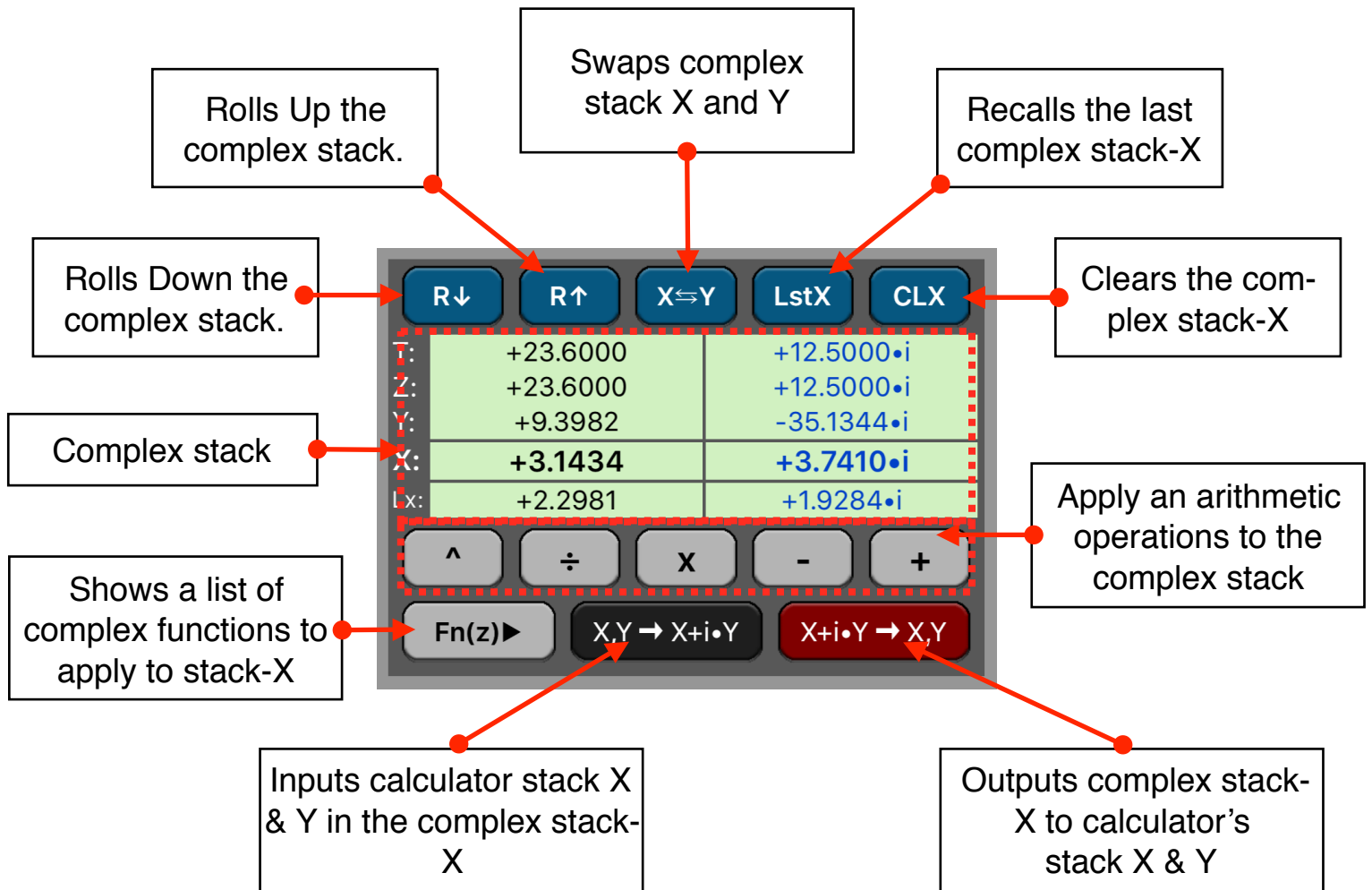


# Complex Math Tool

This “Complex Math” tool implements a complex number stack to perform operations and functions to expand the original HP-11C calculator. To show it, press the **OPT**, touch the “**Scientific**” menu, and then select the “**Complex Math**” option.



This tool shows a stack similar to the normal calculator, but specially designed for operations with complex numbers. The number are entered in the Complex Stack from the calculator using the  $[X,Y \rightarrow X+Y\cdot i]$  button, the calculator's stack-X value is used as the real part and the value in stack-Y is used for the imaginary part.

The Complex Stack, operations and functions are completely independent from the calculator, but behaves in the same way of the normal calculator's stack.

**Example 1:** (Arithmetic calculation)

Evaluate the following expression:

$$\frac{2i \cdot (-8 + 6i)^3}{(4 - i \cdot 2 \cdot \sqrt{5}) \cdot (2 - i \cdot 4 \cdot \sqrt{5})}$$

Keystrokes	Description
"2" [ENTER] "0" [→X+Y·i]	Enter the first complex number "2i" into the Complex Stack.
"6" [ENTER] "8" [CHS] [→X+Y·i]	Enter the second complex number "-8+6i" into the Complex Stack.
"0" [ENTER] "3" [→X+Y·i]	Enter the exponent number "3+0i" into the Complex Stack.
tool [y <sup>x</sup> ]	Calculate $(-8 + 6i)^3 = (352 + i \cdot 936)$
tool [ x ]	Calculate the numerator $2i \cdot (-8 + 6i)^3 = (-1,872 + i \cdot 704)$
[OPT]	Close the "Complex Math" view to access the calculator functions.
"5" [√x] "2" [x] [CHS]	Calculates $-2 \cdot \sqrt{5}$ value = -4.4721
[OPT] "Complex Math"	Shows the "Complex Math" to continue with the calculation.
"4" [→X+Y·i]	Enter the first part of the denominator $(4 - i \cdot 2 \cdot \sqrt{5})$ .
[OPT]	Close the "Complex Math" view to access the calculator functions.
"5" [√x] "4" [x] [CHS]	Calculates $-4 \cdot \sqrt{5}$ value = -8.9443
[OPT] "Complex Math"	Shows the "Complex Math" to continue with the calculation.
"2" [→X+Y·i]	Enter the second part of the denominator $(2 - i \cdot 4 \cdot \sqrt{5})$ .
tool [ x ]	Calculates the denominator $(4 - i \cdot 2 \cdot \sqrt{5}) \cdot (2 - i \cdot 4 \cdot \sqrt{5}) = 32 + i \cdot 44.7214$
tool [ ÷ ]	Divides the numerator by the denominator to obtain the final evaluation of the expression. <b>Result = 9.3982 - i·35.1344</b>
[→X, Y]	Output the complex stack-X to the calculator stack-X and Y.

## Example 2: (Arithmetic calculation)

Calculate the phasor expression:  $2 \angle 65^\circ + 3 \angle 40^\circ$

Keystrokes	Description
[g] [DEG]	Sets the calculator to degrees.
"65" [ENTER] "2" [f] [→R]	Enter the 1 <sup>st</sup> phasor and convert it to rectangular coordinates.
[→X+Y·i]	Enter the coordinates in the Complex Stack.
"40" [ENTER] "3" [f] [→R]	Enter the 2 <sup>nd</sup> phasor and convert it to rectangular coordinates.
[→X+Y·i]	Enter the coordinates in the Complex Stack.
tool [+]	Adds the complex numbers.
[→X, Y]	Output the complex stack-X to the calculator stack-X and Y.
[g] [→P]	Convert back to polar coordinates. <b>Result = 4.8863 ∠ 49.9612°</b>

## Complex Functions:

Additionally to the arithmetic operations for complex numbers, touching the [Fn(z)▶] button, brings up a list with a complete set of functions that can be applied to the complex stack-X value.

Re⇌Im	Swap the real and imaginary parts of complex stack-X.
Conjugate	Change the sign of the imaginary part of complex stack-X.
1 / z	Calculates the reciprocal of complex stack-X.
√ z	Calculates the square of complex stack-X.
z <sup>2</sup>	Calculates the square of complex stack-X.
LN( z )	Calculates the Natural Logarithm of complex stack-X

<b>LOG( z )</b>	Calculates the Common Logarithm of complex stack-X
<b>e<sup>z</sup></b>	Calculates the Natural Anti-Logarithm of complex stack-X
<b>10<sup>z</sup></b>	Calculates the Common Anti-Logarithm of complex stack-X
<b>SIN( z )</b>	Calculates the Sine of complex stack-X
<b>COS( z )</b>	Calculates the Cosine of complex stack-X
<b>TAN( z )</b>	Calculates the Tangent of complex stack-X
<b>SIN<sup>-1</sup>( z )</b>	Calculates the Inverse Sine of complex stack-X
<b>COS<sup>-1</sup>( z )</b>	Calculates the Inverse Cosine of complex stack-X
<b>TAN<sup>-1</sup>( z )</b>	Calculates the Inverse Tangent of complex stack-X
<b>HYP SIN( z )</b>	Calculates the Hyperbolic-Sine of complex stack-X
<b>HYP COS( z )</b>	Calculates the Hyperbolic-Cosine of complex stack-X
<b>HYP TAN( z )</b>	Calculates the Hyperbolic-Tangent of complex stack-X
<b>HYP SIN<sup>-1</sup>( z )</b>	Calculates the Inverse Hyperbolic-Sine of complex stack-X
<b>HYP COS<sup>-1</sup>( z )</b>	Calculates the Inverse Hyperbolic-Cosine of complex stack-X
<b>HYP TAN<sup>-1</sup>( z )</b>	Calculates the Inverse Hyperbolic-Tangent of complex stack-X