

USING THE
TI- 83 GRAPHICS CALCULATOR

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TO THE STUDENT:

As you prepare to learn a particular skill in this booklet, you should first read through the entire discussion of that skill to get an overview of the procedure being described. Then, with calculator in hand, actually go through the keystrokes on your calculator. As you press a key, look up at the screen to see the effect of each such keystroke. You will find that the actual working through of the procedure on your calculator, rather than just reading the procedure, will be an immense help.

SOME COMMON KEYS

TI-83

You should locate each of these keys on your calculator. You will learn their use as you work through the examples that follow.

X, T, θ , n

enters the variable x

(-)

negative sign key, used to make a number or quantity negative

2nd

accesses the function or object written above a key

Alpha

accesses letters of the alphabet

\wedge

exponentiation

Clear

clears a line or the screen

Y=

takes you to the screen in which to enter functions

Window

takes you to the screen to establish viewing window

Graph

graphs the functions defined in $Y=$ screen

Math

accesses math menu for math computations

2nd \wedge

π (pi)

x^2

squares a quantity

Mode

accesses the modes of the calculator

2nd **0** **ENTER** accesses the absolute value

Notes:

1. The cursor keys are the directional arrow keys located at the top right corner of the keypad right below the **Trace** and **Graph** keys. They are used to move the cursor around on the screen ; they have other uses also.
2. Press the keys **2nd** **Mode** to quit and return to the home screen.
3. Press and release **2nd** , then press and hold down the up cursor key to darken screen.
4. Press and release **2nd** , then press and hold down the down cursor key to lighten screen.
4. Press **2nd** **ON** to turn the calculator off.

1. Evaluate $\frac{7+\pi^3}{-3-\frac{3}{7}}$

You need parentheses around the numerator and denominator, but you do not need parentheses around the $\frac{3}{7}$ in the denominator since the division of 3 by 7 will be done before the subtraction. Also, note the negative sign key (-) used for the negative sign before the 3 in the denominator as opposed to the subtraction key used for the subtraction in the denominator.

Press

The answer is - 11.08516403

2. Evaluate $3 + \frac{\pi}{7}$

Press

The answer is 3.448798951

3. Evaluate $\frac{3+\pi}{7}$

Press

The answer is .8773703791

Note that the parentheses are needed around the numerator.

4. Evaluate $7^{\frac{2}{3}}$

Press

The answer is 3.65930571 The parentheses are needed around the exponent.

5. Scientific Notation

To enter a number in scientific notation, you will use the **EE** option which is located above the comma key **,**. To access the EE option, you first press the **2nd** key and then the comma key.

Enter 5.34×10^{-23}

Press **5** **.** **3** **4** **2nd** **,** **(-)** **2** **3**

The display will appear as 5.34E-23

6. Accessing the previous answer

If you perform a calculation and then wish to use that answer in the next calculation, you can access the previous answer by pressing **2nd** **(-)**.

For example, divide 3 by 7 and press enter to evaluate. The answer is .4285714286

Now if you wish to raise 4 to that number, press

4 **^** **2nd** **(-)** The display will appear as 4^Ans. Press **ENTER**

to get an answer of 1.811447329

7. Changing a decimal answer to a fraction

Evaluate $\frac{2}{3} + \frac{4}{5}$ and express the answer as a fraction.

To change a decimal to a fraction, use the 1st option under the MATH menu.

Press **2** **÷** **3** **+** **4** **÷** **5** **ENTER** to get an answer of 1.466666667

Now press MATH 1 ENTER to get an answer of 22/15

Note that the display appears as Ans \triangleright Frac which indicates that the previous answer is converted to a fraction.

The viewing window for a graph is the portion of the coordinate system shown on the screen.

Xmin: leftmost value on x-axis

Xmax: rightmost value on x-axis

Xscl: number of units between each tick mark on x-axis

Ymin: lowermost value on y-axis

Ymax: uppermost value on y-axis

Yscl: number of units between each tick mark on the y-axis



Notation is $[Xmin, Xmax]$ by $[Ymin, Ymax]$. For example, set the viewing window to $[-40, 30]$ by $[-25, 15]$ $Xscl=5$ and $Yscl=5$. This means that Xmin is -40 and Xmax is 30, Ymin is -25, Ymax is 15, and the number of units between each tick mark on the x and y axis is 5 units.

Press Window

Press -40 and Enter, 30 and Enter, 5 Enter, and so on.

Note: The standard viewing window is $[-10, 10]$ by $[-10, 10]$ with $Xscl= 1$ and $Yscl= 1$. You can quickly set this window by pressing Zoom 6.

To graph a function, you must enter the expression in the $Y=$ screen.

Example:

Graph the function $f(x) = -2x^2 + 4x - 5$

1. Press $Y=$ You can enter up to 10 different functions.
2. Press $(-)$ 2 X,T,θ,n x^2 $+$ 4 X,T,θ,n $-$ 5 $ENTER$
3. Establish a viewing window as explained before by pressing $WINDOW$ and entering appropriate values.
4. Press $GRAPH$

OR

5. After entering the function in y_1 , you can press $ZOOM$ 6 to graph the function in the standard window, if that is a good window. You do not need to press $GRAPH$ in this case.

To find the intersection of 2 curves, you enter the expressions for both functions in the $\boxed{Y=}$ screen, the first expression is entered in y_1 and the second expression is entered in y_2 .

Example:

Find the intersection of the 2 lines $y = 2x + 3$ and $y = -x - 5$

1. Press $\boxed{Y=}$.
2. Enter $2x + 3$ into y_1 and $-x - 5$ into y_2 .
3. Graph the lines in an appropriate viewing window; the intersection point must appear in the window, so you may need to experiment with different window settings.
4. Press $\boxed{2nd}$ \boxed{TRACE} to access the "CALCULATE" menu. Press $\boxed{5}$ for INTERSECT.
5. The calculator will ask for "FIRST CURVE?". The cursor should be on the first curve as indicated by the function shown in the upper left of the screen. You confirm that the cursor is on the first curve by pressing \boxed{ENTER} .
6. The calculator will then ask for "SECOND CURVE?". You answer by pressing \boxed{ENTER} .
7. The calculator will ask for a "GUESS?". You should move the cursor near the point of intersection using the left and right cursor keys. Once the cursor is near the point, press \boxed{ENTER} .

The x and y coordinates of the intersection point will appear at the bottom of the screen.

The answer for this example is $x = -2.667$, $y = -2.333$ rounded to 3 decimal places.

Note: For some problems, just the x-coordinate is the answer and, for other problems,

both coordinates are required.

To find the maximum or minimum of a function $f(x)$, first graph $f(x)$ in an appropriate viewing window. The maximum or minimum point should appear in the window.

Press $\boxed{2\text{nd}}$ $\boxed{\text{TRACE}}$ to access the CALCULATE menu. Choose $\boxed{3}$ for minimum and $\boxed{4}$ for maximum.

Example :

Find the relative minimum point of $f(x) = -x^3 + x$

1. Press $\boxed{Y=}$ and enter $-x^3 + x$ into y_1 .
2. Press $\boxed{\text{WINDOW}}$ to set the viewing window to $X_{\text{min}} = -3$, $X_{\text{max}} = 3$, $X_{\text{scl}} = 1$, $Y_{\text{min}} = -2$, $Y_{\text{max}} = 2$, $Y_{\text{scl}} = 1$.
3. Press $\boxed{\text{GRAPH}}$ to graph the function.
4. Press $\boxed{2\text{nd}}$ $\boxed{\text{TRACE}}$ and choose option 3 for minimum.
5. The calculator asks for "LEFT BOUND?" . Move the cursor to a point to the left of the minimum point and press $\boxed{\text{ENTER}}$. You use the left and right cursor keys to move the cursor left and right.
6. The calculator asks for "RIGHT BOUND?" . Move the cursor to the right of the minimum point and press $\boxed{\text{ENTER}}$.
7. The calculator asks for "GUESS?" . Move the cursor near the minimum point , but make sure your cursor is between the 2 bounds you set above. Press $\boxed{\text{ENTER}}$.

The x and y coordinates of the minimum point appear at the bottom of the screen, in this case, $x = -.577$, $y = -.385$, rounded to 3 decimal places.

To find the x - intercept of a function $f(x)$, first graph $f(x)$ in an appropriate viewing window so that the x - intercept appears in the window.

Press $\boxed{2\text{nd}}$ $\boxed{\text{TRACE}}$ to access the CALCULATE menu. Choose option 2 "ZERO" , which is another name for x - intercept. Some calculators may use the term "ROOT" .

Example :

Find the x - intercept of $f(x) = 2x^3 - 3x + 2$.

1. Press $\boxed{Y=}$ and enter $2x^3 - 3x + 2$ into y_1 .
2. Press $\boxed{\text{WINDOW}}$ to set the viewing window (for this example) to $X_{\text{min}} = -5$, $X_{\text{max}} = 5$,
 $X_{\text{scl}} = 1$, $Y_{\text{min}} = -5$, $Y_{\text{max}} = 5$, $Y_{\text{scl}} = 1$.
3. Press $\boxed{\text{GRAPH}}$ to graph the function.
4. Press $\boxed{2\text{nd}}$ $\boxed{\text{TRACE}}$ and choose option 2.
5. The calculator asks for "LEFT BOUND?" . Move the cursor (using the left or right cursor keys) to the left of the x - intercept and press $\boxed{\text{ENTER}}$.
6. The calculator asks for "RIGHT BOUND?" . Move the cursor to the right of the x -intercept and press $\boxed{\text{ENTER}}$.
7. The calculator asks for "GUESS?" . Move the cursor near the x - intercept , but make sure the cursor is between the 2 bounds you set above. Press $\boxed{\text{ENTER}}$.

The word "ZERO" will appear at the bottom of the screen and the x - coordinate shown is the x - intercept. For this example, the x - intercept is - 1.476 , rounded to 3 places.

To graph a piecewise function, you enter the first piece (in parentheses) juxtaposed with its condition (in parentheses) into y_1 , then you enter the second piece (in parentheses) juxtaposed with its condition (in parentheses) into y_2 , and so on for any additional pieces.

Note: 1. To access the inequality symbols, press $\boxed{2nd}$ \boxed{MATH} to go to the TEST menu.

Then, press $\boxed{3}$ for $>$, $\boxed{4}$ for \geq , $\boxed{5}$ for $<$, and $\boxed{6}$ for \leq .

2. If there are breaks in the graph, it may be best to graph in DOT mode rather than CONNECTED mode. Press \boxed{MODE} and move the cursor down to "Connected" and over to "Dot" and press \boxed{ENTER} .

3. If a condition is a compound inequality, such as $1 \leq x < 5$, the inequalities should be entered individually. For this inequality, it would be entered as ($1 \leq x$)($x < 5$) rather than as ($1 \leq x < 5$).

Example :

$$\text{Graph } f(x) = \left\{ \begin{array}{l} x + 1, x \leq 2 \\ -x + 7, x > 2 \end{array} \right\}$$

1. Press $\boxed{Y=}$ and enter the first piece into y_1 in this form:

$$y_1 = (x + 1)(x \leq 2) \text{ and press } \boxed{ENTER}.$$

2. Enter the second piece into y_2 in this form :

$$y_2 = (-x + 7)(x > 2) \text{ and press } \boxed{ENTER}.$$

3. Press **GRAPH** to graph . Since this graph has a break at $x = 2$, it is best to graph in DOT mode.

GREATEST INTEGER FUNCTION $f(x) = \lfloor x \rfloor$

To graph the greatest integer function, press **Y=** , press **MATH** , move cursor over to NUM and press **5** for $\text{int}($, which is the symbol for this function. Then press **X,T, θ ,n** and **)** . The expression in y_1 should be $\text{int}(x)$. Press **GRAPH** to graph the function. Be sure to graph in DOT mode.

General Remarks

To create a table of values for a function $f(x)$, you first enter the function in y_1 . To access the TABLE SETUP menu, press $\boxed{2\text{nd}} \boxed{\text{WINDOW}}$.

"TblStart" defines the first x value to appear in the table; you can begin with any x value.

" Δ Tbl" defines the increment of the x values, that is, the amount each x value will change

in the x column; you can set this increment to be any value.

"Indpnt" represents the x variable and "Depend" represents the y variable. Setting both of these to "Auto" will allow the table to be automatically generated. If you set "Indpnt" to

"Ask", you can input any x value when you go to the table.

Example:

Create a table of values for $f(x) = x^2 + 5x + 1$ beginning with an x value of -3.

1. Press $\boxed{y=}$ and enter the expression $x^2 + 5x + 1$ into y_1 .
2. Press $\boxed{2\text{nd}} \boxed{\text{WINDOW}} \boxed{(-)} \boxed{3} \boxed{\text{ENTER}}$.
3. Press $\boxed{1} \boxed{\text{ENTER}}$ to set the increment of the x values to 1.
4. Set both "Indpnt" and "Depend" to "Auto". You may need to move the cursor down and press $\boxed{\text{ENTER}}$ for the "Depend" option.
5. Press $\boxed{2\text{nd}} \boxed{\text{GRAPH}}$ to create the table.

Notes : 1. Move the cursor up or down to find more values of x as the table extends indefinitely in both directions.

2. Move the cursor right to the y column and the corresponding y value is displayed in its entirety at the bottom of the screen.

3. You can make a table of values for as many as ten functions. For example,
if

cursor you enter five functions and create a table of values as above, move the
to the right to display the other functions once you go to the actual table.

To access the MATRIX menu , press **MATRIX** . There are 3 sub-menus to choose;

NAMES menu accesses the names of the matrices; to perform calculations with a matrix , you must call up the name of the matrix.

MATH menu accesses various matrix mathematical functions for computations.

EDIT menu allows you to enter a new matrix or change an already existing matrix.

Example:

Enter the matrix
$$\begin{bmatrix} 2 & -1 & 5 \\ 3 & 6 & -2 \\ 1 & 0 & 4 \end{bmatrix}$$
 into the matrix A .

1. Press **MATRIX** and move the cursor over to **EDIT** , press **ENTER** to access the matrix A. You would choose the number of the matrix if you want another matrix, such as **2** for matrix B, **3** for matrix C , and so on.

2. Press **3** **ENTER** **3** **ENTER** to enter the size of the matrix. The first number is the number of rows and the second number is the number of columns.

3. Press **2** **ENTER** **(-)** **1** **ENTER** **5** **ENTER** **3** **ENTER** **6** **ENTER**

(-) **2** **ENTER** **1** **ENTER** **0** **ENTER** **4** **ENTER** to enter the entries

of the matrix.

4. Press 2nd MODE to return to the Home screen.

1. Enter the matrix into the name A as described previously. You can enter the matrix under any name you wish.
2. Return to the Home screen after you enter the matrix by pressing $\boxed{2\text{nd}}$ $\boxed{\text{MODE}}$.
3. Press $\boxed{\text{MATRIX}}$ and move cursor over to the MATH menu and press $\boxed{\text{ENTER}}$ to choose option 1 for " det(" , which represents the determinant function.
4. Press $\boxed{\text{MATRIX}}$ $\boxed{\text{ENTER}}$ to choose the matrix A. If you were using another matrix, you would choose the number of that matrix, for example, 2 for matrix B, and so on.
5. Press $\boxed{)}$ to close the parentheses. You should see " det(A) " on the screen.
6. Press $\boxed{\text{ENTER}}$ to evaluate the determinant.

Example:

Enter the matrix $A = \begin{bmatrix} 3 & -3 & 1 \\ 2 & 9 & 7 \\ -8 & 1 & 5 \end{bmatrix}$ and find the determinant.

You should obtain that $\det(A) = 386$.

1. The intersection-of-graphs method

Graph the left side of the inequality as y_1 , and the right side of the inequality as y_2 .

Then, find the point of intersection using the "Intersect" option.

To solve $y_1 > y_2$ means to find the x values for which y_1 lies above y_2 .

To solve $y_1 < y_2$ means to find the x values for which y_1 lies below y_2 .

2. The x-intercept method

First subtract the terms of the right side from both sides of the inequality so that only

zero remains on the right side. Then, graph the left side of the inequality as y_1 . Now find the

x-intercept of the graph using the "Zero" option.

To solve $y_1 > 0$ means to find the x values for which y_1 lies above the x-axis.

To solve $y_1 < 0$ means to find the x values for which y_1 lies below the x-axis.

3. Compound Inequality

To solve a compound inequality, let y_1 be the left side, let y_2 be the middle expression , and let y_3 be the right side. Now, graph all three functions. Find the point of intersection of y_1 and y_2 , and the point of intersection of y_2 and y_3 .

To solve $y_1 < y_2 < y_3$ means to find all x values for which y_2 is between y_1 and y_3 .

Solve each inequality using the procedures described on previous page.

1. Solve $2x + 6 < -x + 1$ using the intersection-of-graphs method.

Enter $2x + 6$ into y_1 and enter $-x + 1$ into y_2 and graph in the standard window. Now, find the intersection of the two lines using the "INTERSECT" option. The curves intersect at $x = -1.667$. Since we are solving the inequality $y_1 < y_2$, we want to find all the x values for which the line y_1 lies below y_2 . From inspection, we see that $2x + 6$ lies below $-x + 1$ for all x values to the left of -1.667 . So, the solution set is $(-\infty, -1.667)$.

2. Solve $5x + 2 < \pi x + 3$ using the x-intercept method.

Subtract $\pi x + 3$ from both sides of the inequality to obtain

$$5x + 2 - (\pi x + 3) < 0 \quad \text{Note the parentheses around both terms } \pi x \text{ and } 3.$$

Enter $5x + 2 - (\pi x + 3)$ into y_1 and graph in the standard window. Find the x-intercept using the "ZERO" option. The x-intercept is $x = .538$. Since we are solving the inequality $y_1 < 0$, we want to find all x values for which the line is below the x axis. From inspection, we see that the line lies below the x axis for x values to the left of $x = .538$. So, the solution set is $(-\infty, .538)$.

3. Solve the compound inequality $-15 < 3(x - 4) < 6\pi$

Enter -15 into y_1 , enter $3(x - 4)$ into y_2 , and enter 6π into y_3 . You must graph in a window in which all 3 lines appear and in which the intersection points appear. For this example, set the window to $[-15, 15]$ by $[-20, 25]$.

Find the lower intersection point using the "INTERSECT" option. Note that this point is the intersection of y_1 and y_2 , so use those 2 curves when finding the intersection. This intersection point is $x = -1$.

Find the upper intersection point using the curves y_2 and y_3 . You can scroll through the curves by pressing the up or down cursor keys. This intersection point is $x = 10.283$

Since we are solving the inequality $y_1 < y_2 < y_3$, we want all x values for which the line y_2 lies between the other two lines. From inspection, we see that this occurs for x values between -1 and 10.283 . So, the solution set is $(-1, 10.283)$.

You should enclose the radicand of the radical in parentheses. The square root and the cube root options automatically supply the open parenthesis immediately following the radical sign. Take care to close the parentheses in the appropriate place.

1. Square root

The square root function is located above the x^2 key and is accessed by $\boxed{2nd}$ $\boxed{x^2}$

Example 1 : Evaluate $\sqrt{5 + \pi}$

Press $\boxed{2nd}$ $\boxed{x^2}$ $\boxed{5}$ $\boxed{+}$ $\boxed{2nd}$ $\boxed{\wedge}$ $\boxed{)}$ \boxed{ENTER}

The answer is 2.853347622

Example 2 : Evaluate $\sqrt{5} + \pi$

Press $\boxed{2nd}$ $\boxed{x^2}$ $\boxed{5}$ $\boxed{)}$ $\boxed{+}$ $\boxed{2nd}$ $\boxed{\wedge}$ \boxed{ENTER}

The answer is 5.377660631 The parentheses are closed after the 5 since the π is not part of the radicand.

2. Cube root

The cube root is located under the MATH menu, option 4.

Example 1 : Evaluate $\sqrt[3]{15}$

Press \boxed{MATH} $\boxed{4}$ $\boxed{1}$ $\boxed{5}$ $\boxed{)}$ \boxed{ENTER}

The answer is 2.466212074

3. Other roots

To access 4th roots and higher, you go to the MATH menu and select option 5. However, you must supply the index of the radical before selecting the option from the MATH menu.

Example 1 : Evaluate $\sqrt[5]{32}$

Press

The answer is 2 .

Example 2 : Evaluate $\sqrt[7]{8 + \pi} + 5$

The parentheses are not automatically supplied for 4th roots and higher, so in this example, we must enclose the $8 + \pi$ in parentheses.

Press

The answer is 6.411119836

4. Rational Exponents

Since eponentiation has a higher priority than division, you must enclose a rational exponent in parentheses.

Example : Evaluate $19^{\frac{2}{3}}$

Press

The answer is 7.120367359

Exercises : Evaluate the following expressions and round the answer to 4 decimal places.

1. $\sqrt[3]{-97}$

2. $\sqrt[5]{1122}$

3. $\sqrt[7]{5^2 - \frac{2}{7}}$

4. $41^{\frac{5}{2}}$

5. $(-73)^{\frac{3}{2}}$

6. $21^{\frac{-2}{3}}$

7. $\sqrt{10 - \pi^2} + \frac{9}{5}$

8. $\sqrt[3]{45} + \pi^3$

Answers:

1. -4.5947

2. 4.0738

3. 1.5812

4. 10,763.6518

5. nonreal answer if calculator is in "REAL" mode or
-623.7123i if calculator is in "a + bi" mode

6. .1314

7. 2.1611

8. 34.5632

QUADRATIC FORMULA PROGRAM

TI-83

To create a program, press **PRGM** , move cursor over to NEW and press **ENTER**

Type in the name of the program (the calculator is locked in "alpha" mode so that when you press a key, the corresponding letter is accessed). You can name this program QUAD.

When you type in the name of the program, press **ENTER** and you are ready to begin typing in the actual program. Each line of the program begins with a colon.

Below is the way the program looks on the calculator and the keystrokes for that line.

PROGRAM

KEYSTROKES

:Prompt A

PRGM **▷** **2** **ALPHA** **MATH** **ENTER**

:Prompt B

PRGM **▷** **2** **ALPHA** **MATRIX**

ENTER

:Prompt C

PRGM **▷** **2** **ALPHA** **PRGM**

ENTER

: $B^2 - 4AC \rightarrow D$

ALPHA **MATRIX** **X²** **-** **4** **ALPHA** **MATH**
ALPHA **PRGM** **STO** **ALPHA** **X⁻¹**

ENTER

:If $D < 0$

PRGM **1** **ALPHA** **X⁻¹** **2nd** **MATH** **5**

0

ENTER

:Goto 1

PRGM 0 1 ENTER

:(- B + $\sqrt{(D)}$) / (2A) → P

((-) ALPHA MATRIX + 2nd X²

ALPHA

X⁻¹)) ÷ (2 ALPHA MATH)

STO ALPHA 8 ENTER

:Disp P

PRGM ▷ 3 ALPHA 8 ENTER

:(- B - $\sqrt{(D)}$) / (2A) → P

((-) ALPHA MATRIX - 2nd X²

ALPHA

X⁻¹)) ÷ (2 ALPHA MATH)

STO

ALPHA 8 ENTER

:Disp P

PRGM ▷ 3 ALPHA 8 ENTER

:Stop

PRGM ALPHA COS ENTER

:Lbl 1

PRGM 9 1 ENTER

Note: The second symbol in the second line of the keystrokes below, \times , is the multiplication sign, not the variable x.

:Disp " NO REAL SOLUTION"

PRGM ▷ 3 2nd ALPHA + LOG 7

0 \times SIN MATH) 0 LN 7) 5

4 x² 7 LOG + ENTER

:Stop

PRGM ALPHA COS ENTER

To leave the program, press 2nd MODE .

To use the program, press PRGM , choose the number of the program, and press ENTER . You then enter the values of a, b, and c from the equation.

Examples:

1. Solve $5x^2 - 6x - 14 = 0$. Ans: 2.3776 , - 1.1776

2. Solve $3x^2 - 5x + 9 = 0$. Ans: No Real Solution