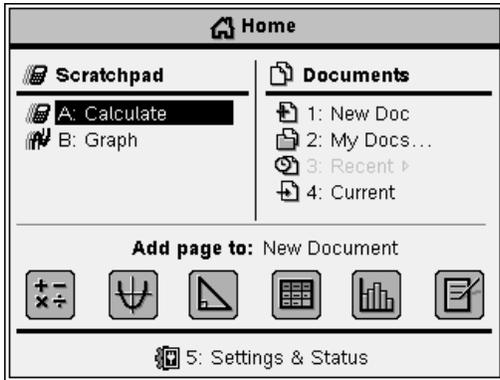


TI-Nspire CAS Touchpad primer (especially for TI-83/84 users)

This primer will help you get a feel for your new super graphing calculator. Updated by Mr. Bird on August 4, 2010. OS 2.1. Enjoy. (This document is available as a Word document at <http://covenantchristian.org/bird/Nspire.html>. You may need to install the Nspire fonts for the Word doc to appear correct or simply use the [pdf version](#).)

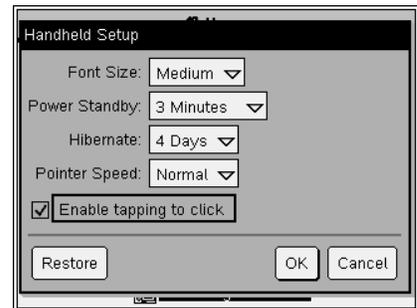
Section 1: Intro – Home & Settings (84 users would call it MODE)

Welcome to the most intelligently designed and mathematically enjoyable technology ever developed for the high school classroom. There are several features on the TI-Nspire where your computer knowledge will carry over. Press **(on)**.



This Home screen is like the desktop of a computer. My Documents is just like 'My Documents' on a computer with all the files in folders. Navigate around this page by clicking the arrows on the Touchpad, or just slide your finger across the Touchpad.

Yes, the rectangle is a touchpad like on a laptop computer. You could even double tap one of the options



on the Home screen if you enable that feature. In order to enable this go to Settings & Status, Handheld Setup...

Let's look at the buttons around the Touchpad.

(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. It removes menus or dialog boxes. Tab is a nice way to jump through fields on a dialog box or even on the Home screen. Other keys that work just like on a computer keyboard are **(shift)** and the backspace button is **(del)**. **(esc)** Notice the yellow word 'CAPS' above **(shift)** and 'clear' above **(del)**. If you press **(ctrl)(shift)**, you will turn on caps lock; repeat to turn it off. **(ctrl)(del)** will clear the entry.

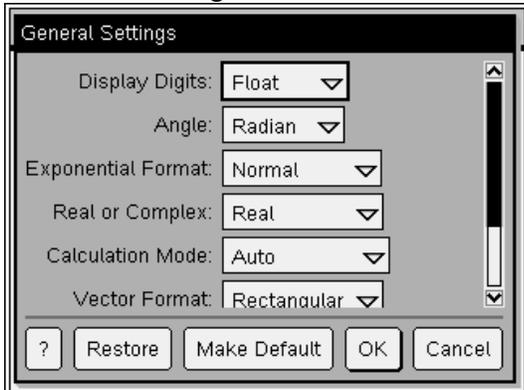
In the middle of the Touchpad is **(click)**. This is the 'click' button. It serves as the left click on a mouse button. Most times, pressing **(click)** or **(enter)** will accomplish the same thing. To access the contextual menu, right click is done by pressing **(ctrl)(menu)**, designated with the symbol **(menu)**.

Now under Settings & Status, select Settings, General. (You can also get to document settings from any other screen by pressing **(doc)**.)

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...

General Settings looks like this on the handheld



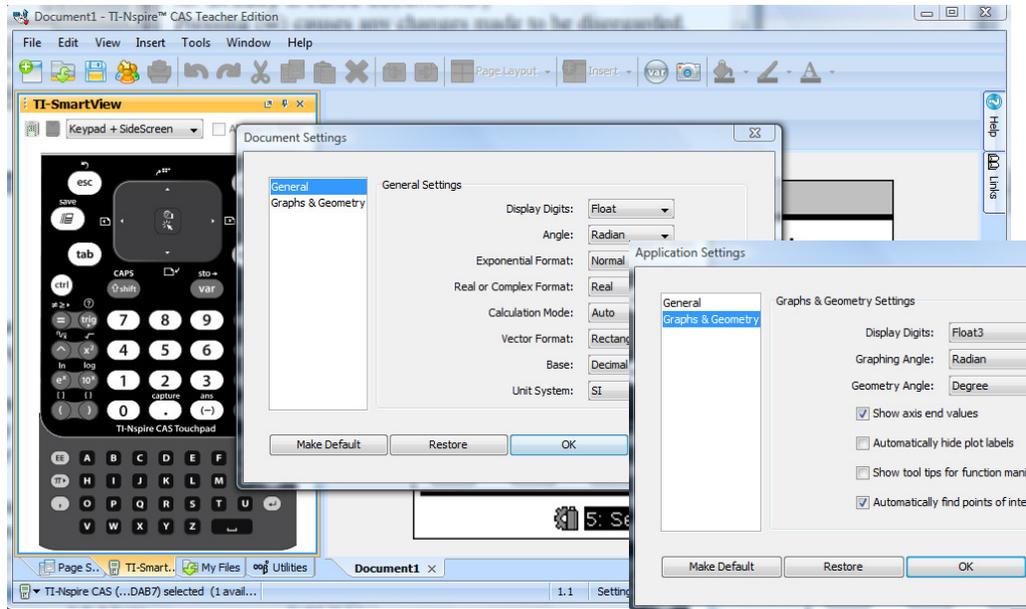
Use **(tab)** to get to the setting you want to change. Then arrow down by pressing on the bottom of the Touchpad. Press **(click)** to make your selection. Be sure to tab to Make Default to apply this setting to the current and all future new documents as well as the Scratchpad. (This will not change the settings for already created documents.)

Pressing **(esc)** causes any changes made to be disregarded.

On your computer software that came with your Nspire, it looks like this (to the right) when you choose File, Settings, Document Settings.

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 always be shown as a decimal. 'Auto' means the answer will be displayed as exact whenever possible. **Let's use AUTO.**

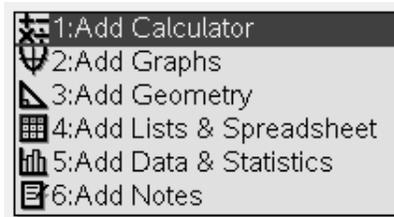


After selecting 'Make Default,' let's look at the setting options for Graphs & Geometry. In calculus we'll need to make sure the general and graphing angle is set to radians. For the AP exam you may want to change the display digits on a graph to Fix3, but I would keep it on the default Float2 setting for now.

Can you find Status in the Settings & Status option? This will tell you the version of your operating system, OS. For example, the screen to the right shows a handheld with OS version **2.0**. You can find your Product ID by looking in About. (This is the answer to the first question on page 11.)

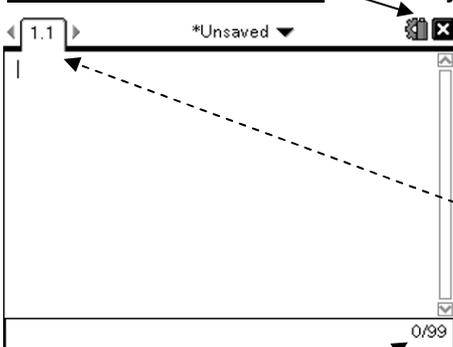


Now begin a new document. Press **(ctrl) on**, 1:New Doc. When you first begin a new document you get to choose between one of six options: a Calculator, Graphs, Geometry (dynamic geometry like Cabri on a handheld!), Lists & Spreadsheet (like Excel®), Data & Statistics (behaves similar to Fathom®) and Notes (press **(ctrl) M** on this page to write and do math here). All of these are dynamically interactive with each other! This is a glorious paradigm shift. No other device brings this fantastic capability to the table of mathematics and science education. Oh, the connections we will make!



Section 2: Calculator

Battery life is good.



New with 2.0, you can close a document. Cursor over here with the Touchpad and click to close. Typically I say 'No' when asked if I want to save. You can also close by pressing **(doc)**, File, Close. What else does **(doc)** do?

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.

Press trig . YES! There are all the trigonometric functions and their inverses. Arcsecant (also known as inverse secant) is no longer hidden. But this trig button can be used fast.
Press 3 . WHOA! What just happened? You didn't even have to press enter to say you wanted sine. And no more sloppy TI-84 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. (Sometime try just pressing the close parenthesis) .)

Press pi . Enjoy looking at all that is there for a moment: imaginary number $i = \sqrt{-1}$, infinity, Euler's number $e \approx 2.718$, and theta θ will all come in handy.

Press div . That is interesting, isn't it? Usually you need to press $\text{ctrl} \text{div}$ to do 'fancy fraction divided by'. I highly recommend this to keep you from making the old 84 mistake of $5/3+2$ when you meant $5/(3+2)$. And please don't use a calculator to do that calculation.

Press $\text{4} \text{enter}$.

This is the exact answer. Isn't "math print" beautiful? The parentheses are large, the division is 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 **yellow** (blue if you are using the TI-Nspire Touchpad, Clickpad, or the TI-Nspire CAS Clickpad) that is above various operations. To access the **yellow** commands, first press ctrl .

What do you think the symbol above the enter key will do? Try it. Press $\text{ctrl} \text{enter}$.

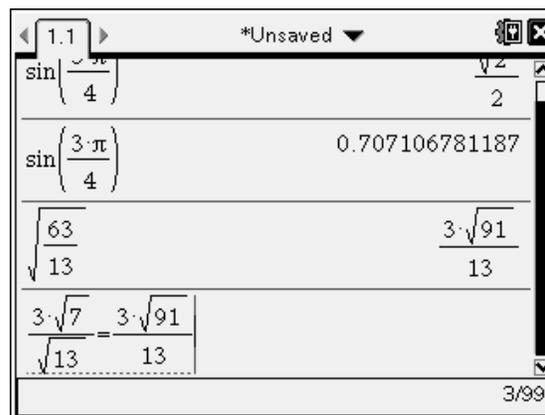
(It gives you the decimal approximation.)

Generally, give three decimal places on the AP exam, unless you like to lose points.)

Try a radical expression like $\sqrt{63/13}$ by typing $\text{ctrl} \text{x}^2 \text{6} \text{3} \text{ctrl} \text{div} \text{1} \text{3}$ 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. To get out from under a radical or denominator, click the arrows on the Touchpad or press tab.



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 $\text{A} \text{var}$.



Oops, that's what it would say with a TI-Nspire.

TI-Nspire **CAS** has no problem talking about variable a .

Type $\text{5} \text{ctrl} \text{var} \text{A} \text{enter}$.

Type $\text{B} \text{ctrl} \text{neg} \text{3} \text{enter}$. (For the $:=$, the colon could also be found in with punctuation punct . And \ominus is at the top of left column.)

Use the negative (opposite) sign instead of the minus sign.

Well, actually the Nspire is kind enough to generally understand either the minus or negative.

Type $\text{A} \text{x} \text{B} \text{+} \text{B} \text{^} \text{3} \text{enter}$.

a	a
$5 \rightarrow a$	5
$b := -3$	-3
$a \cdot b + b^3$	

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. For example, $y(2x+3)$ is not "y times $(2x+3)$ ", it is understood as the function y of $(2x+3)$.

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 cubed actually looks like the way it would appear in a book or how you write it on your homework instead of like you are talking to a computer? Math print is a beautiful thing.

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) Use the 'such that' symbol to temporarily assign a variable.

Press $\text{X} \times \text{1} \text{ 2 } \text{X} + \text{3} \text{ 1}$

Now to get the vertical line, press $\text{ctrl} (=)$ and arrow back once. Press $\text{enter} \text{X} (=) \text{3}$.

When you press enter the expression is evaluated *such that* $x=3$. (When you learn about derivative at a point, the vertical bar or 'such that' will be used again.)

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. The TI-Nspire takes you back 99 entries simply by pressing the top of the Touchpad to up arrow, \blacktriangle , until you get to the expression you want.

Press \blacktriangle until $a \cdot b + b^3$ is highlighted. Press enter .

The expression pops 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?

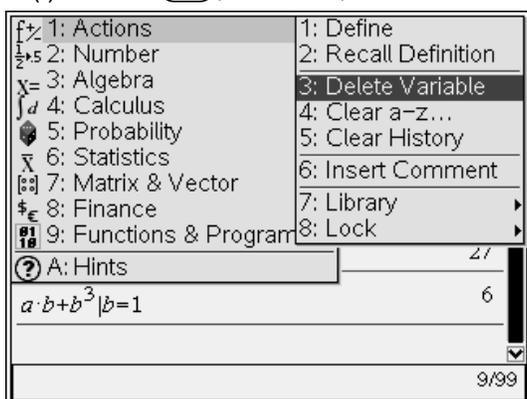
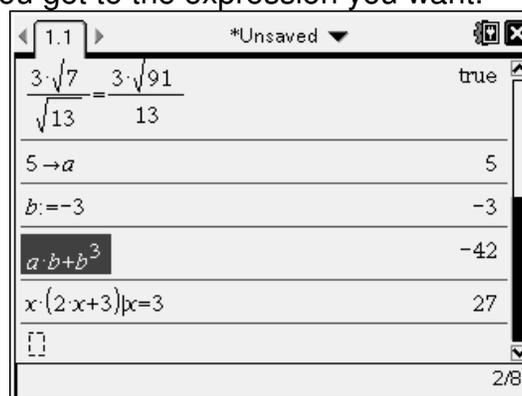
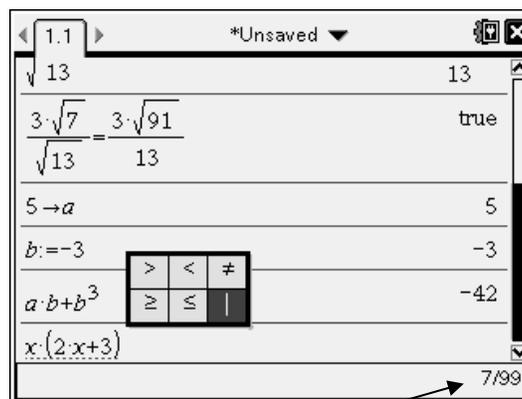
Press $\text{B} \text{enter}$.

Here are 3 ways to delete what is stored in a variable:

(i) Press menu , Actions, Delete Variable. You can

choose which variable you want to delete by pressing var .

(ii) If you want to delete all the single letter variables, choose the option below Delete Variable.



(iii) Perhaps the easiest way to start fresh is to press $\text{ctrl}(\text{on})$, New Doc. And good job observant students. Yes, you can just press $\text{ctrl}(\text{N})$ as you noticed when you pressed $\text{ctrl}(\text{doc})$, File.

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.

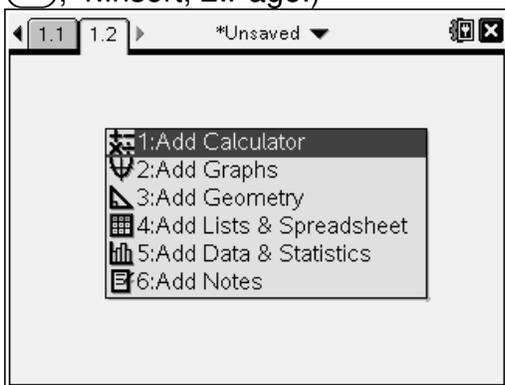
According to the AP Calculus course description “A graphing calculator appropriate for use on the exams is expected to have the built-in capability to:

- 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”

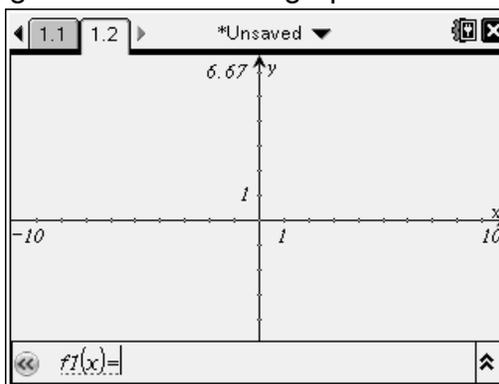
You will learn how to do the 3rd and 4th bullets later in the school year, but the Graphs & Geometry application will be introduced by teaching you effective means of doing the first two bullets now.

First off, press $\text{ctrl}(\text{I})$, to add a new page.

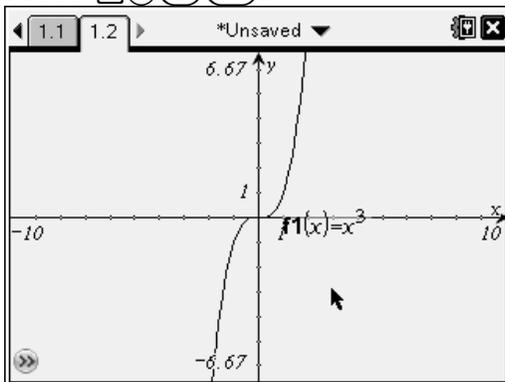
(This could be done using $\text{ctrl}(\text{doc})$, or $\text{ctrl}(\text{doc})$, 4:Insert, 2:Page.)



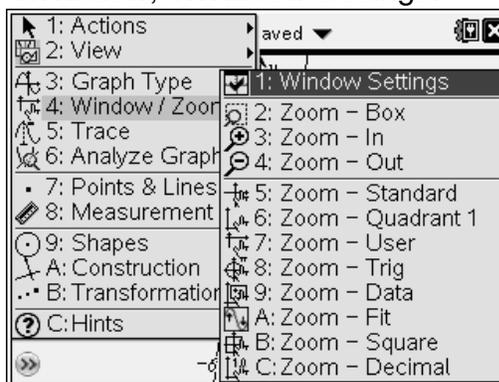
Choosing 2:Add Graphs gives this standard graph window.



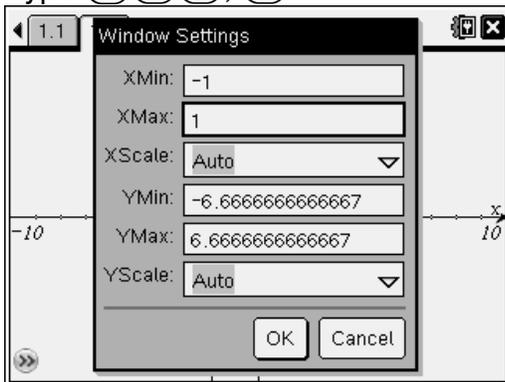
Press $\text{X}(\wedge)(3)(\text{enter})$.



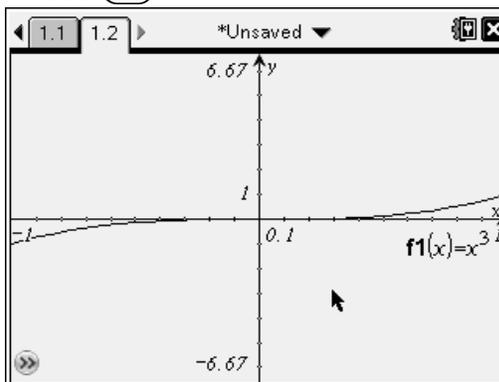
To adjust the window settings press menu , 4:Window, 1:Window Settings.



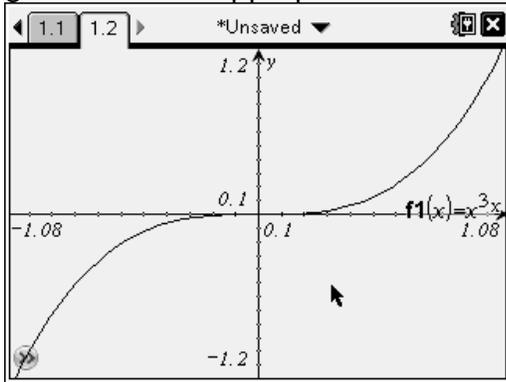
Type $\text{ctrl}(\text{tab})$, 1



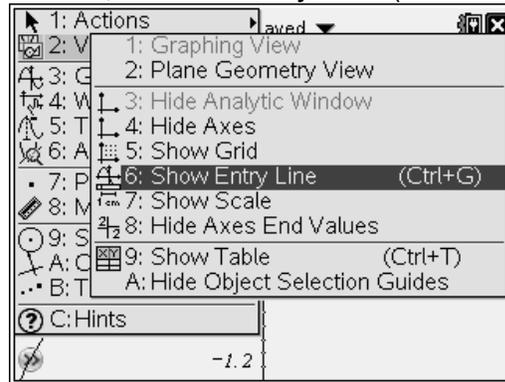
Press enter



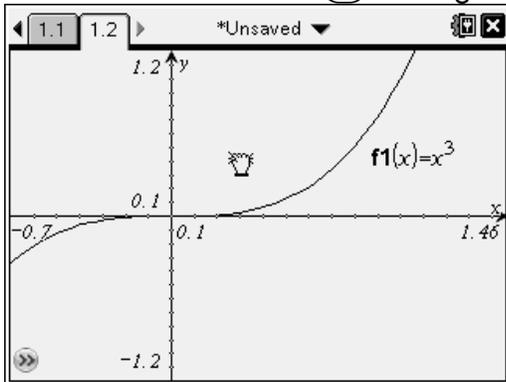
Press **(menu)**, 4:Window, **[A]**:Zoom-Fit.
 (If you know the domain, this will quickly give a window appropriate to the range.)



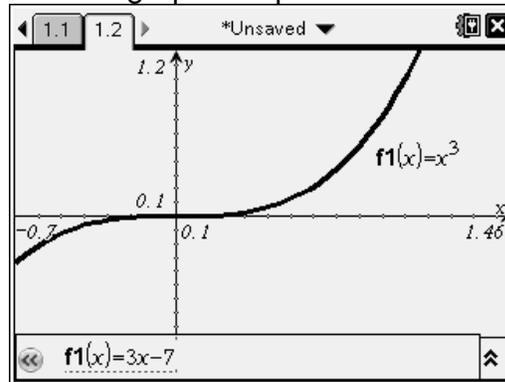
With the new OS the entry line is hidden automatically. **(tab)** will reveal it or press **(menu)**, 2:View, 6:Show Entry Line (or Ctrl+G).



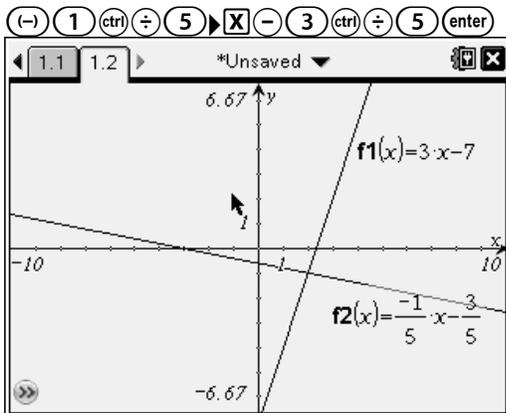
The screen shot below shows the screen being grabbed and moved. Slide your finger on the Touchpad to move the cursor to an empty place. Press **(ctrl)** **[mouse icon]** to make the open hand close. Try moving the page to look like this. Press **(esc)** to let go.



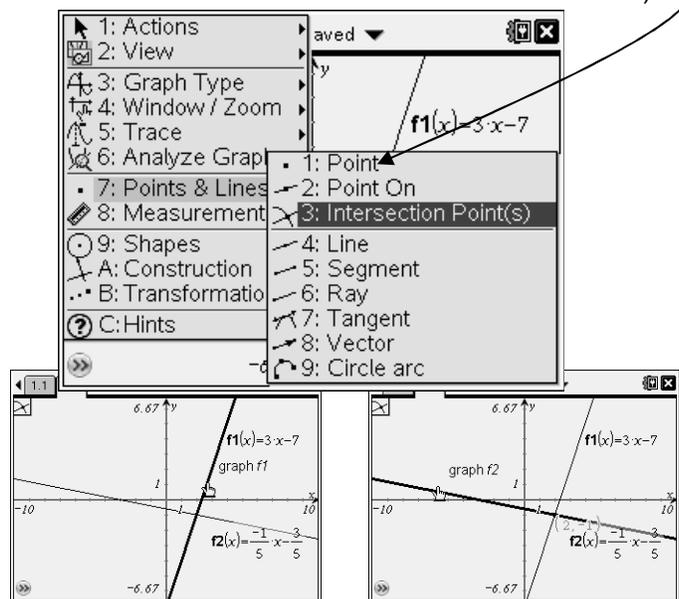
Now let's clear the cubic function and graph a linear function, $y=3x-7$, in a standard window. Press **(tab)** to get to the entry line. Up arrow, **▲**, to $f_1(x)$. Press **(ctrl)** **(del)**. Type **(3)** **(x)** **(-)** **(7)**. Then to graph this press...



... **(enter)**. **(menu)**, Window, Zoom-Standard.
 Press **(tab)**. Type the following in $f_2(x) =$

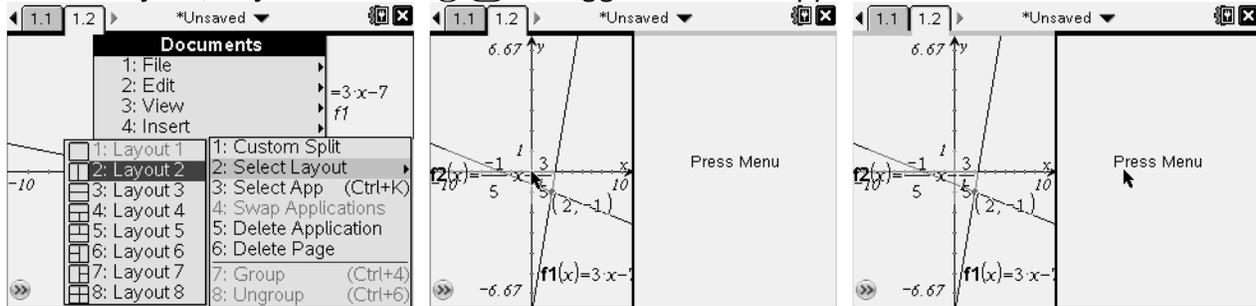


To find the intersection point press **(menu)**, 7,3. Now just click each line. **(ctrl)** **(Z)** to undo. Try using 1:Point to find the intersection. Click when close.)

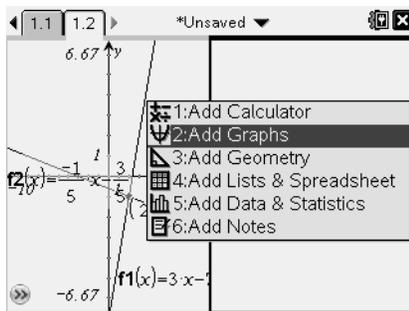


Press **(esc)** to get out of the 'Intersection Point(s)' mode.

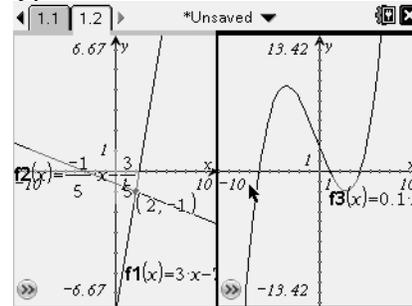
Let's try some of the split screen features of TI-Nspire. Press **(docv)**, 5:Page Layout, Select Layout, Layout2. Use **(ctrl tab)** to toggle between applications. Note the border.



Press **(menu)**, 2:Add Graph

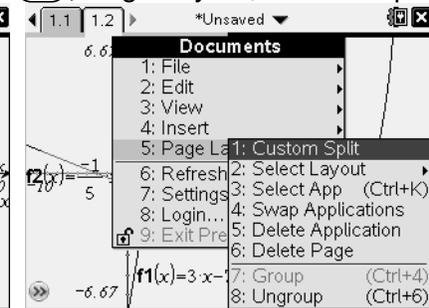


In $f_3(x)$, type $.1x^3 + .1x^2 - 2.6x + 2.4$



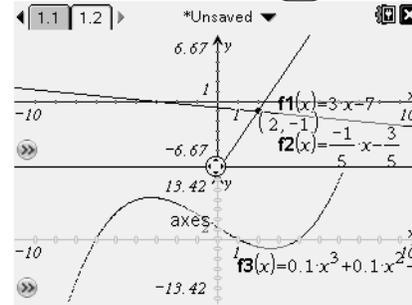
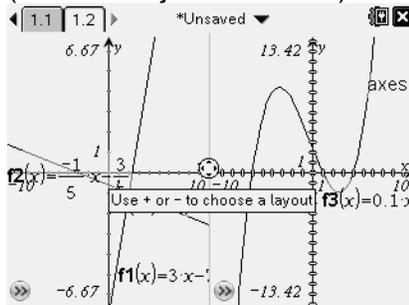
Split screen can be customized.

(docv), Page Layout, Custom Split



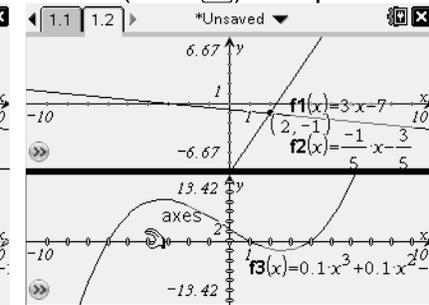
Use **(+)** and **(-)** to scroll through the options.

(Arrows adjust the size.) Get it horizontal. Press **(enter)**.

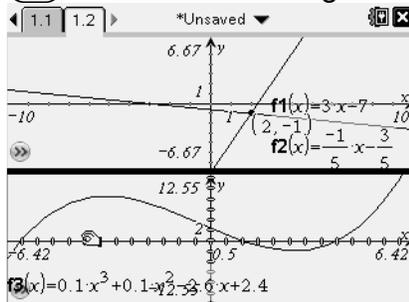


Move the cursor to hover over the ticks on the x-axis.

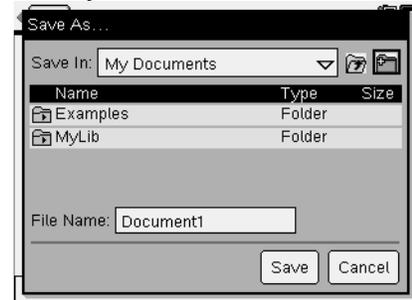
Grab (hold **(grab icon)**) and pull it out.



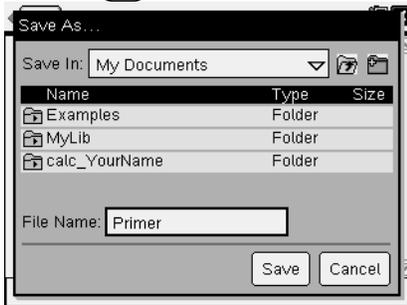
Don't want the vertical scale to change. Hold down the **(+shift)** and arrow left & right.



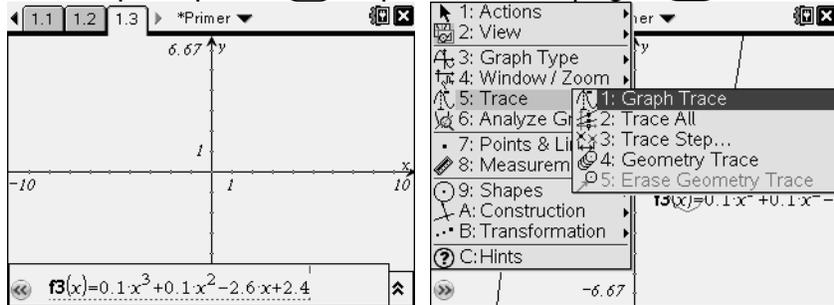
Now, let's save this file. Press **(docv)** Save (or **Ctrl+S**). Press **(tab)** or **(+shift)(tab)** to get to the +folder icon. Press **(enter)**. Add a folder with your name on it. Underscore, **(ctrl)** **(_)**



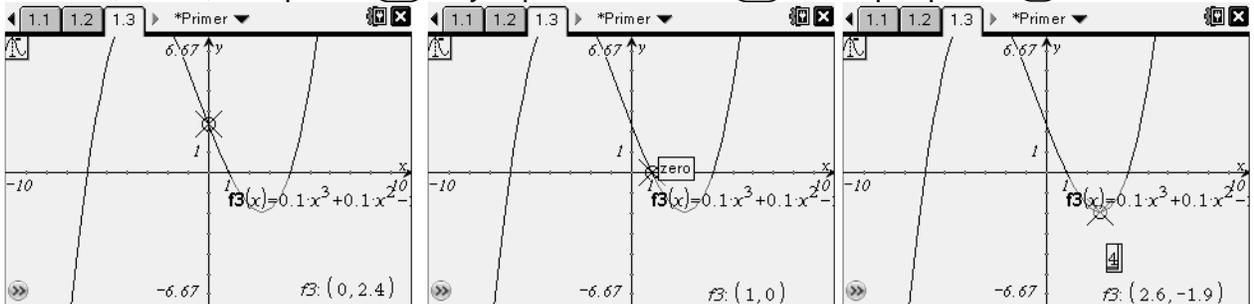
tab down and type Primer. Press **enter**.



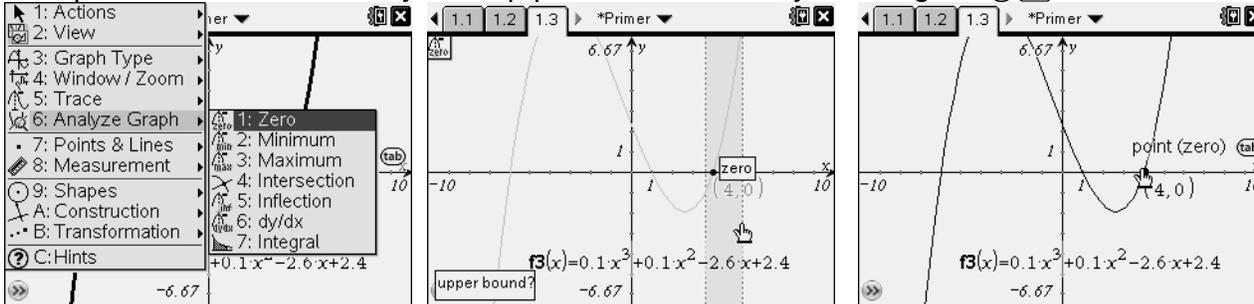
Let's TRACE & find ZEROS. On a new Graph page, **ctrl doc v**, arrow up, **▲**, press **enter** to put f3 on this page. **menu**, 5, 1



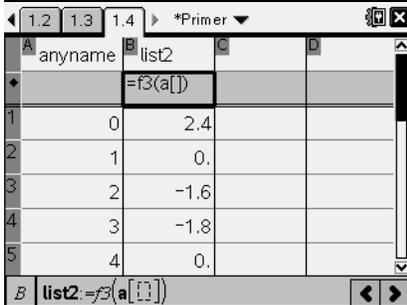
Arrow around. What do you notice? This happens because 'Automatically find points of interest' is checked on Graphs & Geometry Settings (see pg2 of this Primer). Type a number, like 4, and press **enter** to jump there. Press **enter** to drop a point. **esc** to end Trace.



Now try **menu**, Analyze Graph, Zero. Click **left arrow** the left/lower bound, move the cursor, & **right arrow**. This point is locked there. If you drop points with Trace, you can grab **ctrl right arrow** & move them.



Section 4: Lists and Spreadsheet Insert a new List & Spreadsheet page. Press **ctrl doc v**.



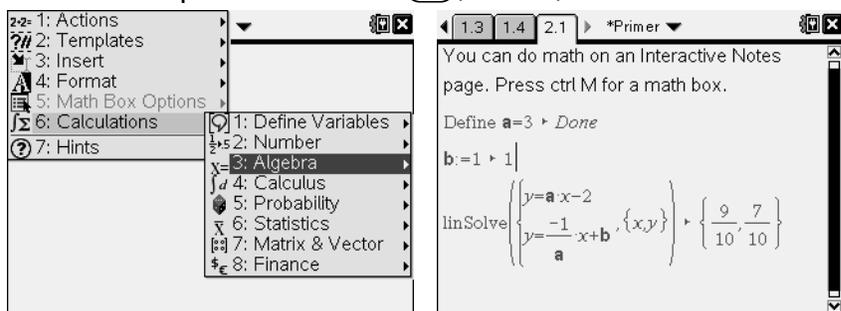
Explore the options under **menu**. (If you wanted to go back to the previous page press **ctrl 4**, **[left arrow]**.) This much improved spreadsheet behaves like Excel. To write a formula start with **=**.

You can take data and try to fit an equation to it using all sorts of regressions, but don't use a regression to answer a question on an AP Calculus exam, or you will get it wrong.

Section 5: Notes This time let's add a new problem. Press **ctrl doc v**, Insert, Problem.

Choose Notes. Explore **menu**. Press **ctrl M** for a Math Box.

ctrl menu, **[right arrow]**, is "right-click". Check out this context menu.

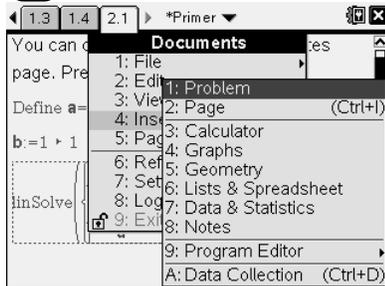


Section 6: CAS (Computer Algebra System)

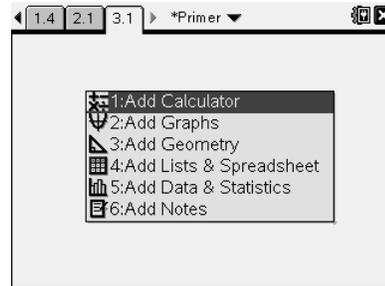
This is what you have been waiting for. What makes the calculator really special? Besides the fact that it look like mathematics, it actually does algebra (and more).

Let's begin with a new problem in case you stored something as x while exploring Notes.

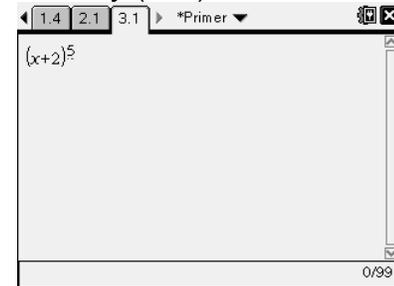
(docv), 4, 1:Insert Problem



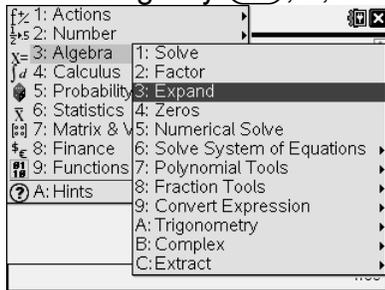
1:Add Calculator



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



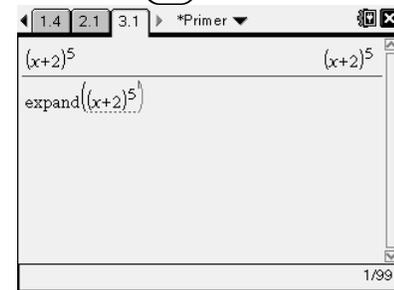
That answer wasn't very interesting. Try **(menu)**, 3, 3



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

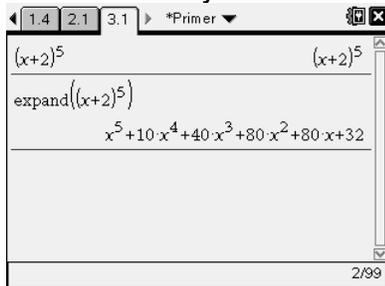


Oh yeah, it "retyped" it for you. Press **(enter)**.

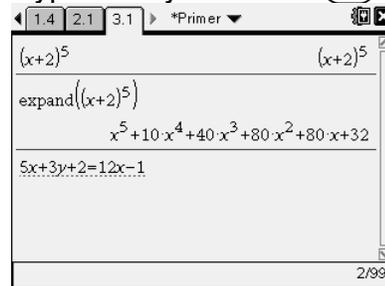


Let's do some step by step algebra.

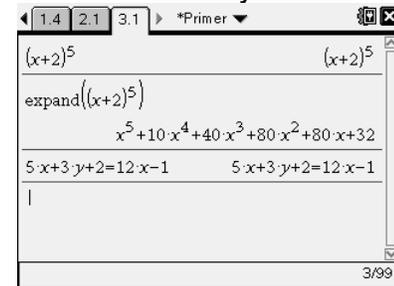
Isn't that lovely.



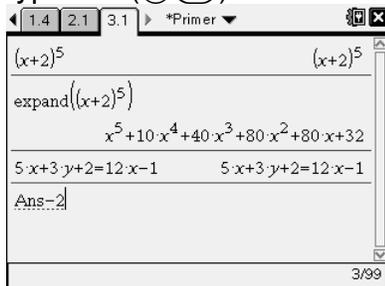
Type $5x+3y+2=12x-1$ **(enter)**.



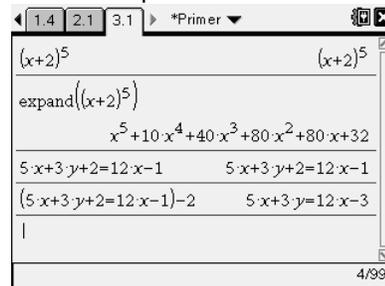
Goal: solve for y. What's next?



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

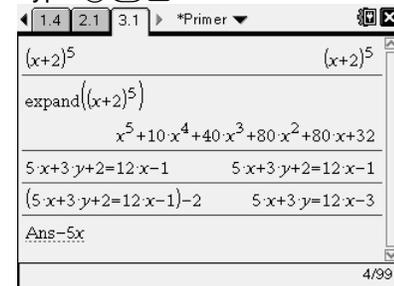


Subtractions was distributed over the equals. What's next?

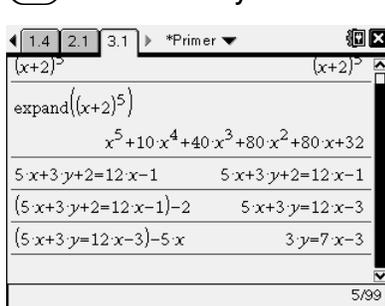


Alright, let's subtract 5x

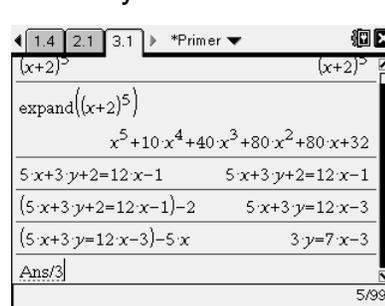
Type **(-)(5)**



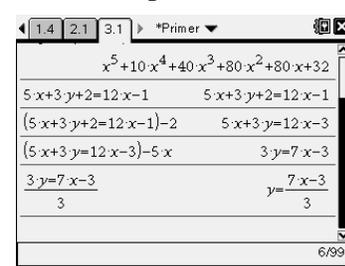
(enter)... And finally?



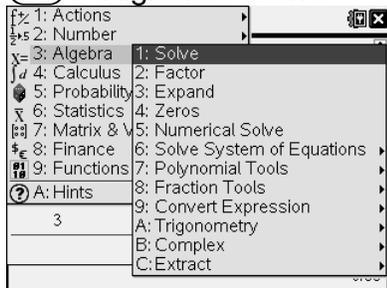
Divide by 3.



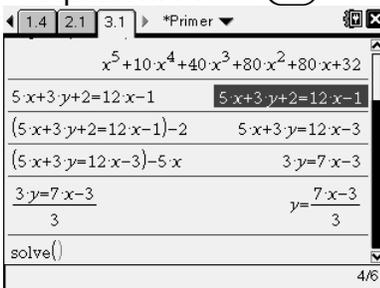
Press **(enter)**. Ta da. And no mistakes. (We could expand it, but it's okay.)



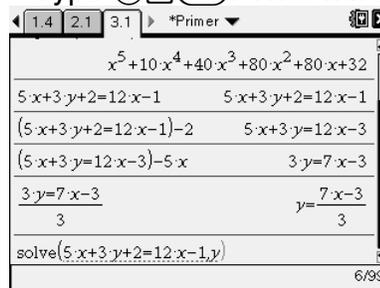
Alright, now do it in one step
 (menu) > Algebra > Solve



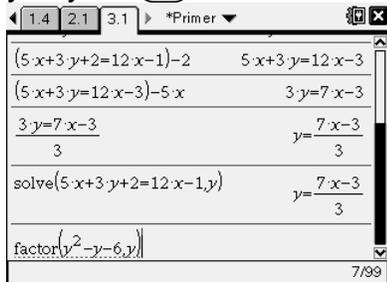
Arrow up to highlight the equation. Press (enter)



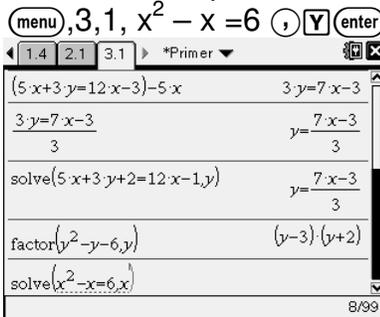
But what are we solving for?
 Type (,) (Y) (enter). That will do.



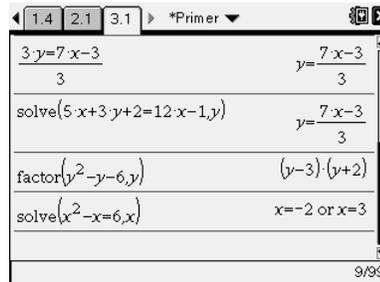
Let's factor. (menu), 3, 2:Factor
 $y^2 - y - 6$ (enter)



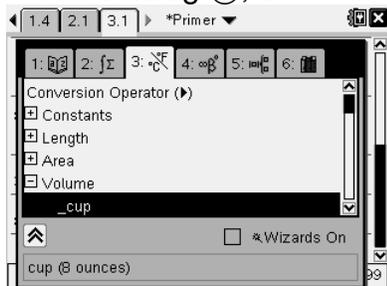
Let's solve a quadratic for x.



Isn't the 'or' beautiful?

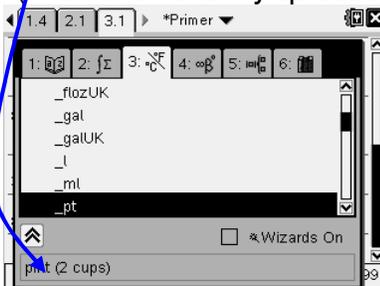


Look what else it can do...
 Press catalog (Ⓜ), 3.

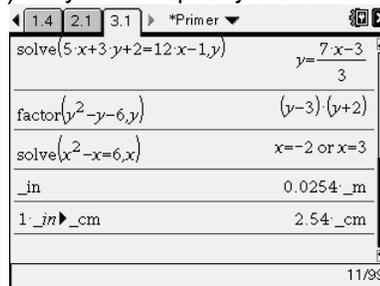


IT CONVERTS.

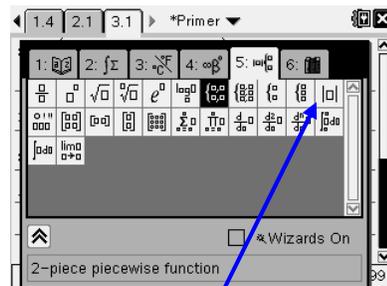
(That answers my question.)



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

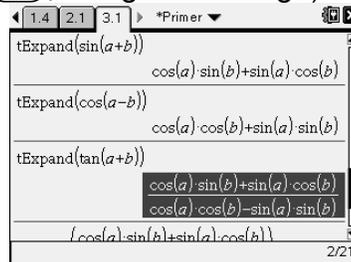
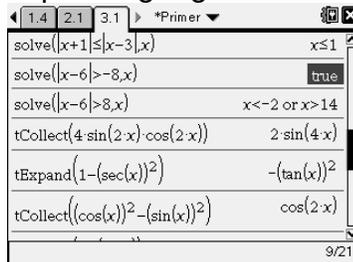


Press (Ⓜ) again and browse
 the other features, like 5:templates



absolute value

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



Another fun thing to try is graphing an inequality: For $f_1(x)=$, backspace (⌫) once and
 change = to an inequality (ctrl) (=). To learn more about Lists & Spreadsheets, Notes, Data &
 Statistics, etc, check out the files in the Examples folder like "Getting Started." Press (ctrl) (n),
 2: My Docs. Look in the Examples folder.

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 about half of the test. NO calculator of any kind is allowed on the other half of the test. The exam begins with multiple choice, 55 minutes to do 28 no calculator allowed problem, the 50 minutes for 17 graphing calculator permitted. Starting in 2011, you’ll then have 30 minutes to do 2 free response questions with your TI-Nspire CAS, followed by 60 minutes without technology where you can go back to the first two problems.

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. Some quizzes and parts of some tests will permit the TI-Nspire, others will not. I need your help. 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. For more info see page 12-14 of the course description, <http://apcentral.collegeboard.com/apc/public/repository/ap-calculus-course-description.pdf>.

Practice What You've Learned So Far (There will be a test over this soon.)

1. Create a new Calculator page. For each of the following, use TI-Nspire to find the
i) Exact answer and ii) Approximate answer, rounded to the nearest thousandth.

a) $\frac{13}{32} + \frac{17}{48}$ b) $\sin \frac{\pi}{12}$ c) $\cos^{-1} \left(\frac{\sqrt{3}}{2} \right)$ d) $\sqrt{768}$

e) $\sqrt[3]{128}$ f) $\sqrt{45} + \sqrt{20}$ g) $\tan 30^\circ$

2. Create a new Calculator page. For each of the following, use TI-Nspire to find the
i) Exact answer and ii) Approximate answer, rounded to the nearest thousandth.

a) Evaluate for $a = -2$: $\frac{a^3 + 4a^2 - 3a}{5a}$

b) Evaluate for $x = 3$: $\sqrt{\frac{x^3 - x}{3x}}$

c) Expand: $(x + 2)^5$

d) Factor: $2x^3 - x^2 - 25x - 12$

e) Solve: $2x^2 - 3x = 5$

f) Solve: $2x^2 - 3x = 6$

g) Find the sum: $\sum_{i=1}^{50} i^2$ (hint: under the Calculus menu, number 4, sum)

3. Start a new Graphs. Change the window so that $-5 < x < 8$ and $-8 < y < 8$. Graph:

$y = f(x) = \frac{1}{2}x^3 - 3x^2 + 2x + 4$. Use the Trace tool to find: (round to the coordinates to the nearest thousandth)

a) Maximum b) Minimum c) Zeros d) Y-intercept

4. Start a new Graphs and Geometry page. Find an appropriate window to view the following graphs. a) Record the window you used. b) Find the points of intersection. Round the coordinates to the nearest thousandth.

$y = f(x) = 16 - x^2$ and $y = f(x) = -\frac{2}{3}x + 10$

Answers to the previous exercises (make sure you can do problems like these!):

$$1.a) \frac{73}{96} \approx 0.760$$

$$b) \frac{(\sqrt{3}-1)\sqrt{2}}{4} \approx 0.259$$

$$c) \frac{\pi}{6} \approx 0.524$$

$$d) 16\sqrt{3} \approx 27.713$$

$$e) 4 \cdot 2^{\frac{1}{3}} \approx 5.040$$

$$f) 5\sqrt{5} \approx 11.180$$

$$g) \frac{\sqrt{3}}{3} \approx 0.577$$

$$2a) -\frac{7}{5} \approx -1.4$$

$$b) \frac{2\sqrt{6}}{3} \approx 1.633$$

$$c) x^5 + 10x^4 + 40x^3 + 80x^2 + 80x + 32$$

$$d) (2x+1)(x+3)(x-4) \quad e) x = -1 \text{ or } x = \frac{5}{2}$$

$$f) x = \frac{-(\sqrt{57}-3)}{4} \approx -1.137 \text{ or } x = \frac{\sqrt{57}+3}{4} \approx 2.637$$

$$g) 42,925$$

3. Maximum: (0.367, 4.355)

Minimum: (3.633, -4.355)

Zeros: (2, 0) (4.828, 0) (-0.828, 0)

y-intercept: (0, 4)

4. Points of intersection: (-2.139, 1.426) (2.805, 8.130)