



» **Connecting your world**

HP kicks off a new era of calculators with the new HP 20b Business Consultant calculator. With new design standards and its "user-centered commitment", it's the perfect combo of style and usability.

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Your articles



» **Power hungry starring the HP StreamSmart 400**

Learn the difference between voltage and electrical current, how to measure it, and see how a bunch of potatoes and some shiny pennies can turn on a light.



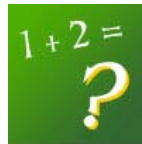
» **Express yourself; pick your favorite color**

The HP Quick Calc comes in fun colors that allow you to express yourself. You can also fit it right on your key chain for those times in the check out line or when calculating a tip! Be ready anytime, anywhere.



» **Calculating solutions for everyone**

The new HP Print Calc 100 and the HP Office Calc 200 were born on June 10, 2008 and quickly became perfect tools to use in the home or office. Stay tuned for exclusive promotions on these two!



» **The Technical Corner**

Learn the technical operations behind adding numbers in a calculator in this month's technical corner.



» **RPN Tip #6**

This month's RPN tip teaches you to calculate the equivalent resistance of two connected resistors using the product divided by the sum formula. Learn how with this month's RPN tip.



» **Where to Buy**

Take a closer look at the new HP Calculating Solutions.

**Volume 6
July 2008**

Welcome to the sixth edition of the HP Solve newsletter. Learn calculation concepts, get advice to help you succeed in the office or the classroom, and be the first to find out about new HP calculating solutions and special offers.

Featured Calculator



» **HP 20b Business Consultant**

The pride and joy of the HP Calculator world is here: The HP 20b Business Consultant. Your calculator of the month elevates the bar and paves the way for future HP Calculating Solutions.

[Learn more »](#)

HP Calculator Blog

Check out Wing Kin Cheung's blog, "The Calculating World with Wing and You."

[View blog »](#)

The Calculator Club

Join the Calculator Club and take advantage of:

- Calculator games & Aplets
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- Custom calculator pouches
- HP Calculator forum

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Upcoming HP Calculator events

Event	Dates - Location
AP Annual	July 16-20 - Seattle, WA
WIPTE	October 15-16 - Westville, IN
Educause	October 28-31 - Orlando, FL

Connecting your world

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A little over 35 years ago, HP marked the birthplace of its innovative and successful heritage in the handheld calculator market with the introduction of the HP-35 – the world's first handheld scientific calculator.

- Virtually displaced the then-ubiquitous slide rule; was an instant hit among engineers and scientists
- HP's first consumer product and essentially HP's first handheld device

Having spurred the leap from slide rules to handheld scientific calculators, HP today continues its heritage of delivering innovative products, and our goal is to be the leading calculating solution provider. We will redefine the way people learn, teach and use our handheld calculating technologies and solutions for students, professionals and consumers of all stages of life.

Today we would like to share with you how we are delivering on that goal:

- Focus on design
- Solutions for the education market
- Broadening the HP calculator portfolio

Focus on design



HP is kicking off a new era of HP calculators with the HP 20b Business Consultant calculator. The HP Business Consultant is the first device based on the new HP calculator industrial design platform that unites style and usability to deliver visually distinct and meaningful elements across the HP calculator lineup. It unifies the HP calculator family through consistency in ID and UI, combines “user centered” design commitment to technical innovation, and a paradigm shift for professionals to deliver inspired and trusted products to our customers. Examples of user-centric design elements include:

- Tapered surfaces for a visually thinner aesthetic, a comfortable grip and a guide when slipping the calculator into a pocket
- Raised edges provide added protection to screen and keypad, contributing to a sense of durability while maintaining a sleek form

It builds on the cache of products such as the revolutionary HP-35 and the best-selling HP 12c and is based around design elements that are useful, relevant and aesthetically engaging to today's users.

The HP 20b Business Consultant is as beautiful as it is functional. Design also plays into the Business Consultant's functional layout with an intuitive key layout with frequently used business functions grouped together for easy access. The beveled keys allow for dual function key labeling and it greatly contributes to the calculator's clean, uncluttered look. The HP Business Consultant also continues in HP's tradition of technical innovation and product quality:

- Choice of RPN, hierarchical or traditional algebraic data entry

- New high-speed, low power CPU for fast, accurate results while extending battery life
- Scroll keys for better navigation through functions
- Advanced math library and only calculator in its class with four advanced probability distributions

As part of the HP Business Consultant's thoughtful design, the product packaging is earth- and user-friendly as it offers more than a 50% reduction of packaging materials by weight, reduces transportation carton space by more than 40%, and its new "clip and zip" feature makes the packaging easier to open at home with common scissors, but as a theft deterrent it is difficult to open in the store

You can expect to see HP calculators continue to build on the new design platform to further redefine usability and style with our new line of calculating solutions.

Solutions for the education market



HP calculators are committed to delivering education-focused calculating solutions that enhance today's digital classroom. HP recently introduced the Mobile Calculating Lab (MCL) solutions. HP is currently running Middle-grade calculator pilot workshops, offers free Web-based calculator training, and HP Calculator emulation software provided free to all educators.

The MCL solutions bring math and science experiments to life! HP's MCL solution combines an HP 39gs/40gs graphing calculator, HP StreamSmart 400, Fourier probes, software and theme-specific course materials to visually communicate experimental data as it happens. The MCL solutions enable students to better connect mathematical formulas and scientific theories to everyday physical phenomena by easily collecting and analyzing real-world data in real time. The MCL solutions allow students to better visualize concepts such as loss of rainforest and industrial run-off into water supply by experiencing phenomenon while simultaneously seeing the data in graphical or numerical form. The MCL solutions offer plug-and-play simplicity and flexibility:

- Virtually no set up – when the HP StreamSmart 400 is plugged into the calculator's serial port, the calculator automatically recognizes the probe type and immediately displays the stream of incoming data
- Saves teachers time both in the classroom and when preparing lesson plans
- Students and teachers can modify experiments as they go to adapt to the real world experience and help make learning fun
- In comparison, traditional data loggers require teachers to pre-determine experiment parameters for the desired outcome, which entails more time-intensive set up and a steeper learning curve.

The portable MCL solutions are ideal for conducting experiences outside the classroom as well as inside. The HP StreamSmart 400 is up to five times smaller than traditional data loggers. To more effectively meet teaching needs, HP will offer customized MCL solutions by subject area (physics, chemistry, biology, environment, math and general science lesson plans) that include specific equipment and resource materials.

Broadening HP Calculator portfolio

HP is creating new convenient, easy-to-use and stylish calculating solutions and products to expand its current portfolio designed for students and professionals to include home and office consumers.

HP OfficeCalc series



- Stylish desktop offering for simple calculations
- Ideal for office or retail workers (i.e. to calculate mark-up percentages, sales totals and taxes)

HP PrintCalc



- Ideal for small business owners that make quick calculations that require receipts or documentation

HP Quick Calc



- Compact size allows users to keep handy for on-the-go calculations
- Designed for quick convenient access (i.e. keychain ring and magnetic backing)
- Available in fashionable colors

To learn more about HP Calculating Solutions, please visit the [HP Calculator](#) website.

Feature calculator of the month: HP 20b Business Consultant

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This is our pride and joy. The HP 20b Business Consultant elevates the bar and paves the way for HP Calculating Solutions into the future. We put our heart and soul into the development of this new product and we simply love it. It has been designed with the students and professionals in mind; the sleek HP 20b offers quick solutions for your business and finance calculations. Here's why we think you will love it too!

As part of its functional design, the HP Business Consultant boasts an intuitive key layout with frequently used business functions such as TVM (Time Value of Money), depreciation, amortization, bonds and cash flows grouped together for easy access. It also offers dedicated keys for commonly used math functions.

In addition, beveled keys allow for easy visual separation of dual function labeling directly on the key, which leaves the faceplate free of text, contributing to the calculator's clean, uncluttered look.

The HP Business Consultant also continues in the HP tradition of technical innovation and product quality. Feature highlights include:

- Two-line display allowing users to view up to 12 digits and scroll through variables, real-text labels, menus and prompts
- New high-speed, low-power CPU delivering fast, accurate results with up to 15-digit internal precision while extending battery life
- Choice of time-saving Reverse Polish Notation (RPN), hierarchical or traditional chain algebraic data entry
- Scroll keys permitting users to navigate through menu lists, variables and recent results
- More than 15 statistical analysis functions including eight statistical models, standard error and covariance
- Advanced math library including trigonometry and hyperbolic functions
- Easily configurable display format and language preferences

Fun facts about the new HP 20b Business Consultant:

- Born: June 10, 2008
- The 20b is the first in its class to offer a 32 bit, 30Mhz ARM CPU which delivers blazingly fast results even on the most complex operations such as probability distributions.
- You can customize your 20b to display your name when it turns ON by doing the following: shift mode UP UP UP (select the language) SHIFT UP. the screen then becomes blank and you are ready to enter your name (up to 8 characters). use the UP and down arrow to select a letter, INPUT to validate the letter and = to erase the last letter and ON to exit... for example to enter CDB, press UP INPUT UP UP INPUT UP UP UP . Once you have entered your name, press SHIFT OFF and then ON again and your name will display.
- It is the only financial calculator in its class with four advanced probability distributions: normal distribution, Chi-squared, student distribution, and F-distribution.

To learn more about HP Calculating Solutions, please visit please visit the [HP Calculator](#) website.

RPN Tip #6

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Avoiding Entry Errors

An electrical engineering student calculates the equivalent resistance, R_T , of two resistors R_1 and R_2 connected in parallel, using the product divided by the sum formula.

$$R_T = \frac{(R_1 * R_2)}{(R_1 + R_2)}$$

His desired R_T value is to be calculated from $R_1 = 12.341$ ohms, and $R_2 = 8.037$ ohms. There are three ways the student may make the calculation on an RPN calculator to avoid errors when entering the values more than once. The HP35s is used for the examples. Numeric data entry keystrokes are not counted.

Underlining; single, double, or triple [3_triple.jpg], indicates keystrokes (ks).

1. Store the values on the stack using the RPN key sequences.

a. Press 12.341, ENTER, ENTER, ENTER, 8.037, x, LAST X, R↑, +, ÷ to calculate 4.86724001374 ohms. (10 ks).

Or alternately;

b. Press 12.341, ENTER, ENTER, 8.037, x, X↔Y [3_X-Y.gif], LAST X, +, ÷ to calculate 4.86724001374 ohms. (7 ks).

The second method, 1a, if the problem is solved often, may be quicker because pressing the ENTER key three times successively is faster. The roll up operation, R↑, requires two keystrokes and may balance the time saved keying the three ENTERs.

2. Store the values in registers. This method is especially useful if the values are to be used multiple times.

a. Press 12.341, STO 1, 8.037, STO 2, x, RCL 1, RCL 2, +, ÷ [3_sto1.jpg] to calculate 4.86724001374 ohms. (13 ks)

b. or alternately only use one register and LASTX.

Press 12.341, STO 1, 8.037, x, LASTX, RCL 1, +, ÷ [3_sto2.jpg] to calculate 4.86724001374 ohms. (10 ks)

3. Recognize that the mathematical equivalent formula is:

$$R_T = \frac{1}{\frac{1}{R_1} + \frac{1}{R_2}}$$

[3_RT2.jpg]

Press 12.341, 1/X, 8.037, 1/X, +, 1/X to calculate 4.86724001374 ohms. (4 ks).

Observe that the latter method uses the fewest keystrokes and doesn't require storing or entering the values more than once, which avoids errors. This method is also keystroke optimum if the R_T of three or more resistors is to be calculated.

There is one minor accuracy issue with this method. The multiple divisions may produce an error in the least significant digit of \pm several counts. If R_1 is 6 ohms and R_2 is 18 ohms the answer will be two counts low. Depending on your display mode you may not even see this 2×10^{-11} error. You will have to press left shift, ENTER (SHOW) to see 4.4999999998 instead of 4.5000000000.

Challenge for the student.

Can you find two values where the count will be off by 3?

If the student explores these solution methods he or she will most likely discover other keystroke sequences to solve the problem, especially with approach No. 1.

Click here to learn more about [RPN](#).

Power hungry starring the HP StreamSmart 400

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Introduction

Making electricity from common foods and household items is a time-honored science fair project. Here, we will take a closer look at the difference between voltage and electric current, and how simple geometry plays a crucial role in determining the attributes of an electric circuit.

Materials

- 4 potatoes
- wires with alligator clip connectors on both ends (available at Radio Shack)
- copper pennies
- galvanized nails
- HP 39gs Graphing Calculator with SmartStream applet
- StreamSmart 400
- Fourier voltage probe and current probe
- knife (plastic will do) for cutting potatoes
- steel wool to clean the nail and pennies
- soft-tip pen marker

Set Up and Procedure

Cut the potatoes in half, giving you eight pieces. Each piece will make a single battery. After that, you will combine several batteries together in different ways and measure the voltage and current of the different circuits.

Clean the pennies and the nails with the steel wool. Try to make them shine.

Push one galvanized nail into a potato, leaving enough sticking out so that you can attach an alligator clip to it. Then push a penny into the same potato, again leaving enough exposed that you can clip a wire onto it. Make sure the penny does not touch the nail. Clip one wire to the nail and another wire to the potato. Now attach the red (positive) lead from the voltage probe to the other end of the wire that is attached to the penny, and the black (negative) lead from the probe to the other end of the wire that is attached to the nail.

Plug the voltage probe into the StreamSmart 400 and then plug the StreamSmart 400 into the HP39gs. Start the SmartStreamer applet. You should see a voltage reading right away.

Exploration

1. What voltage do you get?

Use the marker to label this potato number 1. Record the voltage in the table. Typically, you should see about 0.5 – 0.9 volts from your potato battery. If you see nothing, check your connections.

Now disconnect the voltage probe and connect the current probe (or use them both simultaneously, if possible). Measure the current of potato 1 and record it in the table.

- Build seven more single-potato batteries just like the last one. Number each one with a marker and measure the voltage and current of each one. Record the voltages and currents in the table.

Potato	1	2	3	4	5	6	7	8
Voltage								
Current								

Now you'll combine the potatoes in various ways and measure the voltages and currents.

First you will connect two potato batteries in "series". To do this, use a wire to connect the penny on one potato to the nail on another. Then attach the positive lead from the voltage probe to the penny on one potato, and the negative lead to the nail on the other potato. See photo 1.



Photo 1: Two batteries in series

- Measure the voltage of this circuit. How does it compare to the voltages of the two separate potatoes that you put together?
- Measure the current of this circuit. How does it compare to the currents of the two separate potatoes that you put together?
- Now continue to add one more potato in series at a time, starting with potato 3. Measure the voltages and currents and record in the table:

Potatoes	1 and 2	1 thru 3	1 thru 4	1 thru 5	1 thru 6	1 thru 7	1 thru 8
Voltage							
Current							

- Take a look at the voltages of the individual potatoes. What is the affect of adding more batteries in series?
- Take a look at the currents of the individual potatoes. What is the affect of adding more batteries in series?

Now you'll connect the batteries differently. Disconnect the series circuit. Take potatoes 1 and 2, and connect the pennies with a wire, and the nails with a second wire. This is called a parallel circuit. See Photo 2.

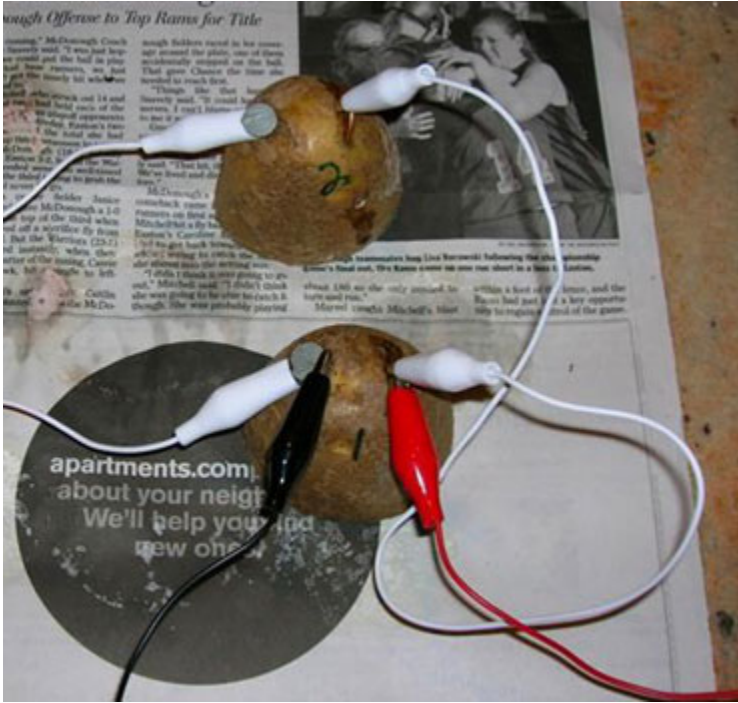


Photo 2: Two batteries in parallel

Now just add one more potato in parallel, potato 3.

8. Measure the voltage and current. What do you get?
9. What happens to voltage when you connect batteries in parallel?
10. What happens to current when you connect batteries in parallel?

Extensions

1. Connect four pairs of two batteries each in series. Then connect the resulting four pairs in parallel. This should give you a battery with a voltage equal to 2 potatoes and a current of 4 potatoes. Try it! Then take a small flashlight bulb and see if you can light it up with your potato battery. See photo 3.

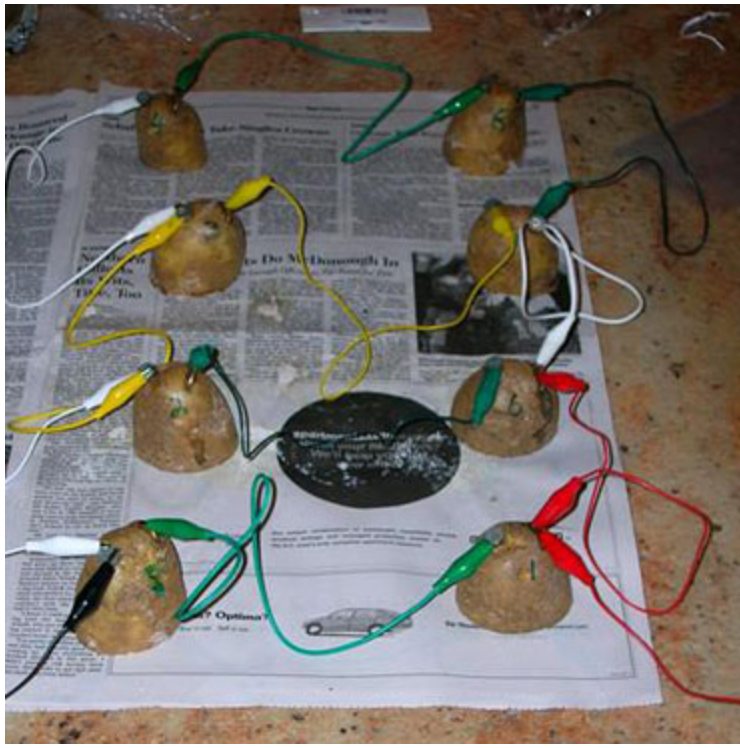


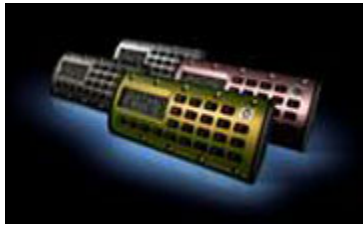
Photo 3: Four pairs of series batteries in parallel

2. Research what makes a potato battery work. You should find out what an electrolyte is (phosphoric acid in the potato acts as an electrolyte) and how the two different metals used in this activity create an electric current.

Click here for more information about the [HP 39gs Graphing Calculator](#).

Express yourself; pick your favorite color

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Express your style this summer with the new HP Quick Calc!

HP is having a little more fun this summer with all the exciting new line of fun products. There will be new categories like the HP Print Calc 100, HP Office Calc series, and HP Stream Smart 400 solutions. The HP Quick Calc is the coolest calculator product you'll see this summer with four hip colors to select from to express your style.

The compact, stylish HP Quick Calc is for quick calculations on the go. Its unique design is small enough to carry with you on a keychain or lanyard strap, or you can attach it to a metal surface like a locker, file cabinet, or refrigerator. There's always a need for a calculator so you want to be ready anytime,

anywhere. There's pink, green, silver, and metallic bronze. Express yourself by matching your calculator with your outfits and gadgets this summer.

To learn more about HP Calculating Solutions, please visit please visit the [HP Calculator](#) website.

Calculating solutions for everyone

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On June 10, 2008 HP launched some exciting new products within the calculator business unit. While all of them promise to be big sellers, a few of the products are specifically aimed at the workplace and home use.



Take the HP Print Calc 100 our “convenient solution for quick calculation needs” – with the HP Print Calc 100 you can get quick and easy answers to the most common calculator functions. You can use the calculator to calculate sales total and tax functions for retail calculations and business functions such as mark-up and percentage. With it's large 10-digit, angled screen it is easy-to-view and reliable.



The HP Office Calc 200 is the larger version of the desktop calculators and delivers the same quality and proficiency of the 100. However, the HP Office Calc 200 has a 14-digit display and quick keys easily calculating sales tax. Both products come with HP's legendary warranty and support service.



The final product in this category is the HP Print Calc 100. Unlike the other two the HP Print Calc 100 does just what its name implies – it prints! It also comes with some of the most common business functions: cost, sell price, and margin.

With these new products we hope to bridge the gap between our current financial, scientific, and graphing calculators and a simpler, easier-to-use, convenient calculator used more frequently in the home and office. Every worker, professional or retail based, can find a use for these calculators and will find they too live up to the HP reputation of great quality and design.

In the coming months keep your eyes open for exciting promotions on these calculators directly aimed at our business and enterprise customers.

To learn more about HP Calculating Solutions, please visit please visit the [HP Calculator](#) website.

The Technical Corner

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How does my calculator add two numbers?

HP calculators stores numbers as a set of 3 items: a sign, + or -, a 12 digit number called 'mantissa' always greater or equal to 100,000,000,000 and an exponent.

For example, 34.432 is stored as '+', 344320000000, 1.

Adding two numbers is actually more complicated than it looks as they are lots of special cases. From adding two numbers of opposite signs (which is actually a subtraction), to issues of rounding.

The first thing that the calculator will do is check if the operation is an addition (in this case, the sign of the two numbers will be the same) or a subtraction (in this case, the sign of the two numbers will be opposite).

After this, the calculator orders the absolute value of the two numbers. This is done for two reasons: First to find the exponent of the result (which will be the exponent of the larger number, optionally plus one, in the case of the addition), Second to increase the precision of the result in the case of a subtraction by adding one digit of precision on the smallest number.

The next step to perform the addition is to find if one of the number needs to be 'shifted' compared with the second one. "Shifting" refers to the action of shifting toward the right the smallest number in order to have the units line up with the units, the tens line up with the tens, etc. The shifting required can be calculating by subtracting the exponent of the smallest number from the exponent of the largest number.

Once the number of digit to shift the number mantissa by is determined, three cases are possible:

In the first case, the amount of shift is larger than the precision of the mantissa, as in the example of adding $10E20$ with 1. Such an addition will result in a complete lost of the '1' as it is much too small relatively to $10E20$.

In the second case, the two numbers have the same exponent and there is no shift required.

The last case is the case where a shift is required. In that case, the mantissa of the number is shifted. And there is 'magic' in this case because this is where rounding comes into play, and rounding is more complex than most people imagine. But before we talk about rounding in more details, let us finish to talk about the addition!

It is only in the fourth step that the addition (or subtraction) is performed! Since the operations are done in 13 digits (and not 12), there is no risk of lost precision due to carry out at that stage.

The last operation is a normalization of the number. Ie, a test to make sure that the number is properly formatted (mantissa $\geq 100,000,000,000$ and valid exponent).

Now, it's time to finish our discussion on rounding. Most of you are familiar with the rounding to 'above' if the value is larger than 5. For example, if one pound of flour is \$1.25, and since you can not pay ½ cents, you will expect to pay \$0.63 for your ½ pound of flour. This means that the 'shifting' function needs to handle the case of the 'lost' or 'shifted' out numbers to be smaller or larger than 5. But the problem with the round up approach is that over time, the rounding is ALWAYS in the same direction, ie, the seller in the case of the flour makes an extra 0.5 cent for all sales of ½ pound. At the end of the day, after hundreds of sales, this can be real dollars! Things are even worse in numerical calculator where some algorithms can ask for literally millions of successive additions (such as calculations of interest rates for cash flow for example). So the HP calculator does what is called a 'round to even'. This means that the rounding algorithm is as follow:

If the 'data' which is dropped out is smaller than 0.5, it rounds to 0, if it larger than 0.5, it rounds to 1, but, if the data is exactly 0.5, it will round UP if the number is odd and DOWN if the number if even.

If we return to the example of our windmill operator selling his ½ pounds of flour, this would be the equivalent of him rounding UP to \$0.62 for every 'even' customer and DOWN \$0.63 for every 'odd' customer (and by that, we do not mean strange looking, but every other customer). The net effect of this is that at the end of the day, the maximum difference between the amount of cash in the seller teller and the number of pounds of flour multiplied by \$1.25 is only going to be 1 cent, while if the round to even was not implemented, the seller would have number of customer divided by 2 extra cents in his teller.

You can test that on any advanced HP calculator (the low cost calculators typically do not implement round to even) by adding 10.0000000001 to 1.00000000005. The first addition will yield 11.0000000002 (round UP), but performing the addition again (11.0000000002 + 1.00000000005) will return 12.0000000002 (round DOWN).

Let us look at the code now:

```
// step 1, check if it's an addition or subtraction
samesign= sign_x = sign_y;

// Step 2: then make y <= x in absolute value
if exponent_x = exponent_y then
{
  if mantissa_x < mantissa_y then swap(x, y);
} else {
  if exponent_x < exponent_y then swap(x, y);
  // make sure than a subtraction will not cause a carry
  // by multiplying the mantissa of x by 10 (the exponent is
  // reduced by 1 to keep the value of x the same.
  // this operation means that the addition/subtraction will be
  // performed on 13 digits and not just 12.
  if not samesign then
  {
    Mantissa_x= mantissa_x*10; exponent_x= exponent_x-1;
  }
}

// step 3: calculate the shift required.
shift= exponent_x - exponent_y;
if shift>12 then return normalize(x);
if shift<>0 then
  mantissa_y = ShiftAndRound(mantissa_y, shift);

// Step 4: the addition or subtraction (as needed)
```

```

if (samesign)
    mantissa_x = mantissa_x + mantissa_y;
else
    mantissa_x = mantissa_x - mantissa_y;

// Step 5: normalize the result
return normalize(x);

// the normalize function is used to make sure that a number
// has the proper format (ie: that the mantissa is in the right range
// and it looks like

// handles the case of 0.
If x=0 then return x

// make sure that the mantissa is larger than the minimum number
While mantissa_x < 100,000,000,000 do
{
    Mantissa_x= Mantissa_x*10;
    Exponent_x= exponent_x-1;
}
// make sure that the mantissa is smaller than the max allowable value
// and round the result if nessecary
while mantissa_x >= 1,000,000,000,000 then
{
    Mantissa_x= ShiftAndRound(Mantissa_x, 1);
    Exponent_x= exponent_x+1;
}
// make sure that the exponent are within acceptable values and
// return infinity or 0 if not...
if (exponent_x > MaxExponent) return PositiveInfinite;
else
if (exponent_x < -MaxExponent) return 0;
return x

```

Click here for more information about the [HP Calculators](#).