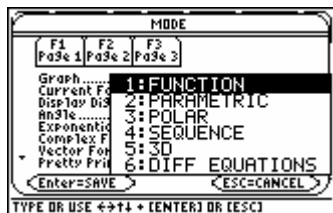
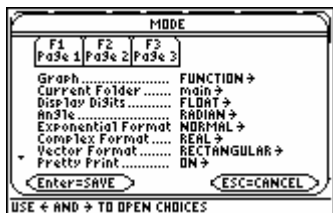


## USING THE TI-89 A Primer for TI-83 Users (Easy Calculus Summer Assignment)

Come to school on the first day with your TI-89. We will start school by learning calculus, so this assignment will help you have a good time learning about the amazing features of your new calculator. On the Titanium (recommended) you can even fit a goodly amount of the Bible on it. (Contact me as soon as possible if this is a problem. [covenantbird@gmail.com](mailto:covenantbird@gmail.com)) This paper is due on the first day as a 10 point homework assignment. See <http://cs3.covenantchristian.org/bird> Calc for this and other info. [Thanks to Tom Reardon for the following document]

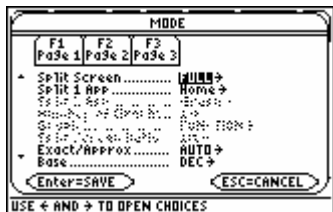
### Section 1. <MODE> key Notice 3 different pages

With the cursor flashing on the word FUNCTION, press the right cursor button



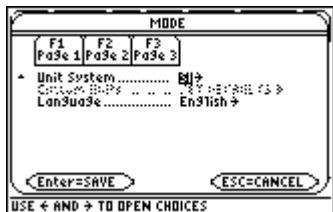
Notice all the different modes of graphing. The first four are on the TI-83 but the last two are not. We will investigate those later. Press <ENTER> to get back to the mode page. Leave angle in Radian mode for now.

Go ahead and investigate the Display Digits and Angle and anything else on that page. Press <F2>. Do NOT hit <ESC> -- it cancels all changes!



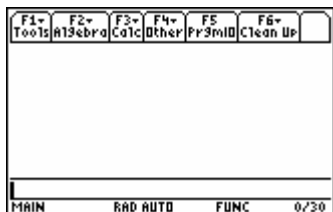
Investigate the Exact/Approx item. 2:EXACT means the answer will be displayed as an exact number (no decimal approximations) 3:APPROXIMATE means the answer is not shown exactly, but as a decimal. 1:AUTO means the answer will be displayed as exact, if possible. If not – decimal approximation. We will usually use AUTO.

Press <F3>



You can investigate the options here if you like. Press <ENTER> to keep the changes. Press <ESC> to leave the screen but NOT keep the changes. This usually takes a while to completely understand/remember, for some unknown reason.

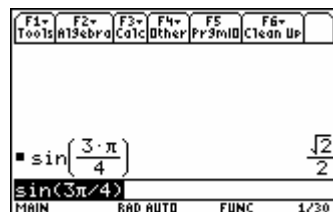
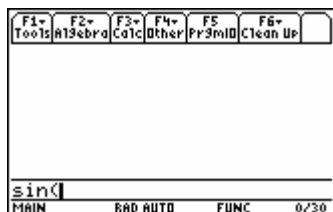
### The HOME screen



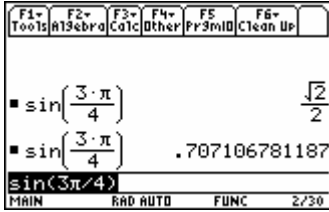
Notice along the top of the screen: the function keys F1, F2, ... Along the very bottom of the screen, it displays the MAIN folder, RADian mode, AUTO mode, FUNCtion mode. The bar just above that is called the command line. The vertical cursor should be blinking.

### The difference between EXACT and APPROXIMATE on the TI-89.

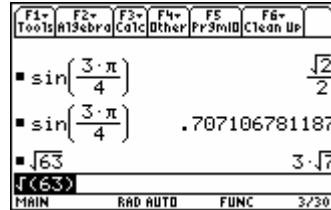
<2<sup>nd</sup>> <SIN>      <3> <2<sup>nd</sup>> <π> </> <4> <)>      <ENTER> (Notice the pretty print)



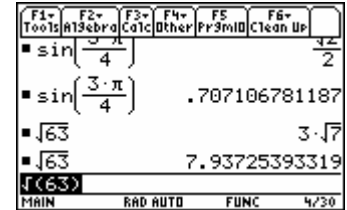
To obtain the approximate value, Press the green diamond key,  $\blacklozenge$ , then <ENTER>



Try a similar idea but with a radical expression. Type  $\sqrt{(63)}$  <ENTER>



Now press the green diamond key  $\blacklozenge$ , then <ENTER>

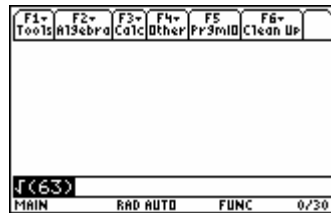


### Section 2 The F1 menu

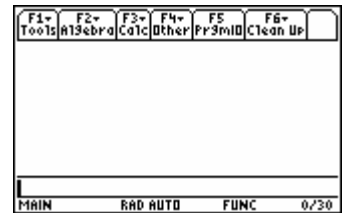
Press <F1>



Press <8> to Clear the Home screen



Notice that the screen was cleared, but not the command line. <CLEAR>



<F1> and cursor down to A:About...



Press <ENTER>



Notice that your screen probably has many different codes than mine. If your Titanium isn't OS v. 3.10 you'll want to update it.

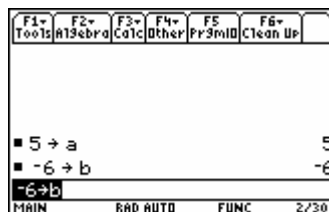
1. Email me your ID a.s.a.p. ([covenantbird@gmail.com](mailto:covenantbird@gmail.com)) Press the <HOME> key to get back to the HOME screen.

### Section 3 Evaluate expressions two different ways

Type <5> <STO> <alpha> <A> <ENTER>



Type <-> (negative NOT the minus sign) <6> <STO> <alpha> <B> <ENTER>



Type <alpha> <A> <\*> (times) <alpha> <B> <+> <alpha> <B> <^2>



<ENTER> (Is this right?)

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	5 → a				5
■	-6 → b				-6
■	a · b + b <sup>2</sup>				6
■	a*b+b^2				
MAIN RAD AUTO FUNC 3/30					

\*\*\***IMPORTANT**\*\*\*

You must realize that you HAD to type the times sign between the a and the b. On this calculator, 'ab' is an acceptable variable name. 'ab' does NOT mean a times b on this calculator. You will forget this and get frustrated but I warn you anyway. ☺

Just like on the TI-83, the value stored in 'a' is 5 and the value stored in 'b' is -6. These values will not change until other values are stored in 'a' or 'b'. To verify this:

Press <alpha> <A>  
<ENTER>

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	5 → a				5
■	-6 → b				-6
■	a · b + b <sup>2</sup>				6
■	a				5
■	b				-6
■	a				5
MAIN RAD AUTO FUNC 4/30					

You could try the same but with 'b'.

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	5 → a				5
■	-6 → b				-6
■	a · b + b <sup>2</sup>				6
■	a				5
■	b				-6
■	b				-6
MAIN RAD AUTO FUNC 5/30					

Now type  
 $x^2+3|x=3$  the '|' is located below the = sign

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	5 → a				5
■	-6 → b				-6
■	a · b + b <sup>2</sup>				6
■	a				5
■	b				-6
■	$x^2+3 x=3$				
MAIN RAD AUTO FUNC 5/30					

Press <ENTER>

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	-6 → b				-6
■	a · b + b <sup>2</sup>				6
■	a				5
■	b				-6
■	$x^2+3 x=3$				12
■	$x^2+3 x=3$				
MAIN RAD AUTO FUNC 6/30					

What value is stored for 'x' now? <x> <ENTER>

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	a · b + b <sup>2</sup>				6
■	a				5
■	b				-6
■	$x^2+3 x=3$				12
■	x				x
■	x				x
MAIN RAD AUTO FUNC 7/30					

Surprised? 'x' is still a variable. It does not retain the value 3 when you use the '|' 'such that' key. Hmm...

Do you remember how you could go through the 'history' on your TI-83? By pressing <2<sup>nd</sup>> <ENTER>? This is done much easier, much cooler on the TI-89. You just use the cursor keys and press the up arrow until you get to the expression you want. Press the up arrow key until  $a \cdot b + b^2$  is highlighted:

Press <ENTER>

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	a · b + b <sup>2</sup>				6
■	a				5
■	b				-6
■	$x^2+3 x=3$				12
■	x				x
■	x				x
MAIN RAD AUTO FUNC 5/7					

|a=7 <ENTER>

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	a · b + b <sup>2</sup>				6
■	a				5
■	b				-6
■	$x^2+3 x=3$				12
■	x				x
■	x				x
MAIN RAD AUTO FUNC 7/30					

F1+	F2+	F3+	F4+	F5	F6+
Tools	13&brd	Calc	Other	Pr3mID	Clean Up
■	a				5
■	b				-6
■	$x^2+3 x=3$				12
■	x				x
■	a · b + b <sup>2</sup>   a=7				-6
■	a · b + b <sup>2</sup>   a=7				
MAIN RAD AUTO FUNC 8/30					

Hmmm... now what happened here? Investigate by finding out what values are stored in 'a' and in 'b'.

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
■ $x^2 + 3$   $x = 3$					12
■ $x$					$x$
■ $a \cdot b + b^2$   $a = 7$					-6
■ $a$					5
■ $b$					-6
MAIN      RAD AUTO      FUNC      10/30					

What happened to the '7'?  
Think about it.  
Ask around if you are unsure.

## Section 4 The <F2> Algebra menu ... POWERFUL!

The TI-89 has a Computer Algebra System (CAS) that can do just about anything that you learned how to do in Algebra 1 and Algebra 2. Let's look at just a little of what the CAS can do. First of all, clear the HOME screen. Hint: <F1> <8>. Then press the <CLEAR> button to clear the command line. [Bird recommends against clearing the HOME screen. It is fun having the option of scrolling back 30 times to see what I've done lately.]

<F2> has the algebra menu. Let's first expand a binomial.

<F2> <3>:expand(

$(x+2)^5$

\*Notice 2 left (

<ENTER> Oh, wow

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
expand(					
MAIN      RAD AUTO      FUNC      0/30					

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
expand((x+2)^5)					
MAIN      RAD AUTO      FUNC      0/30					

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
■ expand((x+2)^5)					
x^5 + 10 · x^4 + 40 · x^3 + 80 · x^2					
expand((x+2)^5)					
MAIN      RAD AUTO      FUNC      1/30					

In order to see the rest of the answer, cursor up and to the right

Cursor back down to the command line and press <CLEAR>

<F2> <2>:factor(

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
■ expand((x+2)^5)					
◀ + 40 · x^3 + 80 · x^2 + 80 · x + 32					
expand((x+2)^5)					
MAIN      RAD AUTO      FUNC      1/1					

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
■ expand((x+2)^5)					
◀ + 40 · x^3 + 80 · x^2 + 80 · x + 32					
MAIN      RAD AUTO      FUNC      1/30					

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
■ expand((x+2)^5)					
◀ + 40 · x^3 + 80 · x^2 + 80 · x + 32					
factor(					
MAIN      RAD AUTO      FUNC      1/30					

Type  $y^2 - y - 6$ )

<ENTER>

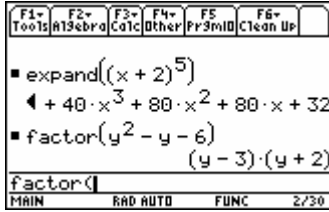
Press the right cursor

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
■ expand((x+2)^5)					
◀ + 40 · x^3 + 80 · x^2 + 80 · x + 32					
factor(y^2-y-6)					
MAIN      RAD AUTO      FUNC      1/30					

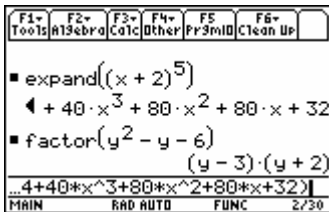
F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
■ expand((x+2)^5)					
◀ + 40 · x^3 + 80 · x^2 + 80 · x + 32					
■ factor(y^2-y-6)					
(y-3) · (y+2)					
factor(y^2-y-6)					
MAIN      RAD AUTO      FUNC      2/30					

F1→	F2→	F3→	F4→	F5→	F6→
Tools	Algebra	Calc	Other	Pr3mlD	Clean Up
■ expand((x+2)^5)					
◀ + 40 · x^3 + 80 · x^2 + 80 · x + 32					
■ factor(y^2-y-6)					
(y-3) · (y+2)					
factor(y^2-y-6)					
MAIN      RAD AUTO      FUNC      2/30					

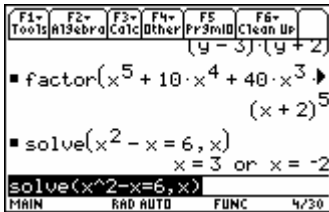
Use the backspace key  
← to delete as shown:



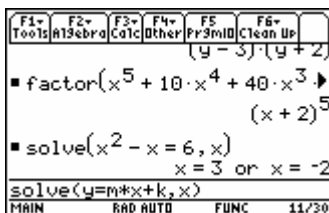
You still need to add the right )



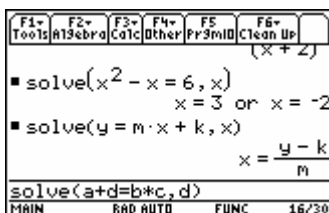
<ENTER>  
I love the word 'or' here



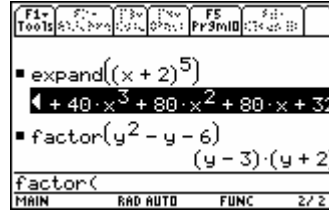
Type  $y = m \cdot x + k$ ,  
\* means 'times'



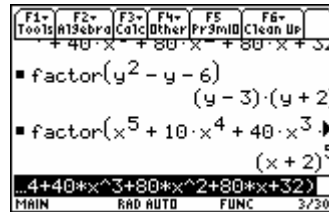
$a+d=b \cdot c, d$ )



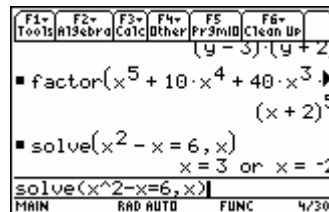
Press the up cursor to go  
up to the line as shown:



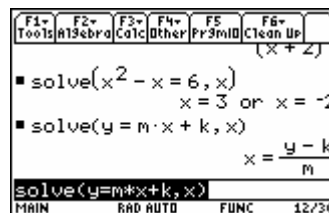
Now <ENTER>  
Oh, wow, WOW!



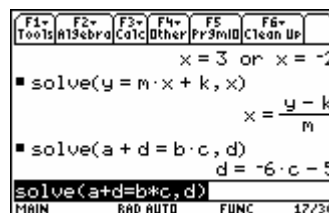
Press the right cursor  
key



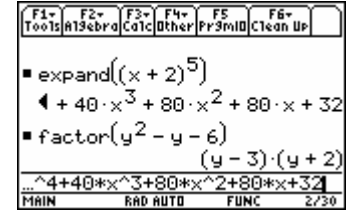
<ENTER>



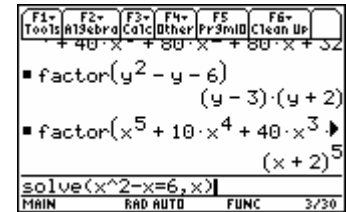
<ENTER>



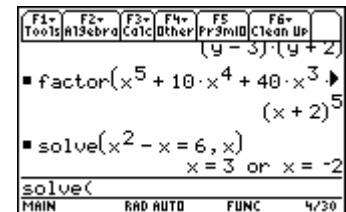
Press <ENTER>



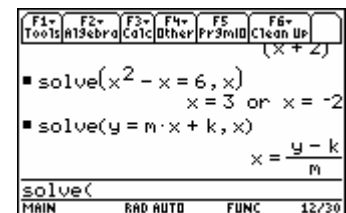
<F2> <1:solve(  
 $x^2-x=6,x$ )



Backspace as below



Press the right cursor  
key and backspace



This is NOT what was  
expected. WHY?

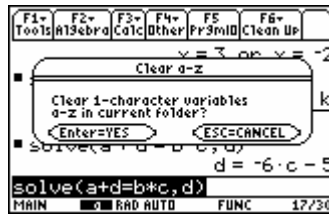
Answer: Because there are  
values stored into a and b.  
This is a concern and something  
we have to deal with.

We need to clear out the values that are stored in a and b. We do this using:

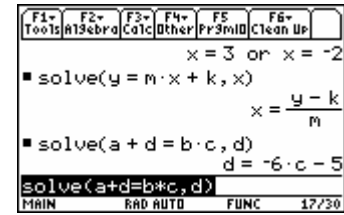
<F6> <1:Clear a-z>  
(<F6> is <2<sup>nd</sup>> <F1>)



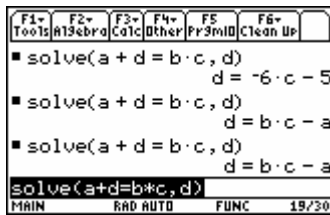
<1> or <ENTER>



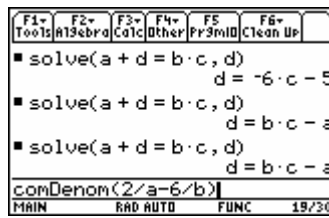
<ENTER> for YES



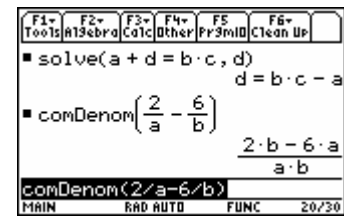
Press <ENTER> again to re-solve the equation



<F2> <6:comDenom(2/a - 6/b)>



<ENTER>  
Oooh...Aaaahh...



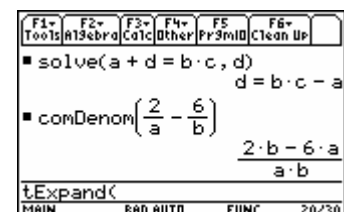
<F2> <9↓Trig>



Cursor to the right



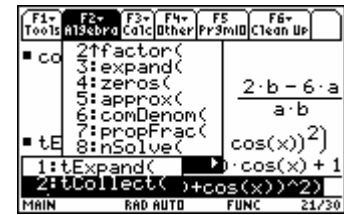
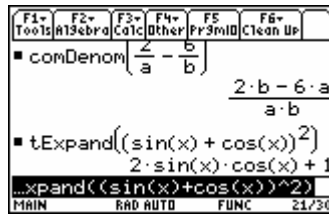
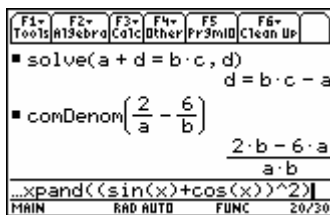
<ENTER>



Type EXACTLY as below:

<ENTER>

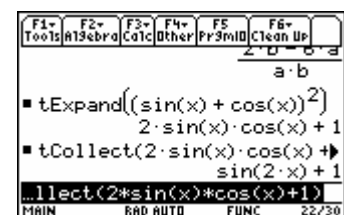
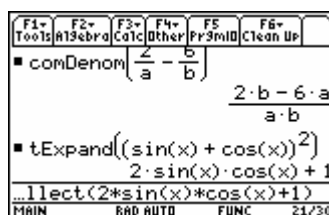
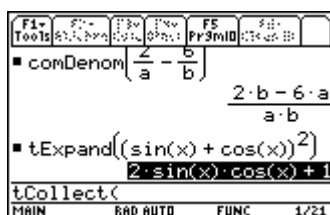
<F2> <9> <2>



'Grab' the previous answer

<ENTER> right)

<ENTER>

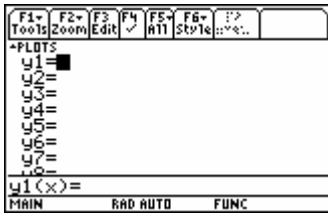


SO! This calculator even knows the trig identities. Well at least some of them, anyway.

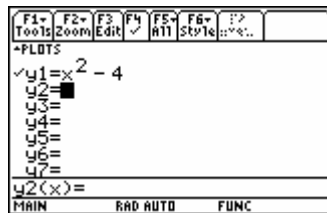
## Section 5 Graphing on the TI-89

Notice that the Graphing Keys on the TI-89 are where they are on the TI-83 but are green. So we need to use the green diamond key (GRN♦) to access these keys.

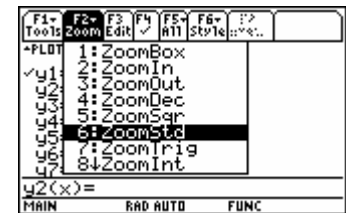
GRN♦ <F1> for y=



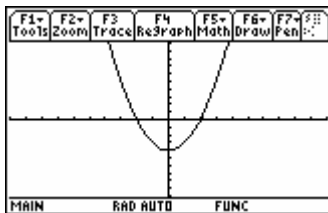
$x^2 - 4$  <ENTER>



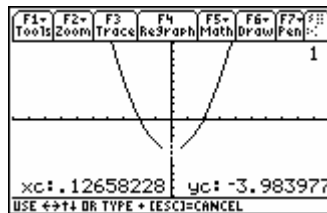
<F2> <6:ZoomStd>



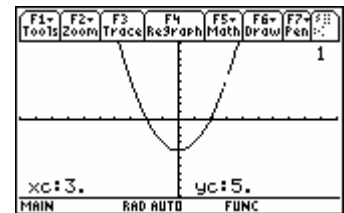
Voila!



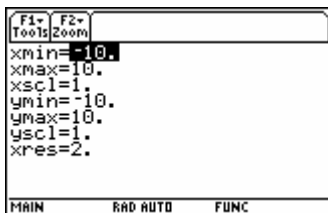
<F3> to trace



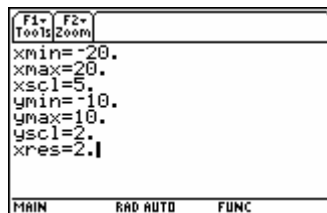
Type 3 <ENTER>



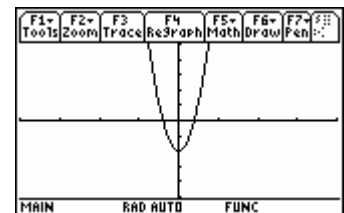
GRN♦ <F2> for WINDOW



Type as below:



GRN♦ <F3> for GRAPH



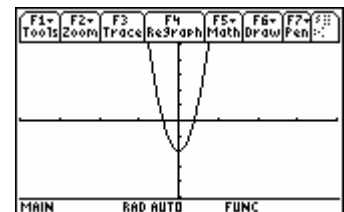
GRN♦ <F4> for TblSet



Type as below: \*Use the down cursor to go to  $\Delta$ tbl box.



Press <ENTER> to save (You may have to press <ENTER> twice)



GRN ♦ <F5> for TABLE

Cursor up and down to go through the table

F1	F2						
Tools	Setup						
x		u1					
3.		5.					
3.5		8.25					
4.		12.					
4.5		16.25					
5.		21.					
x=3.							
MAIN RAD AUTO FUNC							

F1	F2						
Tools	Setup						
x		u1					
-1.		-3.					
-.5		-3.75					
0.		-4.					
.5		-3.75					
1.		-3.					
x=-1.							
MAIN RAD AUTO FUNC							

This is just a small, minute part of what the TI-89 is capable of doing. It is an awesome machine, as you will find out even more as you use it.

## BIG IMPORTANT MESSAGE – DO NOT UNDERESTIMATE THIS

The TI-89 is a very powerful calculator. It is like a mini-computer with \$1500 of software on it. The AP exam allows it on half of the test. NO calculator of any kind is allowed on the other half of the test. None, nada, zilch.

Some colleges allow students to use the TI-89. Many do not. Many colleges require all students to have laptops or allow other types of calculators (TI-83, HP, scientific, ...). At some colleges it depends upon the individual professor as to whether or not you can use any kind of 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. (Sam I am. ☺) But you have to help me with this. Do NOT let yourself become dependent on a calculator.

Consider the following:

There are three types of calculations in this world:

- Mental Math
- Paper and Pencil
- 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.’

## PRACTICE WHAT YOU HAVE SEEN SO FAR

*(And don't be afraid to 'play around' and try other features. Investigate. Try some other problems. Start to see just what mathematical power you hold in your hands.)*

**Suggestions:** Write something for the bolded problems.

Work with other people on this – even if it is over the telephone.

Start to refer to the TI-89 manual.

WHAT?! You think that we are going to read the manual?!! Did you see that document? ...Yes, I do believe that you will read the manual, but as a reference. Get used to doing things like this. ☺ Old people like me have to do this all the time.

2.
  - a) Go to the HOME screen.
  - b) Use the <MODE> key to change DisplayDigits to FLOAT6 and the Angle to DEGREE
  - c) Type the  $\pi$  key and <ENTER>
  - d) Did you get 3.14159? Why not? How could you get the approximate value for  $\pi$ ?
  - e) That's right, use the GRN  $\blacklozenge$  key
  - f) Evaluate  $\sin 30$  both exact and approximate  
Evaluate  $\cos 30$  both exact and approximate  
Evaluate  $\tan 30$  both exact and approximate  
Evaluate  $\sqrt{28}$  both exact and approximate
  - g) Reset the MODE back to FLOAT and RADIAN
3.
  - a) Store 3 into c; - 4 into d
  - b) Evaluate the expression:  $c^2 + c \cdot d$  with the TI-89
  - c) Store - 5 into c; 2 into d. Grab  $c^2 + c \cdot d$  and reevaluate with the new values
  - d) Evaluate  $x^3 - x^2 + 2x + 5$  for  $x = 6$  using the 'I' key
  - e) Use <F6> to 'clean up', that is, Clear a-z
4. Using the algebra menu:
  - a) Expand:  $(a + b)^2$                        $(a + b)^3$                        $(a + b)^4$
  - b) Factor:  $y^2 + 2y - 15$                        $x^3 - 16x$                        $a^3 - 64$                        $b^3 + 8$
  - c) Use the up arrow to highlight the answer to  $(a + b)^3$  and then factor that answer
  - d) Factor:  $x^2 - 5$
  - e) OK so part e didn't factor. Just for fun, type: `factor(x^2 - 5, x)` and <ENTER>  
Hmmm...
  - f) Factor  $y^2 - 12$  in the same way as we did part e
  - g) Solve:  $3x + 4 = 14$  Exact solution and approximate solution.  
Solve:  $y^2 = 6y$  Exact solution and approximate solution.  
Solve:  $3z^2 - z = 5$  Exact solution and approximate solution.  
Solve:  $a = \frac{1}{2} \cdot h \cdot (c + d)$  for  $c$   
Solve:  $a = \frac{1}{2} \cdot h \cdot (c + d)$  for  $h$
  - h) Use the trig expand feature to expand each of the following:  
 $\sin(a + b)$                        $\cos(x - y)$                        $\tan(c + d)$

OK so the calculator doesn't know ALL of the trig identities.

5. a) In  $y1$ , type  $y1 = -3x + 2$  Graph with ZoomDecimal
- b) Leave  $y1$  on. Graph  $y2 = x^2 - 2$  using the same window
- c) Use <F5> <5:Intersection> to find a point of intersection in the fourth quadrant (See if you can figure this out, OK? Don't forget about referring to the manual)
- d) Highlight  $y1$  and 'turn it off' by pressing the <F4> key to 'uncheck' it. Do the same for  $y2$ .
- e) Graph  $y3 = x^3 - 4x^2 + 2x - 3$  using ZoomSatndard
- f) Use <F5> <3> to find the coordinates of the relative minimum point. Use <F5> <4> to find the coordinates of the relative maximum point. Label your answers as ordered pairs rounded to 4 decimal places.
- g) Regraph  $y3$  using the following window: X[-5, 8]2 Y[-20, 20]5
- h) Set up a table that starts with  $x = 2$  and a  $\Delta t$  of 1. View the table for the values generated by  $y3$ . Use that table to evaluate the following:  
 when  $x = 6$ ,  $y3 = ?$   
 when  $x = -1$ ,  $y3 = ?$

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

*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	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.