



## Using a Scientific Calculator

## Hardware on the TI-89

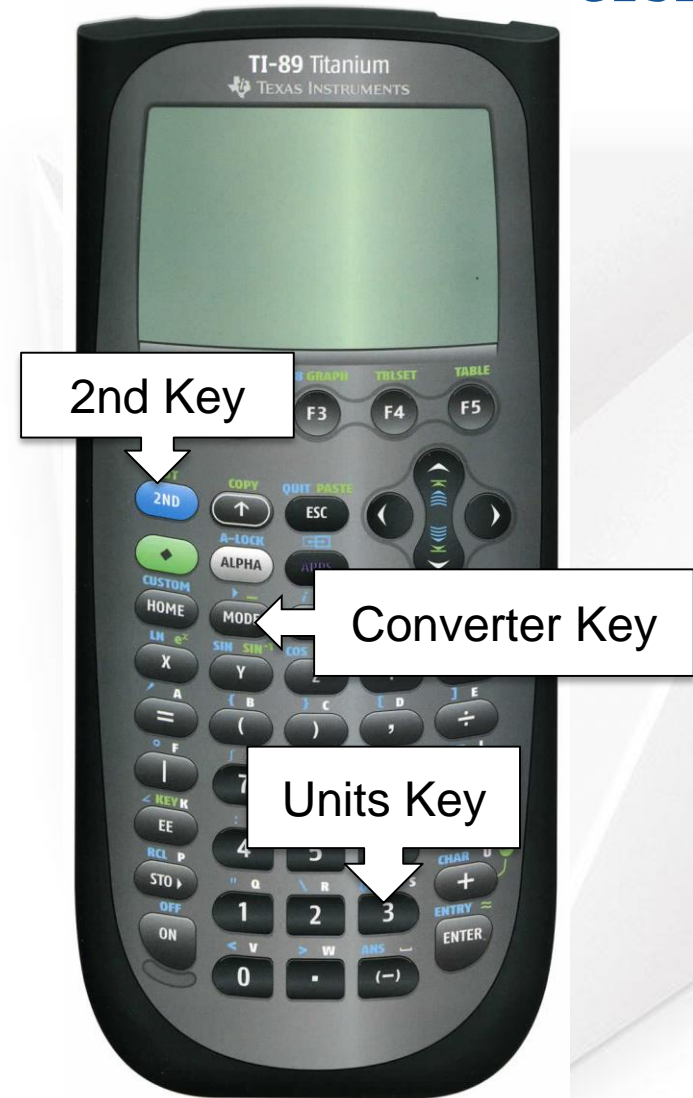
- **How much memory does the TI 89 have?**
  - The TI-89 has 188k of RAM and 384k of memory that can be used for archiving programs, making a total memory of 572k
- **How large is the TI-89's screen?**
  - The TI-89's screen is 160x100 pixels

## Hardware on the TI-89

- **What type of processor does the TI-89 have?**
  - The TI-89, like the TI-92 and TI-92 Plus, uses a 68k Motorola processor.
  - The processors are 10 MHz.
  - On TI-89 Titanium they are 12 MHz.
  - You can double the speed of the TI-89 by over clocking.
  - Information about this is located at the TI-89 Acceleration Pages.
    - *Note: this is a risky process that could potentially damage your calculator.*

# Unit Conversion

- **Step 1** Type in the number you wish to convert. Then press the blue 2nd key followed by the blue Units key (the #3 on your keypad).
- **Step 2** A list will pop up. Scroll down to select the category for your unit, then use the right arrow key and the down/up keys to make your selection.
- **Step 3** Here we wish to convert 3 ft to meters. This is a unit of length, so the Length category has been selected, and ft has been chosen for our original unit. (Note, you may also type in the unit if you know the abbreviation).
- **Step 4** To convert the units, press the 2nd key again and then the convert key (the blue triangle pointing to the right, above the Mode key).



# Converting Decimals to Fractions

- **Step 1** Input a decimal you wish to see as a fraction such as:  
.56
- **Step 2** Hit MODE and scroll down to Exact/Approx and hit Exact. The screen will come back to your home screen and the number you wanted to change to fraction will be in the input bar.
- **Step 3** Hit enter and the screen should come up with something like this:

.56 4/25

# Converting Fractions to Decimals

- **Step 1** Input fraction in home input bar.
- **Step 2** Hit MODE and scroll down to Exact/Approx and hit Approx. The screen will come back to your home screen and the number you wanted to convert to decimal will be in the input bar.
- **Step 3** Hit enter and the screen will come up with:

14/ 25    .56

# Selecting the Correct Exponential Format

There are 3 different modes in the TI 89 calculator.

- The first one is Normal this means that:

$$\begin{array}{r} 34.2 \\ + 34.5 \\ \hline 68.7 \end{array}$$

- The next selectable mode is Scientific. This means that:

$$\begin{array}{r} 34.2 \\ + 34.5 \\ \hline 6.87e1 \end{array}$$

- The last mode is Engineering. This means that:

$$\begin{array}{r} 34.2 \\ + 34.5 \\ \hline 68.7e0 \end{array}$$

# How to Convert Decimal to Binary to Hexadecimal

- **Step 1** Go into your MODE and scroll down until you reach Exact/Approx and change it to Exact.
- **Step 2** Type in what you would like to convert to binary such as 455 in the address box at the bottom of the main screen.
- **Step 3** Hit the blue 2<sup>nd</sup> and the number 5. This will take you to the MATH menu.
- **Step 4** Find the Base and hit the >. This will take you to another screen.
- **Step 5** Hit 4 for Binary. You will return to the home screen with the number you wanted converted with a > Bin. It will appear as 455 >Bin.
- **Step 6** Hit enter to display your decimal number in Binary format.



# Using the Solve Function

This function will allow you to solve for a specific variable. For example, solve for:  $3x^3-2x*y+3y=2$

- **Step 1** On your home screen press F2 and then press 1 or enter.
- **Step 2** Enter in the equation after solve as:  
 $\text{solve}(3x^3-2x*y+3y=2,y)$
- **Step 3** Press enter and it will solve for y.

You can also solve for a system of equations using the solve function. For example:  $3x-5y=4$  and  $-2x+5y=6$

- **Step 1** On your home screen press F2 and then press 1 or enter .
- **Step 2** Enter in the equation after solve as so:  $\text{solve}(3x-5y=4$   
and  $-2x+5y=6, \{x,y\})$ . \*You can access the word and by  
pressing 2<sup>ND</sup> , 5, 8, 8.
- **Step 3** Press enter and it will solve for x and y.

# Systems of Equations and Matrices

Like the solve function, you can use the matrix function to solve for a system of equations. For example:

$$3x-5y=4 \text{ and } -2x+5y=6$$

- **Step 1** Press 2<sup>nd</sup> 5(MATH), 4(Matrix), and then 5(simult).
- **Step 2** Enter the coefficients as a matrix and the results as a constant column matrix as so: `simult([3,-5;-2,5],[4;6])`
- **Step 3** Press enter. The value for  $x$  on top and  $y$  on bottom.

Using the same equations, you can solve for  $x$  and  $y$  using the rref function.

- **Step 1** Press 2<sup>nd</sup> 5(MATH), 4(Matrix), and then 4(rref).
- **Step 2** Enter an augmented matrix, this contains the variables  $x$ ,  $y$ , and  $c$  where  $c$  is the constant. It should look like this: `rref([3,-5,4;-2,5,6])`
- **Step 3** Press enter;  $x$  is on top,  $y$  is on bottom.

## Example: Factor $x^2-6x+5$

- **Step 1** On your home screen press F2 and then press 2.
- **Step 2** Enter in the expression as so: `factor(x^2-6x+5)`.
- **Step 3** Press enter. The solution comes up as two expressions.

## Complex Factoring Example: $x^2+1$

- **Step 1** On your home screen press F2 and then arrow down to A:Complex. Arrow to the right and select 2:cFactor.
- **Step 2** Enter in the expression as so: `cFactor(x^2+1)`.
- **Step 3** Press enter. The solution comes up as two expressions.

# Working with Graphs Zoom Menu

## Using ZoomBox

Start with a function that we can graph:  $X^3-(x/4)$

- **Step 1** To get to the “Y=” screen from the home screen, press F1 and the “Y=” screen will appear.
- **Step 2** Enter in the function as :  $Y= X^3-(x/4)$
- **Step 3** Press F2 and then 4:ZoomDec. This will graph the function.
- **Step 4** Press F2 and then 1:ZoomBox.
- **Step 5** A cursor will appear. Drag the cursor up and to the left of the area you want to zoom in on. The cursor will create the top left corner of the rectangle to be zoomed in on. Press enter after selecting where you want the rectangle positioned.
- **Step 6** Drag the cursor down and you will see the rectangle form. Drag it to cover the area to zoom in upon. Then press enter. The calculator will then resize the graph and display the selected zoomed in area.
- If you want to return to the original graph; press F2 and scroll down to B:Memory and select 1ZoomPrev.

## ZoomSqr:

This application will redraw the graph by adjusting xmin and xmax so that the tic marks are equal in distance on both axes. This is useful when you need to see an accurate shape, such as a circle.

For example, graph the circle  $x^2+y^2=25$ .

- **Step 1** Enter in the functions as so:  
 $y1=\sqrt{25-x^2}$  and  $y2=-\sqrt{25-x^2}$ .
- **Step 2** Press F2 and then press 6:ZoomStd. This will create an oval shaped graph.
- **Step 3** For a more circular result, go back to the “Y=” screen, press F2, and then press 5:ZoomSqr.

The command that will let you solve first and second order differential equations is deSolve.

First order example:  $y' = y + x^2$

- **Step 1** To enter in deSolve, press F3. Continue down until you reach “C:deSolve.”
  - Press enter and it will appear on the home screen.
- **Step 2** Enter in the equation as: deSolve ( $y' = y + x^2, x, y$ ). Press enter.
- **Step 3** The answer given is the general solution  $y = @1 * e^x - x^2 - 2x - 2$ . Thus @1 stands for an arbitrary parameter (that we usually write as c or c1.)

Using this command will allow you to find the zeros of any function, so long as they exist.

Example:  $Y = x^4 - 4x^2$

- **Step 1** Press 2<sup>nd</sup> then MATH (button #5). Next scroll down to the algebra tab in the calculator or press (button #9).
- **Step 2** Select the function zeros (Enter the equation  $\text{zeros}(x^4 - 4x^2, x)$  it must have the  $(,x)$  at the end or else it will not work properly.
- The result are given in values of x and equal  $(-2, 0, 2)$ .

## Quick Algebra Solutions (cont.)

Factoring and expanded form are two methods used in all levels of algebra and calculus.

**Factoring :  $y = x^3 - 16x^2 - 4x + 64$**

- **Step 1** Press 2<sup>nd</sup> then MATH (button #5). Scroll down to the algebra tab in the calculator or press button #2.
- **Step 2** Select factor and enter equation.

The result will be the same as the equation in expanding since these two cancel out:  $(x-2)(x+2)(x-16)$

**Expanding:  $y = (x-2)(x+2)(x-16)$**

- **Step 1** Press 2<sup>nd</sup> then MATH (button #5). Next scroll down to the algebra tab in the calculator or press (button #3)
- **Step 2** Select expand and enter the equation

The result will be:  $x^3 - 16x^2 - 4x + 64$



# Using Polar Form

Polar format is the vector form with an angle in degrees. In engineering it determines the values of capacitive reactance and inductive reactance.

**Example:  $Y = 400 + 500j$**

(Note: engineers use  $j$  instead of  $i$  as the imaginary number, but it is  $i$  on the calculator)

- **Step 1** Change the mode to polar output by going into the mode menu and scroll down to the complex vector and press enter then choose polar.
- **Step 2** Enter the equation (can be in either polar or rectangle form)

The rectangular input will be converted to a polar output if the calculator is in polar output mode.

The result will be ( $40 \times \text{square root of } 2$  at a angle of 45 degrees)

# Rectangular Form

A with polar, rectangular form is giving the dimensions of a vector, but by breaking the vector into two parts a  $y$  component and an  $x$  component.

$Y = 35$  at an angle of 30 degrees

- **Step 1** Change the mode to rectangular output by going into the mode menu and scroll down to the complex vector and press enter then choose rectangle
- **Step 2** Enter the equation (can be in either polar or rectangle form)
- The results will be:

$$((35 * \text{square root of } 3) + 35) / 2 = 30.311 + 17.5j$$

# Graphing in a TI-89 Calculator

- **Step 1** Make sure that your equation is in Y intercept form.
  - For example:  $Y=5X-3$
- **Step 2** Press the yellow button then press F1. Then insert your equation and press enter.
- **Step 3** Press the yellow button then press F3.

**Option 1** Press the yellow button and F2. Manually input the values.

- Make sure that  $X_{min} < X_{max}$  and  $Y_{min} < Y_{max}$

**Option 2** Press yellow button then press F3. After that press F2 and a menu pops up.

- If you want your window to standard mode press 6.
- If you have an equation that does not fit in the screen, scroll down and highlight ZoomFit then press enter.

# Finding your Zeros

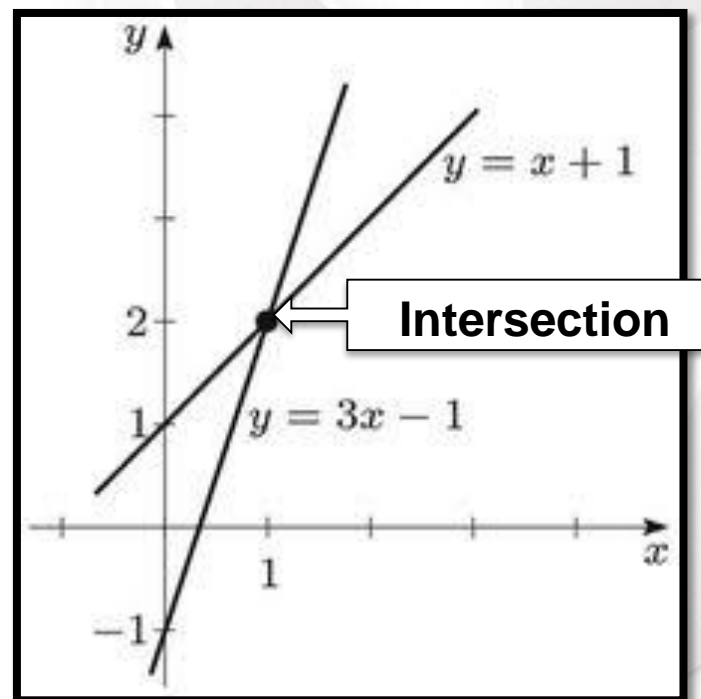
- **Step 1** Type in your equation in the  $y1=$  section.
- **Step 2** Graph your function.
- **Step 3** Press F5 then 2.
- **Step 4** Go to the left of the X-axis and press enter then go to the right of the X-axis and press enter.
- **Step 5** Your answer is in the number beside xc:
  - This does not give you any imaginary roots

# ***Minimum and Maximum***

- **Step 1** Graph a parabola
- **Step 2** Press F5 then choose minimum or maximum
- **Step 3** Go to the left, then to the right of the minimum or maximum.
  - Press enter.
  - Go to the right of it and press enter.
- **Step 4** Your answer is beside xc:

# How to Find the Intersection of Two Lines

- **Step 1** Enter the first equation in  $y1=$  and the second equation in  $y2=$
- **Step 2** Graph the equations.
- **Step 3** Press F5 then press 5.
- Then press enter 2 times.
- Go to the left of the intersecting point and press enter.



# ***Finding the Area Under a Function***

- **Step 1** Type in your function
- **Step 2** Press F5 then press 7
- **Step 3** Look for the lower value
  - Press enter
  - Look for the greater value
  - Press enter.





# Helpful Links for TI 89

- [TI-89 Titanium / Voyage™ 200 Guidebook](#)
- [Using the TI-89 Graphing Calculator](#)
- [Software, OS Updates and Apps](#)

