

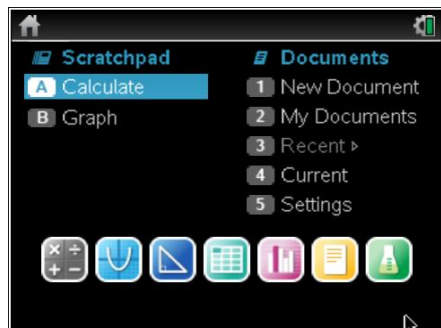
TI-Nspire CX CAS primer (especially for TI-83/84 users)

This primer will help you get a feel for your new, beautiful, colorful, super graphing calculator.

Original by Mr. Bird Updated and edited by Mrs. Martin 5/30/11 OS 3.1. Updated by Mr. Bird in the Summer of 2012 for OS3.2. Enjoy!!!

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

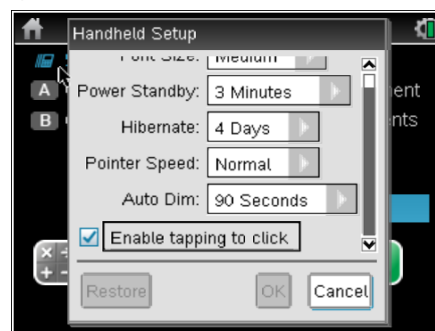
Welcome to the most intelligently designed and mathematically enjoyable technology ever developed for the high school classroom. There are several features on the TI-Nspire where your computer knowledge will carry over.



Press **[on]**.

This Home screen is like the desktop of a computer. Notice the battery icon in the upper right hand corner. Glide the pointer over it to see your angle mode and battery status – this calculator comes with rechargeable batteries, therefore, you must be vigilant in monitoring their status and recharging when needed ☺.

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 5: Settings, 3: Handheld Setup...



Don't forget to **[tab]** to OK and press **[enter]** to save this 'Setup.'

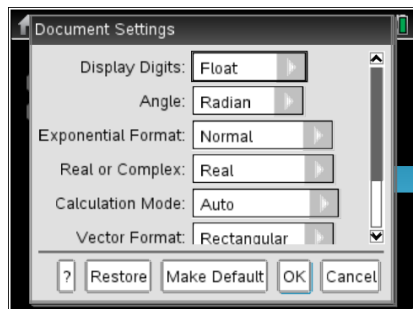
Let's look at the buttons around the Touchpad.

[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]**.

Notice the blue 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 on the current line.

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 by the symbol **[menu]**.

From the **[on]** Home screen, under Settings, select Document Settings... (You can also get to document settings from any other screen by pressing **[doc]**.) For the 83/84 this was referred to as MODE. On the TI-Nspire you are working in a document that can be saved. More on this later...

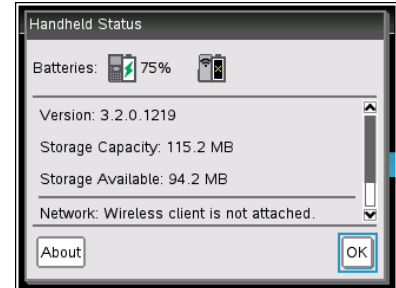


Document Settings looks like this on the handheld.

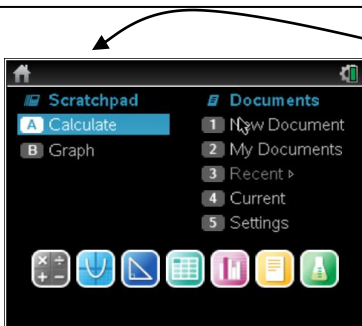
Use **[tab]** or push the down arrow to get to the setting you want to change. Then click the arrow to the right to open the menu. Scroll through the options by pressing the arrows on the Touchpad. Press **[click]** or **[enter]** to make your selection. Be sure to **[tab]** to Make Default to apply 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.

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.**

We'll look at the settings for Graphs and Geometry pages later, but when you take AP calculus you will want to have the angle set to radians (which is the default) and you will be required to have AT LEAST 3 decimal places for all approximate answers. 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 for now.

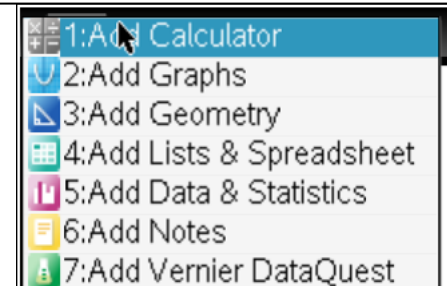


Can you find Status in the Settings option? This will tell you the version of your operating system, OS. For example, the screen to the right shows a handheld with OS version **3.2**. You can find your Product ID by looking in About. (This is the answer to the first question on page 11.)



A word about Documents... You can quickly do calculations and graphs in your Scratchpad. However, problem sets you'll want to go back to should be saved for easy reference. Examples for when you will want to open a new document and save it with an appropriate name include homework, WebAssign HW, Problem of the Week, data collection for labs, and when using Lists & Spreadsheets and Data & Statistics, like for Stats class. When you are taking Physics – I recommend you create a Document titled Physics – change the document settings to degree – click OK (do not make it default) and do all calculations for Physics there 😊

Now begin a new document. Press **[on]**, 1:New Doc. When you first begin a new document you get to choose between one of seven options: a Calculator, Graphs, Geometry (dynamic geometry like Cabri on a handheld!), Lists & Spreadsheet (like Excel®), Data & Statistics (behaves similar to Fathom®) Notes (press **[ctrl][M]** on this page to write and do math here) and Vernier DataQuest. 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 Pages



Battery life is good. 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 **[docv]**, File, Close. What else does **[docv]** 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 of each page.

Notice the **blue** writing above various operations. To access the **blue** commands, first press **ctrl**. **ctrl** **esc** is “UNDO” (so is **ctrl** **Z**; **ctrl** **Y** is redo).

Press **trig**. YES! There are all the trigonometric functions and their inverses. Arcsecant (also known as inverse secant) is no longer hidden.

Press **enter** to select sin- 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 **3** then **π**. 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 **enter** to choose π .

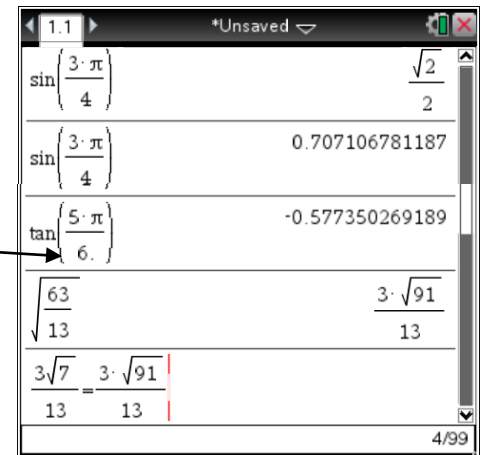
Press **ctrl** **÷**. That is interesting, isn’t it? This is a quick way to do a ‘fancy fraction divided by’. I highly recommend this to keep you from making the old TI-84 mistake of $5/3+2$ when you meant $5/(3+2)$. *And please, don’t use a calculator to do that calculation.*

Press **4** **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. On the TI-Nspire CAS, the radical in the answer even goes over everything it should... it even rationalizes ☺

But what if you wanted an approximate answer?

What do you think the symbol above the **enter** key (\approx) does? Try it. Press **ctrl** **enter**. (It gives you the decimal approximation. Always give at least three decimal places on the AP calc exam- unless you like to lose points.) Another way to do this is to include a decimal point in the input. Try $\tan(5\pi/6.)$. Decimal in the question gives a decimal in the answer.



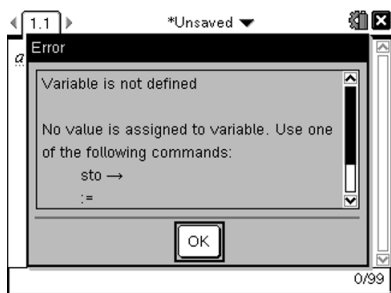
Try a radical expression like $\sqrt{63/13}$ by typing **ctrl** **x²** **6** **3** **ctrl** **÷** **1** **3**. Hey, did you notice that it rationalized the denominator. Perhaps you were expecting $\frac{3\sqrt{7}}{\sqrt{13}}$. If you ever wonder if those two are the

same, how could you check it? Try it...

Note: To get out from under a radical, denominator or out of an exponent, 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 **A** **enter**.



Hey, that screen shot is from a numeric TI-Nspire.

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

Type **5** **ctrl** **var** **A** **enter**.

Type **B** **ctrl** **⌈** **(-)** **3** **enter**. (For the $:=$, the colon could also be found in with punctuation **⌈**. And $=$ 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 **A** **x** **B** **+** **B** **^** **3** **▶** **-** **1** **enter**.

IMPORTANT! You HAD to type the multiplication sign between the a and b .

a	a
$5 \rightarrow a$	5
$b := -3$	-3
$a \cdot b + b^3 - 1$	-43
$a \cdot b + b^3 - 1$	

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 with a caret (^)? 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. If you start a new problem, 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 $\boxed{\times} \boxed{\times} \boxed{1} \boxed{2} \boxed{\times} \boxed{+} \boxed{3} \boxed{1}$

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

When you press $\boxed{\text{enter}}$ 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.)

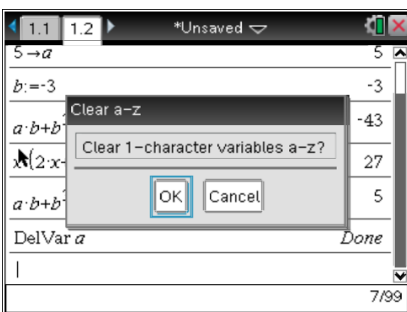
Do you remember how you could go through the 'history' on your TI-83/84? It would take you back through the previous 10 entries by hitting 2nd ENTER. The TI-Nspire takes you back 99 entries simply by pressing the top of the Touchpad to up arrow, \blacktriangle , until you get to the expression you want.

Press \blacktriangle until $a \cdot b + b^3 - 1$ is highlighted. Press $\boxed{\text{enter}}$.

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 $\boxed{\text{enter}}$. Hmm... How can you find out what b is defined as? Press $\boxed{\text{B}} \boxed{\text{enter}}$.

Expression	Result
a	a
$5 \rightarrow a$	5
$b := -3$	-3
$a \cdot b + b^3 - 1$	-43
$x : (2x+3) x=3$	27
$a \cdot b + b^3 - 1 b = 1$	



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

(i) Press $\boxed{\text{menu}}$, Actions, Delete Variable. You can choose which variable you want to delete by pressing $\boxed{\text{var}}$. Choose a.

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

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

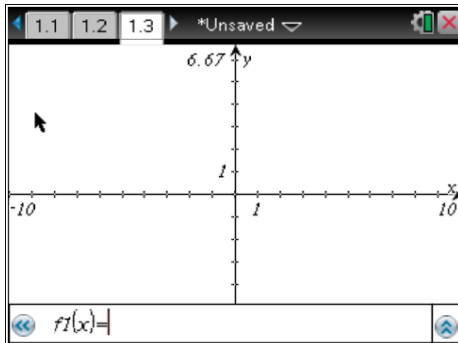
Section 3: Graphs We will return again to the Calculator features later and consider more about why your TI-Nspire CX **CAS** is such a valuable tool. Perhaps you will even consider it to serve as a ladder to help you reach new heights to succeed in mathematics.

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"

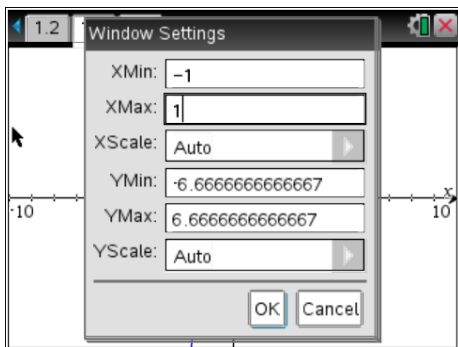
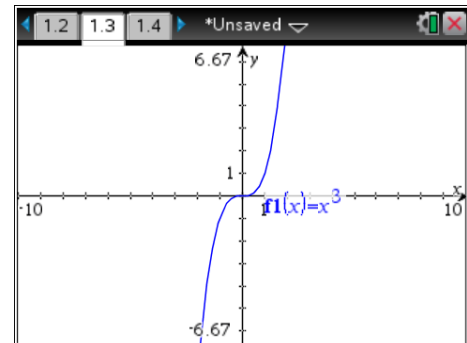
You will learn how to do the 3rd and 4th bullets later in the school year, but the Graphs & Geometry application will be introduced by teaching you effective means of doing the first two bullets now.

First off, press **ctrl**I, to add a new page. (This could be done using **ctrl** **doc**↓, or **doc**↓, 4:Insert, 2:Page.) Choosing 2:Add Graphs gives this standard graph window.



Press **x** **^** **3** **enter**
(COLOR!!!)

Press **menu** to explore the options and see what looks familiar. Graph settings (84 users, think mode) can be changed here.

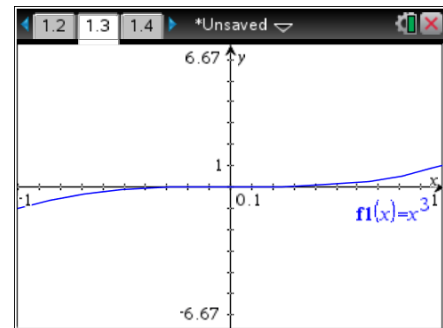


To adjust the window press **menu**, 4:Window/Zoom, 1:Window Settings Type

(←) **1** **tab** **1**

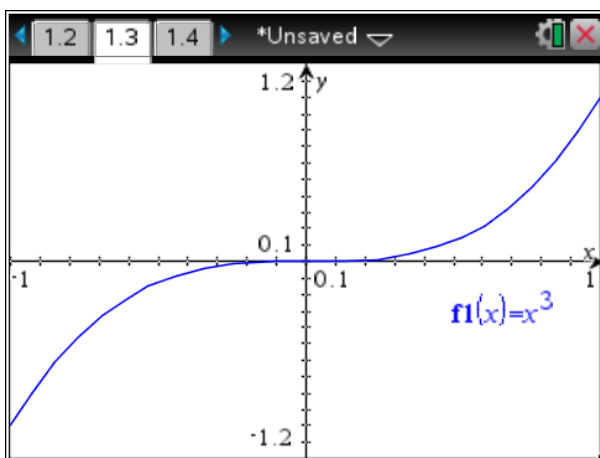
Press **enter**

(Another fun way is to double click the end value and type what you want them to be.)



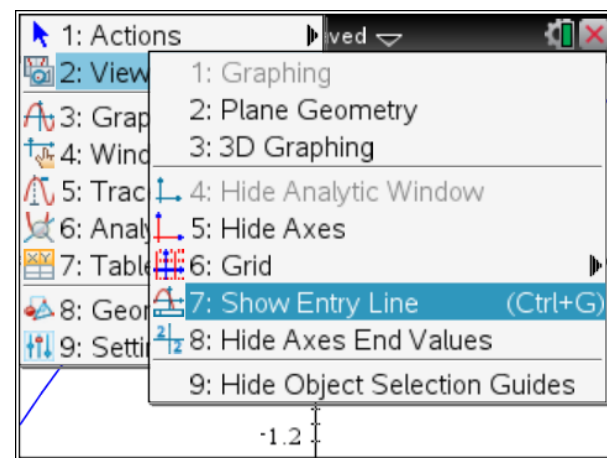
Press **menu**, 4:Window, **A**:Zoom-Fit.

(If you entered the domain, this will quickly give a window appropriate to the range.)

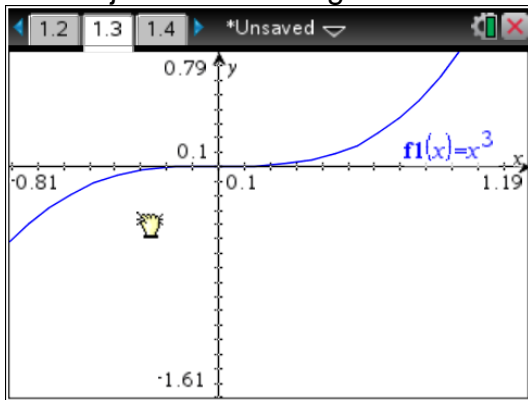


With the new OS the entry line is hidden

automatically. **tab** will reveal it or press **menu**, 2:View, 6:Show Entry Line (or **Ctrl**+**G**).

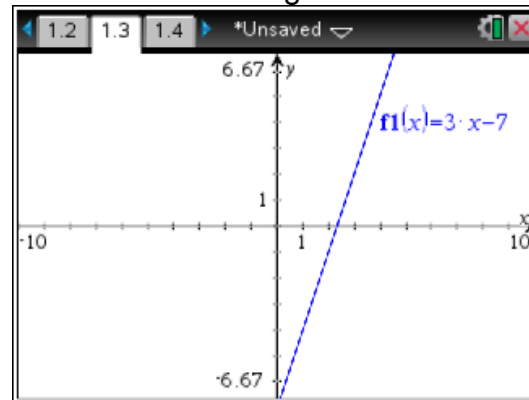


The screen shot below shows the screen being grabbed and moved. Slide your finger on the Touchpad to move the cursor to an empty place. Press **ctrl** + **⌘** to make the open hand close. Try moving the page to look like this. Press **esc** to let go. This adjusts the viewing window.



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 $f1(x)$. Press **ctrl** + **del**. Type **3****X****-****7**.

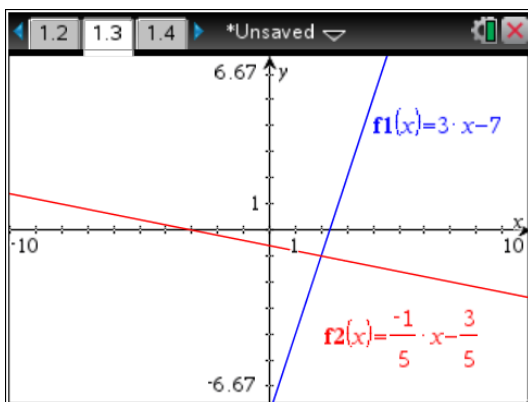
Then to graph this press **enter**. Press **menu** Window Zoom–Standard to get a standard window.



Press **tab**. Type the following in $f2(x)=$

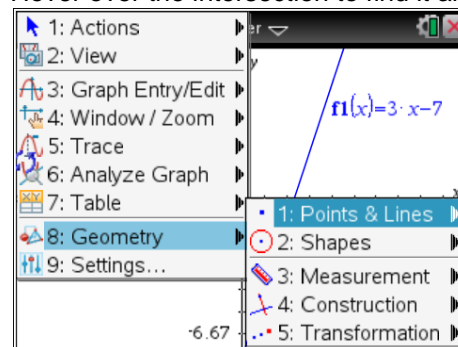
(←) **1** **ctrl** **÷** **5** **▶** **X** **-** **3** **ctrl** **÷** **5** **enter**

Notice the different colors 😊



To find the intersection point press **menu** Geometry, Points & Lines, Intersection Point(s). Now just click each line.

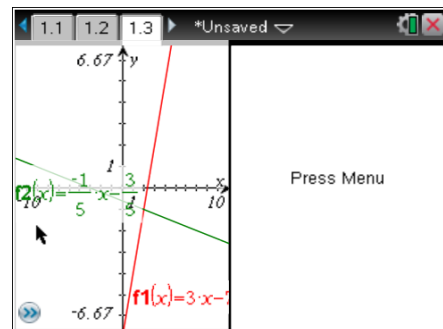
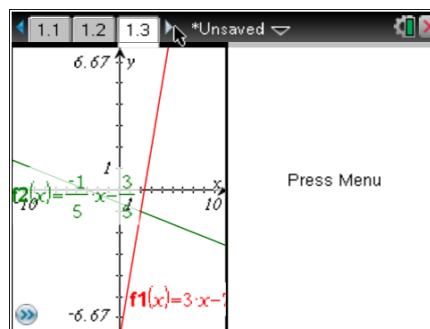
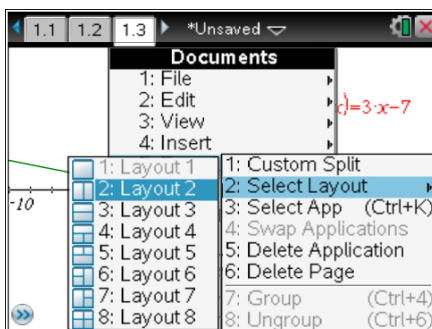
(**ctrl** **Z**) to undo. Try using 1:Point instead of 3:Intersection. Hover over the intersection to find it and click you've got it.)



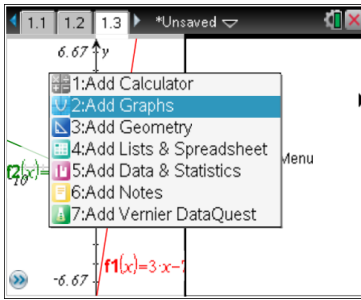
Press **esc** to get out of the 'Intersection Point(s)' mode.

This method will **not** work in the Graphs **Scratchpad**. You will need to use the Analyze Graph tool.

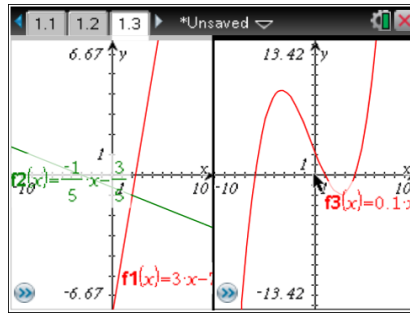
Let's try some of the split screen features of TI-Nspire. Press **doc**, 5:Page Layout, 2: Select Layout, Layout2. Use **ctrl** **tab** to toggle between applications. Note the dark border.



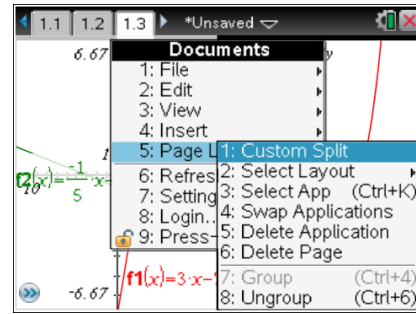
Press **menu**, 2:Add Graphs



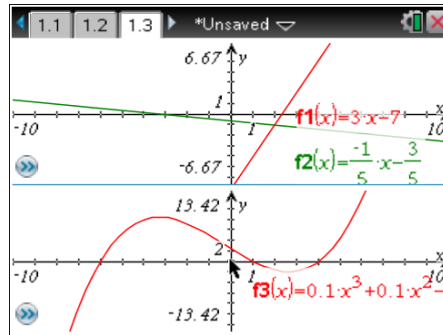
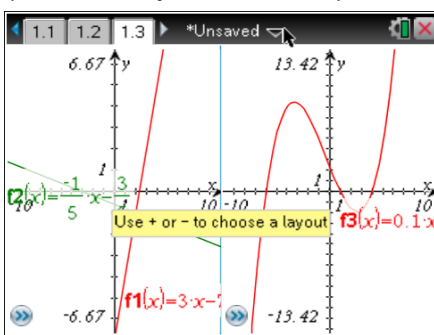
In f3(x),
type $.1x^3 + .1x^2 - 2.6x + 2.4$



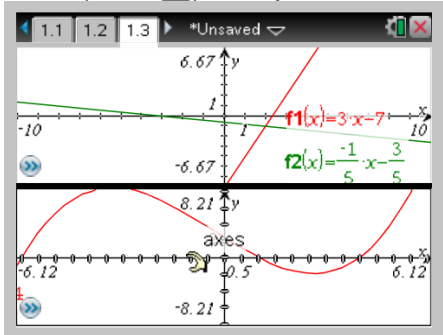
Split screen can be customized.
docv, Page Layout, Custom Split



Use **+** and **-** to scroll through the options.
(Arrows adjust the size.) Get it horizontal. Press **enter**.



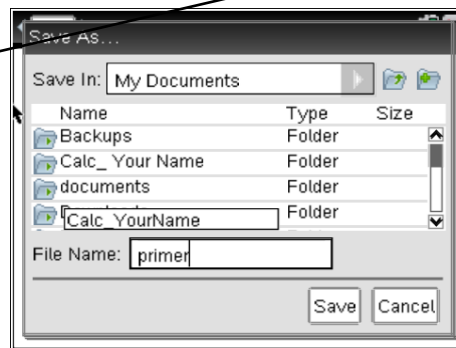
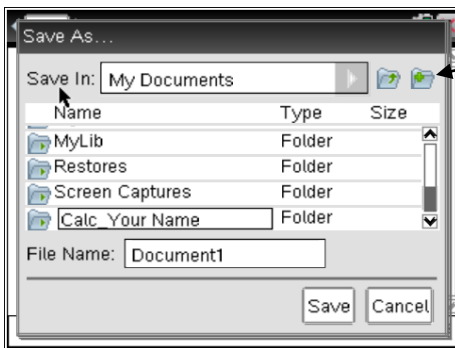
Move the cursor to hover
over the ticks on the x-axis.
Grab (hold **ctrl**) and pull it out.



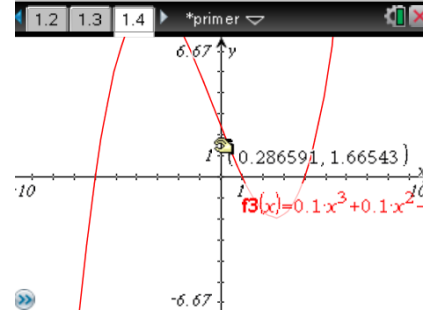
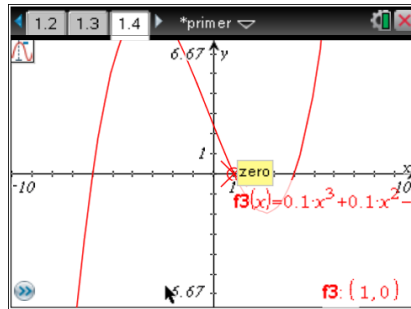
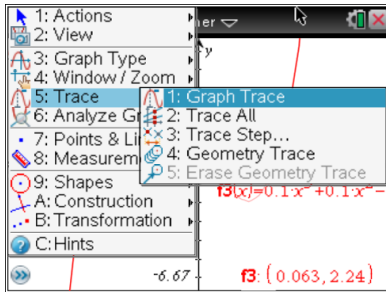
Don't want the vertical scale to change. Hold down the **shift** and arrow left & right.

To un-split the screen, **ctrl tab** to app you want to delete, then press **docv** Page Layout, Delete Application. Notice that you could also press **ctrl 6** to Ungroup. This will split up the split screen.

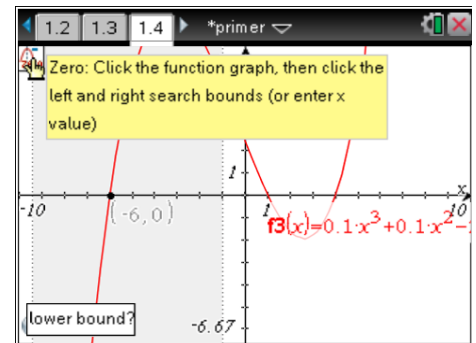
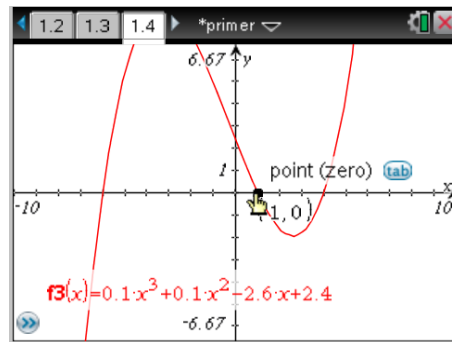
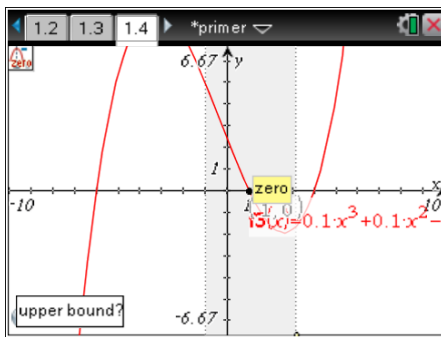
Now, let's save this file. Press **docv** Save (or Ctrl+S). Press **tab** or **shift tab** to get to the +folder icon. Press **enter**. Add a folder with your name on it. Underscore, **_**, is made with **ctrl _**. Tab **tab** down to File Name and type Primer **enter**



Let's **TRACE & find ZEROS**. On a new Graph page, **ctrl docv**, choose 2:Add Graphs. arrow up, **▲**, press **enter** to put f3 on this page. **menu**, 5:Trace, 1: Graph Trace Arrow or hover 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 3, and press **enter** to jump there. Press **enter** to drop a point. **esc** to end Trace. Hover over the point til you can grab it & drag it around



Now try **menu**, 6:Analyze Graph, Zero. 1: Click **□** the left/lower bound, move the cursor, & **□**. You can find mins/maxs this way too! Note: This point is locked there. But, if you drop points with Trace (as above), you can grab **ctrl** **□** & move them.



Also, notice the box in the upper lhs – hover over it for hints ☺

A	B	C	D
anyname	list2		
	=f3(a[])		
1	0	2.4	
2	1	0.	
3	2	-1.6	
4	3	-1.8	
5	4	0.	

B list2:=f3(a[])

Section 4: Lists and Spreadsheet

Insert a new List & Spreadsheet page. Press **ctrl docv**.

Explore the options 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, plot it, fit an equation to it using all sorts of regressions using the options in **menu**, but don't EVER use a regression to answer a question on an AP Calculus exam, or you will get it wrong.

Section 5: Notes

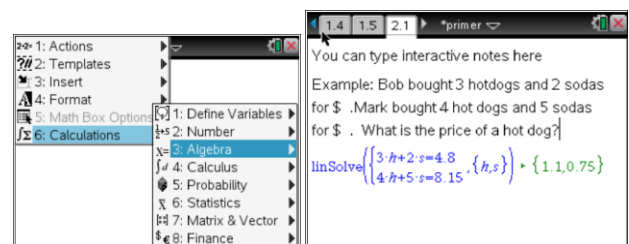
This time let's add a new problem. Press **docv**, Insert, Problem. Choose Notes.

Explore **menu**. Press **ctrl M** for a Math Box (for calculations).

ctrl **menu**, **□**, is "right-click". Check out this context menu...

linSolve is in **menu**, 6: Calculations, 3: Algebra,

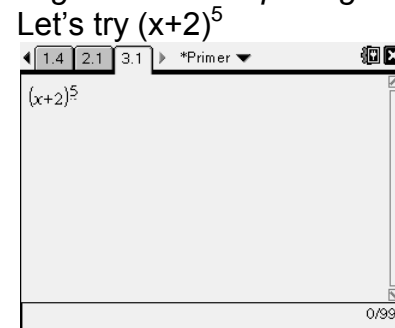
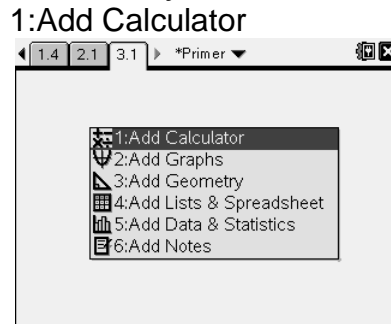
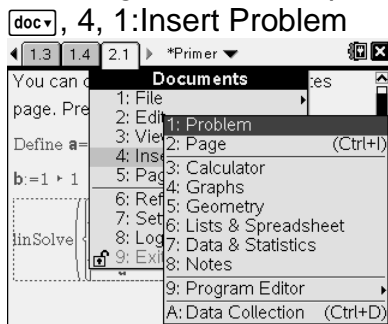
7: Solve Systems - you must enter the variables its solving for in braces { }



Section 6: CAS (Computer Algebra System)

This is what you have been waiting for..... Drum Roll... What makes the calculator really special? Besides the color, and the fact that it looks like mathematics should, it actually does algebra (and more). This makes it an outstanding tool for checking your work and exploring mathematics.

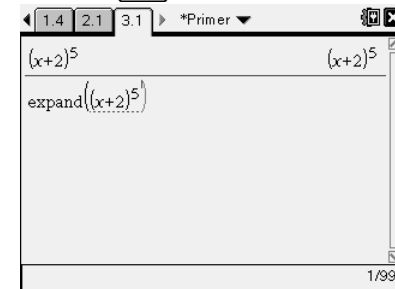
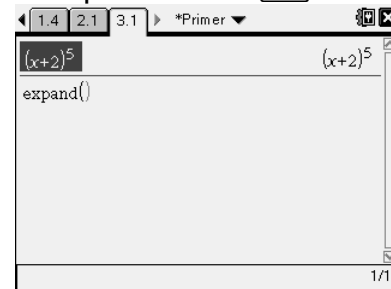
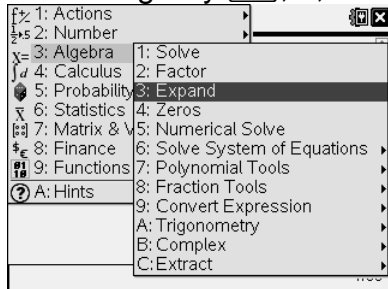
Let's begin with a new problem in case you stored something as x while exploring Notes.



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**.

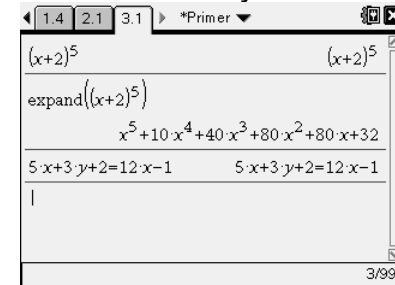
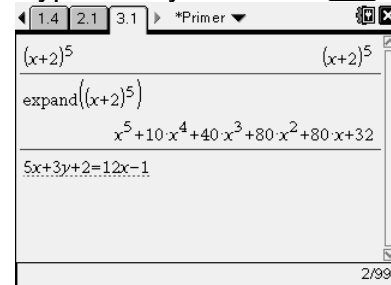
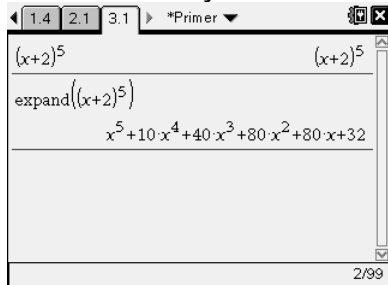


Let's do some step by step algebra.

Isn't that lovely.

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

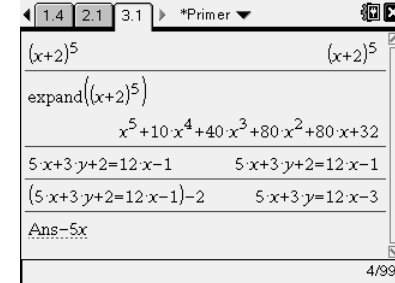
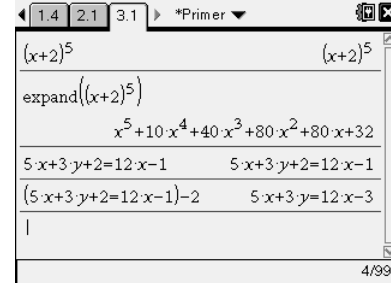
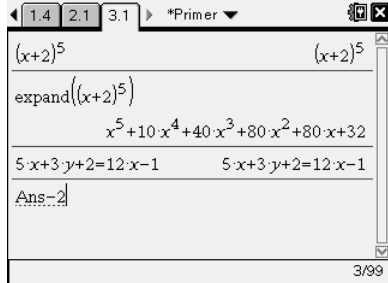
Goal: solve for y. What's next?



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

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

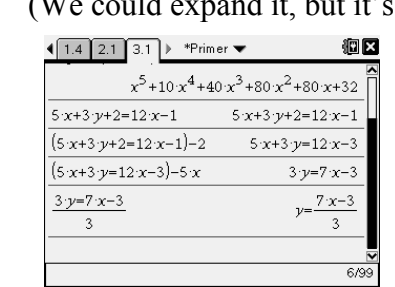
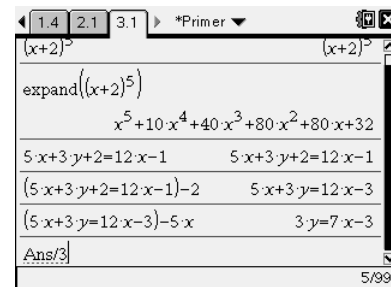
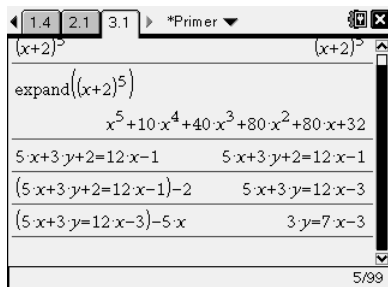
Alright, let's subtract 5x Type **=** **5** **X**



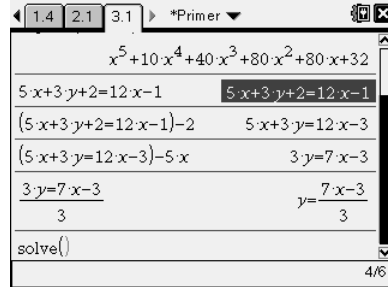
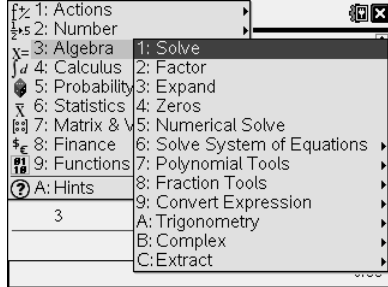
enter ... And finally?

Divide by 3.

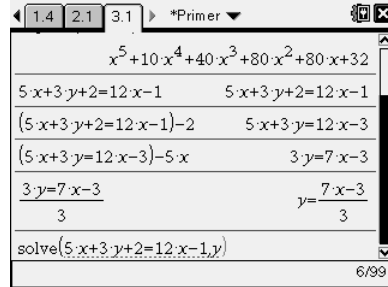
Press **enter**. Ta da. And no mistakes. (We could expand it, but it's okay.)



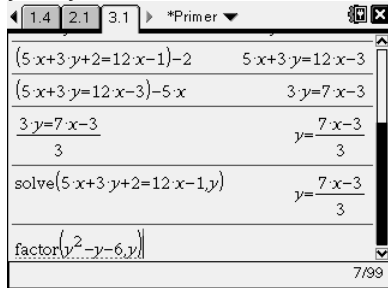
Alright, now do it in one step **Arrow up to highlight the equation. Press `enter`**



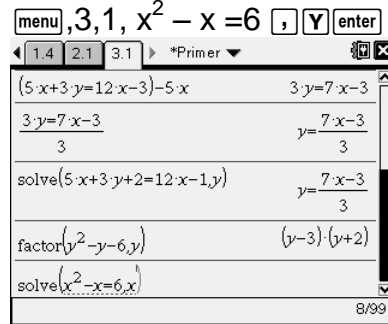
But what are we solving for? Type `[Y][enter]`. That will do.



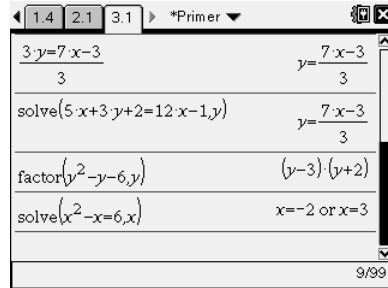
Let's factor. `[menu], 3, 2:Factor y^2 - y - 6[enter]`



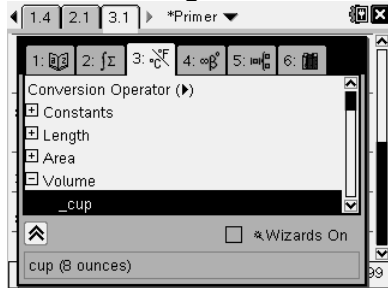
Let's solve a quadratic for x.



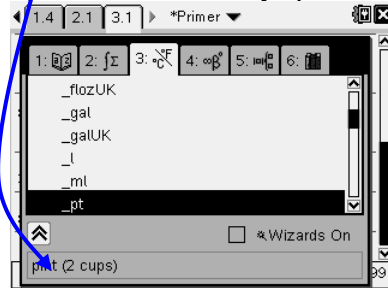
Isn't the 'or' beautiful?



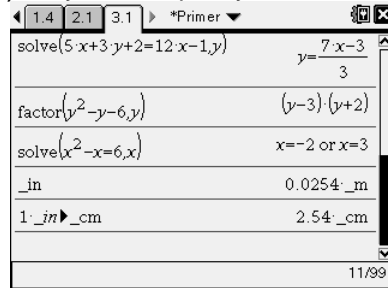
Look what else it can do... Press catalog `[2nd][0]`, 3.



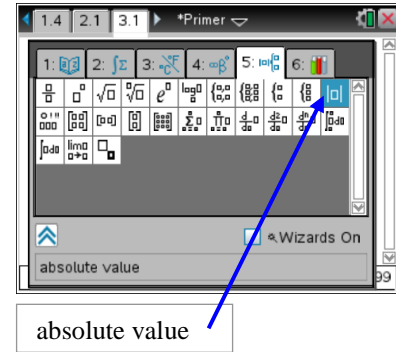
IT CONVERTS. (That answers my question.)



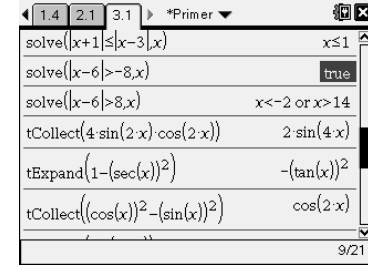
It automatically converts to SI or you can specify the units.



Press `[2nd][0]` again and browse the other features, like 5:templates



Look at what it can do with inequalities, absolute value, and expanding trig identities (`[menu], Algebra, Trigonometry, Expand`).



Another fun thing to try is graphing an inequality: For $f_1(x) =$, backspace `[del]` 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 `[2nd][on]`, 2: My Docs. Look in the Examples folder.

Explore Catalogue `[2nd][0]`

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.) _____
7. Use trig collect to simplify $2 \sin x \cos x$ _____
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.