

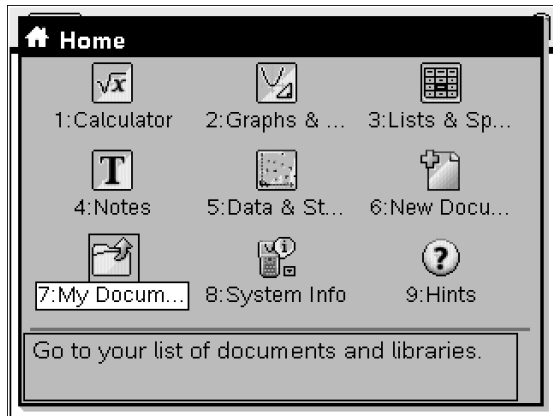
TI-Nspire CAS primer (especially for TI-83/84 users)


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

Created by Sean Bird of Indiana with some edits by Tom Reardon of Ohio. Updated by Bird June 5, 2009, for OS 1.7
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 .





This Home Screen is like the desktop of a computer.






My Documents is just like 'My Documents'.

 and  behave just like Esc and Tab on a computer keyboard.  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  the Shift key. Again, look at a computer keyboard and observe the symbol for Backspace.  is the Backspace button.

Notice the blue word 'clear.' If you press  , it will clear the entry.

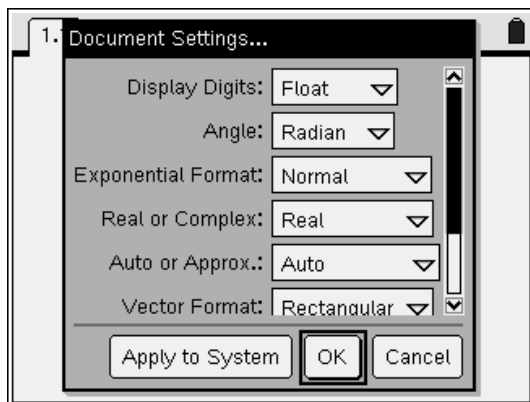
In the middle of the NavPad is , this click button serves as the left click on a mouse button. Right click would be  , designated with the symbol .







Now under 8: System Info, select 1: Document Settings. (You can also get to Document Settings from any screen by pressing  , this is the Tools key . Click  for 1: FILE, then  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  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  a few times, to save the changes. (Pressing  causes any changes made to be disregarded.)

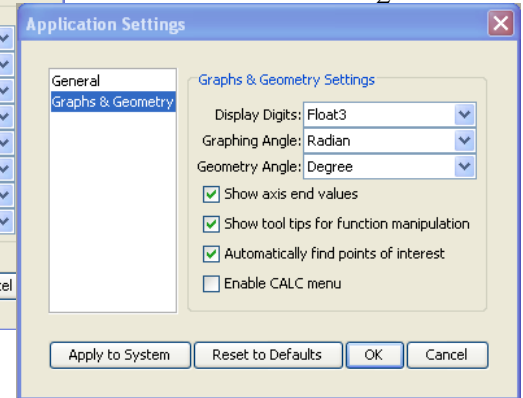
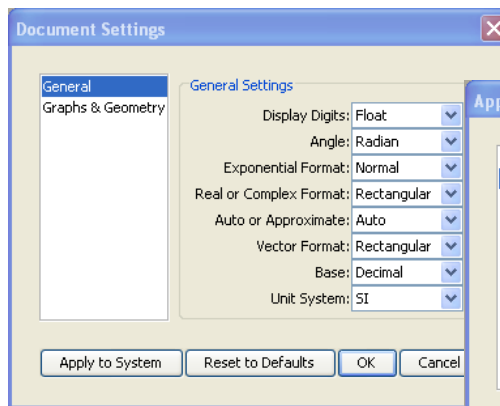
On the computer software, it looks like this (to the right).

I highly recommend using **FLOAT** under 'Display Digits,' and **AUTO** for 'Auto or Approximate.'

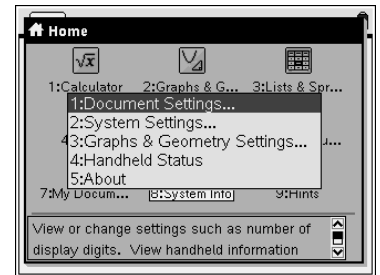
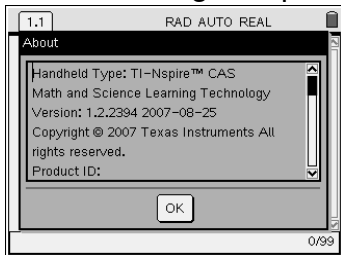
'Exact' means the answer will be given as an exact number (no decimal approximation).

'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.**



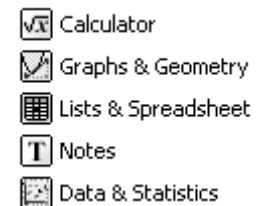
After selecting OK, press 2nd , 8: System Info, 5: About. This will tell you the version and date of your operating system, OS. For example, the screen to the left shows a handheld with OS version 1.2 from August 2007. Now we are up to OS 1.7. It came out on June 5, 2009.



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 the first two boxes so the graphs will not automatically show the end values or tool tips.

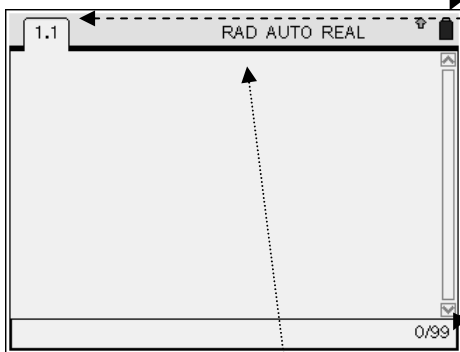
Now begin a new document. Press 2nd , 6: New Documents. When you first begin a new document you get to choose between one of five options: a Calculator, Graphs & Geometry (are now done on the same page), Lists & Spreadsheet (like Excel®), Notes (a word processor with an equation editor that can calculate), 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

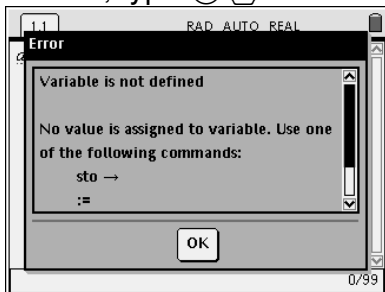
$\frac{3\sqrt{7}}{\sqrt{13}}$. If you ever wonder if those two are the same, how could you check it? Try it.

Don't forget to press to get the decimal approximation.

$\sin\left(\frac{3\cdot\pi}{4}\right)$	$\frac{\sqrt{2}}{2}$
$\sin\left(\frac{3\cdot\pi}{4}\right)$.707106781187
$\sqrt{\frac{63}{13}}$	$\frac{3\cdot\sqrt{91}}{13}$
3/99	

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 .

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 .

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. 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 $\left(\frac{\text{int}}{\text{x}}$ $\left(\frac{1}{\text{}}\right)$ $\left(\frac{2}{\text{}}\right)$ X $\left(\frac{+}{\text{}}\right)$ $\left(\frac{3}{\text{}}\right)$ $\left(\frac{|}{\text{}}\right)$ $\left(\frac{1}{\text{}}\right)$ X $\left(\frac{=}{\text{}}\right)$ $\left(\frac{3}{\text{}}\right)$.

($\left(\frac{1}{\text{}}\right)$ is just to the right of $\left(\frac{\text{ctrl}}{\text{}}\right)$. '|' is the 'such that' key.)

When you press $\left(\frac{\text{enter}}{\text{}}\right)$, 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, \blacktriangle , until you get to the expression you want. Press \blacktriangle until $a \cdot b + b^3$ is highlighted. Press $\left(\frac{\text{enter}}{\text{}}\right)$.

The expression popped down to the last line.

Now type $\left(\frac{1}{\text{}}\right)$ $\left(\frac{\text{B}}{\text{}}\right)$ $\left(\frac{=}{\text{}}\right)$ $\left(\frac{1}{\text{}}\right)$. Will b remain the negative 3 as you defined it earlier or will $b = 1$ win? Press $\left(\frac{\text{enter}}{\text{}}\right)$.

Hmmm.... How can you find out what b is defined as?

Press $\left(\frac{\text{B}}{\text{}}\right)$ $\left(\frac{\text{enter}}{\text{}}\right)$.

Expression	Value
$5 \rightarrow a$	5
$b := -3$	-3
$a \cdot b + b^3$	-42
$x \cdot (2 \cdot x + 3) x = 3$	27
$x $	

Expression	Value
$5 \rightarrow a$	5
$b := -3$	-3
$a \cdot b + b^3$	6
$x \cdot (2 \cdot x + 3) x = 3$	27
$ $	

Expression	Value
$5 \rightarrow a$	5
$b := -3$	-3
$a \cdot b + b^3$	-42
$x \cdot (2 \cdot x + 3) x = 3$	27
$a \cdot b + b^3 b = 1$	6
$ $	

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.

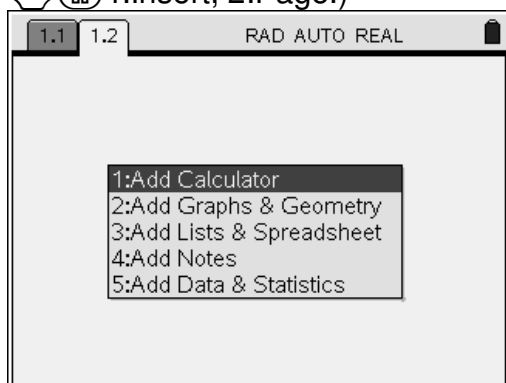
According to the AP Calculus course description "A graphing calculator appropriate for use on the exams is expected to have the built-in capability to:

- 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"

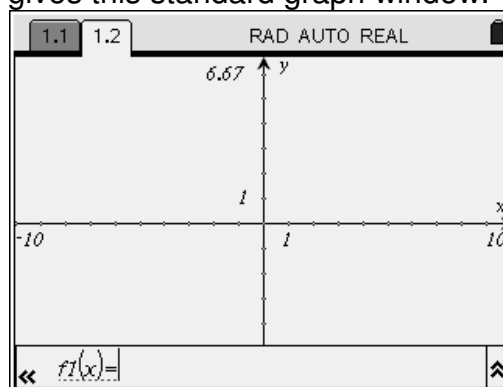
You will learn how to do the 3rd and 4th bullets later in the school year, but the Graphs & Geometry application will be introduced by teaching you effective means of doing the first two bullets now.

First off, press CTRL + I, this means the CTRL key followed by the I key (no + sign). (This could be done using Tools .)

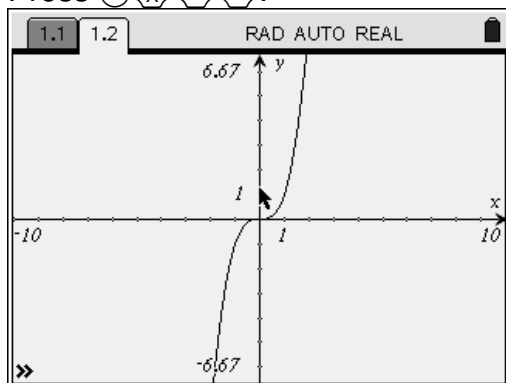
  4:Insert, 2:Page.)




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

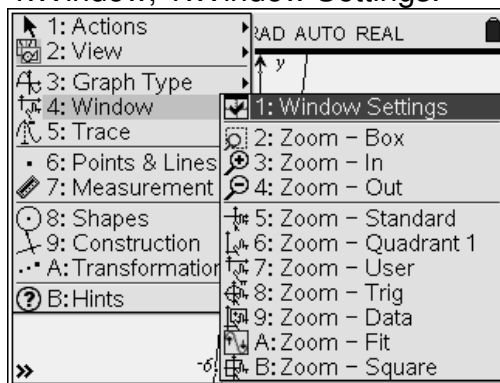





Press    .

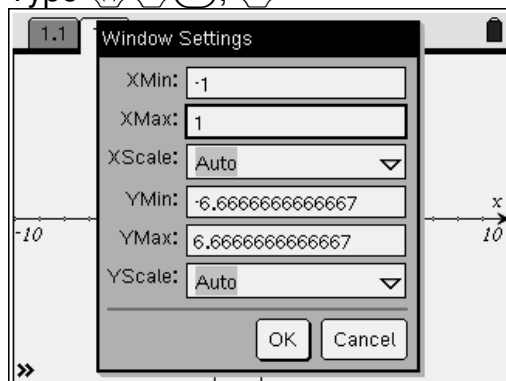


To adjust the window settings press ,

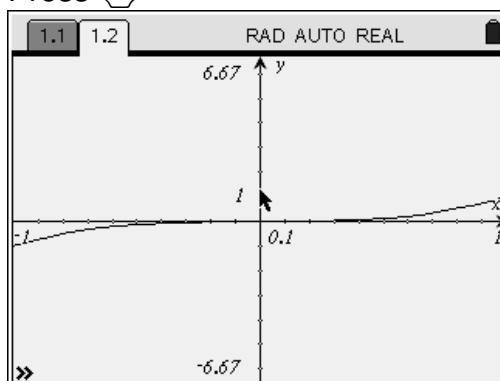
4:Window, 1:Window Settings.



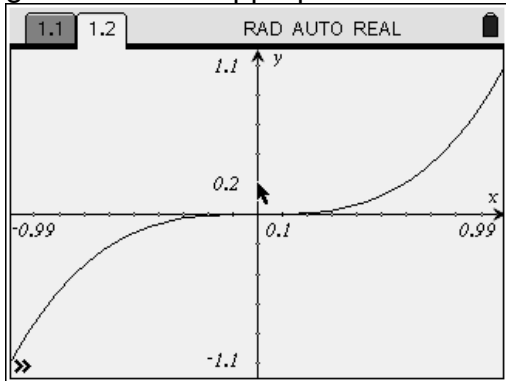
Type  1 , .



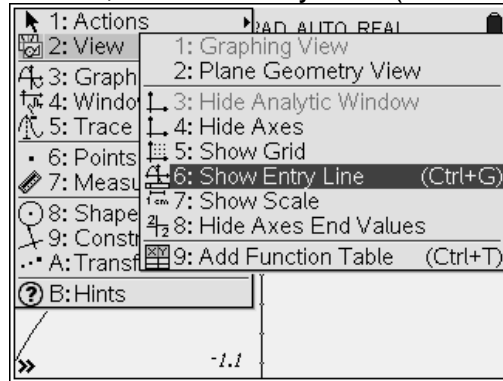
Press .



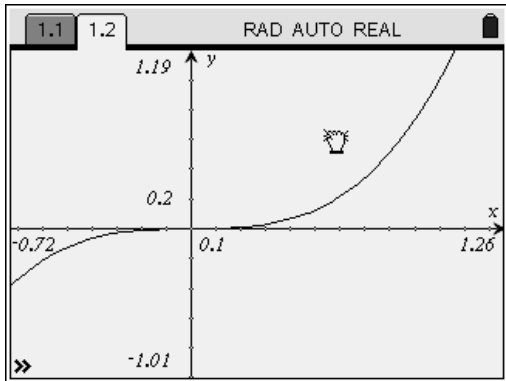
Press **(menu)**, 4:Window, **(A)**:Zoom-Fit.
 (If you know the domain, this will quickly give a window appropriate to the range.)



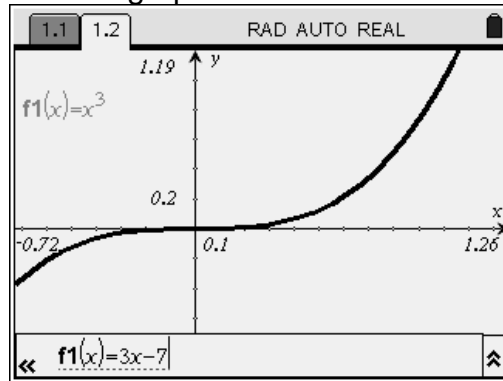
With the new OS the entry line is hidden automatically. **(tab)** will reveal it or press **(menu)**, 2:View, 6:Show Entry Line (or Ctrl+G).



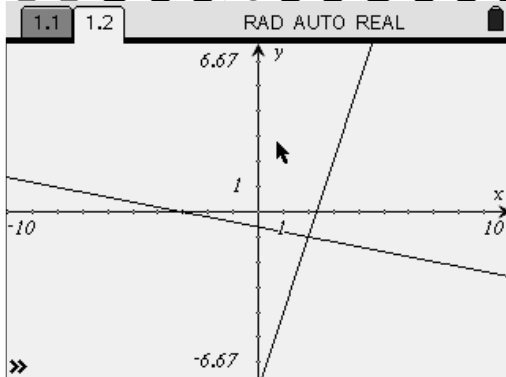
This next screen shot shows the screen being grabbed and moved. Use the NavPad to move the cursor to an empty place. Press **(ctrl)** **(⊞)** or hold down **(⊞)** until the open hand closes. Try moving the page so it looks like the screen below.



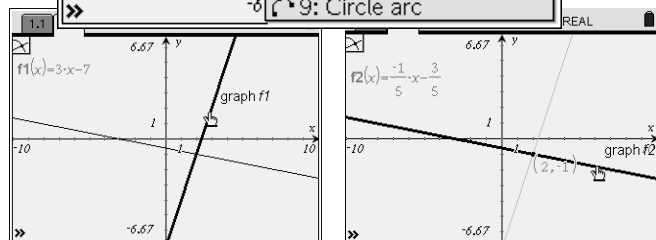
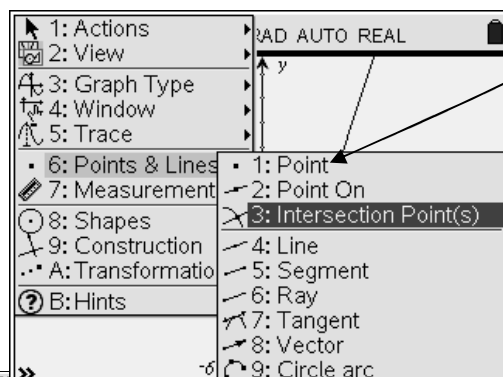
Now let's clear the quadratic and graph a linear function, $y=3x-7$, in a standard window. Press **(tab)** to get to the command line. Up arrow, **(↑)**, to $f_1(x)$. Press **(ctrl)** **(←)**. Type **(3)** **(X)** **(-)** **(7)**. Then to graph this ...



press **(⊞)**. **(menu)**, Window, Zoom Standard. Press **(tab)**. Type the following in $f_2(x)=$
(⊞) **(1)** **(ctrl)** **(⊞)** **(5)** **(X)** **(-)** **(3)** **(ctrl)** **(⊞)** **(5)** **(⊞)**

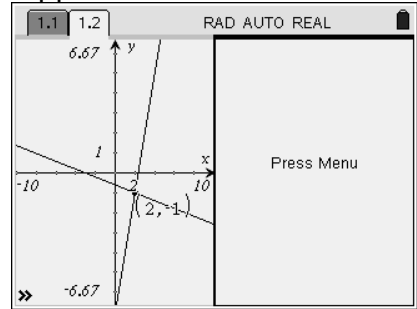
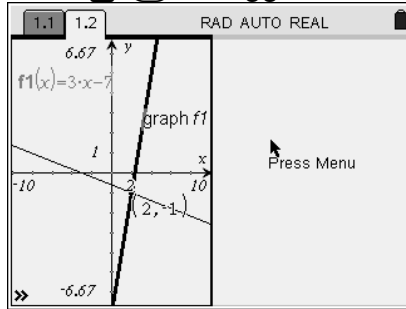
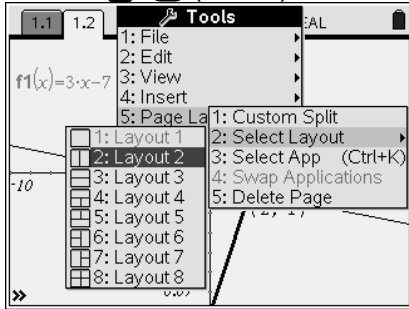


To find the intersection point press **(menu)**, **(6)** **(3)**. Now just click each line. **(ctrl)** **(Z)** to undo. Try using 1:Point to find the intersection. Click when close.)



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

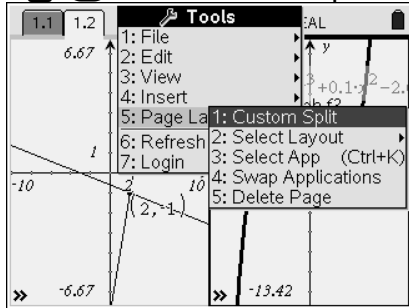
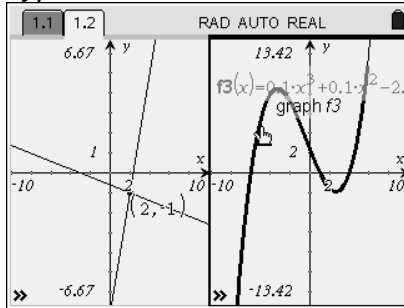
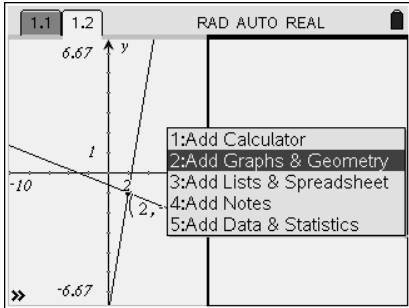
Press **(ctrl) (fn) (Tools)**, 5, 2, 2 Use **(ctrl) (tab)** to toggle between applications. Note the border.



Press **(menu)**, 2: Add G&G

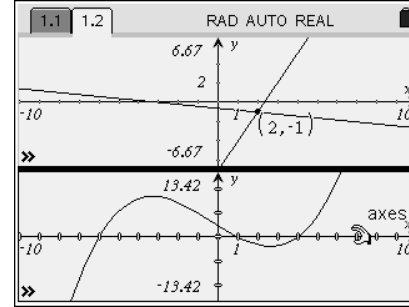
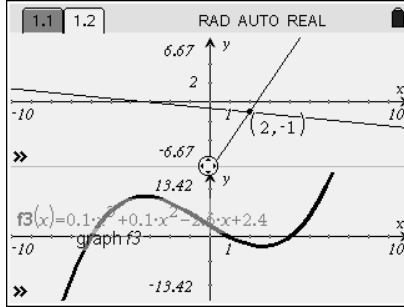
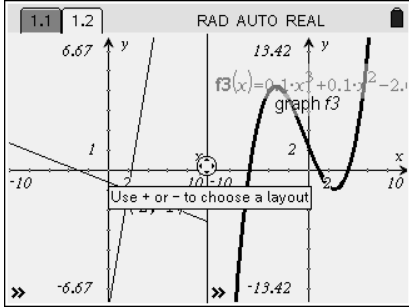
In f3(x), type $.1x^3 + .1x^2 - 2.6x + 2.4$

Split screen can be customized. Press **(ctrl) (fn)**, 5, 1: Custom Split



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

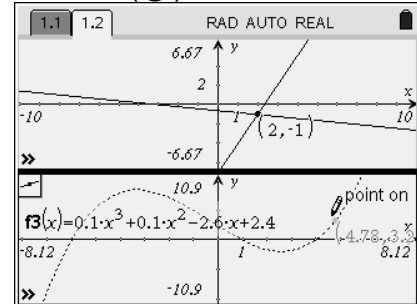
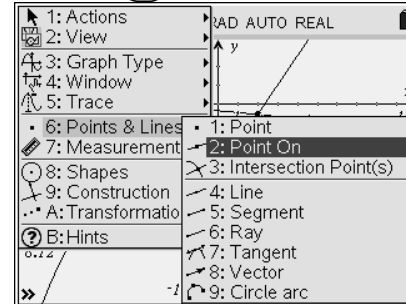
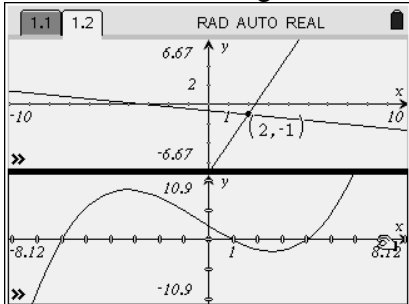
Move the cursor to hover over the ticks on the x-axis. Grab (hold **(mouse button)**) and pull it out.



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

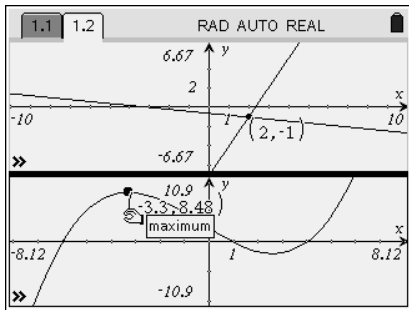
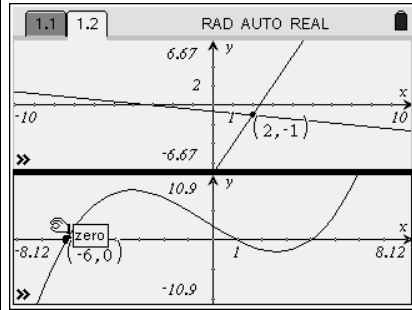
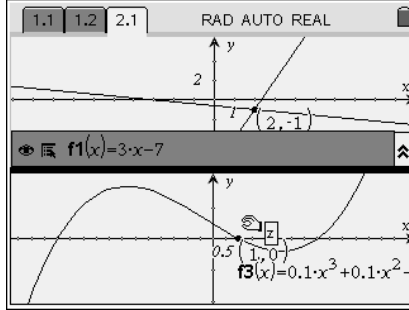
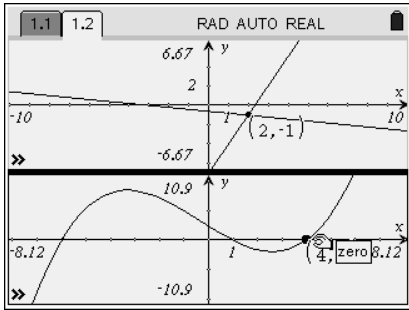
Now, let's find the zero. Press **(menu)**, 6, 2: Point On

Hover over the cubic and **CLICK (mouse button)**



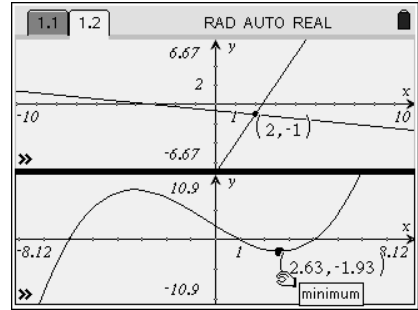
Press (esc) to escape the 'Point On' mode.

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 it 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

A	B	C	D
list1	list2		
	=f3(a1)		
1	0	2.4	
2	1	0.	
3	2	-1.6	
4	3	-1.8	
5	4	0.	
6			

list2 = f3(a [])

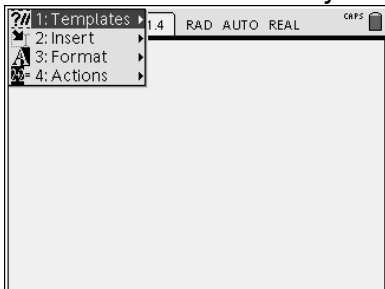
To insert a new page press (ctrl) (I), 3: Add Lists and Spreadsheet. Explore the option under (menu). (If you wanted to go back to the previous page press (ctrl) (left arrow), (right arrow).) This much improved spreadsheet behaves like Excel. To write a formula start with (=)

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

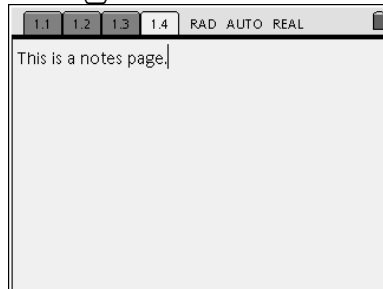
Section 5: Notes

Let's try another method to open a Notes page. Press (fn) 4

To view the options, press (menu). Observe the Format styles.



Try typing something. Use (caps lock) for Shift.

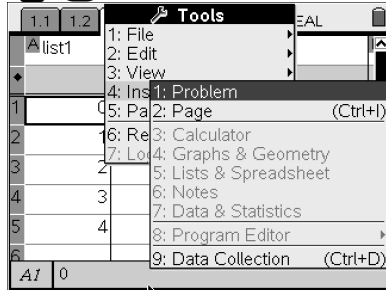


To learn more about Lists & Spreadsheets, Notes, or Data & Statistics applications check out the files in the Examples folder like "Getting Started." Press (fn) (7): My Documents. Look in the Examples folder. (You may choose to save your current document as Primer.)

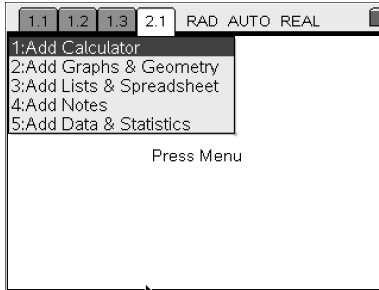
Section 6: CAS (Computer Algebra System)

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).*

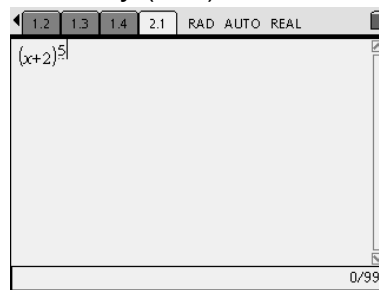
(ctrl) (home), 4, 1:Insert Problem



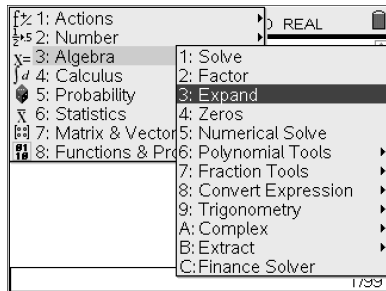
1:Add Calculator



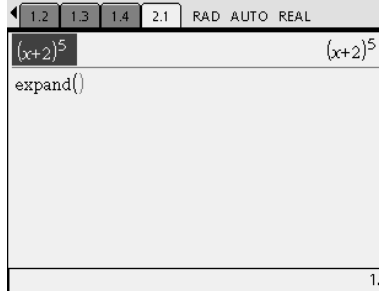
Let's try $(x+2)^5$



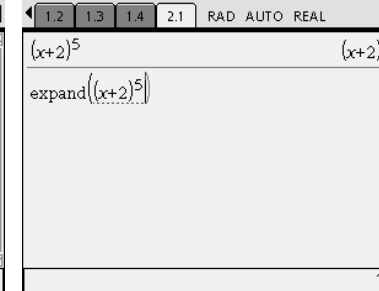
That answer wasn't very interesting. Try **(menu), 3, 3**



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

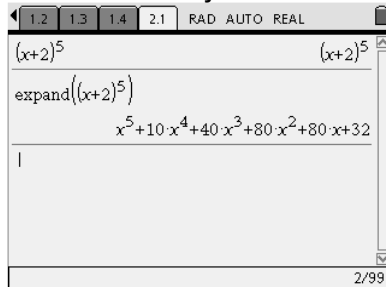


Oh yeah, it "retyped" it for you. Press **(enter)**

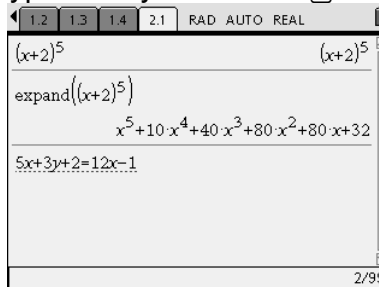


Let's do some step by step algebra.

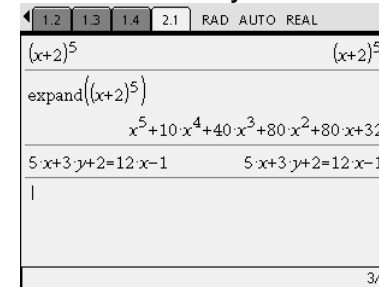
Isn't that lovely.



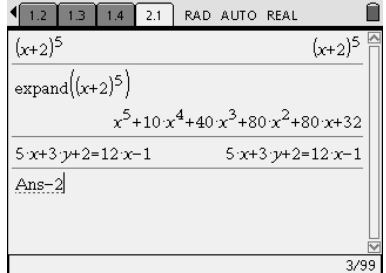
Type $5x+3y+2=12x-1$ **(=) (min)**



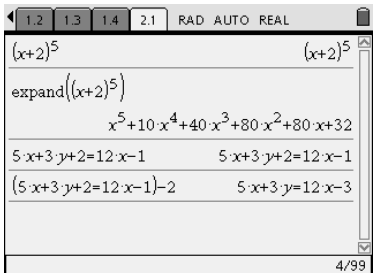
Goal: solve for y. What's next?



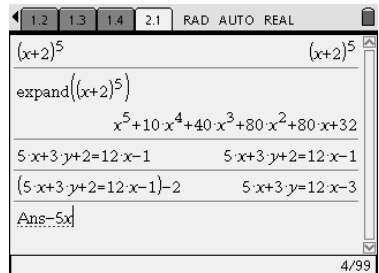
Subtract 2 you say? Just type -2 . **(=) (-) (2)**



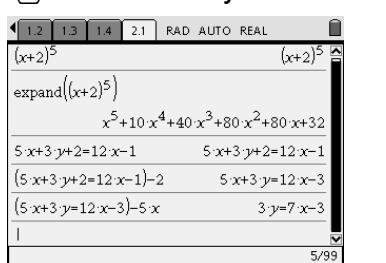
Subtractions was distributed over the equals. What's next?



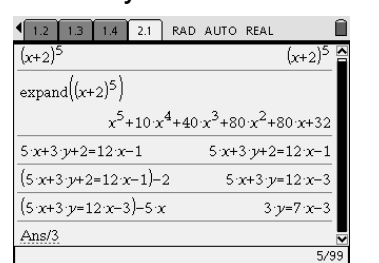
Alright, let's subtract 5x Type **(=) (-) (5) (x)**



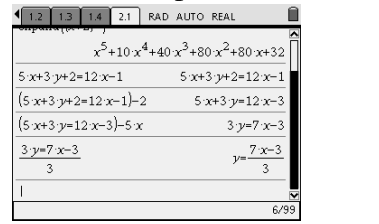
(enter) ... And finally?



Divide by 3.

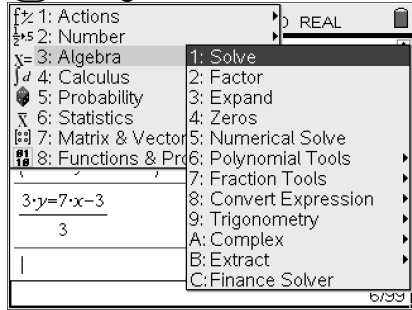


Press **(enter)**. Ta da. And no mistakes. (We could expand it, but it's okay.)



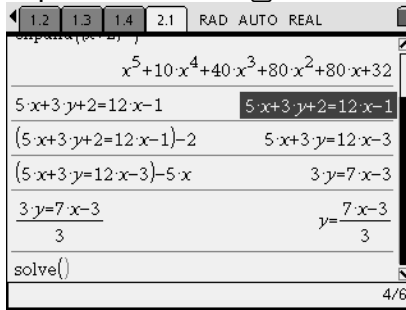
Alright, now do it in one step

(menu) > Algebra > Solve



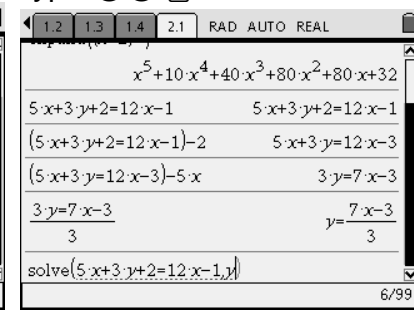
Arrow up to highlight the equation. Press

(enter)



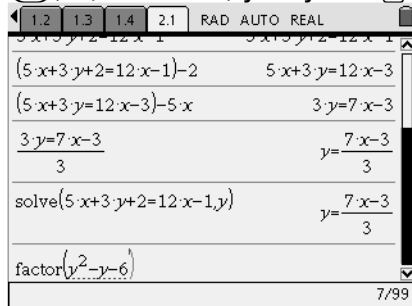
But what are we solving for?

Type (Y) (enter). That will do.



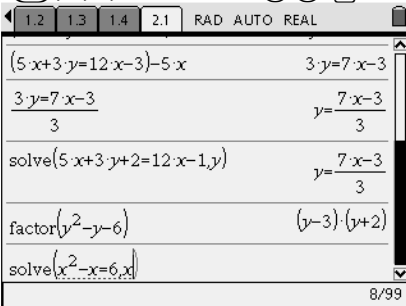
Let's factor.

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

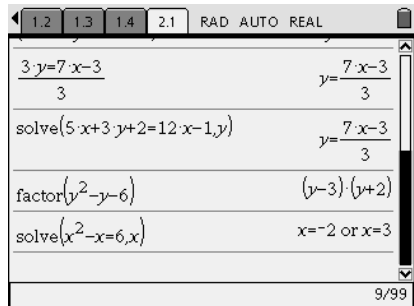


Let's solve a quadratic for x.

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

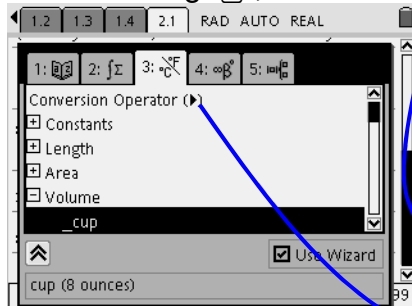


Isn't the 'or' beautiful?



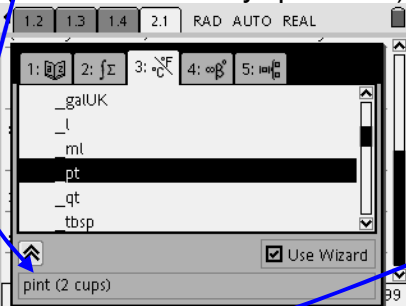
Look what else it can do...

Press catalog (2nd) 3.



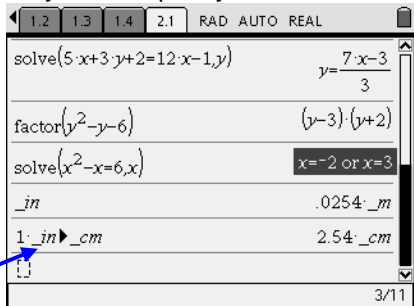
IT CONVERTS.

(That answers my question.)

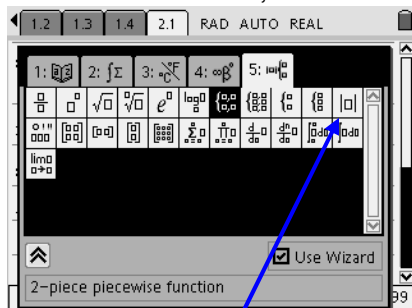


It automatically converts to SI

or you can specify the units.

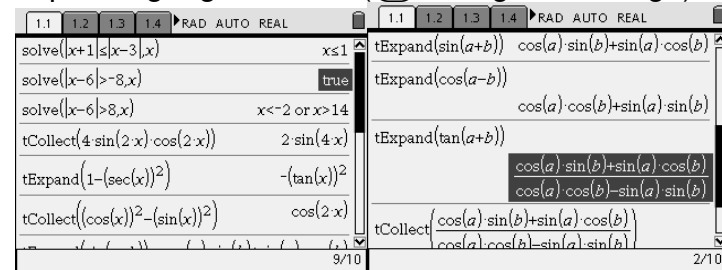


Press (2nd) 3 again and browse the other features, like 5:templates



absolute value

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



Another fun thing you could try is graphing an inequality: For f1(x)=, backspace (clear) once and change = to an inequality. Also graph a circle (menu) > Shapes > Circle, (2nd) 7 to start and stop) and find its equation (menu) > Actions > Coordinates and Eq).

TI-Nspire Primer

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.”

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 and Geometry page. 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)