



hp calculators

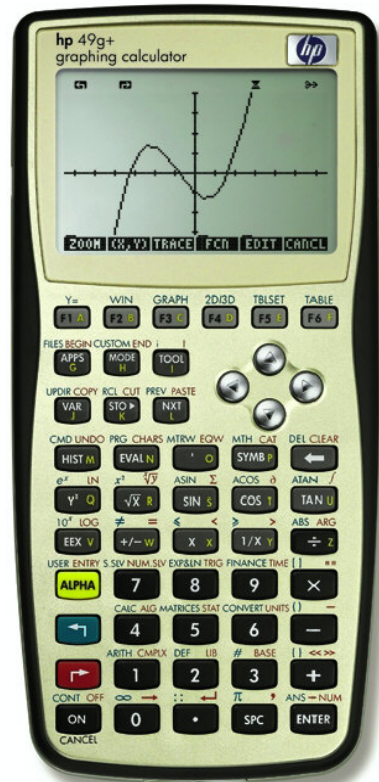
HP 49G+ Complex numbers

The MTH (MATH) menu

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Complex numbers

Practice working problems involving complex numbers



The MTH (MATH) menu

The Math menu is accessed from the GREEN shifted function of the $\boxed{\text{SYMB}}$ key by pressing $\boxed{\leftarrow} \text{MTH}$. When pressed, a CHOOSE box is displayed with a number of choices allowing problems to be solved with different math functions on the HP 49G+ calculator.



Figure 1

The first choice allows for calculations dealing with vectors. The second choice provides access to many functions for working with matrices. The third choice allows for the manipulation of lists and for using lists to apply mathematical functions to a list of numbers, all at the same time. The fourth function provides access to the hyperbolic trigonometric functions. The fifth selection provides a list of many functions that can be applied to real numbers. The sixth choice displays functions dealing with numbers in different bases. Choices seven through eleven are not displayed in the screen above, but deal with probability, fast fourier transformations, complex numbers, constants and a choice dealing with several special functions.

To display the complex function menu, press $\boxed{9} \boxed{\text{ENTER}}$. The screen displays the some of the built-in complex number functions. Figure 2 displays the first six functions, while figure 3 displays the remaining complex number functions built into the MATH menu.



Figure 2



Figure 3

The function RE will take an imaginary or complex number and return the real portion of the number, while the function IM will return the imaginary or complex portion of the number. Functions 3 and 4 will convert a complex number into two real numbers or take two real numbers and convert them into one complex number. Function 5, ABS, will calculate the magnitude of a complex number (which is equivalent to finding the length of the hypotenuse of a triangle formed by the complex point and the origin). Function 6, ARG, will return the angle from the origin to the coordinate of the complex number. Function 7, SIGN, returns a complex number that is the complex modulus of the original complex number. If the original complex number is divided by this complex modulus, the result is a real number. Function 8, NEG, changes the sign of each component of a complex number, making negative components positive and positive components negative. Function 9, CONJ, returns a conjugate complex for the complex number given to it as an argument. The conjugate is a complex number such that when multiplied by the original complex number, produces a real number as the answer.

The CMLX (COMPLEX) menu

The Complex menu is accessed from the RED shifted function of the $\boxed{\text{I}}$ key by pressing $\boxed{\rightarrow} \text{CMLX}$. When pressed, a CHOOSE box is displayed showing complex number functions, some of which have already been seen in the MATH CHOOSE box menu. The differences are that this CHOOSE box does not contain the real to complex and complex to real conversions, and also contains the

additional i function to allow entry of the symbol for an imaginary number. This i symbol can also be entered directly by accessing the GREEN shifted function of the $\boxed{\text{TOOL}}$ key or by pressing $\boxed{\leftarrow} \boxed{i}$. This menu may allow for more convenient access to the complex number functions.



Figure 4



Figure 5

Two commonly used complex number functions are also on the 49G+ keyboard. ARG is the RED shifted function of the $\boxed{\div}$ key, and is accessed by pressing $\boxed{\rightarrow} \boxed{\div} \boxed{\text{ARG}}$. ABS is the GREEN shifted function of the $\boxed{\div}$ key and is accessed by pressing $\boxed{\leftarrow} \boxed{\div} \boxed{\text{ABS}}$.

Complex numbers

Complex numbers occur in problems facing several disciplines, from quantum mechanics to working with magnetic fields. They are also useful in modeling the flow of a fluid around a pipe. They even show up in the solution of a differential equation that models the up and down movement of a car's shock absorber. They are also used to describe the inductance and capacitance of electrical circuits, for example, using the formula $E = I \times Z$, where E is voltage, I is current, and Z is impedance. In many electricity and electronics areas, the "i" of an imaginary number is usually represented as "j" to avoid any confusion with the variable "I" which represents current in electronics formulas.

The 49G+ works with complex numbers in the same way it does with any other type of number. They are often represented as an ordered pair of the form (X,Y), where X is the real part and Y is the complex part of the imaginary or complex number. Sometimes they are represented as distance or magnitude and angle (r,θ). In the examples that follow, the ordered pair view will be shown. The mathematical rules for applying functions ranging from addition and subtraction to sines and logarithms are all handled correctly.

Practice working problems involving complex numbers

Example 1: Compute $(2+3i) * [(7-6i) + (4+5i)]$

Solution: In RPN mode:

$\boxed{\leftarrow} \boxed{)} \boxed{2} \boxed{\rightarrow} \boxed{,} \boxed{3} \boxed{\text{ENTER}} \boxed{\leftarrow} \boxed{)} \boxed{7} \boxed{\rightarrow} \boxed{,} \boxed{6} \boxed{+/-} \boxed{\text{ENTER}} \boxed{\leftarrow} \boxed{)} \boxed{4} \boxed{\rightarrow} \boxed{,} \boxed{5} \boxed{\text{ENTER}}$

In Algebraic mode:

$\boxed{\leftarrow} \boxed{)} \boxed{2} \boxed{\rightarrow} \boxed{,} \boxed{3} \boxed{\rightarrow} \boxed{\times} \boxed{\leftarrow} \boxed{)} \boxed{\leftarrow} \boxed{)} \boxed{7} \boxed{\rightarrow} \boxed{,} \boxed{6} \boxed{+/-} \boxed{\rightarrow} \boxed{+}$

```

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

:(2.,3.)*(7.,-6.)+(4.,5.)
(25.,31.)
EDIT VIEW RCL STOP PURGE CLEAR

```

Figure 6

Answer: (25,31) is shown in the display. This is equivalent to $25 + 31i$.

Example 2: Compute $\sin(2+3i) + \cos(1-4i) + e^{(2+2i)}$

Solution: In RPN mode:

```

<←> () 2 <→> , 3 ENTER SIN <←> () / <→> , 4 +/- ENTER COS
<←> () 2 <→> , 2 ENTER <←> e< <→> + +

```

In Algebraic mode:

```

SIN <←> () 2 <→> , 3 <→> + COS <←> () / <→> , 4 +/- <→> +
<←> e< <←> () 2 <→> , 2 ENTER

```

```

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

:SIN((2.,3.))+COS((1.,-4.)
(20.8342679968,25.5136)
EDIT VIEW RCL STOP PURGE CLEAR

```

Figure 7

Answer: The approximate answer of (20.83,25.51) is shown in the display. This is equivalent to $20.83 + 25.51i$.

Example 3: Find the $3+2i$ divided by $4-4i$.

Solution: In RPN mode:

```

<←> () 3 <→> , 2 ENTER <←> () 4 <→> , 4 +/- ENTER ÷

```

In Algebraic mode:

```

<←> () 3 <→> , 2 <→> ÷ <←> () 4 <→> , 4 +/- ENTER

```

```

RAD XYZ BIN R= 'X'
<HOME>
7:
6:
5:
4:
3:
2:
1: (.125,.625)
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```

Figure 8

Answer: The answer of (0.125,0.625) is shown in the display as computed in RPN mode. This is equivalent to $0.125 + 0.625i$.

Example 4: For the complex number $5+6i$, find the magnitude of the vector represented.

Solution: In RPN mode:

\leftarrow () 5 \rightarrow , 6 ENTER \rightarrow CMPLX 2 ENTER

In Algebraic mode:

\rightarrow CMPLX 2 ENTER \leftarrow () 5 \rightarrow , 6 ENTER

RAD XYZ BIN R= 'X' ALG
[HOME]

: (5., 6.)
7.81024967591
EDIT VIEW RCL STOP PURGE CLEAR

Figure 9

Answer: The answer of 7.81 is shown in the display.

Example 5: The voltage in a circuit is $45 + 5j$ volts and the impedance is $3 + 4j$ ohms. Find the total current.

Solution: Using the equation $E = I \times Z$, the current I is equal to E / Z .

In RPN mode:

\leftarrow () 4 5 \rightarrow , 5 ENTER \leftarrow () 3 \rightarrow , 4 \div

In Algebraic mode:

\leftarrow () 4 5 \rightarrow , 5 \rightarrow \div \leftarrow () 3 \rightarrow , 4 ENTER

RAD XYZ BIN R= 'X' ALG
[HOME]

: (45., 5.)
(3., 4.)
(6.2, -6.6)
EDIT VIEW RCL STOP PURGE CLEAR

Figure 10

Answer: (6.2,-6.6) is shown in the display. This is equal to $6.2 - 6.6j$ amps.