

Some of the following commands appear differently or are not available on the very old 81 and 82 models.

[ON] is in the lower left corner. [Off] is [2nd][ON]. [2nd] is the yellow key in the upper left corner.

If your batteries get weak and you cannot read the screen, press [2nd] and hold UP ARROW to darken the display. [2nd] DOWN ARROW lightens the display.

The two-line display is very useful.

Ex: Apply the quadratic formula to $3x^2 + 13x - 7$ to find its zeroes. You should type this into the TI-83 as

$$(-13 + \sqrt{(13^2 - 4*3*-7)})/(2*3) = 0.4843$$

The short raised minus indicates **negative numbers**. It is entered using the gray key [(-)] on the bottom row. [$\sqrt{\quad}$] is [2nd][x²]. **Subtraction** is indicated by the long minus sign, i.e. the blue key [-] on the right side. You need to understand why all the parentheses are necessary in the formula above.

To execute a command line like this, press [ENTER]. To find the second root, press [2nd][ENTER] to use the **ENTRY** feature, which will recall the previous command line. Use the ARROW keys to move the cursor over the + and type [-] to indicate subtraction. The second root is -4.8176.

Editing a line with errors can be done similarly, either before or after you execute the command line. Recall the line, if necessary, with [2nd][ENTER]. The **DELe** key is left of the ARROW keys. To **INS**ert characters instead of overwriting, position the cursor and press [2nd][DEL]. You can return to the default **over**write mode by using an arrow key.

The **square** key is in the left column, and its second feature is **square root**. Other **exponents** need to be expressed with the circumflex or 'hat' key, [^], e.g. 2^3. A feature for other roots can be found under the [MATH] key, but it is easier to express them using fractional exponents. So $\sqrt[3]{7}$, which is $7^{1/3}$, would be entered as 7^(1/3). Understand that the parentheses in 7^(1/3) are necessary.

ANS is a variable containing the value of the last command executed. You can access it as [2nd][(-)].

Ex 1: Execute 2 + 3 to get 5. Then press [\div][7][ENTER]. You see Ans / 7, because the calculator recognizes that [\div] requires an argument preceding it, and assumes you are continuing the previous calculation.

To calculate the square root of that result with minimal typing and maximum accuracy, type

$$[2^{\text{nd}}][x^2][2^{\text{nd}}][(-)][]]$$

to produce the command $\sqrt{(\text{Ans})}$. Execute the command.

Preserving full precision in your calculations is important. You should never round until the last step of a sequence of calculations.

The home screen we have been viewing is a place in the calculator's memory. We are about to leave it, but it will not be erased. We can always **return to the home screen from another screen by the [QUIT] operation**,

i.e. [2nd] [MODE]. The [MODE] key is next to [2nd].

To graph a function like $y = -0.01x^4 + 3.5x - 3$, first press the blue key [Y=] in the top row and type the function definition into the line Y₁= . Remember how to type exponents, and be careful to use the correct minus sign. Use the key [X,T,θ,n] for X.

Next press [ZOOM] in the top row and select **6:ZStandard** to see this graph. To see the consequence of the standard zoom, press [WINDOW] in the top row. Both X and Y range from -10 to 10 and we have tick marks every 1 unit along the axes, as indicated by Xscale=1 and Yscale=1. The variable Xres is irrelevant for us.

You will need to adjust the window appropriately for different functions. This can be complicated and will sometimes test your mathematical understanding of the function at hand.

The CALCulate menu, accessed by [2nd] [TRACE] in the top row, contains several frequently used functions which interact with the graphing feature.

Ex 2: Suppose the function above is the profit (in millions of dollars) of a company as a function of its production level (in thousands of tons). The break-even production levels are the zeroes of the function. To find them, access the **CALCulate** menu and select **2:zero**.

This calls a numerical approximation method that needs three things: a left bound on the x-coordinate of the zero, a right bound on that x-coordinate, and an initial estimate, or 'guess' between those bounds.

To find the leftmost x-intercept, use the LEFT/RIGHT ARROW keys to position the cursor left of that point on the curve. Press [ENTER] to confirm that as a left bound. When the procedure asks for a right bound, position the cursor right of that zero. Understand that the Y-value must have different signs at these bounds. Finally, press [ENTER] to use the last bound as the initial guess. The zero is approximately 0.8586.

Repeat the procedure for the other zero, which is approximately 6.7346.

Intersecting curves is a little different. You need to specify two curves that intersect between the window limits Xmin and Xmax, and specify an initial guess.

Ex 3: In the example above, to find the production levels which keep profits above 5 million dollars, enter Y₂=5 and [GRAPH] the functions. On the CALC menu, select **5:intersect**. Press [ENTER] twice to confirm the two curves we want to intersect. (Read the screen as you do this, so you understand what you are telling the calculator.)

Position the cursor near one of the intersections and press [ENTER] to make that X-value the initial guess, and press [ENTER]. The intersection is at $X = 2.3769$.

Starting on the CALC menu, repeat the procedure, making sure the initial guess for the second intersection is closer to that intersection than to the first—you do not want to keep returning to the first intersection. $X = 6.0077$ is the approximate value you should find.

If you are familiar with the [TRACE] function, you should forget about using it for test problems. It gives very little precision and you will receive little if any credit for inaccurate answers.

Miscellaneous

Clear a non-empty line by pressing [CLEAR]. On the home screen, if the cursor is on an empty line, pressing [CLEAR] will clear the home screen. You can still use the [ENTRY] feature to recall the previous command line(s). Repeating [2nd] [ENTER] will recall the second last command line, third last, and so on.

STO the value 7.3 as the variable P by executing 7.3 [STO→] [ALPHA] [8]^P. Notice that the variable name P is indicated in teal by the [8] key. Now [ALPHA] [8] produces P, and execution gives its value, 7.3. You can use

[X,T,θ,n] to store values easily in the variable X. Be careful with X, however. Graphing a function will change the values of X, leaving it with the value Xmax. Think about why that is true.

Scientific notation appears in TI calculators as $3.7285E-73$. You need to read such expressions correctly as 3.7285×10^{-73} , though this is not common to any other technology manufacturers. Scientific notation can be entered as such, but it is easier just to type $3.7285 * 10^{-73}$ or $3.7285(10^{-73})$. You should understand that that really is the same thing.

Matrices

Matrix menus for NAMES MATH and EDIT are accessed by pressing [MATRX], which may be [2nd] [x⁻¹]. RightArrow twice to EDIT and press [1] or highlight 1:A and press [ENTER]. Now 2 [ENTER] 3 sets up a 2x3 matrix. That means [A] has 2 rows and 3 columns. Now [ENTER] takes you to $A_{1,1}$ in the upper left corner, as indicated by the command line at the bottom of the screen.

As you press 1 [ENTER] 1 [ENTER] 3 [ENTER] ...you will fill in the entries across the top row of the matrix, then the next row, with the default order left to right, top to bottom, [(-)] 1 [ENTER] 0 [ENTER] 4 [ENTER]

$$\begin{bmatrix} 1 & 1 & 3 \\ -1 & 0 & 4 \end{bmatrix}$$

You can proceed directly to a particular entry with the arrow keys.

After the last entry $A_{2,3}$ is in, and you have pressed [ENTER] to be sure it is really in, QUIT the matrix area. Press [MATRX] and, on the default NAMES menu, select [A] to paste it on the main screen. Press [ENTER] to see it and

verify your entries. Note that text books use boldface **A** to distinguish matrix names.

Entering a matrix as a sequence of rows is also possible. For the example above you can write the following command line:

$$[[1,1,3][-1,0,4]]\rightarrow[A]$$

Commas separate row entries, but not the rows themselves. The brackets are entered as [2nd] [×] and [2nd] [−]. The → is entered by [STO→]. Use the matrix names menu for [A].

Enter any 3×4 matrix as [B]. Matrix multiplication [A][B] can be executed as written here, or as [A]*[B] or as ([A])([B]). Parentheses allow one of the factors to be a sum of matrices.

Matrix inverses can be calculated with the usual key [x⁻¹]. The calculator recognizes that [A]⁻¹ has a variable name reserved for matrices, so it calls the lengthy and complicated procedure for that calculation.