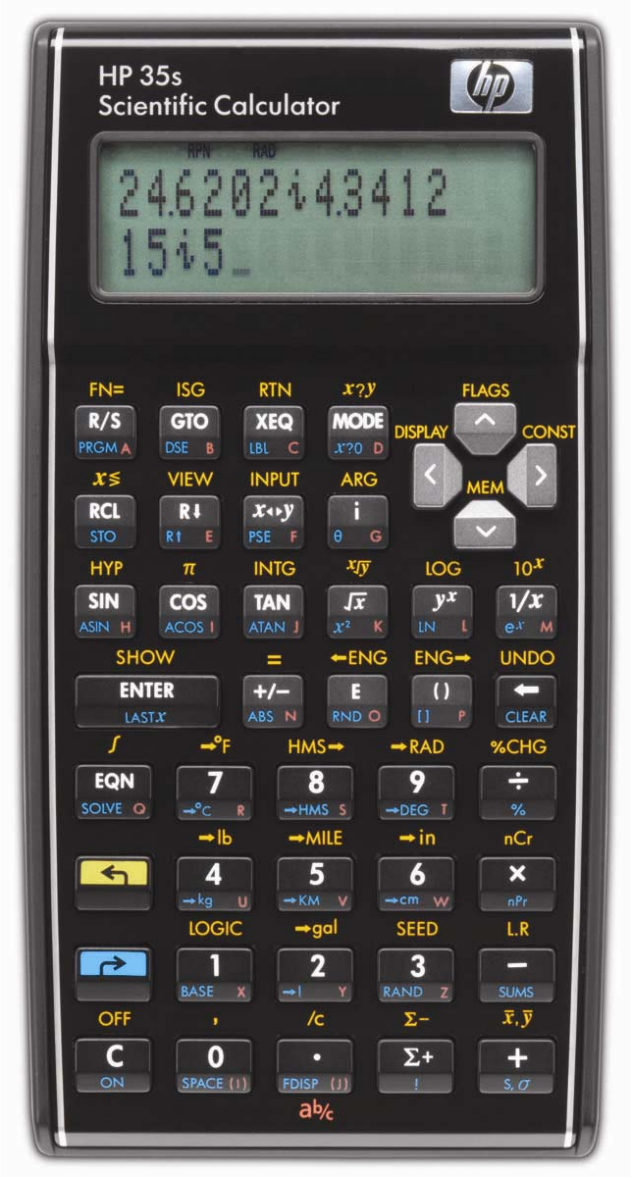
hp calculators

HP 35s Working with complex numbers –part 1

Complex numbers

Practice working problems involving complex numbers



HP 35s Working with complex numbers – part 1

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 HP 35s has a dedicated [i] key, which is pressed between the real and imaginary part of a complex number. Because the HP 35s holds an entire complex number in one stack register, the entire 4-level stack can hold 4 complex numbers at once.

In RPN mode, the HP 35s has two "complex number" modes available. The first is the standard xiy mode, where the real portion is input, the key pressed, and then the complex number portion is input. The second is by entering the complex number in "polar" format or a magnitude r, then the theta symbol, followed by an angle, or simply rΘa. These are selected using the [↶] [DISPLAY] menu choices 9 and 10 as shown in figure 1. To choose option 9 once [↶] [DISPLAY] has been pressed, press 9. To choose option 10, press the decimal point followed by a zero.

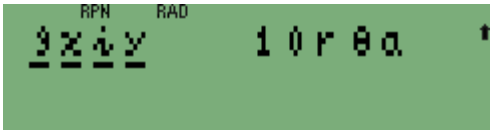


Figure 1

In algebraic mode, the HP 35s has three "complex number" modes available. The first two modes are the same as for RPN and are described in the preceding paragraph. The third mode which is only available in algebraic is the x+yi mode. It is selected using the [↶] [DISPLAY] menu choice 11, as shown in figure 2. To choose option 11 if you have already pressed [↶] [DISPLAY], press the decimal point followed by a one.

Figure 2

Note that changing the display mode changes any previously entered complex numbers to the new format. This means that to convert from polar to rectangular coordinates, for example, all that is needed is to change how a polar form complex number is displayed.

The HP 35s provides a new level of ease of use when dealing with complex numbers.

Practice working problems involving complex numbers

Example 1: Compute (2+3i) * [(7-6i) + (4+5i)]. Use the XiY display mode.

Solution: Press [↶] [DISPLAY] [9]

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

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

In algebraic mode:

[2] [i] [3] [×] [( )] [7] [i] [6] [+/−] [+] [4] [i] [5] [ENTER]

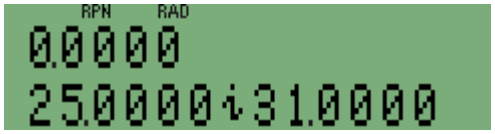


Figure 3

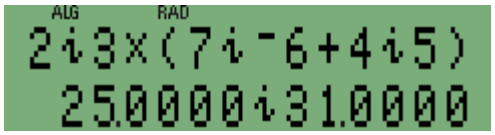


Figure 4

Answer: 25 + 31i. Figure 3 shows the display in RPN mode. Figure 4 shows the display in algebraic mode.

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

Solution: In RPN mode:

[MODE] [2] (Sets Radians mode)
[2] [i] [3] [SIN] [1] [i] [4] [+/−] [COS] [+] [2] [i] [2] [↻] [e^x] [+]

In algebraic mode:

[MODE] [2] (Sets Radians mode)
[SIN] [2] [i] [3] [▷] [+] [COS] [1] [i] [4] [+/−] [▷] [↻] [e^x] [2] [i] [2] [ENTER]

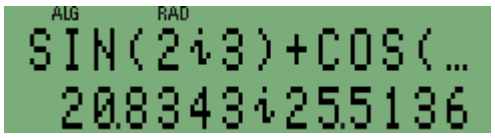


Figure 5

Answer: The approximate answer is 20.83 + 25.51i. Figure 5 shows the display in algebraic mode.

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

Solution: In RPN mode:

[3] [i] [2] [ENTER] [4] [i] [4] [+/−] [÷]

In algebraic mode:

[3] [i] [2] [÷] [4] [i] [4] [+/−] [ENTER]

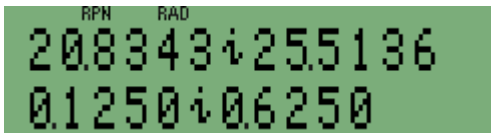


Figure 6

Answer: The answer is 0.125 + 0.625i. Figure 6 shows the answer in RPN mode

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

Solution: In RPN or algebraic mode:

3 i 2 ENTER ↶ DISPLAY . 0

Figure 7

Figure 8

Answer: The answer of 7.8102 is shown in the display. Figure 7 shows the answer in RPN mode. Note that if the magnitude is needed separated from the number shown, the ↷ ABS function will provide it (this is shown in Figure 8). If the angle is desired separated from the number shown, the ↶ ARG function will provide it.

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:

4 5 i 5 ENTER 3 i 4 ÷

In algebraic mode:

4 5 i 5 ÷ 3 i 4 ENTER

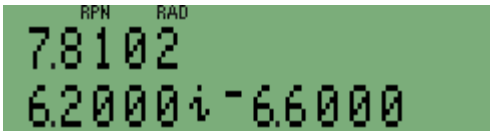


Figure 9

Answer: The answer is 6.2 – 6.6i. This is equivalent to 6.2 - 6.6j amps. Figure 9 shows the answer in RPN mode.