on the left below shows the cursor at (1.4, -.7). Now press NXT to





show the menu, press F3-TRACE, then press F2-(X, Y). The cursor moves onto the curve. Pressing RA or LA will cause the cursor to move to the right or left respectively, but continue to follow the curve. The Y value will now show the function value, not the pixel value of the y-axis. The figure above on the right shows the cursor at (1.1, 1.21), the co-ordinates of that point on the curve, but the cursor is actually at the closest pixel, (1.1, 1.2). Now return to the PLOT WINDOW and change the H-View to go from -5 to 6, and use F4-AUTO to set V-View, then erase and draw. Move the cursor to the origin and press F2-(X, Y). We now see, as shown in the figure to the left, that the co-ordinates are (-7.69E-3, -1.57E-1). This does not interfere with our view of the graph, but it is a bit disconcerting that the origin is not (0,0). These minor discrepancies usually do not matter, but there are times when it is very helpful to have the pixels represent "nice" numbers. What we learn from the above examples is that to achieve this we must be careful with the choices we make for the dimensions of the view window.

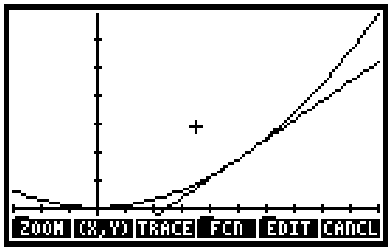


Notice that in the default window the length of H-View is 6.5 – (-6.5) = 13. Thus, if we want the pixels to represent terminating decimals in the horizontal direction the length of H-View must be of the form

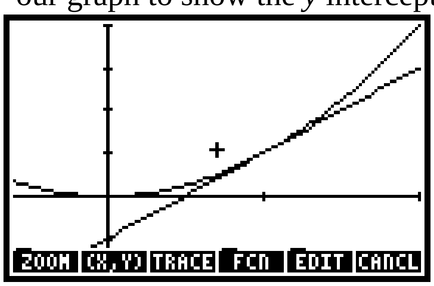
(A) $$13 \times 2^m \times 5^n$$

where *m* and *n* are integers. The default V-View has length 4 – (-3.9) = 7.9, so for the pixels to represent terminating decimals in the vertical direction, the length of V-View must be of the form $7.9 \times 2^m \times 5^n$.

As an example, suppose we want to use a graph to verify that the line $y = 1 + 2(x - 1)$ is tangent to the parabola $y = x^2$ at $x = 1$. In the PLOT SETUP dialog box set the EQ: to {'X^2' '1 + 2*(X – 1)'}. We would like the graph to go from $x = 0$ to $x = 2$, but an H-View of length 2 would not be of the form in (A). If, however, we choose $m = 0$ and $n = -1$, in (A), we can make the length of H-View equal to 2.6. With this in mind we go into the PLOT WINDOW and set H-View from -.6 to 2, giving us H-View of length 2.6. The vertical scale is not critical in this case, so we will set V-View using AUTO, then ERASE and DRAW. The result is shown in the figure on the left. If we now press F3-TRACE we see the cursor move to the curve because that was listed first in the EQ: list. Pressing DA or UA will move the cursor to the line. Each DA or UA will toggle the cursor between the curve and the line. Put the cursor back on the curve, press F2-(X, Y), and move the cursor to the right until the x co-ordinate is 1. Note that the y co-ordinate is also 1. Now press DA to put the cursor on the line and note that the y co-ordinate is still 1. This shows that the two functions are equal at $x = 1$. Now move the cursor one pixel to the left and note that the co-ordinates are now (.98, .96). If we now press DA to put the cursor back on the curve, we see that $y = .9604$. We can thus see that the curve is above the line even though they look the same on the graph. Move the cursor one pixel to the right of 1 and compare the *y* values and we see that the curve is above the line on that side also. Thus, the curve is tangent to the line at 1, it does not cross it there.



From the last figure we can make two observations about using AUTO to set the vertical axis. First, the calculator used only the first function in the EQ: list as the basis to computer V-View. Second, it provides space for the menu commands below the minimum point of the curve. It does this by adding about 15% to distance between the maximum and minimum value of the function on the given domain. Suppose we wanted our graph to show the *y* intercept of the line above the menu. The *y* intercept of the line is -1 and the maximum of the curve is 4, so the length of V-View must be 5. To this we add 15% to make room for the menu, giving us a total of 5.75. Go back to the PLOT WINDOW and set V-View from -1.75 to 4, and in the Plot Setup window set to 1 unit in each direction, then ERASE and DRAW. The result is shown in the figure to the left.



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