........ HEWLETT-PACKARD Try a revolutionary new idea. The HP-28C Scientific Professional Calculator.

It's a revolutionary new idea in calculators. And it goes a giant step beyond the others!

The HP-28C Scientific Professional Calculator brings you computational power never before available in a handheld. Here are just a few of the things it can do:

- Symbolic algebra
- Symbolic calculus
- Equation solving
- Function and data plotting
- Linear algebra matrix/vector operations

- Complex number math
- Binary arithmetic and base conversions
- Advanced statistics
- Powerful programming
- Unit conversions with 120 built-in units and user-defined units

And that's just the beginning! Hard to believe? Push ON and examine the HP-28C more closely.

One simple procedure before you jump right into the examples – clear the HP-28C of any previous examples that may be left in calculator memory.

This is slightly awkward, but it's that way on purpose – so you won't clear it by mistake when you've stored something you really want to keep.

Here's how to clear calculator memory:

Press and hold ON.

Keep holding ON, and press both the first and last light-colored top-row keys at the same time. Release all three keys at once.

Now that you've cleared it, you're set to put the HP-28C through its paces.



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All HP-28C functions are permanently assigned to keys or available through menus and softkeys. Menus represent major groups of built-in functions.

Menu labels appear across the bottom of the display.

They are accessed by softkeys, the row of light-colored keys on the keyboard just below the display. These keys are blank because their functions change based on the menu labels appearing in the display.

Press TRIG and you'll see the first six trig menu labels. There are too many menu selections to fit in the display at once; to step through each grouping, press NEXT.

Please continue for some practice with menus and softkeys.



3

Try this quick exercise using menus and softkeys. Find the log of 100.

Press LOGS (The LOGS menu is the shifted function of the TRIG key.)

Press 1 0 0 and the softkey below the word **LOG** in the display.

Your answer appears in the display on line 1.



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Menus and softkeys are one concept that makes the HP-28C powerful and yet simple to use. But you've barely scratched the surface of the menus available. Please keep exploring. Menu selections are grouped by common application into menus. Menu keys – shown at right – give you access to each menu.

To get to any of these menus, **press** the key, then the appropriate menu key. (TRIG, SOLV and USER are exceptions. Don't press first.)

Each menu has more selections than will fit in the display at one time. Move through each set of menu commands by pressing the appropriate menu key and NEXT.

Explore the menus on your own. And whenever you want to clear the display of the menu line or results of earlier examples, follow the instructions at the bottom of each page. (Push the softkey below **QUIT** to leave the **UNITS** menu.)



he HP-28C is the first calculator to do symbolic math. It handles symbolic terms as easily **L** as numbers. Sound too good to be true? Well, it is true. Try the following and see for yourself. PACKARD 280

Press I

This tells the calculator that your next entry is an algebraic expression.

Now enter this symbolic expression. Use both keyboards.

Press A + B ENTER

Here's how to cube the expression you just entered.

Press 3 (The shifted function of X on the right keyboard.)

Continued . . .



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Now expand the expression you entered.

1. Go to the ALGEBRA menu.

Press ALGEBRA (It's the shifted function of J.)

2. Push the softkey under the word **EXPAN** in the display. This begins – the expansion.

Notice the $((\cdot))$ above the display?

It means that the HP-28C is working. When this annunciator leaves the display, you'll see the expanded form of your expression.

Now watch what happens in the display each time you push the **EXPAN** softkey. Push it five more times to completely expand your expression.

Simplify the equation by collecting the common terms. Watch the display as you push the softkey under **COLCT.**

A calculator that does symbolic algebra is revolutionary. But the HP-28C does symbolic calculus, too!



Until the HP-28C, symbolic calculus wasn't possible on a handheld calculator. Discover for yourself how much the HP-28C can do – try the following calculus example.

Use the instructions at the bottom of the page to clear the display. Then put the HP-28C in radians mode. Here's how:

Press MODE

Now press the softkey under the word **RAD.** So you'll know you're getting the right answers, the radians indicator, (2π) , appears on the annunciator line.

Get the **TRIG** menu by pushing **TRIG**.

Now enter this trig expression. Use the keyboard and softkeys.

Press I SIN Y ENTER

To differentiate with respect to Y, push Y d/dx

Within its memory capabilities, the HP-28C can differentiate any expression. Try doing this same thing using an expression of your own.



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With the HP-28C at work on your matrices, you can throw away your pad and pencil. The HP-28C handles the whole cumbersome process for you – from simplified entry through editing and manipulation.

You'll be amazed at how effortless it is to put a matrix into the HP-28C. Try this one: $\begin{bmatrix} 1 & 2 \\ 5 & 9 \end{bmatrix}$

The brackets you entered mark the beginning of the matrix and of each new line. The HP-28C automatically closes brackets for you.

You can see your entire matrix as a single object – the HP-28C keeps it all in one place. Keep going for more on matrices.





Take the inverse of the matrix you entered in the previous example. It's easy.

Just press 📕 1/x

There are four levels of matrix commands – 24 individual commands. And they're available to you through the **ARRAY** menu.

Press: ARRAY (The shifted function of **A**). Push **NEXT** to get to each additional level of commands. Feel free to practice some algebra or calculus and explore the menu offerings on your own. Then continue getting acquainted with the HP-28C.

No other handheld has as much power to work with complex numbers as the HP-28C. Find out for yourself.

Start by taking the square root of -4. Here's how:

Press 4 CHS

The result is the complex number 0 + 2i represented as (0,2).

You can multiply complex numbers as easily as you can add, subtract or divide them. HP-28C transcendental functions – trig, logs, exponentials, hyperbolics – apply to complex numbers, too.



The HP-28C makes short work of complex vectors and matrices as well. Multiply this small matrix by a complex number.

 $\left[\begin{array}{rrr}1&9\\2&5\end{array}\right]$

Enter the matrix like this:

Press [[1 , 9 [2 , 5 ENTER

Now enter the complex number.

Press	(4	•	9	ENTER
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To multiply them, **press** X.

Working with real and complex numbers with equal ease is something you can't do with the calculator you're using now!



The HP-28C can solve an expression or equation for any variable – in any order. A unique equation solver makes it possible.

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F=m*C^2

Solve for any unknown without rearranging the equation. The HP-28C isolates the unknown for you. And you can experiment with variables without having to reenter the equation each time.

Clear the display, then explore the capabilities of the equation solver with a well-known equation, $E = mC^2$. Enter it, solve for any variable, then experiment with variables. Here's how to enter it:



The HP-28C can plot any single-valued expression (one Y value for each X value). Or you can set two expressions equal to each other and plot both at the same time. Here's how.

Start by putting the HP-28C in radians mode if you didn't do it earlier. **Press** MODE.

Now press the softkey below **RAD.** (You'll see the radians indicator.)

Here are two trig expressions to plot. To enter the first one:

Press TRIG then I SIN A ENTER.

For the second expression, $\ensuremath{\mathsf{press}}$ $\ensuremath{\,\hbox{I}}$ $\ensuremath{\mathsf{COS}}$ $\ensuremath{\,\hbox{A}}$ $\ensuremath{\,\hbox{ENTER}}$.

To equate them, **press** = ENTER.

Now you're ready to plot them.

Press PLOT for the **PLOT** menu.

Press the softkey below **STEQ** to store your equation. (Your equation will disappear from the stack when you store it.)

Now push the **DRAW** softkey, and there you have it!

To clear the display, press CLEAR . To turn the current menu line off or back on, press 🛶 . To back up, press 🗲 . To clear a plot from the display, press [ON]. 14



Use the plot you made in the previous example to solve the equation for one of many possible roots – values of A such that SIN(A) = COS(A). Assume you want to find the first positive root.

The cursor you'll move to indicate your estimate is invisible until you push any of four cursor keys. Push these four keys to locate the cursor where it's shown. It's only a guess – don't worry about being precise.

Now insert the coordinates of your guess into the HP-28C by pressing the light-colored key at the far left – **INS**.

To see the coordinates of your guess, press ON to clear your plot from the display. Your guess will appear on Level 1 of the display.

Continued . . .

To get to the precise root from the guess you made on the previous page, **press** SOLV, then **SOLVR**.

Push the softkey under **A** in the display to enter the values of your guess. For the precise root of your guess – accurate to 12 digits – **press** and the softkey below **A**.

The HP-28C: It's the only calculator to combine an equation solver and visual estimating capabilities so you get exact answers.



Here's the way to get the results of your work down on paper. It's an optional thermal strip printer for the HP-28C, and it works on an AC adapter or four AA alkaline batteries.

But you can't see the best part. It's the infrared beam from calculator to printer. And it's the only link necessary between them. No cords to tangle with.



To try the HP-28C and printer, please keep reading.

If a demonstration thermal printer is available, print the plot you generated. The following sequence creates a small program to bring your plot into the display and send it to the printer – automatically.

Press these keys (use the softkeys, too), turn the printer on and point the HP-28C at it. It's that simple!



Ask your salesperson for specifics on printing with the HP-28C and the invisible connection.





The HP-28C has the most powerful set of built-in functions of any handheld available. The four-line display, menus and softkeys, and RPN or algebraic entry systems give you

▲ The four-line display, menus and softkeys, and RPN or algebraic entry systems give you the flexibility to take full advantage of all this power. Here's the HP-28C:

General Arithmetic. Add, subtract, multiply, divide, square root, square, power, inverse.

Symbolic Algebra. All real and complex number functions; expand, collect terms; expression editor; subexpression recall and substitution, symbolic solve; quadratic equations.

Binary Integer Operations. Decimal, octal, hexadecimal, and binary bases; arithmetic; variable wordsize; bit shift and rotate, byte shift and rotate, arithmetic shift; logical operators; floating-point/integer conversion.

Calculator Modes. Number display mode: standard, fixed, scientific, engineering; number of digits: 0-11; angle modes: degrees, radians; error recovery on/off; fast print; numeric/symbolic evaluation; beeper on/ off.

Calculus. Symbolic differentiation of arbitrary expressions; symbolic integration of polynomials; numerical integration of arbitrary expressions; Taylor series.

Catalogs. Catalog all programmable operations, including stack entry configuration; catalog all built-in units, including names, abbreviations, dimensions, values.

Complex-Number Operations. Arithmetic, trigonometric, hyperbolic and logarithmic functions; conjugate, absolute value, argument, real and imaginary parts, sign; rectangular/polar conversions.

Hyperbolic Functions. Sinh, cosh, tanh, and inverses.

List Manipulations. Element store/recall, concatenation, sub-lists, size.

Logarithmic and Exponential Functions. Natural and common logarithms and antilogarithms, ln(1 + x), exp(x) - 1.

Object Creation. Store, recall, evaluate, purge, edit.

Plotting. Plot mathematical functions and statistical data; set plot scales, axes, and center; display graphics. **Printing.** Print data, stack, variable, display, modes; trace operations.

Programming Features. User-defined functions, local variables, indefinite nesting and recursion, IF . . . THEN . . . ELSE, FOR . . . NEXT, DO . . . UNTIL, WHILE . . . REPEAT; halt, continue, abort, single-step, pause, read key, beep, display, error message, error number; set/clear/test 64 user flags; conditionals, logical operators; object type.

Real and Complex Vector and Matrix Operations. Arithmetic, inversion, systems of equations, norms, determinant, cross product, dot product, conjugate, transpose, redimension, rectangular/polar conversion, real and imaginary parts; real/complex conversion.

Real-Number Operations. Arithmetic; trigonometric, hyperbolic and logarithmic functions; square, square root, power, inverse, absolute value, sign; factorial, gamma function; percent, percent change, percent of total; maximum, minimum, integer and fractional parts, modulus, floor, ceiling, round, exponent, mantissa; random number generator.

Solving. Automated numerical expression/equation solver; symbolic variable isolation; quadratic equations. **Stack Operations.** Duplicate first, second, or *n*th object; duplicate *n* objects; drop object, drop *n* objects; roll up or down; count object, compose and decompose composite objects.

Statistics. Single- or multi-variable statistics: summation, deletion, mean, standard deviation, total, maximum, minimum, variance, covariance, correlation. Linear regression and predicted value. Normal, Students t, F, and Chi-square distributions.

Storage Operations. Arithmetic, inversion, and conjugation.

String Manipulations. Concatenation, substring, position, length, number/character conversion, string/ data conversion.

Trigonometry. Sine, cosine, tangent, and inverses; hours/minutes/seconds conversion, degrees/radians conversions; polar/rectangular conversions.

Unit Conversions. Automatic unit conversions among arbitrary combinations of 120 built-in units and user-defined units.