



hp calculators

HP 49G+ Working with Fractions

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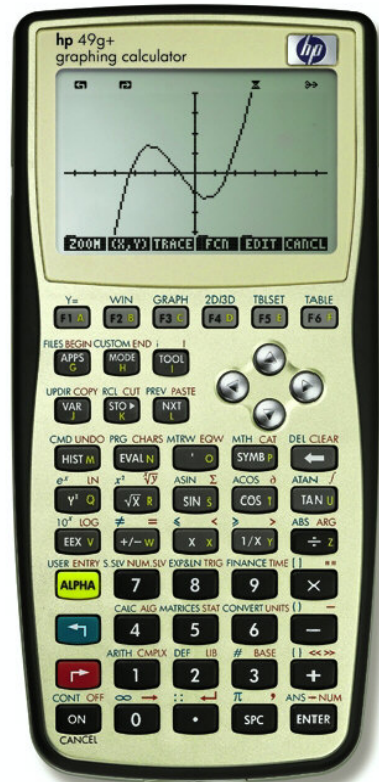
Example of Converting Fractions to Real Numbers

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Examples of Entering Fractions

To enter a fraction on the HP49G+ in Algebraic mode the user just types it. To enter $1/3$, type this:

$\boxed{1} \boxed{\div} \boxed{3} \boxed{\text{ENTER}}$.

Calculating with fractions is just as easy. The HP49G+ knows the “rules of operator precedence”, which means that it carries out divisions before additions, and gives the correct answer. Brackets can be used for greater clarity but are not needed just to show what is a fraction. In Algebraic mode the HP49G+ automatically collects terms as well.

For example to add $2/3$ to $5/7$ it is enough to type

$\boxed{2} \boxed{\div} \boxed{3} \boxed{+} \boxed{5} \boxed{\div} \boxed{7} \boxed{\text{ENTER}}$.

The answer $29/21$ will be displayed. After these two calculations the HP49G+ should show:

```

RAD XYZ OCT R= 'X'      ALG
<HOME>

: 1/3
: 2/3+5/7               1/3
                        29/21
EDIT VIEW STACK RCL PURGE CLEAR

```

Figure 1

Choosing the Right Modes

If the HP49G+ is not set to Exact mode then it is in Approximate mode, and the above will not happen. In Approximate mode exact rational fractions are converted to their approximate decimal equivalents. Assuming that the display mode is set to STD, the Standard mode, the second result will instead be shown as 1.38095238095

So, to work with fractions the HP49G+ should be in Exact mode. It recognizes numbers without decimal points as integers, and tries to keep them as integers when working with rational numbers. If any number is typed with a decimal point, and Exact mode is set, the HP48GII may ask whether the user wants to change to Approximate mode so that a non-integer answer can be calculated. The HP48GII will not ask if flag -120 is set to silent mode on – it will automatically switch modes for you.

```

RAD XYZ BIN R= 'X'      ALG
<HOME>                  06:31 OCT:09

: 1 Approx. mode on?    1/3
: 2 YES
: 3 NO                  29/21
1./3+5/7
      CANCEL OK

```

Figure 2

Pressing $\boxed{\text{YES}}$ to choose YES lets the HP49G+ switch to Approximate mode and give an answer. Pressing $\boxed{\text{CANCEL}}$ or pressing the down arrow key $\boxed{\nabla}$ and then pressing $\boxed{\text{NO}}$ to choose NO means the HP49G+ stays in Exact mode and can not calculate a non-integer answer, so it will give an error message. To clear an error message, if one is displayed, press the $\boxed{\text{ON}}$ key to cancel the error, then press the $\boxed{\leftarrow}$ key to delete the message from the stack.

If the above question has been answered with a “YES”, or if Approximate mode has been set some other way, it is necessary to change to Exact mode so that the examples in this training aid will display the correct answers. Press the $\boxed{\text{MODE}}$ key and then press the $\boxed{\text{F3}}$ key below the $\boxed{\text{CAS}}$ menu label. (CAS stands for Computer Algebra System, which is discussed in other training aids.) Press the down key $\boxed{\nabla}$ twice to reach the APPROX label. If the label is checked, as in Figure 3, Approximate mode is set, so press the $\boxed{\text{F3}}$ key below the $\boxed{\text{CAS}}$ menu label to uncheck it. Then press the $\boxed{\text{F6}}$ key below the $\boxed{\text{OK}}$ menu label to accept the change to Exact mode.

```

RAD XYZ BIN R= 'N'          ALG
<HOME>                      11:28 OCT:07
===== CAS MODES =====
Indep var: X
Modulo: 3
_ Numeric ☒ Approx  _ Complex
_ Verbose _ Step/Step _ Incr Pow
☒ Rigorous ☒ Simp Non-Rational
Perform approx calculations?
[EDIT] [✓CHK] [CANCL] [OK]

```

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 **CAS** menu label, use the up or down arrow to select STANDARD mode, and press the **F6** key below the **OK** menu label to accept the change to Standard mode. The Menu Form should now look as in Figure 4.

```

RAD XYZ BIN R= 'N'          ALG
<HOME>                      11:28 OCT:07
===== CALCULATOR MODES =====
Operating Mode..Algebraic
Number Format....[STD]      _ FM,
Angle Measure....Radians
Coord System.....Rectangular
☒ Beep  _ Key Click ☒ Last Stack
Choose number display format
[FLAGS] [CHOOSE] [CAS] [DISP] [CANCL] [OK]

```

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 **CAS** 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 **CAS** menu label to uncheck it, so the menu looks as in Figure 5.

```

RAD XYZ BIN R= 'N'          ALG
<HOME>                      11:28 OCT:07
===== SYSTEM FLAGS =====
51 Fraction mark: . +
52 Show many lines
53 No extra parens
54 Tiny element + 0
55 Save last args
56 Standard beep on
57 Alarm beep on +
[✓CHK] [CANCL] [OK]

```

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 HP49G+ show fractions on two lines. Press the **F6** key below the **OK** 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 HP49G+ is also in “many lines” and “textbook” modes now, so the fractions are shown on two lines.

```

RAD XYZ BIN R= 'N'          ALG
<HOME>                      11:43 OCT:07
=====
1/3
2/3 + 5/7
29/21
[EDIT] [VIEW] [STACK] [RCL] [PURGE] [CLEAR]


```

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 **CAS** 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 F_6 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 $\left(\frac{2}{3}\right) \left(\frac{3}{7}\right) \div$ to see how the HP49G+ handles a fraction in RPN mode. It displays the fraction as in Algebraic mode. Then type $\left(\frac{5}{3}\right) \left(\frac{7}{7}\right) \div +$ to complete the same calculation as in Algebraic mode. The HP49G+ will show:

```

RAD XYZ BIN R= 'X'
<HOME> 11:42, 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 $\left(\rightarrow\right) \text{ALG}$ to display the Algebra Menu, then select the EXPAND command from the menu labels or press $\left(2\right)$ if you have CHOOSE boxes on. Then press the F_6 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 $\left(3\right) \left(\text{ENTER}\right) \left(4\right) \div$ to see $3/4$. Then type $\left(2\right) \left(\text{ENTER}\right) \left(6\right) \div$ and the result will be $1/3$, which shows that simplification is carried out on single fractions. Multiplying the two by pressing $\left(\times\right)$ again gives a combination of two fractions with no simplification.

```

RAD XYZ BIN R= 'X'
<HOME> 11:42, OCT:07
3:      29
      21
2:      29
      21
1:      21
      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 $\left(\text{TOOL}\right)$ to get the Tools menu keys at the bottom of the display, as in Figure 8. Press the $\left(F1\right)$ key below  to see the expression in the equation editor.

```


RAD XYZ BIN R= 'X'
<HOME> 11:45, OCT:07

8 1
4 3

EDIT CURS BIG = EVAL FACTO SIMP

```

Figure 9

Press $\left(F_4\right)$ below the  menu label to evaluate the expression. Then press $\left(\text{ENTER}\right)$ 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 $\left(\frac{\Box}{\Box}\right)$ key and then type the expression as in Algebraic mode. To type the original example again, but as fractions in RPN, press $\left(\frac{\Box}{\Box}\right) \left(2\right) \div \left(\frac{\Box}{\Box}\right) \left(3\right) + \left(\frac{\Box}{\Box}\right) \left(5\right) \div \left(\frac{\Box}{\Box}\right) \left(7\right) \text{ENTER}$. This takes the same number of keys as doing it in pure RPN mode, pressing $\left(2\right) \left(\text{ENTER}\right) \left(3\right) \div \left(5\right) \left(\text{ENTER}\right) \left(7\right) \div +$, but many users feel it is more natural to type fractions as "numerator \div denominator."

Example of Converting Fractions to Real Numbers

Whether the calculator is in Algebraic mode or In RPN mode, pressing $\left(\rightarrow\right) \text{NUM}$ converts a fraction into the real number that is the closest approximation possible on the HP49G+. (A "real number" is a number with a decimal mark or an exponent, for example 1. or

23.57 or 59.2E19. Only numbers typed without a decimal point are treated as integers by the HP49G+, 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 \rightarrow NUM gives the answer with ANS(1) and pressing \rightarrow ENTER gives the result.

```

RAD XYZ BIN R= 'X'      ALG
[HOME]                   11:46:07
: 2/3 + 5/7
: →NUM(ANS(1))
1.38095238095
[EDIT] [VIEW] [STACK] [RCL] [PURGE] [CLEAR]

```

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.

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

```

RAD XYZ BIN R= 'X'      ALG
[HOME]                   11:47:07
: 2/3 + 5/7
: →NUM(ANS(1))
1.38095238095
: →Q(ANS(1))
29/21
[EDIT] [VIEW] [STACK] [RCL] [PURGE] [CLEAR]

```

Figure 11

Example of Converting Real Numbers to Fractions Involving π

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

\times \rightarrow π ENTER \rightarrow NUM ENTER

This converts $29\pi/21$ into a real number. Now type

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

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

```

RAD XYZ BIN R= 'X'      ALG
[HOME]                   11:50:07
: 2/3 + 5/7
: →NUM(ANS(1))
4.33838985495
: →Q $\pi$ (ANS(1))
29/21  $\pi$ 
[EDIT] [VIEW] [STACK] [RCL] [PURGE] [CLEAR]

```

Figure 12

If $\rightarrow Q\pi$ will convert a real number to whichever is better, a fraction with π , 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 π 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 π itself into a fraction, as will be shown in the next example. Thus $\rightarrow Q\pi$ should be used if there is an expectation that π might be a part of the answer. If π is not wanted in the answer, $\rightarrow Q$ should be used.

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

Accuracy, and an Example

Converting a fraction to a real number with $\rightarrow \text{NUM}$ always gives the most accurate representation of the fraction that is possible on the HP49G+. $\rightarrow Q$ and $\rightarrow Q\pi$ 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 $\rightarrow Q\pi$ 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 π 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 FIXED menu label, then use the up or down key to select FIXED mode, and press the $F6$ key below the FIXED menu label to accept the change. Press the right arrow \rightarrow to reach the selection for the number of digits, and press $F2$ below FIXED again, then use the up and down keys to pick 2, and press $F6$ below FIXED again. Press $F6$ once more to confirm the whole selection and to leave the Calculator Modes Form.

Now to convert π to a fraction in FIX 2 mode, in Algebraic mode, press π $\rightarrow \text{NUM}$ to see 3.14. Then press ALPHA ALPHA $\rightarrow Q$ ALPHA ANS ENTER .

This will show 22/7, the well-known approximation to π . To try the same with more accuracy, repeat the above process for setting FIX 2 mode, but choose FIX 5 mode instead. To convert π to a fraction in FIX 5 mode, press the same keys as before, π $\rightarrow \text{NUM}$ to see 3.14159. Press ALPHA ALPHA $\rightarrow Q$ ALPHA ANS ENTER .

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

Figure 13

In both cases, the most accurate value of π 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 π 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 $\rightarrow \text{CLEAR}$.

Further Details

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

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