Programming Basis

A program in the HP-11C calculator is simply a sequence of keystrokes that is stored in the calculator. Whenever you have to calculate with the same sequence of keystrokes several times, you can save a great deal of time by incorporating these keystrokes into a program. Then pressing only one or two key starts the keystroke sequence and the calculator does the rest automatically.

Usually a program starts with a **[LBL]** marker and ends with the **[RTN]** key. In this way you can easily address and begin a program execution indicating the "Label" where it starts and the **[RTN]** where it ends.

Labels:
The "Label " is an address for a program, program branches and program subroutines. The alpha labels (**[A]** through **[E]**) and the numeric labels ("**0**" through "**9**") are keying into the program memory using **[f] [LBL]** and the desire alpha or numeric key. With the calculator in "Run" mode (normal mode) any key sequence program addressed by and alpha label is executed pressing **[f]** and the alpha label key. Labels "**0**" through "**9**" can also be used to address programs by the GSB key¡, but are usually reserved for program subdivisions (branches and subroutines).

User Mode:
User mode is a convenience feature. In USER mode, the normal key functions **[√x]**, **[e^x]**, **[10^x]**, **[y^x]** and **[1/x]** are swapped by the **[A]**, **[B]**, **[C]**, **[D]** and **[E]** labels. So, in USER mode, to execute the program addresses by label **[A]** simply press the **[√x]** key and to perform the "√x" function press **[f]** **[√x]**.
Pressing **[f] [USER]** toggles between the User mode and the normal mode. While USER mode is set, the "**USER**" annunciator appears in the display.

Beginning and Ending a Program:
To define the beginning of a program use **[f] [LBL]** instruction followed by one of the alpha or numeric keys to specify which label. The use of labels permits you to have several different programs or parts of programs loaded in the calculator at any time, and run them in any desired order.
To define the end of a program, use the **[g] [RTN]** (return) instruction. In a running program, using the return instruction in this way causes the calculator to immediately transfer the exception to line 000 and halt.

Programming Special Keys:
The calculator has several special keys that only have meaning when you are dealing with programs. Some of them are programmable and others are not. The non-programmable keys are for reviewing or debugging the program. The programmable Special keys are for controlling the program execution, such as displaying intermediate results, performing a conditional jump or continuing the execution at a specific program label.

The following listing describes the actions of the Non-programmable keys in the Program entry mode (PRGM annunciator in the display)

Non Programmable Special Keys Actions in PRGM mode	
[g] [P/R]	Toggles the calculator between **Program** or **Run** modes.
[f] clear [PRGM]	Clears the program memory and sets the current program line to line “000”.
[SST]	Advances the calculator to the next program line.
[g] [BST]	Sets the calculator to the previous program line.
[GTO] [•] ”nnn"	Sets the current program line to the designated “nnn” line.
[f] clear [PREFIX]	Does nothing.
[f] [USER]	Does nothing.
[g] [MEM]	Shows the Register and program lines available.
[←]	Deletes the current program line and displays the previous line.
[OPT]	Does nothing.
[g] [HELP]	Does nothing.

The following listing describes the actions of the Programmable keys when a program is running and executes the instruction.

Programmable Special Keys in Program Running State	
[GTO] “n”	Looks for the “n” label (A-E or 0-9) in the program memory and set it as the current program line.
[GSB] “n”	Looks for the “n” label (A-E or 0-9) in the program memory and transfer the program execution at that line. When reach a “RTN” instruction or an empty line, the control returns to the next line of the original GSB “n”call.
[R/S]	Stops the execution of the program at the current program line showing the stack-X in the display. To resume execution press **[R/S]** in the keyboard.
[g] [RTN]	Ends program execution or returns from subroutine.
[f] [X≤Y], **[X>Y]**, **[X≠Y]** or **[X=Y]** **[g] [X≤0]**, **[X>0]**, **[X≠0]** or **[X=0]**	Conditional testing. If the condition is met, the nest program line is executed, otherwise the next program line is skipped.
[f] [LBL] “n”	Label mark. Execution of the program continues in the next line.
[g] [SF] “n” **[g] [CF]** “n” **[g] [FS?]** “n”	Sets the Flag “n” (0 through 9) to “YES” state. Clears the Flag “n” (0 through 9) to “NO” state. Test flag “n”. If set, the next line is executed, otherwise is skipped.
[f] [PSE]	Pauses program execution for a second and displays the stack-X.
[f] [DSE]	Decrement the index register and skip the next line if the condition is met (see the Index Register topic for detailed information).
[f] [ISG]	Increment the index register and skip the next line if the condition is met (see the Index Register topic for detailed information).

Creating a Program:

Two create a program, is useful to follow the next general pattern:

1)	Press [f] [P/R] to set **program** mode allowing the calculator to record keystrokes (PRGM annunciator displayed).
2)	Press [f] clear [PRGM] to erase any previous programs. If you want to add a new program without erasing a program already stored, skip this step.
3)	Create a label to address the program with [f] [LBL] and, preferably, any alpha key key ([A] through [E]).
4)	Key in the sequence of keystrokes that constitute the program.
5)	When the keystroke sequence is finished, press [f] [P/R] to set the calculator back to **run** mode. The display will be normal showing the stack-X registers and the **PRGM** indicator will vanish.

Example:

Build a program to calculate the area of the base and the volume of cylindrical shape can. The input data is the radius of the base and the height of the can. Calculate the area and volume for for two cans. One of height 25 and radius 10. the other of height 8 and radius 4.5.

Solution: First enter the program for calculating the volume (π • radius^2 • height) following the next sequence:

Keystrokes	Display	Description
[g] [P/R]		Sets the calculator to program mode
[f] clear [PRGM]	000,	Clear the program memory.
[f] [LBL] [A]	001,42,21,11	Sets the label of the program.
[g] [x^2]	002, 43 11	Square of number in stack-X (radius).
[f] [π]	003, 42 16	Enters the number Pi.
[x]	004, 20	Calculates the area of the base, π•(radius)^2.
[R/S]	005, 31	Stops the program to show the base area.
[x]	006, 20	Calculates the final volume.
[g] [RTN]	007, 43,32	Stops the program and set program line to 000.
[g] [P/R]	—	Sets the calculator to Run mode

Second, calculate the area and the volume of the given cans :

Keystrokes	Display	Description
Type “25” **[ENTER]** “10”	10	Enter the height and the radius of the 1st can (height in stack-Y and the radius in stack-X).
[f] [A]	Running…	Executes the program “A”
	314.1593	Program stops showing the 1st can base area.
[R/S]	Running…	Resume program execution.
	7,853.9816	Program halts showing the volume of the 1st can.
Type “8” **[ENTER]** “4.5”	4.5	Enter the height and the radius of the 2nd can (height in stack-Y and the radius in stack-X).
[f] [A]	Running…	Executes the program “A”
	63.6173	Program stops showing the 2nd can base area.
[R/S]	Running…	Resume program execution.
	508.9380	Program halts showing the volume of the 2nd can.

NOTE: For a complete explanation and program examples, please download the HP-11C Owner’s Manual from the Hewlett-Packard website at “www.hp.com”