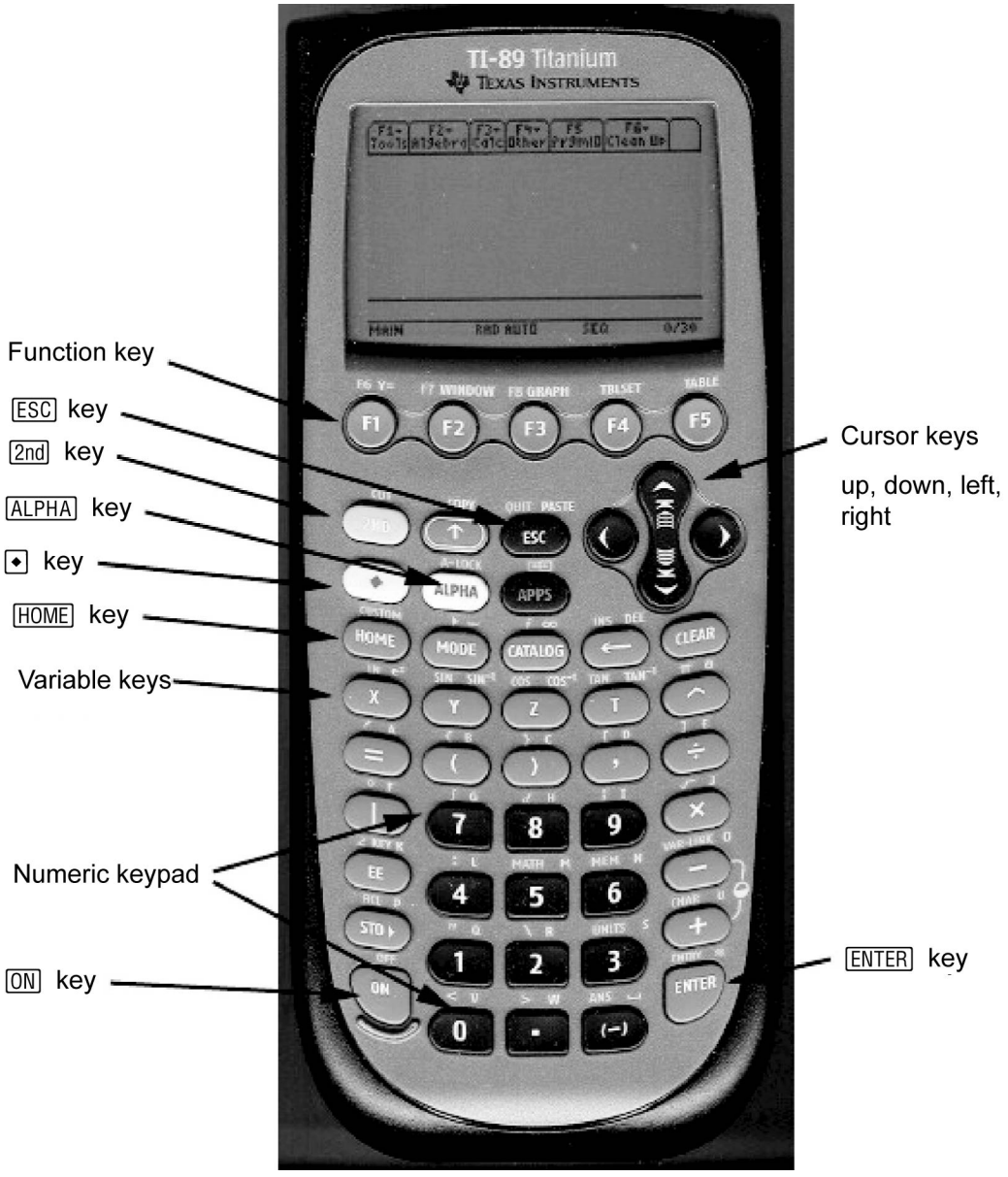
The Computer Algebra System (CAS) on the TI-89 Calculator

The TI-89 calculator features a Computer Algebra System (CAS) engine that allows you to perform algebraic operations, such as manipulating and solving algebraic equations. The following overview will provide you with what you need to know to use the CAS on the TI-89 calculator.



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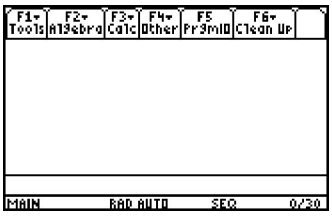
Starting the CAS



Turn on your TI-89 calculator by pressing the ON key. If you don't see the Home screen shown, press the HOME key.

The TI-89 Keyboard

Refer to the annotated picture of the TI-89 calculator. Most keys have a primary function, as well as one or two secondary functions. For example, the 1 key is usually pressed to enter the number 1. However, if the blue 2nd key is pressed, and then **1**, you will enter opening quotes ". If the white ALPHA key is pressed, and then **1**, you will enter the letter q. Some keys have additional functions labelled in green. If the green ◆ key is pressed, and then the ESC (escape) key, you will access the **PASTE** function.

The Function Keys

The CAS uses the functions **F1** through **F6** to display menus. **F1** through **F5** are accessed by pressing the appropriate key. **F6** is accessed by pressing 2nd, followed by F1. Press F1. Notice the menu. To close the menu without making a selection, press ESC. The ESC key is useful for cancelling a key that you may have pressed in error.

Starting a New Problem

It is wise to clear any data that you or another user may have stored in the memory before starting a new problem. To do this, press 2nd, then F1, to pull down the **F6** menu. Select **2: NewProb** (short for New Problem). Then, press the ENTER key. This procedure will clear the memory and reset all algebraic variables. If you don't do this, you may see unexpected results as you work through CAS solutions. Note that **NewProb** also clears the Home screen.

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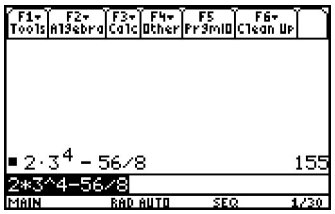
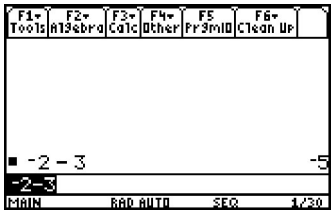
Entering Calculations

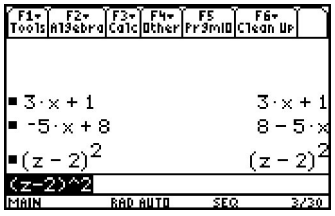


The numeric keypad on your TI-89 works just like the keypad on other graphing calculators, such as the TI-83 Plus or TI-84 plus. For example, consider the expression $2 \times 3^4 - 56 \div 8$. Enter the keystrokes 2 [×] 3 [^] 4 [−] 56 [÷] 8. Then, press [ENTER]. The answer is 155.



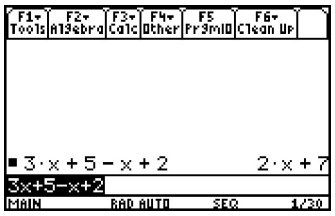
Like the TI-83 Plus and TI-84 plus, the TI-89 has two negative keys, the minus key [(-)] and the subtract key [−]. Use the subtract key when you are subtracting one expression from another, as in the example above. Use the minus key when you are making an expression negative. For example, consider the expression $-2-3$. When entering this expression into your calculator, use the minus key for the negative sign in front of the 2, but the subtract key for the negative sign in front of the 3. Note that the two negative signs appear differently on the Home screen.

Entering and Simplifying Algebraic Expressions



The real power of a CAS lies in an ability to enter and manipulate algebraic expressions. Four of the variable names have their own keys: [X] , [Y], [Z], and [T]. Others are accessed using a combination of [ALPHA] and other keys.

Clear the Home screen if necessary, using **NewProb**. Then, enter the expression $3x + 1$. Press [ENTER]. Notice that the TI-89 enters the expression on the Home screen, and also retains it in the command line. Enter some more expressions, such as $-5y + 8$, and $(z - 2)^2$. Notice that the CAS sometimes changes the format of the expression.



The CAS will simplify expressions by collecting like terms. As an example, enter the expression $3x + 5 - x + 2$, and press [ENTER]. Notice that like terms have been collected.

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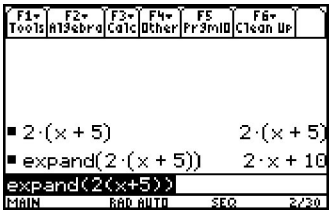
Expanding Expressions

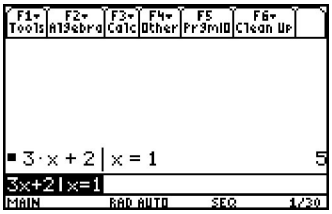
The CAS can expand algebraic expressions using the distributive property. Enter the expression $2(x + 5)$, and press ENTER. Notice that the expression remains unexpanded.



Now, press F2 , and select **3:expand(**. Type the expression $2(x + 5)$. Finally, add a close bracket, and press ENTER. Notice that the CAS has expanded the expression.

Evaluating Expressions

The CAS can evaluate an expression for a particular value of the variable. Enter the expression $3x + 2|x = 1$, and press ENTER. Notice that the CAS substituted the value of 1 for the variable x, and then evaluated the expression for an answer of 5.

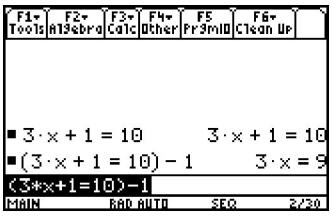


Entering and Manipulating Equations

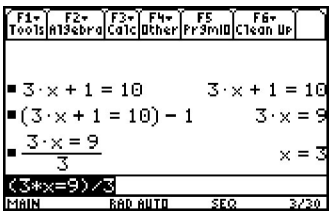
The CAS will let you enter an equation, and apply operators to both sides. For example, enter the equation $3x + 1 = 10$. Press ENTER.

The first step in solving this equation is the subtraction of 1 from both sides. You can do this by entering $(3x + 1 = 10) – 1$ and pressing ENTER. However, you can also use the ◆ key to copy and paste the equation that you have already entered. This is a useful feature, especially for long or complicated expressions.

(Press the up cursor key. Press ◆, and then **COPY** (the ↑ key). Press the down cursor key. Press ◆, and then **PASTE** (the ESC key). Notice that the equation has been pasted after the opening bracket.



Close the bracket, and enter –1. Press ENTER. Notice that 1 has been subtracted from both sides of the equation.
Use a similar procedure to divide both sides by 3. Notice that the CAS displays the value of x that satisfies the equation.



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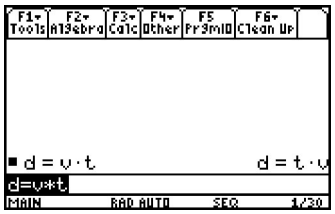
Checking a Solution

You can use the CAS to check a solution to an equation. Suppose that you solved the equation $3x + 1 = 10$, and found that $x = 3$. Enter $(3x + 1 = 10|x = 3)$, and press ENTER. Notice that the CAS returns a value of "**true**" if the solution is correct.

Entering Other Variables



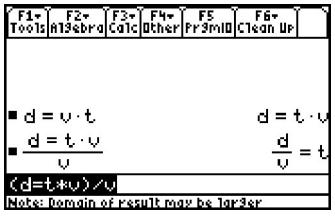
You may find a problem in which it is convenient to use variables other than X, Y, Z, or T . You can access these using the ALPHA key. For example, suppose that you want to enter the equation $d = vt$.

- Press ALPHA, and then ,.
- Press =.
- Press ALPHA, and then **0**.
- Press X.
- Press T, and then ENTER.

Note: when you want to multiply two variables, such as v and t, you must put a multiplication operator between them.

Solving Variable Equations

You can use the CAS to solve equations for a particular variable. For example, suppose that you want to solve $d = vt$ for v. You must divide both sides by t.



Enter the equation $d = vt$ as shown in the section **Entering Other Variables**. Press ENTER. Open a bracket, and use the ◆ key to cut and paste the equation, as shown in the section **Entering and Manipulating Equations**. Close the bracket. Enter $\div v$, and press ENTER.

For More Information

You can obtain more information on the operation of your TI-89 calculator in the calculator manual. You can also download an electronic version of the manual in PDF format at *www.education.ti.com*.