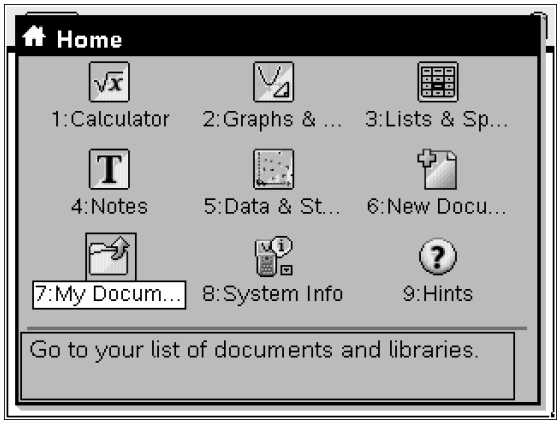
TI-Nspire CAS primer (especially for TI-83/84 users)

This primer will help you get a feel for your new super graphing calculator.
Created by Sean Bird of Indiana. Updated by Bird on June 5, 2009, for OS 1.7. Improved July 30, 2009, by SmartTIap participants.
Enjoy… (This document is available as a Word document at **http://covenantchristian.org/bird/Nspire.html**)

Section 1: Intro – Home & Settings (84 users would call it MODE)

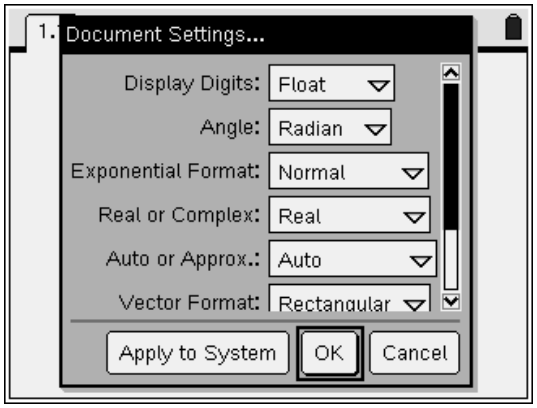
Welcome to the most intelligently designed and mathematically enjoyable technology ever developed. There are several features on the TI-Nspire where your computer knowledge can carry over.



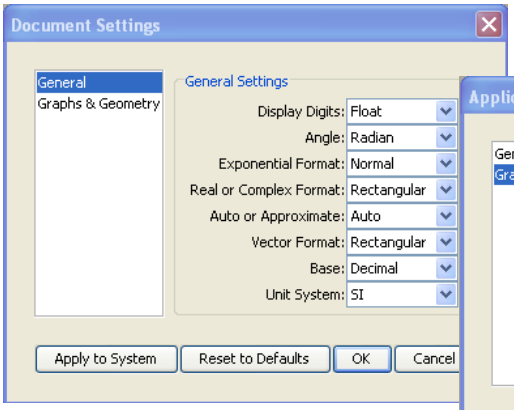
Press (home).
This Home Screen is like the desktop of a computer.
My Documents is just like 'My Documents'.
(esc) and (tab) behave just like Esc and Tab on a computer keyboard. (esc) is a good button to try if you ever get stuck somewhere.
Look on a computer keyboard and notice the symbol associated with Shift. On the TI-Nspire we will call (CAPS) the Shift key. Again, look at a computer keyboard and observe the symbol for Backspace. (clear) is the Backspace button.
Notice the blue word 'clear.' If you press (ctrl)(clear), it will clear the entry.
In the middle of the NavPad is (·), this click button serves as the left click on a mouse button. Right click would be (ctrl)(menu), designated with the symbol ☰.

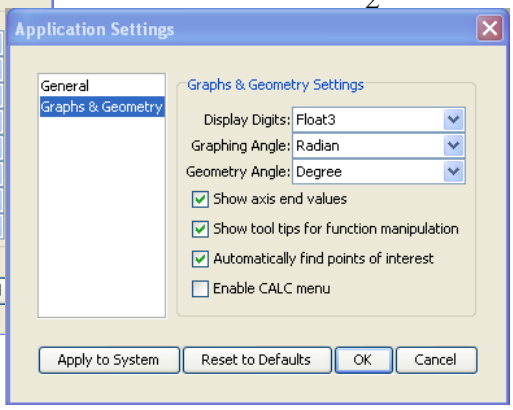
Now under 8:System Info, select 1:Document Settings. (You can also get to Document Settings from any screen by pressing (ctrl)(home), this is the Tools key 🔧. Click (1) for 1:FILE, then (6) for 6:Document Settings.)
For the 83/84 and 89 this was referred to as MODE.
On the TI-Nspire you are working in a document that can be saved. More on this later…

So, Document Settings:



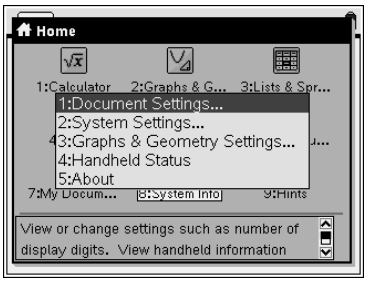
It looks like this on the handheld. Use (tab) to get to the setting you want to change, then click using (·) and arrow down or up, ▼▲, to make your selection. Be sure to Apply to System *or at least hit* OK, or (enter) *a few times, to save the changes.* (Pressing (esc) causes any changes made to be disregarded.)



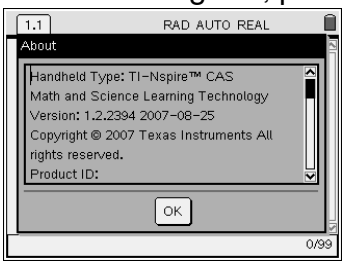


On the computer software, it looks like this (to the right).

I highly recommend using **FLOAT** under 'Display Digits,' and **AUTO** for 'Auto or Approximate.'
'Exact' means the answer will be given as an exact number (no decimal approximation).
'Approximate' means the answer will be shown as a decimal.
'Auto' means the answer will be displayed as exact whenever possible. **Let's use AUTO.**

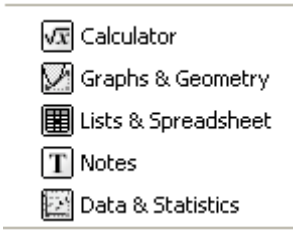


After selecting OK, press (home), 8:System Info, 5:About. This will tell you the version and date of your operating system, OS. For example, the screen to the left shows a handheld with OS version 1.2 from August 2007. Now we are up to OS **1.7**. It came out on June 5, 2009.



A new feature with 1.7 is the Graphs and Geometry Settings. The default settings are shown on the top right of this page. I'd recommend unchecking (use click (ctrl)) the first two boxes so the graphs will not automatically show the end values or tool tips.

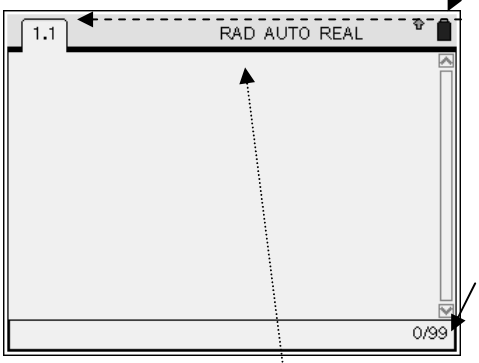
Now begin a new document. Press (home), 6:New Documents. When you first begin a new document you get to choose between one of five options: a Calculator, Graphs & Geometry (are now done on the same page), Lists & Spreadsheet (like Excel®), Notes (a word processor with an equation editor that can calculate), or Data & Statistics (behaves similar to Fathom®).



First, let's examine the Calculator features.

Section 2: Calculator

The Calculator screen looks like. Battery life is good.



The "1.1" tells you what page you are on. In a document there can be more than one page.
Each document can consist of up to 30 "problems" and each problem can have at most 50 pages.
1.1 indicates that we are in the first page of the first problem. 3.4 would indicate that we are in the 4th page of the 3rd problem.
And as you can see, the calculator remembers 99 entries in the history.

Remember the days when you would get a trig problem wrong because you were in degrees and you wanted to be in radians?
Now it tells you the settings for this document right at the top. How nice. ☺

Press 

. WHOA! What just happened? No more sloppy TI-84 of allowing you to forget the close parenthesis. Even more importantly, no more getting lost in the parentheses. You open and it automatically closes. Just like an automatic door closer on your screen door, it will let fewer flies in, fewer syntax mistakes.

Now press 

.
Right now the screen displays $\sin(3\pi/4)$. Get ready. Watch what happens when you press 

.

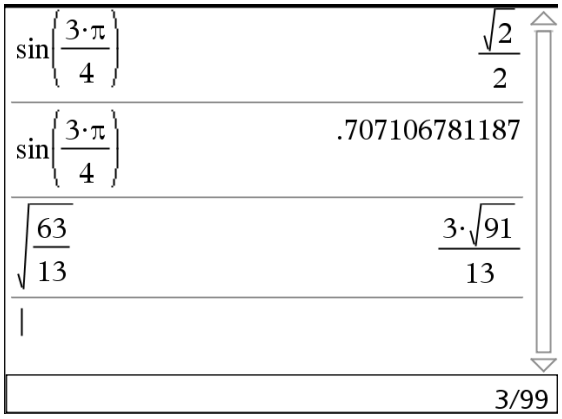
This is the exact answer. (Isn't "pretty print" beautiful?) The parentheses grew, the division became a lovely fraction, and there was even a multiplication symbol added between the 3 and pi. The radical in the answer even goes over everything it should.

But what if you wanted an approximate answer? Notice the **blue** that is above various operations. To access the **blue** commands,

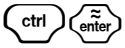
you must first press 

.
What do you think the symbol above the enter key will do? Try it. Press 

. (It gives you the decimal approximation)



Try a radical expression like $\sqrt{63/13}$ by typing 

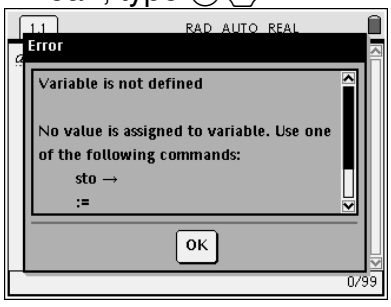
Hey, did you notice that it rationalized the denominator. Perhaps you were expecting $\frac{3\sqrt{7}}{\sqrt{13}}$. If you ever wonder if those two are the same, how could you check it? Try it.
Don't forget to press 

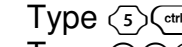
to get the decimal approximation.

Evaluating expressions a couple of different ways (I prefer the second)

1. You can store or define a variable. To show you what I mean, type 

.



Oops, that's what it would say with a TI-Nspire.
TI-Nspire **CAS** has no problem talking about variable a.
Type 

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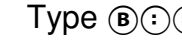
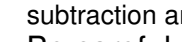
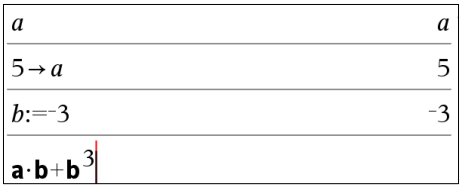
Type 

. (: is on the right between subtraction and multiplication; = is at the top of left column.)
Be careful to use the negative (opposite) sign, NOT the minus sign. Well, actually the Nspire is kind enough to generally understand either the minus or negative.
Type 

.

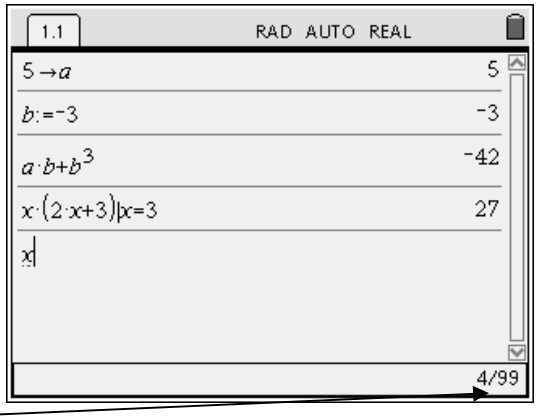


IMPORTANT! You HAD to type the multiplication sign between the **a** and **b**. On the TI-Nspire or TI-Nspire CAS you are not limited to the 26 letters of the alphabet for variables or names of functions. So 'ab' is an acceptable variable name. 'ab' does NOT mean a times b.
Try to get in the habit of using the multiplication sign between variables and also between variables and parentheses to indicate multiplication. If you are using parentheses for multiplication with variables, like x(2x+3), they have rigged it up to give you a friendly "Invalid implied multiply" error message to remind you to use the multiplication sign. Get used to it.

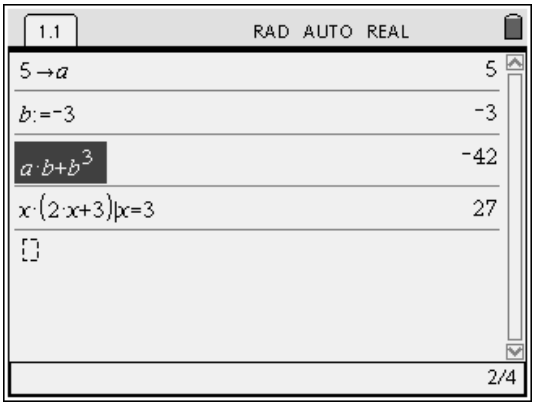
Hey, did you notice that variables that are defined turn bold when you type them. This can be a comfort that you are doing things right. Also, isn't it great that the expression actually looks like the way it would appear in a book instead of like you are talking to a computer? We call this instant pretty print.

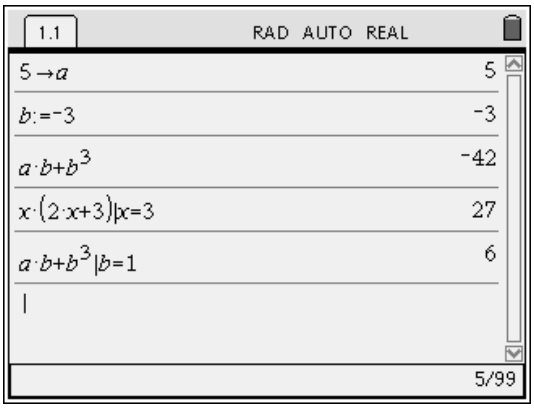
Just like on the TI-83/84, the value stored in 'a' is 5 and 'b' is -3 until the values are redefined, but now on the TI-Nspire these values are only stored on this problem. Start a new problem and the variables are freshly available. More on this later…

2. (I like this method better)
Press X (2 X + 3) | X = 3.
(| is just to the right of ctrl. '|' is the 'such that' key.)
When you press enter, note that it shows the multiplication between 2 and *x*.
What value is stored in *x* ? Surprised? There is nothing stored in *x*. "Such that" is temporary.



Do you remember how you could go through the 'history' on your TI-83/84? It would take you back through the previous 10 entries by hitting 2nd ENTER. With the TI-Nspire now you can go back 99 entries simply by using the NavPad to up arrow, ▲, until you get to the expression you want. Press ▲ until $a \cdot b + b^3$ is highlighted. Press enter.
The expression popped down to the last line.
Now type | B = 1. Will *b* remain the negative 3 as you defined it earlier or will *b* = 1 win? Press enter.
Hmmm…. How can you find out what *b* is defined as?
Press B enter.





Section 3: Graphs and Geometry

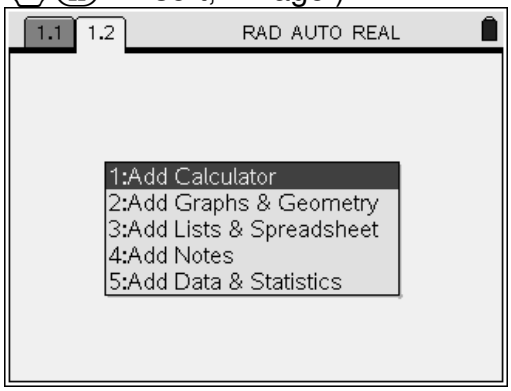
We will return again to the Calculator features later and consider more about why your TI-Nspire CAS is such a valuable tool. Perhaps you will even consider it to serve as a ladder to help you reach new heights and succeed in calculus. So far we haven't done any mathematics that your previous calculator could not do.

According to the AP Calculus course description "A graphing calculator appropriate for use on the exams is expected to have the built-in capability to:

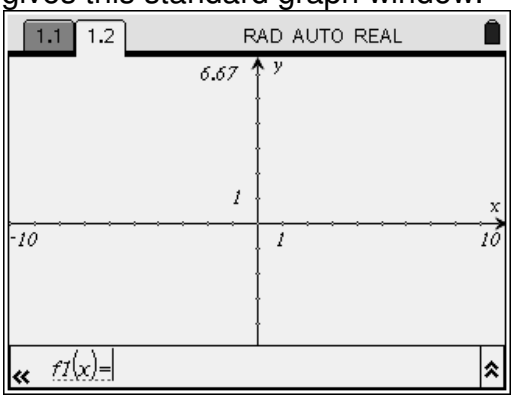
- Plot the graph of a function within an arbitrary viewing window
- Find the zeros of functions (solve equations numerically)
- Numerically calculate the derivative of a function
- Numerically calculate the value of a definite integral"

You will learn how to do the 3rd and 4th bullets later in the school year, but the Graphs & Geometry application will be introduced by teaching you effective means of doing the first two bullets now.

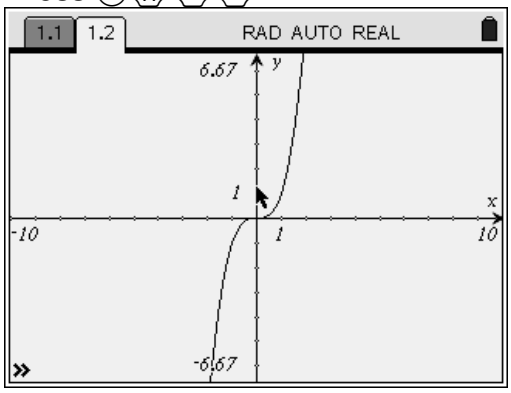
First off, press CTRL + I, this means the CTRL key followed by the I key (no + sign). (This could be done using Tools. (ctrl)(home)4:Insert, 2:Page.)



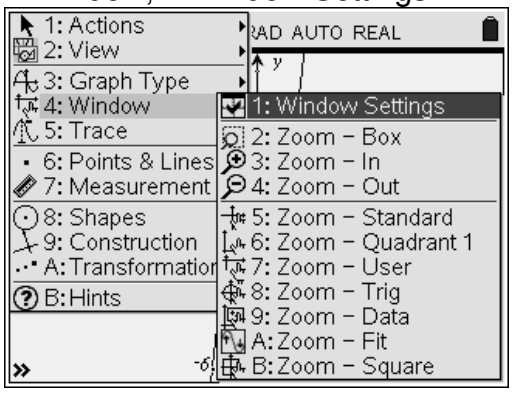
Choosing 2:Add Graphs & Geometry gives this standard graph window.



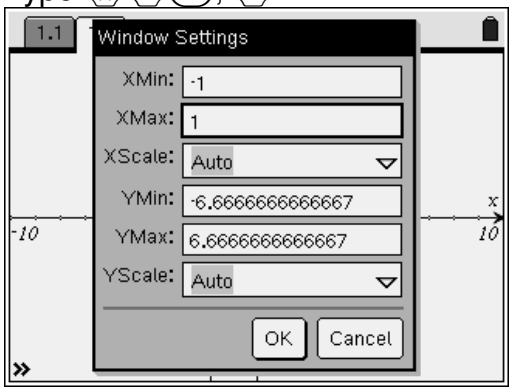
Press (x)(^)(3)(enter).



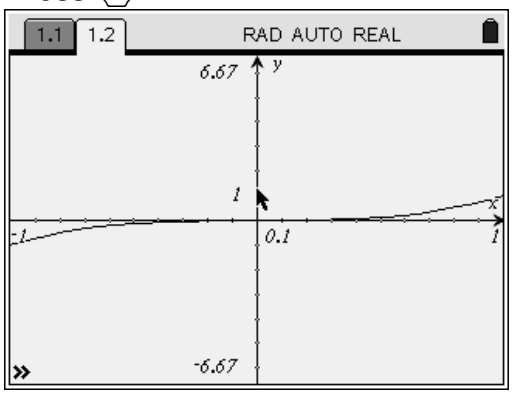
To adjust the window settings press (menu), 4:Window, 1:Window Settings.



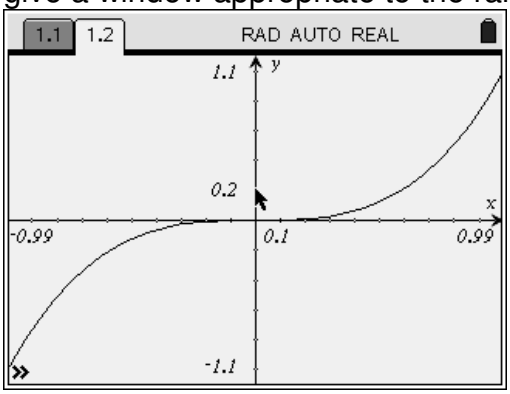
Type (ans)(1)(tab), (1)



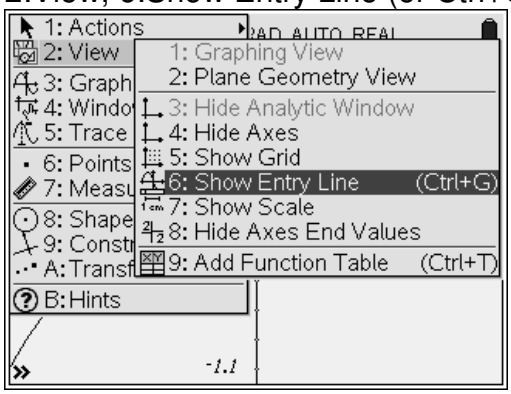
Press (enter)



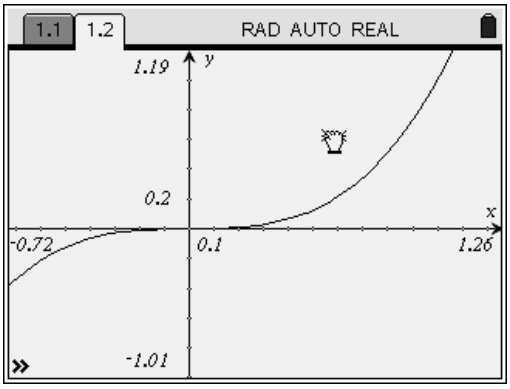
Press (menu), 4:Window, (A):Zoom-Fit.
(If you know the domain, this will quickly give a window appropriate to the range.)



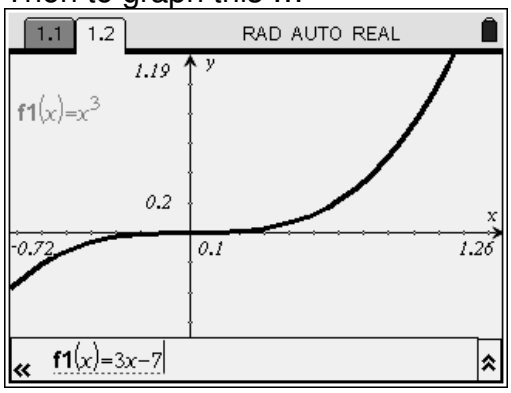
With the new OS the entry line is hidden automatically. (tab) will reveal it or press (menu), 2:View, 6:Show Entry Line (or Ctrl+G).



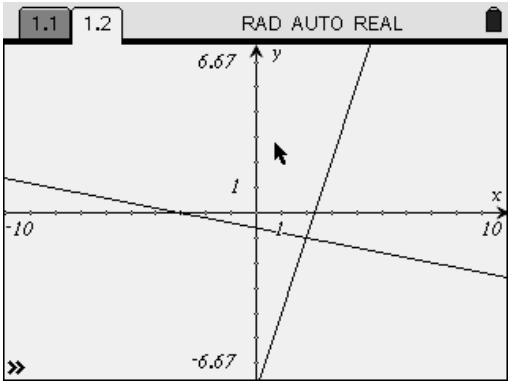
This next screen shot shows the screen being grabbed and moved. Use the NavPad to move the cursor to an empty place. Press (ctrl)(hand) or hold down (hand) until the open hand closes. Try moving the page so it looks like the screen below.



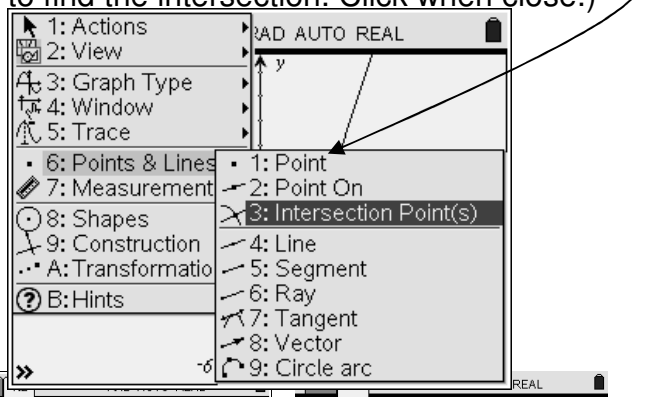
Now let's clear the cubic and graph a linear function, y=3x-7, in a standard window. Press (tab) to get to the command line. Up arrow, ▲, to f1(x). Press (ctrl)(clear). Type (3)(X)(÷)(7). Then to graph this …

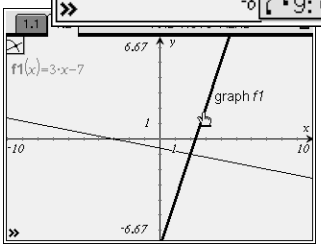


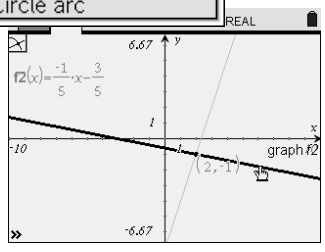
press (enter). (menu),Window, Zoom Standard. Press (tab). Type the following in f2(x)= $-\frac{1}{5}x-\frac{3}{5}$ (Use (ctrl)(÷) for fractions). Press (enter).



To find the intersection point press (menu), (6) (3). Now just click each line. ((ctrl)(z) to undo. Try using 1:Point to find the intersection. Click when close.)

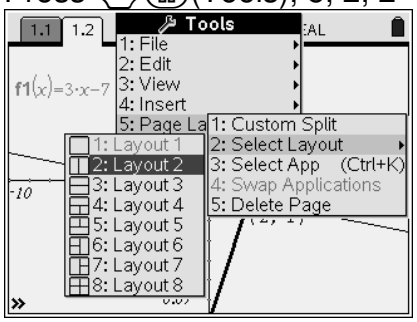




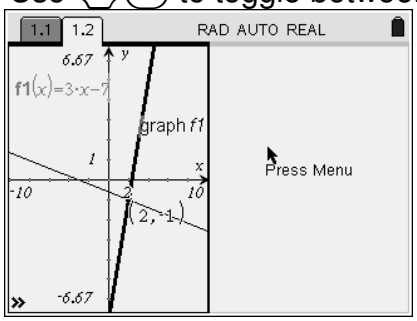


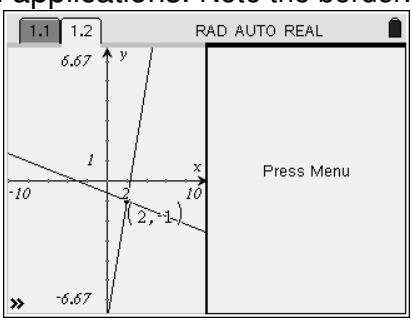
esc to get out of the 'Intersection Point(s)' mode. Move the cursor and click "graph f1". Notice f1(x) appears in the upper left. Let's try some of the split screen features of TI-Nspire.

Press ctrl ⌂ (Tools), 5, 2, 2

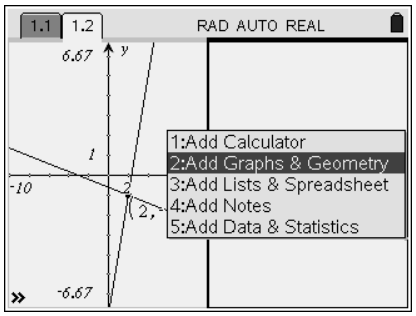


Use ctrl tab to toggle between applications. Note the border.

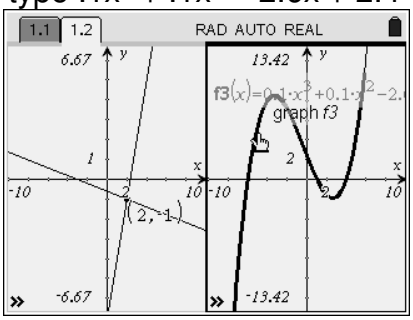




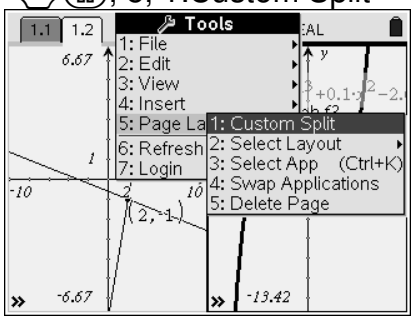
Press menu, 2:Add G&G



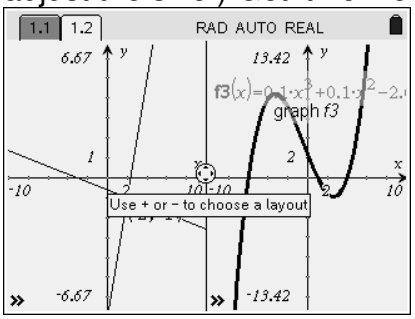
In f3(x), type $.1x^3 + .1x^2 – 2.6x + 2.4$

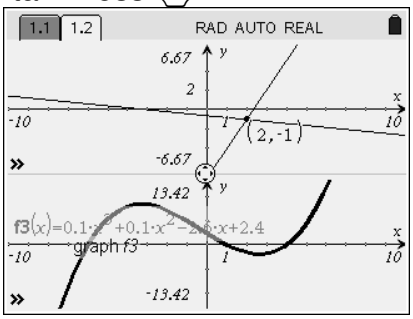


Split screen can be customized. ctrl ⌂, 5, 1:Custom Split

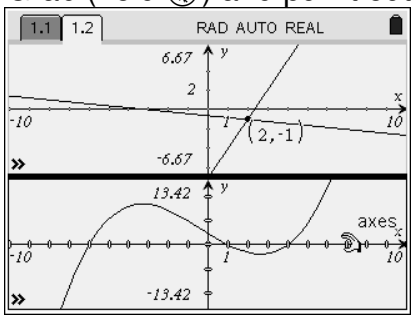


Use ⊕ and ⊖ to scroll through the options. (Arrows adjust the size.) Get it horizontal. Press enter.

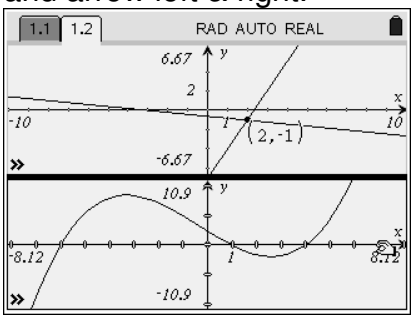




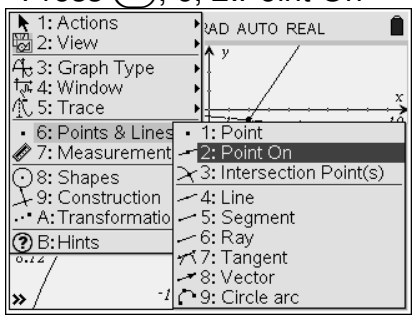
Move the cursor to hover over the ticks on the x-axis. Grab (hold ☜) and pull it out.



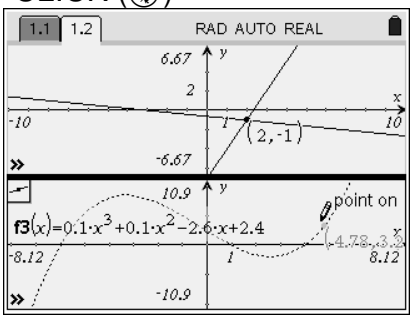
Don't want the vertical scale to change. Press SHIFT (⇧) and arrow left & right.



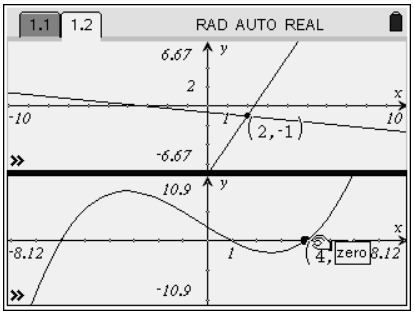
Now, let's find the zero.
Press menu, 6, 2:Point On

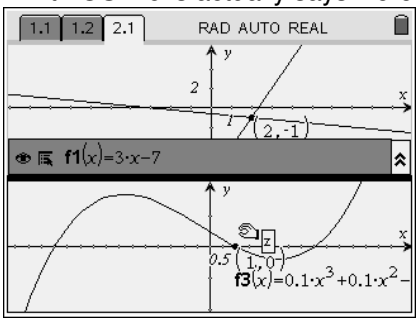


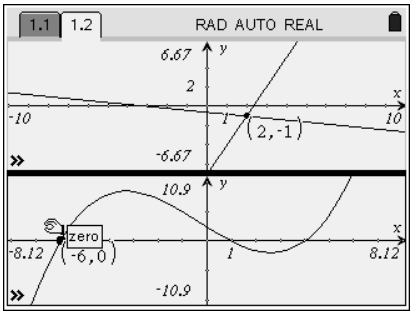
Hover over the cubic and CLICK (☜)

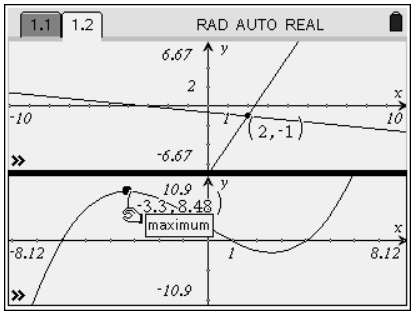


Press (esc) to escape the 'Point On' mode.
Now grab the point and drag it along f3(x). Notice that each time you get close to a zero it jumps there and a 'z' appears. With OS 1.6 is actually says 'zero.' Did you notice anything else?



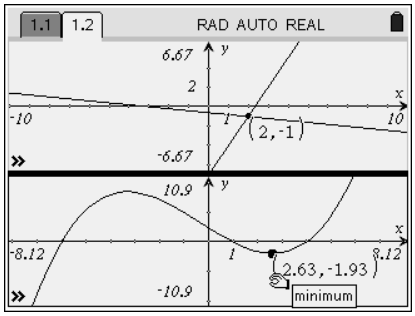




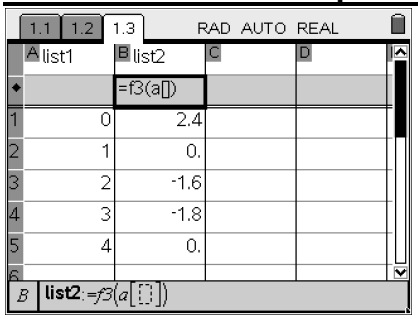


Notice the words 'maximum' and 'minimum.'

(You can also do this easily by using trace (menu) 5, 1.
Press enter to "drop" a point.)



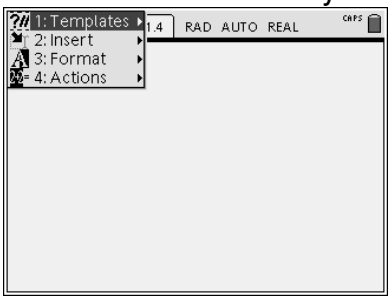
Section 4: Lists and Spreadsheet



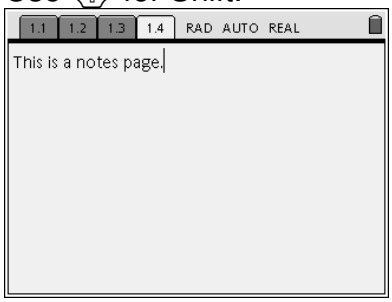
To insert a new page press (ctrl)(I), 3:Add Lists and Spreadsheet.
Explore the option under (menu).
(If you wanted to go back to the previous page press (ctrl) ◀, ⧉.)
This much improved spreadsheet behaves like Excel.
To write a formula start with (=)

You can take data and try to fit an equation to it using all sorts of regressions.

Section 5: Notes Let's try another method to open a Notes page. Press (home) 4
To view the options, press (menu).
Observe the Format styles.



Try typing something.
Use (caps) for Shift.



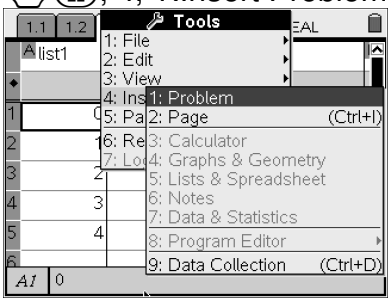
To learn more about Lists & Spreadsheets, Notes, or Data & Statistics applications check out the files in the Examples folder like "Getting Started." Press (home), (7):My Documents. Look in the Examples folder. (You may choose to save your current document as Primer.)

Section 6: CAS (Computer Algebra System)

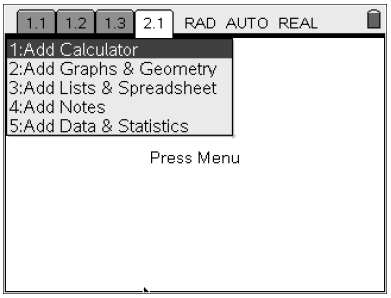
This is what you have been waiting for. What makes the calculator really special? Besides the fact that it look like mathematics, it actually does algebra (and more).

Let's begin with a new problem (or new document).

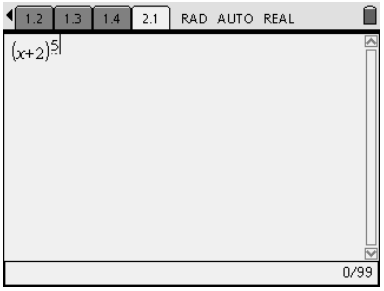
(ctrl)(home), 4, 1:Insert Problem



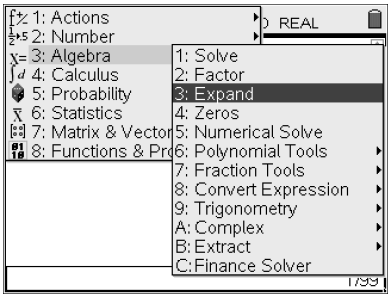
1:Add Calculator



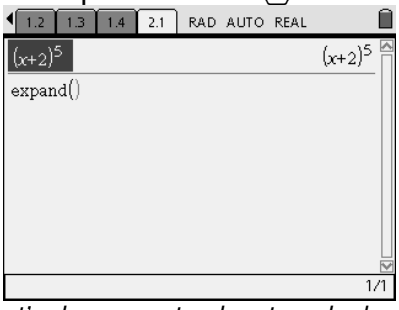
Let's try $(x+2)^5$



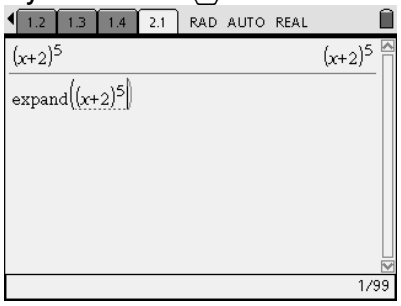
That answer wasn't very interesting. Try (menu), 3, 3



Now up arrow to highlight last question. Hit (enter)

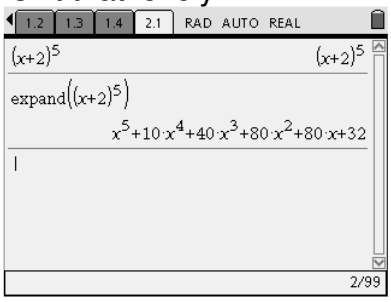


Oh yeah, it "retyped" it for you. Press (enter)

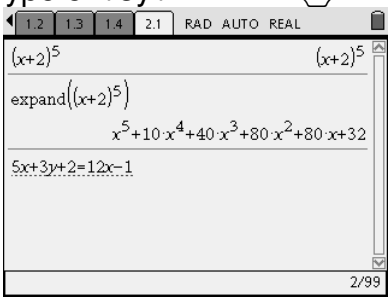


Let's do some step by step algebra.

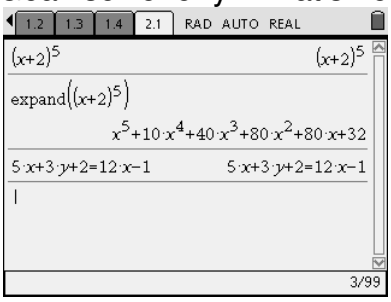
Isn't that lovely.



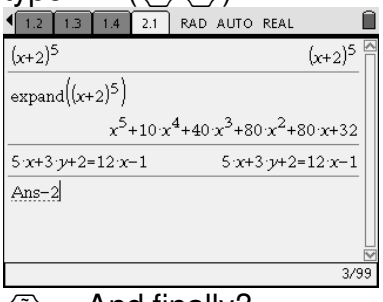
Type 5x+3y+2=12x-1 (enter).



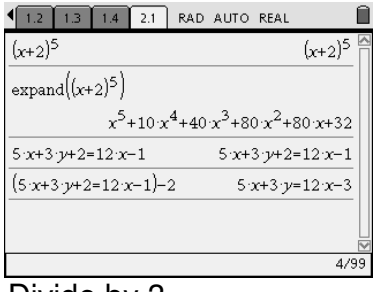
Goal: solve for y. What's next?



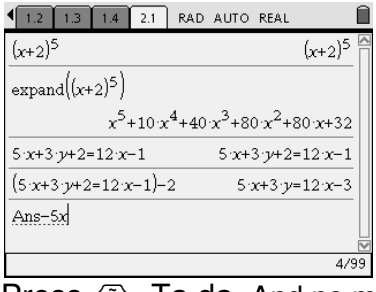
Subtract 2 you say? Just type –2. ((-)2)



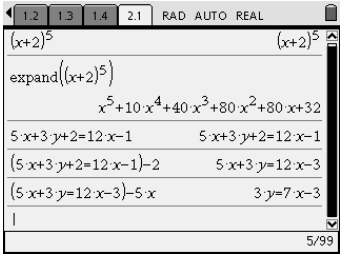
Subtractions was distributed over the equals. What's next?



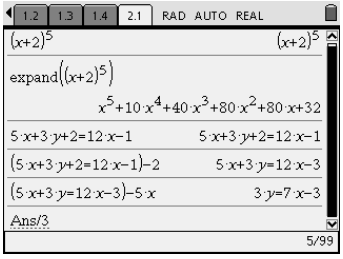
Alright, let's subtract 5x Type (-)(5)(x)



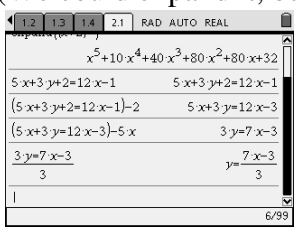
(enter)… And finally?



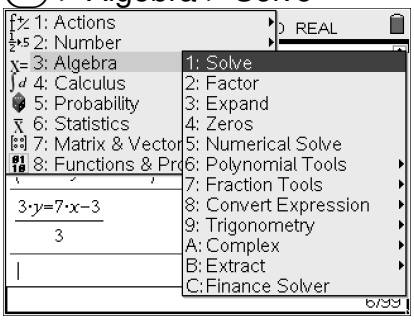
Divide by 3.



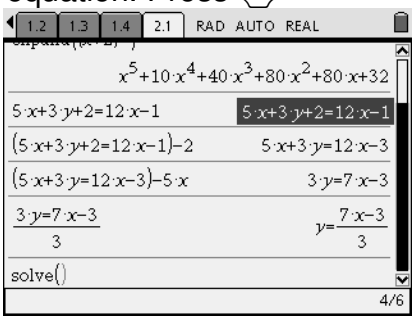
Press (enter). Ta da. And no mistakes. (We could expand it, but it's okay.)



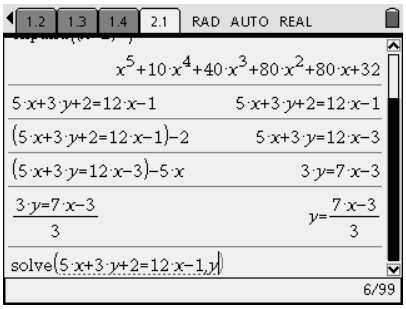
Alright, now do it in one step (menu) > Algebra > Solve



Arrow up to highlight the equation. Press (enter)

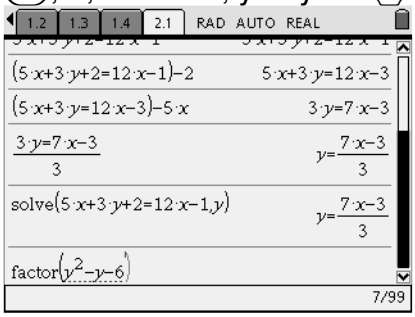


But what are we solving for? Type (,)(Y)(enter). That will do.



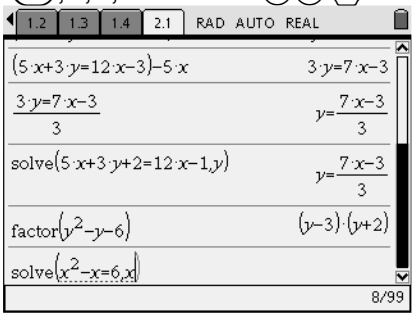
Let's factor.

(menu), 3, 2:Factor, $y^2 - y - 6$(enter)

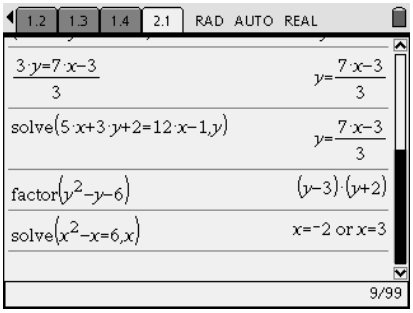


Let's solve a quadratic for x.

(menu),3,1, $x^2 - x = 6$ (,)(X)(enter)

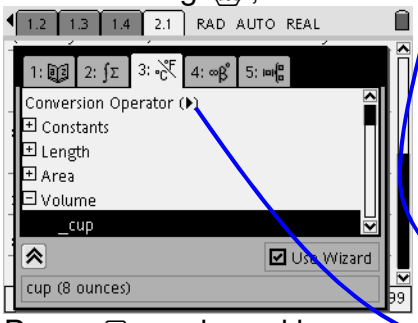


Isn't the 'or' beautiful?



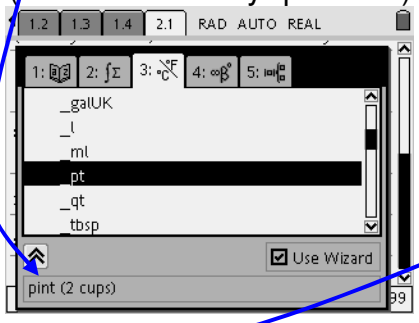
Look what else it can do…

Press catalog (doc), 3.

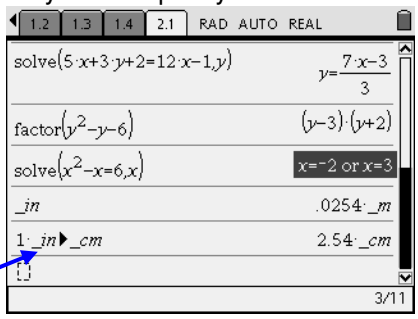


IT CONVERTS.

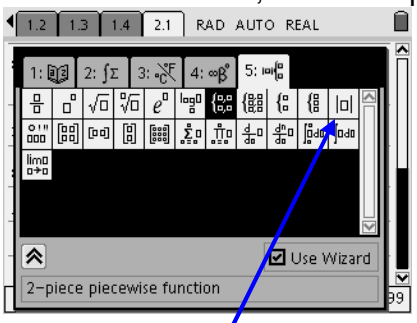
(That answers my question.)



It automatically converts to SI or you can specify the units.



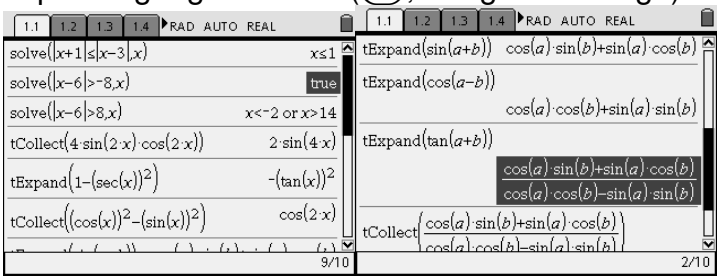
Press (doc) again and browse the other features, like 5:templates



absolute value

(Shortcut for underline: CTRL (␣) look down next to (enter))

Look at what it can do with inequalities, absolute value, and expanding trig identities ((menu), > Algebra > Trig4).



Another fun thing you could try is graphing an inequality: Press (home) 2:G&G. For f1(x)=, backspace (clear) once and change = to an inequality. Also graph a circle ((menu) > Shapes > Circle, (ctrl) to start and stop) and find its equation ((menu) > Actions > Coordinates and Eq).

Calc Summer Assignment – TI-Nspire Primer Name _____

BIG IMPORTANT MESSAGE – Do not underestimate this.

The TI-Nspire CAS handheld is a very powerful ~~calculator~~ learning tool (As we have seen, calculator is only part of its functionality.) It is like a mini-computer with $1500 of software on it. In fact, it does things that no other software can do. With its portability, affordability, and integrated functionality the TI-Nspire is the best choice.

The AP exam allows it on half of the test. NO calculator of any kind is allowed on the other half of the test.

Some colleges may allow students to use the TI-Nspire CAS. Many do not. Many colleges require all students to have laptops or allow other types of calculators (TI-89, TI-83/84, HP, scientific, …). At some colleges it depends upon the individual professor as to whether or not you can use technology.

For these reasons, I must teach you how to do calculus WITH the technology and without the technology. I must prepare you for any college – any professor – any situation. I cannot, will not, let you become calculator dependent. But you have to help me with this. Do NOT let yourself become dependent on a calculator.

There are three types of calculations in this world: mental math, paper & pencil, and calculator/computer. It is my job to, not only teach you HOW to do each of those three types of calculations, but also – and just as important – WHEN to use each of those three types of calculations. I will be stressing 'appropriate use of a calculator.'

On the College Board AP Calc website it says the following:
"The use of a graphing calculator is considered an integral part of the AP Calculus course, and is permissible on parts of the AP Calculus Exams. Students should use this technology on a regular basis so that they become adept at using their graphing calculators. Students should also have experience with the basic paper-and-pencil techniques of calculus and be able to apply them when technological tools are unavailable or inappropriate." This page, http://www.collegeboard.com/student/testing/ap/calculus_ab/calc.html, also contains the list of calculators permitted. TI-Nspire CAS has been permitted on the AP Calc Exam and on the SAT since 2007.

Practice What You've Learned So Far

1. What is the Product ID on your TI-Nspire CAS Math and Science Learning Technology handheld? This could come in handy if you lose yours and don't have your name on it. (Put you name on it.) _____
   What version is your OS (operating system)? If it isn't 1.7 get it from a friend using (home) 7:My Documents, (menu) A:Send OS or go to http://www.ti-nspire.com/tools/nspire/resources/download_upgrade.html. The receiving handheld doesn't need to press anything besides being turned on.
   I have OS _____

2. What does the calculator give you when you press π, enter? _____

   How do you get an approximation for π ? Do it. What did you get? _____
   Why did you get as many decimals as you did? (What are your document settings?)

3. What is the y-intercept of $y = \frac{1}{10}(x+6)(x-1)(x-4)$? _____
   (I showed you how to find zeros and max & mins. You could do that same type of thing. Click the *x*-value of the point until you get a cursor. Back space over all of it until is says zero, 0. You could also try Trace and just type 0. (menu), 5:Trace. Graph Trace is useful ☺ .
   Also, when near the graph, try "right-click" (ctrl)(menu) and choose Graph Trace.)

4. Where does $y = e^{2x}$ and $y = -1/3\ x^2 + x + 7$ intersect? (On AP Calculus exams you generally need to give at least 3 decimal places in your answer. Exact answers are generally fine too, e.g. $\sqrt{2} \approx$ _____) _____

5. Solve for x.
   a. $x(x^3 - 8) = 3$ _____
   (Did you remember the multiplication symbol?)
   b. $x(x^3 - 8) = 0$ _____
   (I hope you didn't use your calculator for that one.)
   c. $x(x^3 - 7) = 0$ _____
   (What do you think about that answer?)
6. For fun factor $x^2 + 5$. Type cFactor(x^2+5,x) to do it. _____
   You can find cFactor *under* **menu**>Algebra>Complex>Factor
7. Use trig collect to simplify 2sin(x)cos(x) _____
   You can find tCollect *under* **menu**>Algebra>Trigonometry>Collect
8. Make up your own problem which demonstrates that you found something that you think is cool and exciting about the TI-Nspire.

9. Read the following and fill in the table. Some of the table has been done for you.

(This has been adopted from Kuyers Mathematics Curriculum http://www.calvin.edu/kuyers/math/lessons.html.
For a more thorough and colorful treatment see the website.)

Whatever way he [the geometer] may go, through exercise will he be lifted from the physical to the divine teachings, which are little accessible because of the difficulty to understand their meaning…and because of the circumstance that not everybody is able to have a conception of them, especially not the one who turns away from the art of demonstration. Preface to the *Book on Finding the Chords in the Circle* by al-Biruni, c. 1030 A.D.

…the theory of number is not to be lightly regarded, since it is made quite clear, in many passages of the Holy Scriptures, how highly it is to be valued. It was not for nothing that it was said in praise of God, "You have ordered all things in measure, number, and weight." Augustine, *City of God*, 430 A.D. or so

Philosophy is written in this grand book, the universe, which stands continually open to our gaze. But the book cannot be understood unless one first learns to comprehend the language and read the letters in which it is composed. It is written in the language of mathematics, and its characters are triangles, circles, and other geometric figures without which it is humanly impossible to understand a single word of it; without these, one wanders about in a dark labyrinth. Galileo Galilei, 1623

The long chains of simple and easy reasonings by means of which geometers are accustomed to reach the conclusions of their most difficult demonstrations led me to imagine that all things, to the knowledge of which man is competent, are mutually connected in the same way, and that there is nothing so far removed from us as to be beyond our reach, or so hidden that we cannot discover it, providing only that we abstain from accepting the false for the true, and always preserve in our thoughts the order necessary for the deduction of one truth from another. Rene Descartes, from his *Discourse on Method*, 1637

Genesis 1:27-28, Proverbs 3:13-20

Author/source	What reason does this suggest?	Why?
al-Biruni	Understanding math can help us understand God	God wants us to know him. Understanding the order and beauty of God's world can also help us understand God's order and beauty.
Augustine		
Galileo		
Descartes		
Genesis 1:27-28	This quote is sometimes called the "cultural mandate" – God has made us stewards of the earth and has given us the responsibility to care for and nurture it and to build cultures.	Caring for something involves understanding it, and mathematics can help us a great deal to understand both the physical and the social worlds around us.
Proverbs 3:13-20		The last two verses suggest that wisdom is the basis on which the earth is founded. When we begin to see how much of the structure of the universe is mathematical, it seems like a reasonable inference to conclude that some of the wisdom referred to here is mathematical.