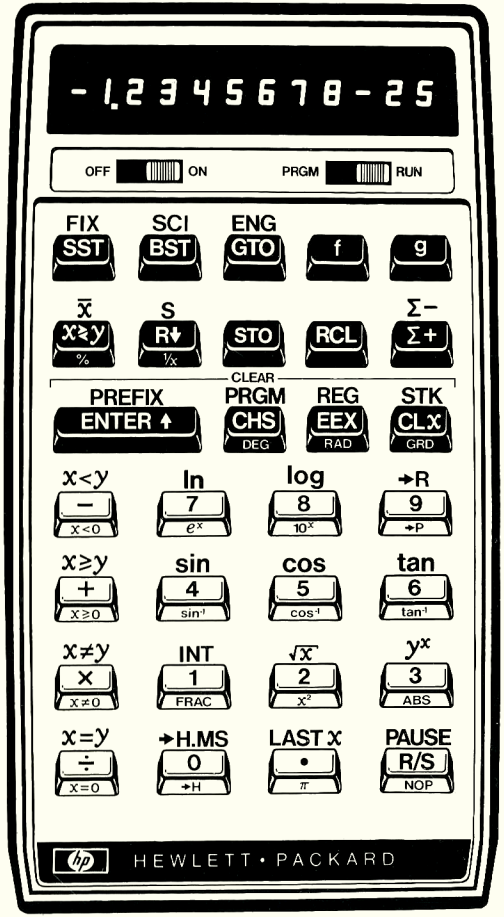


SCIENTIFIC PROBLEMS:

THE EASY WAY

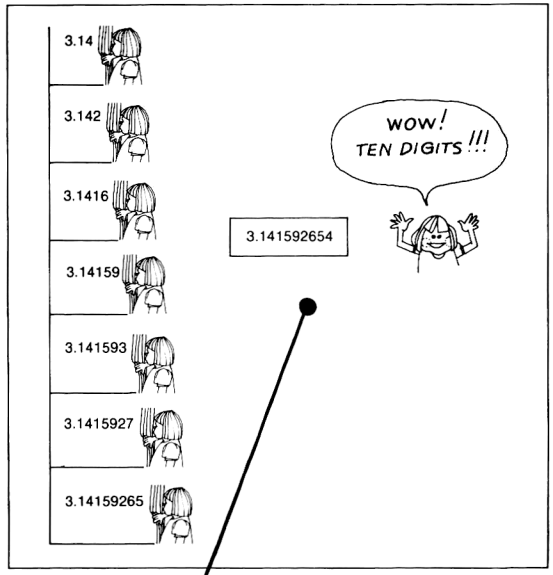
HEWLETT hp PACKARD

HERE you will find the correct answer from the preceding page.

HERE you will find new information.

1. 6
2. 1
3. 5
4. 4
5. 0

66



When our calculators are first turned on, the display reads 0.00 and all numbers are displayed with two decimal places. Internally, however, the numbers have *ten digits* and every calculator can display all ten.

Refer to the illustration on the left. You can think of the display as having a curtain. When you turn the calculator on, the curtain is open only enough to expose two decimal places. From the keyboard, however, you can open the curtain as far to the right as you need to see up to ten digits in the display.

1. When a Hewlett-Packard calculator is first turned on, how many decimal places are displayed?

2. Internally, how many digits does a number contain?

67

HERE you will find pictures which will help you understand the right-hand page.

HERE the questions will be asked.

HERE you should write the answer.

In this manual we are using programmed learning techniques to acquaint you with Hewlett-Packard scientific calculators.

You will be given information and then you will be asked questions pertaining to that information. After answering the questions, you will be able to check if your answers are correct by referring to the left side of the following page.

The picture on page 2 illustrates the format we will be using.

Keying in Numbers

The keyboard on any calculator serves two purposes: it allows you to put numbers into the calculator, and it lets you perform functions using those numbers. Since the calculator must first have numbers before functions can be performed, we will begin our program by introducing to you the keys that let you put numbers into the calculator. First, there are the digit keys listed below:

DIGIT KEYS

7	8	9
4	5	6
1	2	3
0	•	

To put 1.25 into the display press 1 • 2 5 . We refer to this as *"keying in"* a number. Notice that the digits were pressed in the same order as you would write them down on a piece of paper.

Next, there is the CHANGE SIGN key, designated CHS , which allows you to change the sign of the number in the display. **Press** the CHS key on your calculator. The display should now read −1.25. **Press** CHS a second time and see that the display again reads 1.25.

Finally, the CLx key clears the display when it is pressed. This key enables you to remove the number currently being displayed. **Press** CLx . The display should now read 0.00. CLx is similar to a *"clear entry"* key.

1. The process of putting a number into the display by pressing the digit keys is called _____ .

2. The key which is similar to a *"clear entry"* key is _____ .

3. Key in the number 148.65. Write down the keys you pressed here. _____

1. Keying in

2. CL x

3. 1 4 8 • 6 5

COMMON ONE-NUMBER FUNCTIONS

$\sqrt{x}$	log x	TAN
1/x	10^x	SIN^{-1}
1n x	SIN	COS^{-1}
e^x	COS	TAN^{-1}

Other One-Number Functions:

n! x^2 → H.MS → H

One-Number Functions

Now that we have shown you how to put numbers into the calculator, we can proceed to performing functions which is the second purpose of a calculator keyboard.

When performing functions, all Hewlett-Packard calculators work the same way—*the way **you** think*. For example, do the following problem in your head:

1. Given the number 25,
2. Take the square root ($\sqrt{\ }$) of it. (answer is 5)

In doing this problem you followed two steps:

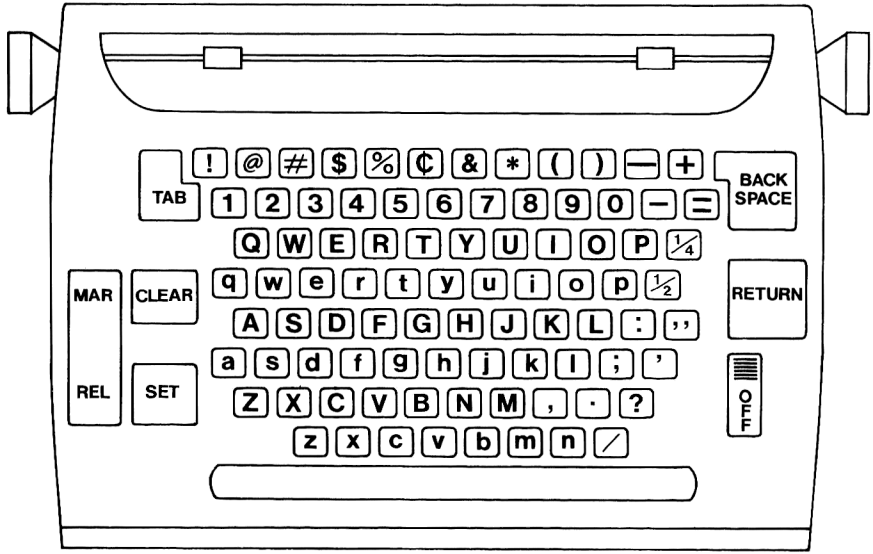
1. We gave you the number (25).
2. You did the function ($\sqrt{\ }$).

To do the same problem on our calculator:

1. First give the calculator the number by keying in 25.
2. Now **press** the key labeled $\sqrt{x}$.

Please note that the calculator must first be given the number, and then the function to be performed.

This type of a function is called a *one-number function* because only one number must be in the calculator before you can perform the function. On the opposite page is a list of one-number functions that are usually available on Hewlett-Packard scientific calculators.


TAB
BACK SPACE
MAR
REL
CLEAR
SET
RETURN
OFF

Prefix Keys

The picture on the left illustrates the possible appearance of a typewriter if it had no shift key. The shift key enables each key on the keyboard to type two symbols: lower case and upper case. Since there is no shift key on our typewriter, the keyboard contains twice as many keys! It would be very difficult to design a portable typewriter without a shift key.

People who purchase our calculators require Hewlett-Packard's successful combination of power and portability. In order to provide these desirable qualities, Hewlett-Packard uses a concept very similar to that of a shift key on a typewriter. A typical calculator keyboard may contain any or all of the symbols listed below:

1. Functions *written* on the keys.

2. Functions *written* in a special color above the keys.

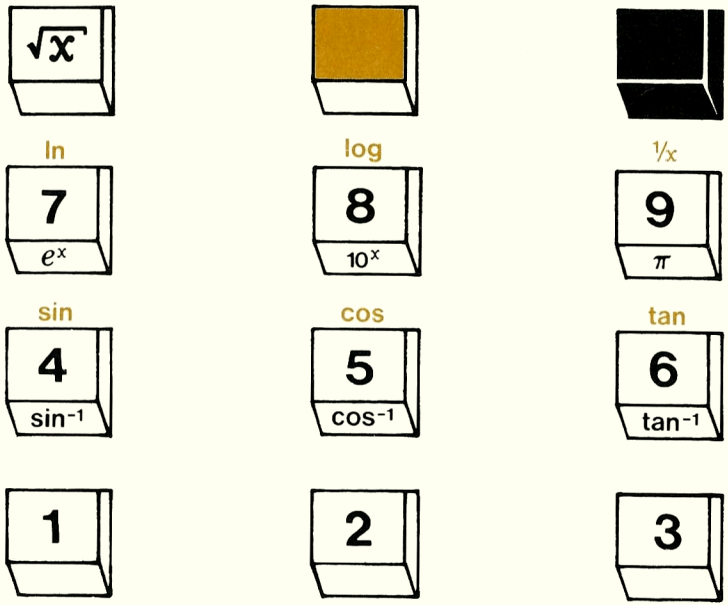
3. Functions *written* in a special color on the slanted front part of the keys.

To perform a function printed in color *above* a key, first **press** the corresponding color key, then **press** the function key.

or

To perform a function printed in color on the *slanted* face of a key, first **press** the corresponding color key, then **press** the function key.

The solid colored keys are called **prefix keys** because they must be pressed first, before the actual function key is pressed. Usually the colors will be blue, gold or black.


√x
ln
7
e^x
log
8
10^x
1/x
9
π
sin
4
$\sin^{-1}$
cos
5
$\cos^{-1}$
tan
6
$\tan^{-1}$
1
2
3

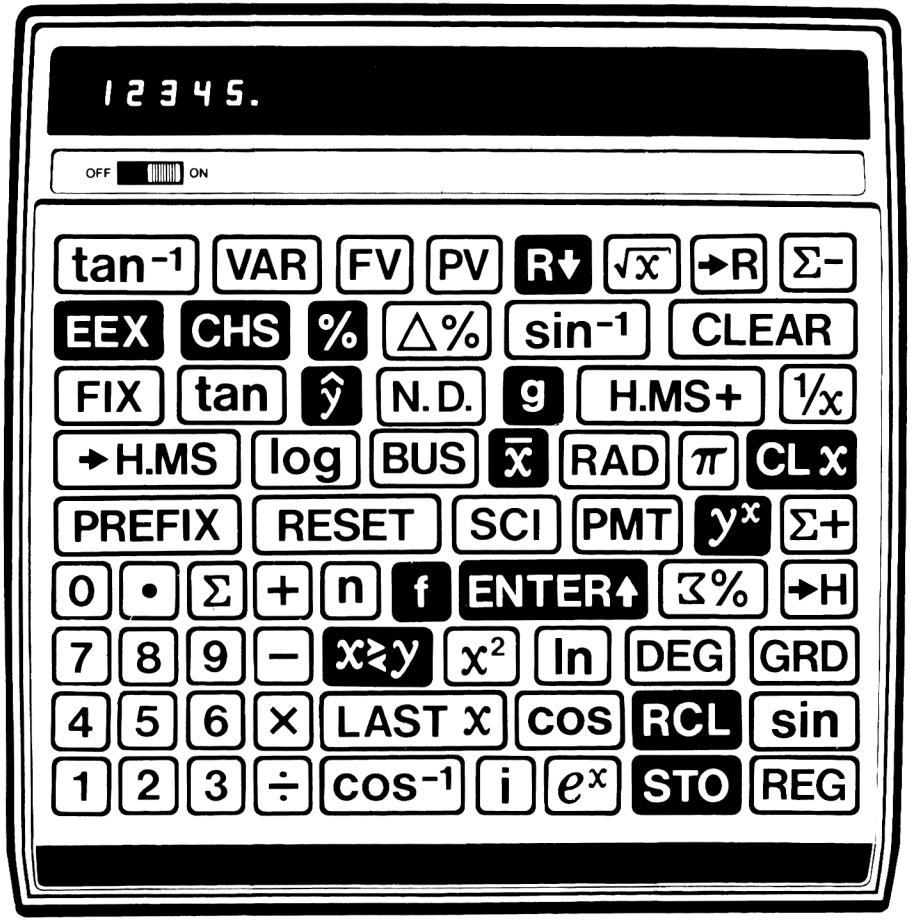
The page on the left contains a sample keyboard. This keyboard does not actually exist on any HP calculator but it is used here for illustration purposes.

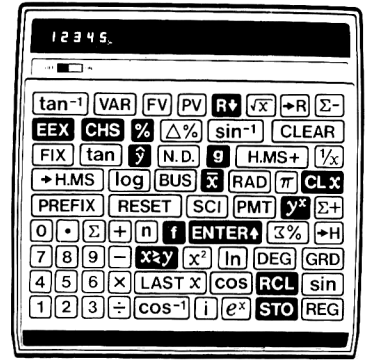
Suppose we had to calculate the following:

1) $\sqrt{36}$ 2) SIN 30 3) $COS^{-1}0.71$

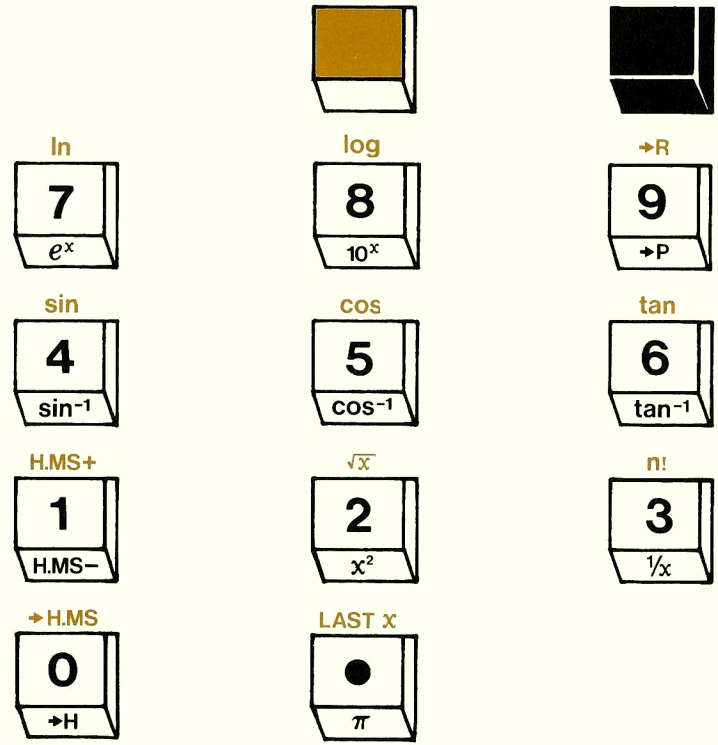
Using our keyboard to solve the first problem, we must key in 36 and **press** $\boxed{\sqrt{x}}$. We would get an answer of 6.00. For the second problem, as always, we first key in our number 30. Since SIN is written in gold above $\boxed{4}$, we must first **press** the solid gold key ■ and then $\overset{\text{SIN}}{\boxed{4}}$ to get an answer of 0.50.

Finally, to do the third problem we key in 0.71, **press** the solid black key ■ and then **press** $\underset{\text{COS}^{-1}}{\boxed{5}}$, since this key has COS^{-1} written in black on the slanted front. The answer is 44.77.


12345.
OFF ON
tan⁻¹ VAR FV PV R↓ √x →R Σ-
EEX CHS % Δ% sin⁻¹ CLEAR
FIX tan ŷ N.D. g H.MS+ 1/x
→H.MS log BUS x̄ RAD π CL x
PREFIX RESET SCI PMT y^x Σ+
0 • Σ + n f ENTER↑ Σ% →H
7 8 9 − x≷y x² ln DEG GRD
4 5 6 × LAST x cos RCL sin
1 2 3 ÷ cos⁻¹ i e^x STO REG


12345.
tan⁻¹ VAR FV PV R↓ √x →R Σ-
EEX CHS % Δ% sin⁻¹ CLEAR
FIX tan ŷ N.D. g H.MS+ 1/x
→H.MS log BUS x̄ RAD π CL x
PREFIX RESET SCI PMT y^x Σ+
0 • Σ + n f ENTER↑ Σ% →H
7 8 9 − x≷y x² ln DEG GRD
4 5 6 × LAST x cos RCL sin
1 2 3 ÷ cos⁻¹ i e^x STO REG

The calculators pictured on the left illustrate the necessity of a prefix key. Rather than using a prefix key, these calculators have one key for every function. As you can see, in order to have keys that can be easily pressed, the calculator has to be large. To have a pocket-sized calculator the keys would be too small.


ln
7
e^x
log
8
10^x
→R
9
→P
sin
4
$\sin^{-1}$
cos
5
$\cos^{-1}$
tan
6
$\tan^{-1}$
H.MS+
1
H.MS−
$\sqrt{x}$
2
x^2
n!
3
$1/x$
→H.MS
0
→H
LAST x
•
π

Using the sample keyboard on the opposite page, write down the keystrokes necessary to do the following one-number functions. Be sure to include any digits that need to be keyed in and any prefix keys that need to be pressed. Designate the black key by writing [Black]and the gold key by writing [Gold].

Problem	Keys Pressed
1. $\sqrt{49}$	
2. 1n 8	
3. TAN^{-1} .47	
4. 1/5	
5. e^4	

6. List 5 one-number functions:
7. A function which requires only one number is called a _____ _____ _____ .
8. An example of a prefix key is a _____ _____ on a typewriter.
9. A key that must be pressed before another key to perform a function is called a _____ _____ .

1. [4] [9] [Gold] [2]
2. [8] [Gold] [7]
3. [•] [4] [7] [Black] [6]
4. [5] [Black] [3]
5. [4] [Black] [7]
6. Any five of the following are satisfactory:

   $\sqrt{x}$, x^2, log x, 10^x, 1n x, e^x, SIN, COS, TAN, SIN^{-1}, COS^{-1}, TAN^{-1}, 1/x, n!, → H.MS, → H.

7. One-number function
8. Shift key
9. Prefix key

Now take any Hewlett-Packard scientific calculator and calculate the answers to the following problems.

Problem	Write Answers Here
1. $\sqrt{78}$	
2. e^5	
3. 1n 18	
4. 1/7	
5. log 30	
6. SIN 45	
7. COS 60	
8. TAN^{-1} .82	
9. SIN^{-1} .50	
10. COS^{-1} .71	

1. 8.83
2. 148.41
3. 2.89
4. 0.14
5. 1.48
6. 0.71
7. 0.50
8. 39.35
9. 30.00
10. 44.77

If you are having difficulty in obtaining the correct answers, review pages 11 to 17. If the difficulty continues after reviewing, speak to your Hewlett-Packard representative.

Basic Arithmetic

The problems you have been doing are one-number functions. In doing basic arithmetic (*addition, subtraction, multiplication and division*) you must work with **two numbers**. Hence, these functions are called **two-number functions**.

1. A function which requires two numbers in order to be performed is called a ____ _____ _____ .

2. List the four basic two-number functions:

1. Two-number functions

2. Add, subtract, multiply, divide

When performing two-number functions, again Hewlett-Packard calculators work the same way you think. To illustrate, do the following problem in your head:

1. Take the following two numbers
   12, 3

2. Add them. (Answer is 15)

To do this problem, you followed the same two steps used earlier to do one-number functions. That is,

1. We gave you the numbers

first	12
then	3

2. You did the function (+).

$$\begin{array}{r} 12 \\ +\ 3 \\ \hline \end{array}$$

,


ENTER

To do this addition on any Hewlett-Packard scientific calculator:

1. First give the calculator the two numbers by pressing:

   12
   ENTER↑
   3

2. Then add by pressing: ⊞

Notice that the same basic rule was followed for doing one-number functions. In doing addition, the only difference is you must put two numbers into the calculator instead of one before performing the function. The ENTER↑ key was used so you could put both numbers into the calculator. Just as the *comma separated* 12 and 3 when we gave them to you, ENTER↑ *separated* 12 and 3 when you gave them to the calculator.

In Your Head	**On The Calculator**
12, 3	12 ENTER↑ 3
+	⊞

Using the rules we just gave you, do the following problems on any Hewlett-Packard scientific calculator:

Problem	Keys Pressed	Answer
1. 12 +3		
2. 12 −3		
3. 12 ×3		
4. 12 ÷3		

5. The ENTER↑ key is similar to a _____ and serves to _____ two numbers when you put them into the calculator.

	Keys Pressed	Result
1.	12 ENTER↑ 3 +	15.00
2.	12 ENTER↑ 3 −	9.00
3.	12 ENTER↑ 3 ×	36.00
4.	12 ENTER↑ 3 ÷	4.00

5. Comma, separate

More Practice Problems

Problem	Keys Pressed	Answer
1. 17 + 23		
2. 1096 ÷ 4		
3. 27 ×44		
4. 238 − 524		
5. 733 +499		
6. 5346 / 19		
7. 62 × 19		
8. 7982 −3425		

	Keys Pressed	Result
1.	17 ENTER↑ 23 +	40.00
2.	1096 ENTER↑ 4 ÷	274.00
3.	27 ENTER↑ 44 ×	1188.00
4.	238 ENTER↑ 524 −	−286.00
5.	733 ENTER↑ 499 +	1232.00
6.	5346 ENTER↑ 19 ÷	281.37
7.	62 ENTER↑ 19 ×	1178.00
8.	7982 ENTER↑ 3425 −	4557.00

While add, subtract, multiply and divide are on all HP calculators, below is a list of some other two-number functions which may be on the calculator you are using:

Y^x	raising a number to a power
%	percent
Δ%	percent difference
$\rightarrow$P	converting rectangular coordinates to polar coordinates
$\rightarrow$R	converting polar coordinates to rectangular coordinates

All two-number functions are performed in the same manner as add, subtract, multiply and divide. That is, you:

1. Key in the first number.
2. Press ENTER↑ to separate the first number from the second.
3. Key in the second number.
4. Perform the function.

In raising a number to a power, the Y^x function is used. Let's raise 2 to the third power (expressed 2^3). Below are the keys we must press:

2
ENTER↑

3
y^x

ANSWER IS 8.00

Using the Y^x function on your calculator, calculate the answers to these problems. Remember to use a prefix key if it is necessary for your calculator.

Problem	**Result**
1. 5^4	
2. $16^{1.4}$	
3. 7^3	
4. $36^{.5}$	

5. A function that requires two numbers before it can be performed is called a ___ _____ _____ .

6. List three functions other than $+$, $-$, $\times$, $\div$, which are two-number functions:

1. 625.00

2. 48.50

3. 343.00

4. 6.00

5. Two-number function.

6. Any three of the following are satisfactory:

   Y^x

   %

   Δ %

   → P

   → R

Whether performing one-number or two-number functions, you follow a consistent rule:

1. Give the calculator the number or numbers.

2. Perform the function.

In each case, the numbers must first be in the calculator, because the function is immediately performed when the function key is pressed. Therefore, for Hewlett-Packard scientific calculators:

PRESSING A FUNCTION KEY CAUSES THE CALCULATOR TO IMMEDIATELY PERFORM THAT FUNCTION FOR *ALL* FUNCTIONS.

Examples of Chain Calculations

1. $12 + 2 + 6 - 3$

2. $7 \times (12 + 3)$

3. $(2 + 3) \times (6 + 7)$

4. $\dfrac{4 \times (12 - 7)}{(9 - 7)}$

5. $(1.5 \times 4)^{(21 \div 7)}$

Chain Calculations

There are many problems which involve more than one function, such as the expressions pictured on the opposite page. These problems are called *chain calculations*.

You must solve a chain calculation a portion at a time. Refer to the first problem pictured on the left. To solve this problem with pencil and paper you must work with two numbers at a time until you have the final answer.

~~12 + 2~~ + 6 − 3
~~14 + 6~~ − 3
~~20 − 3~~
17

The *final result* is 17. We call 14 and 20 *intermediate results*. They were calculated first in order to find the final result of 17.

$12 + 2 + 6 - 3$

Steps	Keys Pressed	Display
1.	12 ENTER↑ 2 ⊞	14.00
2.	6 ⊞	20.00
3.	3 ⊟	17.00

Hewlett-Packard calculators make the process of working through a problem as natural as it would be if you were working it out with pencil and paper, but the calculator takes care of the hard part. That is, intermediate results are automatically stored inside the calculator and then inserted into the calculation when you need them. To illustrate this point, we have solved our first example on the page at the left using a Hewlett-Packard calculator.

Explanation of Steps

1. Just as with pencil and paper, we began our calculation by adding 12 and 2. We see that the intermediate result of 14 is displayed.

2. Next, we added 6 to our intermediate result of 14 and a result of 20 is displayed. Notice that we did not have to press ENTER↑ before we keyed in 6. Since 14 was a result of a calculation, it was *automatically saved* by the calculator.

3. Finally, we subtracted 3 from our intermediate result of 20 to obtain a final result of 17. Again the result 20 was automatically saved by the calculator and we did not have to press ENTER↑ before we keyed in 3.

$7 \times (12 + 3)$

Pencil and Paper Solution

$7 \times \cancel{(12 + 3)}$

15

(INTERMEDIATE RESULT)

$\cancel{7 \times 15}$

105

(RESULT)

Hewlett-Packard Solution

Keys Pressed	**Display**
12 ENTER↑ 3 +	*15.00*
7 ×	*105.00*

Now let's look at the second example. The solutions to this problem using pencil and paper and using a Hewlett-Packard calculator are shown on the page to your left.

This problem has introduced the use of *parentheses.* Since chain calculations consist of more than one function, it is important to know the order in which the functions should be performed. Parentheses are used to indicate the order of performing functions in a chain calculation. In this particular problem, parentheses tell you where to start. First, we add 12 and 3 because this expression is contained in parentheses. This gives us the intermediate result of 15. Then we multiply this result by 7 to obtain the final result of 105.

Again, notice that the calculator *automatically* remembered the intermediate result of 15. The ability of Hewlett-Packard calculators to handle intermediate results automatically is one of the greatest advantages of our calculators. They can handle up to *four* intermediate results at the same time. The only thing you need to write down is the final answer.

The next few pages will show the solutions to examples 3 through 5. In each case the same format is followed: first the pencil and paper solution is given, then the calculator solution is illustrated. Use any Hewlett-Packard scientific calculator to work through the problems and verify the answers.

EXAMPLE 3: $(2 + 3) \times (6 + 7)$

Pencil and Paper Solution

$\cancel{(2+3)} \times \cancel{(6+7)}$

5 13 (Intermediate Results)

$\cancel{5 \times 13}$

65 (Final Result)

Hewlett-Packard Solution

Keys Pressed	**Display**
2	
ENTER↑	
3	
⊞	5.00
6	
ENTER↑	
7	
⊞	13.00
⊠	65.00

EXAMPLE 4: $\dfrac{4 \times (12 - 7)}{(9 - 7)}$

In this example the line (————) indicates division.

Pencil And Paper Solution

$\dfrac{4 \times \overset{5}{\cancel{(12 - 7)}}}{(9 - 7)}$ (Intermediate Result of 12-7)

$\dfrac{\cancel{4 \times 5}\,20}{(9 - 7)}$ (Intermediate Result of Top)

$\dfrac{20}{\cancel{(9 - 7)}\,2}$ (Intermediate Result of Bottom)

$\dfrac{20}{2}$

10 (FINAL RESULT)

Hewlett-Packard Solution

Keys Pressed	Result Displayed
12	
ENTER↑	
7	
−	5.00
4	
×	20.00
9	
ENTER↑	
7	
−	2.00
÷	10.00

EXAMPLE 5: $(1.5 \times 4)^{(21 \div 7)}$

In this problem we must use Y^x, raising a number to a power, where $y = 1.5 \times 4$ and $x = 21 \div 7$.

Pencil and Paper Solution

~~(1.5×4)~~ $(21 \div 7)$ (Intermediate Result Y)

6

~~$(21 \div 7)$~~ 3 (Intermediate Result x)

6

~~6^3~~

216 (Final Result)

Hewlett-Packard Solution

Keys Pressed	**Result Displayed**
1.5	
ENTER↑	
4	
⊠	6.00
21	
ENTER↑	
7	
÷	3.00
* y^x	216.00

**Remember to use a prefix key if necessary.*

Now try solving these problems. They are very similar to the ones you have been doing, so you may wish to review the examples we presented.

Problem	Keys Pressed	Result
1. $9 + 7 + 8 - 2$		
2. $6 \times (5 + 3)$		
3. $2 \times (12 - 9)$		
4. $(45 \div 5) - 6$		
5. $(6 - 4) \times (7 + 3)$		
6. $(10 \div 2) - (15 \div 5)$		
7. $\frac{5 \times (17 - 11)}{(9 - 4)}$		
8. $(6 \times .5)\ (18 \div 9)$		

9. Problems which involve more than one function are called _____ _____ .
10. How many intermediate results can Hewlett-Packard calculators automatically handle at the same time?
11. One of the greatest advantages of Hewlett-Packard calculators is their ability to handle intermediate results _____ .
12. What are commonly used to indicate the order of performing chain calculations?

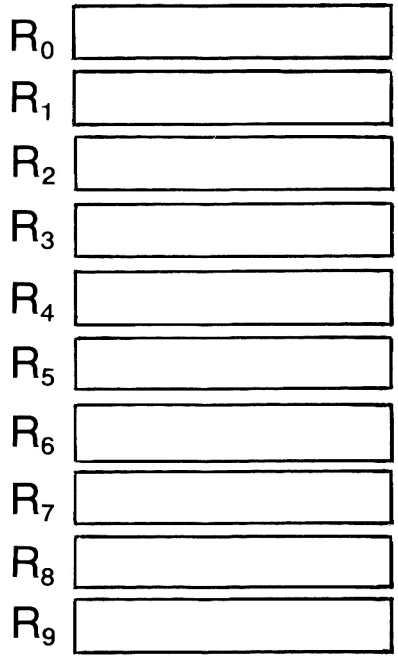
	Keys Pressed	*Result*
1.	9 ENTER↑ 7 + 8 + 2 −	22.00
2.	5 ENTER↑ 3 + 6 ×	48.00
3.	12 ENTER↑ 9 − 2 ×	6.00
4.	45 ENTER↑ 5 ÷ 6 −	3.00
5.	6 ENTER↑ 4 − 7 ENTER↑ 3 + ×	20.00
6.	10 ENTER↑ 2 ÷ 15 ENTER↑ 5 ÷ −	2.00
7.	17 ENTER↑ 11 − 5 × 9 ENTER↑ 4 − ÷	6.00
8.	6 ENTER↑ .5 × 18 ENTER↑ 9 ÷ y^x	9.00

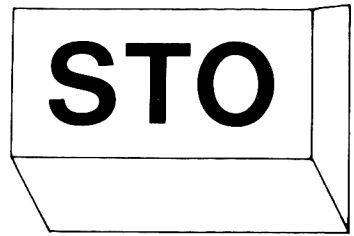
9. Chain calculations
10. Four
11. Automatically
12. Parentheses

If difficulty persists, review pages 41 to 51 or contact your Hewlett-Packard representative for assistance.

The first portion of this workbook has been dedicated to acquainting you with the vast problem-solving capabilities of Hewlett-Packard calculators—the many one-number and two-number scientific functions and the ability to handle the largest calculations easily and consistently. These features, needed by engineers and scientists, are available on all of our scientific calculators. Now we will present some other features which increase the power and convenience of using Hewlett-Packard scientific calculators.

STORAGE





Storage

In addition to automatic storage of intermediate results, Hewlett-Packard calculators also have *addressable storage* that is unaffected by chain calculations. This storage allows you to set aside numbers as constants or for use in later calculations. See illustration on opposite page.

The amount of addressable storage available varies with each calculator. Every Hewlett-Packard scientific calculator contains the following two keys for storing and recalling numbers:

STO RCL

1. Storage which is unaffected by chain calculations is called _____ _____ .

2. Write down the two keys on Hewlett-Packard calculators that are used to store and recall numbers _____ _____ .

1. Addressable storage

2. STO RCL

When a Hewlett-Packard calculator has *one* addressable storage register, the rules below apply for storing and recalling a number:

1. To store a value appearing in the display, press STO (store).

2. To recall a number from the storage register into the display, press RCL (recall).

Therefore, if we were using a Hewlett-Packard calculator with one storage register and wanted to store 25 in that register, we would:

Key in 2 5.
Press STO.

To verify that we had stored our number properly, we would:

Press	Display
CL x	0.00
RCL	25.00

If a Hewlett-Packard calculator has 10 or less addressable memories, generally the following rules apply:

1. To store a value appearing in the display, press STO (store) followed by a number key (0 through 9) to specify the register in which the value is to be stored.

2. To recall a number from one of the storage registers into the display, press RCL (recall) followed by a number key (0 through 9) to specify the register you wish to recall.

Suppose we have a calculator that has 10 memories (0–9) and we want to store the number 30 in register one.

Press

3 0 STO 1

To verify that we have stored our number properly:

Press	Display
CLx	0.00
RCL 1	30.00

Use a Hewlett-Packard calculator that has ten memories and try the previous example.

You can recall a number from a storage register any number of times without altering it—the number will remain in the storage register until you:

1. Overwrite it by storing another number there.

2. Clear the storage registers. (This procedure varies for every calculator)

To summarize, it is wise to consult the owner's handbook when you are attempting to use addressable storage for the first time. The handbook will tell you how may memories are available, how to access those memories, and how to clear the memories.

1. Suppose you have a calculator with 10 memories. Write down the buttons you must press to:
   a. Store 60 in register 5.
   b. Recall the contents of register 5.

2. List two ways you can alter the contents of a storage register.

1. a. 6 0 STO 5
   b. RCL 5

2. a. Overwrite it by storing another number there.

   b. Clear the storage registers.

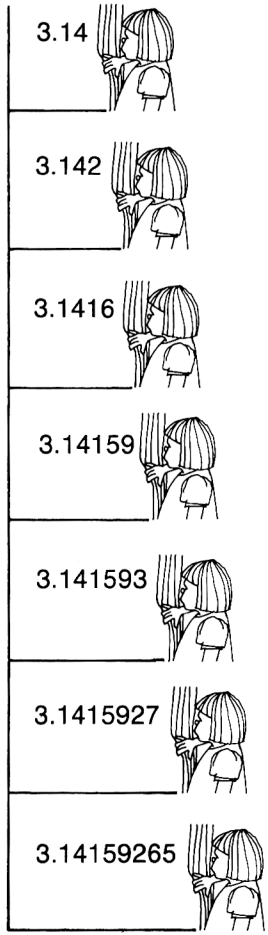
Getting More Digits Into the Display

Before we begin our discussion of controlling the display, we will explain the expression "decimal place." When a number is displayed with two digits to the right of the decimal point, such as 3.14, we say that the number has two decimal places. If the number has five digits to the right of the decimal point, it has five decimal places, as in 23.14592. Hence, you can determine how many decimal places a number has by counting the number of digits to the right of the decimal point.

How many decimal places do each of the following numbers have?

	Number of Decimal Places
1. 3.145927	
2. 45.8	
3. 0.65835	
4. 123.4673	
5. 156	

1. 6
2. 1
3. 5
4. 4
5. 0



3.141592654

When our calculators are first turned on, the display reads 0.00 and all numbers are displayed with two decimal places. Internally, however, the numbers have *ten digits* and every calculator can display all ten.

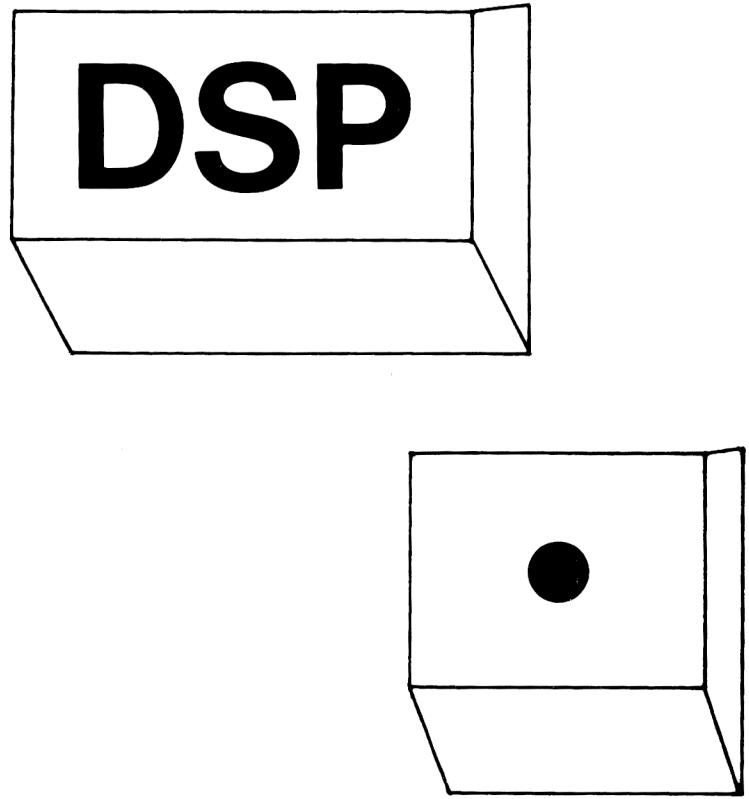
Refer to the illustration on the left. You can think of the display as having a curtain. When you turn the calculator on, the curtain is open only enough to expose two decimal places. From the keyboard, however, you can open the curtain as far to the right as you need to see up to ten digits in the display.

1. When a Hewlett-Packard calculator is first turned on, how many decimal places are displayed?

2. Internally, how many digits does a number contain?

1. Two

2. Ten

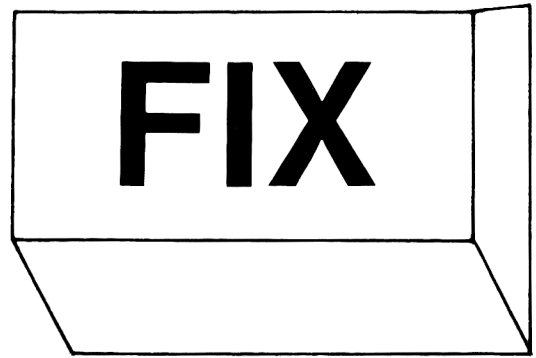


There are several methods used by our calculators to "open the curtain." One calculator uses a [DSP] key. Suppose you want to display all numbers to five decimal places. You would press:

Keys	Display
[DSP]	0.00
[.]	0.00
[5]	0.00000

Every number will now be displayed with five decimal places until you turn off the calculator, or tell the calculator something else. Suppose you decided that you needed eight decimal places instead of five. You would press:

Keys	Display
[DSP]	0.00000
[.]	0.00000
[8]	0.00000000


FIX

The second method uses a key labeled [FIX]. To put five decimal places into the display using this method, you would press:

Keys	Display
* [FIX]	0.00
[5]	0.00000

To change this display to eight decimal places, press:

Keys	Display
* [FIX]	0.00000
[8]	0.00000000

*Most calculators using this method have FIX written in gold above a key. Hence, it is necessary to press the gold key first and then the key with FIX written above it.

Now try to obtain a calculator that uses one of the two methods described. See if you can set the display to the following number of decimal places.

1. Nine
2. Seven
3. Zero
4. Two

If using a calculator with a [DSP] key:

1. [DSP] [•] [9]
2. [DSP] [•] [7]
3. [DSP] [•] [0]
*4. [DSP] [•] [2]

If using a calculator with a [FIX] key:

1. [FIX] [9]
2. [FIX] [7]
3. [FIX] [0]
*4. [FIX] [2]

*This may also be accomplished by turning the calculator off and then on again.

There are two reasons Hewlett-Packard calculators operate this way. One reason is *to save battery power*. The display uses more power than any other part of the calculator. Therefore, the fewer digits you display, the less power you use from the battery.

For example, suppose you had a long calculation to perform and needed all ten digits of the final answer. Also, suppose you wanted to make the charge on your battery last as long as possible. You could work through the entire problem displaying only a few digits, and when you obtain the final answer, display all ten digits.

The second reason for operating this way is *to provide automatic rounding for the user*. You have the flexibility to set the display to the number of decimal places you require and the calculator will round the display automatically. Internally, however, the entire ten digits are still there.

Hence, if you were taking an exam and were required to provide five decimal places in all answers, you could set the display accordingly and the calculator would round all of your answers correctly. This saves you from having to search through the number for the fifth decimal place, and from having to decide how to round off the number.

The method of displaying more digits varies with each calculator. It is best to consult the owner's handbook to find out how to display more digits for a particular calculator. Usually, instructions will be in a section called "Display Control" or "Display Formatting." The important point is our calculators use ten digits to calculate and not two or three.

1. Internal calculations on Hewlett-Packard calculators are done to *how many* digits?

2. Can you display more than two digits after the decimal point on a Hewlett-Packard calculator?

3. Give two reasons why Hewlett-Packard calculators offer a controllable display.

1. Ten
2. Yes
3. To save battery power.
   To provide automatic
   rounding for the user.

Scientific Notation

If a calculator is to be truly scientific, it is not enough just to have scientific functions. Because engineers and scientists often work with very large and very small numbers, it was necessary that they find an easy way to express such numbers. Hence, a sort of shorthand has been developed for writing very large and very small numbers. It is called *scientific notation*. Below are two numbers first written in regular form, then written in scientific notation.

Regular	Scientific Notation
602,257,000,000,000,000,000,000. (23 decimal places)	6.02257×10^{23}
.000000000000000000000000062554 (27 decimal places)	6.62554×10^{-27}

The first number is used frequently in gas compression calculations, while the second number is used in energy calculations. As you can see, it would be quite cumbersome to write these entire numbers down everytime they were used! It is much more convenient to express these numbers in scientific notation. Please notice that a number written in scientific notation must:

1. Have only one digit to the left of the decimal point, with everything else to the right of the decimal point.
2. Be multiplied by 10 raised to a power. For example, the first number is multiplied by 10^{23}. The 23 indicates how many places to the *right* you move the decimal point to get the actual number. The second number is multiplied by 10^{-27}. The minus (−) sign indicates you must move the decimal point *left* 27 places to get the actual number.

Hewlett-Packard scientific calculators allow you to express numbers in scientific notation. By using the EEX key, you can key in numbers written in scientific notation. Consider the two examples used earlier.

6.02257×10^{23}

Press	Display
6.02257	6.02257
EEX	6.02257 00
23	6.02257 23

6.62554×10^{-27}

Press	Display
6.62554	6.62554
EEX	6.62554 00
27	6.62554 27
CHS	6.62554 -27

Also, by referring to the display control section of the owner's handbook, you can learn how to set the display so that all numbers are automatically displayed in scientific notation.

1. The shorthand developed for writing very small and very large numbers is called _____ _____ .
2. A number expressed in scientific notation should have only _____ digit to the left of the decimal point.
3. Below, write down the keys you must press to put 1.234×10^{12} into the display of a calculator.

1. Scientific notation
2. One
3. [1] [•] [2] [3] [4] [EEX] [1] [2]

Factor by which unit is multiplied	Prefix	Symbol
10^{12}	tera	T
10^{9}	giga	G
10^{6}	mega	M
10^{3}	kilo	k
10^{23}	milli	m
10^{-6}	micro	μ
10^{-9}	nano	n
10^{-12}	pico	p
10^{-15}	femto	f
10^{-18}	atto	a

A "silly millimeter" is 10^{-3} silly meters.

A kilowatt is 10^{3} watts.

A microsecond is 10^{-6} seconds.

To illustrate the difference between the two forms of notation, below we have expressed a number first in engineering notation and then in scientific notation.

Engineering	Scientific
12.3×10^{-9}	1.23×10^{-8}
$456. \times 10^{6}$	4.56×10^{8}
7.89×10^{3}	7.89×10^{3}

Engineering Notation

Several Hewlett-Packard scientific calculators offer a special form of scientific notation called *engineering notation*. Engineering notation differs from scientific notation in the following two ways:

1. Ten is always raised to a power that is a multiple of three (e.g. 10^3, 10^6, 10^9).
2. There may be one, two, or three digits to the left of the decimal point.

This notation is particularly useful in scientific and engineering calculations, where units of measure are often specified in multiples of three. Refer to the page on the left for clarification.

Since this feature is not available on all of our calculators, be sure to consult the owner's handbook to verify that a particular calculator offers engineering notation. This topic will be explained in the section on "Controlling the Display." Presently, Hewlett-Packard calculators are the only ones which have engineering notation.

1. In engineering notation, ten is raised to a power that is a multiple of _____.
2. Circle the number below which is expressed in engineering notation.

1.23×10^7 12.3×10^6

1. Three

2. 12.3×10^6

Who Uses Hewlett-Packard Scientific Calculators?

You may be asked by a customer, "What is the best calculator for me?" While you may not be able to narrow down the customer's needs to a single calculator, you should be equipped with enough information to help the customer determine what type of calculator best fulfills his needs. For example, if someone plans to use the calculator mostly for balancing a checkbook, or adding grocery bills, a calculator that adds, subtracts, multiplies, divides, and computes percent would probably be sufficient. However, this calculator would fall short of fulfilling the requirements of an engineer who needs trigonometric and logarithmic functions on a calculator.

Owners of Hewlett-Packard scientific calculators will normally use them in one of the following capacities:

- Engineering
- Science
- Research and Development
- Education

These areas may be further broken down in the following manner:

ENGINEERING
- Electrical/Electronic
- Civil/Structural
- Chemical
- Mechanical

SCIENCE
- Physics
- Mathematics
- Statistics
- Chemistry
- Biology
- Medicine

EDUCATION
- Instructors (high schools and colleges)
- Students (high schools and colleges)

RESEARCH & DEVELOPMENT
- Design
- Administrative Statistics

Please keep in mind that these are not the only uses for Hewlett-Packard calculators. They are, however, intended to be general guidelines for undecided customers. If you are having difficulty in categorizing a particular customer, please have him contact your Hewlett-Packard representative.

1. Which of the following people would be satisfied with a scientific calculator? (Circle the corresponding letter).

   a. A *real estate agent* who needs to calculate monthly payment amounts.

   b. A *homemaker* who needs to balance the checkbook and add up the grocery bill.

   c. An *electrical engineer* who is designing an integrated circuit.

2. List three of the main areas where Hewlett-Packard scientific calculators are used.

1. c. electrical engineer

2. Any three of these four are satisfactory:

   Engineering
   Science
   Education
   Research &
   Development

Design & Quality

Every Hewlett-Packard pocket calculator is developed to meet the highest standards of:

Performance
Reliability
Serviceability

Hewlett-Packard is a company built on repeat customers and a reputation of quality. Whatever the product, Hewlett-Packard customers are confident that it was made right. Good design, quality manufacturing and a genuine concern for customer goodwill are a reality at Hewlett-Packard. Listed below are some of the specific quality features offered by Hewlett-Packard—features you'll find in few, if any, other brands:

The Case

- The hard plastic case gives a strength and tightness to HP calculators that is unmatched. This solid construction gives the calculator the durability to keep working after being accidentally dropped.

The Keyboard

- A sheet of plastic under the keyboard protects internal circuitry from any accidentally spilled liquid.
- The symbols on the keys will not wear off because they are molded completely through the key.
- The keys have a "snap feel" that comes from a special spring contact developed by HP.

The Display

- The numbers appear in the display *left to right*—just as you would write them.
- The display window is molded into the assembly to prevent the intrusion of dust or moisture.

The Battery Compartment:

- The battery is easy to remove; there is no prying with a coin or key, so there is no need to worry about nicks, mars, or other possible damage.
- There are no exposed wires or electronic components in the battery compartment—just two contacts.

In the preceding section, we listed eight (8) quality features of Hewlett-Packard calculators. Below, list any four (4) of these features and compare your list with the one we gave you.

This concludes our course on Hewlett-Packard scientific calculators. For specific information regarding each calculator, consult the owner's handbook.

The following appendix is included for your interest and information. It explains how Hewlett-Packard calculators are able to do long chain calculations without the user having to write down intermediate results.

If you have any questions regarding the operation of Hewlett-Packard calculators, contact your local representative.

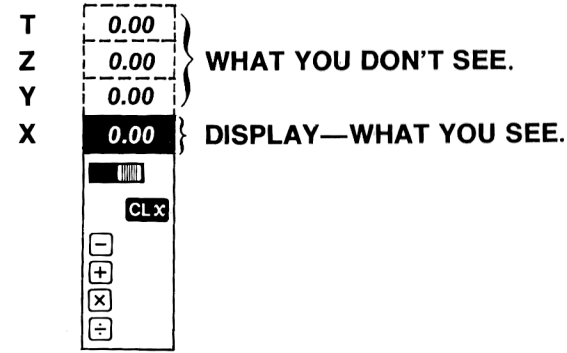
APPENDIX—Automatic Memory Stack

Earlier in this workbook, we demonstrated that you can solve long chain calculations on Hewlett-Packard calculators without writing down intermediate results along the way. Automatic storage of intermediate results is the reason that Hewlett-Packard calculators handle so easily even the most complex equations. Automatic storage is made possible by our automatic memory stack.

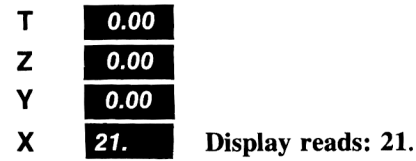
Inside your calculator is a memory of four registers, "*stacked*" one on top of each other, like shelves. These are labeled **X**, **Y**, **Z** and **T**, with **T** at the top and **X** at the bottom, like so:

When the calculator is switched ON, the entire machine is cleared so all four stack registers are set to 0.00. When you key in a number and it appears on the display, it can be a single digit, like 1 or 2, or it can be a long sequence of digits, like 3.141592654. Each number, no matter how simple or complex, occupies one register.

The X-register is the display. What you see on the display is also the X-register. Below is an illustration to help clarify our explanation.



If you keyed in 21, the stack would look like this:



Now, add 21 and 34. In order to key in a second number, you must separate the first number from the second by pressing ENTER↑. When you press ENTER↑, the first number is moved up into the Y-register to make room for your next entry.

T 0.00
Z 0.00
Y 21.00
X 21.00 **Display**

The number 21 still appears on the display (*X-register*) until you write over it by keying in a new number. Since you are adding 21 and 34, key in the second number, 34. The memory stack now looks like this:

T 0.00
Z 0.00
Y 21.00
X 34. **Display**

The numbers in the stack are positioned vertically the same way you might perform the arithmetic on paper:

$$\begin{array}{r} 21 \\ +34 \\ \hline ? \end{array}$$

The old-fashioned math notation explains what is happening inside your calculator. Both numbers are positioned in the stack first; the function is performed when you **press** the proper key (⊞ ⊟ ⊠ or ⊟).

To add the two numbers, **press** ⊞. The display reads 55.00.

If you want to verify what is in the Y-register at this time, simply **press** the x≷y (x exchange y) key. The x≷y key exchanges the contents of the X- and Y- registers while the top two registers remain unchanged.

By pressing x≷y

what was		**becomes**	
T	0.00	T	0.00
Z	0.00	Z	0.00
Y	0.00	Y	55.00
X	55.00	X	0.00

Notice that the numbers move, but the registers themselves (*the storage "shelves"*) remain in the same position.

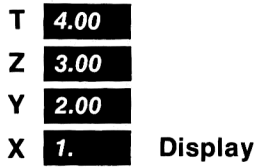
Pressing x≷y again restores the numbers in the X- and Y- registers to their original positions.

Another benefit of x≷y is that you can use it to correct your own entry errors. Suppose you want to divide 25 by 5, but you accidently key in 5 ENTER↑ 25. If you **press** ÷ (*don't press it yet*), you will be solving 5/25 not 25/5. Since 25 is in the X-register and 5 is in the Y-register, **press** x≷y to place them into the right positions, then press ÷.

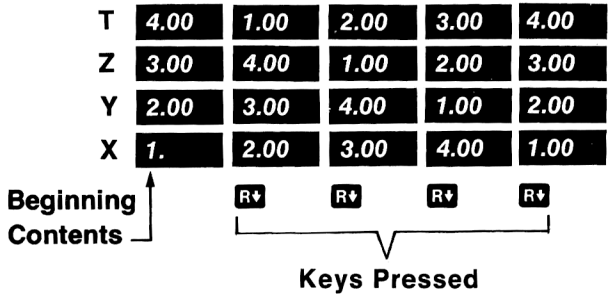
There is another key, the R↓ (*roll down*) key on your calculator which allows you to manipulate the stack contents. To see how the R↓ key works, first load the stack with numbers 1 through 4 by **pressing**

4 ENTER↑ 3 ENTER↑ 2 ENTER↑ 1.

The numbers you entered are loaded into the stack and its contents look like this:



Press R↓ four times and watch the display each time you press it. Each time R↓ is pressed, the stack contents shift downward one register; the number currently in the X-register is rotated around to the T-register. Below is a visual representation of what is happening in the stack:



Notice that the *contents* of the registers are shifted. The registers remain in the same position. Please note that it takes **four** presses of the R↓ key to return the contents to their original positions.

The R↓ and x≷y keys allow you to review the stack contents or to shift data within the stack for computation at any time.

The next few examples will show you what happens in the stack during chain calculations.

7 × (12+3)

T						
Z						
Y		12.00	12.00		15.00	
X	12.	12.00	3.	15.00	7.	105.00
Keys Pressed	1 2	ENTER↑	3	+	7	×

Display

(2+3) × (4+6)

T									
Z						5.00	5.00		
Y		2.00	2.00		5.00	4.00	4.00	5.00	
X	2.	2.00	3.	5.00	4.	4.00	6.	10.00	50.00
Keys Pressed	2	ENTER↑	3	+	4	ENTER↑	6	+	×

Display

$$\frac{5 \times (12 - 8)}{10 - 6}$$

T											
Z								20.00	20.00		
Y		12.00	12.00		4.00		20.00	10.00	10.00	20.00	
X	12.	12.00	8.	4.00	5.	20.00	10.	10.00	6.	4.00	5.00
Keys Pressed	1 2	ENTER↑	8	−	5	×	1 0	ENTER↑	6	−	÷

If you are interested in a further study of the stack, please consult the owner's handbook of any Hewlett-Packard scientific calculator.