

Back to the future, with the company where it all started

Who Ya Gonna Call? Look Again to HP

By Chris Coffin

My grandfather was almost completely bald by the time he was 30. We grandkids would ask him why, and he'd always point out that "grass doesn't grow on a busy street." Sure enough, he was a busy man, self-employed for most of his life in a wide variety of ventures. He never stopped noticing needs and seeking ways to address them, making personal habits of inquiry and innovation—besides the everyday need to earn his keep. It made for a full and rich life. He was an interesting man, because he was an *interested* man.

The same is true of a few companies. They're busy, interesting, *interested*—in more than just making a buck. They care about how their products and work affect people's lives, and that concern shows in their consistent quality and constant innovation. The example I know best is the Hewlett-Packard Company, specifically their calculator products. Just look at what they've done to shape the past quarter century.

In 1972, HP brought to market the first handheld calculator—"the electronic slide rule." Throughout the 70's, they put the power of HP Solve, numerical integration and programming into the hands of a generation of engineers and scientists. In 1981, HP 41C calculators were aboard the Space Shuttle's first mission. In 1986, the HP 28S led the revolution in symbolic calculator math. In 1993, the HP 48SX's large graphical display gave students a huge new window on the world of math. 1995 saw the advent of HP ApLets—self-contained lessons—in the HP 38G. In 1999 so far, HP has already introduced the compact new models HP 6S and HP 6S Solar. And the year is still young...

Normally, I wear the editorial hat here, but I write this as an observer and fellow traveler in an information revolution now turning the corner on the millennium: If you're wondering where to look for the technology and learning products that will really matter in the years ahead, try the same company whose products have lead the way this far. Not much grass grows under them—or the students and professionals they empower.

Past laurels? It's not even in the HP vocabulary. Their very mission statement pledges constant improvement and value added—value to our productivity and to our understanding of this world. *You ain't seen nothin' yet.* So watch this space. If you've been a subscriber to **hpC** for awhile, you'll notice our new look this spring; we'll keep right on innovating, just like HP. If you've never subscribed, now would be a very good time. Your students will see math in action—and you'll see more history in the making.

For the learning products that will really matter in the years ahead, try the company who has lead the way this far....

Past laurels? It's not even in the HP vocabulary.... You ain't seen nothin' yet.

Math illiteracy no longer fashionable: the power of visual understanding

Classroom Reality Checks with the HP 38G

By Kevin Fitzpatrick

We all know the clichés: “One picture is worth a thousand words.” “Seeing is believing.” “Every picture tells a story.” But we repeat them because they’re true; we’re very visual beings. Beside mere words, we communicate also with gestures, expressions, body language, colors, clothing, movement and images. And apparently this is how we prefer to use our technology, too: movies, TV’s, VCR’s, DVD’s. Visual elements comprise much of the “multi” in “multi-media.” We all live in the “Show Me” state—a truly visual world.

Well, mostly we do. One exception for a very long time has been in the math classroom. Traditionally, even the most common math “stories” were told in symbolic language accessible (so the notion went) only to mathematical scribes. When average folks were asked about math, most, like Melville’s Bartleby, replied that they simply “preferred not to.” And this attitude is still a common badge of normalcy. Many a family will still proudly attest that they are “not a math family.” (Yet how reluctant they would be to admit being unable to read.)

As you know, a remedy is here: More mobile than laptops, cheaper than decent running shoes, graphing calculators tell real-life tales in pictures as well as symbols or numbers. What you may not know is how profound an impact this has on kids who thought they weren’t “math people.”

I teach a “last-ditch” graduation requirement math course for high school seniors—the same old lessons on fractions and decimals that these kids have struggled with for years. In 1995, I began to use HP 38G graphing calculators in that course, and suddenly everything changed: the students could see what I was talking about. Now they’re immersed in studies of loan amortization, lease-vs.-buy decisions, rebates, credit offers and interest comparisons. When they input the formulas I give them, they can see the effects of

variables. Rather than read loan payments from a chart, they see where the numbers come from and are amazed at how easy it is to explore options. Tracking graphs, following the numbers, they participate in the telling of the story.

In short, the students transform from passive observers to active learners. They build an ownership in the subject—and in their own growth. After all, what young person couldn’t benefit from a little more attention to variables (choices) and the visible results (consequences)? It’s an altogether better learning experience—and without a “Sage on the Stage” lecturer—to discover for oneself the relevance of math.

I began to use HP 38G graphing calculators, and suddenly everything changed.... “Show me what you mean” changed to “Let me show you what I found!”

It’s no surprise when upper level students benefit from technology like this, but it’s far more rewarding to see it happen for kids who thought that math just wasn’t for them. Such success builds confidence, opens minds, lifts horizons. Hey, if they can watch compound interest make their money grow, or find the impact angle that sends the ball off the bat and over the fence, *what else might math be good for?* It comes alive as their tool—their ally—as it describes and predicts real-world phenomena.

For a math teacher, it doesn’t get any better than this. The chance to see even a few “light bulbs” of connection go on over the heads of students is what keeps the juices flowing. We’re used to bemoaning TV as having raised a “video generation” with dull, passive learning skills, but the technology *can* cut the other way, too. It can pull students “off the couch” and into the learning process. Graphing calculators have surely done this with my students. Now, instead of asking me, “Show me what you mean,” they say, “Let me show you what I found!”

Kevin Fitzpatrick has been teaching Mathematics since 1976. Currently in his 15th year at Greenwich High School in Greenwich CT, he has been involved with graphing calculators since 1989, conducting numerous regional and national presentations, and he’s still excited about advances in technology for the classroom.

In cooperation with major school districts

Summer HP Sessions Slated in Ten Cities

Hewlett-Packard has announced their summer calculator workshops for 1999, to be held in ten major metropolitan areas, in association with local school districts:

Baltimore, MD

Boston, MA

Chicago, IL

El Paso, TX

San Jose, CA

Portland, OR

Toronto, ONT (Canada)

Los Angeles, CA

Denver, CO (Golden)

Milwaukee, WI

All educators throughout the U.S. and Canada are welcome. The specific dates, times and locations for these two-day workshops are now being arranged. Space is limited, so anyone interested in attending should contact the **Math Learning Center (MLC)** as soon as possible to register or ascertain more details.

The Math Learning Center (MLC)

Hewlett-Packard Educator Program

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A Student

Remembers When

calculators lead the revolution

By Whit Hickman

Looking Back

The alarm clock buzzes at 6 am. I set it just 2 hours earlier, but it's time to get up. I need to use the hour before class starts to do some final calculations on the lab due this day. My HP 41CV calculator sits ready on my desk. It is one of my closest friends—it has never let me down—and this first quiet hour is no exception.

I pack up my belongings for the day and head off to the computer lab. This is a good year for the computer, really. We now use keyboard entry—terminals—rather than card readers to input our data and programs. *(Odd, isn't it? This is a new feature and a big deal for a computer, while Hewlett-Packard has been building calculators with keypad entry for years!)*

I log into my computer account and put some finishing touches on the thermodynamics program I am writing. Then I send it to the debugger, and... *I wait...* Seems as if everyone else on campus is logged on this morning, too—it is getting close to the end of the quarter, come to think of it.

(Hmmm... if only the instructor had let me program this on my 41, I could have finished it by now—and in the comfort of my home. Just because a machine is small and hand-held doesn't mean it can't use sophisticated programming techniques. But this is a computer class, so I'm stuck waiting...)

My debugging session finishes barely in time to let me get to my first class of the day. Partial Differential Equations seems to be going well for me. I'm not a math major, but the instructor has done an excellent job of relating this stuff to the real world.

(Hmmm... I've got the Math Pac for my 41CV. I wonder why it doesn't cover this stuff? Doesn't matter, I guess—the instructors wouldn't allow it on exams anyway. Maybe one day

they'll figure out how great these calculators are and embrace them as teaching aids rather than resist them as "cheat machines." Some day, I guess....)

My second class of the day is a cruiser: I purposely put off taking a couple of general education classes earlier so that I could now use them to break up a difficult schedule. I feel

like a grizzled old veteran around all the frosh in these general ed classes. They seem to be more focused on finding the right date for the weekend and figuring out where the beer bust is going to be on Friday. Ah, it's a tough life!

(I, on the other hand, have an interview on Friday with a company that makes some product I really couldn't care less about—and then I'll be spending the weekend working on my Senior Project.)

Oops, day dreaming again! Oh well—the instructor is reading right from the textbook, as usual, so it shouldn't be too hard to catch up later.

(Speaking of later, I wonder what I have scheduled for the rest of the day—guess I'll take a look... My buddy has written a cool little program that runs on my 41CV. It lets me schedule my days and holds information up to a week in advance. I bet he could sell this program if he spiced it up a little. Sure beats carrying an appointment book!)

Well, now it's off to Vibrations class—a real "heavy" in my schedule. It's amazing how such a small book can contain such difficult curriculum. But I really do like the subject; it's great to see that all that math I took does have a real-life use. What a concept, math is more than just a bunch of numbers!

(And there sure are bunches of them, all right. I'm really glad I took the time to program in all the main equations before the quarter started. They're in the back of the book, but it

Odd, isn't it? Hot new features that are now big deals on computers have been standard on HP calculators for years.

sure is more convenient to have them in the calculator. I use that book enough without having to use it to look up stuff the calculator could store for me. The cover on the book is almost worn off as it is.)

Lunch comes and goes—a chance for me to refuel for a busy afternoon. The 4-hour Vibrations Lab is a lot of work for 1 lousy unit, but the school swears that applicable experience is a real benefit in finding a job. I think they just enjoy working us hard. But at least the lab is well equipped. It's outfitted with the latest Hewlett-Packard scientific equipment—pretty impressive stuff.

(Hmmm... HP seems to have a major share of that market too, but nobody seems to hold it against them. Interesting. Often the company with a large market share becomes a target to shoot at and gets a bad image. People do tend to root for the underdog, after all. But that's not true with HP. I guess their products are just too good. I know that I'd never bet against them—not after what they've done for me with their calculators!)



The day winds up with another evening in the library. Finals are approaching, my lab write-ups are due, and I guess I'd better be preparing for that interview, too, even if it doesn't really interest me. *(Sure wish I could work for a company that makes really great stuff—like my calculator here...)*

Looking Ahead

Well, I made it through college, and I actually look back fondly at those years. But I wouldn't want to go back, not after seeing where time has taken me.

The PDA has become a product on its own—no more time-management hacking in my calculator on the side! And Hewlett-Packard's scientific equipment business has been so successful that it's spun off to become its own company.

That good old HP 41CV blazed the trail for a host of HP calculators to come—and now they do symbolic manipulation, too! And educators and manufacturers have come together to figure out how to continue to improve and use the calculator as a learning tool.

Best of all, I got my wish! I landed that job with HP—still the company of innovation and expertise. And I can tell you that the revolution in learning technology isn't over—it's barely begun—and I'm thrilled to be right in the middle of it. I now work with college-level educators to build a better learning environment for their students and to take their input back to our developers.

It's a great way to say thanks to HP for helping me through my student years—and to pass on the favor. For no matter how times change, I know there is still an Engineering student out there, waking now, after too little sleep, to a full load of classes and a trusty, well-worn Hewlett-Packard calculator, ready for another day.

Whit Hickman is the Technical Sales Manager for Hewlett-Packard's Calculator Division. Sometimes he still doesn't get enough sleep, but that's because he enjoys his work.

Animating Plots

Taylor Polynomials on the HP 48G Series

By R. Staff

Prior to graphing calculators, it was sometimes difficult for students to visualize how well Taylor polynomials might approximate a particular curve. With the HP 48G Series calculators, you can take advantage of the ANIMATE feature to show how higher degree Taylor polynomials can give better approximations.

For $f(x) = \cos x$, do the five Taylor polynomials of orders 1, 3, 5, 7, and 9, about $x = 0$, produce increasingly better approximations? To find out, graph each polynomial and save it as a graphics object (“grob”) to compare via animation.



1. First, to calculate the Taylor polynomial for $f(x) = \cos x$ at $x = 0$, press $\left(\rightarrow\right)$ **SYMBOLIC**, then select **Taylor Poly...**, and set up the screen as shown here.

Press $\left[\text{OK}\right]$. The polynomial now appears on the stack. Save this polynomial in the variable **EQ** (type 'EQ' **STO**).

2. Next, $\left(\rightarrow\right)$ **PLOT** this polynomial as a **Function** (using default plot settings). While the graph is displayed, press **STO**, then **CANCEL CANCEL** to return to the stack, where you'll see **Graphic 131 × 64**. Now type 'T1' and press **STO**. The grob is now stored in the variable **T1**.
- 3... Repeat the above two steps for each of the four other polynomials, storing their grobs under the variables **T3**, **T5**, **T7**, and **T9**, respectively. You may also want to store the grob of $f(x) = \cos x$ and include it in the animation. (To do this, graph $y = \cos x$, then follow the above two steps, storing the grob under the name **CO**).

Note that you can easily display any stored grob individually. To do so, first press **VAR** and find and press the desired grob's storage name—say, $\left[\text{TE}\right]$. You'll see **Graphic 131 × 64**. Press **PRG**, then $\left[\text{PICT}\right]$ $\left[\text{PICT}\right]$, which will put the reserved name **PICT** onto the stack. Now just press **STO** to store the grob (now at level 2) as the current picture. Then $\left(\leftarrow\right)$ **PICTURE** will display it.

Now to animate your stored graphics for comparison, use the following small program. Type this in:

```

« T1 T3 T5 T7 T9
  { 5 { #0d #0d } 1 0}
  ANIMATE
»

```

(Note that you can use the **ANIMATE** menu item as a typing aid for **ANIMATE**, via **(PRG) [ANIMATE] (NXT)**.) After typing, press **(ENTER)** and store this program in the variable **TAYL**. (Type 'TAYL' and press **(STO)**.) To run it, simply press **(VAR)** and **TAYL**.... Voilà!

What's happening here? How does the **ANIMATE** command work?

ANIMATE takes a number of arguments from the stack (in this order):

- The grobs to be animated, in order (in this case, **T1 T3 T5 T7 T9**).
- The number of objects to be animated (in this case, **5**).
- The pixel coordinates, which is a list of two binary integers—that's the **#** notation—to indicate the area of the display to be animated. (In this case, you want to animate the entire display, indicated by **{ #0d #0d }**).
- The time lapse, in seconds, between successive “frames” (grobs) in the animation (in this case, **1** second).
- The number of times you want to cycle through the “frames.” (**0** means the program will run until you press **(CANCEL)** to halt it.)

So if you wanted to include your grob, **C0**, of the original function as one of the frames in your animation, you would modify the above program to look like this:

```

« T1 T3 T5 T7 T9 C0
  { 6 { #0d #0d } 1 0}
  ANIMATE
»

```

Of course, you don't have to use a program to use the **ANIMATE** command. You could just as well enter all the above arguments onto the stack and then execute **ANIMATE** by typing it in (or by selecting **ANIMATE** via **(PRG) [ANIMATE] (NXT)**). But notice that having all the arguments and the function itself all “pre-recorded” as a small program makes it much easier if you want to execute it repeatedly—no need to manually retype all those arguments onto the stack each time.

We don't know who created this lesson originally, but it has been a popular part of the summer workshop materials and seemed appropriate to include in this issue. We'd like to extend credit where credit is due, if someone would oblige us by identifying those responsible.

HP 48G/GX Slopefields

The Visual Pivot from Derivative to Integral

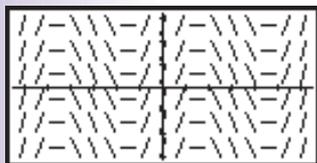
By G.T. Springer

The HP 48G Series slopefield plot offers various options for representing indefinite and definite integrals graphically. Such tools help students discover for themselves the relationship between differentiation and integration and deepen their understanding of the concepts via these visual, cognitive structures.



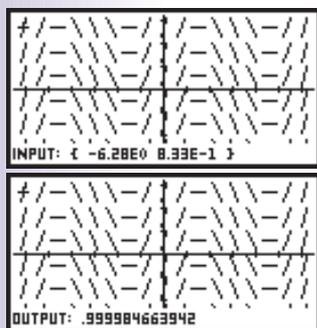
For simplicity, look at the slopefield produced by the function $f(x) = \sin x$. First, press \rightarrow PLOT. At the TYPE field, \rightarrow Slopefield. (Also, if your PLOT screen shows your calculator to be in Degree mode, \rightarrow Radian mode.) Now enter 'COS(X)' in the EQUATION field, then set the number of horizontal steps to 17 and the number of vertical steps to 6. At this point, your PLOT menu screen should look like the screen shown at left.

Press \rightarrow OPTS to set the domain and range for plotting as shown here. Press \rightarrow OK when you are finished, and the calculator will return to the PLOT menu screen.



Now press \rightarrow ERASE and \rightarrow DRAW to see the slopefield pictured here. (To see the graph without a menu line, press \rightarrow . Press \rightarrow again to get the menu back.) To trace over the slopefield, press both \rightarrow TRACE and \rightarrow CURSOR. (Pressing TRACE alone would allow you to trace over the slopefield graph, but the coordinates of the cursor would not be displayed.)

At this point, the cursor should be at the upper left-hand corner of the screen, as shown (and the menu labels are gone).



Besides its own menu label, the \rightarrow CURSOR key toggles between two other settings on the "menu-less screen." Press \rightarrow CURSOR a couple of times now to see how it can show you either INPUT or OUTPUT values, as shown in the two screens at left.

These data suggest that at $x = -2\pi$, the slope of the function we're looking for is $\cos(-2\pi) = 1$. With our current domain, \rightarrow and \rightarrow use an increment $\Delta x \approx \pi/4$. So, for example, at $x = 1.57E0$, the OUTPUT is 1.38456166253E-3—not quite 0.

Notice that you can move the tracer beyond the screen edge! The cursor remains at the edge, but the read-outs at the screen bottom show the tracing movement.

With the slopefield graphing available on the HP 48G Series, it may be beneficial for students to draw slopefields well before they study integrals instead of using them as an introduction to integrals. I teach this topic as soon as my students can comfortably estimate the graph of a function's derivative from the function's graph, since I can then present the graphing of a slopefield as simply an inversion of that process. I can also point out the big difference between these two skills: In graphical differentiation, the x - and y -coordinates are known and the slope is estimated to get an estimate of the derivative. In a slopefield, the x -coordinate and slope are known, but the y -coordinate is missing! Hence the general nature of the slopefield solution.

So, when do differential equations come in? I say that if we teach slopefields even before differentiation formulae, we can then show that a known initial condition "anchors" our function in its slopefield graphically—without resorting to any analytical skills. This creates a visual berth for the concepts of both indefinite and definite integration that will be invaluable when the numerical and analytical aspects are developed later. Of course, all this is a matter of sequence, not scope!

Continuing the example, suppose that you now wish to graph the solution to the differential equation $y'(x) = \cos x$, with the initial condition that $y(-2\pi) = 0$. Use **CANCEL** to return to the **PL**OT menu screen, highlight the **TYPE** field and **CH**OOSE **D**iff **E**q. Then set the main window and **OPTS** window as shown here, and use **OK** to accept the changes in the plot options.

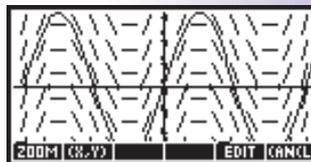
Now press **DRAW** to see the solution to your differential equation superimposed on your slopefield.... (Allow some time for the entire graph to emerge. Increasing the **TOL**erance in the **PL**OT **OPT**IONS window will increase the speed somewhat.)

Is the solution to your differential equation really $y = \sin x$? Use **CANCEL** to return to the **PL**OT screen, highlight **TYPE** and **CH**OOSE **F**unct **I**on. Now highlight **EQ** and enter **SIN(X)**, so that your **PL**OT menu screen appears as shown here. Press **DRAW** to see... *no visible change in the graphing screen.*

Note that, when appropriate (as in this case), you could also plot the function as an integral:

$$\int_{-2\pi}^x \cos(t) dt$$

To do this, use **CANCEL** to return to the **PL**OT menu screen, highlight the **EQ** field, press **NXT**, then **CALL** to go temporarily to the stack. Press **EQ** to go to the EquationWriter. Type the above integral (**→** **J** **+/-** **2** **←** **π** **▶** **α** **X** **▶** **COS** **α** **T** **▶** **α** **T**), then **ENTER** and **OK**. Now press **NXT** and **DRAW** to see again that there are no visible changes in the graphing screen.



Patterns in the Stars

Fascinating Polar Plots on the HP 38G

By Lori Niegel

This activity is based on "Seeing Stars in a Mathematical Microworld," an activity by Maggie Niess which appeared in the April 1992 edition of *The Computing Teacher*. She has her students make stars first by using string to connect toothpicks spaced evenly around a circle drawn on styrofoam. This helps them visualize how star patterns are made and see that the string can wrap either clockwise or counterclockwise. Students begin with 5 toothpicks spaced evenly around the circle. They can make a pentagon or a 5-pointed star (either clockwise or counterclockwise). Then they try a 10-pointed star, describing the procedure and central figure, noting the number of toothpicks they skip when wrapping the string. They continue likewise, trying stars with 4 points, 8 points, 7 points, etc., describing each star's construction, central figure, and possible variations in method and form (e.g., fat vs. skinny points). Sets of dotted circles on paper let them explore further.

- Suggested questions:
- Can you make a 3-pointed star? Why not?
 - Can you make a 9-pointed star? How many ways?
 - Can you make a 6-pointed star?
 - Can you make a 12-pointed star? How many ways?
 - Can you make an 11-pointed star? How many ways?
 - Can you make a 15-pointed star? How many ways?

After the toothpick activity, the students are ready to investigate stars on the HP 38G.



To begin, press **LIB** and select the **Polar** Aplet. Press **RESET**, **YES**, and **START** to see the **POLAR SYMBOLIC VIEW**. For **R1(θ)**, press **2****ENTER**. To set the angle measure to degrees, press **SETUP(SYMB)** and **MODE** **Degrees**. Then go to **SETUP(PLOT)** and set that window as shown here.

Next, press **PAGE** and set that window as shown here.

Now **PLOT**.... You'll get a star on your screen. How many points does it have? To find out, be sure **TRACE** mode is on (i.e. the menu looks like this: **TRACE**). Each time you press **▶**, the cursor moves to a new point; it will trace the points in the order that they were plotted. So note the point where you started, and just keep pressing **▶** and count the points until you return to the starting point.... Looks like this is an 18-pointed star, plotted counterclockwise.

The $\#STEP$ setting in the **POLAR PLOT SETUP** is an angle used in plotting the star's points. It determines the number of points in the star—but how, exactly? What must you specify for $\#STEP$ to get a star with a given number of points? Vary $\#STEP$, then **PLOT** to see the result. Try other values for $\#STEP$. (You may end up with stars with too many points to count, or stars that have not been completed.)

Try to find 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16, 17, and 18-pointed stars. See how many ways you can create them. Note, too, the $\#STEP$ values that produce regular polygons. Some of your stars may have “fat” or “skinny” points. Fill in this chart:

Points	$\#STEP$	Description
5	72	pentagon
6	144	_____
7	_____	_____
8	_____	_____
9	_____	_____
10	_____	_____
11	_____	_____
12	_____	_____
13	_____	_____
14	_____	_____
15	_____	_____
16	_____	_____
17	_____	_____
18	_____	_____

When you think you have enough information, try to answer the questions below. (When you think you have an answer, test it several times to be sure it will work.)

1. What $\#STEP$ will create an n -sided regular polygon?
2. What happens to the shape of the polygon as n gets very large?
3. What $\#STEP$ will create an n -pointed star? Is this possible for every n ? If not, when is it possible?
4. Can you make a 6-pointed star? Why or why not?
5. Can you make a 17-pointed star? Why or why not?
6. How could you make a star with a compass and a protractor? How does that compare to the way the calculator does it?
7. What happens when the $\#STEP$ is $360(2/n)$, where the fraction $2/n$ is not in lowest terms? What about when $2/n$ reduces to $1/2$? Explain why.

Answers

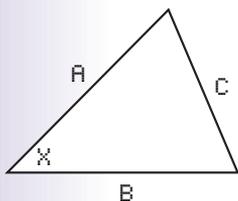
Points	$\#STEP$	Description
5	72	pentagon, ccw
5	144	star, ccw
5	216	star
6	60	hexagon, ccw
6	240	triangle
7	102.85	star, ccw, fat
8	45	octagon, ccw
8	135	star, ccw
8	225	star
9	80	star, fat, ccw
9	160	star, skinny, ccw
9	200	star, skinny
10	108	star, ccw, fat
10	152	star, ccw, skinny
:		
(etc.)		

1. $360(1/n)$.
2. It becomes a circle.
3. $\#STEP = 360k$ gives an n -pointed star, where k is any of the following fractions, if and only if this fraction is in lowest terms: $2/n$, $3/n$, ... $(n-2)/n$.
4. No, because $2/6$, $3/6$, and $4/6$ are the only possible fractions, and none are in lowest terms.
5. Yes. Different stars are possible since all possible fractions, $2/17$, $3/17$, ..., $15/17$, are in lowest terms.
6. (Answers will vary.)
7. When $2/n$ is not in lowest terms, a regular polygon with $n/2$ sides results, because $2/n = 1/(n/2)$, so that $\#STEP$ is $360(1/(n/2))$. When $n/2$ reduces to $1/2$, a straight line results, because $\#STEP$ is 180.

Triangle Solutions

Using the law of cosines on the HP 38G

By Jim McManus

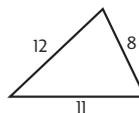


The triangle law of cosines states that $C^2 = A^2 + B^2 - 2AB\cos x$. This is great for solving triangles where you know 2 sides and an angle (SAS or SSA) or all 3 sides (SSS). Restated explicitly for C , the formula becomes $C = \sqrt{A^2 + B^2 - 2AB\cos x}$.

Enter both the above versions of the law of cosines into the HP 38G's Solve Aplet: Press **LIB**, highlight **Solve**, then press **RESET** **YES** **START**. Highlight **E1**: and type $C^2 = A^2 + B^2 - 2 * A * B * \cos(X)$ **OK**. Then highlight **E2**: and type it again in a slightly form: $\sqrt{A^2 + B^2 - 2 * A * B * \cos(X)} - C = 0$ **OK**. Now go back and highlight **E1**: check it (**CHK**), then set degrees mode (i.e. **SETUP** **SYMB**, **CHOS** **Degrees** and press **OK**). Finally, go to **SYMB**.

Example

Find the angles of this triangle.



Let C be the side of length 8 and find the angle, X , opposite to it. (C is always the side opposite the desired angle, X . It doesn't matter which sides you label A or B .) Press **NUM**, highlight C and enter 8. Input $A = 12$ and $B = 11$ similarly. Highlight the X field and input a guess, say, 70 : **70** **OK**. Highlight X again and press **SOLVE**. The calculator uses 70 as a guess and solves for the angle to fit the law of cosines. The solution is 40.415 . (Get in the habit of using **INFO**, which shows **Zero** for an exact solution and other stuff if no solution is found.)

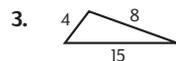
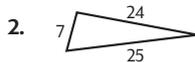
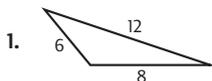
Find the angle opposite the side of 11 similarly: Use $C = 11$ $A = 8$ and $B = 12$, and a guess for angle X —say, 58 . Re-highlight the X field and **SOLVE** 63.056 is the desired angle; **INFO** confirms that it's a solution. Repeat the process again with $C = 12$ $A = 8$ $B = 11$ The third angle is 76.529 .

Can you trick the calculator into solving a "triangle" whose three sides don't actually form a triangle. Try $A = 2$ $B = 8$ $C = 14$. Input them and make a guess of 60 for angle X , then **SOLVE**.... Yes, the angle opposite side C is 180 —or is it? Press **INFO**.... It says **Extremum**, not **Zero**. In other words, "It can't be done!" And other impossibilities, such as values of 2 or 8 for C will give similar results.

Answers

- 26.384°, 117.280°, 36.336°
- 16.260°, 73.740°, 90°
- Not a triangle.

Find the angles of these triangles.



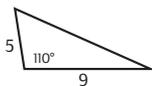
How do you tell if a triangle is truly a right triangle? The law of cosines can help—same process as before. Just let the longest side (the “hypotenuse”) be C . Then if X , the angle opposite this side, is 90° , it’s a right triangle.

4. A triangle has sides measuring 15, 8 and 17. Is it a right triangle?

Answers

4. Yes.

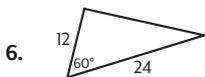
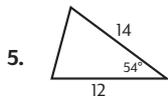
How do you solve a triangle like this SAS—where you know two sides and the included angle?



Again, the same law of cosines formula works. Just be sure that side C is opposite to angle X . Input the known values: $A: 5$ $B: 9$ $X: 110$, then a guess for C —say, 13. Press **NUM**, then re-highlight C and press **SOLVE** to get 11.695. **INFO** says Zero, so this is indeed a solution for side C .

Next, find the angle opposite the side of length 5. Now side C must be 5 (and thus side A is the 11.695). Making those changes and solving for X , you should get 23.689 . Again, **INFO** says Zero, so this is indeed a solution. And you can find the third angle similarly (46.317).

Find the missing angles of these triangles:

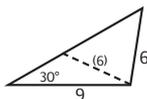


5. 11.938, 54.414° , 71.583°

6. 20.785, 30° , 90°

7. 193.273, 4.380° , 5.620°

What about an ambiguous SSA triangle like this—where the known angle is not included?

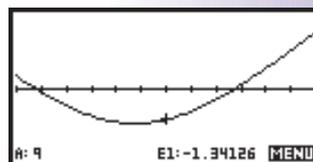


You can still use the same procedure. Input $C: 6$ $B: 9$ $X: 30$, and a guess at A (say, 12) and **SOLVE** for A 11.763 is the result. But try a guess of, say, 5 for A and **SOLVE** again.... You get 3.826! Which value is correct?

Maybe both are. You can find out for sure if there are two solutions by using the other form of the law of cosines you have stored to graph the possible values of A , given specific values for C , B and X : Press **SYMB**, highlight EE : and **WCHR**: it. Press **NUM** to confirm the values $C: 6$ $B: 9$ $X: 30$. Highlight A and press **SETUP****PLOT**. Knowing that the sum of any two triangle sides must be greater than the third, you can set the plot window accordingly, as shown here.

Now **PLOT** to see $\sqrt{A^2 + 9^2 - 2A \cdot 9 \cdot \cos 30^\circ} - 6$, plotted with A as the independent variable. Points where the graph intersects the horizontal axis represent solutions.

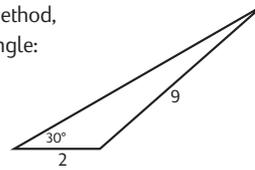
Once the graph is drawn, trace along the curve to where it intersects the horizontal axis and then press **NUM** **SOLVE**. The HP 38G uses the traced value as a guess and finds that solution. Go back to **PLOT** and trace similarly to the other intersection.



(continued on page 14)

(continued from page 13)

Practice your “graphical qualifier” method, using your EE equation, on this triangle:



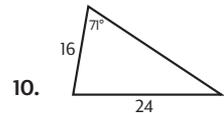
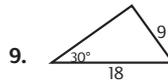
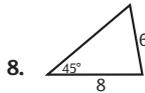
First, input the known values, $B=2$ $X=30$ $C=9$. Then highlight A and press SETUP PLOT . Set the FORMG : $\text{ABS}(C-B)$ $C+B$. Then press PLOT

There's only one intersection, side A (the unknown side) has only one possible length. Trace to the intersection and press NUM SOLVE . The result is 10.676. Now you can find the angles as before. (Don't forget to CHECK E1 : again.)

As a final exercise, solve the following triangles. Remember: There may or may not be more than one solution—and the drawings may be deceiving, so examine each carefully. Remember, too, that side C is always opposite angle X in your formula E1 : (and don't forget to CHECK the formula you need to use).

Answers

8. 3.657, 25.530° , 109.469°
or 7.657, 64.473° , 70.528°
9. 15.588, 60° , 90°
10. 23.841, 69.926° , 39.075°



Extension: Adding the law of sines will provide a method of solving triangles given 2 angles and 1 side (AAS).

Jim McManus teaches math at West Albany High School in Albany, Oregon. He is an HP calculator veteran, having used various HP calculators in his classroom for over ten years. He has also conducted workshops on the classroom uses of the HP 38G and HP 48 throughout the U.S. and in England, Singapore and Canada. Jim and his wife, Marti, and their two kids, Kinsey and Corey, live in the heart of the Willamette Valley in western Oregon.

The Costs of College

Box-and-Whisker Data on the HP 38G

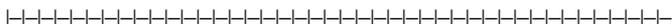
By Wade White

Turn your calculator on, press **(LIB)**, highlight **Statistics**, press **RESET** **YES** **START**. Input the expense data from the table (below right) into column **C1**. (You could also receive this data from another calculator, if it's available.) Be sure that **DATA** is displayed on the menu line. Press **(SYMB)**, and **DATA** **H1:C1** 1.

- Press **(NUM)**, **STATS**, and then **▼** down so that you can complete this table:

minimum	1st quartile	median	3rd quartile	maximum
_____	_____	_____	_____	_____

- Press **OK** to exit. Then press **SETUP** **(PLOT)** and set that window as shown (above right). Then **PAGE** and set that window as shown (right).
- Press **(PLOT)**, **MENU**, **TRACE** and **XXXX**. Use **▶** and **◀** to verify that the values in your table above match your calculator. Now draw an accurate box-and-whisker plot below, labeling the scale.



- In which fourth do values appear to be most concentrated?
- In which fourth do values appear to be most spread out?
- If there are outliers, where would you expect them to be?
- To check your answer to question 6, compare this box plot to a histogram. You can do this by using the **Overlay Plot**. After plotting the box-and-whisker plot above, press **SETUP** **(PLOT)** and change the **STATPLOT: BoxW** to **Hist**. Now press **(VIEWS)**, highlight **Overlay Plot**, and press **OK**. Sketch the resulting histogram on your graph of question 3, above, to indicate where the data are clustered, stacked, and spread. Be sure to label the vertical axis with a scale.



Basic Yearly Student Charges for Room, Board, and Tuition in Public Colleges, by State

(Source: College Scope, Citicorp.)

U.S. Avg. = \$4210 (figures rounded to nearest \$10)

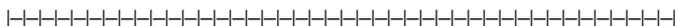
Rank	State	Expense	Rank	State	Expense
1.	AR	\$2980	26.	MA	\$4120
2.	SD	3110	27.	IN	4120
3.	OK	3210	28.	WV	4140
4.	ND	3240	29.	CO	4150
5.	NM	3270	30.	SC	4160
6.	MS	3300	31.	IA	4220
7.	NC	3350	32.	MN	4260
8.	NE	3360	33.	OR	4390
9.	AK	3400	34.	DE	4400
10.	ID	3450	35.	HI	4510
11.	TN	3480	36.	NH	4570
12.	AL	3510	37.	WA	4580
13.	KS	3720	38.	NY	4630
14.	TX	3740	39.	ME	4730
15.	KY	3760	40.	OH	4790
16.	LA	3780	41.	PA	4810
17.	GA	3870	42.	CA	4830
18.	WI	3940	43.	CT	4970
19.	WY	3960	44.	MI	5020
20.	MO	4000	45.	IL	5100
21.	MT	4020	46.	NJ	5340
22.	NV	4060	47.	MD	5600
23.	AZ	4060	48.	VA	5890
24.	UT	4070	49.	RI	6040
25.	FL	4090	50.	VT	6530

(continued on page 16)

(continued from page 15)

8. Use the **TRACE** feature to identify any possible outliers. Name the states and corresponding charges for the possible outliers.
9. Determine the actual outliers, if any, by using the following procedure. (If you choose to use your calculator, press **HOME**.)
 - a. What is the interquartile range (IQR)?
 - b. Multiply the IQR by 1.5.
 - c. Add this number to the 3rd quartile.
 - d. Subtract this number from the 2nd quartile.
 - e. Trace the histogram. Name the values that are greater than the value you found in **9c** or less than the value you found in **9d**.
 - f. Which states have college charges that are outliers?

Now make a new box plot to indicate which values are outliers. (Whiskers will stop at the largest or smallest values that are not outliers. Use a small **x** to represent outliers.)



10. If the outliers were decreased to fit within the top fourth of data, how would this affect the value of the median?
11. How would this affect the value of the mean?
12. Check that: Press **NUM**, make sure that **LOCK** is active, and press **STATS**. Record the current mean and median. Press **DEL**. Now change the two outlier values in **C:1** and press **STATS** again. How accurate were your answers to questions **10** and **11**?
13. Calculations that measure spread sometimes use the mean and sometimes the median. Why might it be better to use the median when outliers are present in the data?

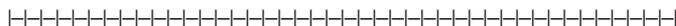
Suppose this is 1989, and you plan to enter college in two years. In that two years, inflation would make a difference in the charges listed. Suppose that you estimate the inflation rate to be 4.5% annually. You would then multiply each 1989 charge by 1.045 twice—once for each year of inflation. In other words, you multiply by $(1.045)^2$.

14. Why do you use 1.045 instead of 0.045 as the yearly inflation adjustment?
15. Be sure that C1 contains the original data for 1989. Then press **HOME** and type $C1 * 1.045^2$ **STO>** C2 **ENTER**. Press **NUM** to see that the new data was stored in C2. Press **SYMB** and **WCHS** H2: C2 1.

Now press **NUM**, **STATS** and **▼** down to compute this table:

minimum	1st quartile	median	3rd quartile	maximum
_____	_____	_____	_____	_____

16. Find the range and the interquartile range (IQR).
17. How were the original range and IQR affected by the inflation?
18. How was the scale factor involved in this change?
19. Suppose that a younger sibling will be entering college in four years (1993). Inflation-adjust the 1989 data for that scenario. (Store that adjusted data in C3.) Graph all three box and whisker plots on the grid below.



20. Describe the changes in the critical values, range, IQR, and overall spread with relation to the scale factors used.
21. What are some things to consider about college charges now and in the future? (You may want to have a group discussion before writing anything.)

Wade White wrote this activity for the HP 38G in 1995. At the time, he was on leave from teaching math at Central High School in Independence, OR, to be a full-time home parent for his two boys. Since that time, his interests evolved to elementary-age students. He now teaches first grade at Lyle Elementary School in Dallas, OR.

The easy way to integrate Hewlett-Packard calculators into the learning process? Try them for yourself! That's what the HP Educator Program is all about. Through HP's partnership with The Math Learning Center (MLC—see the contact information below), you 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 an evaluation request form. Soon HP will be offering entire classroom sets for your students to try, too—plus other special classroom equipment. Contact **MLC** for all details on this equipment loaner program.

Training Workshops

HP is committed to helping you get the most out of HP graphic calculators through its ongoing training program. For an up-to-date list of scheduled workshops on HP graphic calculators, contact **MLC** by phone, mail, e-mail or fax. Or, if the already-scheduled workshops don't fit into your calendar, 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

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

- Classroom posters for HP 38G or HP 48G series
- Overhead transparencies of all HP calculator keyboards
- Training guides/examples for the HP 38G and HP 48G series
- Additional copies of any issue of this newsletter—or a free subscription

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

The Math Learning Center (MLC)

Hewlett-Packard Educator Program, P.O. Box 3226, Salem, OR 97302-0226

Tel: 800.750.8130 (8-5 PT, M-F), Fax: 503.370.7961, E-mail: hp@bbs.mlc.pdx.edu

More Resources:

Books and Software

The books listed here address the use of HP Graphic calculators. (HP does not represent or endorse them.)

For these and other books, see your local bookseller or visit amazon.com online (and search with the keywords “HP 48G” or “HP 38G”).

Public-domain software is also available via links from HP’s web site at www.hp.com/calculators.

Algebra & Pre-Calculus on the HP 48G/GX

Dan Coffin; Grapevine Publications; ISBN 0-931011-43-4

Calculator Enhancement for Differential Equations

T.G. Proctor; Harcourt Brace Jovanovich; ISBN 0-155056-73-5

Calculator Enhancement for Linear Algebra

D.R. LaTorre; Harcourt Brace Jovanovich; ISBN 0-155056-74-3

Calculator Enhancement for Multivariable Calculus

J.A. Reneke; Harcourt Brace Jovanovich; ISBN 0-155056-78-1

Calculator Enhancement for Single-Variable Calculus

James Nicholson; Harcourt Brace Jovanovich; ISBN 0-155056-76-X

Calculus Activities for Graphic Calculators

Dennis Pence; PWS Publishing Co.; ISBN 0-534924-31-X

Calculus Concepts: Graphing Calculator Instruction Guide

Iris B. Fetta; DC Heath and Co.; ISBN 0-669398-69-1

Calculus Concepts: An Informal Approach to the Mathematics of Change

D.R. LaTorre, John W. Kenelly, Iris B. Fetta, Cynthia R. Harris, Laurel L. Carpenter; DC Heath and Co.; ISBN 0-669398-65-9

Calculus Investigations with the HP 48G/GX

D.R. LaTorre; Charles River Media, Inc.; ISBN 1-886801-18-5

Calculus of a Single Variable

Thomas P. Dick, Charles M. Patton; PWS Publ. Co.; ISBN 0-534939-36-8

Differential Equations using the HP 48G/GX

T.G. Proctor; Charles River Media, Inc.; ISBN 1-886801-19-3

An Easy Course in Using and Programming the HP 48G/GX

Chris Coffin; Grapevine Publications, Inc.; ISBN 0-931011-41-8

Experiments in Computational Matrix Algebra

David Hill; Random House/Birkhauser; ISBN 0-394356-78-0

Exploring Calculus with a Graphing Calculator

Charlene E. Beckman, Ted Sundstrom; Addison-Wesley Publishing Company; ISBN 0-201555-74-3

Graphing Calculator Laboratory Manual for Calculus

Charlene E. Beckman, Ted Sundstrom; Addison-Wesley Publishing Company; ISBN 0-201549-71-8

HP 48G/GX Investigations in Mathematics

D.R. LaTorre, Donald Krieder, T.G. Proctor; Charles River Media, Inc.; ISBN 1-886801-23-1

Linear Algebra Investigations with the HP 48G/GX

D.R. LaTorre; Charles River Media, Inc.; ISBN 1-886801-20-7

Mastering the HP 38G Graphics Calculator – A Guide for Students and Teachers

Colin Croft; Applications in Mathematics; ISBN 0-958691-72-X

Technology in Calculus

Thomas P. Dick, Charles M. Patton; PWS Publishing Co.; ISBN 0-534930-81-6

More Resources:

Purchase Incentives

What Can You Get?

When you and your students buy Hewlett-Packard calculators, you're on your way to earning free calculators and accessories through HP's Calculator Redemption Program, open to all educators throughout the U.S and Canada.

The program is based on a point system. When you buy 30, 60 or 90 HP graphic calculators, you earn points that you can redeem toward free calculator products and accessories.

For 25 Points	For 50 Points	For 100 Points
Connectivity Kit (for PC or Mac) or HP 38G or HP 48G	HP 48G+ or HP Infrared Printer (usable with the HP 38G, HP 48G Series, HP 17BII, and HP 19BII)	HP 48GX or HP Overhead Display Unit (usable with the HP 38G, HP 48SX and HP 48GX)

Notice that you can apply your redemption points flexibly—in whatever way works best for your program. For example, if you earn 100 points, you could apply it all to a single redemption from the 100-point column or, if you prefer, choose multiple redemptions from the 25- or 50-point columns.

How Do You Earn Points?

You can earn points whenever you or your students purchase HP graphic calculators, as follows:

Calculators Purchased	Calculator Type	
	HP 38G or HP 48G	HP 48G+ or HP 48GX
30	Earn 25 points	Earn 50 Points
60	Earn 50 points	Earn 100 Points
90	Earn 75 points	Earn 150 Points

**What Documentation
Do You Need?**

If you are a primary or secondary educator, just send the proof-of-purchase (UPC) codes from the ends of the boxes, along with a letter on your school stationery detailing the product(s) you want to receive. (Your position as an educator will be verified prior to fulfillment.)

If you are a college or university educator, just send a letter on your school's stationery that includes these three items:

1. A statement that HP graphic calculators are required or strongly recommended for your class (please indicate models);
2. A description of the classes for which the HP calculator is required or recommended;
3. An estimate of the number of students purchasing HP graphic calculators per term or semester.

(Only one request per department is eligible for each term or semester. Your position as an educator will be verified prior to fulfillment.)

Where Do You Apply?

Send your request and documentation to:

The Math Learning Center

Hewlett-Packard Educator Program
P.O. Box 3226
Salem, OR 97302-0226

Note that Hewlett-Packard Company reserves the right to change this program or discontinue it at any time and without notice. If you have any questions about the program, feel free to contact The Math Learning Center:

Call: 1-800-750-8130
E-mail: hp@bbs.mlc.pdx.edu

In Detail:

The HP 38G Graphic Calculator

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 ever with interactive, electronic lessons, called ApLets, that help students learn faster and get more from classroom and homework sessions. It's the future of calculator-based instruction: powerful, flexible, easy. And the HP 38G can connect to an overhead display unit, so students can see your keystrokes or share their own work!

Understanding comes more naturally to students, too, as the HP 38G lets them view expressions numerically, graphically and symbolically. The split-screen view lets them compare two views at once, helping them to build a stronger conceptual base; the HP 38G makes math make sense.

Easy Menus and Commands

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 for future use. Just move up the list and copy the information you want—it's point and shoot!

With easy-to-use menus, you get results fast. Pop-up menus offer commands 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, Lots of Power

The HP 38G offers over 200 easy-to-find commands 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; 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 necessary. ApLets are so natural to use that students will even begin to create their own to share with you and others.

It's easy to create ApLets! Once you 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 wireless infrared. (You 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 *you* prepared.



An ApLet (such as this one, written by G.T. Springer) is stored in the ApLet Library.



It can begin with a note....

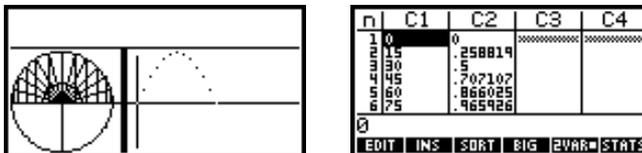


Students can then see a sketch of the problem...



and even customized views....

They can compare graphical and numeric views as they are generated.



And if they goof, they just start over—the original ApLet isn't altered until saved.

ApLets are created by teachers, publishers, and HP and are available on bulletin boards and on the Internet. (See page 38 for more information.)

Please turn to page 27 for Bid Specifications for the HP 38G Graphic Calculator.

In Detail:

The HP 48G Series Graphic Calculator

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.

Truly at the head of its class, the HP 48G Series of calculators offers 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, quite simply, the finest calculator for your education and career—period. With 128 KB of RAM built-in, plus the expandability of two plug-in ports for application cards or up to 1.25 MB of RAM, it's the most power you'll find in a calculator anywhere.

Power with No Equal

The power packed by the HP 48G Series is staggering. Graphics and calculus combine as in no other calculator. While you view 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 customized 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 is easy to use, even for beginners.

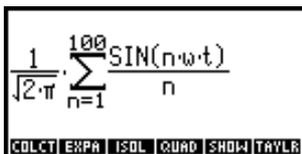


Look at the easy-to-use forms that speed up learning: each built-in application tool has an input form you just fill in.



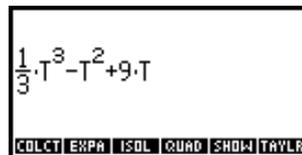
With clear prompts and menus organized for easy access, you and your students get satisfying results quickly.

From unit management to matrices, the HP 48G Series is first-class in friendliness, too. For example, with the EquationWriter tool, you can key in an expression like this...
...instead of this....



And 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 1.125 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! And even the HP 48G and HP 48G+ offer expandability via data transfer—and you don't even need cables with 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 HP 48G Series Graphic Calculators.)

Side-By-Side Comparisons:

HP Graphic Calculators

Product Name	HP 38G	HP 48G Series
Display	8-line × 22-character LCD	8-line × 22-character 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
Re-definable keyboard and menu keys	Yes	Yes
$+$, $-$, \times , \div , $+/-$, $\ln(x)$, e^x , y^x , $\log(x)$, 10^x	Yes	Yes
Square root, $1/x$, $n!$, x^2 , $\%$, π	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 statistics	Multivariate statistics
Σx , Σx^2 , Σy , Σy^2 , Σxy	Yes	Yes
Sample stand. dev./mean/weighted mean	Yes + population stand. deviation	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
Opt. infrared printer (HP 82240B)	Yes	Yes
Computer link	Yes	Yes
Two-way infrared I/O	Yes	Yes
Batteries	3 x AAA	3 x AAA
Warranty	One-year warranty	One-year warranty

In addition, all HP 48G Series calculators 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 two slots for multiple applications or up to 1.25 MB of memory.

Bid Specifications:

HP Graphic Calculators

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, 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 the display
- Sequence graphing mode shows both time series and cobweb/ stairstep plot
- HP Equation Solver

- 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 comparisons
- Notes and pictures
- 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 in HP 48G; 128KB in HP 48G+ and HP 48GX
- 131 x 64 dot display
- 12-digit values with 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 and numbers limited only by available memory

- Object-based programming language; structures include FOR, DO, IF, CASE, 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, conic, 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, 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
- Size: 8.1 x 18.0 x 2.9 cm (3.2 x 7.1 x 1.2 inches)
- Weight: 264 g (0.58 lb)
- 1-year warranty
- HP 48GX has two expansion ports, allowing plug-in applications or RAM memory cards



Accessories for HP Graphic Calculators

Classroom Overhead Display

The Overhead Display Unit (ODU) is the perfect way to present your lessons, demonstrating HP 38G or HP 48SX/GX calculations to the whole class, step by step. Just set this unit on an overhead projector, connect it to your calculator, adjust the contrast, and you're ready for class. The ODU has cables for the HP 38G and HP 48SX/GX and a built-in cable storage compartment.



HP F1212A Overhead Display Unit

Includes the display unit, one 9V battery, 2 cables and a User's Guide.

Memory Cards



Take advantage of additional RAM—store more data and large programs 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. Your information is saved even when you unplug the RAM card—each card has its own long-lasting battery!

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

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

HP 82216A 1 MB Battery-backed RAM Card, for HP 48GX

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

Other Accessories

There's lots of concise information in book form for HP 48G Series calculators—replacement Owner's Manuals or extra help on programming and other topics.

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

Programming techniques and examples, tables of commands, equations, system messages, units, system flags and reserved variables.

00048-90126 HP 48G Series Replacement O. Manual & Quick Start Guide

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

Connectivity

Share your computer's peripherals with your HP 38G and HP 48G Series—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 Windows-compatible programs) to capture HP 38G or HP 48G Series screen images, and to remotely control the HP 38G or HP 48G Series.

F1207C Serial Interface Kit for IBM-compatible PC's

F1208B Serial Interface Kit for Macintosh computers

Program transfers files (libraries, programs, grobs, data sets, or Applets) between calculator and computer. Includes screen capture/save utility. Controls HP 48G Series memory from the computer. Controls file storage remotely from HP 38G. PC version includes 1.5-meter serial cable, 4-pin to 10-pin connector, two 3.5" HD disks with PC software (Windows 3.1 and DOS 5.0 versions), User's Guide, and requires open PC serial port (9-pin to 25-pin). Macintosh version includes a 1.5-meter serial cable, a 4-pin to 10-pin connector, a 3.5-inch disk with Macintosh software, User's Guide, and requires open serial port.

F1015A Serial Interface Cable for IBM-compatible PC's

F1016A Serial Interface Cable for Macintosh computers

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.

Printing



The battery-powered infrared printer is a revolutionary companion for your HP graphic calculator—now with easier-to-read output and automatic shutoff to extend battery life. Using an invisible infrared beam, it needs no cord to connect to the calculator, so producing hard copies in the field or office couldn't be easier! Just aim your calculator at the printer (up to 18 inches away), send print instructions, and you get a neat, clean copy of your calculations. Just 4 AA alkaline batteries give the printer go-anywhere portability—or use the optional AC adapter as you wish.

HP 82240B HP Infrared Printer

Includes: Printer, 4 AA alkaline batteries, 1 roll of paper, User's Guide.

HP 82175A Thermal Paper for HP 82240B or HP 82240A Infrared Printers

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

HP F1011A AC Adapter for HP 82240B or HP 82240A Infrared Printers

Where to Buy:

HP Graphic Calculators and Accessories

Distributors

Axidata (Canada)...514-738-6996
Azerty...check local area listings
Beamscope (Canada)...905-763-3000
Carolina Wholesale...check local area listings
Commonwealth...check local area listings
D&H Distributors...800-877-1200
Daisytek (Canada)...905-940-9800
Douglas Stewart Co....800-279-2795
El Dorado Trading Co....800-227-8292
Hartco Enterprises/MultiMicro (Canada)...514-354-0580
NEAMCO...check local area listings
PRO Distributors...check local area listings
Taylor...check local area listings
United Stationers...check local area listings

National Retailers

Best Buy (HP 38G only)...check local area listings
Boise Cascade...check local area listings
Business Depot (Canada)...905-513-6116
CDW Computer...check local area listings
Circuit City...check local area listings
Corporate Express...check local area listings
CostCo...check local area listings
Fry's Electronics...408-487-1000
J&R Computer World...800-221-8180
Nobody Beats the Wiz...800-846-NBTW
Office Depot...800-685-8800
Office Depot/Office Place (Canada)...905-615-0980
OfficeMax (HP 48G only)...800-788-8080
S.P. Richards...check local area listings
Service Merchandise...800-251-1212
Staples...800-333-3330
Walmart...check local area listings

Local and Independent Retailers

Alabama

Auburn University Bookstore...1360 Haley Center...Auburn, AL 36849...334-844-1354
Off Campus College Bkstr....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. Bkstr....4101 Univ. Dr....Anchorage, AK 99608-4625...907-564-8218
Univ. 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
University of Arizona Bookstore...850 E. 18th St....Tucson, AZ 85719...520-621-8870

California

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
Kenel 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...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 Bus. Sys....1787 Tribute Rd., Suite E...Sacramento, CA 95815...916-922-9221
Hornet Bookstore...6000 J St....Sacramento, CA 95819-2605...916-278-7297
Adams Office Supply...3038 University Ave....San Diego, CA 92104-3072...619-295-4131
Aztec Shops Ltd....San Diego, CA 92182-1701...619-594-7508
USD Bookstore...5998 Alcalá Park...San Diego, CA 92110...619-260-4551
Franciscan Bookstore...1650 Holloway Ave....San Francisco, CA 94132-1781...415-338-7369
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
Stanford Bookstore...Stanford, CA 94305-3079...800-533-2670
Mawson Computer...3343 Industrial Dr., Ste. 1...Santa Rosa, CA 95403...707-528-2841
University Book Center...Campus Box 36...Boulder, CO 80309...303-492-6411
Cadet Bkstr....Bldg. 2360, Vandenburg Hall...USAF Academy, CO 80841...719-472-6268
Follett's CSM Bkstr....Ben Parker Student Ctr....Golden, CO 80401-1887...303-273-3113
Follett's GWU Bkstr....2110 "I" St., N.W....Washington D.C 20052-0001...202-994-6870

Colorado

District of Columbia

Florida

Univ. of Miami Bookstore...University Center...Coral Gables, FL 33124...305-284-3592
ERAU Bkstr...Embry-Riddle Aero. Univ....Daytona Beach, FL 32114...904-226-6062
Florida Bkstr. & Comp. 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
Univ. of Florida Bookstore...Stadium Rd.-Hub...Gainesville, FL 32611-2011...904-392-0194
International Calculator...2916 Corrine Dr....Orlando, FL 32803...800-535-5692
UCF Computer 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 Office Supply...6120 Pensacola Blvd....Pensacola, FL 32589...904-477-1111
FSU Store...New Union Bldg. #0127...Tallahassee, FL 32306...904-644-2072
USF Bookstore...4202 Fowler Ave....Tampa, FL 33620-6550...813-974-0523

Georgia

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 Bkstr...2802 Moore Hwy...Tifton, GA 31793-0016...912-386-3226

**Hawaii
Idaho**

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

Indiana

The Write Stuff, Inc....1 S. 781 Country Club...Wheaton, IL 60564-5646...708-871-8545
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
Louisiana**

University Book Store...106 Student Center...Lexington, KY 40506-0001...606-257-6304
Louisiana State Univ. Bkstr...110 Union Bldg...Baton Rouge, LA 70893...504-388-5137
University Bookstore...P.O. Box 41209 USL...Lafayette, LA 70504-1209...318-482-6922
Comp. Store of Louisiana...1440 Canal Street...New Orleans, LA 70112...504-486-9055

**Maine
Maryland**

Maine Surveyors Supply...28 U.S. Route 1...Yarmouth, ME 04096...207-846-5143
U.S. Naval Academy Store...101 Wilson Rd....Annapolis, MD 21402-5081
Maryland Book Exch....4500 College Ave....College Park, MD 27040...301-927-2510

Massachusetts

The University Shop...Campus Center...Amherst, MA 01003-0146...413-545-2619
Boston University Bookstore...660 Beacon St...Boston, MA 02215...617-267-8484
Campus Camera & Video...660 Beacon St...Boston, MA 02215...617-236-7476
Harvard Coop...1400 Mass. Ave...Cambridge, MA 02238...617-499-2000
MIT Comp. Connection...84 Mass. Ave., Rm. W20...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

Michigan

Ulrich's...549 E. University Ave...Ann Arbor, MI 48104...313-662-3201
Lundberg Bkstr....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. Bkstr....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

Minnesota

Univ. Ctr. Bkstr....175 Kirby Student Ctr...10 Univ. Dr...Duluth, MN 55812...218-726-7286
Harold Smith Bookstore...259 19th Ave., S...Minneapolis, MN 55455...612-626-0522
Office Products of Minn....7794 Bush Lake Rd...Minneapolis, MN 55439...612-835-6776
Univ. of Minn. Bookstore...231 Pillsbury Dr., S.E...Minneapolis, MN 55455...612-626-1782

**Mississippi
Missouri**

Miss. State Univ. Bkstr....Colvard Student Union...Miss. State, MS 39762...601-325-1576
University Bookstore...Brady Commons...Columbia, MO 65201...573-882-7611
Rolla Bookstore...788 University Center, W...Rolla, MO 65401...314-341-4705
Washington Univ. 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

**Nevada
New Hampshire
New Jersey**

A.S.U.N. Bookstore...Reno, NV 89507-8049...702-784-6597
Dartmouth College...33 South Maine St...Dartmouth, NH 03755...603-643-3616
Campus Store...Castle Point Station...Hoboken, NJ 07030...201-420-5101
New Jersey Inst. of Tech....150 Bleeker St...Newark, NJ 07103-3902...973-596-3200
Princeton Univ. Store...36 University Place...Princeton, NJ 08540-5116...609-921-8500

New Mexico

Holman's Inc....420 Wisconsin St., N.E...Albuquerque, NM 87123...505-343-0007
Univ. of New Mexico Bookstore...Main Campus...Albuquerque, NM 87131...505-277-6364
New Mexico State Univ. Bkstr....Corbett Center...Las Cruces, NM 88001...505-646-4431

New York

Follett's Univ. Bookstore...200 Lee Entrance...Buffalo, NY 14260-0001...716-645-3131
Collegetown of Ithaca, Inc....111 N. Aurora Street...Ithaca, NY 14850-4301...607-272-4477
47th Street Photo...New York, NY...212-921-1287
Columbia Univ. Bookstore...2926 Broadway...New York, NY 10027-7088...212-854-4131
NY Inst. of Tech. Bookstr....Student Lecture Ctr...Old Westbury, NY 11568...516-686-7584
BASIX...Stony Brook Union, Rm. 046...Stony Brook, NY 11794-0001...516-632-9281
Orange Student Bkstr....Marshall Square Mall...Syracuse, NY 13210-1731...315-478-6821
Syracuse Univ. Bookstore...303 University Pl...Syracuse, NY 13244-0001...315-443-1647
ITS Product Ctr....Rensselaer Polytechnic Institute...Troy, NY 12180-3590...518-276-8164
Rensselaer Union Bookstore...Sage & 15th St...Troy, NY 12181...518-276-4021

North Carolina

Surveyors Supply Co....1511 N. Salem St....Apex, NC 27502...919-362-7000
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
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. Bkstr....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...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 Univ....11111 Euclid Ave...Cleveland, OH 44106...216-368-2650
University Bookstore...Thwing Center...Cleveland, OH 44106-1715...216-368-2650

Oklahoma

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...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. Bkstr....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 Bkstr....P.O. Box 14007...Salem, OR 97309...503-399-5131

Pennsylvania

Lehigh Univ. Bkstr....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. Bkstr....13th & Montgomery Ave...Philadelphia, PA 19122...215-204-7385
Univ. of Penn. Bkstr....3729 Locust Walk...Philadelphia, PA 19104-3610...215-898-7595
CMU Bookstore...Baker Hall, Schenley Pk...Pittsburgh, PA 15213...412-268-2966

Puerto Rico

Penn State Bookstore...Bookstore Bldg...University City, PA 16802...814-863-3250
Relojos y Calculadoras...Mayaguez Mall...Manaqueer, PR 00680...787-834-5559
HP Only...Bivero Avenue #1031...Puerto Nuevo, PR 00920...787-793-8033

**Rhode Island
South Carolina**

Brown Univ. Bookstore...71244 Thayer St...Providence, RI 02912-0001...401-863-3216
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 Bkstr....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. Bkstr....The Russel House...Columbia, SC 29208-0001...803-777-4160

South Dakota
Tennessee

Tech Bookstore...501 E St....Rapid City, SD 57701...605-871-1984
University Center Bookstore...Box 5075...Cookville, TN 38505...931-372-3226
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 Univ. Dr., E....College Station, TX 77840...409-846-4818
CompuCom Systems, Inc....9333 Forest Ln....Dallas, TX 75243...972-783-1252
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
Palmtop Connection...6814 Leyland...San Antonio, TX 78239...210-590-7444

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
R H Enterprises, Inc....3601 S. 2700 W....West Valley City, UT 84119...801-576-8301

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 Bkstr....4326 Univ. Way, N.E....Seattle, WA 98105...206-634-3400
Pacific Lutheran Bookstore...Tacoma, WA 98447...253-535-7665

Wisconsin

Weiherts Bus. Machines...18050 Continental Dr....Brookfield, WI 53045...414-782-0909
Your One-Stop Palmtop Shop...170 S. Jackson St....Janesville, WI 53545...800-709-9494
University Bookstore...711 State St....Madison, WI 53703...608-257-3784
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 Univ. Dr., N.W....Calgary T2N 1N4...403-220-4765

British Columbia

Trentech Office Products...2828 18th St., N.E., #3...Calgary T2E 7B1...403-250-9267
UBC Bookstore...6200 University Blvd....Vancouver V6T 1Z4...604-822-2665
Cariboo College Bookstore...900 College Dr....Kamloops V2C 5N3...250-828-5141

Nova Scotia

St. Francis Xavier University Bookstore...Antigonish B2G 1C0...902-867-2450

Ontario

Bkstr. – Tech. Univ. of Nova Scotia...P.O. Box 1000...Halifax B3J 2X4...902-420-7707
McMaster University Bookstore...1280 Main St., W....Hamilton L8S 4L8...905-525-9140
Queens Univ. Campus Bkstr....Queens Univ. Grounds...Kingston K7L 3N6...613-545-2955
Downtown Electronics...356 Yonge Street...Toronto M5B 1S5
University of Waterloo Bookstore...200 University Ave., W....Waterloo N2L 3G1

Quebec
Saskatchewan

COOP Concordia...1455 de Maisonneuve, O....Montreal H3G 1M8...514-848-3615
Univ. of Saskatchewan Bookstore...Marquis Hall...Saskatoon S7N 0W0...306-966-4468

About the HP 48G

Frequently Asked Questions

Why does my HP 48 flash when I turn it on, or pause momentarily during a calculation?

This is normal. The pauses are to “tidy up” memory (needed more often as more memory is used).

What is the meaning of the ⏏ annunciator?

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

Is the calculator malfunctioning or am I doing something wrong?

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

How much free memory does my calculator currently have?

To find out, press ⏏ MEMORY MEM .

How do I change the display format or decimal places?

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

What's an E doing in my number?

This is scientific notation. For example, $6.02\text{E}23 = 6.02 \times 10^{23}$.

How do I get a new battery door, port cover, or rubber foot?

Call Calculating Edge at 888-338-2252.

What kind of replacement batteries should I get for my machine?

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 make it easier to read?

While holding the ON key down, press + or - repeatedly.

Why is my calculator “locking” up or behaving strangely?

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

Why can't I find my variable(s)?

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. If you see the annunciator **RAD** or **GRAD**, the machine isn't using degrees. Use \leftarrow **RAD** or the \rightarrow **MODES** menu to adjust accordingly.

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

If you get $'\text{SIN}(\pi)'$, the calculator is in Symbolic Results mode (i.e. Flag -3 is clear) but not in **RADIANS** mode. Set **RADIANS** mode (via \leftarrow **RAD**), then use either \leftarrow **+NUM** or **EVAL**. **EVAL** will return the trig identity, 0, if Flag -2 (Symbolic Constants) is also clear. Otherwise, **EVAL** behaves like \leftarrow **+NUM**, which never returns 0, because it does its calculation on the 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 \square \sqrt{x} \leftarrow x^2 on the HP 48 doesn't return $\sqrt{2}$.

Why do I get an Undefined Name error when integrating or differentiating?

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

Why does the calculator give me complex numbers when I evaluate expressions such as $'(-1)^{(2/3)}'$?

The machine gives a complex principal solution for expressions with fractional exponents. To get a real-valued result to the expression, you need to use $'\text{XROOT}(3, (-1)^2)'$ (or the keyboard equivalent to it: \square $\sqrt[3]{x}$ \leftarrow x^2 \rightarrow $\sqrt[3]{x}$).

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

The command you are attempting 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 I turn off the HALT annunciator?

Use \square **QUIT** (**PRG** **NXT** \square **QUIT** \square **QUIT**).

Why does my machine seem to gradually slow down?

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 after 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 \square **MODE** **NXT** \square **MODE**, then select your units.

About the HP 38G

Frequently Asked Questions

What calculus can I do with the HP 38G?

Some instructors have already written calculus ApLets, but even without ApLets, the HP 38G can help you study derivatives and integrals numerically and Taylor polynomials either numerically or symbolically.

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

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 offers 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?

First, set up the **Statistics** and **Function** ApLets identically. Next, draw the scatter plot and store **PREDY (X)** into **F1 (X)**. Check only **F1 (X)** in **FUNCTION SYMBOLIC VIEW** (using **VIEW** with **F1 (X)** highlighted to see the fit), then choose **Overlay Plot** via **VIEW**.

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 then type **PRVAR GO** **ENTER**.

How do I get ApLets from the HP ApLets Library?

Go to http://www.hp.com/calculators/products/hp38g_aplets_lib.html on the Internet, then select the link called **HP 38G ApLets Library**, then your desired topics/ApLets.

ApLets in the HP Library are compressed with **pkzip**, so after downloading, “unzip” the package. The files inside include a Word 6.0 file, a text file, and files tagged with **.000** (e.g. **HP38DIR.000** and **HP38DIR.CUR**). (Note that all ApLet packages contain the **HP38DIR.000** file, so be careful not to overwrite this file by unzipping or copying other packages of ApLets into the same directory or folder.)

How to Contact HP

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

Internet:

www.hp.com/calculators

When?

Phone:

8 am - 5 pm
Pacific Time

Internet:

Anytime!

Educators!

Keep in mind the HP Educators Program 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

Pop Quiz

In Case You Were Wondering

Test yourself.

No one should be without these indispensable mathematical facts.

1. If your IPO of **BefortheStorm.com** opens at \$1 per share, then doubles every 15 minutes over a 7-hour trading day, how many shares would you need to be able to buy out Microsoft for \$500 billion at the end of that day? How does this relate to the wealth of Ireland?
2. Find the sum of all even numbers $4^x + 5^x$, where x is an integer.
3. What is the minimum number of persons you must gather in a room so that there is at least a 50% chance that two of them have the same birthday?
4. Is your HP calculator ever vulgar?
5. When does Halloween = Christmas?
6. A speeding bullet flies at 1,320 feet per second. Superman, of course, is faster, four times faster, than that. So, from his home in Krypton, 30 trillion miles away (these new subdivisions are really getting out of hand), how much time should he allow for his morning commute to the Daily Planet?
7. Mr. Julius Orange has created the perfect 3-inch orange. As a promotion for his business and a celebration of the millennium, on New Year's Day, 2000, he plans to give one orange to each of 6,193,152 persons in the greater New York City area. If you're his shipping agent, and refrigerator trucks are 8 feet by 10 feet by 42 feet and will hold cubic-foot boxes of 64 oranges each, how many such trucks will you need to ship the fruit to New York from Florida?

- 0 I won't tell anyone—if you promise to send in your own calculator/math/classroom sorts of jokes, humor, quizzes, games, trivia, and letters to the editor—so that we don't need to perpetuate any more of this sort of thing.
- 1 6 You're normal—most people get at least the Superman question.
- 7 You're exceptionally bright—warped, in fact. Either that or you peeked.
- Scoring and Diagnoses**
7. None—you don't need refrigerator trucks in New York City in January. (About 32 ordinary trucks would probably do it.)
6. About 951,294 years. (Hence the apartment in the city.)
5. When you're short 2 fingers, $25^{\text{dec}} = 31^{\text{oct}}$. (basically speaking.)
4. No, but the HP 38G does improper fractions.
3. It depends on the room. In the maternity ward at the local hospital, you might need just 2 persons. At the average party, it's about 22. (for 90% odds, it's only 40.)
2. The expression's value is even only if $x = 0$, so the sum is 2.
1. At \$268,435,456 per share at the closing bell, you'd need only 1863 shares—and Bill Gates would owe you some change. Ireland is the world's richest nation because its capital has been Dublin for years.

Answers

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If you have an idea for a technical article or sample lesson, please contact Dianne Hart at 541.917.4627 or hardt@gw.lbcc.cc.or.us.

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