Introduction to the TI-89 for Beginners

International Teachers Teaching with Technology
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1:30 - 3:00 PM
Harrison

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DISPLAY CONTRAST

To *increase* the contrast, hold down the green diamond key (◆) and the + sign
To *decrease* the contrast, hold down the green diamond key (◆) and the - sign

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LAYOUT OF THE KEYBOARD

Many keys on the calculator have more than one function:
a) what is written on the key in white lettering (just press the key)
b) what is written above the key in green lettering (press **green diamond** ◆, located row 3, column A)
c) what is written above the key in yellow lettering (press **2nd**, located row 2, column A)
d) what is written above the key in purple lettering (press **alpha**, row 3, column B)
e) the ⇧ (shift or up arrow key, row 2, column B) is used to capitalize a letter.

Function keys (8 of them F1-F8) below the calculator screen.

Special keys:

◆ green diamond key (row 3, column A, shortcut for Y=, Window, Graph, TblSet, Table, Cut, Copy, Paste, ≈, Del)

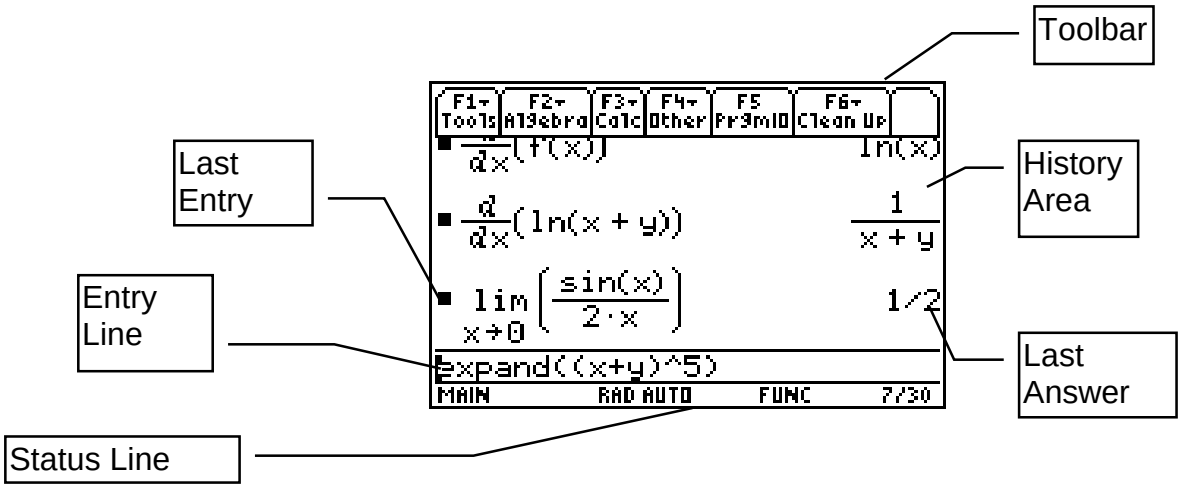
2nd yellow key (row 2, column A, access to functions printed in yellow above the key)

Four Cursor keys (left, right, up, down arrow keys)

ENTER keys (row 10, column E)

ESC key (row 2, column C)

LAYOUT OF SCREEN



LAYOUT OF SCREEN

The top row is the Toolbar for the F1-F6 keys

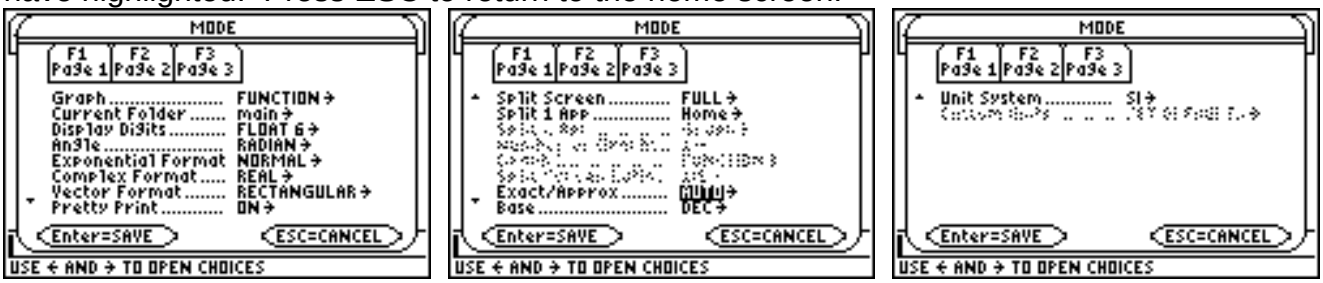
The next area, called the "History Area," may show up to 5 rows of print; keeps a record of your entry/answer pairs

The Entry line is between two horizontal lines.

Below the entry line is the Status Line - current state of your calculator.

SETTINGS

To clear the home screen, press **F1** and choose #8:Clear Home, press **CLEAR** if there is something on the insert line. For this worksheet, change the **MODE** (row 4, column B) settings of your calculator to look like the screen below. Press **ENTER** to select what you have highlighted. Press **ESC** to return to the home screen.



Exact: Any result that is not a whole number is displayed in a fractional or symbolic form ($2/3$, $\pi/4$, $2\sqrt{2}$)

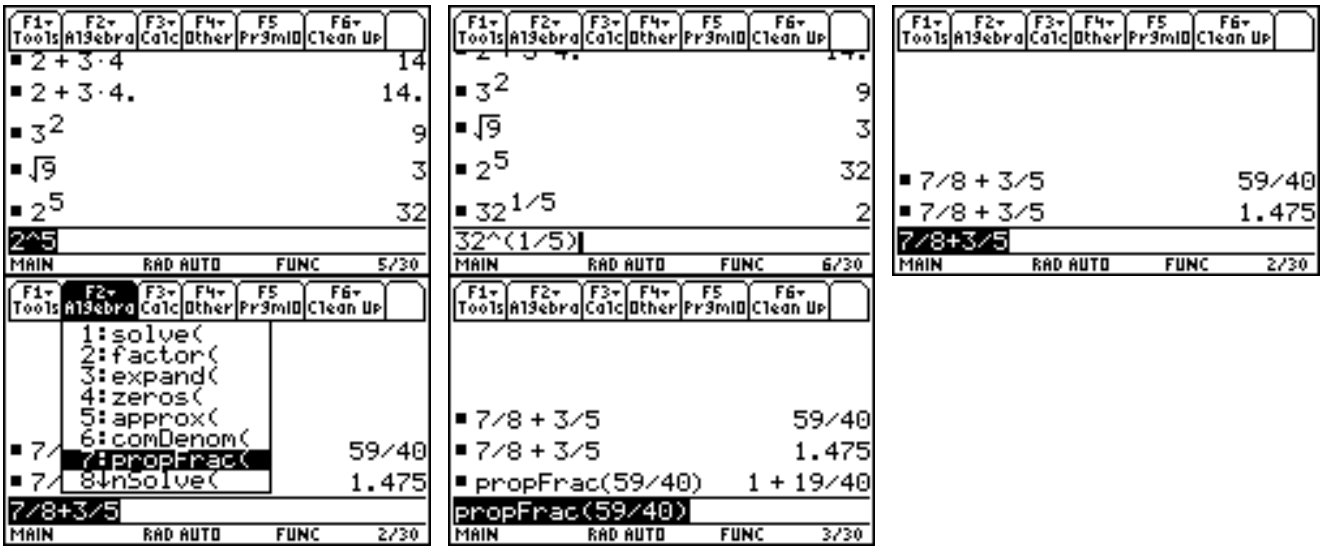
Approximate: All numeric results, where possible, are displayed in floating-point (decimal) form.

Auto: Uses Exact form where possible, but uses the Approximate form when entry contains a decimal point.

Accuracy: Floating-point decimal values in memory are stored using up to 14 digits with a 3-digit exponent. Integer values in memory are stored using up to 614 digits. The TI-89 carries more digits internally than it displays.

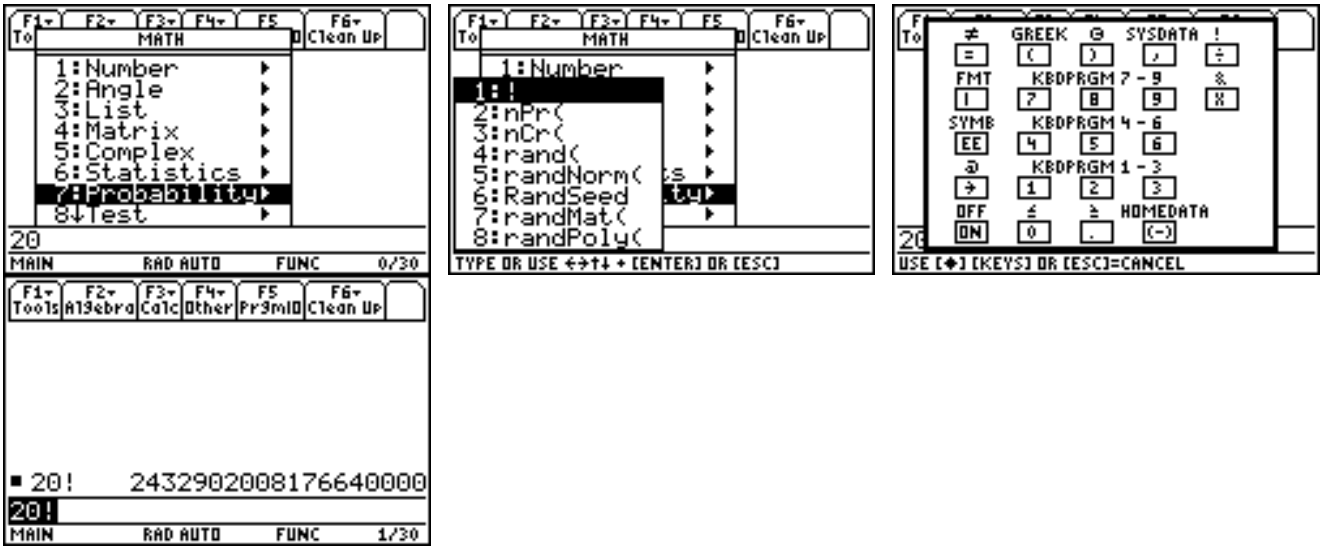
OPERATIONS

2+3*4, **ENTER**	14
2+3*4., **ENTER** (notice a decimal in one number of the expression determines that the answer will be printed with a decimal point)	14.
3^2, (type 3 ^ 2, ^ row 5, column E, notice the pretty print), **ENTER**	9
$\sqrt{9}$, (square root, row 7, column E), (remember right parenthesis), **ENTER**	3
2^5 (2^5, use ^ (row 5, col E) to raise a number to a power)	32
$\sqrt[5]{32}$ (32^(1/5))	2
Add 7/8 and 3/5	59/40
Use Green Diamond (◆) and ENTER	1.475
Write 59/40 as a mixed number	1 + 19/40



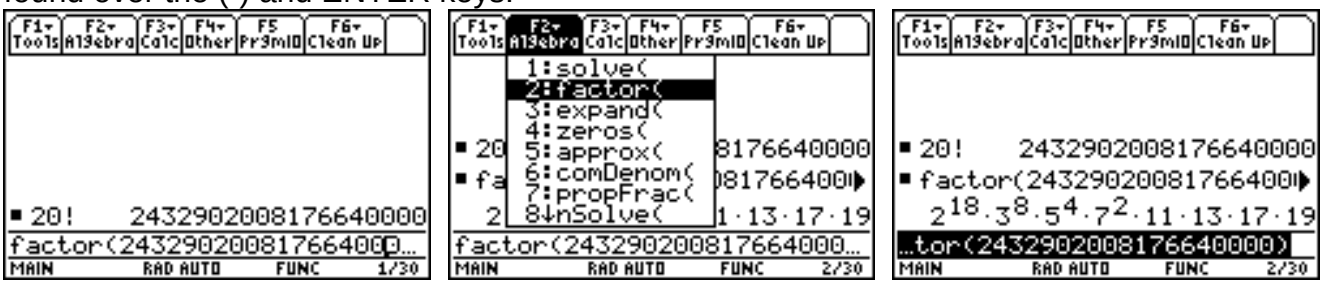
Factorial, Factor, Expand, Solve, Zeros Commands

20! can be entered two ways. One way, using the MATH key and 7: Probability menu 1: !, a second way using the short cut. To find the short cut for !, activate the keyboard map with ◆K. Note that factorial is ◆ ÷.

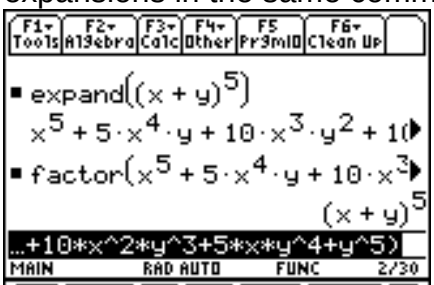


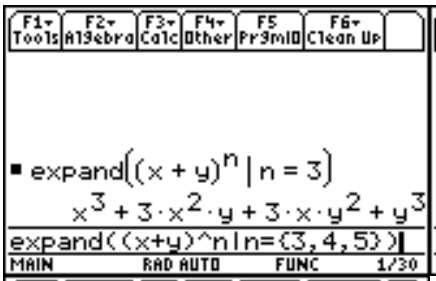
A choice was made not to clutter the keyboard with all the special characters.

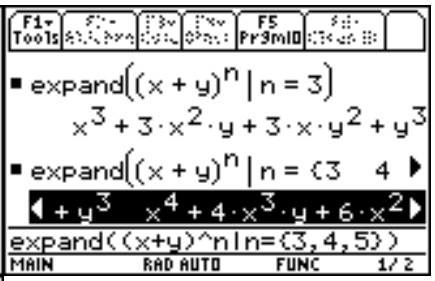
Factor the answer given for 20! Either type the word “factor”, or under the **F2:Algebra** menu, select *2:factor(*, or press **CATALOG** (row 4 column C) select *factor(* by pressing **ENTER** once it is highlighted in the list. In the Entry line, type **factor(ans(1))**. Note ans and entry are found over the (-) and ENTER keys.

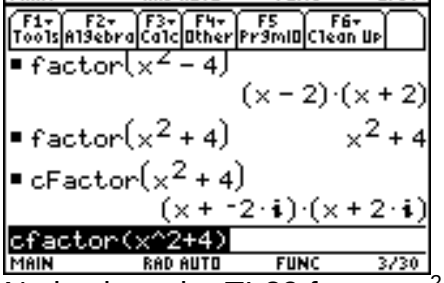


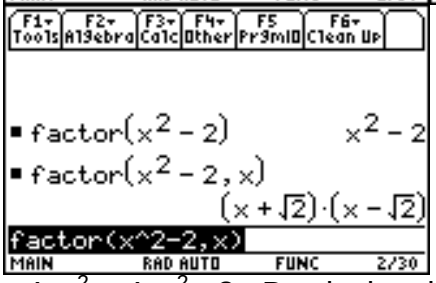
Expand $(x+y)^5$, then factor the expansion! To expand this expression in general, use the **with** (**|**)command (row 7,column A) with n = 3, then 4, etc. A list can be used to do multiple expansions in the same command.



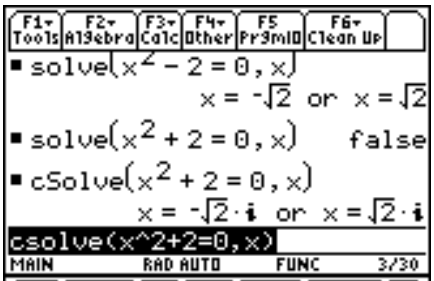


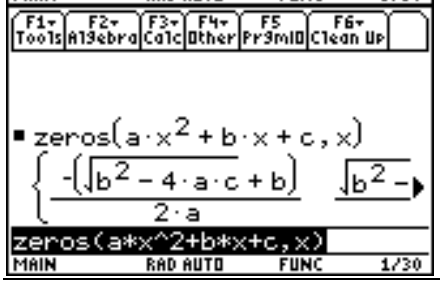


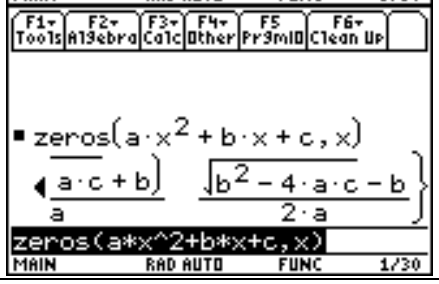




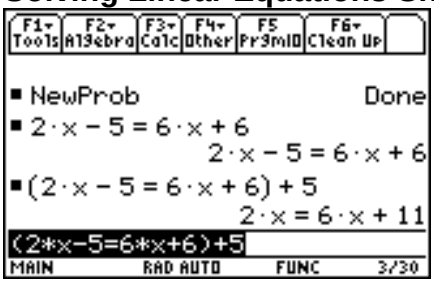
Notice how the TI-89 factors $x^2 - 4$, $x^2 + 4$, $x^2 - 2$. By placing the variable after the expression, the expression is factored as much as possible toward real factors that are linear, even if it introduces irrational constants. A "cFactor" was necessary before factoring complex roots.

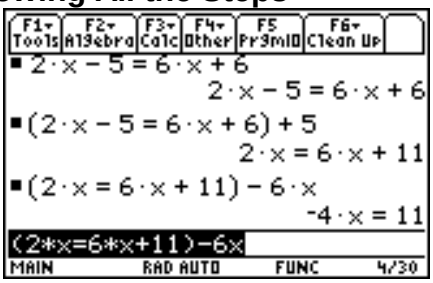


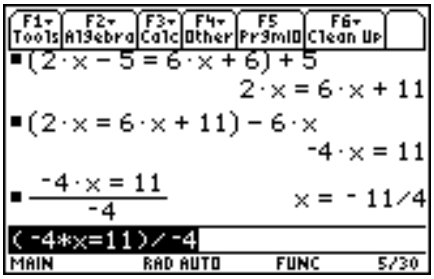


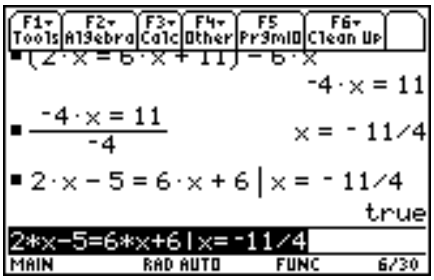


Solving Linear Equations Showing All the Steps

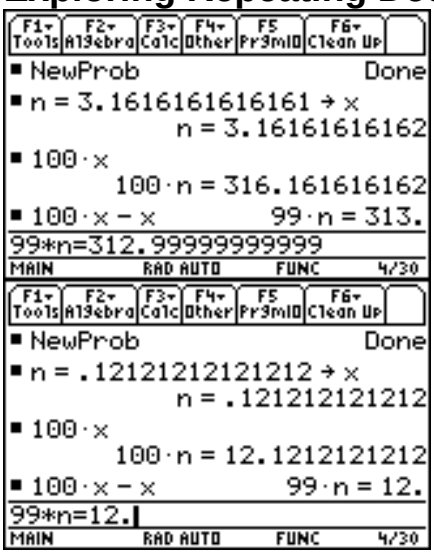


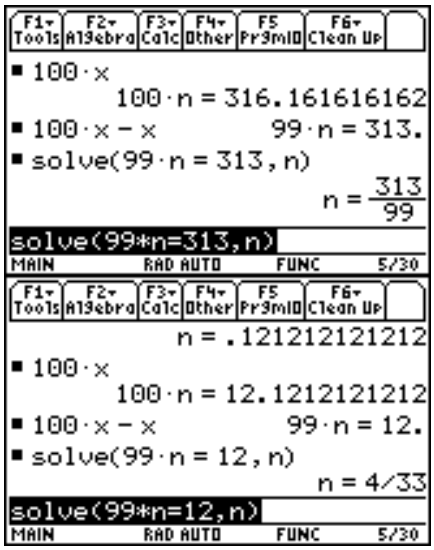






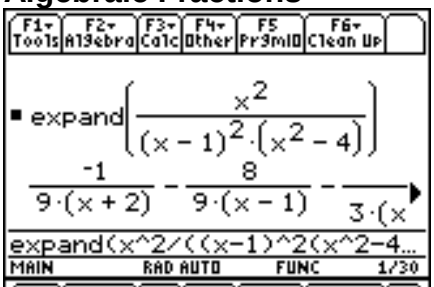
Exploring Repeating Decimals

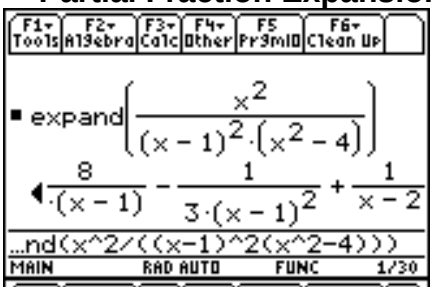


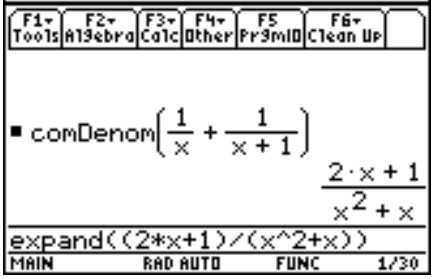


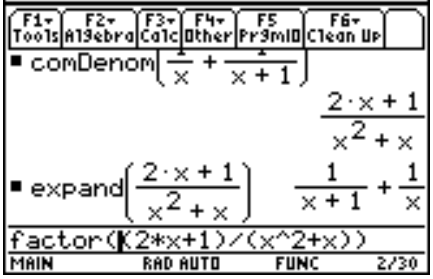
Try n=1.23555555…

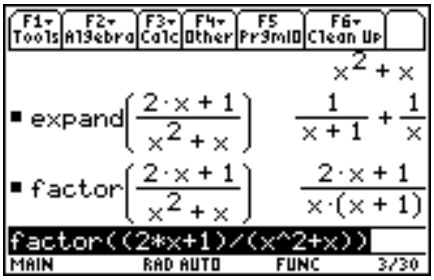
Algebraic Fractions **Partial Fraction Expansion**



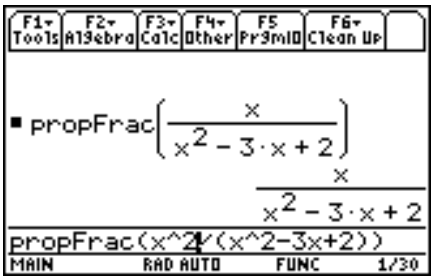


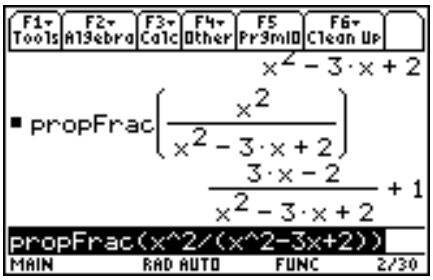


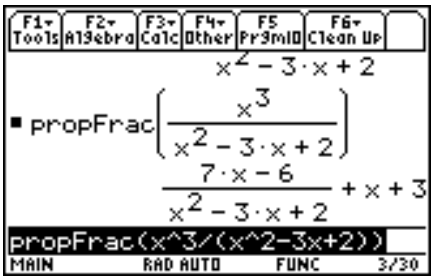




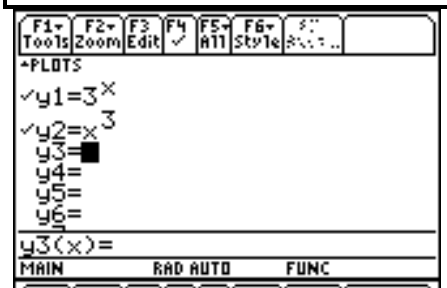
Notice if the degree of the numerator is lower than the degree of the denominator, the same fraction returns; if the degree of the numerator is the same degree as the denominator, or higher than the degree as the denominator, then the partial fractions are returned.

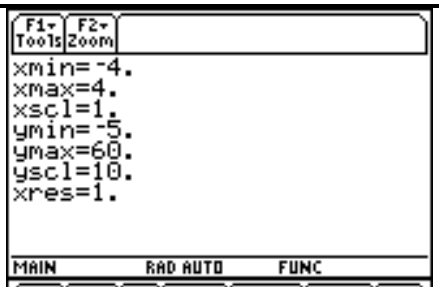

propFrac(x/(x^2-3x+2))
MAIN RAD AUTO FUNC 1/30


propFrac(x^2/(x^2-3x+2))
MAIN RAD AUTO FUNC 2/30


propFrac(x^3/(x^2-3x+2))
MAIN RAD AUTO FUNC 3/30

Solve $3^x = x^3$


*PLOTS
y1=3^x
y2=x^3
y3=
y4=
y5=
y6=
y3(x)=
MAIN RAD AUTO FUNC


xmin=-4.
xmax=4.
xscl=1.
ymin=-5.
ymax=60.
yscl=10.
xres=1.
MAIN RAD AUTO FUNC

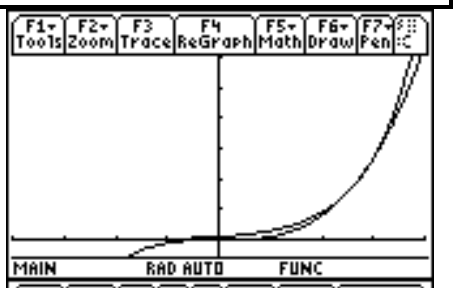
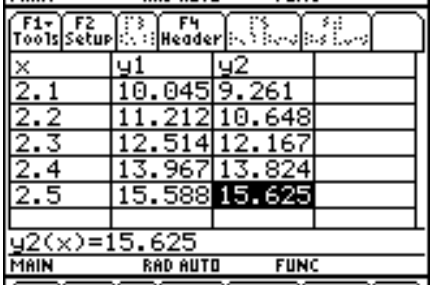
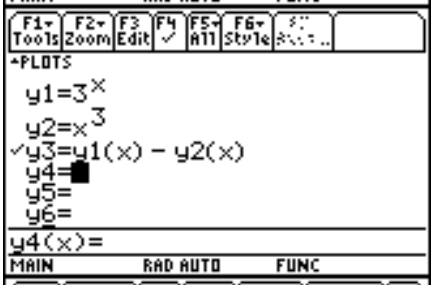
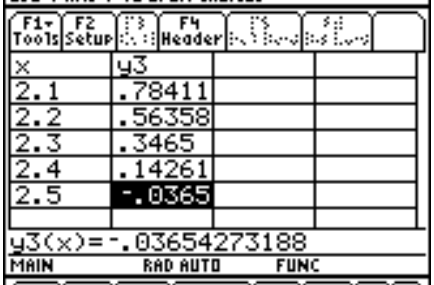
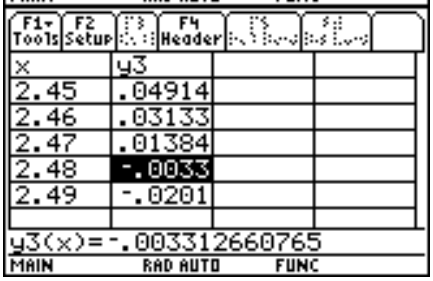

MAIN RAD AUTO FUNC

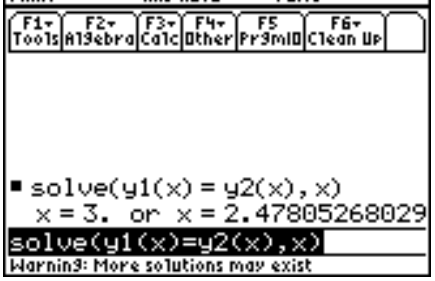

TABLE SETUP
tblStart: 2.
Δtbl: .1
Graph <-> Table: OFF
Independent: AUTO
Enter=SAVE
ESC=CANCEL
y4(x)=
USE ← AND → TO OPEN CHOICES

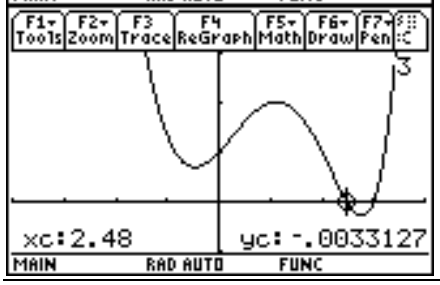

x y1 y2
2.1 10.045 9.261
2.2 11.212 10.648
2.3 12.514 12.167
2.4 13.967 13.824
2.5 15.588 15.625
y2(x)=15.625
MAIN RAD AUTO FUNC


*PLOTS
y1=3^x
y2=x^3
y3=y1(x) - y2(x)
y4=
y5=
y6=
y4(x)=
MAIN RAD AUTO FUNC

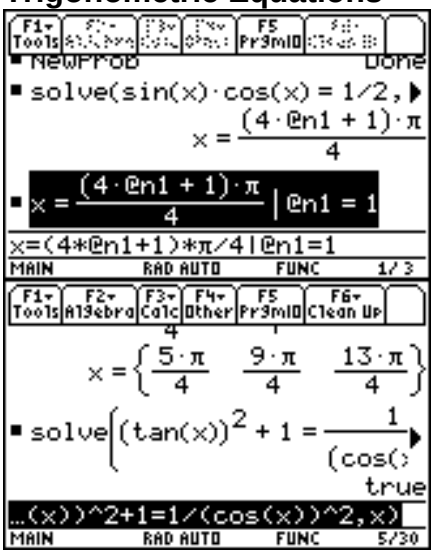

x y3
2.1 .78411
2.2 .56358
2.3 .3465
2.4 .14261
2.5 -.0365
y3(x)=-.03654273188
MAIN RAD AUTO FUNC


x y3
2.45 .04914
2.46 .03133
2.47 .01384
2.48 -.0033
2.49 -.0201
y3(x)=-.003312660765
MAIN RAD AUTO FUNC


solve(y1(x) = y2(x), x)
x = 3. or x = 2.47805268029
solve(y1(x)=y2(x),x)
Warning: More solutions may exist

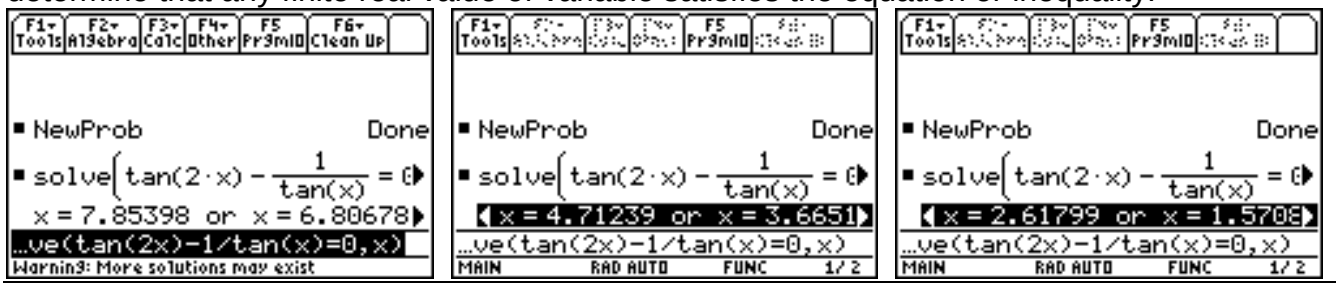

3
xc:2.48
yc: -.0033127
MAIN RAD AUTO FUNC

Trigonometric Equations



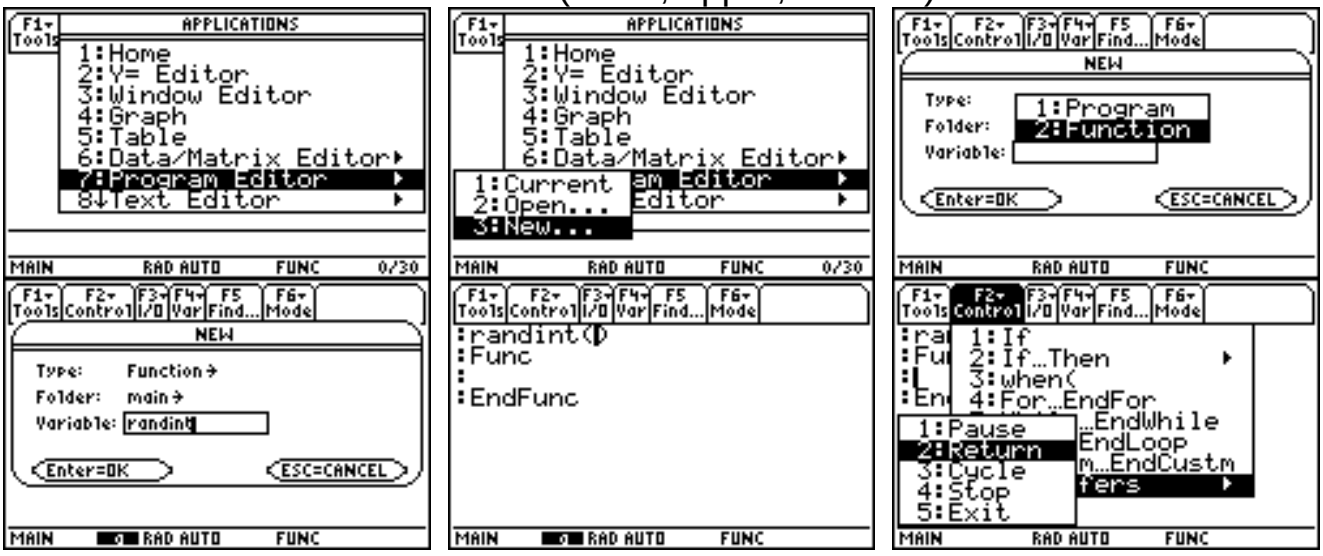
Note that @n1 in the example above represents the first arbitrary integer that has appeared in this session. To evaluate some of the answers, highlight and paste the answer in the entry line and use the with **|** operator (row 7, column A) to assign a list of values to @n1. Use ◆ STO to get the @ symbol.

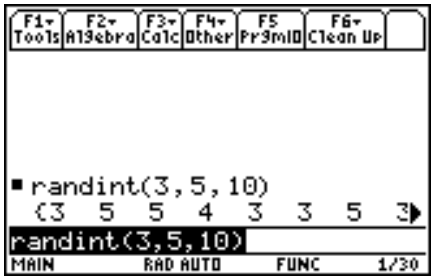
The Solve command returns “false” if no real solutions are found, “true” when solve can determine that any finite real value of variable satisfies the equation or inequality.

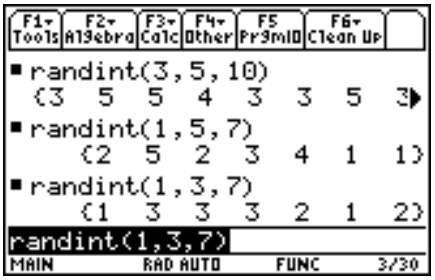


A useful function for simulations.

The function will be called randint(lower, upper, number)

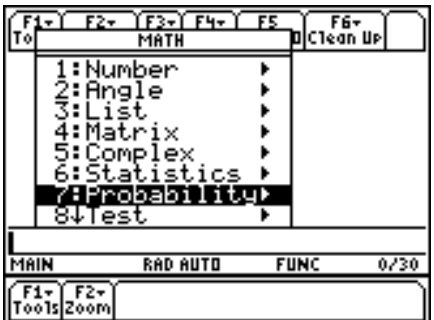


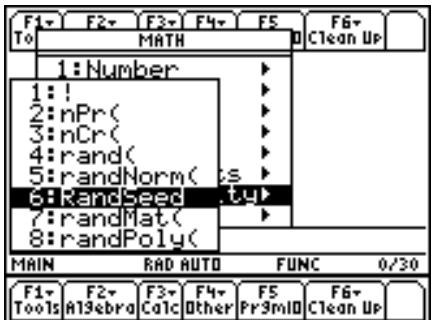


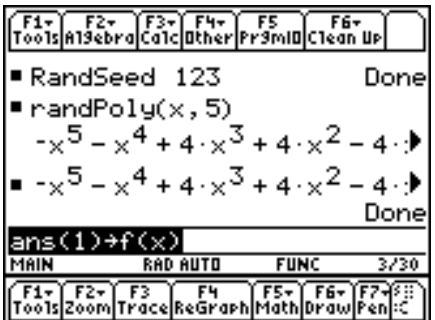


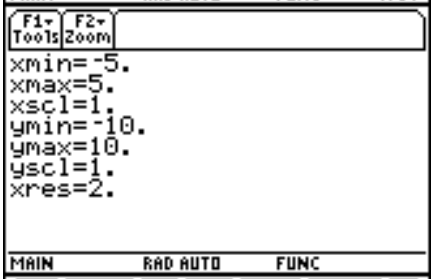
Random Polynomial

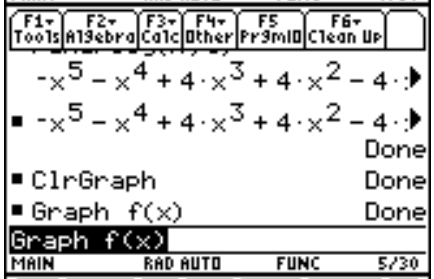
To generate a polynomial with random integer coefficients between -9 and 9, select the MATH key (row 8, column C), then 7:Probability, then 6:RandSeed. After seeding the random number generator, go back to that same menu and choose 8:randPoly(, make the random polynomial of degree 5 in the variable x. The function can then be differentiated. The roots can be found for both the first and second derivative.

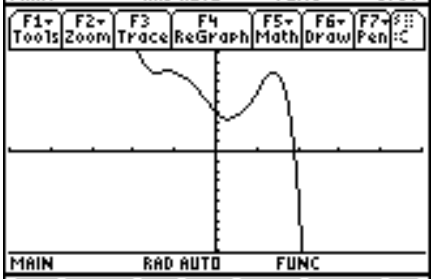


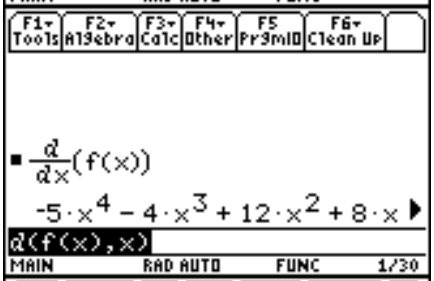


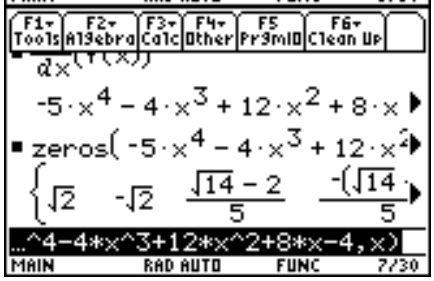


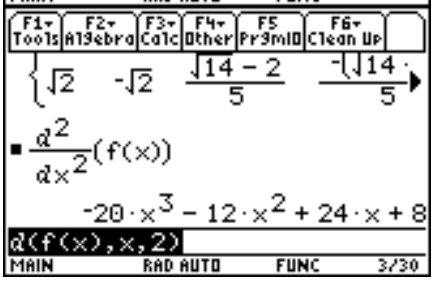


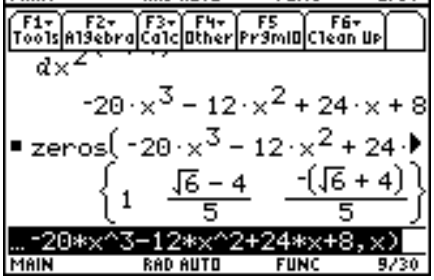




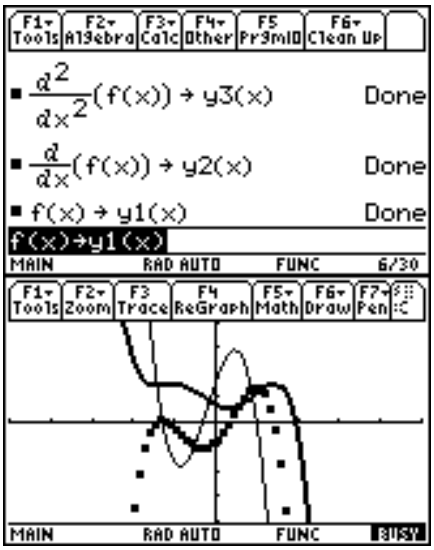


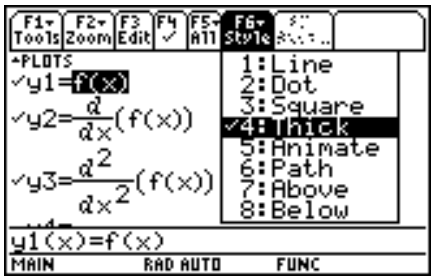


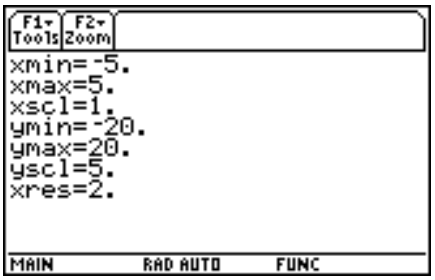




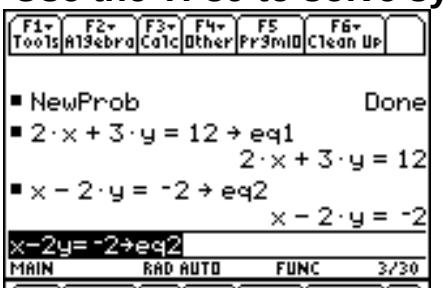
Each of the derivatives may be stored in y2(x), and y3(x). Choose different style to graph the functions.

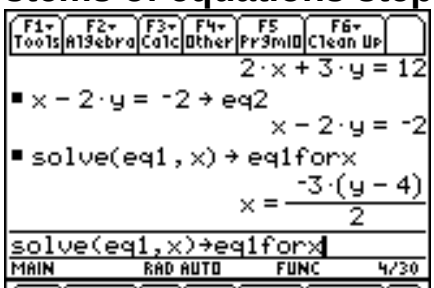


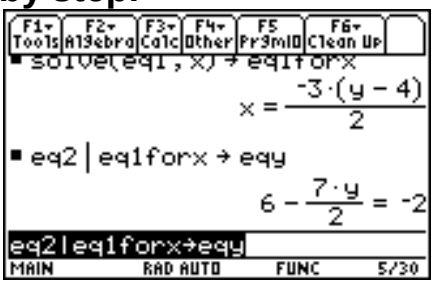


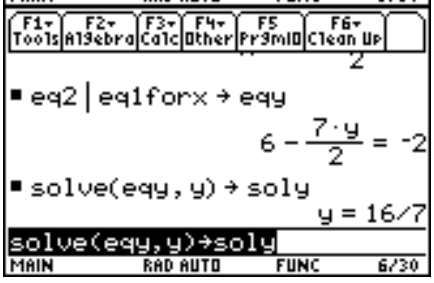


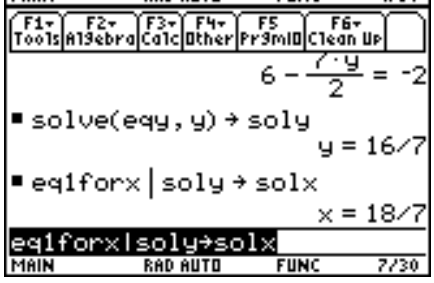
Use the TI-89 to solve systems of equations step by step.



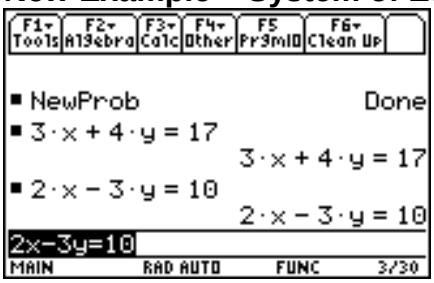


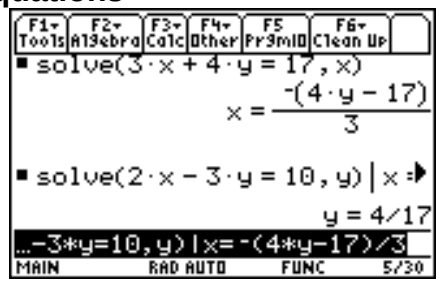


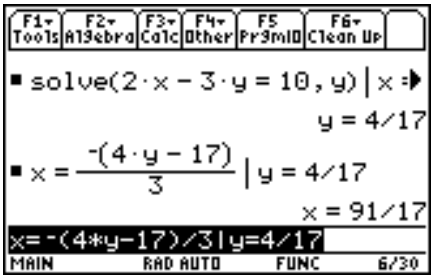


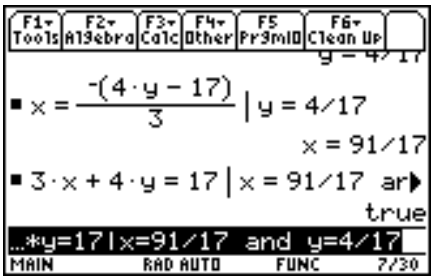


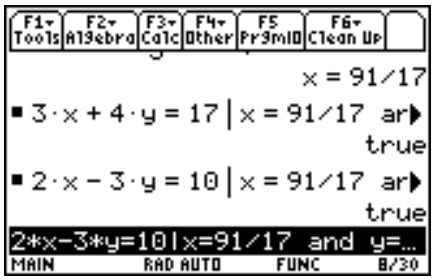
New Example – System of Equations

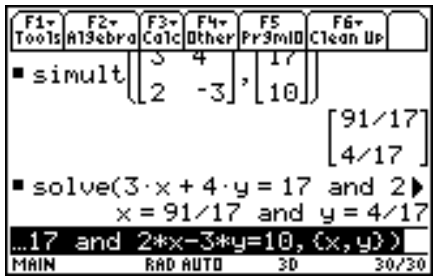






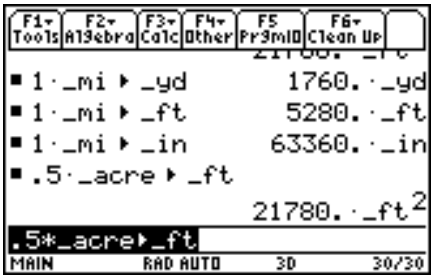


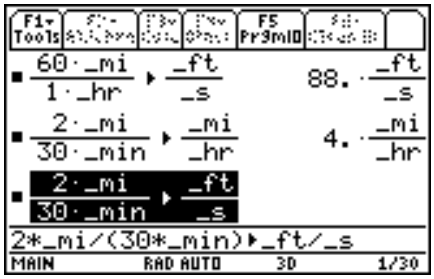


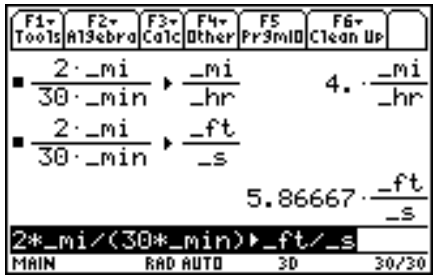


Converting from One Unit to Another

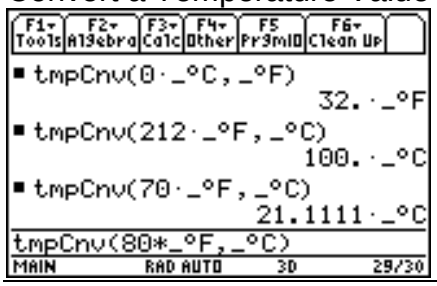
Convert Units of Measure







Convert a Temperature Value



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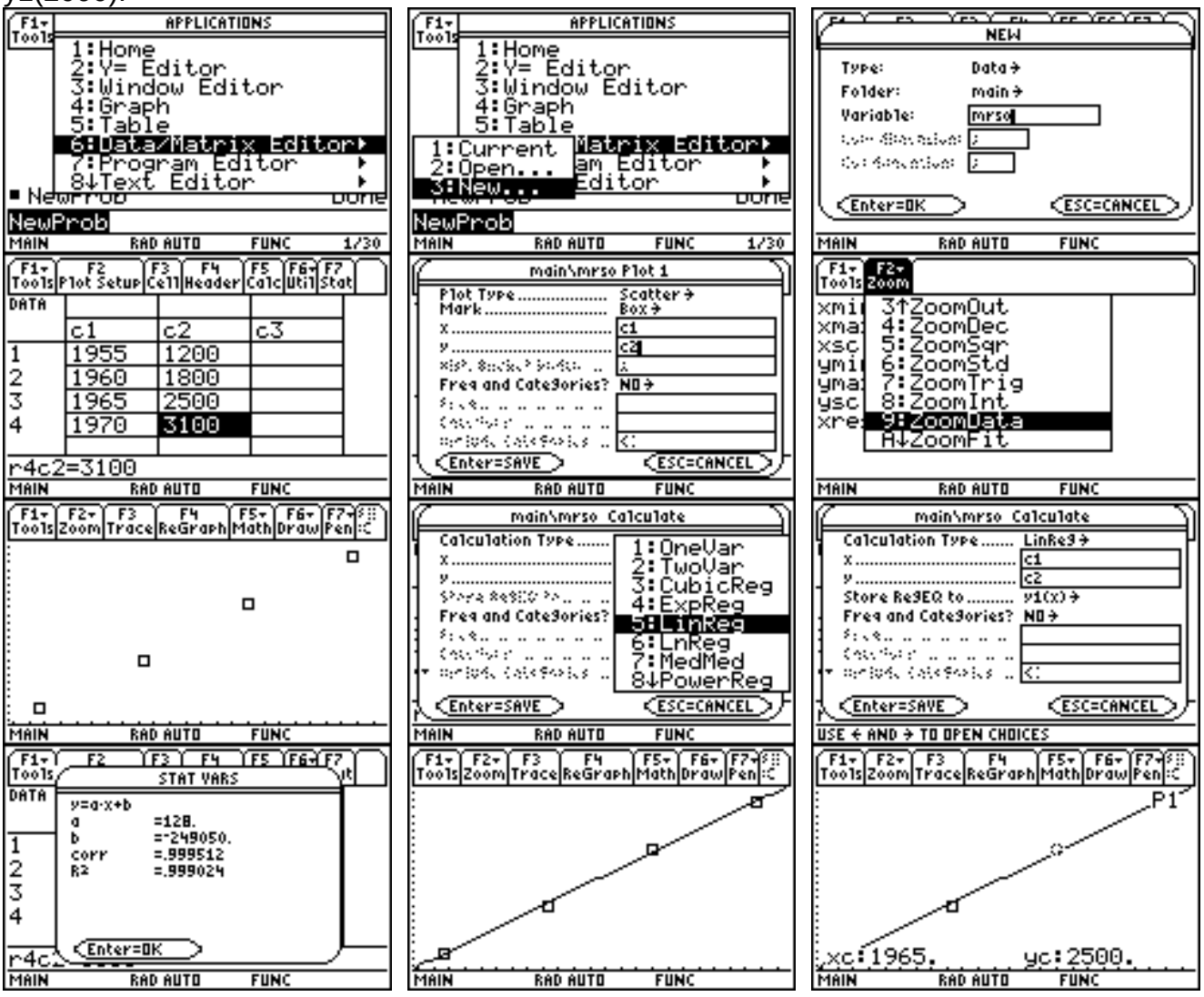
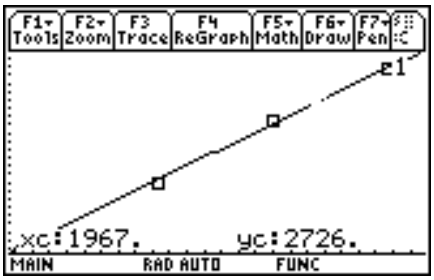
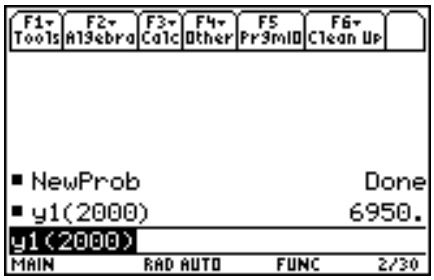
Two Variable Statistics Example:

Mrs. O purchased a item in 1955 for $1200. Its value was $1800 in 1960, $2500 in 1965, and $3100 in 1970. If the value of the item were to appreciate according to the same pattern through 2000, estimate the value of the antique in the year 2000. Input the following data and fit a curve.

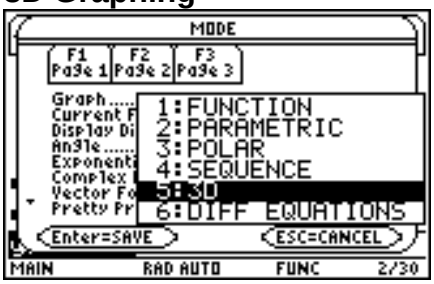
Go to the application key (APPS), choose 6:Data/Matrix Editor, choose 3:New from the submenu. Input the years in c1, input the value of the items in c2. Choose F5:Calc. Under the Calculation Type, choose 5:LinReg. For the x catagory, input c1, use c2 for y. At the Store RegEQ submenu, choose y1(x). Press ENTER to keep all the selections made. Notice the box with the regression equation and the correlation coefficient. Press F2 Plot Setup, then press F1 Define. Choose Scatter for Plot Type; Cross for Mark; c1 for x, and c2 for y. Press ENTER. Make sure all other plots are turned off as well as all functions, other than y1(x). Choose 9:ZoomData from F2 Zoom menu. To find the value in year 2000, use y1(2000).

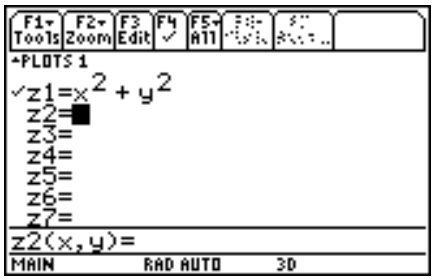


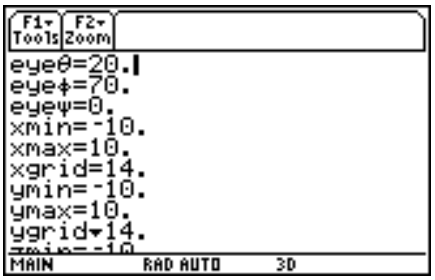




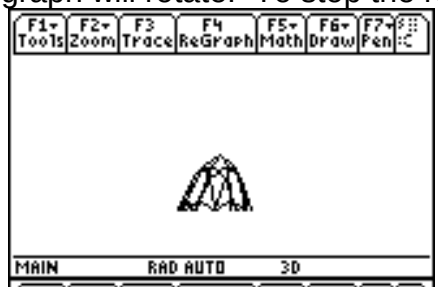
3D Graphing

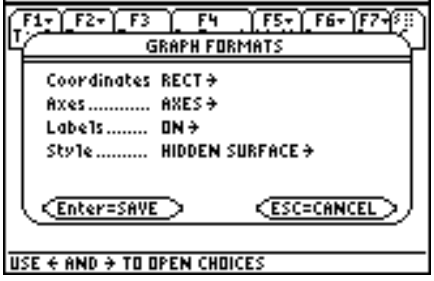


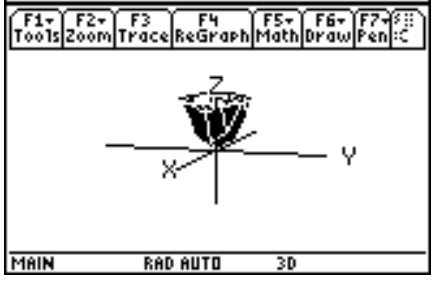




By moving the arrow keys, the graph will rotate. To stop the rotation, press ENTER.



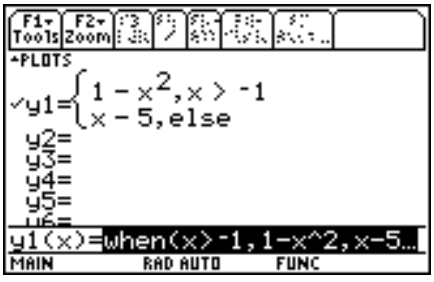


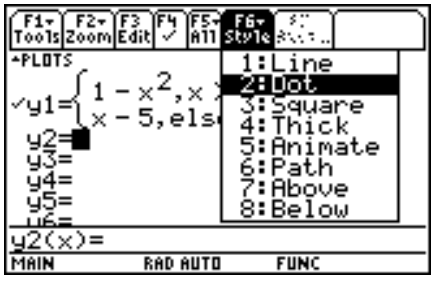


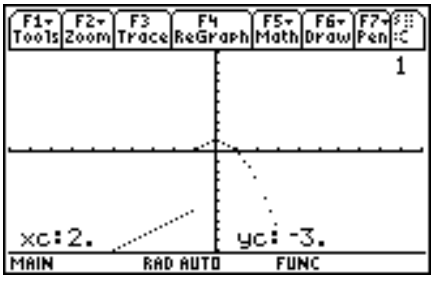
OTHER GRAPHING TECHNIQUES

Piecewise Functions:

Graph: $f(x)=\begin{cases} 1-x^2 & x>-1 \\ x-5 & \text{otherwise} \end{cases}$

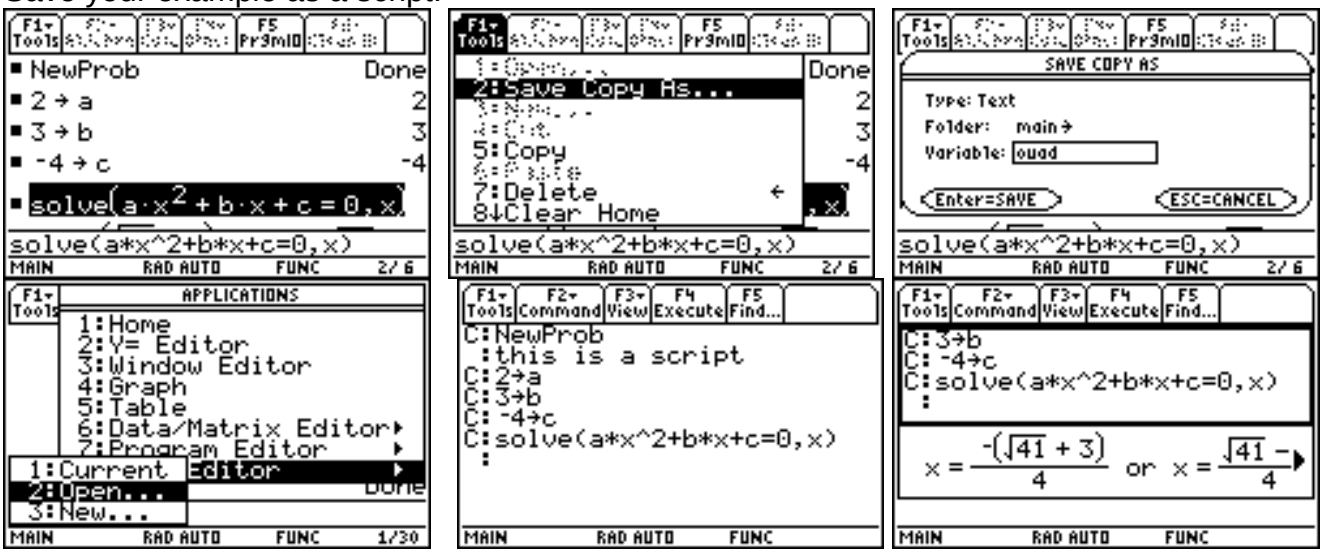






Script Using the Text Editor

Save your example as a script.



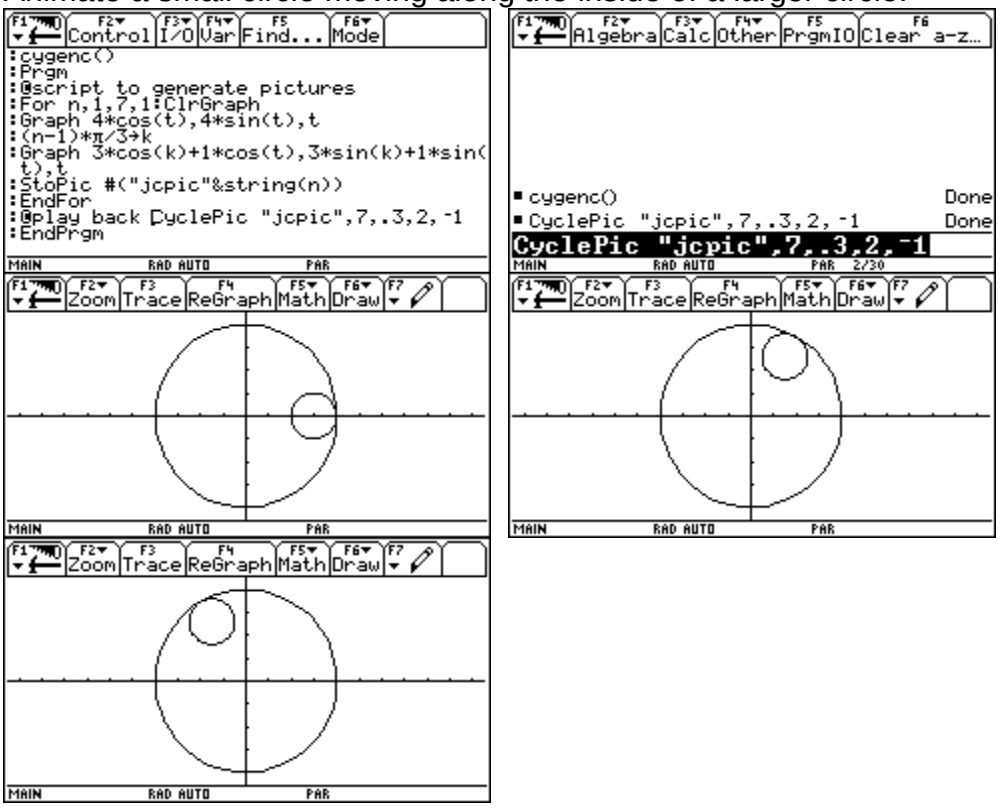
If you are starting on the script page: Press the APPS key and choose 9:Text Editor, then 3:New.

Use F2 to generate a command line and Enter to generate a comment line. Press F3 to view the Script. Press F4 to execute each line in the script one a time.

Use F3 to clear the split screen.

Animation

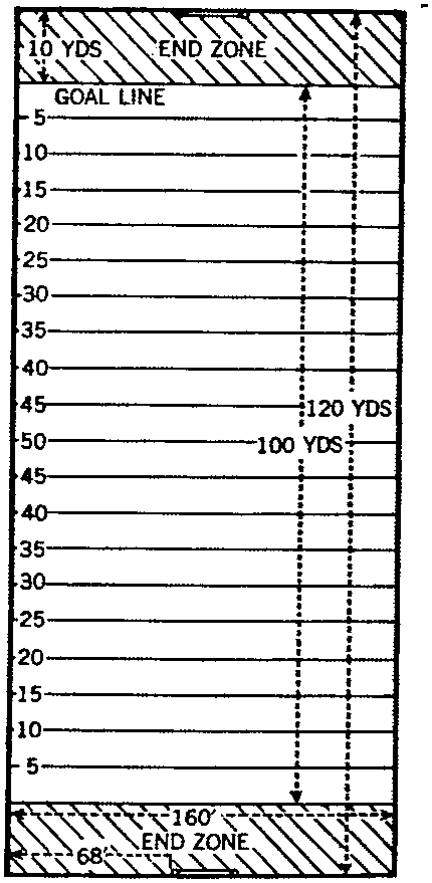
Animate a small circle moving along the inside of a larger circle.



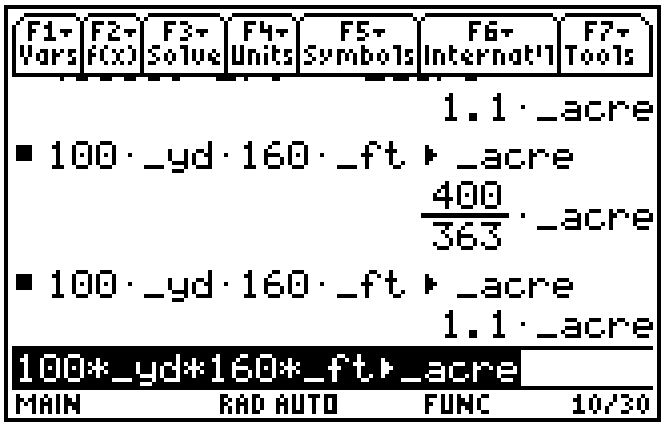
How Big is an Acre?

Note: 1 acre = 43560 sq. ft.

Is an Intercollegiate football field larger or smaller than an acre?



Random House Dictionary 2nd Edition,1987



Transformations on the TI-89

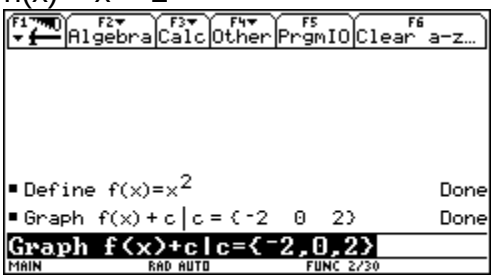
This is a lab to be completed using your TI-89. On a separate paper, answer the questions in complete sentences and draw the graphs neatly. Be sure to number your answers.

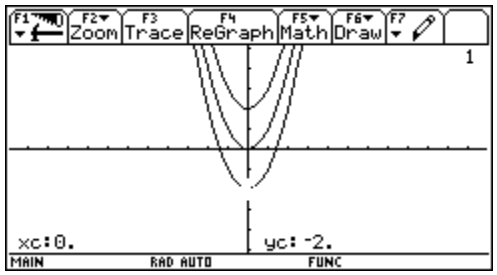
Part A: On the same axis, graph the following functions on your TI-89:

$f(x) = x^2$

$g(x) = x^2 + 2$

$h(x) = x^2 - 2$





1. Describe what happens to a graph when a basic function, f(x) has a positive constant added to it, i.e., f(x) + c.

2. Describe what happens to a graph when a basic function, f(x) has a positive constant subtracted from it, i.e., f(x) - c.

3. Without using your calculator, predict what your sketch of the graph $y = x^2 + 4$ would look like. Draw the graph using a pencil and paper.

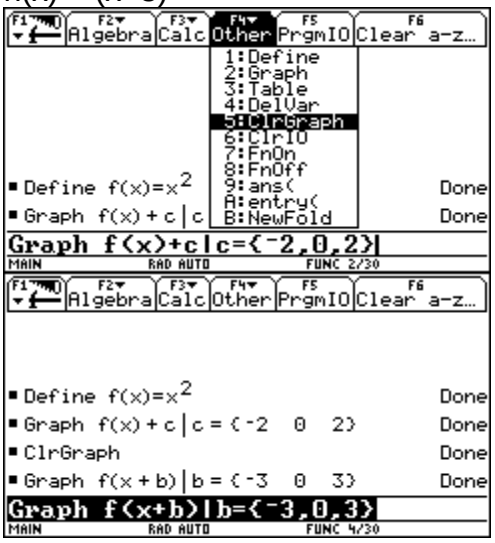
4. Without using your calculator, predict what your sketch of the graph $y = x^2 - 4$ would look like. Draw the graph using a pencil and paper.

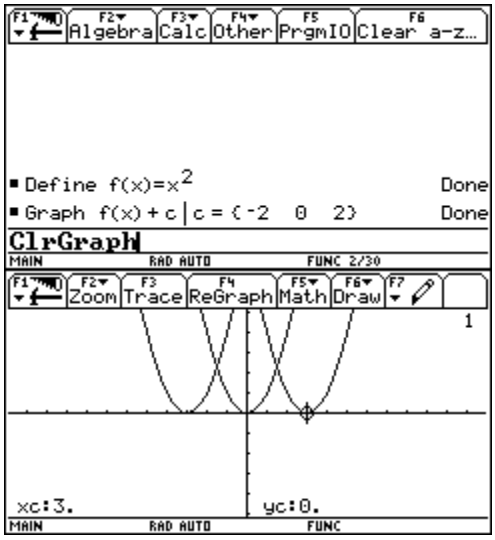
Part B: On the same axis, graph the following functions on the TI-89:

$f(x) = x^2$

$g(x) = (x-3)^2$

$h(x) = (x+3)^2$



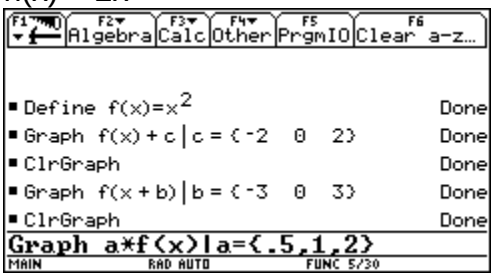


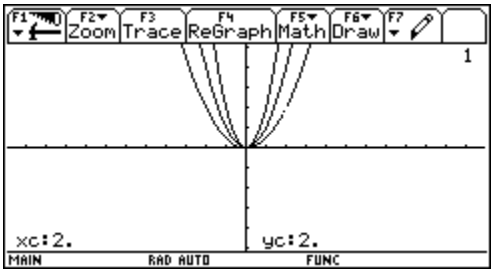
5. Describe what happens to a graph when the argument of a basic function, the x of the f(x) has a positive constant added to it, i.e., f(x + b).
6. Describe what happens to a graph when the argument of a basic function, the x of the f(x) has a positive constant subtracted from it, i.e., f(x - b).

7. Without using your calculator, predict what your sketch of the graph $y = (x + 4)^2$ would look like. Draw the graph using a pencil and paper.

8. Without using your calculator, predict what your sketch of the graph $y = (x - 4)^2$ would look like. Draw the graph using a pencil and paper.

Part C: On the same axis, graph the following functions on the TI-89:
$f(x) = .5x^2$
$g(x) = x^2$
$h(x) = 2x^2$





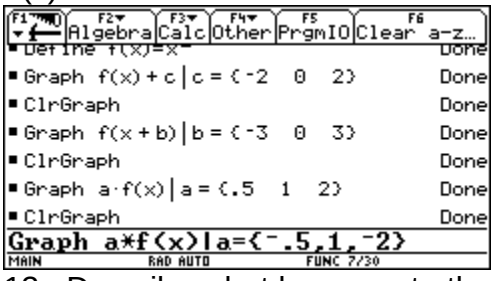
9. Describe what happens to the graph of a function when the function is multiplied by a positive constant greater than 1, i.e., a*f(x).

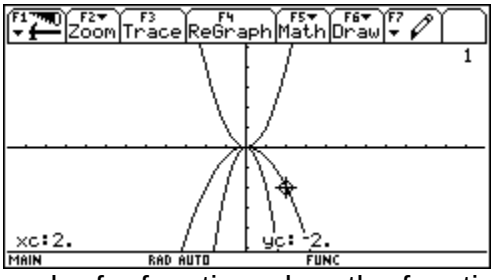
10. Describe what happens to the graph of a function when the function is multiplied by a positive constant less than 1, i.e., a*f(x).

11. Without using your calculator, predict what your sketch of the graph $y = 4x^2$ would look like. Draw the graph using a pencil and paper.

12. Without using your calculator, predict what your sketch of the graph $y = .25x^2$ would look like. Draw the graph using a pencil and paper.

Part D: On the same axis, graph the following functions on the TI-89:
$f(x) = -.5x^2$
$g(x) = x^2$
$h(x) = -2x^2$

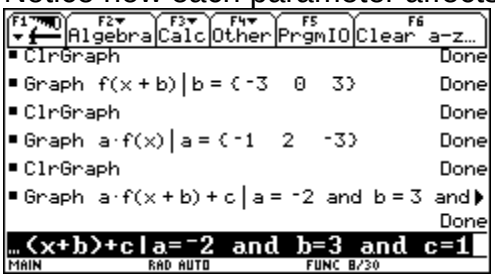


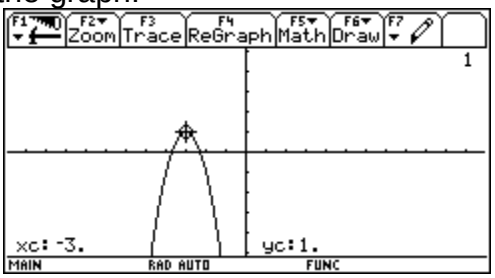


13. Describe what happens to the graph of a function when the function is multiplied by a negative constant, i.e., a*f(x).

14. Without using your calculator, predict what your sketch of the graph $y = -4x^2$ would look like. Draw the graph using a pencil and paper.

Part D: Use the general form of a function a*f(x + b) + c, and let a = -2, b= 3 and c = 1. Notice how each parameter affects the graph.





15. Now go back and make the original f(x) = abs (x). Display the graphs of

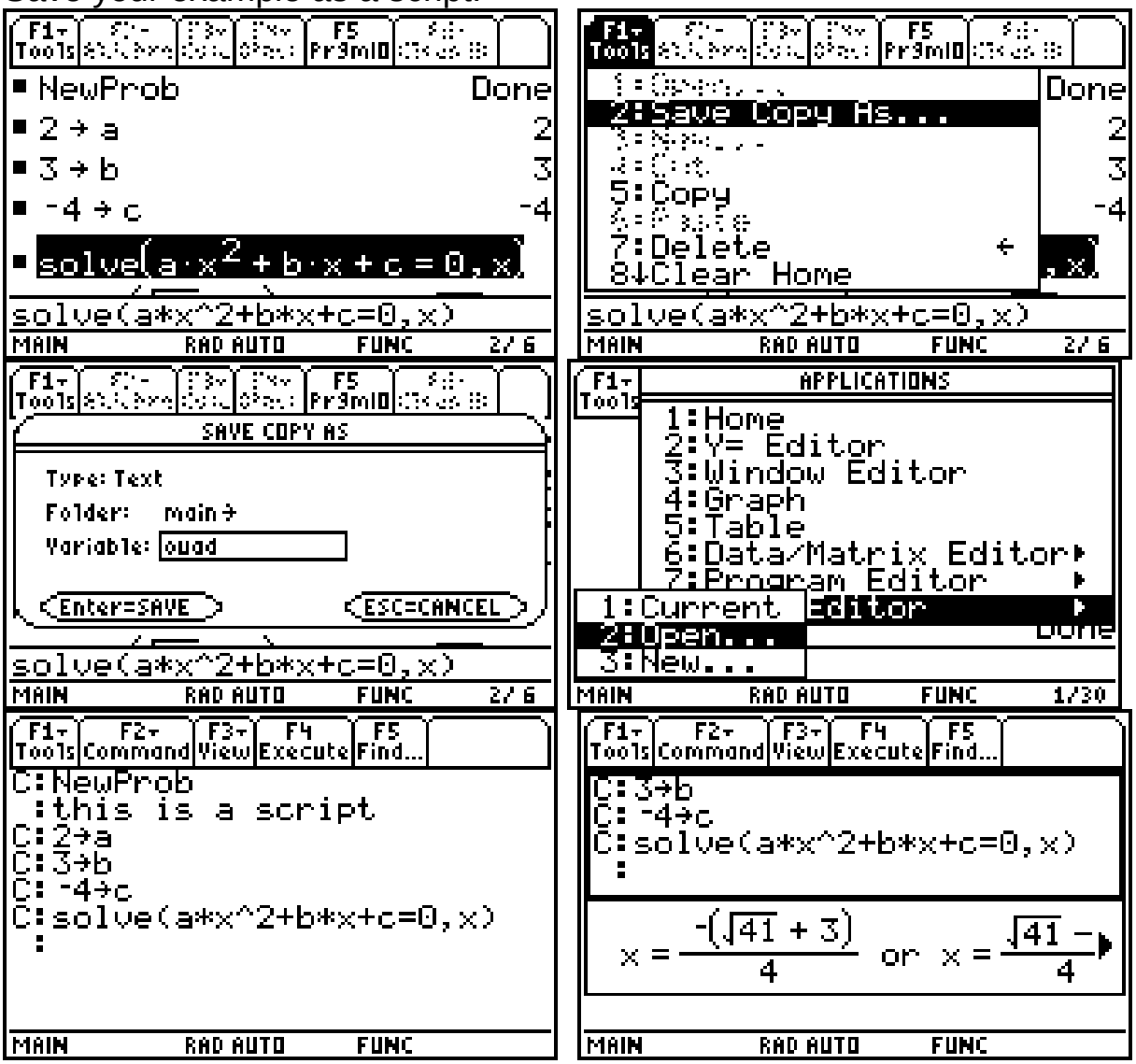
a) f(x + 2)
b) f(x) + 3
c) 4 * f(x)
d) .25 * f(x)
e) -f(x)

16. Now go back and make the original $f(x) = x^3$. Display the graphs of

a) f(x + 2)
b) f(x) + 3
c) 4 * f(x)
d) .25 * f(x)
e) -f(x)

Script Using the Text Editor

Save your example as a script.



If you are starting on the script page: Press the APPS key and choose 9:Text Editor, then 3:New.

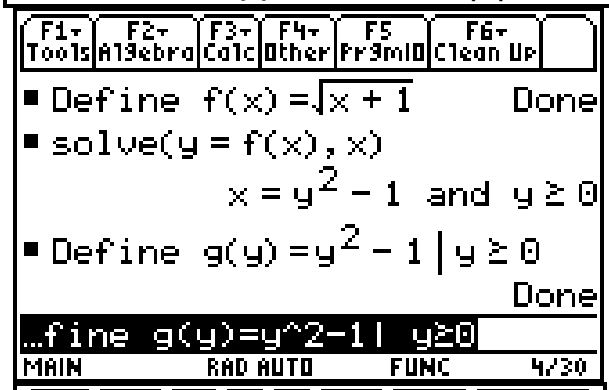
Use F2 to generate a command line and Enter to generate a comment line.

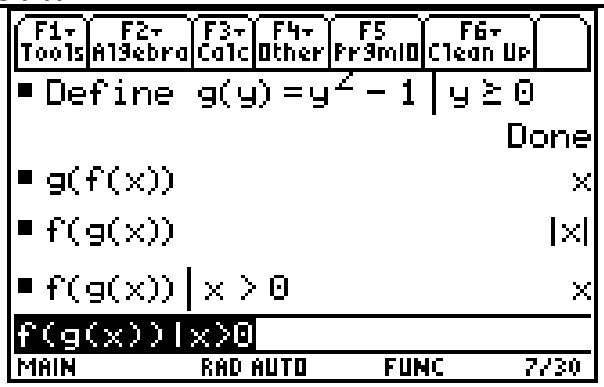
Press F3 to view the Script. Press F4 to execute each line in the script one a time.

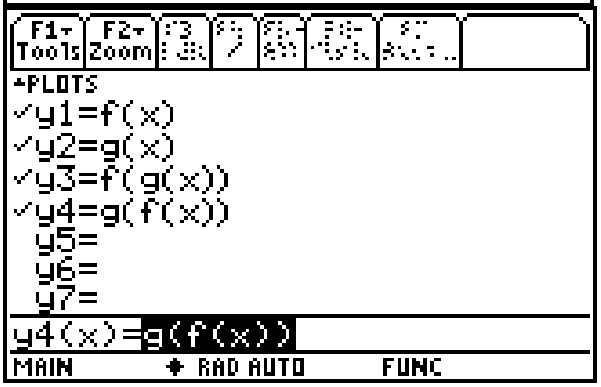
Use F3 to clear the split screen.

Inverse Functions

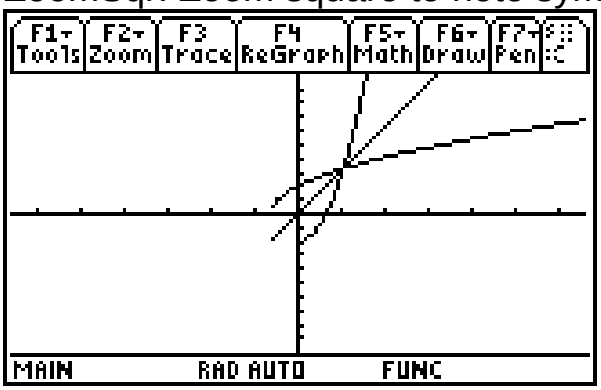
Define f(x). Solve y=f(x) for x. Define g(y). Interchange x and y by writing g(x).
Check using composition of functions.
Discuss the appearance of |x| in the f(g(x))







ZoomSqr. Zoom square to note symmetry about the line y=x.



Try a second function. $f(x) = \frac{1}{2x+1}$ $f(x) = x^2$