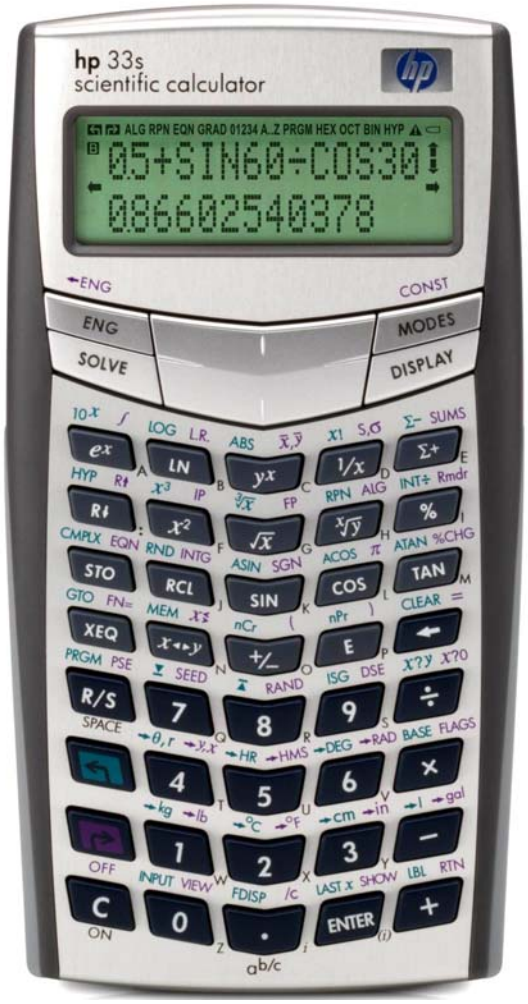
hp calculators



HP 33S Working with complex numbers

Complex numbers

Practice working problems involving complex numbers

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 x 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.

To distinguish complex numbers from real numbers, the function [↰] [CMPLX] is used to group the two portions of the complex number into one logical unit.

In RPN mode, since the HP 33S works with complex numbers by storing each pair of numbers in two levels of the four-level RPN stack, two complete complex numbers can be held and manipulated at the same time. In RPN mode, [↰] [CMPLX] expects an operation to be executed on the complex number(s) just entered. The imaginary portion of a complex number is entered first and then the real portion.

In algebraic mode, the HP 33S works with complex numbers in the same manner as other numbers. The real portion of a complex number is keyed first and then the imaginary portion.

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, perform the addition of the two complex numbers and then the multiplication:

[6] [+/-] [ENTER] [7] [ENTER] [5] [ENTER] [4] [↰] [CMPLX] [+] [3] [ENTER] [2] [↰] [CMPLX] [×]

In algebraic mode:

[↱] [(] [2] [+] [3] [↰] [CMPLX] [↱] [)] [×] [↱] [(] [7] [−] [6] [↰] [CMPLX] [+]
[4] [+] [5] [↰] [CMPLX] [↱] [)] [ENTER]

Figure 1

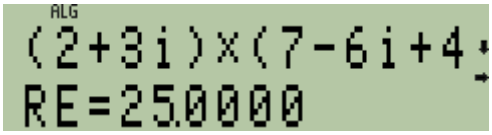


Figure 2

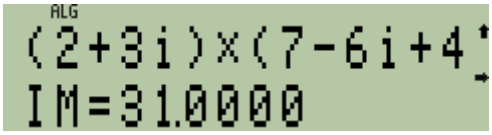


Figure 3

Answer: 25 + 31i. Figure 1 shows the display in RPN mode. Figure 2 shows the display in algebraic mode immediately after pressing the last keystroke in the solution presented above. Then press [↓] to see the display in Figure 3 in algebraic mode only.

Example 2: In Radians mode, compute $\sin(2+3i) + \cos(1-4i) + e^{(2+2i)}$

Solution: In RPN mode:

[MODES] [2] (Sets Radians mode)
[3] [ENTER] [2] [↰] [CMPLX] [SIN] [4] [+/−] [ENTER] [1] [↰] [CMPLX] [COS] [↰] [CMPLX] [+]
[2] [ENTER] [2] [↰] [CMPLX] [e^x] [↰] [CMPLX] [+]

In algebraic mode:

[MODES] [2] (Sets Radians mode)
[↱] [(] [2] [+] [3] [↰] [CMPLX] [↱] [)] [SIN] [+] [↱] [(] [1] [−] [4] [↰] [CMPLX] [↱] [)] [COS] [+]
[↱] [(] [2] [+] [2] [↰] [CMPLX] [↱] [)] [e^x] [ENTER]

Figure 4

Answer: The approximate answer is 20.83 + 25.51i. Figure 4 shows the display in RPN mode.

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

Solution: In RPN mode:

[2] [ENTER] [3] [ENTER] [4] [+/−] [ENTER] [4] [↰] [CMPLX] [÷]

In algebraic mode:

[↱] [(] [3] [+] [2] [↰] [CMPLX] [↱] [)] [÷] [↱] [(] [4] [−] [4] [↰] [CMPLX] [↱] [)] [ENTER]

Figure 5

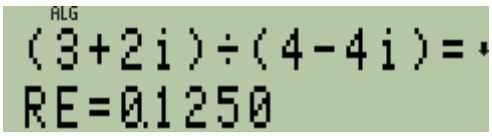


Figure 6

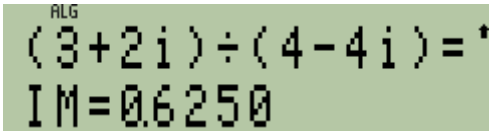


Figure 7

Answer: The answer is 0.125 + 0.625i. Figure 5 shows the answer in RPN mode. Figure 6 shows the display in algebraic mode immediately after pressing the last keystroke in the solution presented above. Then press [↓] to see the display in Figure 7 in algebraic mode only.

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

Solution: In RPN mode:

[6] [ENTER] [5] [f] [CMPLX] [+] [f] [→θ,r]
or simply [6] [ENTER] [5] [f] [→θ,r]

In algebraic mode:

[g] [(] [5] [+] [6] [f] [CMPLX] [g] [)] [ENTER] [f] [→θ,r]
or simply [5] [x↔y] [6] [f] [→θ,r]

Figure 8

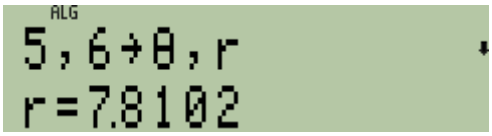


Figure 9

Answer: The answer of 7.81 is shown in the display. Figure 8 shows the answer in RPN mode. Figure 9 shows the answer in algebraic mode.

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 x Z, the current I is equal to E / Z.

In RPN mode:

[5] [ENTER] [4] [5] [ENTER] [4] [ENTER] [3] [f] [CMPLX] [÷]

In algebraic mode:

[g] [(] [4] [5] [+] [5] [f] [CMPLX] [g] [)] [÷] [g] [(] [3] [+] [4] [f] [CMPLX] [g] [)] [ENTER]

Figure 10

Answer: The answer is 6.2 – 6.6i. This is equivalent to 6.2 - 6.6j amps. Figure 10 shows the answer in RPN mode.