HEWLETT-PACKARD

HP·70

Owner's Handbook

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July 1974

About H-P

Hewlett-Packard'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 designed to work easily and effectively with scientific instruments.

In 1966 we introduced the first digital minicomputer specifically designed to meet this need. Soon after, we followed up with our first programmable desktop calculator. From these beginnings, HP has now become an acknowledged leader in the field of computational problem solving. Many thousands of HP programmable desktop calculators and digital computers are at work in a wide range of applications in science, industry, education, medicine, and business. Their effectiveness is further enhanced by a complete line of accessory devices, ranging from digital tape and disc drives, to card and tape readers, printers and plotters.

Lately we've coupled our experience in scientific problem solving and computational technology to bring you new dimensions in personal computation—the HP-35 Scientific Pocket Calculator, the HP-45 Advanced Scientific Pocket Calculator, the HP-65 Programmable Pocket Calculator for engineering/scientific applications, and the HP-80 Financial Pocket Calculator for solving problems in business and finance. The acceptance of our pocket calculator products has been significant—over 300,000 have been sold to date. Now we bring you the HP-70 Business Pocket Calculator whose capabilities are directed to those applications most commonly encountered in business.

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3. Applications Casebook

Introduction

Few professions demand so much of their members as does business. Throughout history, the staggering array of personal qualities deemed necessary for success in business might have been drawn from a combination of the Discourses of Machiavelli, a biography of Albert Einstein and the Boy Scout oath. Even Aristotle warned "...*he who proposes to manage any branch of economy should be naturally clever, and by choice industrious and just; for if any one of these qualities be wanting, he will make many mi\$take\$...*"

20th century business, even more demanding and fraught with peril, has tried to solve some of its problems through automation. The basic idea was good, but contributed a new problem—most machines tend to make automatons of their users! Human beings must act as mere cogs in the machinery, must be compatible components, must not deviate from a rigid procedure at the machine's level. A business can't survive long if its principals indulge in much of this mind-deadening activity.

We at HP believe machines should solve problems, not create them—that people should not become the tool of their tools. This philosophy is exemplified in your HP-70 Business Pocket Calculator— the *rehumanizing* machine.
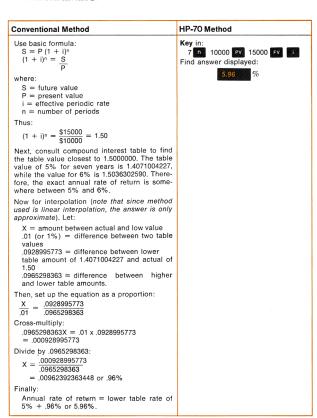
The HP-70 performs all the drudgery of complex (and simple) business calculations, yet demands very little of you in the way of memorizing rigid data entry procedures, since it's a relatively freeform process. Weighing just 9 ounces (you can take it anywhere you go), it replaces tomes of tricky tables and other such "inundata." What's more, it never gets fatigued or bored, its attention doesn't wander, and it never makes subjective errors.

To give you a sample of what you can do with your HP-70, switch the calculator to ON and we'll work a typical compound interest problem. Suppose you wanted to calculate the annual rate of return on an investment as a basis for evaluating various investment opportunities. If you could buy property today for $10,000 and could expect to sell it in 7 years for $15,000, what would be the annual rate of return on your original investment? To solve, simply enter the known values **in any order**:

Press **CLR** . Key in 7 (number of years) and press **n** (number of periods in terms of time), key in 10000 (initial investment) and press

7

PV (present value), key in 15000 (amount to be returned) and press **FV** (future value), then press **i** (interest). Find your answer (annual rate of return) on the display: `5.96` %

Compare that with the painful procedure used with the conventional calculation method:

Conventional Method	HP-70 Method

Use basic formula:
$S = P (1 + i)^n$
$(1 + i)^n = \dfrac{S}{P}$
 	
where:
  S = future value
  P = present value
  i = effective periodic rate
  n = number of periods
 	
Thus:
$(1 + i)^n = \dfrac{\$15000}{\$10000} = 1.50$
 	
Next, consult compound interest table to find the table value closest to 1.5000000. The table value of 5% for seven years is 1.4071004227, while the value for 6% is 1.5036302590. Therefore, the exact annual rate of return is somewhere between 5% and 6%.
 	
Now for interpolation (*note that since method used is linear interpolation, the answer is only approximate*). Let:
  X = amount between actual and low value
  .01 (or 1%) = difference between two table values
  .0928995773 = difference between lower table amount of 1.4071004227 and actual of 1.50
  .0965298363 = difference between higher and lower table amounts.
 	
Then, set up the equation as a proportion:
$\dfrac{X}{.01} = \dfrac{.0928995773}{.0965298363}$
Cross-multiply:
  .0965298363X = .01 x .0928995773
  = .000928995773
Divide by .0965298363:
$X = \dfrac{.000928995773}{.0965298363}$
  = .00962392363448 or .96%
Finally:
  Annual rate of return = lower table rate of 5% + .96% or 5.96%.
	Key in:
	7 **n** 10000 **PV** 15000 **FV** **i**
	Find answer displayed:
	`5.96` %

This problem is typical of a large class of financial calculations dealing with relationships between time and money. It's just one of many preprogrammed into your HP-70. Furthermore, your HP-70 provides an automatic percent and net amount feature (useful for chained discounts, etc); two general purpose memory registers—one with accumulation capability; five special purpose memory registers; as well as the four-register operational stack with RPN* so you never have to store intermediate results or reformat equations.

In addition to its more exotic features, the HP-70 is fast, accurate, and convenient to use. It handles numbers as small as 10^{-99} (that's a decimal point followed by 98 zeros and a 1), and numbers as large as 10^{99} (1 followed by 99 zeros), automatically places the decimal point, and allows you to round the display to settings ranging from zero to nine decimal places. It does everything a conventional four-function desk calculator does, too—only better. (Ecology note: your HP-70 uses less power than an ordinary flashlight battery.)

One thing your HP-70 *doesn't* have is an equals key. And you may notice that while your HP-70 works in a consistent and natural way, it *is* a slight departure from other pocket calculators. We designed it this way on purpose (*we could have done it the conventional way more easily*) because we believe our logic system is the simplest, most consistent and most practical for pocket calculator users. It allows you to concentrate on problem **solving** instead of worrying about how to reorganize a problem to fit the calculator logic or what to do with intermediate results. Once you get accustomed to the way it works (which should take about an hour), you won't want it any other way.

In short, with your HP-70, you're not just a cog in the machinery, you're the brains of the outfit—the creative one. And, your HP-70 respects you for it.

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*Reverse Polish Notation. (If you're interested in etymology, see page 81.)

1. Fundamental Operations

Getting Started

Your HP-70 is shipped fully assembled with its rechargeable battery pack in place. Slide the power switch to ON. If anything other than 0.00 appears on the display, refer to Servicing, page 99. Be sure to read battery operation instructions (appendix D) before operating the calculator on battery power. Note that you can operate the calculator on ac power while the battery pack is being charged.

The first thing most new calculator owners want to know is how to add two numbers. To start, let's add 2 and 3. Press 2 **ENTER↑** 3 **+** , then see the answer (5.00) displayed. Another thing you might like to know is that the display blinks if you attempt an improper operation; it stops blinking when you press **CLX**.

Of course, your HP-70 does a lot more than just simple arithmetic. A great deal of the power of HP pocket calculators only becomes apparent after you have used other pocket calculators. What is the difference—beyond the highly sophisticated preprogrammed functions? The big difference is the working storage area—called the operational stack—consisting of four pigeonholes "stacked" one on top of the other. (For sake of convenience, we have named these pigeonholes the X-register, Y-register, Z-register, and T-register.) This feature enables you to perform arithmetic operations in any order, which means you don't have to analyze problems for mathematical ambiguity. Further, you don't have to write down or manually store intermediate results; they will be there when you need them—automatically.

Although it's not necessary for you to understand the operational stack to solve any of the sample problems in this handbook, knowing how the stack works will allow you to make full use of your HP-70's power, and will enable you to extend your application repertoire beyond those applications we have provided. The rules are few, simple, and gratifyingly consistent. They are described in conjunction with each of the fundamental operations that follow. If theory intrigues you, refer to the in-depth discussion of the operational stack in appendix B.

Keyboard

The HP-70 keyboard is illustrated in figure 1. A summary of all keys and an index to where they are described and used are provided on page 120 at the back of this handbook.
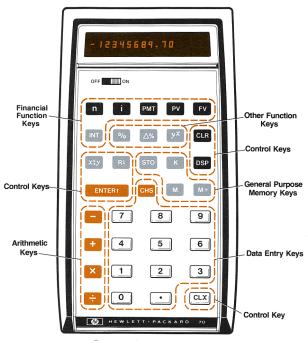
Figure 1. Keyboard Layout

Keying In and Entering Numbers: $\boxed{0}$ **through** $\boxed{9}$, $\boxed{\cdot}$, $\boxed{\text{ENTER}\blacklozenge}$
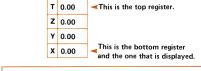
Key in the following numbers:

Press	See Displayed
1	*1.*
2	*12.*
3	*123.*

Note that the decimal point moved one position to the right each time you keyed in a digit. Until you press the decimal point key, or run out of digit positions in the display, the decimal point continues to move to the right. To continue,

Press	See Displayed
.42	*123.42*

The display is actually a window that shows the contents of the bottom register (X-register) of the stack. Imagine that all stack registers were visible at once. Your stack would look like this when you turned on the calculator:

T	0.00	◄ This is the top register.
Z	0.00	
Y	0.00	
X	0.00	◄ This is the bottom register and the one that is displayed.
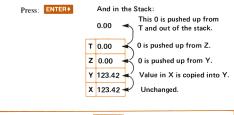
> **Remember:** The stack is filled with zeros every time the power switch is turned on.

When you keyed in 123.42, it was recorded in the stack as follows:

T	0.00	
Z	0.00	Unchanged.
Y	0.00	
X	123.42	◄ 123.42 in X.

> **Remember:** Each time a value is keyed in, it goes into the X-register and is displayed.

To put this number into position for a calculation,

Press: `ENTER◆`   And in the Stack:

		This 0 is pushed up from
	0.00	T and out of the stack.
T	0.00	0 is pushed up from Z.
Z	0.00	0 is pushed up from Y.
Y	123.42	Value in X is copied into Y.
X	123.42	Unchanged.

> **Remember:** Every time `ENTER◆` is pressed, the value in X is copied into Y. The contents of Y and Z *are pushed up;* the contents of T *are pushed up and out* of the stack.
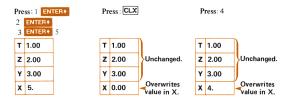
Now key in a second number—say 5.

Press: 5   Review Stack

T	0.00	
Z	0.00	Unchanged.
Y	123.42	
X	5.	Overwrites value in X.

> **Remember:** When a number is keyed in immediately following `ENTER◆`, the new value overwrites the contents of X and is displayed. The contents of the stack are *not pushed up.*

Clearing: `CLX` , `CLR`

If you make a mistake keying in a number, press `CLX` to clear the display. Then key in the correct number. For example, assume that you have filled up the stack with numbers and you need to change the last number keyed in.

Press: 1 `ENTER◆`   Press: `CLX`   Press: 4
2 `ENTER◆`
3 `ENTER◆` 5

T	1.00
Z	2.00
Y	3.00
X	5.

T	1.00	
Z	2.00	Unchanged.
Y	3.00	
X	0.00	Overwrites value in X.

T	1.00	
Z	2.00	Unchanged.
Y	3.00	
X	4.	Overwrites value in X.

> **Remember:** CLX overwrites the contents of the X-register with zero; the contents of the stack *are not pushed up.* When a number is keyed in immediately following CLX , the number overwrites the contents of X and is displayed; again, the contents of the stack *are not pushed up.*

An important point about your HP-70 is that it isn't necessary to clear it between arithmetic calculations.* Because of the operational stack, intermediate results are there *automatically* when you want them; but they don't get in the way if you don't need them.

CLR clears the entire operational stack including the display (X-register). **CLR** also clears special storage registers related to financial functions. These are described starting on page 33.

Clearing with CLX and **CLR** doesn't have any effect on the two general-purpose memory registers, K and M. When new values are stored, they simply overwrite any existing values, so there is no need to clear.

Note that the entire calculator is cleared when the power switch is turned off; when turned back on, all registers are automatically reset to zero, with the exception of the K-register which is reset to 12 (more about that later in the section on storing and recalling numbers, page 29).

Performing Simple Arithmetic: ⊞ , ⊟ , ⊠ , ⊞

If you have operated an ordinary adding machine, you already know how to use your HP-70 for simple arithmetic problems. The ⊞ key adds the last number keyed in to the number in the Y-register. Likewise, the ⊟ key subtracts the number keyed in from the number in the Y-register. For example, add 12 and 3, then subtract 9.

Press	See Displayed
12 ENTER↑ 3 ⊞	15.00
9 ⊟	6.00
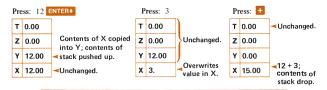
Repeat the same problem and see how it affects the stack.
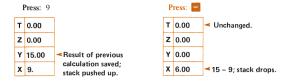
> **Note:** For the sake of simplicity, in the following examples, we are going to assume that the stack contains no data from previous examples.

*Financial functions utilizing the top row keys have special clearing requirements; these are outlined on page 35.

Press: 12 `ENTER◆`

T	0.00
Z	0.00
Y	12.00
X	12.00

Contents of X copied into Y; contents of stack pushed up.

◄ Unchanged.

Press: 3

T	0.00
Z	0.00
Y	12.00
X	3.

} Unchanged.

Overwrites value in X.

Press: `+`

T	0.00
Z	0.00
Y	0.00
X	15.00

◄ Unchanged.

◄ 12 + 3; contents of stack drop.

> **Remember**: Arithmetic operations (`×` , `−` , `+` , `÷`) are performed on the contents of X and Y; the result is displayed in X, and the operands are lost. The contents of Z are *pushed down* into Y, and the contents of T are *copied* into Z.

Now subtract 9 from 15.

Press: 9

T	0.00
Z	0.00
Y	15.00
X	9.

◄ Result of previous calculation saved; stack pushed up.

Press: `−`

T	0.00
Z	0.00
Y	0.00
X	6.00

◄ Unchanged.

◄ 15 − 9; stack drops.

> **Remember**: When you key in a number after performing an arithmetic operation, the contents of the stack *are pushed up.*

The principle is the same for `×` and `÷` . For example, multiply 12 by 3.

Press

12 `ENTER◆` 3 `×`

See Displayed

`36.00`

Now divide 12 by 3.

Press

12 `ENTER◆` 3 `÷`

See Displayed

`4.00`

Combined Arithmetic Processes

The HP-70 performs combined arithmetic operations—serial, mixed, and chained calculations—with unprecedented ease.

Serial Calculation

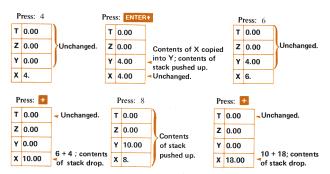As you observed in a previous example, any time a new number is keyed in after an arithmetic calculation, the HP-70 pushes up the result of the calculation automatically. This feature permits serial calculation (while generating a series of intermediate results) without writing down or manually storing any of the intermediate results. For example, find the sum of 4, 6, 8 and 10.

Press   **See Displayed**

4 **ENTER↑** 6 **+**   `10.00`

8 **+**   `18.00`

10 **+**   `28.00`

The same principle applies to serial multiplication, division and subtraction, too. An equals key (=) is not needed since results are displayed when an arithmetic or function key is pressed. This point becomes clear upon analysis of the stack when solving the problem.

Press: 4

T	0.00
Z	0.00
Y	0.00
X	4.

}Unchanged.

Press: **ENTER↑**

T	0.00
Z	0.00
Y	4.00
X	4.00

Contents of X copied into Y; contents of stack pushed up.
◄Unchanged.

Press: 6

T	0.00
Z	0.00
Y	4.00
X	6.

}Unchanged.

Press: **+**

T	0.00
Z	0.00
Y	0.00
X	10.00

◄ Unchanged.

6 + 4 ; contents of stack drop.

Press: 8

T	0.00
Z	0.00
Y	10.00
X	8.

}Contents of stack pushed up.

Press: **+**

T	0.00
Z	0.00
Y	0.00
X	18.00

◄Unchanged.

10 + 18; contents of stack drop.

Press: 10

T	0.00
Z	0.00
Y	18.00
X	10.

Contents of stack
pushed up.

Press: +

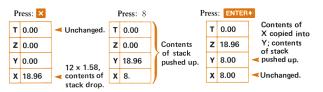| T	0.00	◄ Unchanged.
Z	0.00	
Y	0.00	
X	28.00	◄ 18 + 10; contents of stack drop.

Chained Calculation

Chained calculations are things like adding the results of two or more multiplication operations (sums of products), or multiplying the results of two or more addition operations (products of sums). For example, if you sold 12 items at $1.58 each, 8 items at $2.67 each, and 16 items at $0.54 each, the gross sale is

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

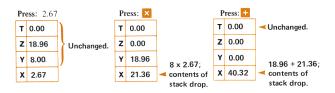| Press	See Displayed	
12 ENTER↑ 1.58 ✕	$ *18.96*	12 @ $1.58
8 ENTER↑ 2.67 ✕	$ *21.36*	8 @ $2.67
+	$ *40.32*	Subtotal
16 ENTER↑ .54 ✕	$ *8.64*	16 @ $.54
+	$ *48.96*	Gross sale

With ordinary calculators you have to make two passes for this type of problem by first calculating the items in parentheses and then adding the results. With your HP-70, you merely key in the numbers from left to right and perform all arithmetic operations possible; or, if none are possible, press ENTER↑ and continue. The reason that you are able to handle this problem so easily is revealed as you review the stack.

Press: 12

T	0.00
Z	0.00
Y	0.00
X	12.

Unchanged.

Press: ENTER↑

T	0.00
Z	0.00
Y	12.00
X	12.00

Contents of X copied
into Y; contents of
stack pushed up.

◄ Unchanged.

Press: 1.58

T	0.00
Z	0.00
Y	12.00
X	1.58

Unchanged.

Press: ✕

T	0.00
Z	0.00
Y	0.00
X	18.96

◄ Unchanged.

12 x 1.58, contents of stack drop.

Press: 8

T	0.00
Z	0.00
Y	18.96
X	8.

Contents of stack pushed up.

Press: ENTER↑

T	0.00
Z	18.96
Y	8.00
X	8.00

Contents of X copied into Y; contents of stack pushed up.

◄ Unchanged.

Press: 2.67

T	0.00
Z	18.96
Y	8.00
X	2.67

Unchanged.

Press: ✕

T	0.00
Z	0.00
Y	18.96
X	21.36

8 x 2.67; contents of stack drop.

Press: +

T	0.00
Z	0.00
Y	0.00
X	40.32

◄ Unchanged.

18.96 + 21.36; contents of stack drop.

Press: 16

T	0.00
Z	0.00
Y	40.32
X	16.

Contents of stack pushed up.

Press: ENTER↑

T	0.00
Z	40.32
Y	16.00
X	16.00

Contents of X copied into Y; contents of stack pushed up.

Press: .54

T	0.00
Z	40.32
Y	16.00
X	.54

◄ Unchanged.

Press: ✕

T	0.00
Z	0.00
Y	40.32
X	8.64

◄ Unchanged.

16 x .54; contents of stack drop.

Press: +

T	0.00
Z	0.00
Y	0.00
X	48.96

◄ Unchanged.

40.32 + 8.64; contents of stack drop.

> **Remember**: Key in the problem and perform all possible operations between two numbers after they are both in the stack (X- and Y-registers). If you can't perform one or more operations, press **ENTER↑** and continue until the calculation is complete.

Products of sums are calculated in the same way. Try this:

$$(2 + 3) \times (4 + 5) = 45$$

Press	See Displayed	
2 **ENTER↑** 3 **+**	**5.00**	2 and 3 are summed.
4 **ENTER↑** 5 **+**	**9.00**	4 and 5 are summed.
×	**45.00**	5 and 9 are multiplied.

Notice that you perform this calculation (products of sums) in exactly the same way—left to right—as the previous calculation (sums of products). Further, chained calculations aren't limited to addition and multiplication; subtraction and division are handled the same way.

Mixed Calculation

Calculations may be performed with any combination of arithmetic operations. To give you an idea of how the stack tames a complicated problem, calculate the following and use the left-to-right entry rules.

$$[(12 \times 5) - 2 + (8 \div 2) + 10] \times 213.08 \times 5 \div 1.33 = 57675.79$$

Press	See Displayed	
12 **ENTER↑** 5 **×**	**60.00**	12 × 5
2 **−**	**58.00**	60 − 2 (This is as far as you can go until you have more data.)
8 **ENTER↑** 2 **÷**	**4.00**	8 ÷ 2
+	**62.00**	58 + 4
10 **+**	**72.00**	62 + 10
213.08 **×**	**15341.76**	72 × 213.08
5 **×**	**76708.80**	15341.76 × 5
1.33 **÷**	**57675.79**	76708.80 ÷ 1.33

You could do this same problem several ways. Refer to Solution Method Model, page 87 for examples varying the calculation procedure.

Keying In Negative Numbers: CHS

CHS changes the sign of displayed numbers. To key in a negative number, key in the number, then press CHS (change sign key). The number, preceded by a minus sign (–), will appear on the display. For example,

Press	See Displayed
12 CHS	— 12.
ENTER↑ 9 +	— 3.00

Numbers retain their given signs until changed, even when the numbers are moved about in the stack. To change the sign of either a negative number or positive number* press CHS . For example, to change the sign of –3.00 now in the display,

Press	See Displayed
CHS	— 3.00

Rounding the Display

When you turn on your HP-70 the display is automatically set to two decimal places. However, you can display up to 15 characters: sign (–), 10-digit number, decimal point, exponent sign (–), and 2-digit exponent.

sign ➤ — 1.234567891 — 10 ◄ exponent

10-digit number and decimal point ▲ exponent sign

Figure 2. Display

Two display modes (fixed decimal and scientific notation) are provided. When you round off the display, it's only the display itself that is affected; the HP-70 always maintains 10 digits internally.

*Numbers not preceded by a minus sign are always assumed to be positive.

Fixed Decimal Notation: `DSP` `0` **through** `9`

Fixed decimal notation is specified by pressing `DSP` followed by any number key `0` through `9` The display is then rounded to the number of decimal places corresponding to the number key pressed. The display is left-justified and may include trailing zeros within the setting specified. For example,

Press	**See Displayed**
123.456	`123.456`
`DSP` `0`	`123.`
`DSP` `1`	`123.5`
`DSP` `4`	`123.4560`
`DSP` `7`	`123.4560000`
`DSP` `2`	`123.46`

If the number you key in combined with the display mode you specify exceed the display capacity, the result is truncated in the 10th digit. For example,

Press	**See Displayed**	
`DSP` `9`	`123.4560000`	Compare this with the `DSP` `7` result above.

The display setting is retained until a different one is specified or the calculator is turned off. For example,

Press	**See Displayed**
`CLX`	`0.000000000`
`DSP` `2`	`0.00`
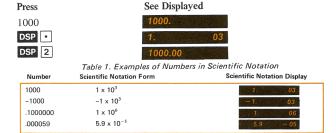
If the result of a calculation is too small in magnitude for the display mode selected, it will be displayed as zero. In this event, change the display mode to include more decimal places. For example, calculate 1/400.

Press	**See Displayed**
1 `ENTER↑` 400 `÷`	`0.00`
`DSP` `6`	`0.002500`
`DSP` `2`	`0.00`

Scientific Notation : `DSP` `•`

Scientific notation is a convenient and economical way of expressing very large or very small numbers. In scientific notation, a number has the form $N \times 10^n$ where N is a number having a magnitude between 1 and 10, and n is a positive or negative integer.

If you want to display in scientific notation, merely press `DSP` `•`. The display is left-justified and trailing zeros are deleted. For example,

Press	See Displayed
1000	`1000.`
`DSP` `•`	`1.          03`
`DSP` `2`	`1000.00`

Table 1. Examples of Numbers in Scientific Notation

Number	Scientific Notation Form	Scientific Notation Display
1000	1×10^3	`1.          03`
−1000	-1×10^3	`−1.          03`
.1000000	1×10^6	`1.          06`
.000059	5.9×10^{-5}	`5.9       −05`

If you key in a very large number whose digits exceed the 10-digit display capacity—say 1 trillion—it will be displayed automatically in scientific notation.

Press	See Displayed
1000000000000	`1.000000000  12`

This represents 1×10 raised to the 12th power.
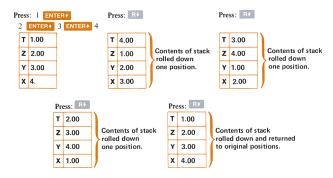
Calculations whose results have a magnitude greater than the display capacity will be displayed in scientific notation automatically. For example, calculate 1,000,000 x 1,000,000. (Terminate the displayed number with `CLR`.)

Press	See Displayed
`CLR` 1000000 `ENTER↑` `X`	`1.          12`

Repositioning Numbers
Reviewing/Verifying Numbers Entered : `R↓`
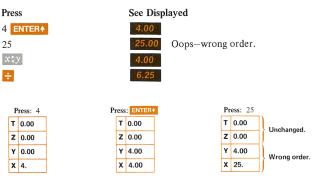
The `R↓` (roll down) key permits you to review and/or reposition the contents of the stack registers. Each time `R↓` is pressed, the contents of each stack register move into the display in last-in/first-out order. No

data are lost by rotating the register contents; after a complete circuit (`R↓` `R↓` `R↓` `R↓`) they return to the same locations they occupied before rotation. For example, 1 `ENTER↑` 2 `ENTER↑` 3 `ENTER↑` 4 can be keyed in, then viewed and returned to their respective registers by pressing `R↓` four times as follows:
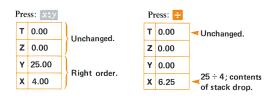
Press: 1 `ENTER↑`
2 `ENTER↑` 3 `ENTER↑` 4

T	1.00
Z	2.00
Y	3.00
X	4.

Press: `R↓`

T	4.00
Z	1.00
Y	2.00
X	3.00

Contents of stack rolled down one position.

Press: `R↓`

T	3.00
Z	4.00
Y	1.00
X	2.00

Contents of stack rolled down one position.

Press: `R↓`

T	2.00
Z	3.00
Y	4.00
X	1.00

Contents of stack rolled down one position.

Press: `R↓`

T	1.00
Z	2.00
Y	3.00
X	4.00

Contents of stack rolled down and returned to original positions.

Reversing Operand Order : `x⇄y`

Frequently you will want to subtract or divide when the number displayed must be interchanged with a previously displayed number. To do so press `x⇄y` For example, say you wanted to divide 25 by 4, but the latter number was keyed in first as follows:

Press	See Displayed	
4 `ENTER↑`	4.00	
25	25.00	Oops—wrong order.
`x⇄y`	4.00	
`÷`	6.25	

Press: 4

T	0.00
Z	0.00
Y	0.00
X	4.

Press: `ENTER↑`

T	0.00
Z	0.00
Y	4.00
X	4.00

Press: 25

T	0.00
Z	0.00
Y	4.00
X	25.

Unchanged.

Wrong order.

Press: [x≷y]

T	0.00
Z	0.00
Y	25.00
X	4.00

} Unchanged.

} Right order.

Press: [÷]

T	0.00
Z	0.00
Y	0.00
X	6.25

◄ Unchanged.

◄ 25 ÷ 4; contents of stack drop.

Performing Simple Functions

Calculating Percentage Problems

The HP-70 simplifies the calculation of percentage problems because you don't have to convert percents to their decimal equivalents before using them; just press the [%] key after keying in the percent value. Equations used for calculating percentage problems are included in appendix C, Formulas for Financial Problems.

Finding Percentage: [%] . To find the percentage of a number, key in the base number and press [ENTER↑]. Then key in the percent and press [%] . For example, find 14% of 300.

Press

300 [ENTER↑] 14 [%]

See Displayed

42.00   Percentage amount

Finding Net Amount: [%] [+] , [%] [−] . After the percentage is calculated, the Y-register still contains the base number from which you may calculate the net amount by simply pressing [+] or [−] , respectively. For example,

Press

300 [ENTER↑] 14 [%]
[+]

See Displayed

42.00   Percentage amount.

342.00   Net amount (base plus percentage amount).

or

Press

300 [ENTER↑] 14 [%]
[−]
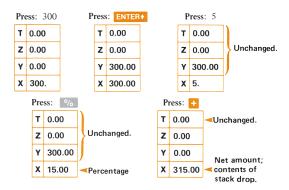
See Displayed

42.00   Percentage.

258.00   Net amount (base less percentage amount).

The reason you can do this problem without writing down the base (300) is because our percent function is specially programmed so that the base number remains in the Y-register after a percent calculation— where it is ready for a net amount calculation.

Take a look at the stack while calculating a net amount problem. For example, if the tax on a $300 item is 5%, what is the amount of tax (percentage) and the total cost?

Press: 300

T	0.00
Z	0.00
Y	0.00
X	300.

Press: ENTER↟

T	0.00
Z	0.00
Y	300.00
X	300.00

Press: 5

T	0.00
Z	0.00
Y	300.00
X	5.

⎫ Unchanged.

Press: %

T	0.00
Z	0.00
Y	300.00
X	15.00

⎫ Unchanged.

◄Percentage

Press: +

| T | 0.00 | ◄Unchanged.
Z	0.00
Y	0.00
X	315.00

Net amount;
◄ contents of
stack drop.

Finding Percent Difference Between Two Numbers: △% . To find the percent difference between a number and the base, key in the base number and press ENTER↟ . Key in the second number and press △% . For example, find the percent of increase of your current house payment ($240/month) over what you were paying in rent 15 years ago ($70/month).

Press	**See Displayed**
70 ENTER↟ 240 △%	242.86 % increase.

Finding Proportion: To find what percent one number is of another, key in the percentage and press ENTER↟ , then key in the base and press ÷ . Since this type of percentage problem is a straight division calculation, the result is displayed as a decimal rather than %. For example, 120 is what percent of 240?

Press	See Displayed
120 **ENTER↑** 240 **÷**	*0.50*
100 **✕**	*50.00* %

Raising a Number to a Power — Exponentiation: **yˣ**

yˣ permits you to raise a positive number (integer/decimal) to a positive or negative power. In many calculators you'd have to perform a number of serial calculations to do this sort of problem. For example, calculate 2^9 (2x2x2x2x2x2x2x2x2).

Press	See Displayed
2 **ENTER↑** 9 **yˣ**	*512.00*

Now find $4.37^{-2.5}$.

Press	See Displayed
4.37 **ENTER↑** 2.5 **CHS** **yˣ**	*0.03*

yˣ calculations have the same effect on the stack as arithmetic operations; that is, the value in the Y-register is raised to the power in the X-register, where the result is displayed. (Remember, the stack drops, the contents of T are duplicated into Z, and the operands are lost.) To illustrate, let's analyze the last problem.

Press: 4.37
ENTER↑ 2.5
CHS

T	0.00
Z	0.00
Y	4.37
X	−2.5

Press: **yˣ**
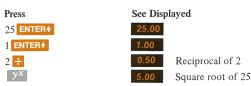
T	0.00	◀ Unchanged.
Z	0.00	
Y	0.00	
X	0.03	◀ $4.37^{-2.5}$; contents of stack drop.

If you try to raise zero or a negative number to a power you will see an error message (flashing zeros) on the display.
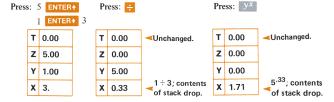
Extracting Roots

To extract roots of positive numbers, key in and enter the number, key in and enter 1, key in the root desired, divide to get the reciprocal of the root, then press y^x . For example, find the square root of 25. (Note that this could be expressed as $\sqrt{25}$ or $25^{\frac{1}{2}}$ or $25^{.5}$.)

Press	See Displayed	
25 **ENTER↑**	**25.00**	
1 **ENTER↑**	**1.00**	
2 **÷**	**0.50**	Reciprocal of 2
y^x	**5.00**	Square root of 25

Find the cube root of 5 (again, this could also be expressed as $\sqrt[3]{5}$ or $5^{1/3}$).

Press	See Displayed	
5 **ENTER↑**	**5.00**	
1 **ENTER↑**	**1.00**	
3 **÷**	**0.33**	Reciprocal of 3.
y^x	**1.71**	Cube root of 5.

And in the stack,

Press: 5 **ENTER↑**
          1 **ENTER↑** 3

T	0.00
Z	5.00
Y	1.00
X	3.

Press: **÷**

T	0.00	◄Unchanged.
Z	0.00	
Y	5.00	
X	0.33	◄ $1 \div 3$; contents of stack drop.

Press: **y^x**

T	0.00	◄Unchanged.
Z	0.00	
Y	0.00	
X	1.71	◄ $5^{.33}$; contents of stack drop.

Storing and Recalling Numbers

Two general purpose memory registers are provided apart from the stack. One memory register (M) is primarily useful when you need to store data for use in subsequent problems or for accumulation. The other memory register (K) will probably be most convenient to use in repetitive calculations where one value remains the same (constant).

Although the store and recall functions work identically for both memory registers, since each has been assigned special purpose features to extend its use, we have described them separately.

M-Register: `STO` `M` , `M`
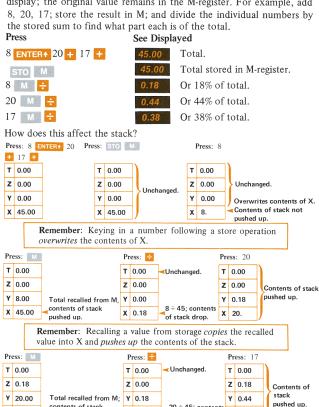
When the calculator is turned on, the M-register is automatically reset to zero. To store a displayed value (whether the result of a calculation or a keyboard entry) in the M-register, press `STO` `M`. To retrieve the value merely press `M`. A copy of the recalled value appears on the display; the original value remains in the M-register. For example, add 8, 20, 17; store the result in M; and divide the individual numbers by the stored sum to find what part each is of the total.

Press	See Displayed	
8 `ENTER↑` 20 `+` 17 `+`	`45.00`	Total.
`STO` `M`	`45.00`	Total stored in M-register.
8 `M` `÷`	`0.18`	Or 18% of total.
20 `M` `÷`	`0.44`	Or 44% of total.
17 `M` `÷`	`0.38`	Or 38% of total.

How does this affect the stack?

Press: 8 `ENTER↑` 20   Press: `STO` `M`   Press: 8
`+` 17 `+`

T	0.00
Z	0.00
Y	0.00
X	45.00

T	0.00
Z	0.00
Y	0.00
X	45.00
Unchanged.

T	0.00
Z	0.00
Y	0.00
X	8.
Unchanged.
Overwrites contents of X.
Contents of stack not pushed up.

Remember: Keying in a number following a store operation *overwrites* the contents of X.

Press: `M`   Press: `÷`   Press: 20

T	0.00
Z	0.00
Y	8.00
X	45.00
Total recalled from M, contents of stack pushed up.

T	0.00
Z	0.00
Y	0.00
X	0.18
Unchanged.
8 ÷ 45; contents of stack drop.

T	0.00
Z	0.00
Y	0.18
X	20.
Contents of stack pushed up.

Remember: Recalling a value from storage *copies* the recalled value into X and *pushes up* the contents of the stack.

Press: `M`   Press: `÷`   Press: 17

T	0.00
Z	0.18
Y	20.00
X	45.00
Total recalled from M; contents of stack pushed up.

T	0.00
Z	0.00
Y	0.18
X	0.44
Unchanged.
20 ÷ 45; contents of stack drop.

T	0.00
Z	0.18
Y	0.44
X	17.
Contents of stack pushed up.

Press: M   Press: •

0.00 (Lost)

T	0.18
Z	0.44
Y	17.00
X	45.00

Total recalled from M; contents of stack pushed up.

| T | 0.18 | ◄ Unchanged.
|---|---|
| Z | 0.18 |
| Y | 0.44 |
| X | 0.38 |

17 ÷ 45; contents of stack drop.

As you have now observed, recalling the contents of M displays the copy in the X-register and pushes up the stack. Whatever value resides in the T-register (top) is pushed out and lost.

To enter a new value or to clear the M-register, merely store another value or zero.

K-Register : STO K , K

This register operates exactly the same as the M-register for storing and recalling values; that is STO K stores the displayed value in the K-register, and K recalls and displays a copy of the value. A special feature of the K-register is that it is set automatically to 12 each time you turn on your calculator. Try it. Turn the power switch off, then on. Now recall the value.

Press   **See Displayed**

K   12.00

Why 12? Since financial functions require that interest rates and compounding periods (usually 12 per year) be expressed in compatible units, you may frequently have to multiply or divide by 12.* Therefore, it is usually a good idea to save the K-register for this special purpose unless the compounding frequency is other than monthly. Then it will probably be more convenient to store the appropriate constant in K, in place of 12.

Accumulation : M+ , M

The M-register can also be used as an accumulator; that is, you can add a value displayed in the X-register to the contents in M by pressing M+ . Further, to subtract a value from the M-register, press CHS to change the sign of the displayed value before pressing M+ . For example, store 5 in the M-register, increase it by 3, decrease it by 2.

*See discussion of compounding period conversions, page 36.

Press	See Displayed
5 **STO** **M**	`5.00`
3 **M+**	`8.00`
2 **CHS**	`— 2.00`
M+	`6.00`

Now if you go on to other calculations or clear the display, you can still recall the current value of M.

Press	See Displayed
CLX	`0.00`
M	`6.00`

> **Note:** If you want to use M as a counter, first set it to zero with 0 **STO** **M** .

Another feature of the accumulation function is that you are able to calculate two separate running totals—one in the stack and the other in the M-register. For example, suppose you sold two large ski caps at $2.99, four medium caps at $1.59, and three small caps at $.99. What is the gross sale and the total number of ski caps sold?
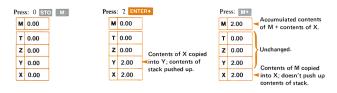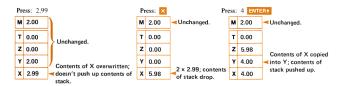
Press	See Displayed	
0 **STO** **M**	`0.00`	M-register set to zero.
2 **ENTER↑** **M+** 2.99 **X**	$ `5.98`	2 large caps @ 2.99.
4 **ENTER↑** **M+** 1.59 **X**	$ `6.36`	4 medium caps @ 1.59.
+	$ `12.34`	Subtotal gross sale.
3 **ENTER↑** **M+** .99 **X**	$ `2.97`	3 small caps @ .99.
+	$ `15.31`	Total gross sale (accumulated in stack).
M	`9.00`	Total items (accumulated in M-register).
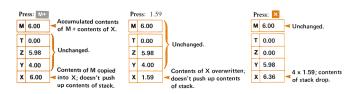
A look at the stack and the M-register shows how this works.

Press: 0 STO M

M	0.00
T	0.00
Z	0.00
Y	0.00
X	0.00

Press: 2 ENTER◆

M	0.00
T	0.00
Z	0.00
Y	2.00
X	2.00

◄ Contents of X copied into Y; contents of stack pushed up.

Press: M+

M	2.00
T	0.00
Z	0.00
Y	2.00
X	2.00

◄ Accumulated contents of M + contents of X.

◄ Unchanged.

◄ Contents of M copied into X; doesn't push up contents of stack.
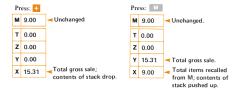
> **Remember:** M+ and data entries immediately following M+ overwrite contents of X-register, and *do not push up* contents of the stack.

Press: 2.99

M	2.00
T	0.00
Z	0.00
Y	2.00
X	2.99

◄ Unchanged.

◄ Contents of X overwritten; doesn't push up contents of stack.

Press: ×

M	2.00
T	0.00
Z	0.00
Y	0.00
X	5.98

◄ Unchanged.

2 × 2.99; contents of stack drop.

Press: 4 ENTER◆

M	2.00
T	0.00
Z	5.98
Y	4.00
X	4.00

◄ Unchanged.

Contents of X copied into Y; contents of stack pushed up.

Press: M+

M	6.00
T	0.00
Z	5.98
Y	4.00
X	6.00

◄ Accumulated contents of M + contents of X.

◄ Unchanged.

◄ Contents of M copied into X; doesn't push up contents of stack.

Press: 1.59

M	6.00
T	0.00
Z	5.98
Y	4.00
X	1.59

◄ Unchanged.

◄ Contents of X overwritten; doesn't push up contents of stack.

Press: ×

M	6.00
T	0.00
Z	0.00
Y	5.98
X	6.36

◄ Unchanged.

4 × 1.59; contents of stack drop.

Press: **+**

M	6.00	◄ Unchanged.
T	0.00
Z	0.00
Y	0.00
X	12.34	◄ Subtotal gross sale; contents of stack drop.

Press: 3 **ENTER◆**

M	6.00	◄ Unchanged.
T	0.00
Z	12.34
Y	3.00	◄ Contents of X copied into Y; contents of stack pushed up.
X	3.00

Press: **M+**

M	9.00	◄ Accumulated contents of M + contents of X.
T	0.00	◄ Unchanged.
Z	12.34
Y	3.00
X	9.00	◄ Contents of M copied into X; doesn't push up contents of stack.

Press: 99

M	9.00
T	0.00	◄ Unchanged.
Z	12.34
Y	3.00
X	0.99	◄ Contents of X overwritten; doesn't push up contents of stack.

Press: **×**

M	9.00	◄ Unchanged.
T	0.00
Z	0.00
Y	12.34
X	2.97	◄ 3 × .99; contents of stack drop.

Press: **+**

M	9.00	◄ Unchanged
T	0.00
Z	0.00
Y	0.00
X	15.31	◄ Total gross sale; contents of stack drop.

Press: **M**

M	9.00	◄ Unchanged.
T	0.00
Z	0.00
Y	15.31	◄ Total gross sale.
X	9.00	◄ Total items recalled from M; contents of stack pushed up.

2. Using Financial Functions

The Nature of Time and Money Calculations: `n` , `i` ,
`PMT` , `PV` , `FV` , `INT` .

In your HP-70 you have the solution to myriad financial calculations, involving time and money relationships, literally at your fingertips. To give you an idea of typical applications, work through the examples that follow (take the keystrokes on faith—we'll explain following the examples).

Suppose you had $10,000 to invest in one of the following enterprises:

	Investment A	Investment B
Initial investment:	$10,000	$10,000
Expected return:	$25,000	$15,000
Time:	7 years	3 years

Which investment is more profitable, assuming all other considerations such as risk, inflation, etc., are equal?

To solve this problem on your HP-70, first calculate the annual rate of return for investment A.

Press	See Displayed	
`CLR`	`0.00`	
10000 `PV`	$ `10000.00`	Initial investment (present value).
25000 `FV`	$ `25000.00`	Expected return (future value) for investment A.
7 `n`	`7.00`	Number of years.
`i`	`13.99`	% annual rate of return (interest).

Now calculate the annual rate of return for investment B. Since the initial investment, $10,000, is the same, you only need change the values for expected return and number of years as follows:

Press	See Displayed	
15000 `FV`	$ `15000`	Expected return (future value) for investment B.
3 `n`	`3.00`	Number of years.

| i | | **14.47** | % annual rate of return (interest)—clearly the better investment. |

Previously, this problem was extremely difficult to calculate—unless you had access to a large computer—because it could only be handled after lengthy calculations and interpolations of table values before a comparison could be made. It is typical of an entire class of calculations involving time and money—particularly the interest compounding process.

Your HP-70 has the most common business calculations (including the associated tables) preprogrammed into the top row keys (compound interest keys). Since you may also have occasion to calculate simple (or accrued) interest, we have included a simple interest key (INT) to be used along with the applicable top row keys. The entire set of financial function keys, including some of the values associated with each, are shown in figure 3.

n Total number of compounding periods, payment periods, time periods, etc., (days, years, months) for compound interest problems; total number of days for simple interest problems.

PMT Periodic payment amount, savings deposit, or installment portion of annuity or sinking fund (includes ordinary annuities, annuity due*, mortgage* and loan amortization payments, payments in arrears).

PV Present value, principal, investment, price, beginning balance, original amount, etc.

i Interest rate per period expressed as percent (not decimal equivalent).

FV Future value, principal plus interest amount, final balance, face value of a note etc.

INT Simple interest amount; discount amount and accrued interest of notes.

Figure 3. Financial Function Keys

Formatting the Calculation

In computer technology and mathematics there is a very useful word that—as far as this writer knows—has no equivalent in everyday English. The word is "parameter" meaning—in the context of this handbook—a name that classifies or identifies a value as to kind; the *name* remains *constant* (fixed) but the *value* may *change* (is variable). Think of a parameter as a box with a label on it. If you were counting all your paperclips, regardless of kind, the total (say 150) would be put in the box and the label (parameter) would say "paperclips".

*Used with keystroke routine combining preprogrammed financial functions with additional keystrokes.

Parameter ►	**Paperclips**
	150 ◄ Variable value
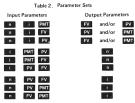
Now, if you were sorting paperclips according to kind, you would need as many boxes as you have different kinds of paperclips. And, if you took a new count every day or so, the values would probably change.

Parameter ►	**Metal clip**		Parameter ►	**Plastic clip**
	100 ◄ Variable value			50 ◄ Variable value

Now think of each of the top row keys as a box; the lettered symbol is the label (parameter). The values you put into the box (by pressing the appropriate top row key) are variable.

The nature of financial calculations in the HP-70 requires three input parameters to solve for one or two output parameters. This means you have a total of five parameters (**n** **i** **PMT** **PV** **FV**) of which three must be input, and one or two can be output. Input parameters can be entered in any order; output parameters can be executed in any order. Both **n** and **i** are essential to all calculations and must be included as two of the input parameters, or as one input parameter and one output parameter.

> **Note**: Always press **CLR** before using a different input parameter set to clear parameters of any existing values.

The following table shows all possible parameter combinations.

Table 2. Parameter Sets

Input Parameters			Output Parameters		
n	i	PMT	FV	and/or	PV
n	i	FV	PV	and/or	PMT
n	i	PV	FV	and/or	PMT
i	PMT	PV		n	
i	PMT	FV		n	
i	PV	FV		n	
n	PV	FV		i	
n	PV	PMT		i	
n	FV	PMT		i	

Try the following examples to get a feeling for keying in problems.

If you invested $1000 for 2 years at a rate of 6% per year,* what is the total amount you would receive at the end of 2 years?

*Interest is always expressed as an annual rate in examples unless otherwise specified.

Press	See Displayed	
CLR	`0.00`	
1000 PV	$ `1000.00`	Principal (present value).
2 n	`2.00`	Number of compounding periods.
6 i	`6.00`	% annual interest.
FV	$ `1123.60`	Principal plus interest (future value).

If you know the future value and want to figure the annual interest rate,

Press	See Displayed	
CLR	`0.00`	
1000 PV	$ `1000.00`	Principal.
1123.60 FV	$ `1123.60`	Principal plus interest.
2 n	`2.00`	Number of compounding periods.
i	`6.00`	% annual interest rate.

Compounding Period Conversions

Throughout the following examples, compounding periods, payment periods, time periods, and periods are synonymous and are used interchangeably. Furthermore, payment periods and compounding periods are assumed to be both equal and coincident, that is, interest is compounded and periodic payments are due at the same time.

The n parameter represents the total number of compounding periods, i.e., the total number of times interest is compounded.

If the total number of compounding periods is not given, it must be calculated by multiplying the number of years by the number of compounding periods per year. For example, if the interest is compounded monthly on a 30-year loan, the total number of compounding periods is 360 (30 x 12 = 360).

The [i] parameter represents the interest rate per period (expressed as a percent rather than the decimal equivalent).

If the interest rate per period is not given (usually it is expressed as an annual rate), it must be calculated by dividing the annual interest rate by the number of compounding periods per year. For example, if the interest on that 30-year loan is expressed as 12% (annual interest) and is compounded monthly, the interest rate per period is 1% (12 ÷ 12 = 1).

You'll save time if you use the K-register for repetitive conversion constants. (Remember—the K-register is set to 12 for monthly compounding whenever you turn the calculator on; it remains set to 12 until you store another value in K, and is not affected by [CLX] or [CLR] operations.) If you are using a compounding period other than monthly, merely store the appropriate value in K and recall it as needed.

For example, with K set to 12, calculate the total number of compounding periods on a 30-year loan having interest compounded monthly.

Press | **See Displayed**
30 [K] [X] [n] | 360.00

Further, 9% interest per year is equal to .75% per month (9 ÷ 12 = .75). Again, it can be keyed directly into [i] following the conversion calculation:

Press | **See Displayed**
9 [K] [÷] [i] | 0.75   Remember, you don't
 | change percent values
 | to decimal equivalents
 | in financial functions.

Payment Calculations

Values associated with the [PMT] (payment) key assume an ordinary annuity problem; that is, payments are assumed to be equal, equally spaced, and occurring at the end of the payment period. However, because the HP-70 was designed to accommodate a wide variety of applications beyond the basic preprogrammed functions, annuity due (payments occurring at the beginning of a payment period) and balloon payment problems can be solved with a few extra steps as shown in the applicable sample cases (Applications Casebook, section 3).
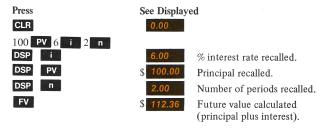
You may note some slight discrepancies between what happens in the real world and what you see displayed on your HP-70 in calculations involving periodic payments. The reason is that your HP-70 gives you results carried out to 10 significant digits. Since, in the real world, things rarely come out evenly, the amount and/or number of payments may have to be adjusted. Otherwise, you would have to write checks for amounts like $242.764537, or make 360.25 payments on a 30-year loan. Therefore, institutions (banks, etc.) generally round or truncate the payment amount to the nearest cent in a fully amortized loan, then make up the difference by adjusting the final payment amount or number of payments. If you want to compare an actual (adjusted) loan with the HP-70 equivalent, be sure to use the payment amount as established by your lender instead of computing it with the top row keys. This will allow for any real world adjustments.

Recalling and Displaying Input Values

A separate memory register is reserved for each of the five top row keys; only the three input values can be stored at a time. Values are stored by keying in a number and pressing a financial function key. To retrieve an input value, merely press **DSP** (display), then press the key associated with the desired input value— **n** **i** **PMT** **PV** **FV** . A copy of the value will appear on the display which, in turn, pushes up the contents of the stack. The original value is retained in its storage register until you press **CLR** , overwrite it with a new value, or turn your calculator off. This store and recall feature can be very useful for follow-on calculations, or for picking up where you left off should your phone ring or you are otherwise interrupted.

For example, calculate the future value of $100 at 6% for 2 years (assuming interest is compounded annually), then display some of the original values.

Press	See Displayed	
CLR	`0.00`	
100 **PV** 6 **i** 2 **n**		
DSP **i**	`6.00`	% interest rate recalled.
DSP **PV**	$ `100.00`	Principal recalled.
DSP **n**	`2.00`	Number of periods recalled.
FV	$ `112.36`	Future value calculated (principal plus interest).

| DSP | PV | | $ `100.00` | Principal recalled (future value pushed up into Y-register). |

Now calculate the total interest amount.

Press   **See Displayed**

| − | $ `12.36` | Interest amount (future value less principal). |

Changing Output Values

After three input parameters have been selected and their respective values entered, either or both of the remaining parameters may be calculated (as output parameters) without reentering any of the input values.

For example, recalculate the previous problem to solve for payment instead of future value. (If you cleared out your calculator, go back and key in the input parameters and solve for future value before proceeding.)

Press   **See Displayed**

| PMT | $ `54.54` | Payment amount. |

Changing Input Values

You may change the *value* of one or more existing input parameters (the parameters themselves must not change) and perform repetitive calculations without re-entering remaining input data. This feature is particularly useful when examining various combinations of interest rates, compounding periods and dollars.

For example, if you invest $10,000 in a venture paying 8% compounded annually, how much money will you have at the end of 3 years? 7 years? 15 years?

Press   **See Displayed**

CLR	`0.00`	
10000 PV 8 i 3 n FV	$ `12597.12`	Amount after 3 years.
7 n FV	$ `17138.24`	Amount after 7 years.
15 n FV	$ `31721.69`	Amount after 15 years.

Try another example. Suppose you plan to take a trip around the world as soon as you have saved up $5,000 (well—maybe a trip to Disneyland?). After paying for all your necessaries you can afford to set aside up to $150 at the end of each month. Assuming that you can get a fixed 6% on savings, how long must you wait to take the trip? (The input parameters for this problem are different from the previous problem, so press **CLR** before proceeding.)

Press	See Displayed	
CLR	*0.00*	
5000 **FV**		
6 **K** **÷** **i**	*0.50*	We assume K is set to 12.
150 **PMT**		
n	*30.91*	Months.
K **÷**	*2.58*	Years.

But what if you can only save $100/month?

Press	See Displayed	
100 **PMT**		
n	*44.74*	Months.
K **÷**	*3.73*	Years.

And if you're really profligate and have only $50/month left over?

Press	See Displayed	
50 **PMT**		
n	*81.30*	Months.
K **÷**	*6.77*	Years.

What if you could get a better return on your money—say 10%?

Press	See Displayed	
10 **K** **÷** **i**	*0.83*	Monthly interest.
n	*73.04*	Months.
K	*6.09*	Years.

And so on—until you get a combination of time and money that you can live with.

Be sure to press `CLR` before calculating problems having a different set of input parameters. If you don't, errors will result. However, don't press `CLR` if you are merely changing values of existing input parameters or selecting the other output parameter.

Simple Interest Amount and Discounted Notes

The simple interest calculation requires `i` `n` and `PV` as input parameters to solve for `INT` (simple interest amount), for both a 360- and 365-day basis. Refer to page 42 for detailed examples of simple interest problems for accrued interest and discounted note applications.

Common Logarithms

You might like to know that because compound interest formulas are based on logarithms (refer to appendix C, Compound Interest Formula, when used to solve for n), you can calculate common logarithms with your HP-70. "Who needs it?" you say. (Well, as long as you've got it you may as well know about it—right?) At any rate, if you ever have occasion to find the common log ($\log_{10}$) of a number, key in the number, press `FV` 900 `i` 1 `PV` `n`. For example, find the common log of 15.

Press	See Displayed
`CLR`	*0.00*
15 `FV` 900 `i` 1 `PV` `n`	*1.18* Common log of 15.

Financial Applications

Now you should be ready to turn to the Applications Directory, page 104 . There you'll find a representative list of financial calculations listed alphabetically and cross referenced according to the various names by which they are commonly known. Included are page numbers where examples may be found. Or, if you prefer, go through the Applications Casebook, section 3, and work the problems in order. Along the way, be sure to try a few of your own. You may come up with some goodies we've never thought of and that's part of the satisfaction of owning an HP-70.

3. Applications Casebook

The applications and examples that follow are arranged according to generic categories. An alphabetic listing by specific calculation type is provided in the Applications Directory, starting on page 105. A list of business calculation formulas used for HP-70 are included in appendix C. Examples given are merely representative of a wide range of possible calculations. Included are a number of extended applications using combinations of preprogrammed functions and stack manipulations. After a short familiarization you should be able to tailor the preprogrammed functions to your particular needs.

Ground Rules

To maintain continuity where annual compounding period calculations are required, we have shown the longer conversion method. In actual practice, however, we suggest you use the K-register for repetitive conversion constants. If you are using a compounding period other than monthly (remember, K is initially set to 12), merely store the appropriate value in K and recall it as needed.

Be sure to clear any values remaining in the top row key registers with **CLR** before calculating a problem having a different input parameter set.

Simple Interest Amount

Accrued Interest — 360 Day Basis

This calculation finds the amount of accrued interest on a 360-day basis, when the number of days, interest rate, and principal (present value) are known. A nice feature is the ability to add the accrued interest to the principal which is returned to the Y-register during the calculation.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in principal, press **PV** .
   - Key in annual interest rate, press **i** .
   - Key in number of days, press **n** .
3. Press **INT** to obtain the amount of accrued interest on a 360-day basis.

4. Press ➕ to obtain the net amount (sum of the principal and interest) on a 360-day basis.

Sample Case: What is the amount of accrued interest and the net amount on $450 for 50 days at 7%, figured on a 360-day basis?

Solution:

Press	See Displayed	
CLR	`0.00`	
450 **PV** 50 **n** 7 **i** **INT**	$ `4.38`	Accrued interest.
➕	$ `454.38`	Net Amount (interest plus principal).

Accrued Interest — 365 Day Basis

This calculation finds the amount of accrued interest on a 365-day basis, when the number of days, interest rate, and principal (present value) are known.

1. Press **CLR**.
2. Enter the following information in any order:
   - Key in principal, press **PV**.
   - Key in interest rate, press **i**.
   - Key in number of days, press **n**.
3. Press **INT** **R↓** **x≷y** to obtain the accrued interest on a 365-day basis.
4. Press ➕ to obtain the net amount (interest plus principal) on a 365-day basis.
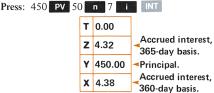
Sample Case: What is the amount of accrued interest and the net amount on the same $450 for 50 days at 7%, figured on a 365-day basis?

Solution:

Press	See Displayed	
Press	**See Displayed**	
CLR	0.00	
450 PV 50 n 7 i		
R↓ x≷y	$ 4.32	Accrued interest.
+	$ 454.32	Net amount (interest plus principal).

Note: Accrued interest calculations for both 360 and 365 days are actually calculated in the same step. This is possible because we return the principal and both interest amounts to the stack as follows:

Press: 450 PV 50 n 7 i INT

T	0.00	
Z	4.32	◄ Accrued interest, 365-day basis.
Y	450.00	◄ Principal.
X	4.38	◄ Accrued interest, 360-day basis.
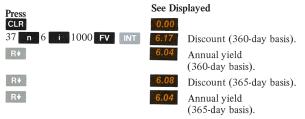
Discounted Notes

This calculation finds discount amounts and annual yields on both a 360- and 365-day basis when the number of days, discount rate, and face value of a discounted note are known.

1. Press CLR .
2. Enter the following information in any order:
   - Key in number of days, press n .
   - Key in annual interest rate, press i .
   - Key in face value (future value), press FV .
3. Press INT to obtain discount on 360-day basis.
4. Press R↓ for annual yield on a 360-day basis.
5. Press R↓ again for discount on 365-day basis.
6. Press R↓ again for annual yield on a 365-day basis.

Sample Case: Calculate the discount amounts and annual yields on a discounted note having a face value of $1000 discounted at 6%, for 37 days.

Solution:

Press

Press	See Displayed	
CLR	`0.00`	
37 **n** 6 **i** 1000 **FV** **INT**	`6.17`	Discount (360-day basis).
R↓	`6.04`	Annual yield (360-day basis).
R↓	`6.08`	Discount (365-day basis).
R↓	`6.04`	Annual yield (365-day basis).

Compounded Amounts (Compound Interest)

Future Value of Compounded Amount

This calculation finds the future value of an amount compounded at a certain interest rate over a specified number of periods.

1. Press **CLR** .
2. Enter the following information in any order:
    *   Key in number of time periods, press **n** .
    *   Key in interest rate per period, press **i** .
    *   Key in principal (present value), press **PV** .
3. Press **FV** to obtain the future value.

Sample Case 1: What is the future value of $500 invested at 6% for 7 years if interest is compounded annually?

Solution:

Press	See Displayed	
CLR	`0.00`	
7 **n** 6 **i** 500 **PV** **FV**	$ `751.82`	Value in 7 years compounded annually.

Sample Case 2: What is the future value of the same $500 invested at the same rate (6%) for the same number of years (7) if compounded quarterly?

Solution:

Press	See Displayed	
7 **ENTER↑** 4 **×** **n**	**28.00**	Number of periods (quarters) in 7 years.
6 **ENTER↑** 4 **÷** **i**	**1.50**	% interest rate per quarter.
FV	**758.61**	Value in 7 years compounded quarterly.

Note that the third parameter value (500 **PV**) didn't change so it wasn't reentered.
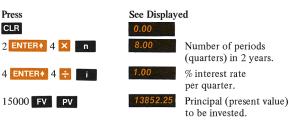
Present Value of Compounded Amount

This calculation finds the present value of a compounded amount when the future value, number of periods and interest rate are known.

1. Press **CLR**.
2. Enter the following information in any order:
   - Key in number of time periods, press **n** .
   - Key in interest rate per period, press **i** .
   - Key in future value, press **FV** .
3. Press **PV** to obtain the present value (principal).

Sample Case: If you wanted to establish a fund of $15,000 for an extended vacation which you planned to take in 2 years, what would be the investment required now if money is worth 4% compounded quarterly?

Solution:

Press	See Displayed	
CLR	**0.00**	
2 **ENTER↑** 4 **×** **n**	**8.00**	Number of periods (quarters) in 2 years.
4 **ENTER↑** 4 **÷** **i**	**1.00**	% interest rate per quarter.
15000 **FV** **PV**	**13852.25**	Principal (present value) to be invested.

Rate of Interest for Compounded Amount

This calculation finds the interest rate (or the rate of appreciation) needed to amass a given sum if a fixed amount is invested for a specified period.

1. Press CLR .
2. Enter the following information in any order.
   - Key in the number of periods, press n .
   - Key in the amount of investment, press PV .
   - Key in the sum required in the future, press FV .
3. Press i to obtain the required interest rate per period.

Sample Case: What annual rate of interest must be obtained in order to amass a total of $10,000 in 10 years on an investment of $6,000?

Solution:

Press	See Displayed	
CLR	0.00	
10 n 6000 PV 10000		
FV i	5.24	% annual interest rate (compounded annually).

What if the interest were compounded daily (assume 365 days per year)?

Press	See Displayed	
10 ENTER↑ 365 ✕ n	3650.00	Number of periods (days) in 10 years.
i	0.01	% daily interest rate (rounded to two decimal places).
365	5.11	% annual interest rate if compounded daily.

Number of Periods for Compounded Amount

This calculation finds the number of periods required to amass a given sum at a specified rate on a given investment.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in rate per period, press **i** .
   - Key in present value, press **PV** .
   - Key in future value, press **FV** .
3. Press **n** to obtain number of periods.

Sample Case: You now have $887 in a savings account paying 5.4% compounded monthly. How long will it take to reach one million dollars?

Solution:

Press	See Displayed	
CLR	`0.00`	
5.4 **ENTER↟** 12 **÷** **i** 887		
PV 1000000 **FV** **n**	`1565.21`	Number of months.
12 **÷**	`130.43`	Number of years.

Compounded Amount and Interest Earned

This calculation finds the interest earned (dollar amount) on a fixed amount when the interest is compounded at a specified rate over a given period.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in number of periods, press **n** .
   - Key in interest rate per period, press **i** .
   - Key in principal (present value), press **PV** .
3. Press **FV** to obtain future value.
4. Press **DSP** **PV** **−** to obtain dollar amount of interest.

Sample Case: What would be the future value and interest earned on $500 at 5% for 2 years if interest is compounded quarterly?

Solution:

Press	See Displayed	
CLR	`0.00`	
2 ENTER↑ 4 × n	`8.00`	Number of periods (quarters) in 2 years.
5 ENTER↑ 4 ÷ i	`1.25`	% interest rate per quarter.
500 PV FV	$ `552.24`	Net amount (future value).
DSP PV −	$ `52.24`	Interest earned.

Nominal Rate Converted to Effective Annual Rate

This calculation finds the effective annual interest rate when the number of periods per year and the nominal (stated) annual interest rate are known. Enter the information as follows:

1. Press CLR .
2. Key in the number of periods per year, press n .
3. Key in the nominal rate, press DSP n ÷ i .
4. Key in 100, press PV .
5. Press FV .
6. Press DSP PV − to obtain effective annual rate.

Sample Case: What is the effective annual rate of interest if the annual nominal rate of 12% is compounded quarterly?

Solution:

Press	See Displayed	
CLR	`0.00`	
4 n 12 DSP n ÷ i	`3.00`	
100 PV FV DSP PV −	`12.55`	% effective annual interest rate.
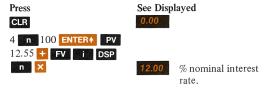
Effective Annual Rate Converted to Nominal Rate

This calculation finds the nominal (annual) rate of interest when the number of periods per year and the effective annual interest rate are known. Enter the information as follows:

1. Press **CLR** .
2. Key in number of periods per year, press **n** .
3. Key in 100, press **ENTER↑** **PV** .
4. Key in effective annual rate, press **+** **FV** **i** .
5. Press **DSP** **n** **X** to get nominal rate.

Sample Case: Find the nominal rate if the effective annual rate is 12.55%, compounded quarterly.

Solution:

Press	See Displayed	
CLR	`0.00`	
4 **n** 100 **ENTER↑** **PV**		
12.55 **+** **FV** **i** **DSP**		
n **X**	`12.00`	% nominal interest rate.

Direct Reduction Loans

Periodic Payment Amount (Ordinary Annuity)

This calculation finds the periodic payment amount to be paid at the end of each period when the principal (present value), number of periods, and interest rate per period are known.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in total number of periods, press **n** .
   - Key in interest rate per period, press **i** .
   - Key in principal, press **PV** .
3. Press **PMT** to obtain amount of periodic payment.

Sample Case: If a member of a credit union borrows $1800 to be repaid over 24 months at a 9.25% annual rate, what is his monthly payment?

Solution:

Press	See Displayed
CLR	`0.00`
24 **n** 9.25 **ENTER↑**	
12 **÷** **i** 1800 **PV** **PMT**	$ `82.44` Payment per month.

Interest Rate Per Period, Annual Interest Rate
(Ordinary Annuity)

This calculation finds the periodic and annual interest rates of an annuity when the payment amount, principal, and number of periods are known.

1. Press **CLR** .
2. Enter the following information in any order.
   - Key in principal, press **PV** .
   - Key in payment amount, press **PMT** .
   - Key in number of periods, press **n** .
3. Press **i** to obtain periodic interest rate, then multiply by number of periods per year to obtain annual interest rate.

Sample Case: Suppose that you knew your monthly payment in the previous sample case, but didn't know the annual interest rate.

Solution:

Press	See Displayed	
CLR	`0.00`	
82.44 **PMT** 1800 **PV**		
24 **n** **i**	`0.77`	% monthly interest rate.
12 **✕**	`9.25`	% annual interest rate.

Number of Periods Required to Amortize Loan
(Ordinary Annuity)

This calculation finds the number of periods required to pay off a direct reduction loan when the interest rate, principal and payment amount are known.

1. Press **CLR** .
2. Enter the following information in any order.
    - Key in principal, press **PV** .
    - Key in payment amount, press **PMT** .
    - Key in interest rate per period and press **i** .
3. Press **n** to obtain number of periods.

Sample Case: How long will it take to pay off an auto loan if you need to borrow $3,000? Assume the going rate is 9.5% and you can afford payments of $80 per month.

Solution:

Press   **See Displayed**

CLR   `0.00`

3000 **PV** 80 **PMT**

9.5 **ENTER↑**

12 **÷** **i** **n**   `44.67`   Number of monthly
                                             payments or number
                                             of periods. (You'll
                                             probably have to lower
                                             yours sights or increase
                                             your monthly income—
                                             most auto loans don't
                                             exceed 36 months.)

Loan Amount (Present Value of Ordinary Annuity)

This calculation finds the principal amount of a direct reduction loan when the interest rate per period, payment amount and number of payments (periods) are known.

1. Press **CLR** .
2. Enter the following information in any order.
   - Key in payment amount, press **PMT** .
   - Key in interest rate per period, press **i** .
   - Key in number of payments, press **n** .
3. Press **PV** to obtain principal (present value).

Sample Case: If you decide to buy a car for which you plan to pay $80 per month for 36 months, and you are willing to pay 10% annual interest, how much can you afford to pay for the car?

Solution:

Press	See Displayed
CLR	*0.00*
36 **n** 10 **ENTER↑**	
12 **÷** **i**	
80 **PMT** **PV**	$ *2479.30* Amount you can pay for car. (A Bentley is definitely out.)

Amortization Schedule (Ordinary Annuity)

This calculation generates an amortization schedule for a fully amortized loan (mortgage) from the first payment to a given payment, when the mortgage amount, periodic interest rate and amount of periodic payment are known. Enter the information as follows:

1. Key in periodic payment amount, press **STO** **M** .
2. Key in periodic interest rate, press **ENTER↑** **ENTER↑** .
3. Key in loan amount.
4. Press **x⇄y** . Press **%** to obtain the interest portion of the first payment.
5. Press **M** **x⇄y** **−** to obtain the principal portion of the first payment.
6. Press **−** to obtain the remaining principal balance.
7. Repeat steps 4 through 6 for subsequent periods.

Sample Case: Generate an amortization schedule for the first two months of a $30,000 loan, at 7%, with monthly payments of $200.

Solution:

Press	See Displayed
200 STO • M	
7 ENTER↑	
12 ÷ ENTER↑ ENTER↑	
30000 x⇄y %	$ **175.00** Interest portion of first payment.
• M x⇄y −	$ **25.00** Principal portion of first payment.
−	$ **29975.00** Remaining balance after first payment.
x⇄y %	$ **174.85** Interest portion of second payment.
• M x⇄y −	$ **25.15** Principal portion of second payment.
−	$ **29949.85** Remaining balance after second payment.
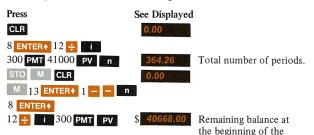
Accumulated Interest with Remaining Balance
(Ordinary Annuity)

This calculation finds the accumulated interest and remaining balance at any point in the life of a fully amortized mortgage (given the beginning and ending payment numbers), when the mortgage amount, payment amount, and periodic interest rate are known.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in the interest rate per period, press **i** .
   - Key in payment amount, press **PMT** .
   - Key in amount of mortgage, press **PV** .

3. Press █n█ to obtain the total number of periods throughout the life of the mortgage.

4. Press █STO█ █M█ █CLR█ .

5. Press █M█ to recall the total number of periods.

6. Key in payment number associated with beginning of the time frame to be examined, press █ENTER↑█ 1 █−█ █−█ █n█ .

7. Key in the interest rate per period again, press █i█ .

8. Key in payment amount, press █PMT█ .

9. Press █PV█ to obtain the remaining balance at the beginning of the time frame.

10. Press █M█ to recall total number of periods; key in last payment number of the time frame, then press █−█ █n█ , █PV█ to obtain the remaining balance at the end of the time frame.

11. Press █−█ to obtain the total principal paid during the time frame (the difference between the beginning and ending principal balances).

12. Press █DSP█ █PMT█ to recall payment amount; key in number of payments made during the time frame, press █×█ to obtain total amount paid in time frame.

13. Press █x≷y█ █−█ to obtain accumulated interest paid during the time frame.

Sample Case: If you have an 8%, $41,000 mortgage, with monthly payments of $300, what is the accumulated interest paid for payments 13 through 24 inclusive, and remaining balance?

Press   **See Displayed**

█CLR█   │ *0.00* │

8 █ENTER↑█ 12 █÷█ █i█

300 █PMT█ 41000 █PV█ █n█   │ *364.26* │   Total number of periods.

█STO█ █M█ █CLR█   │ *0.00* │

█M█ 13 █ENTER↑█ 1 █−█ █−█ █n█

8 █ENTER↑█

12 █÷█ █i█ 300 █PMT█ █PV█ $ │ *40668.00* │   Remaining balance at
                                                  the beginning of the
                                                  13th time period.

`M` 24 `−` `n` `PV`	$ `40308.45`	Remaining balance at the end of the 24th time period.
`−`	$ `359.55`	Total principal paid, payments 13 through 24.
`DSP` `PMT` 12 `×`	$ `3600.00`	Total paid, payments 13 through 24.
`x≷y` `−`	$ `3240.45`	Accumulated interest paid, payments 13 through 24.

Remaining Balance Only (Ordinary Annuity)

This calculation finds the remaining balance of a fully amortized mortgage, when the mortgage amount, payment amount, and periodic interest are known.

1. Press `CLR` .
2. Enter the following information in any order:
   - Key in periodic interest rate, press `i` .
   - Key in periodic payment amount, press `PMT` .
   - Key in loan amount, press `PV` `n` to obtain the total number of time periods required to amortize the loan.
3. Press `STO` `M` , `CLR` .
4. Press `M` to recall the total number of periods. Key in the payment number associated with the end of the time frame, press `−` `n` .
5. Key in periodic interest rate, press `i` .
6. Key in payment amount, press `PMT` .
7. Press `PV` to obtain remaining balance.

Sample Case: Find the remaining balance on an 8.5%, $45,000 loan after 24 monthly payments of $346 each.

Press

`CLR`

8.5 `ENTER↑` 12 `÷` `i`

346 `PMT` 45000 `PV` `n`

See Displayed

`0.00`

`360.05`   Total number of periods.

`STO` `M` `CLR`   `0.00`
`M` 24 `−` `n` 8.5
`ENTER↟` 12 `÷` `i` 346
`PMT` `PV` $ `44289.85`   Remaining balance.

Payment Amount for Mortgage with Balloon Payment
(Ordinary Annuity)

This calculation finds the periodic payment amount when the total
number of payments, periodic interest rate, principal (mortgage
amount), and balloon payment amount are known.

1. Press `CLR`.
2. Enter the following information in any order:
    - Key in periodic interest rate, press `i`.
    - Key in total number of payment periods (not including balloon
      payment), press `n`.
    - Key in balloon payment amount, press `FV`.
3. Press `PV`.
4. Key in principal, press `x⇄y` `−` `STO` `M`.
5. Press `CLR`.
6. Enter the following information in any order:
    - Key in total number of payment periods, press `n`.
    - Key in periodic interest rate, press `i`.
    - Press `M` `PV`.
7. Press `PMT` to obtain periodic payment amount.

Sample Case: A borrower has a $12,000, 10%, 10-year mortgage with a
balloon payment coinciding with the final periodic payment. If he
specifies that the balloon payment is not to exceed $5,000, what is the
minimum monthly payment required?

Solution:

Press	See Displayed	
`CLR`	`0.00`	
10 `ENTER↟` 12 `÷` `i`	`0.83`	Monthly interest rate.

Press	See Displayed	
10 `ENTER↑` 12 `×` `n`	`120.00`	Total periods in mortgage.
5000 `FV`	$ `5000.00`	Balloon payment amount.
`PV`	$ `1847.03`	Discounted value of balloon.
12000 `x≷y` `−` `STO` `M`	`10152.97`	
`CLR`	`0.00`	
`M` `PV`	`10152.97`	
10 `ENTER↑` 12 `÷` `i`	`0.83`	
10 `ENTER↑` 12 `×` `n`	`120.00`	
`PMT`	$ `134.17`	Monthly payment amount.

Sinking Funds

Future Value of Sinking Fund (Ordinary Annuity)

This calculation finds the amount to be amassed at the end of a specified number of periods when the amount of the periodic payment and interest rate per period are known.

1. Press `CLR` .
2. Enter the following information in any order:
   - Key in number of periods, press `n` .
   - Key in interest rate per period, press `i` .
   - Key in amount of periodic payment, press `PMT` .
3. Press `FV` to obtain future value.

Sample Case: How much money will you have at the end of 5 years if you invest $250 at the end of each month in a venture paying 6% compounded monthly?

Solution:

Press	See Displayed	
`CLR`	`0.00`	
5 `ENTER↑` 12 `×` `n`	`60.00`	Number of periods in 5 years.
6 `ENTER↑` 12 `÷` `i`	`0.50`	% interest rate per month.

250 **PMT** **FV** $ **17442.51**   Value in 5 years,
                                          compounded monthly.

Rate of Interest for Sinking Fund (Ordinary Annuity)

This calculation finds the rate of interest for a sinking fund when the amount to be amassed (future value), the number of time periods, and the periodic payment amount are known.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in number of periods, press **n** .
   - Key in amount of payment, press **PMT** .
   - Key in future value, press **FV** .
3. Press **i** to obtain required rate of interest per period.

Sample Case: What annual rate of interest must be obtained to amass a total of $10,000 in 10 years on an annual investment of $600?

Solution:

Press	**See Displayed**	
CLR	**0.00**	
10 **n** 600 **PMT**		
10000 **FV** **i**	**10.93**	% annual interest rate.

Payment Amount for Sinking Fund (Ordinary Annuity)

This calculation finds the periodic payment to be set aside for a sinking fund, when the future value, number of periods, and interest rate per period are known.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in number of periods, press **n** .
   - Key in interest rate per period, press **i** .
   - Key in future value, press **FV** .
3. Press **PMT** to obtain amount of periodic payment for sinking fund.

Sample Case: As a farsighted parent, you are planning ahead for your children's education. How much money must be invested at the end of each month to amass $10,000 in 10 years, when interest is earned at a rate of 5% compounded monthly?

Solution:

Press	See Displayed	
CLR	0.00	
10 ENTER↑ 12 X n	120.00	Number of periods (months) in 10 years.
5 ENTER↑ 12 ÷ i	0.42	% monthly interest rate.
10000 FV PMT	$ 64.40	Monthly payment for sinking fund.

Number of Periods for Sinking Fund (Ordinary Annuity)

This calculation finds the number of periods required to amass a specific sum when the periodic payment amount and interest rate per period are known.

1. Press CLR .
2. Enter the following information in any order:
   - Key in future value, press FV .
   - Key in payment amount, press PMT .
   - Key in interest rate per period, press i .
3. Press n to obtain the number of periods.

Sample Case: It's January 1, 1975. You are going to sail to Tahiti as soon as you can save $2,000 but—since you are a so-so sailor and tend to seasickness—would like to avoid the typhoon season (August to November). Assume money is worth 6% and you can save only $200 per month. After you sell all your earthly goods (you're not coming back are you?), should you invest the proceeds in art supplies or Dramamine?

Solution:

Press	See Displayed
CLR	`0.00`
2000 **FV** 200 **PMT**	
6 **ENTER↑** 12 ÷ **i** **n**	`9.78` Months. (Right in the middle of typhoon season!)

Consumer Finance

Add-on Interest-to-APR Conversion; Finding Monthly Payment

This calculation finds the annual percentage rate (APR)* and monthly payment when the add-on interest rate,** loan amount, and number of months are known. Enter the information as follows:
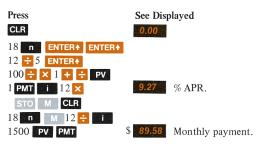
1. Press **CLR** .
2. Key in number of months in loan, press **n** **ENTER↑** **ENTER↑** 12 ÷ .
3. Key in add-on rate, press **ENTER↑** 100 ÷ **×** 1 **+** ÷ **PV** 1 **PMT** .
4. Press **i** 12 **×** to obtain the APR.
5. Press **STO** **M** **CLR** .
6. Key in term of loan in months, press **n** , recall APR by pressing **M** ; press 12 ÷ **i** .
7. Key in loan amount, press **PV** **PMT** to obtain monthly payment.

---

*Actual cost of a loan expressed as an annual percent rate as required by U.S. Federal Reserve (Reg. Z—Truth in Lending) to provide a common, standard measure for comparison of finance charges.

**Method of calculating finance charges, on loans reduced by periodic payments, where simple interest for the full original loan amount and for the full term is added to the loan.

Sample Case: Calculate the APR and monthly payment of a 5% add-on loan in the amount of $1500 for 18 months.

Solution:

Press	See Displayed
`CLR`	`0.00`
18 `n` `ENTER↟` `ENTER↟`	
12 `÷` 5 `ENTER↟`	
100 `÷` `×` 1 `+` `÷` `PV`	
1 `PMT` `i` 12 `×`	`9.27` % APR.
`STO` `M` `CLR`	
18 `n` `M` 12 `÷` `i`	
1500 `PV` `PMT`	$ `89.58` Monthly payment.

APR–To–Add-On Interest Conversion

This calculation finds the equivalent add-on interest rate when the number of periods (months only) and annual percentage rate (APR) are known.

1. Press `CLR` .
2. Enter the following information in any order:
    - Key in number of months of loan, press `n` .
    - Key in APR, press `ENTER↟` 12 `÷` `i` .
    - Key in 100 `PV` , press `PMT` .
3. Press `DSP` `PV` `DSP` `n` `÷` `−` 12 `×` to obtain add-on rate.

Sample Case: What is the equivalent add-on rate for an 18-month loan with an APR of 14%?

Solution:

Press	See Displayed
`CLR`	`0.00`
18 `n` 14 `ENTER↟`	
12 `÷` `i` 100 `PV` `PMT`	`6.19`
`DSP` `PV` `DSP` `n` `÷`	
`−` 12 `×`	`7.63` % add-on rate.

Rule-of-78 Rebate

This calculation finds the balance due for a prepaid consumer loan using the rule-of-78's. The known values are current installment number, total number of installments, total finance charge, and payment amount. Enter the information as follows:

1. Key in number of months of the loan, press `STO` `M` `ENTER↑`.
2. Key in payment number when prepayment occurs, press `−` `STO` `K` `ENTER↑` 1 `+` .
3. Key in total finance charge, press `×` `M` 2 `yˣ` `M` `+` `÷` .
4. Key in periodic payment amount, press `x≷y` `−` `K` `×` to obtain balance due prior to regular payment.

Sample Case: A 30-month loan, having a finance charge of $180, is being repaid at $39.33 per month. What is the balance due prior to regular payment?

Solution:

Press   **See Displayed**

30 `STO` `M` `ENTER↑`
25 `−` `STO` `K`
`ENTER↑` 1 `+` 180 `×` `M`
2 `yˣ` `M` `+` `÷`
39.33 `x≷y` `−` `K` `×` $ `190.84`   Balance due prior to
                                             regular payment.

Savings Calculations

Number of Time Periods for Savings Calculation
(Annuity Due)

This calculation finds the number of periods required to amass a given sum when the periodic interest rate and payment amount are known. Payments occur at the beginning of each period rather than at the end.

1. Press `CLR` .
2. Enter the following information in any order:
   - Key in periodic interest rate, press `i` .
   - Key in future value, press `FV` .

3. Key in periodic deposit amount, press **DSP** **i** **%** **+** **PMT** .
4. Press **n** to obtain the number of time periods.

Sample Case: If you deposit $40 per month in an account which pays 7% interest compounded monthly, how long will it take to amass $10,000?

Solution:

Press	See Displayed
CLR	`0.00`
7 **ENTER▲** 12 **÷** **i**	
40 **DSP** **i** **%** **+** **PMT**	
10000 **FV** **n**	`154.05` Number of months.
12 **÷**	`12.84` Number of years.

Rate of Interest for Savings Calculation (Annuity Due)

This calculation finds the periodic interest rate needed to amass a given sum when the number of periods and payment amount (to be made at the beginning of each period) are known.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in the number of time periods, press **ENTER▲** 1 **+** **n** .
   - Key in periodic deposit amount, press **PMT** .
3. Key in future value, press **DSP** **PMT** **+** **FV** .
4. Press **i** to obtain the periodic interest rate.

Sample Case: If you require $10,000 at the end of 15 years, and can deposit $20 per month at the first of each month, what rate of interest, compounded monthly, mùst you receive?

Solution:

Press	See Displayed
CLR	`0.00`
15 **ENTER▲** 12 **✕** **ENTER▲**	

1 [+] [n] 20 [PMT]
10000 [DSP] [PMT] [+] [FV]
[i]

| [0.99] | % monthly interest rate. |
| [11.90] | % annual interest rate. |

12 [×]
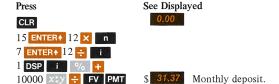
Payment Amount Required for Some Future Value — Savings Calculations (Annuity Due)

This calculation finds the monthly deposit (to be made at the beginning of each period) required to amass a given sum when the number of periods and periodic interest rate are known.

1. Press [CLR] .
2. Enter the following information in any order:
   - Key in number of deposit periods, press [n] .
   - Key in periodic interest rate, press [i] .
3. Press 1 [DSP] [i] [%] [+] .
4. Key in future value, press [x≷y] [÷] [FV] .
5. Press [PMT] to obtain the periodic deposit amount.

Sample Case: Suppose a savings plan will pay 7% compounded monthly. What monthly deposit must be made to have $10,000 in 15 years?

Solution:

Press	See Displayed
[CLR]	[0.00]
15 [ENTER↑] 12 [×] [n]	
7 [ENTER↑] 12 [÷] [i]	
1 [DSP] [i] [%] [+]	
10000 [x≷y] [÷] [FV] [PMT]	$ [31.37] Monthly deposit.

Future Value of a Series of Deposits (Annuity Due)

This calculation finds the future value (principal plus interest) of a series of deposits (to be made at the beginning of each period) when the number of periods and periodic interest rate are known.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in number of deposit periods, press **n** .
   - Key in periodic interest rate, press **i** .
3. Key in periodic deposit amount, press **DSP** **i** **%** **+** **PMT** .
4. Press **FV** to obtain the future value.

Sample Case: How much money will you have at the end of 6 years, in a savings account paying 5% compounded monthly, if you deposit $75 each month beginning tomorrow?

Solution:

Press	See Displayed	
CLR	*0.00*	
6 **ENTER↑** 12 **×** **n**		
5 **ENTER↑** 12 **÷** **i**		
75 **DSP** **i** **%** **+**		
PMT **FV**	$ *6308.50*	Future value.

Leases and Rent (Payments in Advance)

Number of Payments in Advance (Annuity Due)

This calculation finds the total number of payment periods required for an initial amount when the payment amount (to be paid at the beginning of each period) and periodic interest rate are known.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in periodic interest rate, press **i** .
   - Key in initial amount, press **PV** .
3. Key in periodic payment amount, press **DSP** **i** **%** **+** **PMT** .
4. Press **n** to obtain total payment periods.

Sample Case: How many payments are required to retire a mortgage in the amount of $35,000 having monthly payments in advance of $375 and an 8% annual interest rate?

Solution:

Press   **See Displayed**

`CLR`   `0.00`

8 `ENTER↑` 12 `÷` `i`
35000 `PV`
375 `DSP` `i` `%` `+`
`PMT` `n`   `144.87` Number of payments
                                                       required.
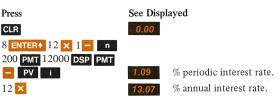
Interest Rate for Payments in Advance (Annuity Due)

This calculation finds the periodic interest rate on a given initial amount
when the total number of periods and payment amount (to be paid at
the beginning of each period) are known.

1. Press `CLR`.
2. Enter the following information in any order:
    *   Key in number of time periods, press `ENTER↑` 1 `−` `n`.
    *   Key in periodic payment amount, press `PMT`.
3. Key in initial amount, press `DSP` `PMT` `−` `PV`.
4. Press `i` to obtain periodic interest rate.

Sample Case: Equipment worth $12,000 is leased for 8 years with
monthly payments in advance of $200. The equipment is assumed to
have no salvage value at the end of the lease. What yield rate does this
represent?

Solution:

Press   **See Displayed**

`CLR`   `0.00`

8 `ENTER↑` 12 `×` 1 `−` `n`
200 `PMT` 12000 `DSP` `PMT`
`−` `PV` `i`   `1.09`   % periodic interest rate.
12 `×`   `13.07`   % annual interest rate.

Periodic Payment Amount for Payments in Advance
(Annuity Due)

This calculation finds the periodic payment amount (to be paid at the beginning of each period) of a given initial amount, when the total number of periods and periodic interest rate are known.

1. Press **CLR** .
2. Enter the following information in any order:
    - Key in number of payment periods, press **n** .
    - Key in periodic interest rate, press **i** .
3. Press 1 **DSP** **i** **%** **+** .
4. Key in initial amount, press **x≷y** **÷** **PV** .
5. Press **PMT** to obtain periodic payment amount.

Sample Case: The owner of a building presently worth $70,000 intends to lease it for 20 years at the end of which time he assumes the building will be worthless. How much must quarterly payments (in advance) be to achieve a 10% annual yield?

Solution:

Press	See Displayed
CLR	`0.00`
20 **ENTER↑** 4 **X** **n**	
10 **ENTER↑** 4 **÷** **i**	
1 **DSP** **i** **%** **+**	
70000 **x≷y** **÷** **PV** **PMT**	$ `1982.27` Quarterly payment amount.

Present Value of Payments in Advance (Annuity Due)

This calculation finds the present value of a series of payments (made at the beginning of each period) when the total number of payments, periodic interest rate, and payment amount are known.

1. Press **CLR** .
2. Enter the following information in any order:
    - Key in number of payment periods, press **n** .
    - Key in periodic interest rate, press **i** .

3. Key in periodic payment amount, press `DSP` `i` `%` `+` `PMT` .

4. Press `PV` to obtain present value.

Sample Case: The owner of a downtown parking lot has achieved full occupancy and a 7% annual yield by renting parking spaces for $40 per month payable in advance. Several regular customers want to rent their spaces on an annual basis. What annual rent, also payable in advance, will maintain a 7% annual yield rate?

Solution:

Press	See Displayed
`CLR`	`0.00`
12 `n` 7 `ENTER↟`	
12 `÷` `i` 40 `DSP` `i`	
`%` `+` `PMT` `PV`	$ `464.98` Present value of payments, or minimum annual charge.

Depreciation

Straight-Line Depreciation Schedule

This calculation finds the depreciation amount and remaining depreciable value for each year of an asset's useful life according to the straight-line method. Required data are the beginning depreciable value (starting book value less salvage value) and the asset's useful life expectancy.

1. Key in the beginning depreciable value, press `ENTER↟` `ENTER↟` .

2. Key in the asset's life, press `÷` to obtain the depreciation amount for each year.

3. Press `STO` `M` `−` to obtain the remaining depreciable value at the end of the first year.

4. Press `M` `−` to obtain the remaining depreciable value at the end of the second year.

5. Repeat step 4 for subsequent years' remaining depreciable value.

Sample Case: An asset has a starting book value of $200,000, a salvage value of $30,000, and a life expectancy of 40 years. Calculate the annual depreciation and the remaining depreciable amount for the first and second years.

Solution:

Press	See Displayed	
200000 `ENTER↑` 30000 `−`		
`ENTER↑` `ENTER↑`	$ `170000.00`	Beginning depreciable value.
40 `÷`	$ `4250.00`	Annual depreciation.
`STO` `M` `−`	$ `165750.00`	Remaining depreciable value, first year.
`M` `−`	$ `161500.00`	Remaining depreciable value, second year.

Declining Balance Depreciation

This calculation finds depreciation and remaining book value for each year of an asset's depreciable life when the present value, salvage value, and life expectancy are known. Enter the information as follows:

1. Key in declining factor, *press `ENTER↑` .
2. Key in 100 (100% of depreciation), press `×`
3. Key in number of years, press `÷` to obtain multiplier.
4. Press `STO` `M` .
5. Key in present value of asset.
6. Press `M` , then press `%` to obtain first year's depreciation.
7. Press `−` to obtain remaining book value in first year.
8. Repeat steps 6 and 7 to obtain each succeeding year's depreciation and remaining book value until the book value is equal to or less than the salvage value. In the latter case, the previous book value is reduced by the salvage value to obtain the final year's depreciation.

*Use the declining factor rather than the declining rate (e.g., 1.5 instead of 150%, 2 instead of 200%).

Sample Case: A fleet car has a value of $2500, a salvage value of $400 which is not deducted from the present value, and a life expectancy of 6 years. If you are using the double declining balance method, what is the amount of depreciation and book value for years 1 through 4?

Solution:

Press	**See Displayed**
2 ENTER↑ 100 × 6 ÷	`33.33` Multiplier.
STO M 2500 M %	$ `833.33` 1st year depreciation.
−	$ `1666.67` Remaining book value.
M %	$ `555.56` 2nd year depreciation.
−	$ `1111.11` Remaining book value.
M %	$ `370.37` 3rd year depreciation.
−	$ `740.74` Remaining book value.
M %	$ `246.91` 4th year depreciation.
−	$ `493.83` Remaining book value.

Note that an asset cannot be depreciated beyond salvage value; therefore, depreciation for year 5 would be $93.83 and book value $400.
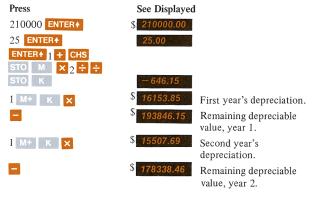
Sum-of-the-Year's-Digits Depreciation

This calculation finds the depreciation and remaining depreciable amount for each year of an asset's useful life according to the sum-of-the-years'-digits method. The known values are the beginning depreciable value (starting book value less salvage value), and years of useful life. Enter the information as follows:

1. Key in the beginning depreciable value, press ENTER↑ .

2. Key in the asset's life, press ENTER↑ .

3. Press ENTER↑ 1 + CHS STO M × 2 ÷ ÷ STO K .

4. Press 1 M+ K × to obtain the first year's depreciation amount.

5. Press − to obtain the remaining depreciable value at the end of the first year.

6. Repeat steps 4 and 5 for subsequent years' depreciation.

Sample Case: An office building has a cost basis (excluding land cost and salvage value) of $210,000, and a useful life expectancy of 25 years. Using the sum-of-the-years'-digits method, what are the depreciation allowances and remaining depreciable values for each of the first two years?

Solution:

Press	See Displayed	
210000 **ENTER↟**	$ 210000.00	
25 **ENTER↟**	25.00	
ENTER↟ 1 **+** **CHS**		
STO **M** **×** 2 **÷** **÷**		
STO **K**	− 646.15	
1 **M+** **K** **×**	$ 16153.85	First year's depreciation.
−	$ 193846.15	Remaining depreciable value, year 1.
1 **M+** **K** **×**	$ 15507.69	Second year's depreciation.
−	$ 178338.46	Remaining depreciable value, year 2.

Discounted Cash Flow Analysis—Net Present Value

For purposes of capital budgeting, evaluating investments, etc., it is often necessary to perform a discounted cash flow analysis to see if a particular investment is at least as profitable as some norm (often called *cost of capital* or *discount rate*).

This calculation finds the present values of all future cash flows (appropriately discounted by cost of capital, less original investment). If the result is greater than or equal to zero, the venture is deemed profitable—at least to the extent of the discount rate or cost of capital. Conversely, if the net present value is less than zero, it is not profitable.

Known values are the cost of capital (%), amount of original investment (present value), and the expected cash flow schedule.

1. Press **CLR** .
2. Enter the following information in any order:
   - Key in time period number of the first cash flow, press **n** .

- Key in periodic interest rate, press `i` .
- Key in amount of first cash flow, press `FV` .

3. Key in initial investment amount, press `CHS` `STO` `M` .
4. Press `PV` `M+` to obtain the current net present value.
5. Enter the following information in any order:
   - Key in number of next cash flow, press `n` .
   - Key in next cash flow amount, press `FV` .
6. Press `PV` `M+` to obtain the current net present value.

7. Repeat steps 5 and 6 for each cash flow period.

Note 1: For periods with negative cash flows (cash outlays), press `CHS` before pressing `FV` .

Note 2: To find the present value of a series of cash flows, skip step 3.

Sample Case: Will the following investment be profitable based on the cash flows?

Original investment	$100,000
Cost of capital	10%
Cash flow year 1	$34,000
Cash flow year 2	$27,500
Cash flow year 3	$59,700
Cash flow year 4	$ 7,800

Solution:

Press	See Displayed	
`CLR`	*0.00*	
100000 `CHS` `STO` `M`		
1 `n` 10 `i`		
34000 `FV` `PV` `M+`	$ *− 69090.91*	Current net present value.
2 `n` 27500 `FV` `PV` `M+`	$ *− 46363.64*	Current net present value.
3 `n` 59700 `FV` `PV` `M+`	$ *− 1510.14*	Current net present value.

4 `n` 7800 `FV` `PV` `M+` $ `3817.36` Final net present value
is positive so deal
is okay.

Merchandising, Purchasing

Cost and Price (Markup, Chain Discounts)

Among the most used business calculations are those related to establishing retail prices based upon costs, trade discounts and profit margins.

This calculation finds the amount of markup, net price, dealer discount and list price when the per unit manufacturing/purchase cost, profit margin and dealer discount rates are known. Enter the information as follows:

1. Key in unit cost, press `ENTER↑` .
2. Key in profit margin rate, press `%` to obtain amount of markup.
3. Press `+` to obtain net price.
4. Key in 1, press `ENTER↑` .
5. Key in discount rate, press `%` `−` to calculate first discount.
6. Repeat step 5 for each discount rate.
7. Press `÷` to obtain list price.

Sample Case: ABC Corporation has produced a valve costing $2.26 to manufacture. They want a profit of 25% over production cost and are offering a trade discount to distributors of 30/15/15. Determine the following per unit amounts:

- Amount of Markup
- Net Price
- Dealer Discount Ratio
- List Price

Solution:

Press	See Displayed
2.26 `ENTER↑` 25 `%`	$ `0.57` Amount of markup.
`+`	$ `2.83` Net price.
1 `ENTER↑` 30 `%`	`0.30`
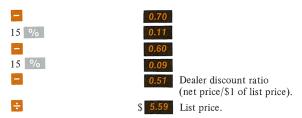
▬	`0.70`	
15 `%`	`0.11`	
▬	`0.60`	
15 `%`	`0.09`	
▬	`0.51`	Dealer discount ratio (net price/$1 of list price).
÷	$ `5.59`	List price.

Cash Discounts

Cash discounts are offered to retailers by manufacturers/wholesalers as an incentive for prompt payment. Typical terms of payment would be 2/10, n/30. This means that the buyer is entitled to deduct 2% of the invoice amount if paid within 10 days. Otherwise, the net amount of invoice is due in 30 days. Another type of discount is termed *anticipation* where the buyer is entitled to the 2% discount plus an additional discount of a percentage of the invoice balance if paid within 60 days.

This calculation finds the standard and anticipated discounts, and the net invoice amount when discount rates (terms), amount of invoice, and dates of invoice and payment are known. Enter the information as follows:

1. Key in invoice amount, press `ENTER↑`.
2. Key in standard discount rate, press `%` to obtain amount of discount.
3. Press `▬` to obtain balance.
4. Key in anticipation discount rate, press `%`.
5. Key in days remaining, press `✕`.
6. Key in number of days used as interest base (either 360 or 365).
7. Press `÷` to obtain the amount of anticipation discount.
8. Press `▬` to obtain net invoice amount.

Sample Case: An invoice for $600 is dated October 10, 1974 and is paid on October 20. Terms are specified as 2/10, n/60—anticipation allowance is 6%. Determine the following:

- Amount of 2/10 Discount
- Invoice Balance Remaining (Net Difference)
- Amount of Anticipation Discount
- Net Invoice Amount

Solution:

Press	See Displayed	
600 **ENTER↑** 2 **%**	$ `12.00`	2/10 discount.
−	$ `588.00`	Balance (net difference).
6 **%** 50 **×** 360 **÷**	$ `4.90`	Anticipation discount.
−	$ `583.10`	Net invoice amount.

Denominate Number Conversion

Denominate numbers are used to express units of measure: length, weight, time, currency, etc. The principles illustrated by the following examples of currency conversion can be extended to other types of unit conversion problems. If you do repetitive calculations using the same constant, store it in K or M, and recall it as needed.

U.S.-to-Foreign Currency Conversion

This calculation finds the value of U.S. dollars in terms of foreign currency when the prevailing foreign-to-U.S. currency exchange rate, and the amount of dollars to be converted are known. Enter the information as follows:

1. Key in dollar amount to be converted, press **ENTER↑** .

2. Key in exchange rate, press **÷** to obtain equivalent amount of foreign currency.

Sample Case: If the rate of exchange is $2.233 per £, what is $30.20 worth in English currency?

Solution:

Press	See Displayed
30.20 **ENTER↑** 2.233 **÷**	£ `13.52`

Foreign-to-U.S. Currency Conversion

This calculation finds the value of foreign currency in terms of U.S. dollars when the prevailing foreign-to-U.S. currency exchange rate and amount to be converted are known. Enter the information as follows:

1. Key in amount to be converted, press `ENTER↑` .

2. Key in exchange rate, press `×` to obtain equivalent amount of U.S. dollars.

Sample Case: Using the same exchange rate of $2.233 per £, how much is £ 15.11 worth in U.S. money:

Solution:

Press	**See Displayed**
15.11 `ENTER↑` 2.233 `×`	$ *33.74*

Appendix A

Operating Characteristics

Execution Time

Execution time varies according to the numbers entered. This is especially true for solutions for i in annuity problems. Some solutions for i in extreme cases outside those normally encountered may require minutes—depending upon the values input for **n** , **PMT** , and **PV** or **FV** .

Roundoff Error

The HP-70 rounds numbers to 10 significant digits. This sometimes results in what is known as "roundoff error." An illustration of roundoff error can be seen when using **y^x** to calculate $(5^{1/2})^2$. The expected answer is 5.000000000; however, rounding $5^{1/2}$ (square root of 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 10-digit number whose square is 5.000000000.*

Calculating Range

Input Parameters

The algorithms in the HP-70 were designed to accommodate the wide range of values that a business environment might impose. However, extreme input values sometimes cannot be used. For example, financial calculations requiring a value for the periodic interest rate should not be performed when that rate is very close or equal to zero. Specifically, rates between i = −0.0000001% and i = +0.0000001% are not handled.

Range Errors

Any computation or data entry resulting in an absolute magnitude greater than or equal to $9.999999999 \times 10^{99}$ triggers an overflow signal (a display of ±9.999999999 99). The result of any computation having an absolute magnitude less than 1×10^{-99} (underflow) is displayed as zero.

Improper Operations

If you attempt a calculation containing an improper operation—say division by zero—an error signal is triggered (blinking zeros appear on the display). To reset, press $\boxed{\text{CLX}}$. The following are examples of improper operations:

- $\boxed{÷}$, where x = 0.
- $\boxed{y^x}$, where y ⩽ 0.
- $\boxed{n}$, where PV = 0, and FV and i > 0. (PV must be greater than 0 in order to increase in value.)

> **Note:** Some input combinations in financial functions may generate range errors or improper calculations internally. For example, should an algorithm use $\boxed{y^x}$ internally, where y ⩽ 0 because of the particular input values used, the display would show flashing zeros indicating an improper calculation.

Overflow Display Format

Answers greater than or equal to 10^{10} (9,999,999,999 + 1) are displayed in scientific notation—an abbreviated form of the number showing an exponent of 10 in the last two character positions.

Temperature Range

Mode	Temperature $°$C	Temperature $°$F
Operating	0 to +50	32 to 122
Charging	+10 to +40	50 to 104
Storage	−40 to +55	−40 to 131

Appendix B

Operational Stack

Stack Registers

The HP-70 uses the most efficient way known to computer science for evaluating mathematical expressions: the operational stack and reverse "Polish" notation (so called after its discoverer—Jan Lukasiewicz, the Polish logician and mathematician—because "Lukasiewicz" is so difficult to spell or pronounce).

The four temporary memory locations (number registers)—arranged in the form of a vertical stack are called X (bottom register), Y, Z, and T (top register), respectively.

Contents	Register Name
t	T
z	Z
y	Y
x	X
NOTE: The contents of the **X** register are always displayed.	

To avoid confusion between the name of a register and its contents, the register is designated by a capital letter and the contents by a small letter. Thus, **x**, **y**, **z** and **t** are the contents of **X**, **Y**, **Z** and **T**, respectively.

When you key in a number, it goes into the X-register—the bottom register and the only one displayed. When you press `ENTER↑`, this number is duplicated into the Y-register. At the same time, y is moved up to Z, z is moved up to T, and t is lost as follows:

Press:	Contents	Register
`ENTER↑`	t → (contents lost) → T	
	z → Z	
	y → Y	
	x → X	
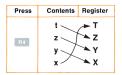
When you press `+`, x is added to y, and the entire stack drops to display the answer in X. The same thing happens for `−`, `×` and `÷`. Whenever the stack drops, t is duplicated from T into Z, and z drops to Y, as follows:

Press:	Contents		Register
`+`, `−`, `×` or `÷`	t →		T
	z →		Z
	y →	y+x y−x	Y
	x →	y×x y/x	X

81

Look at the contents of the stack as we calculate $(3 \times 4) + (5 \times 6)$ (figure 4). Directly above the keys pressed you see the information in X, Y, Z and T after the keystroke.

Manipulating The Stack

The ![R↓] key "rolls down" the stack and lets you review the contents (in last-in/first-out order) without losing data. It is also used to reposition data within the stack. Here is what happens each time you press ![R↓] :

Press	Contents	Register
![R↓]	t z y x	T Z Y X

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: the stack is raised and t is lost when a keyboard entry or memory recall operation follows ![R↓], unless that entry follows ![ENTER↑] or ![CLX].

The ![x↔y] key exchanges x and y as shown below.

Press	Contents	Register
![x↔y]	t z y x	T Z Y X

You will often find that x and y should be exchanged before ![−] , ![÷] , and ![y^x] operations.

Example: Find 2^9 .

Press	See	Remarks
9	9.	
![ENTER↑]	9.00	
2	2.	**x** and **y** are in wrong order.
![x↔y]	9.00	**x** and **y** are in right order.
![y^x]	512.00	

Table 4 provides a summary of all stack operations in capsulized form.
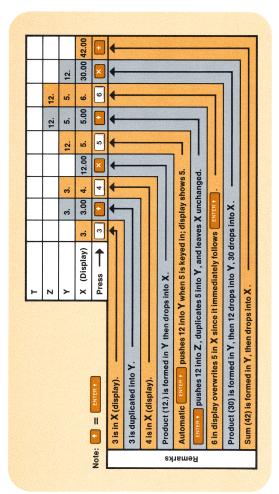
T								42.00
Z							12.	30.00
Y			3.	12.	5.	5.	12.	6.
X (Display)	3.	3.	4.	12.00	5.	5.00	6.	42.00
Press →	3	↑	4	×	5	↑	6	+

Note: ↑ = [ENTER↑]

Remarks

3 is in X (display).

3 is duplicated into Y.

4 is in X (display).

Product (12.) is formed in Y then drops into X.

Automatic [ENTER↑] pushes 12 into Y when 5 is keyed in; display shows 5.

[ENTER↑] pushes 12 into Z, duplicates 5 into Y, and leaves X unchanged.

6 in display overwrites 5 in X since it immediately follows [ENTER↑].

Product (30) is formed in Y, then 12 drops into Y, 30 drops into X.

Sum (42) is formed in Y, then drops into X.

Figure 4. Stack Operations

Table 4. Stack Operation Summary

Operation	Keys	Effect on Stack	Before	After
Clearing display	CLX	X-register is overwritten with zero; contents of stack are not pushed up.	T 1 / Z 2 / Y 3 / X 4	T 1 / Z 2 / Y 3 / X 0
Clearing stack	CLR	Contents of stack overwritten with zeros.	T 1 / Z 2 / Y 3 / X 4	T 0 / Z 0 / Y 0 / X 0 (Overwritten.)
Keying in value following CLX, ENTER+, STO K, STO M, n, i, PMT, FV, PV (if stored as input parameters), M+	any number	X-register is overwritten; contents of stack are not pushed up.	T 1 / Z 2 / Y 3 / X 4	T 1 / Z 2 / Y 3 / X (New value keyed in.)
Keying in value following any other operation (other than those above)	any number	Contents of stack pushed up.	T 1 / Z 2 / Y 3 / X 4	T 2 / Z 3 / Y 4 / X (New value keyed in.)
Loading stack manually	ENTER+	Copies value in X-register into Y-register; contents of stack are pushed up.	T 1 / Z 2 / Y 3 / X 4	T 2 / Z 3 / Y 4 / X 4

Operation	Keys	Effect on Stack	Before	After
Exchanging operands	x≷y	Contents of X and Y exchanged.	T 1 / Z 2 / Y 3 / X 4	T 1 / Z 2 / Y 4 / X 3
Rolling down	R↓	Contents of stack rolled down one position.	T 1 / Z 2 / Y 3 / X 4	T 4 / Z 1 / Y 2 / X 3
Performing basic functions	+, −, yˣ, +, ×	Contents of T are copied into Z; contents of stack drop.	T 1 / Z 2 / Y 3 / X 4	T 1 / Z 1 / Y 2 / X ◄ Result of function.
Performing percentage functions	Δ%, %	Contents of stack do not drop. X-register is overwritten.	T 1 / Z 2 / Y 3 / X 4	T 1 / Z 2 / Y 3 / X ◄ Result of function.
Recalling from memory registers	K, M, DSP n, DSP i, DSP PMT, DSP PV, DSP PV, DSP FV	Contents of stack are pushed up.	T 1 / Z 2 / Y 3 / X 4	T 2 / Z 3 / Y 4 / X ◄ Recalled value

Table 4. Stack Operation Summary (continued)

Operation	Keys	Effect on Stack	Before	After
Performing financial functions.	n, i, PMT, PV, FV	X-register is overwritten; contents of stack do not drop.	T 1 / Z 2 / Y 3 / X 4	T 1 / Z 2 / Y 3 / X ◄ Result of function.
Performing simple interest function	INT	Contents of Y are pushed up into T (2 pushes); 3-part result returned to Z, Y and X.	T 1 / Z 2 / Y 3 / X 4	T 3 / Z / Y / X ← Results of function.
Performing discounted note function	INT	4-part result returned to stack (overwriting previous contents).	T 1 / Z 2 / Y 3 / X 4	T / Z / Y / X ← Results of function.
Performing accumulation	M+	X-register is overwritten; contents of stack do not drop.	T 1 / Z 2 / Y 3 / X 4	T 1 / Z 2 / Y 3 / X ◄ Result of accumulation.
Storing values changing sign, setting display mode.	STO, M–, STO K, n, i, PMT, PV, FV, CHS, DSP 0 thru 9 or ·	No effect on stack.	T 1 / Z 2 / Y 3 / X 4	T 1 / Z 2 / Y 3 / X 4

Solution Method Model

The flowchart in figure 5 represents an algorithm—that is, a series of repetitive procedures for solving a problem. Further, this algorithm is a model of how you go about solving mathematical equations (mathematicians refer to this as "evaluating an express") with calculators having operational stacks and reverse Polish notation. Although the algorithm implies an operational stack of unlimited length, most practical problems would not exceed the capacity of the four-register stack provided in your HP-70.

Before using the algorithm, write your expression in serial form to make it easier to follow in the example. *All expressions can be written in serial form. For example,*

$$\frac{(2 \times 6) + (4 \times 5)}{4}$$

becomes

$$[(2 \times 6) + (4 \times 5)]/4.$$

According to our algorithm the solution can be obtained for any expression by entering the numbers from left to right as they appear. Use the algorithm to calculate the above expression.
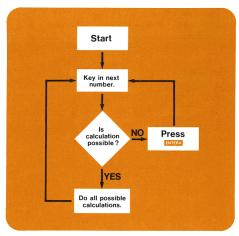
Figure 5. HP-70 Solution Method

Press

2 ENTER↑ 6 × 4 ENTER↑ 5 ×
+ 4 ÷

See Displayed

`8.00`

This could also be entered as follows:

Press

4 ENTER↑ 5 × 2 ENTER↑ 6 ×
+ 4 ÷

See Displayed

`8.00`

The idea is that you can key in the problem in whatever order is convenient to you. Among the obvious advantages of the four-register stack and reverse Polish notation are:

1.   Numbers can be keyed in in the same order as written.

2.   All intermediate results are displayed.

3.   It's not necessary to write down or store intermediate results.

4.   One technique is used for all calculations.

5.   It's not necessary to clear the calculator between calculations.*

*See Using Financial Functions, section 2, for exceptions.

Appendix C

Formulas for Financial Problems

Unless otherwise stated:

n = number of time periods

i = periodic interest rate expressed, for convenience in the following equations, as a decimal value

PMT = periodic payment

PV = present value or principal

FV = future value

I = interest amount

Accumulated Interest/Remaining Balance

- Remaining balance after payment H:

$$BAL_H = PMT \left[\frac{1 - (1 + i)^{H-n}}{i} \right]$$

where n is the total number of periods required to fully amortize the loan.

- Amount of a loan amortized from payments J through K inclusive:

$$AMORT_{J \text{ through } K} = BAL_{J-1} - BAL_K$$

- Amount paid to interest by payments J through K inclusive:

$$I_{J \text{ through } K} = (K - J - 1) \, PMT - (BAL_{J-1} - BAL_K)$$

Add-On Interest Rate Loans

r = add-on rate as a decimal value

N = number of monthly payments

APR = $1200i$

where i is the solution in the following equation:

$$\frac{\left(\dfrac{N}{12} \times PV \times r \right) + PV}{N} = \frac{i}{1 - (1 + i)^{-n}}$$

Compound Amount

$$FV = PV \, (1 + i)^n$$

Depreciation

L = assets' useful life expectancy

SBV = starting book value

SAL = salvage value

DEP_K = depreciation for year K

RBV_K = remaining book value at the end of year K

RDV_K = remaining depreciable value at the end of year K

- **Straight-Line Depreciation**

$$DEP_K = \frac{SBV - SAL}{L}$$

$$RDV_K = RDV_{K-1} - DEP_K$$

- **Sum-of-the-Years'-Digits Depreciation**

$$DEP_K = \frac{2(L - K + 1)}{L(L + 1)} \, (SBV - SAL)$$

$$RDV_K = RDV_{K-1} - DEP_K$$

- **Declining Balance Depreciation**

F = declining balance factor

$$DEP_K = RBV_{K-1} \times \frac{F}{L}$$

$$RBV_K = RBV_{K-1} - DEP_K$$

Direct Reduction Loan (Ordinary Annuity)

$$PV = PMT \left[\frac{1 - (1 + i)^{-n}}{i} \right]$$

Extracting Roots

$$x \sqrt{y} = y^{\frac{1}{x}}$$

Percentage

$$\text{Percentage} = \frac{\text{Base} \times \text{Rate}}{100}$$

$$\text{Percent Difference} = \Delta\% = \left[\frac{\text{New Amount} - \text{Base}}{\text{Base}} \right] \times 100$$

Raising Numbers to Powers

$$y^x = e^{x \ln y}$$

where ln is the natural log and e is 2.718281828.

Rebate — Rule of 78's

FC = total Finance Change

n = total number of monthly payments

$$\text{Rebate}_K = \frac{(n - K + 1)(n - K)/2}{(n + 1)\, n/2} \, FV$$

Rents, Leases (Annuity Due)

$$PV = PMT \left[\frac{1 - (1 + i)^{-n}}{i} \right] (1 + i)^n$$

Savings (Annuity Due)

$$FV = PMT \left[\frac{(1 + i)^n - 1}{1} \right] (1 + i)^n$$

Simple Interest

n = total number of days

i = decimal interest rate on annual basis

D = discount amount

Yield = decimal interest rate for discounted note

● **Accrued Interest for Notes**

$$I_{360} = \frac{n}{360} \times PV \times i$$

$$I_{365} = I_{360} \times \frac{360}{365}$$

● **Discounted Notes**

$$D_{360} = \frac{n}{360} \times FV \times i \qquad D_{365} = D_{360} \times \frac{360}{365}$$

$$Yield_{360} = \frac{D_{360} \times 36000}{n\,(FV - D_{360})} \qquad Yield_{365} = \frac{D_{365} \times 36500}{n\,(FV - D_{365})}$$

Sinking Fund (Ordinary Annuity)

$$FV = PMT\left[\frac{(1 + i)^n - 1}{i}\right]$$

Appendix D

Battery Operation

Use only the HP 82001A Rechargeable Battery Pack, which has been tested and is warranted for one year. The battery provides 3 to 5 hours of continuous operation. By turning off the power when the calculator is not in use, the HP-70 battery power will last easily throughout a normal working day. Battery power can be further lengthened by setting the display to zero decimal places (press **DSP** **0**) for calculations, and extending the display only when needed for results.

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

Example:

└─ True Decimal Position

Operating the calculator for more than 2 to 5 minutes after this low power indication first occurs may result in calculation errors. The battery pack must be recharged by connecting the HP-70 to the HP 82002A Battery Charger.

Recharging Procedure and AC Line Operation

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

1. Turn the HP-70 power switch to OFF.

2. Insert battery charger plug into the rear connector of the HP-70 and insert power plug of battery charger into an ac power outlet. *The HP-70 will not operate when connected to the recharger unless the recharger is connected to a live power outlet.*

3. Slide the power switch to ON, see that 0.00 is displayed.

4. Slide power switch to OFF if you don't want to use the calculator while it is charging. (The calculator can be operated on ac power during the charging cycle if desired.)

5. At the end of the charging period, you may continue using your HP-70 with ac power.

6. For battery operation, slide the power switch to OFF, disconnect the battery charger from both the power receptacle and the HP-70.

The calculator may be operated continuously on ac power with or without the battery pack. There is no danger of overcharging the battery. For convenience, overnight charging is recommended; after 14 hours, a completely discharged battery will be fully charged. Shorter charge periods will cause reduced battery operating time.

If the calculator is used with the recharger for a week or more at a time, it is best to remove the battery pack during these intervals. Otherwise, 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-70 on for at least 5 hours to discharge the batteries completely. Then put it on charge for at least 14 hours. This should correct the temporary degradation.

> **Note:** It is normal for the battery charger to be warm to the touch when in use.

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 101. If the battery pack is out of warranty, use the *Accessory Order Card* provided with you HP-70, to order a new battery pack. *Remember, you can use your HP-70 on ac power until the replacement battery pack arrives.*

Battery Pack Replacement

1. Set power switch to OFF and disconnect the battery charger.

2. Slide the two battery door latches (the top feet) toward middle of the calculator.

3. Let the battery door and battery pack fall into palm of the hand.

4. See if the battery connector springs on the calculator have been inadvertently flattened inward. If so, bend them out and try the battery again.

5. Insert the battery pack so that its contacts face the calculator and contact is made with the battery connectors.

6. Insert the bottom of the battery door behind the retaining groove and close the door.

7. Close the battery door by pressing it gently while sliding the two battery door latches outward.

Note: If you use your HP-70 extensively in field work or during travel, you may want to order the HP 82004A Reserve Power Pack, consisting of battery holder and spare battery pack. This enables you to charge one pack while using the other.

Warning: Do not try to burn old batteries. They may EXPLODE!

Appendix E

Service and Warranty

Servicing

Low Power

All decimal points light to warn you that you have 2 to 5 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

If the display blanks out, turn the HP-70 off, then on. If 0.00 does not appear on the display, check the following:

1. If battery charger is attached to HP-70, make sure it is plugged into an ac outlet.

2. Examine battery pack to see if it is discharged or is not making contact.

3. If display is still blank, try operating the HP-70 from the ac line.

4. If, after step 3, display is still blank, the HP-70 is defective. (Refer to Warranty paragraphs.)

Common Problems

If a top row key calculation starts executing while you are still keying in input values, you probably forgot to press **CLR** to clear the preceding parameter set. You will have to press **CLR** and key in all the new input values before continuing.

If you perform a calculation and the result is displayed as zero, it's probably because the magnitude of the result is too small for the display mode selected. For example, if you calculate 1/400 in **DSP** **2**, the result is displayed as 0.00. But if you change the display mode to include more decimal places—say **DSP** **4**—the result is displayed as 0.0025.

Shipping List

The list below shows standard accessories included with the HP-70. All items were checked at our factory prior to shipment. Please notify Advanced Products Customer Service of any irregularities by returning a copy of the packing slip with your comments, or by telephoning (408) 996-0100. If outside the U.S., please contact the Hewlett-Packard Sales and Service Office nearest you.

Item	Model Part No.
Battery Pack	82001A
Battery Charger (115/230 Vac)	82002A
Zipper Carrying Case	82012A
HP-70 Owner's Handbook	00070-90001

Warranty

In-Warranty

The HP-70 is warranted against defect in materials and workmanship for one (1) year from date of delivery. During the warranty period, Hewlett-Packard will repair or, at its option, replace components that prove to be defective when the calculator is returned, shipping prepaid, to a Hewlett-Packard Customer Service Facility (refer to Shipping Instructions).

This warranty does not apply if the calculator has been damaged by accident, or misuse, or as a result of service or modification by other than an authorized Hewlett-Packard Customer Service Facility. No other warranty is expressed or implied. Hewlett-Packard is not liable for consequential damage.

Out-of-Warranty

Beyond the one (1) year warranty period, calculators will be repaired for a moderate charge. *All* repair work performed beyond the warranty period is warranted for a ninety (90) day period.

Obligation to Make Changes

Products are sold on the basis of specifications applicable at the time of sale. Hewlett-Packard shall have no obligation to modify or update products once sold.

Shipping Instructions

Whether the unit is in warranty or out of warranty, it is the customer's responsibility to pay charges for shipping to the applicable service facility listed on the *Service Card*. During warranty, the service facility will, in turn, ship the unit back to the customer prepaid, via the fastest economical means.

On out-of-warranty repairs, the customer will pay shipping charges both ways. The service facility will ship units back to the customer C.O.D., unless the customer contacts them in advance and prepays the shipping and repair charges.

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

- Calculator with all standard accessories.
- Completed *Service Card*.

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

- Defective battery pack only.
- Completed *Service Card*.

Send returned items safely packaged to the address shown on the *Service Card*

Under normal conditions, calculators will be repaired and reshipped within five (5) days of receipt at any Hewlett-Packard Service Facility listed on the *Service Card*.

Should other problems or questions arise regarding service, please call the applicable service telephone number on the *Service Card,* or call Advanced Products Division, Customer Service, at (408) 996-0100.

Appendix F

Accessories

Standard and optional accessories for the HP-70 can be ordered by completing and mailing the *Accessory Order Card* provided. We will send you additional order cards as new optional accessories are added to our product line.

Standard Accessories	Model/Part No.
Battery Pack	82001A
Battery Charger (115/230 Vac)	82002A*
Zipper Carrying Case	82012A
Owner's Handbook	00070-90001

Optional Accessories	Model No.
Reserve Power Pack	82004A
Security Cradle and Cable	82007A
Hard Field Case	82006A

*If outside the U.S. you may require a different version of the battery charger. Please contact the nearest Hewlett-Packard Sales Office for the appropriate model number.

Applications Directory

This directory is your alphabetic guide to the applications casebook. Headings in the applications casebook are shown below in dark type. Financial calculation formulas associated with these applications may be found in appendix C.

General Index

Note: For your convenience, applications have been indexed separately in the Applications Directory immediately preceding this index.

Keyboard Summary and Index

Keys are listed in alphabetical order; symbols are listed following the alphabetic listing. Page numbers indicate where key usage is described.

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