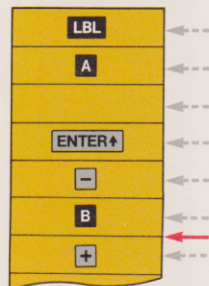


were pressed from the keyboard. Note that only **LBL**'s **A** thru **E** can designate subroutines, not **LBL**'s **0** thru **9**.

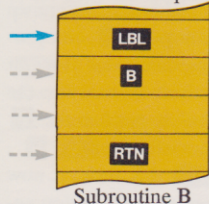
A good thing to remember when using subroutines is that your subroutine often repositions or changes data in the stack. Be sure to allow for this by first storing away values needed later.

Secondary Pointer. How does the calculator keep track of where to return from a subroutine call? It uses a second program pointer. In the previous drawing, when **A** is pressed, execution proceeds sequentially until the main program pointer reaches **B**. Here the pointer stops and marks its place directly after the **B** key.* And there the main program pointer waits.



Main pointer deactivates and marks its place after executing subroutine call **B**.

Meanwhile, a secondary pointer is activated, and it searches for **LBL B**, starting at the top of memory. When it finds the label, it executes the sequence of keys in the subroutine.



Secondary pointer executes subroutine B.

* In marking its place, the main program pointer is inserted into memory, though it does not take up one of your 100 steps. If you stop the secondary pointer in the middle of a subroutine and manually reposition it, you can see the main pointer in the display. It appears as keycode 41 and would execute as **ENTER+** in your program.

The execution of the **RTN** at the end of the subroutine deactivates the secondary pointer and reactivates the main program pointer. Program execution then continues sequentially in the main program.



Secondary pointer deactivated after executing **RTN**.

Main pointer reactivated. Execution continues at **+**.

Writing a Program with a Subroutine. In order to calculate the area and volume of a sphere efficiently we would use a subroutine. The equations for these two problems are:

$$\text{Area} = r^2 \times \pi \times 4 \quad \text{and} \quad \text{Volume} = \frac{r^3 \times \pi \times 4}{3}$$

The volume equation can easily be expressed in terms of the area equation:

$$\text{Volume} = \frac{r \times \text{Area}}{3}$$

And that is the way we'll write our programs. The program controlled by **A** will calculate the area of the sphere. Switch to W/PRGM mode, press **f** **PRGM** to clear the default programs, and key in the following list of keys.

Keys	Comments	Keys	Comments
LBL	Beginning of program.	g	Recall π .
A		TI	
STO 1	Store r for later use.	x	
r²	Calculate r^2 .	4	
↵		x	The area.
		RTN	End of program.