

HP-35



HP's interest in computation evolved as a natural extension of our traditional involvement in measurement problem solving. At an early date, HP recognized the growing need for a family of computational products uniquely designed for ease of interface with scientific instrumentation.

In 1966 we introduced the first digital minicomputer specifically designed to meet this need. Soon after, we followed up with our first programmable calculator. From these modest beginnings, HP has now become an acknowledged leader in the field of computational problem solving. Over 10,000 HP programmable calculators and more than 3000 HP digital computers are now at work in a wide range of scientific, industrial, and educational applications. Their effectiveness is further enhanced by a complete line of peripherals — ranging from digital tape and disc drives to card and tape readers, printers, and plotters.

Now we've coupled our experience in scientific problem solving and computational technology to bring you a new dimension in personal computing — — the HP-35 Pocket Calculator.



- 1.234567809 - 35

1

OFF  ON 2

x^y

log

ln

e^x

CLR

$\sqrt{x}$

arc 3

sin

cos

tan

$1/x$

$x \div y$ 4

$R \downarrow$

STO 5

RCL

ENTER $\uparrow$

CH S

E EX

CL X 7

6

-

7

8

9

+

4

5

6

8

$\times$

1

2

3

$\div$

0

.

π



HEWLETT • PACKARD

- ① DISPLAY
- ② POWER ON-OFF SWITCH
- ③ FUNCTION KEYS
- ④ CONTROL KEYS
- ⑤ MEMORY KEYS
- ⑥ ENTRY KEYS
- ⑦ CLEAR KEYS
- ⑧ ARITHMETIC KEYS

HP-35

operating manual

HEWLETT-PACKARD

10900 WOLFE ROAD, CUPERTINO, CALIFORNIA, 95014

FOREWORD

To give you more computing power, your HP-35 works in a consistent and natural way that may be slightly different from previous calculators you have operated. So even if you are an old hand at using calculators, you will find it worthwhile to read this little book. Beginners, too, will find the step by step explanation easy to follow.

SHIRT POCKET POWER

Our object in developing the HP-35 was to give you a high precision portable electronic slide rule. We thought you'd like to have something only fictional heroes like James Bond, Walter Mitty or Dick Tracy are supposed to own.

The HP-35 has far more computing power than previous pocket calculators. Its ten digit accuracy exceeds the precision to which most of the physical constants of the universe are known. It will handle numbers as small as 10^{-99} and up to 10^{99} , and automatically places the decimal point for you. It is the first pocket calculator to provide you with transcendental functions like logarithms and sines and cosines. The operational stack and the reverse "Polish" (Lukasiewicz) notation used in the HP-35 are the most efficient way known to computer science for evaluating mathematical expressions.

The HP-35 was designed with you, the user, in mind. We spent as much time on the keyboard layout, on the choice of functions, and on the styling as we did on the electronics.

The speed and convenience with which you can arrive at a solution to a problem is unparalleled. You will find that fewer mistakes occur when computations are easier to make. You will also find yourself performing calculations you did not do before. They fall into three categories: first, those calculations in your own field that were avoided in favor of an educated guess. The ability to perform complex calculations wherever you are and whatever the situation will enhance your professional stature. The second category consists of calculations indirectly related to your profession — computing the return on an investment, reconciling your bank account, pursuing your hobby with professional precision, etc. The last category contains those exploratory calculations that you do for fun. They arise when someone asks “Did you know . . . ?”. For example, did you know that one cubic mile of air weighs more than 5 million tons?

Did you know that a man running a 4-minute mile turns 100 yards in a little more than 13.6 seconds?

Did you know that $355/113$ is an excellent approximation to π ?

Why not check and see just how close $355/113$ does approximate π ? Although the rest of this manual must be read, just between the two of us, you can't hurt the calculator by sliding the power switch to ON and pressing a few keys.

To check the approximation, key in 355, then press **ENTER** and key in the denominator, 113. Now press **$\div$** to get the quotient. The approximation is now in the display. Let us now subtract the true value of π (to ten significant digits) from the approximation. Press **π** and **$-$** . It's closer than one would think (2.66×10^{-7}). To find the percent error, divide this difference by π and multiply by 100. (**π** , **$\div$** , 100, **$\times$**). We now know that $355/113$ approximates π to within 8.47 millionths of one percent. (It makes $22/7$ look pretty sad.) Two final comments: ① it is easy to remember the approximation because it is made by duplicating the first three odd numbers and inserting a division sign in the middle: $113 \overline{)355}$; ② you have just evaluated the expression $(355/113 - \pi) \times (100/\pi)$. Congratulations! By the way, switch the calculator off and put it away. (You are not supposed to know how to work it . . . yet).

TABLE OF CONTENTS

SECTION 1	INSTANT ARITHMETIC	1
	SERIAL CALCULATIONS	3
	SUMS OF PRODUCTS	4
	PRODUCTS OF SUMS	5
	THE OPERATIONAL STACK	6
	SOME SIMPLE PROBLEMS	8
	POWERS OF NUMBERS	9
	PROBLEMS IN FINANCE	10
	BIG AND LITTLE NUMBERS	12
	NEGATIVE NUMBERS	14
	MORE MEMORY	15
	REARRANGING THE STACK	16
	LOGARITHMS AND TRIGONOMETRY	17
SECTION 2	OPERATING LIMITS	21
	ACCURACY	21
	OVERFLOW & UNDERFLOW	22
	SCIENTIFIC NOTATION	22
	IMPROPER CALCULATIONS	22
	TEMPERATURE RANGES	23
	BATTERY OPERATION	23
	RECHARGING / A.C. OPERATION	24
	BATTERY PACK REPLACEMENT	26
	ACCESSORIES	27
	STANDARD	27
	OPTIONAL	27
	SERVICING	28
	LOW POWER	28
	BLANK DISPLAY	28
	WARRANTY	28
	IN WARRANTY	28
	OUT OF WARRANTY	29
	SHIPPING INSTRUCTIONS	29
SECTION 3	SAMPLE PROBLEMS	30
	SOLUTIONS	32
	AN ALGORITHM	34

Hewlett-Packard ships your HP-35 fully-assembled, with battery pack in place, and ready to operate. With the battery charger disconnected, slide the power switch to ON. You should see a zero and a decimal point displayed. If any other indication is present, see **SERVICING**, page 28.

SECTION 1

INSTANT ARITHMETIC

In the HP-35, arithmetic answers appear immediately after pressing a $+$, $-$, $\times$ or $\div$ key. As in an adding machine, where the $+$ key adds the last entry to whatever is already in the machine, and the $-$ key subtracts this last entry, so also, in the HP-35, the $\times$ key multiplies what's in the machine by the last entry and the $\div$ key divides by the last entry.

But at the start we've got to get the first number into the machine. To do this you key in the first number and press $\text{ENTER}\uparrow$. Now key in the next number and then press $+$, $-$, $\times$ or $\div$.

Try these examples. It is **not** necessary to clear the machine between problems, but if you make an entry mistake, press $\text{CL}x$ (CLEAR x) and enter the number correctly.

To add 3 to 12

Press

See

$\boxed{1}$	1 .
$\boxed{2}$	12 .
$\text{ENTER}\uparrow$	12 .
$\boxed{3}$	3 .
$+$	15 .

To subtract 3 from 12

Press

See

$\boxed{1}$	1 .
$\boxed{2}$	12 .
$\text{ENTER}\uparrow$	12 .
$\boxed{3}$	3 .
$-$	9 .

To multiply 3 times 12

Press	See
1	1 .
2	1 2 .
ENTER↑	1 2 .
3	3 .
×	3 6 .

To divide 3 into 12

Press	See
1	1 .
2	1 2 .
ENTER↑	1 2 .
3	3 .
÷	4 .

Notice that in the four examples:

- Both numbers (operands) are in the machine before you press **+**, **-**, **×** or **÷**.
- Pressing the **+**, **-**, **×** or **÷** key causes the addition, subtraction, multiplication or division to occur immediately and the result to be displayed.

The **ENTER↑** key repeats the number displayed to a second internal register (a place that holds numbers). The display blinks to show you this has happened. When you now enter a new number, the HP-35 automatically clears the display of the old one. But if you wanted to double the old number, you don't need to enter it again, just press **+** after the **ENTER↑**. Or, if you wanted to square it, just press **×**. Try these examples.

To double 3

Press	See
3	3 .
ENTER↑	3 .
+	6 .

To square 3

Press	See
3	3 .
ENTER↑	3 .
×	9 .

SERIAL CALCULATION

Whenever a new number is entered after any calculation, the HP-35 performs an automatic **ENTER↑** before accepting the new number. This means that the previous answer and the new entry are both in position for the next arithmetic operation.

Examples:

Find the sum of the first five odd numbers

Press	See
1	1 .
ENTER↑	1 .
3	3 .
+	4 .
5	5 .
+	9 .
7	7 .
+	16 .
9	9 .
+	25 .

Find the product of the first five even numbers

Press	See
2	2 .
ENTER↑	2 .
4	4 .
x	8 .
6	6 .
x	48 .
8	8 .
x	384 .
1 0	10 .
x	3840 .

If you were calculating $((2 + 3)/4 + 5) \cdot 6$ by hand, you would first **add 2 and 3**, then **divide the sum by 4**, **add 5 to the quotient** and finally **multiply by 6**. This is exactly what you do on the HP-35:

$$((2 + 3)/4 + 5) \cdot 6$$

Press	See	Comments
2	2 .	
ENTER↑	2 .	
3	3 .	
+	5 .	
4	4 .	Add 2 and 3
÷	1 . 2 5	
5	5 .	Divide the sum by 4
+	6 . 2 5	
6	6 .	Add 5 to the quotient
×	3 7 . 5	
		Multiply by 6

SUMS OF PRODUCTS

Suppose you sold 12 items at \$1.58 each, 8 items at \$2.67 each and 16 items at \$0.54 each. The total sale price is

$$(12 \times 1.58) + (8 \times 2.67) + (16 \times 0.54)$$

Your HP-35 lets you find the answer without writing down or storing intermediate results.

Press	See	Comments
12	1 2 .	
ENTER↑	1 2 .	
1.58	1 . 5 8	
×	1 8 . 9 6	
8	8 .	(12 × 1.58)
ENTER↑	8 .	
2.67	2 . 6 7	(8 × 2.67)
×	2 1 . 3 6	

+	4 0 . 3 2	$(12 \times 1.58) + (8 \times 2.67)$
16	1 6 .	
ENTER ↑	1 6 .	
.54	. 5 4	
×	8 . 6 4	(16×0.54)
+	4 8 . 9 6	Total Sale Price

Obviously, you can find the sum of any number of products this way.

PRODUCT OF SUMS

Problems like $(7+3) \cdot (5+11) \cdot (13+17)$ are done just like sums of products with all the **×** and **+** key strokes interchanged.

Press	See	Comments
7	7 .	
ENTER ↑	7 .	
3	3 .	
+	1 0 .	$(7+3)$
5	5 .	
ENTER ↑	5 .	
11	1 1 .	
+	1 6 .	$(5+11)$
×	1 6 0 .	$(7+3) (5+11)$
13	1 3 .	
ENTER ↑	1 3 .	
17	1 7 .	
+	3 0 .	$(13+17)$
×	4 8 0 0 .	$(7+3) \cdot (5+11) \cdot (13+17)$

THE OPERATIONAL STACK

To do the last examples your HP-35 had to save some answers for future use. Let's see how it does this. There are four number registers in the HP-35, which we call the X, Y, Z and T registers. They are arranged in what is called a "stack", X on the bottom and T on the top. The display always shows the number in the X register.

OPERATIONAL STACK

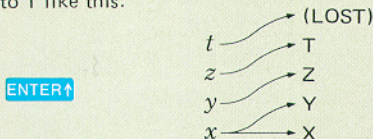
<i>t</i>	← T Register
<i>z</i>	← Z Register
<i>y</i>	← Y Register
<i>x</i>	← X Register

NOTE

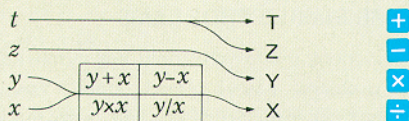
The X Register is
always displayed

To avoid confusion between the name of a register and the number in it, we designate the register by a capital letter and the number by italics. Thus, *x*, *y*, *z* and *t* are the contents of X, Y, Z and T.

When you key in a number, it goes into the X register, which is the only one displayed. When you press **ENTER↑**, this number is repeated into the Y register. At the same time, the *y* is moved up to Z and *z* is moved up to T like this:



When you press **+**, *x* is added to *y*, and the whole stack drops to display the answer in X. The same thing happens for **-**, **×** and **÷**. Whenever the stack drops, *t* is duplicated into T and Z, and *z* drops to Y.



Let us look at the contents of the stack as we do $(3 \times 4) + (5 \times 6)$. The keys used are shown above the circled steps ① through ⑨. Directly above the keys you see the information in the X, Y, Z and T registers after the key stroke.

$$(3 \times 4) + (5 \times 6)$$

T									
Z						12	12		
Y		3	3		12	5	5	12	
X	3.	3.	4.	12.	5.	5.	6.	30.	42.
KEY	3	↑	4	x	5	↑	6	x	+
STEP	①	②	③	④	⑤	⑥	⑦	⑧	⑨

- STEP ① 3 in display (X Register)
- STEP ② 3 duplicated into Y Register
- STEP ③ 4 in display
- STEP ④ Product (12) formed in Y, then drops into X.
- STEP ⑤ Automatic **ENTER↑** pushes 12 into Y, display shows 5.
- STEP ⑥ **ENTER↑** pushes y into Z, x into Y, and leaves x unchanged.
- STEP ⑦ 6 in display
- STEP ⑧ Product (30) formed in Y, then z and y drop to Y and X
- STEP ⑨ Sum (42) formed in Y then drops into X.

SOME SIMPLE PROBLEMS

Calculations that involve only one number are easier than the problems you've already done. You just key the number (x) into the HP-35 and press the key that does what you want done. Let's try some examples:

(a) Square Root of 49

Press

See

4

4 .

9

49 .

$\sqrt{x}$

7 .

(b) Reciprocal of 25

Press

See

2

2 .

5

25 .

$1/x$

. 04

The x on the $\sqrt{x}$ and $1/x$ key means the answer will be the square root or reciprocal of x , that is, of the contents of the displayed X register. This can be the answer from a previous calculation.

(c) Hypotenuse of a right triangle of sides 3, 4. We wish to compute $\sqrt{3^2 + 4^2}$

Press

See

3

3 .

ENTER↑

3 .

$\times$

9 .

4

4 .

ENTER↑

4 .

$\times$

16 .

+

25 .

$\sqrt{x}$

5 .

- (d) Find the area of a circle with a 3 foot radius, i.e.,
 $A = \pi R^2$ with $R = 3$ feet.

Press	See
3	3.
ENTER↑	3.
×	9.
π	3. 14 15 9 2 6 5 4
×	28. 2 7 4 3 3 8 9

POWERS OF NUMBERS

We have already seen how to square a number and to take its reciprocal, that is, how to find x^2 and x^{-1} . The **x^y** key lets you find any power of a positive number. Suppose you want to find $2 \times 2 \times 2 \times 2 \times 2 \times 2 = 2^7$. In most calculators you'd have to do all six multiplications. Here's how you do it with the HP-35:

Press	See	Comments
7	7.	Enter the power, y .
ENTER↑	7.	Put it in Y
2	2.	Enter the number, x .
x^y	128.	Take 2^7

The power (y) does not have to be a whole number; it can be any number. The HP-35 performs x^y with an internal program using logarithms and the answers are not always exact to the last decimal place (see Accuracy page 21). For example, $8^{2/3} = 4$, but if you key **2** **ENTER↑** **3** **÷** **8** **x^y** you get 3.999999999. Call it 4; the error is .000000001, or only one billionth!

PROBLEMS IN FINANCE

If you deposited one dollar at 5% interest compounded annually, how much would you have at the end of 17 years?

$$\text{Value} = (1 + \text{Rate})^{\text{Years}}$$

Press	See	Comments
17	1 7 .	Number of years
ENTER ↑	1 7 .	
1.05	1 . 05	1 + interest rate
x^y	2 . 292018319	Amount after 17 years (\$2.29)

In 1965 a company had gross sales of \$926 million. By 1972 the sales had increased to \$1.37 Billion. What is the growth rate compounded annually?

$$1 + \text{Rate} = \left(\frac{\text{Final Sales}}{\text{Initial Sales}} \right)^{1/\text{years}}$$

Press	See	Comments
1972	1 9 7 2 .	
ENTER ↑	1 9 7 2 .	
1965	1 9 6 5 .	
-	7 .	Years
1/x	. 1 4 2 8 5 7 1 4 2 9	Reciprocal of period
1.37 E EX 9	1 . 3 7 0 9	1.37 billion
ENTER ↑	1 . 3 7 0 9	
926 E EX 6	9 2 6 . 0 6	926 million
÷	1 . 4 7 9 4 8 1 6 4 1	
x^y	1 . 0 5 7 5 5 1 1 1 8	Annual growth rate = 5.7551118%

Find the monthly payment on a 30 year (360 payment), \$30,000 loan having an annual interest of 6% (.005/month).

$$\begin{aligned} \text{Monthly Payment} &= \frac{\text{Principal} \times \text{Monthly Interest Rate}}{1 - \left[\frac{1}{(1 + \text{Monthly Interest Rate})^{\text{Payments}}} \right]} \\ &= \frac{30,000 \times .005}{1 - \left[\frac{1}{(1.005)^{360}} \right]} \end{aligned}$$

T									150	150	150	150	150
Z							150	150	1	150	150	150	150
Y			30000	30000		150	1	1	360	360	1	150	150
X	30000.	30000.	.005	150.	1.	360.	360.	1.005	6.0225	.16604	.83395	179.86	
KEY	30000	↑	.005	×	1	↑	360	↑	1.005	x^y	$1/x$	−	÷

BIG AND LITTLE NUMBERS

Suppose you square 987654 by pressing 987654 **ENTER** **X**. The result you see is

9 . 7 5 4 6 0 4 2 3 7 1 1

This is the way the HP-35 displays numbers above ten billion. The number is read as

$$9.754604237 \times 10^{11}.$$

This way of writing numbers is known as "scientific notation". Don't let it scare you: the 11 means "move the decimal point 11 places to the right" like this:

975,460,423,700.
↓-----↑

Now press **1/x**. You will see

1 . 0 2 5 1 5 6 9 1 6 - 1 2

which is read

$$1.025156916 \times 10^{-12}.$$

The -12 tells you to move the decimal point 12 places to the left.

.000000000001025156916
↑-----↓

Numbers larger than 10^{10} or smaller than 10^{-2} are automatically displayed in scientific notation.

You can enter numbers in scientific notation by using the **E EX** (ENTER EXPONENT) key. To enter 15.6 trillion (15.6×10^{12}):

Press	See
-------	-----

1	1 .
5	1 5 .
.	1 5 .

6	15.6	
EEX	15.6	00
1	15.6	01
2	15.6	12

You can save time when entering exact powers of ten simply by pressing **EEX** and then the desired power of ten. Before doing an example, press **CLX** to terminate the previous example. Now, to enter one million (10^6):

Press	See
EEX	1. 00
6	1. 06

To enter negative powers of ten, press **CHS** (Change Sign) after pressing **EEX** and either before or after keying in the power of ten. To enter the mass of an electron, which is 9.109×10^{-31} kilograms, first press **CLX** to terminate the previous example, then:

Press	See
9	9.
.	9.
1	9. 1
0	9. 10
9	9. 109
EEX	9. 109 00
CHS	9. 109 - 00
3	9. 109 - 03
1	9. 109 - 31

NEGATIVE NUMBERS

The **CH S** key does more than enter negative powers of ten. In fact, its primary uses are for entering negative numbers and changing the sign of a computed result.

Example: In computing the product $(-3)(-4)(-5)(-6)$, you will see that the **CH S** can be used either before or after the number. Since you didn't use the number from the previous example, press **CL x** to get rid of it.

Press	See	Comments
CH S	- 0 .	CH S used before 3
3	- 3 .	
ENTER ↑	- 3 .	
CH S	3 .	CH S used before 4
4	- 4 .	
x	1 2 .	$(-3)(-4) = 12$
5	5 .	
CH S	- 5 .	CH S used after 5
x	- 6 0 .	$(-3)(-4)(-5) = -60$
6	6 .	
CH S	- 6 .	CH S used after 6
x	3 6 0 .	$(-3)(-4)(-5)(-6) = 360$

TRAILING ZEROS

Trailing zeros to the right of the decimal point are blanked out, automatically.

MORE MEMORY

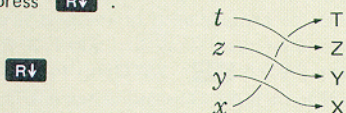
Your HP-35 has an additional memory register for storing constants. It is not affected by computations. However, a keyboard entry or **RCL** immediately following **STO** does not raise the stack.

Example: To find what percentage each of the first five odd numbers is of their total, first add 1, 3, 5, 7 and 9, then press **STO** (**STORE**) to store the sum (25) in memory. The individual entries may now be divided by the stored number simply by pressing **RCL** (**RECALL**) and then $\div$:

Press	See	Comments
2 5	25.	(Key in 25 if not already there)
STO	25.	STORE sum in memory
1	1.	First number
RCL	25.	RECALL sum
$\div$	.04	4% of total
3	3.	
RCL	25.	
$\div$	.12	12% of total
5	5.	
RCL	25.	
$\div$	.2	20% of total
7	7.	
RCL	25.	
$\div$	.28	28% of total
9	9.	
RCL	25.	
$\div$	.36	36% of total

REARRANGING THE STACK

The **R↓** (ROLL DOWN) key lets you review the stack contents without losing data. It is also used to reposition data within the stack. Here is what happens each time you press **R↓**.

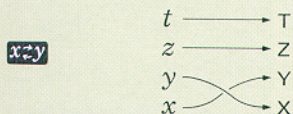


Example: Load the stack by pressing **1** **ENTER↑** **2** **ENTER↑** **3** **ENTER↑** **4**. (The stack now contains $x=4$, $y=3$, $z=2$, and $t=1$). To review the contents of the stack press **R↓** four times. The fourth **R↓** returns the stack to its original position ($x=4$, $y=3$, $z=2$ and $t=1$).

NOTE: Pressing **R↓** after entering a series of digits to form a number terminates the composition of the number (i.e., no additional digits can be appended).

NOTE: The stack is raised and t is lost when a keyboard entry or **RCL** follows **R↓**.

You will often find that x and y should be exchanged before a **−**, **÷** or **x^y** operation. The **$x↔y$** key exchanges x and y as shown below.



Example: Find $\sqrt[9]{512}$

Press	See	Comment
5 1 2	512.	

ENTER↑	512.	
9	9.	
1/x	.1111111111	x and y are in wrong order
x ² y	512.	x and y are in right order
x ^y	2.	

LOGARITHMS AND TRIGONOMETRY

You use the logarithmic and trigonometric functions the same way you use $\sqrt{x}$ and $1/x$; the number in x is replaced by the function requested like this:

$t \longrightarrow T$
 $z \longrightarrow Z$
 $y \longrightarrow Y$
 $x \xrightarrow{f(x)} X$

where $f(x)$ is
 $\sqrt{x}$, $1/x$, $\log x$,
 $\ln x$, or e^x

$\sqrt{x}$
 $1/x$
 $\log$
 $\ln$
 e^x

In the case of trigonometric functions, Z replaces t . (The T register is used when computing trigonometric functions.)

$t \xrightarrow{\quad} T$
 $z \xrightarrow{\quad} Z$
 $y \longrightarrow Y$
 $x \xrightarrow{f(x)} X$

(LOST)

where $f(x)$ is $\sin x$,
 $\cos x$, $\tan x$, $\arcsin x$,
 $\arccos x$, or $\arctan x$.

$\sin$
 $\cos$
 $\tan$
 $\arcsin$
 $\arccos$
 $\arctan$

Your HP-35 computes both natural logarithms ($\ln$ is $\log_e$) and common logarithms ($\log$ is $\log_{10}$).

Natural antilogarithms, $\text{antilog}_e x = e^x$, are formed with the e^x key; common antilogarithms, $\text{antilog}_{10} x = 10^x$, are formed with the x^y key.

Example: To find $\text{antilog}_{10} 2$, press **2** **ENTER↑** **1** **0** **x^y** to read 100.

Although logarithms were originally used to speed multiplication and division, they have particular significance in scientific and engineering problems. There is, for example, a logarithmic relationship between altitude and barometric pressure. Suppose you wish to use an ordinary barometer as an altimeter. After measuring the sea level pressure (30 inches of mercury) you climb until the barometer indicates 9.4 inches of mercury. How high are you? Although the exact relationship of pressure and altitude is a function of many factors, a **reasonable** approximation is given by:

$$\text{Altitude (feet)} = 25,000 \ln \frac{30}{\text{Pressure}}$$

Press	See	Comments
25000	25 000 .	
ENTER↑	25 000 .	
30	30 .	
ENTER↑	30 .	
9.4	9 . 4	Pressure at altitude
÷	3 . 191489362	
ln	1 . 160487693	Altitude
×	29 012 . 19233	

[We suspect that you may be on Mt. Everest (29,028 feet)]

Your HP-35 computes trigonometric functions of angles measured in degrees and decimal fractions of a degree.

Example: Find $\sin 30.5^\circ$, $\cos 150^\circ$, $\tan -25.6^\circ$.

Press	See	Comments
30.5	30 . 5	$\sin 30.5^\circ$
sin	. 5075383628	

150	150.	
cos	- . 8660254041	$\cos 150^\circ$
CH S	. 8660254041	
25.6	- 25.6	
tan	- . 4791197214	$\tan -25.6^\circ$

Inverse trigonometric functions are computed by preceding the desired trigonometric keys with the **arc** key. Answers are returned in decimal degrees.

Example: Find $\arcsin .3$, $\arccos -.7$, $\arctan 10.2$

Press	See	Comments
.	.	
3	. 3	
arc	. 3	
sin	17.45760312	ARC sin .3
CH S	- 17.45760312	
.	- .	
7	- . 7	
arc	- . 7	
cos	134.427004	ARC cos -.7
10.2	10.2	
arc	10.2	
tan	84.40066068	ARC tan 10.2

Many times it is necessary to convert data to a form acceptable to a given algorithm as in the following example:

Example: Convert $35^{\circ} 17' 47''$ to decimal degrees.

Press	See	Comment
3 5	35.	Degrees
ENTER ↑	35.	
1 7	17.	Minutes
ENTER ↑	17.	
4 7	47.	Seconds
ENTER ↑	47.	
6 0	60.	Computation constant
STO	60.	
÷	.7833333333	
+	17.78333333	
RCL	60.	
÷	.2963888888	
+	35.29638889	Decimal degrees

You now know all of the basic facts about operating your HP-35. However you may find the flow chart on page 34 interesting. It describes a procedure (an algorithm) that will allow you to evaluate **any** expression on a calculator like your HP-35, that uses an operational stack and Lukasiewicz notation.

OPERATING LIMITS

ACCURACY

The accuracy of the HP-35 depends on the operation being performed. Elementary operations such as add, subtract, multiply, divide, reciprocal, and square root have a maximum error of $\pm$ one count in the tenth (least significant) digit. Errors in these operations are caused by rounding answers to the tenth (least significant) digit. An example of round off error is seen when evaluating $(\sqrt{5})^2$. Rounding $\sqrt{5}$ to 10 significant digits gives 2.236067977. Squaring this number gives the 19 digit product 4.999999997764872529. Rounding the square to 10 digits gives 4.999999998. If the next larger approximation (2.236067978) is squared, the result is 5.000000002237008484. Rounding this number to 10 significant digits gives 5.000000002. There simply is no ten digit number whose square is 5.000000000.

The accuracy of the remaining operations (trigonometric, logarithmic and exponential) depends upon the argument. The answer that is displayed will be the correct value for an input argument within $\pm N$ counts in the tenth least significant digit of the original input argument.

Values for N are:

OPERATION	VALUE OF N
$\log x$, $\ln x$, and e^x	2
trigonometric	3
x^y	4 for x , and 7 for y

Logarithmic operations have an additional limitation of ± 3 in the 10th decimal (least significant) digit in the displayed answer.

Trigonometric operations have an additional accuracy limitation of $\pm 1 \times 10^{-9}$ in the displayed answer.

Example: Your HP-35 shows that $\ln 5 = 1.609437912$. The accuracy statement says that 1.609437912 is the natural logarithm of a number between 4.999999998 and 5.000000002.

OVERFLOW AND UNDERFLOW

Any computation or data entry resulting in a magnitude equal to or greater than 10^{100} causes 9.999999999 99 to be displayed. Computations or data entries having a magnitude less than 10^{-99} are displayed as zero.

SCIENTIFIC NOTATION

Answers greater than 10^{10} and smaller than 10^{-2} are displayed in scientific notation.

IMPROPER CALCULATIONS

If you attempt an improper calculation such as division by zero, a blinking zero appears. To reset, press **CL x**. The following operations are improper.

- Division by zero
- Square root of a negative number
- $\ln x$, $\log x$ or x^y , where $x \leq 0$
- $\arcsin x$ or $\arccos x$, where $|x| > 1$

CAUTION*Calculator can be damaged by static charge.***TEMPERATURE RANGES**

OPERATING: 0° to $+40^{\circ}\text{C}$ (32°F to 104°F)
 CHARGING: $+10^{\circ}$ to $+40^{\circ}\text{C}$ (50°F to 104°F)
 STORAGE: -40° to $+55^{\circ}\text{C}$ (-40°F to 131°F)

BATTERY OPERATION

The battery provides three to five hours of continuous operation. By turning off the power when the calculator is not in immediate use, the HP-35 battery power will easily last throughout a normal working day.

All decimal points but one light in the display when 2 to 5 minutes of operation time remain in the battery pack. Even when the extra decimal points are turned on, the true decimal position is known because an entire digit position is allocated to the true decimal position.

Example:



Operating the calculator for more than 2 to 5 minutes after this low power indication first occurs may result in wrong answers. The battery pack must be recharged by connecting the HP-35 to the battery charger.

NOTE

The HP-35 should be turned off before plugging in the charger. It can be turned on again after the charger is plugged into the power outlet.

The calculator can be used during the charging cycle. The HP-35 can be operated continuously from the ac line if desired. There is no danger of overcharging the battery.

RECHARGING AND AC LINE OPERATION

CAUTION

To prevent damage, the position of the line voltage select switch on the battery charger must be set to the proper line voltage.

1. Make sure that the power switch is OFF.
2. Insert battery charger plug into the rear connector of the HP-35 and connect power plug to power outlet.

NOTE: Either connection may be made first.

3. Slide the power switch to ON and observe that a zero and a decimal point are displayed.

IMPORTANT

The HP-35 will not operate when connected to the recharger unless the recharger is connected to a live power outlet.

5. Slide power switch to OFF if you don't want to use the calculator while it is charging.

NOTE

After 14 hours, a completely discharged battery will be fully charged. Shorter charge periods will allow reduced battery operating time. There is no danger of overcharge. For convenience, overnight charging is recommended.

6. At end of the charging period, you may continue using your HP-35 with ac power or proceed to next step for dc power operation.
7. With the power switch at OFF, disconnect battery charger from power receptacle.
8. Disconnect battery charger from HP-35.

NOTE

Temporary degradation, peculiar to nickel-cadmium batteries, may cause a decrease in the operating period of the battery pack. Should this happen turn the HP-35 on for at least five hours to completely discharge the batteries. Then put it on charge for at least 14 hours. This should correct the temporary degradation.

If the battery pack won't hold a charge, it may be defective. If the warranty is in effect, return the pack to Hewlett-Packard according to the instructions on page 29. If the battery pack is out of warranty, use the accessory order card in the back cover pocket of this manual to order a new battery.

NOTE

Use only the HP rechargeable Model 82001A Battery Pack which has been tested and is warranted for one year.

You can use your HP-35 on ac power until the replacement battery pack arrives.

BATTERY PACK REPLACEMENT

1. Turn power switch to OFF and disconnect the battery charger.
2. Slide the two battery-door latches (the top feet) toward middle of calculator.
3. Let battery door and battery pack fall into palm of hand.
4. See if the battery connector springs have been inadvertently flattened inward in calculator. If so, bend them outward and try the battery again.
5. Insert the battery pack with its gold contacts facing the calculator so that contact is made with battery connectors.
6. Insert the bottom of the battery door behind the retaining groove and close the door.
7. Gently press the battery door closed while sliding the two battery-door latches outward.

NOTE

If you use your HP-35 extensively in field work or during travel, you may want to order the Model 82004A Battery Holder and Pack.

CAUTION

*Do not try to burn old batteries.
They may explode!*

ACCESSORIES

STANDARD

Your HP-35 comes complete with the following accessories:

(To reorder, see the Order Card in the back cover pocket of this manual.)

ACCESSORY	MODEL/PART NO.
Battery Pack	82001A
Battery Charger/AC Adapter	82002A
Safety Travel Case	82003A
Soft leather Carrying Case	82005A
Operating Manual	00035-90008
Four personalized labels	7120-2946

The personalized labels are provided for your convenience. Type your name or other identification on each label and affix to calculator, battery charger, and safety travel case.

OPTIONAL

Other accessories for your HP-35 are specified on the Order Card in the back cover pocket of this manual. We will send you new Order Cards as additional optional accessories are added to our product line.

The 82004A Battery Holder and Pack consists of a charging attachment and a spare battery pack so that one battery pack can charge while the other is in use.

Optional accessories include:

ACCESSORY	MODEL/PART NO.
Battery Holder and Pack	82004A
Security Cradle	82007A
Hard Leather Field Case	82006A

SERVICING

LOW POWER

All decimal points light to warn you that you have a few minutes of operating time left. You must then either:

- operate from ac power
- charge the battery pack
- insert a fully charged battery pack

BLANK DISPLAY

A blank display while in battery operation means the:

- battery pack is discharged
- battery pack is not making contact
- calculator is defective

To isolate the difficulty, try the following:

1. Examine the Battery Pack (see Replacement procedure, page 26.) If display is still blank, proceed to next step.
2. Operate your HP-35 from ac line, page 24. If the display remains blank, the HP-35 is defective. See the Warranty section, below.

WARRANTY

IN WARRANTY

The HP-35 is warranted against defects in materials and workmanship for one year from date of delivery. During the warranty period we will repair or replace components that prove to be defective, provided they are returned to Hewlett-Packard (see Shipping Instructions). No other warranty is expressed or implied. We are not liable for consequential damage.

OUT OF WARRANTY

Beyond the one (1) year period, your calculator will be repaired for a current fixed price of \$40.00 (U.S. only), plus applicable State and Local Taxes. Return the HP-35 along with all standard accessories (see Shipping Instructions). If only the battery pack is defective, simply order a replacement (see Order Card in the back cover pocket of this manual).

SHIPPING INSTRUCTIONS

Malfunctions traced to the calculator or battery charger require that you return to us:

1. Your HP-35 with all standard accessories in its safety travel case.
2. A completed Service Card (from back cover pocket of this manual).

If a battery pack is defective and within warranty, return to us:

1. only the defective battery pack
2. a completed Service Card (from back cover pocket of this manual)

Send returned items safely packaged to the address listed on the Service Card.

Call the applicable service phone number on the Service Card, or Advanced Products Division, Customer Service: 408-996-0100.

Under normal conditions, your calculator will be repaired and reshipped within two days of receipt at this address.

SAMPLE PROBLEMS

Use the following sample problems to test your skill with the HP-35. Refer to Solutions, page 32, for correct answers and preferred methods of calculations.

1. $(3 \times 4) + (5 \times 6) + (7 \times 8)$

2. $(3 + 4)(5 + 6)(7 + 8)$

3. $\left(\frac{4 \times 5}{7} + \frac{29}{3 \times 11}\right) \left(\frac{19}{2 + 4} + \frac{13 + \pi}{4}\right)$

4. $\frac{1}{1/3 + 1/6}$

5.
$$\begin{array}{r} 3 + \frac{1}{7 + 1} \\ \frac{15 + 1}{1 + \frac{1}{292}} \end{array}$$

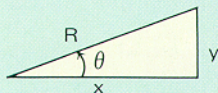
6. $60 \text{ arc cos } (\cos 45^\circ \cos 150^\circ + \sin 45^\circ \sin 150^\circ \cos 60^\circ)$

NOTE

The solutions to the following problems do **not** require multiple entries of the same data:

SECTION 3

7.



a. $R = 5$, $\theta = 30^\circ$. Find x , y
 $(x = R \cos \theta; y = x \tan \theta)$

b. $x = 4$, $y = 3$. Find R , θ
 $(\theta = \arctan (y/x); R = y/\sin \theta)$

8. Convert the following to centimeters:

- 5'3"
- 37"
- 24"
- 36"

9. Compute the annual rate of return (after taxes) of an investment held for 6-1/2 months when

Tax Rate = 35%

Buy Price = \$2341

Sell Price = \$2672

RETURN =

$$\frac{(\text{SELL} - \text{BUY})(1 - \text{TAX})}{\text{BUY}} \cdot \frac{12}{\text{HOLD DURATION}} \times 100$$

SOLUTIONS

1. Answer: 98.

$$\begin{array}{cccccc} 3 & \uparrow & 4 & \times & 5 & \uparrow & 6 \\ \times & + & 7 & \uparrow & 8 & \times & + \end{array}$$

2. Answer: 1155.

$$\begin{array}{cccccc} 3 & \uparrow & 4 & + & 5 & \uparrow & 6 \\ + & \times & 7 & \uparrow & 8 & + & \times \end{array}$$

3. Answer: 26.90641536

$$\begin{array}{cccccccccccc} 4 & \uparrow & 5 & \times & 7 & \div & 2 & 9 & \uparrow & 3 & \div \\ 1 & 1 & \div & + & 1 & 9 & \uparrow & 2 & \uparrow & 4 & + \\ \div & 1 & 3 & \uparrow & \pi & + & 4 & \div & + & \times \end{array}$$

4. Answer: 2.

$$3 \quad 1/x \quad 6 \quad 1/x \quad + \quad 1/x$$

5. Answer: 3.141592653

$$\begin{array}{cccccccc} 2 & 9 & 2 & 1/x & 1 & + & 1/x & 1 \\ 5 & + & 1/x & 7 & + & 1/x & 3 & + \end{array}$$

6. Answer: 6949.392474

$$\begin{array}{cccccccccccc} 4 & 5 & \cos & 1 & 5 & 0 & \cos & \times & 4 & 5 \\ \sin & 1 & 5 & 0 & \sin & \times & 6 & 0 & \cos \\ \times & + & \arccos & \cos & 6 & 0 & \times \end{array}$$

7. a. Answers: $x = 4.33012702$
 $y = 2.5$

3 0 $\uparrow$ tan $x \div y$ cos

5 $\times$ $\times$ — value of $y = 2.5$

— value of $x = 4.33012702$

- b. Answers: $\theta = 36.86989764$
 $R = 5.000000003$

3 $\uparrow$ $\uparrow$ 4 $\div$ arc

tan sin $\div$ — value of $R = 5.000000003$

— value of $\theta = 36.86989764$

8. a. Answer: 160.02

2 $\cdot$ 5 4 STO 5 $\uparrow$

1 2 $\times$ 3 $+$ RCL $\times$

- b. Answer: 93.98

3 7 RCL $\times$

- c. Answer: 60.96

2 4 RCL $\times$

- d. Answer: 91.44.

3 6 RCL $\times$

9. Answer: 16.96710808

2 6 7 2 $\uparrow$ 2 3 4 1 STO $-$ 1

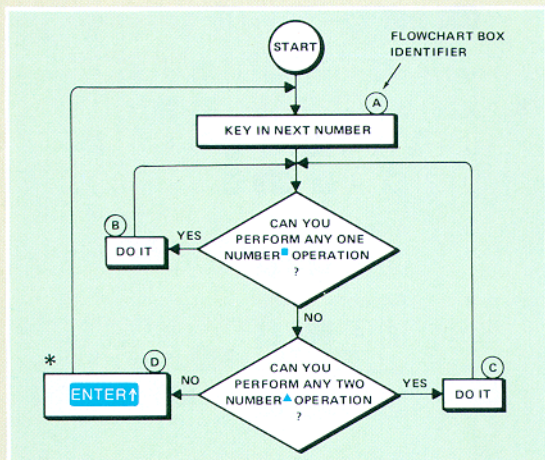
$\uparrow$ $\cdot$ 3 5 $-$ $\times$ RCL $\div$ 1 2 $\times$ 6

$\cdot$ 5 $\div$ 1 0 0 $\times$

AN ALGORITHM

The flow chart shown below allows you to evaluate any expression on a calculator, like your HP-35, that uses an operational stack and Lukasiewicz notation. Although the general solution requires an operational stack of unlimited length, the four register stack in your HP-35 is adequate for most practical problems. Before using the algorithm, write your expression in serial form i.e., write it as if it were to be sent over the teletype. All expressions can be written in serial form. For example:

$$\frac{2}{3 + 1/2} \text{ becomes } 2/(3 + 1/2).$$



* You may omit this step if you've done any operation on the last number entered.

■ One number (Monadic) operations are things like $\sqrt{x}$ $\ln$, etc.

▲ Two number (Diacic) operations are things like $+$ $-$ $\times$ $\div$.

Use the algorithm to solve

$$(3 + 4) [\log (25 \sqrt{7 + 9}) + 6]$$

According to our algorithm, the solution can be obtained for any expression by entering the numbers in the order in which they occur, i.e., 3, 4, 25, 7, 9 and 6.

Press		Flowchart Box
3	3.	(A)
ENTER↑	3.	(D)
4	4.	(A)
+	7.	(C)
ENTER↑ *	7.	(D)
2 5	25.	(A)
ENTER↑	25.	(D)
7	7.	(A)
ENTER↑	7.	(D)
9	9.	(A)
+	16.	(C)
$\sqrt{x}$	4.	(B)
$\times$	100.	(C)
log	2.	(B)
ENTER↑ *	2.	(D)
6	6.	(A)
+	8.	(C)
$\times$	56.	(C)

* You may omit these steps because your HP-35 performs an automatic **ENTER↑** for you.

Although the algorithm will always work, many expressions can be evaluated in fewer steps. You would probably evaluate the example by pressing

7 ENTER↑ 9 + √x 2 5 × log
6 + 3 ENTER↑ 4 + × .

It is worth noting that the expression could have been written as

$$\left(\log [\sqrt{(7+9)} \cdot 25] + 6 \right) \cdot (3+4).$$

Try the algorithm now. Except for three automatic ENTER↑ * , the key steps are identical to the solution shown above.



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