TI-83 Calculus Instructions

Derivatives

This calculator cannot tell you that the derivative of x^2 is $2x$. (Some more advanced calculators can.) But it *can* tell you that the derivative of x^2 *evaluated when* $x=3$ is 6.

1. Hit the MATH key. This takes you to the MATH menu.
2. Scroll down until the cursor is on `nDeriv(` and hit ENTER
   or
   Instead of scrolling around, you can just hit the number 8 since `nDeriv(` is option #8.
3. Type `X²,X,3)`
4. Hit ENTER

If you did everything right, you just executed the instruction `nDeriv(X²,X,3)`. Read this as "the derivative of X^2, with respect to X, evaluated when X=3." The calculator comes back with 6.

Important note: the calculator is using numerical approximation techniques to find derivatives. In some cases, those techniques will not work, and you will get an answer that is just plain wrong. Caveat emptor.

Definite integrals

This calculator cannot tell you that the integral of $2x$ is x^2+C. (Some more advanced calculators can.) But it *can* tell you that the integral of $2x$ *evaluated between* $x=1$ *and* $x=4$ is 15.

1. Hit the MATH key. This takes you to the MATH menu.
2. Scroll down until the cursor is on `fnInt(` and hit ENTER
   or
   Instead of scrolling around, you can just hit the number 9 since `fnInt(` is option #9.
3. Type `2X,X,1,4)`
4. Hit ENTER

If you did everything right, you just executed the instruction `fnInt(2X,X,1,4)`. Read this as "the integral of 2X, with respect to X, evaluated as X goes from 1 to 4." The calculator comes back with 15.

Important note: the calculator is using numerical approximation techniques to find integrals. In some cases, those techniques will not work, and you will get an answer that is just plain wrong. Caveat emptor.

Solving equations

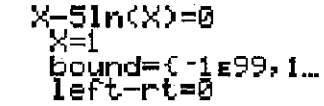
The TI has a built-in "solver" that finds answers to algebra problems.

First of all, the only equations the calculator can solve are of the form *some function*=0. This sounds like a limitation, but it's not, because any algebra problem can be recast that way. For instance, if you want to find out where `cos(x)=x`, you simply rewrite the problem as `cos(x)-x=0`. Now, let's see how we would approach that problem.

1. Hit the MATH key. This takes you to the MATH menu.
2. Scroll down until the cursor is on `Solver...` and hit ENTER
   or
   Instead of scrolling around, you can just hit the number 0 since `Solver...` is option #0.

Here's where the step-by-step-instruction thing becomes a little tricky. Because there are two different solver screens, and which one you land on depends on whether you have ever used the solver before.

You may end up on a screen like this: let's call it *solver screen 1*.



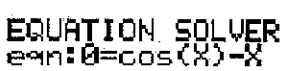
"Solver screen 1": equation on top, X=*some number* below that, and BOUND and left-rt thingies below that.

The equation on top is the last equation anyone used the solver for, and it is probably not the equation you want. So, you need to change that equation before you do anything else.

3. Hit the up arrow key. It looks like this will just move the cursor up, but actually the whole screen changes.
4. Hit CLEAR to erase the function that was previously there.

Now—either because you just never used the solver before, or because you just used the up arrow and CLEAR, you are now in what I call (you guessed it) *solver screen 2*.

5. Type your function. In our example, you would type cos(X)-X.



"Solver screen 2": says EQUATION SOLVER in big letters, and below that says 0= and then your function.

6. Hit ENTER. This takes you back to...solver screen 1! And this is the trickiest moment. The equation you want is displayed on top, and below that it says X=*some number*, and it looks for all the world like it has solved your equation. But in fact, it hasn't done anything yet.
7. Type a number into the X= place. This number tells the calculator where to *start looking* for a solution. For instance, if you type 4, the calculator will start looking in the vicinity of X=4 for a solution to the equation.
8. Hit ALPHA and then hit the ENTER key. As you know, this combination executes the command in green *above* the ENTER key, which is SOLVE. Now, the calculator actually solves your equation, and puts its new answer into the X= spot.

But the solver does have one very important limitation, which is that it *only finds one answer*. Many algebra equations have two answers (or three or four or a hundred); the calculator will generally find the one that is closest to the initial value you gave it in step (7). For this reason, when I really want to solve something thoroughly, here is what I usually wind up doing:

1. Use graphs to find how many solutions there are, and roughly where they are.
2. Use the solver once, giving it a starting value near one of the solutions. The solver will give you an exact solution.
3. Now use the solver again, giving it a different starting value that is near a different solution.
4. Repeat as necessary.

Minimum and Maximum

You spend a lot of time in Calculus finding minima and maxima of curves. The calculator can do it for you.

1. Enter Y1=X^2-2 and then hit GRAPH.

2. Now, *while you are looking at the graph*, hit 2nd CALC (just above TRACE) and choose minimum.
3. The calculator asks for a left bound: type -5 ENTER
4. The calculator asks for a right bound: type 5 ENTER
5. The calculator asks for a guess: type 4 ENTER.

The calculator then finds the minimum for you. Now, even if you've never taken Calculus, you probably know that the actual minimum of this curve occurs when X=0. The calculator comes close, but not exactly on, with its answer of $9.296*10^{-7}$. It's important to learn to look at such answers and recognize them for what they are: more or less, zero.

The min/max function uses much the same process—and with the same limitation—as the Solver. It starts with your initial guess, and looks for a minimum near there. If there is more than one minimum, you will need to repeat the process using a different initial guess.

Tangent line to a curve

Finding the tangent line to a curve is a common calculus problem.

1. Enter $Y1=X^2-2$ and then hit GRAPH.
2. Now, *while you are looking at the graph*, hit 2nd DRAW (just above PRGM) and then choose Tangent.
3. You are returned to the graph, and nothing happens at all: the calculator is waiting for you. Type 3 ENTER.

At this point, the calculator draws the tangent line to the graph at X=3, and also displays the *equation* for that line, y=6x-11