HEWLETT-PACKARD INTRODUCES
THE NEW HP 48G+
ADVANCED GRAPHIC CALCULATOR

A Powerful New Option for Students and Teachers

Hewlett-Packard Company has just announced a powerful new member of the HP 48G Series Graphing Calculators. The HP 48G+ now offers all the power and features of the HP 48G, but with four times the memory. More than just a state-of-the-art calculator, it is a powerful learning and teaching tool, designed both for novice and expert users.

More Memory = More Solutions

Like all the members of the HP 48G Series, the new HP 48G+ offers advanced problem-solving features that allow you to solve for any variable without rewriting your equation. And you can view those equations and formulas just as you would in a textbook or on paper with the HP EquationWriter application. You also can utilize the built-in Equation Library of more than 300 commonly used formulas and scientific constants for computing quick and accurate equations. All these advantages—and now, with an incredible 128 KB of RAM and 512 KB of ROM—make the HP 48G+ advanced graphic calculator the logical choice for math, science, and engineering students and teachers.

Seeing is Believing

Experience the power of the new HP 48G+ for yourself! Call 1-800-752-0900 for more product information or the dealer nearest you. Be sure to visit www.hp.com/calculators (and see pages 22-27 here), too!

HP ANNOUNCES
1998 SUMMER WORKSHOPS
FOR THE HP 38G AND HP 48GX

Palo Alto, CA
  HP 38G: June 22-23
  HP 48GX: June 24-25

Teaneck, NJ (New York City)
  HP 38G: July 7-8
  HP 48GX: July 9-10

Colorado Springs, CO
  HP 38G: July 14-15
  HP 48GX: July 16-17

Atlanta, GA
  HP 38G: July 20-21
  HP 48GX: July 22-23

Seattle, WA
  HP 38G: July 20-21
  HP 48GX: July 22-23

Bedford, MA (Boston)
  HP 38G: August 3-4
  HP 48GX: August 5-6

Portland, OR
  HP 38G: August 10-11
  HP 48GX: August 12-13

Elk Grove Village, IL (Chicago)
  HP 38G: August 17-18
  HP 48GX: August 19-20

The Math Learning Center will be conducting training workshops on the use of Hewlett-Packard graphic calculators this summer. The two-day workshops, covering the HP 38G and HP 48G Series, will be held in eight major metropolitan areas. (See schedule at left.)

Underwritten by HP, these workshops offer a unique, cost-effective opportunity. For just $75, each attendee will receive: a great two-day workshop, a free graphic calculator, a special instructor's guide, curriculum activities ready for use in math classes, and one graduate credit at Portland State University (awarded on the quarter system as Mth 810).

Each workshop will be held on two consecutive days from 8:30 am - 3:30 pm. Exact locations in each area will be announced soon. For that and other information, contact:

The Math Learning Center

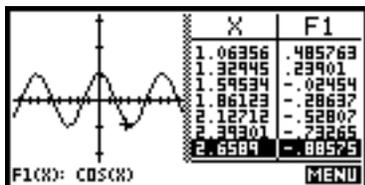Hewlett-Packard Educator Program

P.O. Box 3226

Salem, OR 97302-0226

Phone: **(800) 750-8130** (8-5 PT M-F)

Fax: (503) 370-7961

E-mail: hp@bbs.mlc.pdx.edu

The HP 38G Workshops

The calculator: The HP 38G is the first Hewlett-Packard calculator designed specifically for educational use. Its easy-to-use interface offers algebraic entry and intuitive but powerful graphing and table-making features, including a vertical split-screen format for showing graphs and tables side-by-side. As a classroom tool, the HP 38G allows you to illustrate multiple representations (tabular, symbolic, graphic) in new ways and to encourage students' exploration, experimentation, and in-class participation.

The workshops: Graphic calculators play a significant role in the vision of school math described by the NCTM's Curriculum and Evaluation Standards for School Mathematics. The workshops follow the multiple-representation approach (tabular, graphic, and algebraic) advocated by the Standards and typified by the HP 38G. Hands-on lessons include functions, parametric equations, polar plotting, discrete math, and statistics.

Who should attend? Math teachers in grades 7-12, college professors, community college instructors, and all interested others are encouraged to attend.

The HP 48GX Workshops

$$\frac{1}{\sqrt{2 \cdot \pi}} \cdot \int_{0}^{1} e^{\frac{-x^2}{2}} \, dx$$

The calculator: In today's math classroom, visualization and approximation have become increasingly important. The ability to generate a graph at the beginning of the problem-solving process can completely reverse the approach to a variety of mathematical topics. Graphic calculators such as the powerful HP 48G Series have emerged as the most advanced and exciting tools that provide students with new opportunities to apply math. The HP 48GX acts as a catalyst, allowing the teacher to create (and the student to re-create) a true multiple-representation approach to math, where functions can be viewed from numerical, graphical, and symbolic perspectives.

The workshops: The numeric, graphic, and symbolic tool kit provided by advanced graphing calculators permit an expanded multiple-representation approach to the study of mathematics. The HP 48GX is perhaps the most powerful of inexpensive calculators (non-QWERTY keyboard). This workshop demonstrates through hands-on experiences how such a graphic calculator can be used to take new instructional approaches to topics in pre-calculus and calculus.

Who should attend? Pre-calculus and calculus instructors in high schools, community colleges, colleges and universities, and all interested others are encouraged to attend.

New HP Educator Program

Hewlett-Packard Company has recently announced a new educators' support program. Effective May 1, 1998, HP will enter into a partnership with The Math Learning Center, of Oregon, to provide information, materials and support to teachers and professors who want to utilize HP calculators in their classrooms.

HP and The Math Learning Center will launch the first phase of the HP Educator Program in May, including an easy process for requesting calculators for evaluation, an up-to-date schedule of workshops on the HP 38G and HP 48G Series (see previous article about the upcoming summer sessions), free classroom materials, and access to this newsletter.

Please see also pages 16-17 for more details on HP's Educator Program. Or, contact The Math Learning Center at the address shown on page 2.

A G O O D R A T E F U N C T I O N :
D O W N T H E D R A I N

by Mark J. Howell

How fast does water go down a drain? You can use your HP 38G's quadratic fit capability to model the relationship between time elapsed and water remaining. You can graph the data and then use three points on the graph to calculate your own quadratic model.

You need a 50-ml burette, a plastic cup, water, and a watch with a second hand. With the stopper closed, you'll fill the burette with water, put the plastic cup beneath it, then open the burette's stopper, noting the water depth every 5 seconds until all has drained out.

Procedure: Reset the Statistics ApLet (LIB RESET YES START). Press HOME and put the time data, 0-135 seconds, into C1, via MAKELIST(X, X, 0, 135, 5) STO▶ C1. Do the experiment, noting the depth every 5 seconds. These are stored in C2. Now, the burette measures the water drained, so subtract each raw value from 50, the burette's full capacity, to get a history of the water depth. Store these values back into C2.

Time (seconds)	Depth
0	_____
5	_____
10	_____
15	_____
20	_____
25	_____
30	_____
35	_____
40	_____
45	_____
50	_____
55	_____
60	_____
65	_____
70	_____
75	_____
80	_____
85	_____
90	_____
95	_____
100	_____
105	_____
110	_____
115	_____
120	_____
125	_____
130	_____
135	_____

In the uniform-radius burette, volume, V, is proportional to depth, h: $V = \pi r^2 h$. Water has uniform density (ρ), so its mass is proportional to its volume, thus (in this case) its depth. So we can predict how depth varies with time. Press NUM, set EVARS, then SYMB. Fit C2 (dependent) to C1 (independent). At ■SETUP SYMB, CHOOS Quadratic for S1FIT. Press ■SETUP PLOT PAGE ▼ and enter the settings shown below. Press ■ VIEWS AutoScale to scatter plot, then MENU FIT to compare to the quadratic model.
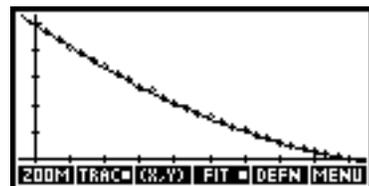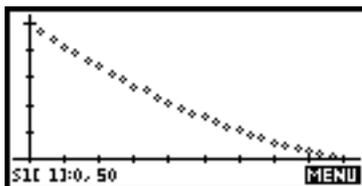
Let $h(t)$ be the function that gives the depth of the water at time t. Consider these questions:

Answers

1. Each time, t, has one depth, h. Domain: $0 \leq t \leq$ (time all water is drained). Range: $0 \leq y \leq 50$.

2. The y-intercept is the initial water depth. The t-intercept is the time when depth became 0.

3. The flow rate from the burette decreased; $y = h(t)$ isn't linear.

4. One fit: $h(t) = .0015384t^2 - .571337t + 49.425123$

5. The domain of the fit equation is all real time, but as a model it makes sense only for $0 \leq t \leq$ (whenever the burette empties); water won't flow back uphill!

6. $c = 50$

7. Points (65, 18.8) and (130,1.1) imply that $18.8=(a)65^2+(b)65+50$ and $1.1=(a)130^2+(b)130+50$.

8. The "fit" is thus $h(t) = .001598t^2 - .5838462t + 50$, which is very close to the calculator.

9. A bigger hole drains faster, so the graph would be steeper, reaching its t-intercept sooner.

10. The water would drain more slowly, so the graph would be flatter, reaching its t-intercept later.

11. Hint: Complete the square in the fit equation, then decide which branch of the graph you need.

---

1. Explain why h is a function of t. What is the domain of h? What is the range of h?

2. What is the real-world meaning of the y-intercept on the graph of $y = h(t)$? What is the real-world meaning of the t-intercept on the graph of $y = h(t)$?

3. Did the water flow from the burette at a constant rate? Is the graph $y = h(t)$ linear?

4. Copy the quadratic fit equation that you 𝖲𝖧𝖮𝖶 from the STATISTICS SYMBOLIC VIEW. Be careful to change the variables to those we've been using here.

5. Look again at your graph of the scatter plot with the overlaid FIT equation. Over what values of t does the quadratic fit equation make sense? Explain.

Find a quadratic fit for your data. Let $h(t) = at^2 + bt + c$ and find values for a, b and c.

6. First, use your knowledge of $h(0)$ to calculate c: _____

7. Now select one time about midway through the experiment and another time near the end. Use your data to create two equations in a and b. Write your equations here:

   _____   _____

8. Solve your two equations simultaneously. (You easily could use matrices to do this.) Compare your calculated quadratic to the fit equation produced by your calculator.

9. How would your graph change if the hole in the bottom of the burette were bigger?

10. How would your graph change if you did this same experiment on the moon?

11. What function would tell you the time if you knew the water depth? Explain how you might build a water clock. (Water clocks were among the earliest known timepieces.)

EXPLORING AREA FUNCTIONS
ON THE HP 48G SERIES

by Michael Grasse

This lab investigates area functions. Understanding the area function and its relation to other functions is crucial to the understanding of calculus.
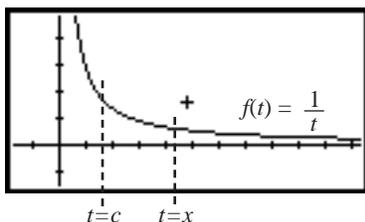
To construct an area function, $A(x)$, you use a function, $f(t)$, and some constant t-value, denoted as c. For any x, then, you find the area bounded by the graph of $f(t)$, the t-axis, the lines $t=c$ and $t=x$. This area is the value of $A(x)$, written symbolically as

$$A(x) = \int_c^x \frac{1}{t}\ dt$$

The line $t=c$ stays fixed, but the line $t=x$ "slides" horizontally according to the value of x. Since "sliding" $t=x$ changes the area of the region, $A(x)$, once you have defined $f(t)$ and c, the value of A is determined only by x. That is, $A(x)$ is truly a function of x.

For example, consider the function $A(x) = \int_1^x \frac{1}{t}\ dt$. Thus $A(2) = \int_1^2 \frac{1}{t}\ dt$, which, when computed to three decimal places, gives 0.693. In other words, $A(2) \approx 0.693$.

1. Given $A(x) = \int_1^x \frac{1}{t}\ dt$, for what value of x is $A(x) = 0$?

2. Investigate the area function $A(x) = \int_0^x 2t\ dt$, using the calculator.
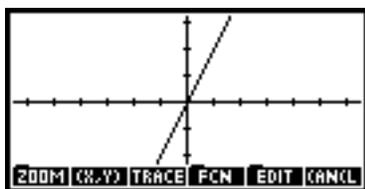
Clear the stack ($\boxed{\leftarrow}$ $\boxed{\text{CLEAR}}$) and enter the plotting environment ($\boxed{\rightarrow}$ $\boxed{\text{PLOT}}$). Reset the plotter ($\boxed{\text{DEL}}$ $\boxed{\blacktriangledown}$ **█OK█**). Set plot TYPE to Function and INDEP variable to T, then plot 2*T. The crosshairs should be at the origin. Press **█FCN█**, then **█AREA█**. The × you now see at the crosshairs sets one of the boundaries of the region. Using $\boxed{\blacktriangleright}$, move the crosshairs along the t-axis to the first tick mark, at $(1,0)$. Press $\boxed{\text{ENTER}}$ to put those co-ordinates on the stack. Now press **█AREA█** once again to compute the area bounded by the graph of $f(t)$, the t-axis, the line $t=0$ and the line $t=1$. Press any menu key to get the menu, and move the crosshairs to the second tick mark, at $(2,0)$. Use $\boxed{\text{ENTER}}$ to put those coordinates on the stack. Press **█AREA█** to compute the area bounded by $f(t)$, the t-axis, the line $t=0$ and the line $t=2$.
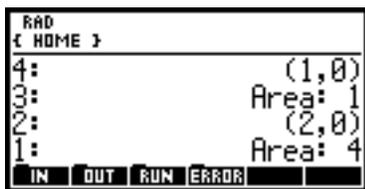
The stack now contains the values shown (but don't look at your stack now). The $(1, 0)$ at Level 4 shows that the first x input was 1; at level 3 is the corresponding area, 1.

So $A(1) = \int_0^1 2t\ dt\ = 1$. And, from Levels 2 and 1, we see that $A(2) = \int_0^2 2t\ dt\ = 4$.

Now repeat that procedure for all of the x-values in the table at left, below. Then press ON ON to get to the stack, and ▲ up the stack to see your entries.

x	$A(x)$
0	_____
1	_____
2	_____
3	_____
4	_____
-1	_____
-2	_____
-3	_____
-4	_____
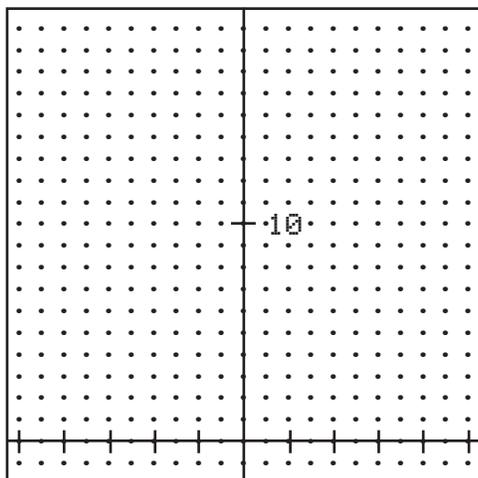
Fill the 2nd column of the table with the computed area values. Now plot the points $(x, A(x))$ on the grid. (The horizontal tick marks are 1 unit apart.)

3. In this case, $A(x)$ is a very common function. What is it? What is $A'(x)$, the derivative of $A(x)$ with respect to x?

4. Examine the area function, $A(x) = \int_{1}^{x} 2t \, dt$. Use a similar procedure, table and grid, but this time put the fixed left boundary at (1,0) instead of (0,0). This $A(x)$ function isn't much more complicated than that in question 3. What is it?

5. What is $A'(x)$, the derivative of $A(x)$ with respect to x?

6. Summarize your results so far. In particular, discuss the effect of the fixed bound on the function $A(x)$ and any relationships between $A(x)$, $A'(x)$, and/or $f(t)$.

x	$A(x)$
0	_____
0.5	_____
1.0	_____
1.5	_____
2.0	_____
2.5	_____
3.0	_____
3.5	_____
4.0	_____
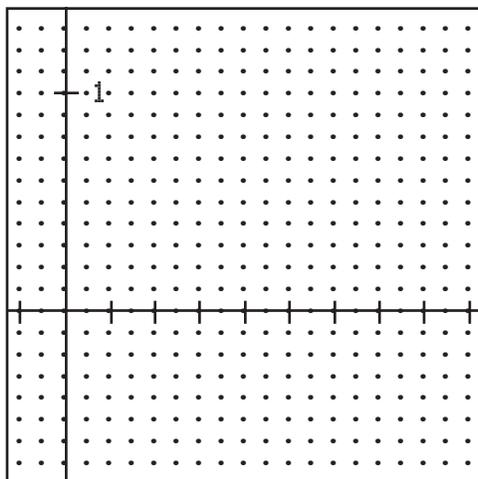
Try one more:

7. Investigate the area function $A(x) = \int_{1}^{x} \frac{1}{t} \, dt$, again using a table and grid, as shown here. This time, the horizontal tick marks on the grid are 0.5 units apart.

8. Again, $A(x)$ is a familiar-looking function. What is it? (Hint: it's not a polynomial.)

9. What is $A'(x)$, the derivative of $A(x)$ with respect to x?

In light of the above results, answer the following question without a calculator.

10. Given $A(x) = \int_{0}^{x} (t^3 + 3t^2 - 4t) \, dt$, find $A'(x)$ and an expression for $A(x)$ that does not involve a definite integral.

7

CLASSROOM LAB DATA COLLECTION
WITH THE HP 38G

by Ning Zhang

The Portable Lab Data Logger 100 is an easy-to-use data acquisition device for your classroom science or math labs. You can use it to collect types of data such as motion, temperature, force, etc. When connected to an HP 38G, HP 48G Series, or computer, it can monitor the data in real time or transfer it for storage to the calculator or computer. Here are two examples of how to use the HP 38G and the PLDL 100 in a classroom lab.

Graphing Motion

Materials: For this experiment, you need a motion detector from Vernier Software, the PLDL 100, an HP 38G, and a serial cable to connect your HP 38G to the PLDL 100.

Connect the motion detector to Port #4 of the PLDL 100, then turn on the PLDL 100. The red LED on the motion detector should come on, also. Have a student stand in front of the motion detector about 10 feet away. Press [LIB] and select the PLDL 100 ApLet from the APLET LIBRARY screen. Press ■SETUP[NUM] to get the TIMING SETUP screen. Enter 0.1 as the sample interval and 100 as the number of readings.

Now PAGE ▼ to the PROBE SETUP screen. Highlight line _4: and press CHOOS. Select Distance (in) from the probe list.

Press ■VIEWS and select Log Data. Now connect your HP 38G to the PLDL 100 with a serial cable. Press START to send data logging commands to the PLDL 100. The red LED of the PLDL 100 should start to blink in a fast double-blink mode. You also should hear the clicking sound made by the motion detector. When the clicking starts, have the student walk back and forth while facing the motion detector. When the detector stops clicking, press INFO. In the LOG DATA screen, you should see 100 records in memory. Press →38G to transfer the data to your HP 38G. After the transfer finishes, disconnect your HP 38G from the PLDL 100.
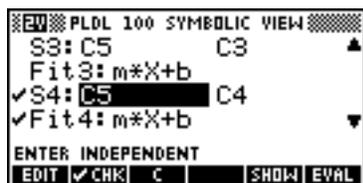
Press [NUM] to see the distance and time data in columns C4 and C5. The best way to view their relationship is to plot the distance against the time. Set S4HR, then press [SYMB] to get the PLDL 100 SYMBOLIC VIEW screen. ▼ down to S4 and make sure that C5 and C4 are entered there—and that S4 is checked (via ✓CHK)—as shown.

Press ■VIEWS, highlight Auto Scale, and press ENTER to plot the graph showing the distance and its first difference vs. time.
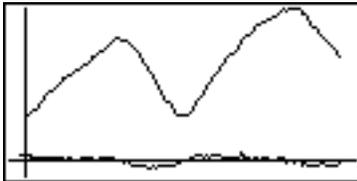
To see the first difference value calculations, press NUM, move the highlight to column C4, press ▓FCN▓ and select List. Then highlight C1 to display the resulting first difference data. Press ▓INS▓ to insert a zero into the first row of the first difference column. Generate the second difference similarly, using the first difference column.

Newton's Cooling Law

Materials: A PLDL 100 data logger, a temperature sensor (one is included with the PLDL), a cup of water, an HP 38G, and a serial cable to connect the PLDL 100 to the HP 38G.

Connect the temperature sensor to Port #1 on the PLDL 100. Press LIB and select the PLDL 100 ApLet from the APLET LIBRARY screen. Press ■SETUP NUM to get the TIMING SETUP screen. Enter 1 for the sample interval and 100 for the number of readings.

Now ▓PAGE ▼▓ to the PROBE SETUP screen. Highlight line _1: and press ▓CHOOS▓. If you are using the temperature sensor included with the PLDL 100, select DCT Temp °F from the probe list. (For any other type of temperature sensor, see the PLDL 100 user's manual for the proper calibrations.) Press ■VIEWS and select Log Data. Connect the HP 38G to the PLDL 100 with the serial cable. Hold the tip of the probe in your hand for 10 seconds to raise the temperature, then press ▓START▓ to send data logging commands to PLDL 100. The red LED of PLDL 100 should blink in a fast, double-blink mode. Wait a few seconds, then put the temperature sensor into the water. When the red LED resumes the slow, single-blink (idle) mode, press ▓INFO▓. You should see 100 records in memory in the LOG DATA screen. Press ▓→38G▓ to transfer the data to your HP 38G. After the transfer finishes, disconnect the HP 38G from the PLDL 100.
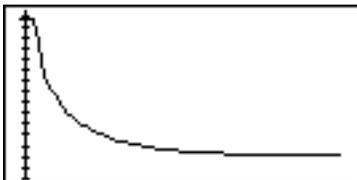
Press NUM to see the distance and time data in columns C1 and C5. The best way to see their relationship is to plot the distance against time. Set ▓XXXX▓, then press SYMB to get the PLDL 100 SYMBOLIC VIEW screen. Be sure that C5 and C1 are entered for S1, and ▓✓CHK▓ S1 (but be sure that no other lines are checked). Press ■VIEWS, then highlight Auto Scale and press ENTER to plot the graph.

(Ning Zhang is an engineer at Firmware Systems, manufacturer of the PLDL 100 Data Logger.)

NAME THAT TUNE: MAKING MUSIC
ON THE HP 38G AND HP 48G

by Bob Firman
and Tom Dick

One question often asked about the HP 48G is "How do I turn off that darn beeper?"
referring, of course, to the tone sounded by the calculator to rudely remind you of your
typing mistakes. (Answer: press ⇨MODES and "uncheck" ..BEEP)

But the beeper in the machine can be useful as a prompt. In fact, both the HP 38G and
HP 48G offer a programmable BEEP command that can sound tones of any frequency
(pitch) and duration. On the HP 48G, find the BEEP command via PRG NXT OUT
NXT. Its syntax is *frequency duration* BEEP, where *frequency* and *duration* are real
numbers (in Hz and seconds, respectively). On the HP 38G, press MATH, CMDS and ▼
to Prompt. You'll see BEEP on the right. Its syntax is BEEP *frequency; duration*.

Of course, if you can control both the pitch and duration of your calculator's tones, the
next logical question soon occurs to you—and the answer is yes: you can actually play
your calculator like a musical instrument! You can program an entire song simply by
stringing together the appropriate BEEP commands to play the desired notes. For a
"rest" interval, use the WAIT command. (WAIT is under Prompt in the MATH CMDS
menu on the HP 38G and in the PRG NXT IN menu on the HP 48G.)

As examples, here are listings of two programs, one for each calculator, that play a
familiar song. For tempo, they use a duration of .25 seconds per quarter note.

HP 48G: Program HBD
```
« 392 .375 BEEP 392 .125 BEEP 440 .25 BEEP 392 .25 BEEP
  523.25 .25 BEEP 493.8 .5 BEEP .25 WAIT
  392 .375 BEEP 392 .125 BEEP 440 .25 BEEP 392 .25 BEEP
  587.33 .25 BEEP 523.25 .5 BEEP .25 WAIT
  392 .375 BEEP 392 .125 BEEP 783.99 .25 BEEP 659.26 .25
  BEEP 523.25 .25 BEEP 493.8 .5 BEEP 440 .25 BEEP .25 WAIT
  698.46 .375 BEEP 698.46 .125 BEEP 659.26 .25 BEEP 523.25
  .25 BEEP 587.33 .25 BEEP 523.25 .5 BEEP »
```

HP 38G: Program HBD
```
BEEP 392;.375: BEEP 392;.125: BEEP 440;.25: BEEP 392;.25:
BEEP 523.25;.25: BEEP 493.8;.5: WAIT .25:
BEEP 392;.375: BEEP 392;.125: BEEP 440;.25: BEEP 392;.25:
BEEP 587.33;.25: BEEP 523.25;.5: WAIT.25:
BEEP 392;.375: BEEP 392;.125: BEEP 783.99;.25:
BEEP 659.26;.25: BEEP 523.25;.25: BEEP 493.8;.5:
BEEP 440; .25:   WAIT   .25: BEEP 698.46;.375:
BEEP 698.46;.125: BEEP 659.26;.25:
BEEP 523.25;.25: BEEP 587.33;.25: BEEP 523.25;.5:
```

Musical tones occur in a geometric progression of sound frequencies: each octave of musical pitch is double the frequency of the octave below it. Since the standard scale has 12 notes per octave, the ratio of frequencies between any two successive notes in the scale is $\sqrt[12]{2}$ (which, being irrational, makes piano tuning as much art as science).

For reference in making your own music, here are frequencies for the American Standard Pitch musical scale. In this notation, A_0 is the lowest note on a standard piano keyboard; C_4 is "middle C;" and C_8 is the highest note on a standard piano keyboard. Note how this standard scale was defined—by establishing "middle A" (A_4) to be 440.00 Hz.

Note	Freq.	Note	Freq.	Note	Freq.	Note	Freq.
C_0	16.35	C_2	65.41	C_4	261.63	C_6	1046.50
$C_0\#$	17.32	$C_2\#$	69.30	$C_4\#$	277.18	$C_6\#$	1108.73
D_0	18.35	D_2	73.42	D_4	293.66	D_6	1174.66
$D_0\#$	19.45	$D_2\#$	77.78	$D_4\#$	311.13	$D_6\#$	1244.51
E_0	20.60	E_2	82.41	E_4	329.63	E_6	1318.51
F_0	21.83	F_2	87.31	F_4	349.23	F_6	1396.91
$F_0\#$	23.12	$F_2\#$	92.50	$F_4\#$	369.99	$F_6\#$	1479.98
G_0	24.50	G_2	98.00	G_4	392.00	G_6	1567.98
$G_0\#$	25.96	$G_2\#$	103.83	$G_4\#$	415.30	$G_6\#$	1661.22
A_0	27.50	A_2	110.00	A_4	440.00	A_6	1760.00
$A_0\#$	29.14	$A_2\#$	116.54	$A_4\#$	466.16	$A_6\#$	1864.66
B_0	30.87	B_2	123.47	B_4	493.88	B_6	1975.53
C_1	32.70	C_3	130.81	C_5	523.25	C_7	2093.00
$C_1\#$	34.65	$C_3\#$	138.59	$C_5\#$	554.37	$C_7\#$	2217.46
D_1	36.71	D_3	146.83	D_5	587.33	D_7	2349.32
$D_1\#$	38.89	$D_3\#$	155.56	$D_5\#$	622.25	$D_7\#$	2489.02
E_1	41.20	E_3	164.81	E_5	659.26	E_7	2637.02
F_1	43.65	F_3	174.61	F_5	698.46	F_7	2793.83
$F_1\#$	46.25	$F_3\#$	185.00	$F_5\#$	739.99	$F_7\#$	2959.96
G_1	49.00	G_3	196.00	G_5	783.99	G_7	3135.96
$G_1\#$	51.91	$G_3\#$	207.65	$G_5\#$	830.61	$G_7\#$	3322.44
A_1	55.00	A_3	220.00	A_5	880.00	A_7	3520.00
$A_1\#$	58.27	$A_3\#$	233.08	$A_5\#$	932.33	$A_7\#$	3729.31
B_1	61.74	B_3	246.94	B_5	987.77	B_7	3951.07
						C_8	4186.01

HOW ORDERED PAIRS OBEY:
TRANSFORMATIONS ON YOUR HP 38G

by Mark Howell

Here's a nifty program that creates a 2 x 131 matrix of ordered pairs, stored in M5 matrix. The points' *x*-coordinates correspond to the *x*-coordinates of the columns of pixels on the calculator screen. Applying function F1 to each *x*-coordinate gives the corresponding *y*-coordinate, resulting in a matrix of ordered pairs on the current graph of Y=F1(X).

```
▓▓▓▓▓▓▓F1MAT5 PROGRAM▓▓▓▓▓▓▓
(XMAX-XMIN)/130▶D:MAKE
MAT(0,2,131)▶M5:1▶N:
FOR I=XMIN TO XMAX
STEP D: I▶M5(1,N):
F1(I)▶M5(2,N):
N+1▶N:END:
STO▶ SPACE          A...Z BKSP
```

What use is this? Well, you could use the Parametric ApLet to graph the matrix, for example. Then (even better), you can apply a transformation to the matrix, then graph and trace on the transformed matrix! Try it: First, within the Function ApLet, define F1(X)=.1*X^2. Then run the program (⬛PROGRAM, select F1MAT5 and press ▓RUN▓). (Be patient: this takes awhile—matrices use a lot of memory.)

```
▓▓▓▓FUNCTION SYMBOLIC VIEW▓▓▓▓
✓F1(X)=.1*X^2
 F2(X)=
 F3(X)=
 F4(X)=
 F5(X)=                    ▼
EDIT ✓CHK  X       SHOW EVAL
```
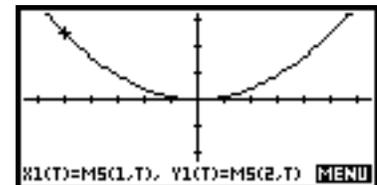
In the Parametric ApLet, let X1(T)=M5(1,T) and Y1(T)=M5(2,T). In PARAMETRIC PLOT SETUP (⬛SETUP PLOT), let T vary from 1 to 131 in steps of 1. Now PLOT:

```
▓▓▓PARAMETRIC SYMBOLIC VIEW▓▓▓
✓X1(T)=M5(1,T)
✓Y1(T)=M5(2,T)
 X2(T)=
 Y2(T)=
 X3(T)=                    ▼
EDIT ✓CHK  T       SHOW EVAL
```

```
▓▓▓▓PARAMETRIC PLOT SETUP▓▓▓▓
TRNG: 1           131
TSTEP: 1
XRNG: ⁻6.5        6.5
YRNG: ⁻3.1        3.2
ENTER MINIMUM TIME VALUE
EDIT        PAGE ▼
```
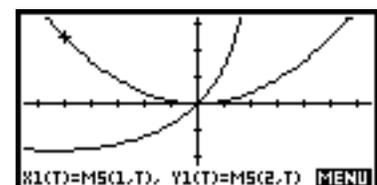
Transformations are the fun part. For example, to rotate the graph by $\pi/4$, multiply M5 by a transformation matrix, M4. Let X2(T)=M3(1,T) and Y2(T)=M3(2,T).

```
M4   1       2
1 .707107 -.70711
2 .707107 .707107

.707106781185
EDIT INS GO→ BIG
```

```
▓DEG▓▓▓▓▓▓ HOME ▓▓▓▓▓▓▓




M4*M5▶M3◀
STO▶
```

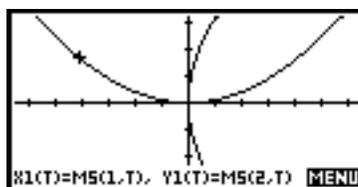**Or, as an example of a reflection rather than a rotation, you could do a reflection of the graph about the line** $y = x$**, like this:**
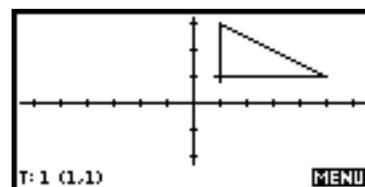

In fact, there's nothing to stop you from stashing away the vertices of any shape in a matrix, and using matrix multiplication and parametric graphing to look at transformations. For example, you can draw a triangle and reflect it over the y**-axis:**

(Notice that you have to store the first vertex twice, to complete the drawing.)

As you can see, this method works very nicely when discussing reflections and rotations of graphs. Students can see exactly what happens to each ordered pair by looking at the transformed matrix, and they can see the overall effect by looking at the graph.

DERIVATIVE APPROXIMATIONS
ON THE HP 48G

by Michael Grasse

This lab shows how to view symmetric and one-sided difference quotients numerically and graphically. It also argues for the accuracy of some common derivative formulas.

Given a function, $f(x)$, and a point, $(a, f(a))$, difference quotients can approximate the derivative of the function at that point, $f'(a)$. The three quotients you will use are:
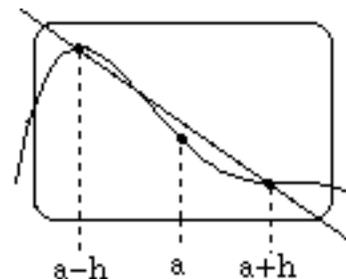
Left difference quotient: $\dfrac{f(a) - f(a - h)}{h}$ $\qquad$ **Right difference quotient:** $\dfrac{f(a + h) - f(a)}{h}$

Symmetric difference quotient: $\dfrac{f(a + h) - f(a - h)}{2h}$ $\qquad$ (h is a small positive number.)

Geometrically, the difference quotient selects two points on the function and finds the slope of the line connecting the two points (called a secant line).
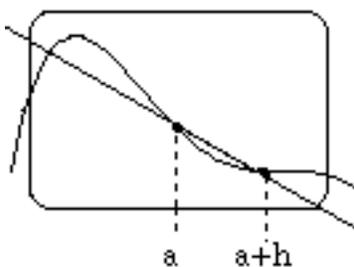
(right difference quotient) $\qquad\qquad$ (symmetric difference quotient)

1a. **Let $f(x) = x^3$. Use the HP 48G to find a symmetric difference quotient approximating $f'(1)$ with $h = 0.1$. Press** ⟵CLEAR ⟶PLOT DEL ▼ **`OK` to reset the plot so Δx will be 0.1. Now set** PLOT TYPE **to** Function **and graph** 'X^3'. **Set** `TRIG`, **activate** `(X,Y)`, **and** ▶ **to** X: 1.1, **then** + **to get the menu back. Use** `FCN` NXT `F(X)` **to put $f(1.1)$ on the stack. Press** + `PICT` **to return to the first menu. Set** `TRIG`, **activate** `(X,Y)`, **and** ◀ **to** X: .9, **then** + `FCN`, NXT **and** `F(X)` **to put $f(0.9)$ on the stack. Now** ON ON **to the stack, subtract the two values, and divide by $2h$ (0.2).**
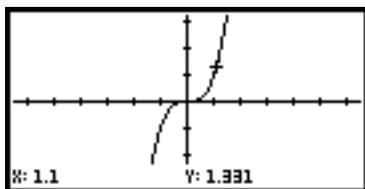
1b. **Now approximate $f'(1)$ via a symmetric difference quotient with $h = 0.01$. First, you must zoom in by a factor of 10, centered at the point $(1, f(1))$:** ⟵PICTURE **returns you quickly to the graph. Trace to** X: 1, **press** + `ZOOM`, `ZFACT`, **set both factors to** 10, **☑CHK** _RECENTER AT CROSSHAIRS, **and press** `OK`. **Now** `ZIN` **and you're ready to repeat the calculation procedure above. (Don't forget to divide by 0.02!)**

1c. How did the picture change with the smaller h? How does this relate to increased accuracy in approximating $f'(1)$?

2a. Let $f(x) = x^4 - 2x^3$. Use the HP 48's graphing capabilities to find the symmetric difference quotient that approximates $f'(1)$ with $h = 0.1$.

2b. Now approximate $f'(1)$ via a symmetric difference quotient with $h = 0.01$.

3. Show algebraically that the symmetric difference quotient is just the average of the right- and left- sided difference quotients.

4a. Let $f(x) = |x - 1|$. (For this function you would type `'ABS(X-1)'` into the HP 48.) Find the symmetric difference quotient that approximates $f'(1)$ with $h = 0.1$.

4b. Now approximate $f'(1)$ via a symmetric difference quotient with $h = 0.01$.

4c. Are these results accurate? Explain.

5a. Let $f(x) = \sqrt{x - 1}$. Using the graphing environment, approximate $f'(1)$ via a right difference quotient with $h = 0.1$.

5b. Approximate $f'(1)$ using a difference quotient with $h = 0.01$.

5c. Can you use the symmetric difference quotient in this situation? Explain.

6. Given the general quadratic function, $f(x) = ax^2 + bx + c$, show algebraically that the symmetric difference quotient yields $2ax + b$ no matter what h you use.

Selected Answers

1a. 3.01

1b. 3.0001

1c. The slopes of the secant lines approach $f'(1)$, the slope of the tangent line.

2a. -1.98

2b. -1.9998

4a. 0

4b. 0

4c. No, these are not accurate. From the graph, we observe that for $x < 1, f'(x) = -1$; but for $x > 1, f'(x) = 1$. No matter how much we zoom in, the graph will never look linear at $x = 1$.

5a. 3.16

5b. 10

5c. No, because the function is not defined for $x < 1$.

The easiest way to integrate Hewlett-Packard calculators into the learning process is to try them for yourself, which is what the HP Educator Support Program is all about. Through HP's partnership with **The Math Learning Center (MLC)**, you now have a wide variety of ways to learn about and get HP products into your classroom.

Evaluating HP Calculators

To evaluate an HP calculator for use in your classroom, just contact **MLC** and they will send you the evaluation request form.

Training Workshops

HP is committed to helping you get the most out of HP graphic calculators through their ongoing training program. For the most up-to-date list of scheduled workshops on HP graphic calculators, contact **MLC** by phone, mail, e-mail or fax. (See also the article on page 2 about upcoming workshops this summer.)

Or, if the already-scheduled workshops don't fit into your calendar, you can schedule your own! **MLC** has a list of instructors who are available to conduct workshops on HP graphic calculators—and they also will help you publicize it! (Just send information on your workshop to **MLC** after you have finalized the schedule.)

Free Classroom Materials

To help you successfully integrate HP calculators into your classroom, Hewlett-Packard offers a wide assortment of materials and aids:

- Classroom poster for HP 38G or HP 48G series
- Overhead transparency of the keyboard for the HP 38G or HP 48G series
- Training guides and examples for the HP 38G and HP 48G series
- Additional copies of the latest **HP^C** newsletter

To request any of these materials, contact **MLC**.

Free Newsletter

HP^C is a newsletter for professors and teachers who use HP graphic calculators. Issued several times per year and independently edited by teachers, it brings you information about new products and programs from HP, articles on using HP calculators in the classroom, and example programs and ApLets that you can use to enhance your teaching. The newsletter is available at no charge. To subscribe to **HP^C**, call **MLC**—or just use the form that appears on the inside back cover of this issue

The Math Learning Center (MLC)

Hewlett-Packard Educator Program

P.O. Box 3226

Salem, OR 97302-0226

Phone: **800-750-8130** (8-5 PT M-F)

Fax: 503-370-7961

E-mail: **hp@bbs.mlc.pdx.edu**

1-VAR INEQUALITIES Solve inequalities using a number line.

2 x 2 SYSTEMS Solve 2 × 2 systems of linear equations, using substitution, linear combination, and Cramer's Rule.

ACTIVE GRAPHER Investigate rigid transformations of seven basic functions: $y = x,\ y = x^2,\ y = x^3,\ y = |x|,\ y = \sqrt{x},\ y = 1/x,\ y = 1/x^2$.

AMPLITUDE/PERIOD Investigate the effects of parameters A and B on the functions $y = A\sin(Bx),\ y = A\cos(Bx),\ y = A\tan(Bx),\ y = A\sec(Bx),\ y = A\csc(Bx),\ y = A\cot(Bx)$.

ANGLES Solve for the missing angle, given a pair of complementary angles, a pair of supplementary angles, or a triangle.

ARCHIMEDES Explore Archimedes' method for approximating the value of π by comparing the area of a regular polygon to that of the corresponding circumscribed circle.

AREA MODEL Multiply first-degree monomials and binomials.

BASIC FUNCTIONS Explore stretches, shrinks, and translations of seven basic graphs.

CARS 1993 Explore relationships among various data to investigate various cars, their cost, mpg, etc.

CONIC PLOTTER Investigate conic sections in general and standard forms.

CONICS – POLAR FORM Investigate polar graphs of conics—how changing the eccentricity and distance from focus to directrix affects these graphs.

COORDINATE GEOMETRY Find the midpoint, distance, and slope of a line segment.

DECIMALS Explore patterns and symmetry by ordering pairs of digits from the decimal expansion of certain fractions that have periodic decimals.

DERIVATIVE Graphically explore the first and second derivatives of functions.

DOT-TO-DOT Explore points, slopes and equations of lines that enclose the figures; investigate the piecewise functions that would create the exact drawing.

DRILL CORE Explore relationships among the different data to predict the percent of iron in a given sample.

EFFECTS ON F(X) Graph functions where negations and absolute values are applied to the function and its inputs.

FACTORING Symbolically factor second-degree trinomials in the form $Ax^2 + Bx + C$.

FIBONACCI Determine an approximation for the golden mean, using the ratio of width to length of the sides of the golden rectangles.

GUESS THE LINE Write the equation of a line in slope-intercept form, given two points.

GUESS RATIONAL Write the equation of a rational function, given horizontal and vertical asymptotes and a root.

algebra | geometry | trig | pre-calc | data/stats | physics | calculus

INEQUALITIES Graphically solve a system of linear inequalities.

INVERSES Explore inverse relations and functions; analyze relations and functions graphically, numerically, and symbolically.

LAWS OF EXPONENTS Apply the laws of exponents to multiply and divide monomials and to raise a monomial to a power.

LAW OF SINES/COSINES Solve oblique triangles with the laws of sines and cosines.

LINEAR Identify the slope and the y-intercept, given a linear equation; describe the various effects that positive, negative and zero values have on the graph.

LINEAR INEQUALITY Graphically solve a linear inequality.

MAP THE WRAP Investigate the relationship between the unit circle and the graphs of $y = \sin x$ and $y = \cos x$.

MATRIX « RREF » Solve systems of equations using Gauss-Jordan elimination; algebraically manipulate the matrix to put it in row-reduced echelon form.

OHM'S LAW/POWER Explore the relationships among voltage, current, and resistance; explore the ideas of Ohm's law and power.

ORDER OF OPERATIONS Simplify expressions using the order of operations.

PARALLEL/PERPENDICULAR Write the equation of a line parallel or perpendicular to a given line through a given point.

PERCENT Write ratios to solve problems of the form "A is B% of C."

PERIODIC Explore the four parameters that affect the graph of $y = A\sin(Bx+C)+D$ and $y = A\cos(Bx+C)+D$; analyze these symbolically and graphically.

PHASE SHIFT Investigate the effects of parameter C on the six functions $y = \sin(x+C)$, $y = \cos(x+C)$, $y = \tan(x+C)$, $y = \sec(x+C)$, $y = \csc(x+C)$, $y = \cot(x+C)$.

POINT GUESS Recognize and name the coordinates of the points.

POLAR EQUATION PLOT Investigate polar equations graphically and symbolically.

POLAR POINT PLOT Plot points in polar form; convert polar coordinates to rectangular coordinates and vice versa.

PROJECTILE Investigate the kinematics equations that govern the motion of an object fired at a given angle with a given velocity.

QUADFORM Determine the nature of the roots; predict how many times, if any, the graph of a parabola will cross the x-axis, and find the solution(s).

QUADRATIC Investigate the effects of changing A, H, and K in the vertex form of a quadratic function; symbolically and graphically analyze these parameters' effects.

algebra geometry trig pre-calc data/stats physics calculus

RATIONAL Investigate rational functions and the asymptotes associated with them.

REFLECTION Reflect graphs of functions about the y-axis, x-axis, origin, and $y = x$.

RESIDUAL Compute residual values; display their graph as another way to determine how well the regression equation fits the data.

RIGHT TRIANGLES Solve right triangles with the Pythagorean Theorem and by using the trigonometric ratios: sine, cosine, and tangent.

SUBSTITUTION Evaluate expressions when given values for the variables.

SURFACE WAVES Explore relationships among data about surface waves.

VOLUME/SURFACE AREA 1 Find volumes & surface areas of pyramids and cones.

VOLUME/SURFACE AREA 2 Find volumes & surface areas of boxes and cylinders.

To obtain any of these ApLets, or to get help in creating your own, visit

HP's Calculator web site at <u>http://www.hp.com/calculators</u>.

algebra

geometry

trig

pre-calc

data/stats

physics

calculus

HP 48G/GX Software

The following public domain software for the HP 48G Series is available for direct download via links from HP's calculator web site at http://www.hp.com/calculators. Note that Hewlett-Packard neither supports nor endorses these, nor makes any representation of any kind as to their fitness.

Math   A collection of programs in numerical and statistical analysis, symbolic math, and vector calculus.

Physics   Programs in astronomy, electricity, air and fluid flow, and laminates.

Songs   A collection of music for the HP 48G/GX.

Utilities   A set of useful programming utilities for the HP 48G/GX.

Games   A favorite collection for HP 48G/GX fans.

Library   An easy-to-use collection of publicly available software and information, assembled by Joseph Horn.

Other Products Available for the HP Graphic Calculators

Many independent companies offer products related to HP graphic calculators, including the following. Note that Hewlett-Packard neither supports nor endorses these companies nor their products, nor makes any representation of any kind as to their fitness.

da Vinci Technologies, Inc.   Plug-in application cards and software for the HP 48G/GX. **541-757-8416** or http://www.sparcom.com

Firmware Systems, Inc.   Overhead displays and data collectors for HP graphic calculators. **541-753-3617** or http://www.E-Z.Net/~Firmware

Grapevine Publications, Inc.   How-to books and software for HP calculators. **800-338-4331** or http://www.read-gpi.com

THE HP 38G GRAPHIC CALCULATOR
IN DETAIL

Easy, Powerful, and Built for Math Class

The HP 38G has all the functionality and features of other graphic calculators, plus a lot more. Designed with the secondary school math classroom in mind, no other calculator makes learning and teaching math so exciting.

The HP 38G is the first calculator designed with interactive, electronically guided lessons, called ApLets, that help your students learn faster and get more from classroom sessions and homework assignments. It's the future of calculator-based instruction—powerful, flexible, easy—and any HP 38G can be connected to an overhead display unit, so your students can see your keystrokes—or share their own work with everyone in class!

Understanding comes more naturally to your students, too, because the HP 38G lets you view expressions numerically, graphically, and symbolically. The new split-screen view lets you compare two views at one time. This helps students to build a stronger conceptual base; the HP 38G makes math make sense.

Easy Calculations and Menus

The HP 38G is the first graphic calculator from HP to use standard algebraic notation for its operations—no need to learn new methods to do the same old calculations. And the HP 38G remembers your calculations in case you want to reuse a previous result. Simply move up the list and copy the information you want—as easy as point and shoot!

With easy-to-use menus, you get satisfying results fast. Pop-up menus make commands and functions available with just a few keystrokes, and input forms offer easy screens to set up problems. Students just fill in the blanks, and the SHOW equation feature lets them be sure they've entered expressions correctly. There's even a fraction display mode!

Built-in Tools and Plenty of Power

The HP 38G offers over 200 functions and commands, all easy to find in clear, organized menus. Evaluate expressions symbolically, isolate variables, solve quadratic equations, and use HP Solve to conduct "What if..." investigations. Other features include:

- Taylor series approximations
- List-based, 1- and 2-variable statistics; several regression models and plot types
- Complex numbers
- Real and complex matrices
- Programming to create your own Views, ApLets, and automatic calculations

ApLets Make Teaching Easier for You

ApLets combine variables, pictures, graphs, and custom-designed views into one complete package. With ApLets, students can explore the problems without your guidance—and without fear of losing their work or the original lesson. They can save their work or start over if things don't work out. ApLets are easy and natural to use: students will even begin to create their own to share with you and their classmates.

It's easy to create ApLets! Once you've set up a problem for use in the classroom, just save it. All of the configuration information is saved, along with any notes and sketches you've created—together in a package easily transferred to your students via simple, wireless infrared. (Just point two calculators at each other and beam it across—and the same infrared beam also operates the I/R printer!) In very little time, everyone in class is working with the same information and problems—a complete lesson that <u>you</u> prepared.

An ApLet (such as this one, written by G.T. Springer, of San Antonio, Texas) is stored in the ApLet Library. It can begin with a note....

Students can then see a sketch of the problem and even customized views....

They can compare graphical and numeric views as they are generated. And if they make a mistake, they just start over—the original ApLet is not changed until it is saved.
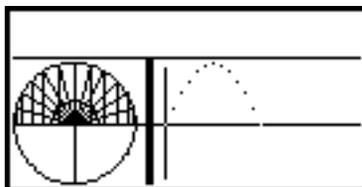
ApLets are being created by teachers, publishers, and HP. They are available on bulletin boards and on the Internet. (Please see pages 18-20 and page 36 for more information.)

(Please see page 27 for Bid Specifications for the HP 38G Graphic Calculator.)

THE HP 48G SERIES GRAPHIC CALCULATORS IN DETAIL

The State of the Art

The HP 48G Series of graphic calculators represent the best of the best—a new level of capability and convenience. They offer more memory, more functionality, and more graphics, including input forms, dialog boxes, enhancements to plotting, 3-D graphics, and built-in equations.

Now with a powerful new member, the 48G+, the HP 48G Series of calculators is truly at the head of its class, offering you and your students a wide range of choices in power, ease of use and expandability for the future.

The HP 48G Graphic Calculator has 32 KB RAM built-in and includes all HP 48GX features except the plug-in option—an excellent choice when plug-in expandability is not a requirement.

The new HP 48G+ Advanced Graphic Calculator opens up new horizons. With a full 128 KB of RAM built-in—four times the memory of the HP 48G—think how many more equations, programs, notes and formulas your students can have at their fingertips!

The HP 48GX Graphic Expandable is as good as it gets—the best calculator for your education and your career—period. With 128 KB of RAM built-in, plus the expandability of two plug-in card ports for application cards or up to a staggering 1.25 MB of RAM, this is the most power you'll find in a calculator anywhere.
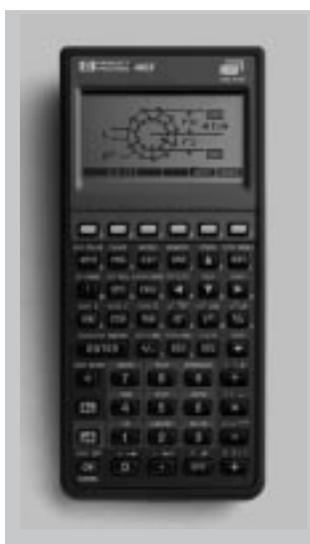
Power with No Equal

The amount packed into the HP 48G Series is truly incredible. Graphics and calculus are combined like never before on a calculator. While you're viewing the graph, the HP 48 finds roots, intersections, local extrema, derivatives, slopes, and areas under curves.

You also get hundreds of built-in equations for geometry, stress analysis, electrical engineering, fluid flow, heat transfer, and more—all with HP Solve that lets you play "What if…" by varying your known values and solving for the unknown values—even with multiple equations!

And if all this isn't already precisely what you need, the HP 48G Series also offers powerful, structured, object-based programming. Write quick, simple utility programs, and then combine them into sophisticated applications—with totally custom menus and key assignments to make their use even faster.

Built to Make Sense

But is all this power only for the technically gifted? Not at all! The HP 48G Series makes its use a real treat, even for beginners. Easy-to-use forms speed up your learning: each built-in application has an input form you just fill in. With clear prompts and menus organized for easy access, you and your students get satisfying results quickly. From unit management to matrices, the HP 48G Series is first-class in friendliness, too.
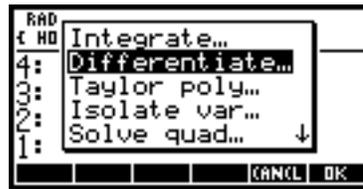
With the EquationWriter, you see this...   ...instead of this.

And look at how its symbolic math capabilities open new possibilities for your students. They can create expressions on the calculator, then evaluate them symbolically....
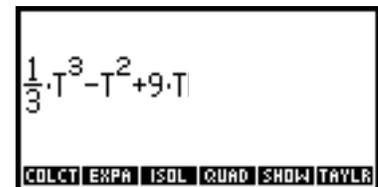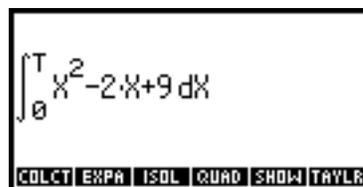
Calculators that Expand with Your Horizons
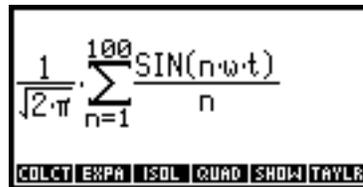
You can add up to 1 MB of RAM to the HP 48GX—or customize it with plug-in application cards. It can grow with you—you'll never need another calculator!

Even the HP 48G and HP 48G+ offer expandability via data transfer—and you don't even need cables to use the built-in infrared I/O! Just send and receive files via the HP 48 infrared port—to another HP 48 or to the optional HP infrared printer. And for longer-term storage and exchange, the built-in serial port makes sharing just as easy: with the Connectivity Kit accessories, you can link your HP 48 to your Macintosh or DOS computer via RS-232 for file exchange, program storage, and program development.

(Please see page 27 for Bid Specifications for the HP 48G Series Graphic Calculators.)

HP GRAPHIC CALCULATORS
FEATURES SUMMARY

Product Name	HP 38G	HP 48G Series
Display	8 line × 22 char. LCD	8 line × 22 char. LCD
Entry system logic	Algebraic	RPN
Menus and softkeys	Yes	Yes
Prompts and alpha messages	Yes	Yes
Built-in RAM	32 KB	32 or 128 KB
Variables or registers	Unlimited within available memory	Unlimited within available memory
Built-in functions	Over 600	Over 2300
Redefineable keyboard and menu keys	Yes	Yes
+, -, ×, ÷, +/-, $\ln(x)$, e^x, y^x, $\log(x)$, 10^x	Yes	Yes
Square root, $1/x$, n!, x^2, %, **pi**	Yes	Yes
Fractions format	Yes	No
Trig., Hyperbolics, HP Solve (root finder)	Yes	Yes
Numeric integration	Yes	Yes
Complex numbers and functions	Yes	Yes
Statistical analysis	Multivariate/stat.	Multivariate/stat.
Σx, Σx^2, Σy, Σy^2, Σxy	Yes	Yes
Sample stand. dev./mean/weighted mean	Yes + population stand. dev.	Yes
Linear regression, comb./permutations	Yes	Yes
Curve fit (LIN, LOG, EXP, POW)	Yes	Yes
Normal, X, t, F distribution	No	Yes
Decimal hrs/hrs.min.sec. conversions	No	Yes
Polar/rectangular and angle conversions	Yes	Yes
Base conversions and arithmetic	No	Yes
Unit conversions	No	Yes
Bit/Boolean operations	No	Yes
Matrix operations, rectangular and polar	Yes	Yes
Matrix operations, cylindrical/spherical	No	Yes
HP MatrixWriter, row/column operations	Yes	Yes
ApLets	Yes	No
Notepad	Yes (built-in)	Yes (via variables)
Graphic functions/interactive graphics	2D	2D, 3D
Programming	Yes	Yes (RPL)
Number of formulas/programs	Unlimited within available memory	Unlimited within available memory
Optional infra-red printer (HP 82240B)	Yes	Yes
Computer link	Yes	Yes
Two-way infra-red I/O	Yes	Yes
Batteries	3 x AAA	3 x AAA
Warranty	One-year warranty	One-year warranty

In addition, the HP 48G Series calculators all offer symbolic algebra (quadratic and polynomial); symbolic calculus (integration and differentiation); symbolic constants; business features; and a built-in Solve Equation Library. The HP 48GX also has expansion capabilities of 2 slots for multiple applications or up to 1.25 MB of memory.

HP GRAPHIC CALCULATORS
BID SPECIFICATIONS

HP 38G.

- 8-line x 22-character display
- Advanced functions access via pop-up display windows
- 15-digit calculation accuracy, displayed with up to 12 digits plus a 3-digit exponent
- Graph rectangular functions, parametric and polar expressions, and recursively-defined sequences
- Up to 10 graphing functions defined, saved, graphed and analyzed simultaneously
- Up to 10 functions traceable on a single graph
- ApLets (small electronic lesson packets); ApLets limited only by available memory
- 15 interactive zoom features accessible from display
- Sequence graphing mode shows both time series and cobweb/stairstep plot

- Numeric evaluation of functions in table format
- Interactive function analysis: values, roots, maxima and minima, integrals, derivatives
- Presents mathematical solutions in multiple views
- Split-screen capability displays 2 screens side-by-side for dynamic comparison
- HP Equation Solver
- Notes and pictures feature
- Matrix operations: inverse, determinant, transpose, augment, eigenvectors, and elementary row operations
- 10 matrices; sizes limited only to available memory
- List-based 1- and 2- variable statistics; regression models: linear, log, power, exponential, quadratic, cubic, logistic
- Box and whisker plots

- Histograms, scatter plots, regression equation graphs
- Programs; quantities limited only by available memory
- Dynamic results history stack at HOME screen
- Symbolic tools: variable isolation, substitution, quadratic solving, Taylor series
- Polynomial root finding
- Complex numbers
- 32 KB memory
- Data transfer with built-in IR (infrared) and serial port
- Connects to overhead projector accessory
- IR printer accessory
- Connectivity accessory kits for IBM-PC or Macintosh
- Powered by 3 AAA batteries
- Sturdy sliding hard case
- 1-year warranty

HP 48G Series

- Built-in RAM: 32KB on 48G; 128KB on 48G+ and 48GX
- 131 x 64 dot display
- 12-digit values; 3-digit exponents
- HP EquationWriter for formatted equation entry
- Multiple plots on single graph; limited only by available memory
- Quadratic and polynomial root finder
- Symbolic and numeric integration and differentiation
- Differential equation solver
- Real and complex matrices; sizes limited only by available memory

- Object-oriented programming language; structures include CASE, DO, FOR, IF, UNTIL, and WHILE; program sizes and numbers limited only by available memory
- Infrared I/O; wireless transfer of instructor data to students
- Dialog-box function access
- Graphing: function, conics, polar, parametric, truth, differential equation, bar, histogram, scatter plots
- Graphic controls: zoom, box Z, tracing, shading, spacing, axis tick marks, scrolling
- Matrix operations: inverse, transpose, determinant, row operations, and row-to-column conversions

- Statistical capabilities: standard deviation, mean, linear regression, combinations, permutations, weighted means
- Keys can be assigned new functions or programs
- Serial-wired Mac/PC interface
- Calculator size: 8.1 x 18.0 x 2.9 cm (3.2 x 7.1 x 1.2 inches)
- Calculator weight: 264 g (0.58 lb)
- 1-year warranty
- HP 48GX has two expansion ports, allowing plug-in application or RAM memory accessory cards

ACCESSORIES FOR HP
GRAPHIC CALCULATORS

Connectivity

Share your computer's peripherals with your HP 38G and HP 48G/G+/GX—and protect your calculator data and programs by storing them to your computer's disk drive! The HP Connectivity Kit provides desktop computer cables and utilities (including programs compatible with Windows) for capturing HP 38G or HP 48G Series screen images, and for remotely controlling the HP 38G or HP 48G Series.

F1207B Serial Interface Kit, HP 38G/48G Series to DOS/Windows compatible PC's.
Program transfers files between calculator and PC: libraries, programs, grobs, data sets, or ApLets. Screen grabber utility captures/saves screen images from calculator.

HP 48G/G+/GX: Control your calculator memory remotely, from your PC. Includes an archive command to back up memory in one compressed file, and a simple file editor.
HP 38G: Control your file storage remotely, from your calculator.

Includes: 1.5-meter serial cable, 9-pin to 25-pin adapter, 4-pin to 10-pin connector, two 3.5-inch HD disks with PC software (Windows 3.1 and DOS 5.0 versions), User's Guide.
Requires: Open PC serial port (9-pin to 25-pin).

F1015A Serial Interface Cable, for IBM compatible PC's.

Includes: 1.5-meter serial cable, 4-pin to 10-pin connector.

F1023A Serial Cable Adapter Kit, for IBM compatible PC's.

Includes: 9-pin to 25-pin serial modem adapter, 9-pin to 25-pin serial PC adapter, 9-pin to 25-pin serial printer adapter, 9-pin to 9-pin null modem adapter.

F1208B Serial Interface Kit, for HP 38G/HP 48G Series to Macintosh Computer.
Program transfers files between calculator and Mac: libraries, programs, grobs, data sets, or ApLets. Screen grabber utility captures/saves screen images from calculator.

HP 48G/G+/GX: Control your calculator memory remotely, from your Mac. Includes archive command to back up memory in one compressed file, and a simple file editor.
HP 38G: Control your file storage remotely, from your calculator.

Includes: 1.5-meter serial cable, 4-pin to 10-pin connector, 3.5-inch disk with Macintosh software, User's Guide.
Requires: Open PC serial port (9-pin to 25-pin).

F1016A Serial Interface Cable, for Macintosh computers.

Includes: 1.5-meter serial cable, 4-pin to 10-pin connector.

Printing

The battery-powered infrared printer is a revolutionary companion for your HP graphic calculator. Because it operates with an invisible infrared beam, no cord is necessary to connect it to the calculator. Producing hard copies in the field or in your office couldn't be easier! And this improved version offers easier-to-read output and automatic shutoff for extended battery life.

Operation of the infrared printer is easy, too. Simply aim your calculator at the printer (from up to 18 inches away), send print instructions, and you get a neat, clean copy of your calculations. You can print a complete record of your work, or select and print only what you need.

Just four AA alkaline batteries give the infrared printer go-anywhere portability. Or, to extend battery life, plug in the optional AC/DC adapter.

HP 82240B HP Infrared Printer

> Includes: Infrared printer, four AA alkaline batteries, one roll of printer paper and User's Guide.

HP 82175A Thermal Paper, for the HP 82240B and HP 82240A Infrared Printers**.**

> Includes: 6 rolls, 2 1/4" x 80" (5.7 cm x 25 cm), black.

Memory Cards

Take advantage of additional RAM! Develop large programs and store more data in your HP 48GX. Choose the memory configuration you need. Add to the main memory or use the plug-in card as an electronic disk. You save your information even when you unplug the RAM card from the HP 48GX! Each card is powered by its own long-lasting battery.

HP 82215A 128 KB Battery-backed RAM Card, for the HP 48GX.

> Includes: 128 KB battery-backed RAM card, CR2016 battery, installation card.

HP 82216A 1 MB Battery-backed RAM Card, for the HP 48GX, Independent Memory Only.

> Includes: 1 MB battery backed RAM Card, CR2016 battery, installation card.

Other Calculator Accessories

There is also plenty of concise information in book form available for the HP 48G Series calculators—either replacement Owner's Manuals or extended help with programming and other advanced topics.

00048-90136 HP 48G Series Advanced User's Reference Manual

> Includes: Programming Techniques; Programming Examples; Comprehensive Command Reference; Equation Reference; Table of System Messages; Table of Units; Table of System Flags and Table of Reserved Variables.

00048-90126 HP 48G Series Replacement Owner's Manual and Quick Start Guide

82221-60001 Soft Case, replacement case for HP 48 Series.

National retailers and distributors

Azerty...check local area listings
Best Buy (HP 38G only)...check local area listings
Boise Cascade...check local area listings
Circuit City...check local area listings
Corporate Express...check local area listings
D&H Distributors...800-877-1200
Douglas Stewart Co....800-279-2795
El Dorado Trading Co....800-227-8292
Fry's Electronics...408-487-1000
J&R Computer World...800-221-8180
NEAMCO...check local area listings
Nobody Beats the Wiz...800-846-NBTW
Office Depot (no HP 38G)...800-685-8800
OfficeMax (HP 48G only)...800-788-8080
Service Merchandise...800-251-1212
Staples (HP 48G only)...800-333-3330
United Stationers...check local area listings

Local and independent retailers

Auburn University Bookstore...1360 Haley Center...Auburn, AL 36849...334-844-1354
Off Campus College Bookstore...1020 Henderson Rd....Huntsville, AL 35816...205-837-9529
University Supply...P.O. Box 870291...Tuscaloosa, AL 35487...205-348-6168

Alaska
Lewis & Lewis Computer Store...611 Fairbank St....Anchorage, AK 99501...907-277-9432
Alaska Pacific Univ. Bookstore...4101 Univ. Dr....Anchorage, AK 99608-4625...907-564-8218
University of Alaska...2905 Providence Dr....Anchorage, AK 99508-4630...907-786-4759
University of Alaska...PO Box 750127...Fairbanks, AK 99775-0001...907-474-7348

Arizona
Computer Physicians Unlimited...10211 N. 60th Dr....Glendale, AZ 85302-1255
Arizona State University Bookstore...Tempe, AZ 86287-0310...602-965-7928
Arizona Bookstore...815 N. Park Ave....Tucson, AZ 85719...520-622-4717
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ASUC Store...Bancroft at Telegraph...Berkeley, CA 94720...510-642-7010
Associated Students Bookstore...Chico, CA 95929-0001
Off Campus Bookstore...236 A St....Davis, CA 95616...916-758-2665
UC Davis Bookstore...Davis, CA 95616...916-752-5907
Kennel Bookstore...Fresno, CA 93740-0022...209-278-4062
UCI Bookstore...Irvine, CA 92717-1550...714-824-7877
UCSD Bookstore...Mail Code 0008...La Jolla, CA 92093-0008...619-534-7095
Forty Niner Shops, Inc....6049 E. 7th St....Long Beach, CA 90840-0001...562-985-7704
UCLA Student's Store...308 Westwood Blvd....Los Angeles, CA 90024-8311...310-206-0825
University Bookstore...840 Childs Way...Los Angeles, CA 90089-0009...213-740-8993
Matador Bookstore...18111 Nordhoff St....Northridge, CA 91330-0001
Titan Shops...2875 Orange-Olive Rd....Orange, CA 92665
Bronco Bookstore...CA St Ply U Building 66...Pomona, CA 91768-2557...909-869-3274
Golden State Business Systems...1787 Tribute Rd., Ste. E...Sacramento, CA 95815...916-922-9221
Hornet Bookstore...6000 J St....Sacramento, CA 95819-2605...916-278-7297
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USD Bookstore...5998 Alcala Park...San Diego, CA 92110...619-260-4551
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Spartan Bookstore...San Jose, CA 95112...408-924-1817
El Corral Bookstore...San Luis Obispo, CA 93407...805-756-1101
UCSB Bookstore...University Center...Santa Barbara, CA 93107-3400...805-893-8579

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Mawson Computer...3343 Industrial Dr., Ste. 1...Santa Rosa, CA 95403...707-528-2841

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Florida
University of Miami Bookstore...University Center...Coral Gables, FL 33124...305-284-3592
ERAU Bookstore...Embry-Riddle Aeronautical Univ....Daytona Beach, FL 32114...904-226-6062
Florida Bookstore & Computer Ctr....1614 W. Univ. Ave...Gainesville, FL 32604...904-376-5606
Mr. Data...3206 S.W. 35th Blvd....Gainesville, FL 32608...904-335-9616
University Book & Supply...1227 W. University Ave....Gainesville, FL 32601...904-377-1788
University of Florida Bookstore...Stadium Rd.-Hub...Gainesville, FL 32611-2011...904-392-0194
International Calculator...2916 Corrine Dr....Orlando, FL 32803...407-898-0081
Univ. of Cent. Florida Comp. Store...4000 C. Florida Blvd....Orlando, FL 32816...407-823-0145
University Bookstore...P.O. Box 25001...Orlando, FL 32816-0444...407-823-3028
Mayes Printing & Office Supply...6120 Pensacola Blvd....Pensacola, FL 32589...904-477-1111
Florida State Univ. Store...New Union Bldg. #0127...Tallahassee, FL 32306...904-644-2072
Univ. of South Florida Bookstore...4202 Fowler Ave....Tampa, FL 33620-6550...813-974-0523

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Allen Precision Equipment...3427 Oakcliff Rd....Atlanta, GA 30340...800-241-6223
Engineers Bookstore...748 Marietta St., N.W....Atlanta, GA 30318...404-221-1669
Georgia Tech Bookstore...Atlanta, GA 30332-0001...404-894-2513
Allen Precision Equipment, Inc....1550 Boggs Rd....Duluth, GA 30136...770-458-8885
Southern Tech Bookstore...Marietta, GA 30060-2896...770-528-7355
A. Baldwin Ag. College Bookstore...2802 Moore Hwy....Tifton, GA 31793-0016...912-386-3226

Hawaii
Univ. of Hawaii Bookstore...2465 Campus Rd....Honolulu, HI 96822-2216...808-956-6612

Idaho
Oregon Digital...5511 Kendall St....Boise, ID 83706...208-377-1521
University of Idaho Bookstore...Moscow, ID 83843...208-885-6469
Ricks College Bookstore...Manwaring Center 116...Rexburg, ID 83460-2211...208-356-2211

Illinois
Illini Union Bookstore...715 S. Wright St....Champaign, IL 61820...217-333-2050
Follett College Store...627 S. Wright St....Champaign, IL 61820-5709...217-356-1368
TIS Bookstore...707 South 6th St....Champaign, IL 61820-5716...217-337-4900
Follett's Commons...3200 S. Wabash Ave....Chicago 60616-3821...312-791-0770
Student Book Exchange, Inc....1737 Sherman Ave....Evanston, IL 60201-3712...847-328-2717
The Alamo II...319 North St....Normal, IL 61761-8100...309-452-7400
Book Center in the Illini Union...Urbana, IL 61801-2917...217-244-3743
The Write Stuff, Inc....1 S. 781 Country Club...Wheaton, IL 60564-5646...708-871-8545

Indiana
Purdue Bookstore...Library Building...Hammond, IN 46323-2051...219-844-1081
Follett's Purdue West...1400 W. State St....West Lafayette, IN 47906-3405...765-743-9642
University Book Store...360 State St....West Lafayette, IN 47906...765-743-9618

Iowa
Campus Bookstore...2300 Lincoln Way...Ames, IA 50010...515-292-1616
Iowa Book & Supply Co....Box 2030...Iowa City, IA 52240-3912...319-337-4188
University Bookstore...Iowa Memorial Union...Iowa City, IA 52242...319-335-3179

Kansas
Kansas Union Bookstore...Jayhawk Blvd....Lawrence, KS 66045-0501...913-864-4640
University Book Shop...1116 W. 23rd St....Lawrence, KS 66045...913-749-5209
K-State Union Bookstore...Manhattan, KS 66506-2809...913-532-6583
University Book Store...623 N. Manhattan...Manhattan, KS 66502-5333...913-539-0511

Kentucky
University Book Store...106 Student Center...Lexington, KY 40506-0001...606-257-6304

Louisiana
Louisiana State Univ. Bookstore...110 Union Bldg....Baton Rouge, LA 70893...504-388-5137
University Bookstore...P.O. Box 41209 USL...Lafayette, LA 70504-1209...318-482-6922
Computer Store of Louisiana...1440 Canal Street...New Orleans, LA 70112...504-486-9055

Maine
Maine Surveyors Supply...28 U.S. Route 1...Yarmouth, ME 04096...207-846-5143

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U.S. Naval Academy Store...101 Wilson Rd....Annapolis, MD 21402-5081

Massachusetts

Maryland Book Exchange...4500 College Ave....College Park, MD 27040-3326...301-927-2510
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MIT Comp. Connection...84 Mass. Ave., Rm. W20-021...Cambridge, MA 02139...617-253-7241
Central Street Assoc., Inc....18 Kenneth Terr....Stoneham, MA 02180...781-438-8622
Worcester Polytechnic Institute...Daniel Hall...Worcester, MA 01609...508-831-5247

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Ulrich's...549 E. University Ave....Ann Arbor, MI 48104...313-662-3201
Lundberg Bookstore...Rankin Ctr....805 Campus Dr....Big Rapids, MI 49307...616-592-2607
Instrument Sales & Service...24037 Acacia...Bretford, MI 48239...313-535-5252
Gibson's Tech. Bookstore...128 W. Grand River Ave....East Lansing, MI 48823...517-332-8681
MSU Bookstore...East Lansing, MI 48824-1035...517-355-3450
Mott College Store...1401 E. Court St....Flint, MI 48502...810-762-0232
Michigan Surveyors Supply...4655 Willoughby...Holt, MI 48842-2162...517-694-4600
Michigan Tech Bookstore...1503 College Ave....Houghton, MI 49931-1295...906-487-2410
Western Michigan University...Bernhard Center...Kalamazoo, MI 49008...616-387-3930
SSI Solutions, Inc....Westland, MI 48185

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Office Products of Minnesota...7794 Bush Lake Rd....Minneapolis, MN 55439...612-835-6776
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Mississippi

Miss. State Univ. Bookstore...Colvard Student Union...Miss. State, MS 39762-5568...601-325-1576

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Rolla Bookstore...788 University Center, W....Rolla, MO 65401...314-341-4705
Washington University Bookstore...One Brookings Dr....St. Louis, MO 63130...314-935-5500
University Store...University Union 128...Warrensburg, MO 64093...816-543-4801

Montana

MSU Bookstore...185 Student Union...Bozeman, MT 59717-0020...406-994-5836
Montana Tech Bookstore...W. Park St....Butte, MT 59701...406-496-4190

Nebraska

CRC Computer Store...501 N. 10th St., Rm. 123...Lincoln, NE 68588-0200...402-472-8444
Nebraska Bookstore...1300 Q St....Lincoln, NE 68508...402-476-0111

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A.S.U.N. Bookstore...Reno, NV 89507-8049...702-784-6597

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New Jersey Inst. of Technology...150 Bleeker St....Newark, NJ 07103-3902...973-596-3200
Princeton University Store...36 University Place...Princeton, NJ 08540-5116...609-921-8500

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New Mexico State Univ. Bookstore...Corbett Center...Las Cruces, NM 88001...505-646-4431

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ITS Product Center...Rensselaer Polytechnic Institute...Troy, NY 12180-3590...518-276-8164
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Southern Photo & Supply...734 Chapel Hill Rd....Burlington, NC 27215...910-227-3477
Duke University Stores...PO Box 90850...Durham, NC 27708...919-684-2344

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Southern Photo & Supply...314 E. Russell St....Fayetteville, NC 28301...919-483-4909
NC A&T Bookstore...Brown Hall...Greensboro, NC 27411-0001...910-334-7593
Southern Photo & Supply...340 N. Wrenn St....High Point, NC 27260...919-882-3127
Addam's Univ. Bookstore...2109 Avent Ferry Rd....Raleigh, NC 27606-2137...919-832-9938
DJ's Textbooks...2416 Hillsborough St....Raleigh, NC 27607-7248...919-787-3512
NCSU Bookstore...Dunn Ave....Raleigh, NC 27695-0001...919-515-2161

North Dakota
Varsity Mart...PO Box 5476...Fargo, ND 58105-7761
Univ. of N. Dakota...Univ. Station, Campus Dr....Grand Forks, ND 58202...701-777-2681

Ohio
Safe Technologies Corp....4131 State Park Dr....Akron, OH 44319...800-638-9121
College Book Store...50 S. Court St....Athens, OH 45701...614-594-3505
Univ. of Cincinnati Bkstr....123 W. Univ. Ave., ML 217...Cincinnati, OH 45221-0001...513-556-1900
Long's College Book Co....1836 N. High St....Columbus, OH 43201-1146...614-294-4674
Ohio State Univ. Bookstore...2009 Millikin Rd....Columbus, OH 43210...614-292-2991
Case Western Reserve University...11111 Euclid Ave...Cleveland, OH 44106...216-368-2650
University Bookstore...Thwing Center...Cleveland, OH 44106-1715...216-368-2650

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OU Computer Store...Norman, OK 73019...405-325-1925
Union Bookstore...900 Asp...Norman, OK 73019-0001...405-325-2171
Applied Computer Systems...2726 Classen...Oklahoma City, OK 73106...405-524-6852
Cowboy Books, Ltd....109 N. Knoblock...Stillwater, OK 74074...405-743-1383
Smith's Bookstore...301 S. Washington...Stillwater, OK 74074-3332
Copier and Computer Systems...6136 E St....Tulsa, OK 74135...918-622-0612

Oregon
Calculating Edge...899 N.W. Grant Ave....Corvallis, OR 97330...800-677-7001
Corvallis System Sales Corp....800 N.W. Starker, Ste. 35...Corvallis, OR 97330...541-752-4419
OSU Bookstore...2301 S.W. Jefferson...Corvallis, OR 97331...541-737-4323
University of Oregon Bookstore...895 E. 19th Ave....Eugene, OR 97401...541-346-4331
Paper Owl Bookstore...3201 Campus Dr....Klamath Falls, OR 97601...541-885-1050
Portland Comm. Coll. Bookstore...1200 S.W. 49th Ave....Portland, OR 97219...503-977-4910
Power Source − PSU Bookstore...626 S.W. College...Portland, OR 97201...503-295-1130
Chemeketa Comm. College Bookstore...P.O. Box 14007...Salem, OR 97309-7070...503-399-5131

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Lehigh Univ. Bookstore...Maginnes Hall, Bldg. 9...Bethlehem, PA 18015-3073...610-758-3376
Drexel University Store...33rd & Chestnut St....Philadelphia, PA 19104...215-895-2855
Temple Univ. Bookstore...13th & Montgomery Ave....Philadelphia, PA 19122...215-204-7385
Univ. of Penn. Bookstore...3729 Locust Walk...Philadelphia, PA 19104-3610...215-898-7595
Carnegie Mellon Univ. Bookstr....Baker Hall, Schenley Pk....Pittsburgh, PA 15213...412-268-2966
Penn State Bookstore...Bookstore Bldg....University City, PA 16802...814-863-3250

Puerto Rico
Relojes y Calculadoras...Mayaguez Mall...Manaquer, PR 00680...787-834-5559
HP Only...Binero Avenue #1031...Puerto Nuevo, PR 00920...787-793-8033

Rhode Island
Brown University Bookstore...71244 Thayer St....Providence, RI 02912-0001...401-863-3216

South Carolina
J & J Electric...384-7 College Ave....Clemson, SC 29631...864-654-3663
Clemson Bookstore...P.O. Box 2096...Clemson, SC 29632-2096...864-656-2050
Student Off-Campus Bookstore...359 College Ave....Clemson, SC 29633...864-654-3000
Carolina's...629B Main...Columbia, SC 29201...803-799-7406
Follett's Addam's Univ. Bkstr....601 Main St....Columbia, SC 29201-4058...803-256-6666
Follett's Univ. Bookstore...The Russel House...Columbia, SC 29208-0001...803-777-4160

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Surveyors Module, Inc....412 Payne Ridge Rd....Church Hill, TN 37642...423-357-8931
Univ. Book & Supply...U.T. Center, Rm. 147...Knoxville, TN 37916-4800...423-974-1040

Texas
University Cooperative Society...2246 Guadalupe...Austin, TX 78705...512-476-7211
Professional Computing...505 Church St....College Station, TX 77640...409-846-5332
U Bookstores & Aggie...700 University Dr., E....College Station, TX 77840...409-846-4818
CompuCom Systems, Inc....9333 Forest Ln....Dallas, TX 75243...972-783-1252

Texas   **Holman's**...5776 N. Mesa...El Paso, TX 79936
Century Business Equipment...6810 Larkwood...Houston, TX 77074...713-777-2673
Rice Campus Store...6100 S. Main St....Houston, TX 77005...713-527-4052
Executive World...3312 Santa Ursula Ave....Laredo, TX 78040...956-722-6385
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Utah   **Utah State University Bookstore**...Logan, UT 84322...801-797-1667
Weber State University Bookstore...Ogden, UT 84408-2103...801-626-6352
BYU Bookstore...Provo, UT 84602...801-378-6808
University Bookstore...Salt Lake City, UT 84112...801-581-3582
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Virginia   **Tech Bookstore**...118 S. Maine St....Blacksburg, VA 24060...703-552-6444
Southern Photo & Supply...3813 Old Forest Rd....Lynchburg, VA 24502...804-385-6060
Washington   **Student Book Corp.**...N.E. 700 Thatuna...Pullman, WA 99163...509-332-2537
Univ. of Washington Bookstore...4326 University Way, N.E....Seattle, WA 98105...206-634-3400
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Wisconsin   **Weiherts Business Machines**...18050 Continental Dr....Brookfield, WI 53045-1203...414-782-0909
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Ace Electronics...1540 N. 68th St....Milwaukee, WI 53213-2806...414-771-8484
B J TV Service...3429 S. 13th St....Milwaukee, WI 53215-5011...414-643-8555
Blue & Koepsell, Inc....739 N. Mayfair Rd....Milwaukee, WI 53226-4281...414-476-5041
The H. H. West Co....P.O. Box 1570...Milwaukee, WI 53233-1570...414-344-1000
Tele-Port, Inc....7120 W. Good Hope Rd....Milwaukee, WI 53223-4611...414-358-1923
University of Wisconsin Bookstore...Milwaukee, WI
University Bookstore...Student Center...Platteville, WI 53818...608-342-1486

Alberta   **Univ. of Calgary Bookstore**...2500 University Dr., N.W.....Calgary T2N 1N4...403-220-4765
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FREQUENTLY ASKED QUESTIONS
ABOUT THE HP 38G

What calculus can I do with the HP 38G?

> Some instructors have written calculus ApLets (which will be available in the future), but even without ApLets, the HP 38G lets you study--either numerically or symbolically--derivatives, integrals, and Taylor polynomials.

Where can I find examples and information about writing my own ApLets?

> On the Internet, go to http://www.hp.com/calculators/products/hp38g_aplets.html.

Does the HP 38G handle any symbolic algebra?

> The HP 38G is more limited in this area than the HP 48G/GX, but it does offer symbolic features such as POLYFORM, which expands and simplifies polynomial expressions.

How can I trace along the FIT that I determine when working with a scatter plot?

> Set up the Statistics and Function ApLets identically. Draw the scatter plot, then store PREDY(X) into F1(X). Check only F1(X) in FUNCTION SYMBOLIC VIEW. (EVAL with F1(X) highlighted to see the fit.) Choose Overlay Plot via ▉VIEWS.

How do I print the current display of the HP 38G on my infrared printer?

> When viewing the display, hold down ⌑ON⌑ and press ⌑PLOT⌑. Align the printer's input port with the triangle atop the HP 38G—within 18". Press ⌑HOME⌑ and type PRVAR G0 ⌑ENTER⌑.

How do I get ApLets from the HP ApLets Library?

> On the Internet, go to http://www.hp.com/calculators/products/hp38g_aplets_lib.html. Select HP 38G ApLets Library and select your desired topics or ApLets.

> ApLets in the HP Library are compressed with pkzip, so after downloading, "unzip" the package. Files inside include a Word 6.0 file, a text file, and some files tagged with **.000** (e.g. **HP38GDIR.000** and **HP38GDIR.CUR**). (All ApLets contain the **HP38GDIR.000** file, so be careful not to overwrite this file by unzipping or copying other packages of ApLets into the same directory or folder.)

FREQUENTLY ASKED QUESTIONS
ABOUT THE HP 48G/GX

Sometimes my HP 48 will flash when I turn it on, or pause momentarily during a calculation. Is this normal?

Yes. The periodic pauses are to "tidy up" memory (more often as more memory is used).

What does the ⁽·⁾ annunciator indicate?

It signals a low battery or past-due alarm. To find out, turn the machine off, then on.

I'm not sure if the calculator is malfunctioning or if I'm doing something incorrect. How can I find out?

See page A-9 of your User's Guide, "Testing Calculator Operation."

How do I determine how much free memory my calculator currently has?

To find out, press ⟵ MEMORY MEM.

How do I change the format or number of decimal places displayed by the calculator?

Use → MODES or ⟵ MODES FMT. See page 4-2 of your User's Guide.

What does an E in a number mean?

It's scientific notation (e.g. 6.02E23 = 6.02×10^{23}).

I lost/broke my calculator's battery door, port cover, or rubber foot. How do I get a new one?

Call Calculating Edge at 888-338-2252.

What replacement batteries should I get for my calculator?

Use three size AAA, all of the same brand. NiCad batteries are not recommended, due to their low capacity and short warning time. See also page A-5 of your User's Guide.

How do I adjust the display to be easier to read?

While holding the ON down, press + or – repeatedly.

My calculator is "locking" up or behaving strangely. How can I check and/or correct this?

See "Special Memory Operations" on page 5-16 of the User's Guide.

Why can't I find the variable(s) I stored?

You're now in a different directory than where you stored the variable(s).

Why am I getting wrong results with trig functions?

Check the angle mode. For example, if you see the annunciator RAD or GRAD, the machine is not using degrees. Use ⟵ RAD or the → MODES menu to adjust accordingly.

Why don't I get 0 when I take the sine of pi?

If you get $'SIN(\pi)'$, the calculator is in Symbolic Results mode (i.e. Flag -3 is clear) but not in RADians mode. Set RADians mode (via ←RAD), then use either ←→NUM or EVAL. EVAL will return the trig identity, 0, if Flag -2 (Symbolic Constants) is also clear. Otherwise, EVAL behaves like ←→NUM, which never returns 0, because it does its calculation on a 12-digit approximation of π, 3.14159265359. (No machine uses a numerically exact value of π; it has an infinite number of digits.) And the sine of 3.14159265359 radians is simply not zero. For similar reasons, pressing 2 √x ← x² on the HP 48 doesn't return 2.

Why am I getting an Undefined Name error when integrating or differentiating?

The machine is in Numeric Results mode (Flag -3 is set) but it is encountering symbolic arguments. Either change the flag or numerically define the arguments.

Why do I get a complex number when I evaluate $'(-1)^{\wedge}(2/3)'$?

The machine returns a complex principal solution for expressions with fractional exponents. To get a real-valued result to the above, use $'XROOT(3, (-1)^{\wedge}2)'$ (or its keyboard equivalent: 1 +/− ← x² 3 → x√y).

Why am I getting an error message such as Too Few Arguments or Bad Argument Type?

The command you attempted needs more or different-type arguments than what it currently finds on the stack. (See also Appendix B in your User's Guide.)

How do turn off the HALT annunciator?

Use KILL: PRG NXT ▓RUN▓ ▓KILL▓.

My machine seems to gradually slow down. Why?

It may need to clean up fragmented sections of memory. To do a cleanup, while holding down ON, press and release C. (This clears both the stack and PICT.)

Why am I getting mixed units in the Equation Library Solver even though I have specified ENG or SI?

The Solver creates only variables not already present in the current directory; the already-present variables may have unintended units. For unit consistency, first select your desired equation category in the Equation Library, press ▓VARS▓ NXT ▓PURG▓, then select your units.

Why

- If your calculator needs repair.

- If you don't understand something in the manuals.

- If you want to locate an HP retailer near you.

- If you want to learn more about HP products.

Where

- **Phone** North American technical support: **970-392-1001**

  Pre-sales product/dealer information: **800-752-0900**

- **Internet: www.hp.com/calculators**

When

- Phone: 8 am - 5 pm Pacific Time

- Internet: Anytime!

Educators! You have a dedicated Hewlett-Packard support center at:

The Math Learning Center (MLC)

P.O. Box 3226

Salem, OR 97302-0226

Phone: **800-750-8130** (8-5 PT M-F)

Fax: 503-370-7961

E-mail: hp@bbs.mlc.pdx.edu

YOUR TURN

Letters to the Editor

This page is dedicated to you—the reader. If you have any comments or questions about the content of **HP^C**, we'd like to hear from you. Whether it's a short note or a lengthy essay, here's where you can air your thoughts. Please send all letters to the editor and opinions regarding **HP^C** to:

Grapevine Publications, Inc.
Attention: Chris Coffin
P.O. Box 2449
Corvallis, OR   97339-2449

This issue marks a new look, a new name, and a new mission for **HP^C**. What do you think of the changes? Let us hear from you!

To Contribute Articles

Do you have material suitable for publication in **HP^C**? Have you developed lessons, ApLets, or other software or curriculum that you'd like to share with other educators? We'd like to make that possible. Please contact Dianne Hart by phone at 541-737-5177, or by e-mail at dkhart@math.orst.edu.

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Hewlett-Packard Educator Program
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