

TI-73 / TI-83 Plus Math by Hand

How To...

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- Use On-screen Options and Menus
- Use Step-by-Step Mode
- Use Fast Math Mode
- Use Missing Pieces Mode
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Important Information

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What Is the Math by Hand Application?

The Math by Hand application familiarizes you with mathematical algorithms for addition, subtraction, multiplication, and division. For each of these, three different modes are available:

- Step-By-Step mode shows the problem worked out one step at a time, emphasizing place value in the base-ten system for each algorithm.
- Fast Math mode shows the problem worked out in an animated sequence that is similar to how you would solve the problem on paper.
- Missing Pieces mode is a quiz that presents solved problems with blank place values. You supply these place values to complete the algorithm.

The Math by Hand application is a concept application that TI wants to share with our customers, educators, and students before the product definition and testing are complete. It is an alpha software version, and as such, it may contain imperfections, or the coding may be incomplete.

TI invites your feedback concerning the functionality and educational value of the Math by Hand application. Please send your comments and questions to concept@list.ti.com.

What You Need

Note In this guidebook, any information that pertains to the TI-83 Plus also pertains to the TI-83 Plus Silver Edition, unless otherwise noted.

Hardware and software	Notes
TI-73 with version 1.60 or higher of the Graph Explorer software —or— TI-83 Plus or TI-83 Plus Silver Edition with version 1.14 or higher of the operating system software	You can download a free copy of the latest Graph Explorer or operating system software from education.ti.com/softwareupdates . Follow the link to Operating Systems.
Computer with Microsoft® Windows® 95/98/2000, Windows NT®, or Apple® Mac® OS 7.1 or higher installed	
TI-GRAPH LINK™ computer-to-device cable	If you do not have this cable, call your distributor, or order the cable from TI's online store .
TI-GRAPH LINK software that is compatible with the TI-73 or the TI-83 Plus —or— TI™ Connect software, which works with all supported models of Flash-based TI graphing devices.	You can download free copies of TI-GRAPH LINK and TI Connect software from education.ti.com/softwareupdates . Follow the link to Connectivity Software.

Where to Find Installation Instructions

Detailed instructions on installing this and other applications are available at education.ti.com/guides. Follow the link to Flash installation instructions.

Getting Help

The instructions in this guidebook are only for this application. If you need help using the TI-73 or TI-83 Plus, refer to its comprehensive guidebook at education.ti.com/guides.

Starting and Quitting the Application

Starting the Application

1. Press **APPS** to display the list of applications on your TI-73 or TI-83 Plus.
2. Select **MathHand**. The application's information screen is displayed.
3. Press any key to continue. The developers' screen is displayed.
4. Press any key to continue. The SELECT AN OPERATION menu is displayed.

Quitting the Application

From the SELECT AN OPERATION menu, select **QUIT** or press **2nd** [QUIT].

Navigating

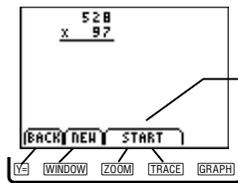
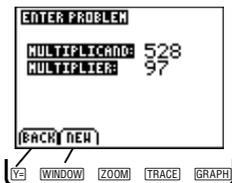
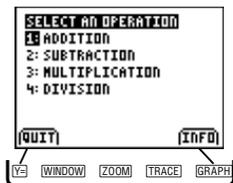
Selecting Menu Items

You can select menu items in the following ways.

- Press \downarrow or \uparrow to highlight the menu item, and then press **ENTER** to select it.
- Press the number key that corresponds to the menu item.

Using On-Screen Options

Each screen displays one or more options along the bottom of the screen. To select an option, press the graphing key directly below the option.



For example, press **ZOOM** or **TRACE** to select **START**.

Using Step-by-Step Mode

The Step-by-Step mode shows an explanation of each step that you take to solve a problem. This mode emphasizes the base-ten system to help develop the fast algorithm for an operation. Each place value is shown separately with details; zeros that are usually left off for efficiency are shown, and carrying numbers to the next higher place value is handled in a developmental form.

1. Select an operation from the SELECT AN OPERATION menu.
2. Select **STEP-BY-STEP** from the SELECT A MODE screen.
3. Enter the first element of the problem, and then press **ENTER** or the appropriate operation key (**+**, **-**, **×**, or **÷**).
4. Enter the second element of the problem, and then press **ENTER**.

Tip

If you make a mistake when you enter a number, you can correct it in one of the following ways.

- Press **CLEAR** to delete the entire number.
- Press **←** to move the cursor to the incorrect number, and then enter the correct number.
- Press **DEL** to delete the digit at the cursor location.

5. Select **START** to display the first step in solving the problem.

6. Select **NEXT STEP** to display subsequent steps until the problem is solved.
7. Select **REPEAT** to erase the solution so that you can step through it again.

—or—

Select **BACK** to return to the SELECT A MODE menu.

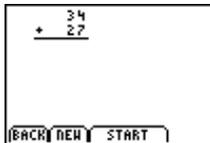
—or—

Select **NEW** to enter a new problem for the same operation.

The examples below show the algorithms used to solve problems for each type of operation.

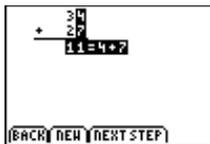
Addition

Example: $34 + 27 = ?$



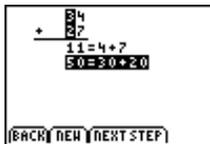
A calculator screen showing the initial addition problem. The numbers 34 and 27 are stacked vertically with a plus sign to the left. Below the numbers is a horizontal line. At the bottom of the screen, there are three buttons labeled BACK, DEL, and START.

First, the values in the ones place are added, and the partial sum is shown: $11 = 4 + 7$.



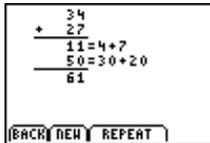
A calculator screen showing the first step of the addition. The numbers 34 and 27 are stacked vertically with a plus sign to the left. Below the numbers is a horizontal line. Below the line, the text "11=4+7" is displayed. At the bottom of the screen, there are three buttons labeled BACK, DEL, and NEXT STEP.

Note: Instead of showing the carrying of the 1 to the tens place above the 3, the partial sum of the values in the ones place, 11, is shown. This helps students who are learning the algorithm for the first time or those who have trouble lining up their writing.



A calculator screen showing the second step of the addition. The numbers 34 and 27 are stacked vertically with a plus sign to the left. Below the numbers is a horizontal line. Below the line, the text "50=30+20" is displayed. At the bottom of the screen, there are three buttons labeled BACK, DEL, and NEXT STEP.

Next, the values in the tens place are added and the partial sum is shown: $50 = 30 + 20$.

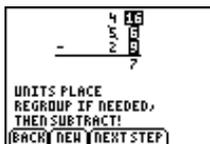


A calculator screen showing the final step of the addition. The numbers 34 and 27 are stacked vertically with a plus sign to the left. Below the numbers is a horizontal line. Below the line, the text "11=4+7" is displayed. Below that, the text "50=30+20" is displayed. Below that, the text "61" is displayed. At the bottom of the screen, there are three buttons labeled BACK, DEL, and REPEAT.

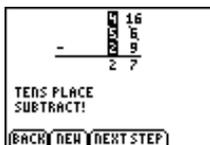
In the final step, the partial sums are added and the answer is shown: $11 + 50 = 61$.

Subtraction

Example: $56 - 29 = ?$



First, the value 56 is regrouped into 4 tens and 16 ones. Now, 9 can be subtracted from 16, leaving 7 in the ones column.



Next, 2 tens are subtracted from 4 tens to arrive at the final answer of 27.

Multiplication

Example: $12 \times 23 = ?$

$$\begin{array}{r} 12 \\ \times 23 \\ \hline 26 \end{array} = 2 \times 2$$

(BACK) (DEL) (NEXT STEP)

The application applies the distributive property to multiplication problems and displays the solution in a vertical format.

$$\begin{array}{r} 12 \\ \times 23 \\ \hline 260 \end{array} = 3 \times 2$$
$$30 = 2 \times 10$$

(BACK) (DEL) (NEXT STEP)

You could also apply the distributive property and display the solution in a horizontal format, as shown below.

$$\begin{array}{r} 12 \\ \times 23 \\ \hline 260 \\ 40 \end{array} = 3 \times 2$$
$$30 = 3 \times 10$$
$$40 = 2 \times 20$$

(BACK) (DEL) (NEXT STEP)

$$12 \times 23 = (10 + 2) \times (20 + 3)$$

$$= (10 \times 20) + (10 \times 3) + (2 \times 20) + (2 \times 3)$$

$$= 200 + 30 + 40 + 6$$

$$= 276$$

$$\begin{array}{r} 12 \\ \times 23 \\ \hline 260 \\ 40 \\ 200 \end{array} = 3 \times 2$$
$$30 = 3 \times 10$$
$$40 = 2 \times 20$$
$$200 = 2 \times 100$$

(BACK) (DEL) (NEXT STEP)

$$\begin{array}{r} 12 \\ \times 23 \\ \hline 260 \\ 40 \\ 200 \\ \hline 276 \end{array} = 3 \times 2$$
$$30 = 3 \times 10$$
$$40 = 2 \times 20$$
$$200 = 2 \times 100$$

(BACK) (DEL) (REPEAT)

Division

$$\begin{array}{r} 10 \\ 22 \overline{) 438} \\ \underline{220} = 22 \times 10 \\ 218 \end{array}$$

BACK NEW NEXT STEP

The application shows that there are 10 groups of 22 in 438, not 1 group of 22 in 43. This helps students who are learning the algorithm for the first time, or who have trouble lining up their writing.

$$\begin{array}{r} 19R20 \\ 22 \overline{) 438} \\ \underline{220} = 22 \times 10 \\ 218 \\ \underline{198} = 22 \times 9 \\ 20 \end{array}$$

BACK NEW REPEAT FRAC

The next step shows that there are 9 groups of 22 in 218. Since the remainder is less than the divisor, the problem is solved.

$$\begin{array}{r} 19 \\ 22 \overline{) 438} \\ \underline{220} \\ 218 \\ \underline{198} \\ 20 \end{array} \quad \text{FRACTION:} \quad 19\frac{20}{22} = 19\frac{10}{11}$$

BACK NEW REPEAT FRAC

To see the answer in fraction form, select **FRAC**. If the fraction can be simplified, the simplified value is also shown.

Using Fast Math Mode

The Fast Math mode shows the problem worked out in an animated sequence without showing the details that the Step-by-Step mode shows.

1. Select an operation from the SELECT AN OPERATION screen.
2. Select **FAST MATH** from the SELECT A MODE screen.
3. Enter the first element of the problem, and then press **ENTER** or the appropriate operator (**+**, **-**, **×**, or **÷**).
4. Enter the second element of the problem, and then press **ENTER**.

Tip

If you make a mistake when you enter a number, you can correct it in one of the following ways.

- Press **CLEAR** to delete the entire number.
- Press **←** to move the cursor to the incorrect number, and then enter the correct number.
- Press **DEL** to delete the number at the cursor location.

5. Select **START** to solve the problem.

Tip

Select **FASTER** to display the solution more quickly.

The examples below show the standard fast algorithm.

Addition

$$\begin{array}{r} 1 \\ 34 \\ + 27 \\ \hline 61 \end{array}$$

BACK NEW FASTER

No partial sums are shown in the standard algorithm. Notice that the 1 is carried to the tens place above the 3.

$$\begin{array}{r} 1 \\ 34 \\ + 27 \\ \hline 61 \end{array}$$

BACK NEW REPEAT

Subtraction

$$\begin{array}{r} 4 \ 16 \\ - 2 \ 9 \\ \hline 2 \ 7 \end{array}$$

BACK NEW FASTER

Subtraction in Fast Math mode is similar to subtraction in Step-by-Step mode. No text is displayed on the screen to explain the steps.

$$\begin{array}{r} 4 \ 16 \\ - 2 \ 9 \\ \hline 2 \ 7 \end{array}$$

BACK NEW REPEAT

Multiplication

$$\begin{array}{r} 12 \\ \times 23 \\ \hline 36 \end{array}$$

BACK NEW FASTER

$$\begin{array}{r} 12 \\ \times 23 \\ \hline 36 \\ 240 \end{array}$$

BACK NEW FASTER

$$\begin{array}{r} 12 \\ \times 23 \\ \hline 36 \\ \hline 240 \\ \hline 276 \end{array}$$

BACK NEW REPEAT

Multiplication in Fast Math mode shows the shortcuts that students can use with this algorithm.

Notice that 3×12 and 20×12 are displayed as partial products, which is a compression of the steps shown in Step-by-Step mode.

Division

19R20
22/438
22
218
188
20

BACK NEW REPEAT FRAC

Division in Fast Math mode shows the shortcuts that students can use with this algorithm.

19 FRACTION:
22/438 19/22 =
22 19/22 =
218 19/11
188
20

BACK NEW REPEAT FRAC

To see the answer in fraction form, select **FRAC**. If the fraction can be simplified, the simplified value is also shown.

Using Missing Pieces Mode

Missing Pieces mode is a quiz that challenges you to fill in the missing place values in a problem. Keep in mind the following rules as you play the game.

- Use \leftarrow and \rightarrow to move the cursor to the next missing place value.
- Enter the missing values, and then press $\boxed{\text{ENTER}}$ to check your answer.
- After you check your answer, press $\boxed{\text{ENTER}}$ to display a new problem.
- A leading zero is never a correct answer for a missing place value. For example, if the problem shows $\blacksquare 9$, the missing number can be 1 – 9. If the problem shows $1\blacksquare 9$, the missing number can be 0 – 9.
- In division problems, the remainder must be less than the divisor.
- In division problems, the divisor cannot be 0.
- There may be more than one correct answer. The TI-83 Plus checks your answer to verify that it is correct.

You score points based on the difficulty of the problem and how quickly you fill in the missing pieces.

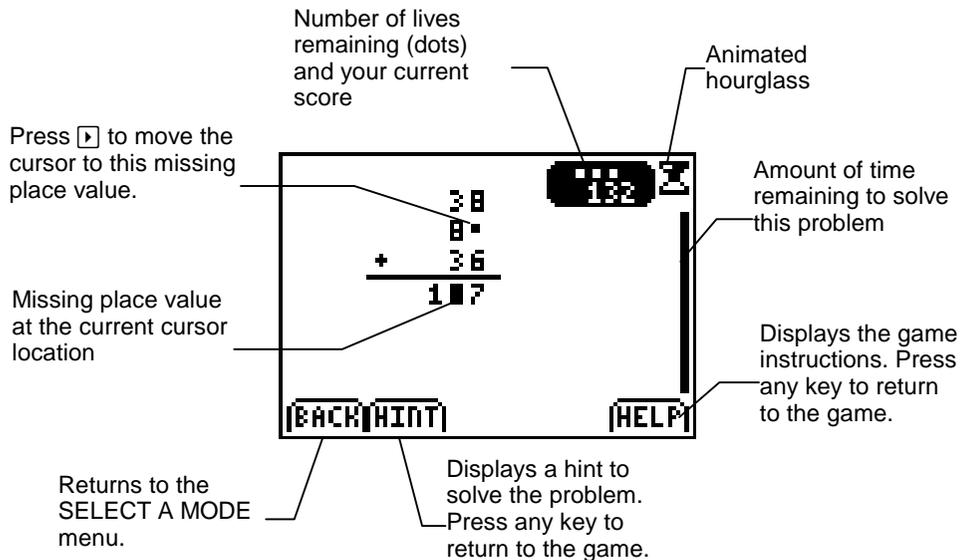
Tip

- When your score exceeds a multiple of 10,000, the score counter is restarted. When the game ends, the cumulative score is displayed.
- The maximum score that is displayed is 50,000. You can continue playing after your score exceeds 50,000, but the score will not change.

At the beginning of the game, you have three lives (lives are the number of opportunities you have to continue playing the game if you give an incorrect answer). You can earn extra lives by scoring points. When your score first exceeds 500 points, you earn one extra life; after that, you earn an extra life each time you score 2000 more points.

Tip

The game displays a maximum of three lives, but you can earn additional lives.



Deleting the Application

TI-73

1. Press **[2nd]** **[MEM]** to display the MEMORY menu.
2. Select **Delete**.
3. Select **Apps**.
4. Move the cursor to **MathHand**.
5. Press **[ENTER]**. A confirmation message is displayed.
6. Select **Yes** to delete the application.

TI-83 Plus

1. Press **[2nd]** **[MEM]** to display the MEMORY menu.
2. Select **Mem Mgmt/Del**.
3. Select **Apps**.
4. Move the cursor to **MathHand**.
5. Press **[DEL]**. A confirmation message is displayed.
6. Select **Yes** to delete the application.

Installation Error Messages

Low Battery

Do not attempt to download a Flash application if the low-battery message appears on the home screen. Low battery indication is shown on the initial screen. If you receive this error during an installation, change the batteries before trying again.

Invalid Signature or Certificate

Either this device does not have a certificate to run the application, or electrical interference caused a link to fail. Try to install the application again.

Error in Xmit

This problem is usually associated with the unit-to-unit cable and its connection between the devices. Make sure the cable is firmly inserted in the link port of each device.

Communication Error

This error indicates that the TI™ Connect software (“Unable to communicate with device”) or TI-GRAPH LINK™ software (“Link Transmission Error”) is unable to communicate with the device. The problem is usually associated with the TI-GRAPH LINK cable and its connection to the device or to the computer.

- Make sure the cable is firmly inserted in the device link port and the computer.
- Verify that the correct cable type is selected in the software link settings.
- Verify that the correct communications port (Com Port) is selected in the software link settings. (This does not apply if you use the USB port and TI Connect software.)

Archive Full

This error occurs when the TI-83 Plus does not have sufficient memory for the application. In order to make room for another application, you must delete an application or archived variables from the TI-83 Plus. Before you delete an application from the TI-83 Plus, you can save it on your computer using TI™ Connect or TI-GRAPH LINK™ software for the TI-83 Plus. You can reload it to the TI-83 Plus later using TI Connect or TI-GRAPH LINK software.

Memory Error

This error occurs when the TI-73 does not have sufficient memory for the application. In order to make room for another application, you must delete an application from the TI-73. Before you delete an application from the TI-73, you can save it on your computer using TI Connect software or TI-GRAPH LINK software for the TI-73. You can reload it to the TI-73 later using TI Connect or TI-GRAPH LINK software.

Other Errors

See Appendix B in the [TI-73 guidebook](#) or pages B-6 through B-10 in the [TI-83 Plus guidebook](#) for information about the specific error.

Checking Version Numbers and Free Space

Verify Operating System Version and ID Number

The Math by Hand application is compatible with TI-73 Graph Explorer software version 1.60 and higher or the TI-83 Plus operating system 1.14 and higher.

To verify your operating system version number:

1. From the home screen, press $\boxed{2\text{nd}}$ [MEM].
2. Select **ABOUT**.

The operating system version number is displayed below the product name and has the format x.yy. The ID number appears on the line below the product number.

Verify Flash Application Version

The version number appears on the information screen below the application name. To display the information screen, do one of the following:

- Press **APPS**, and then select **MathHand**.

—or—

- Select **INFO** from the application's SELECT AN OPERATION menu.

Check Amount of Flash Application Free Space

TI-73

1. From the home screen, press **2nd** **[MEM]**.
2. Select **Check Apps**.

The Math by Hand application requires one free space to load the application.

For more information about memory and memory management, refer to the [TI-73 guidebook](#).

TI-83 Plus

1. From the home screen, press $\boxed{2\text{nd}}$ [MEM].
2. Select **Mem Mgmt/Del**.

The Math by Hand application requires at least 16,384 bytes of ARC FREE (Flash), or one space, to load the application.

For more information about memory and memory management, refer to the [TI-83 Plus guidebook](#).

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