



hp calculators

HP 50g Working with Fractions

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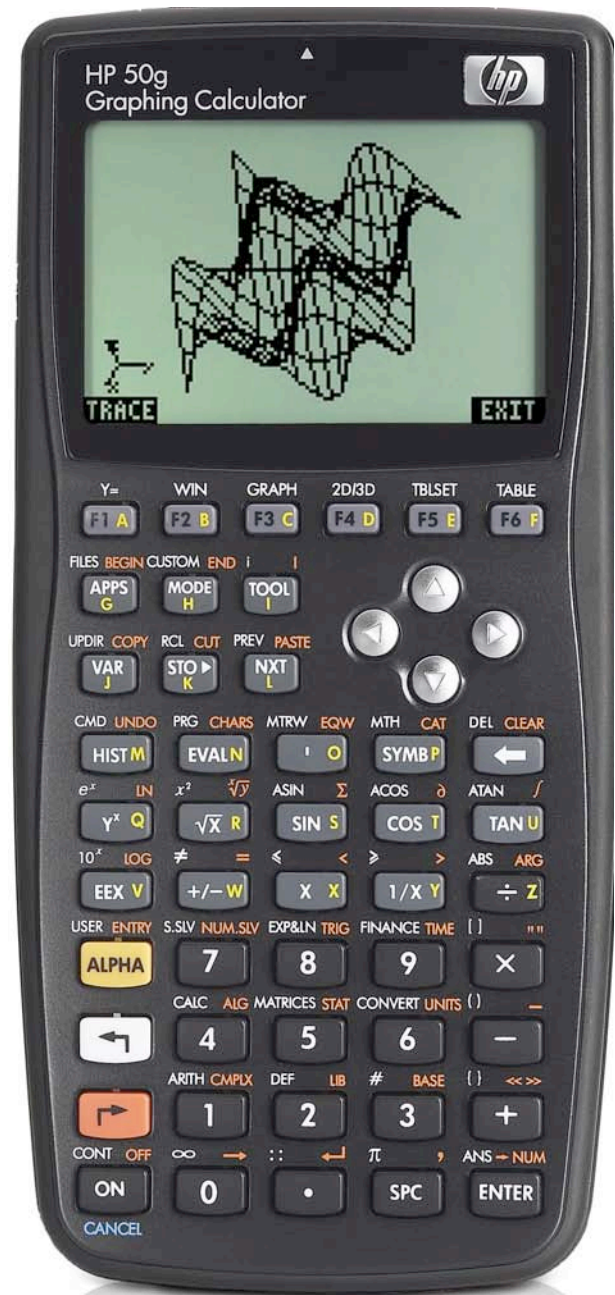




Figure 3

The main Calculator Modes form will now be displayed. If the second line does not say STD then press the down arrow key once, press **F2** below the menu label, use the up or down arrow to select STANDARD mode, and press the **F6** key below the menu label to accept the change to Standard mode. The Menu Form should now look as in Figure 4.

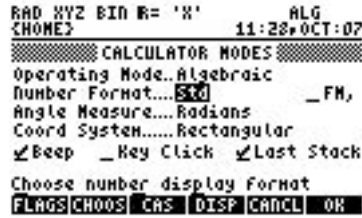


Figure 4

It is also worth checking the status of two system flags so that fractions are displayed as they should be. Press the **F1** key below the menu label to change the flags. Press **5** twice to reach flag 52, the second system flag whose number begins with a 5. If flag 52 has a check mark by it, press the **F3** key below the menu label to uncheck it, so the menu looks as in Figure 5.



Figure 5

This changes from the “one line” display, which shows fractions as in Figure 1 to “many lines” display mode. Now use the down key to reach flag 79, or press the **7** key eight times. If flag 79 is checked, press the **F3** key to uncheck it, so that its description says “textbook on”. These two settings make the HP50g show fractions on two lines. Press the **F6** key below the menu label to accept the flag settings. Press **F6** one more time to accept all the changes and quit the Calculator Modes form.

Now the calculator is in Exact mode and Standard mode. If the examples above did not give the expected answers, it is worth trying them again. The HP50g is also in “many lines” and “textbook” modes now, so the fractions are shown on two lines.



Figure 6

Examples of Fractions in RPN Mode

To try the same examples in RPN mode, the user must first switch from Algebraic mode to RPN mode. Press the **MODE** key and then press **F2** below the menu label, use the up or down arrow key to select RPN mode, then press the **F6** key below the

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Menu label to accept the change to RPN mode, and press the $F6$ key again to leave the Calculator Modes Form. Changing back to Algebraic mode is done the same way, except that ALGEBRAIC should be selected instead of RPN in the Choose list. Now type $2 \text{ (ENTER)} 3 \text{ (÷)}$ to see how the HP50g handles a fraction in RPN mode. It displays the fraction as in Algebraic mode. Then type $5 \text{ (ENTER)} 7 \text{ (÷)} +$ to complete the same calculation as in Algebraic mode. The HP50g will show:

```
RAD XYZ BIN R= 'X'
{HOME} 11:42:07 OCT:07
3:      2 5
      : 3 + 7
2:      29
      21
1:      2 5
      3 + 7
EDIT VIEW STACK RCL PURGE CLEAR
```

Figure 7

RPN works in step-by-step mode, so it does not automatically simplify the result, as Algebraic mode did. To simplify the result, use the EXPAND command in the Algebra menu. Press $\text{F} \rightarrow \text{ALG}$ to display the Algebra Menu, then select the EXPAND command from the menu labels or press 2 if you have CHOOSE boxes on. Then press the $F6$ key below the menu label. This simplifies the expression, giving the same result as in Algebraic mode.

Here is another calculation to be tried in RPN mode. Type $3 \text{ (ENTER)} 4 \text{ (÷)}$ to see $3/4$. Then type $2 \text{ (ENTER)} 6 \text{ (÷)}$ and the result will be $1/3$, which shows that simplification is carried out on single fractions. Multiplying the two by pressing \times again gives a combination of two fractions with no simplification.

```
RAD XYZ BIN R= 'X'
{HOME} 11:42:07 OCT:07
3:      29
      21
2:      29
      21
1:      3 1
      4 3
EDIT VIEW STACK RCL PURGE CLEAR
```

Figure 8

An alternative to simplifying with the EXPAND command is to use the equation editor. Press TOOL to get the Tools menu keys at the bottom of the display, as in Figure 8. Press the $F1$ key below menu label to see the expression in the equation editor.

```
RAD XYZ BIN R= 'X'
{HOME} 11:45:07 OCT:07
      3 1
      4 3
EDIT CURS BIG EVAL FACTO SIMP
```

Figure 9

Press $F4$ below the menu label to evaluate the expression. Then press ENTER to enter the evaluated value on the stack. As expected, you will see $1/4$ on the stack.

Tip! A way to type fractions directly when RPN mode is set is to press the $\text{}$ key and then type the expression as in Algebraic mode. To type the original example again, but as fractions in RPN, press $\text{' } 2 \text{ (÷)} 3 \text{ (+)} 5 \text{ (÷)} 7 \text{ (ENTER)}$. This takes the same number of keys as doing it in pure RPN mode, pressing $2 \text{ (ENTER)} 3 \text{ (÷)} 5 \text{ (ENTER)} 7 \text{ (÷)} +$, but many users feel it is more natural to type fractions as "numerator (÷) denominator."

Example of Converting Fractions to Real Numbers

Whether the calculator is in Algebraic mode or In RPN mode, pressing $\text{F} \rightarrow \text{NUM}$ converts a fraction into the real number that is the closest approximation possible on the HP50g. (A "real number" is a number with a decimal mark or an exponent, for example 1. or

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23.57 or 59.2E19. Only numbers typed without a decimal point are treated as integers by the HP50g, and fractions must be made up of two integer numbers.) In RPN mode, the conversion is carried out immediately. In Algebraic mode, the result is presented in terms of the ANS function. If the calculator is in RPN mode, it should be changed to Algebraic mode (as was described above) for this example, then pressing \leftarrow \rightarrow NUM gives the answer with ANS(1) and pressing \leftarrow ENTER gives the result.



Figure 10

Example of Converting Real Numbers to Fractions

The \rightarrow Q command converts a real number to a quotient, in other words into a fraction. The command can be found in the catalog of commands, or it can be typed by using the ALPHA mode. If it is to be used often, it is best assigned to a key in the menu, or on the User Keyboard. Ways to do this are described in other training aids.

To show the result of the previous calculation as a fraction, execute the \rightarrow Q command by using ALPHA mode. Press the keys below and the result will be seen as in Figure 11.

\leftarrow ALPHA \leftarrow ALPHA \leftarrow \rightarrow Q \leftarrow () \leftarrow ALPHA \leftarrow ANS \leftarrow ENTER



Figure 11

Example of Converting Real Numbers to Fractions Involving PI

The command \rightarrow Q π will convert a real number into a fraction multiplied by PI and another fraction not containing PI, and will then give as its answer the fraction that is simpler. If the most recent result above is multiplied by PI, and converted to a real number then \rightarrow Q π will convert the real number back to a fraction multiplying PI. First type

\leftarrow X \leftarrow π \leftarrow ENTER \leftarrow \rightarrow NUM \leftarrow ENTER

This converts 29 π /21 into a real number. Now type

\leftarrow ALPHA \leftarrow ALPHA \leftarrow \rightarrow Q \leftarrow () \leftarrow π \leftarrow () \leftarrow ALPHA \leftarrow ANS \leftarrow ENTER

As Figure 12 shows, this really does convert the real number into a fraction multiplying PI.



Figure 12

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If \rightarrow QII will convert a real number to whichever is better, a fraction with PI, or without, there may seem to be no reason to use \rightarrow Q. In fact, there are two good reasons to use \rightarrow Q. The first is to use it where PI is not expected in the answer, and if it does appear, this is purely by chance, and is not wanted. The second is in calculations that specifically try to convert PI itself into a fraction, as will be shown in the next example. Thus \rightarrow QII should be used if there is an expectation that PI might be a part of the answer. If PI is not wanted in the answer, \rightarrow Q should be used.

In RPN mode \rightarrow Q and \rightarrow QII convert a value from Level 1 of the stack to a fraction, possibly multiplied by PI if \rightarrow QII is used.

Accuracy, and an Example

Converting a fraction to a real number with \rightarrow NUM always gives the most accurate representation of the fraction that is possible on the HP50g. \rightarrow Q and \rightarrow QII will calculate the simplest fraction that they can find which gives a value as accurate as that shown in the present display mode. If the number of digits shown in the display is increased then \rightarrow Q and \rightarrow QII will try to achieve the greater precision and will often give a result that uses a longer numerator and denominator. This can be seen if PI is converted to a fraction in different display modes.

First, it is necessary to set FIX 2 mode, where only 2 digits are shown after the decimal point. Press the **MODE** key and then press the down key ∇ to reach the number format. Press **F2** below the **MODE** menu label, then use the up or down key to select **FIXED** mode, and press the **F6** key below the **MODE** menu label to accept the change. Press the right arrow \blacktriangleright to reach the selection for the number of digits, and press **F2** below **MODE** again, then use the up and down keys to pick 2, and press **F6** below **MODE** again. Press **F6** once more to confirm the whole selection and to leave the Calculator Modes Form.

Now to convert PI to a fraction in FIX 2 mode, in Algebraic mode, press \leftarrow π \rightarrow \rightarrow NUM to see 3.14. Then press **ALPHA** **ALPHA** \rightarrow \rightarrow Q \leftarrow **ALPHA** \leftarrow **ANS** **ENTER**.

This will show 22/7, the well-known approximation to PI. To try the same with more accuracy, repeat the above process for setting FIX 2 mode, but choose FIX 5 mode instead. To convert PI to a fraction in FIX 5 mode, press the same keys as before,

\leftarrow π \rightarrow \rightarrow NUM to see 3.14159. Press **ALPHA** **ALPHA** \rightarrow \rightarrow Q \leftarrow **ALPHA** \leftarrow **ANS** **ENTER**.

Now this will show 355/113, a better approximation to PI.

```
BAD XYZ BIN R= 'X'      ALG
<HOME>                  11:52:07:07
=  $\pi$ 
:  $\rightarrow$ NUM(ANS(1))           $\pi$ 
                          3.14159
:  $\rightarrow$ Q(ANS(1))           355
                          113
EDIT WIEN STACK RCL PURGE CLEAR
```

Figure 13

In both cases, the most accurate value of PI possible was on the stack, only the display was rounded to fewer decimal places, but in each case \rightarrow Q returned the simplest value that could be found to represent PI to the accuracy displayed.

Once all the examples have been completed it may be worth returning the calculator to its normal modes. It can also be helpful to clear the stack by pressing \rightarrow **CLEAR**.

Further Details

\rightarrow Q and \rightarrow QII will work with complex numbers and with expressions containing several real numbers. They will convert each real number into a fraction separately. Note: \rightarrow QII will also convert real numbers in vectors and matrices to fractions.

The only way to guarantee that PI will appear when a real number is factored into a rational is to divide by PI first, then use \rightarrow Q, not \rightarrow QII. This is because of the way \rightarrow QII works. Most of the time this is not an issue, but there are situations where this must be done if PI must be in the result.