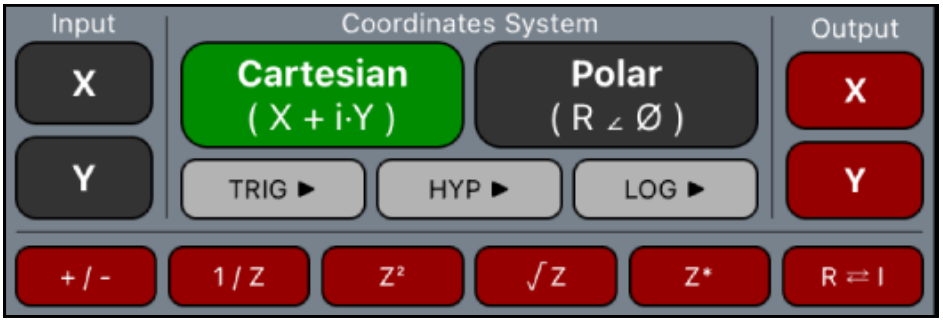
Complex Numbers Worksheet



This worksheet implements a Complex stack to perform operations and functions with complex numbers. A complex number is entered from the calculator using the “Input” buttons in the selected coordinate system (Cartesian or Polar).

3D Vector Menu Actions	
[Cartesian] Input: [X] [Y] Output: [X] [Y]	Set Cartesian coordinates system. Input the calculator’s displayed number in the cartesian ‘X’ or ’Y’ coordinate. Recalls to the calculator the corresponding ‘X’ or ‘Y’ coordinate.
[Polar] Input: [R] [Ø] Output: [R] [Ø]	Set Polar coordinates system. Input the calculator’s displayed number in: the radial distance ‘R’ to the origin or the polar angle ‘Ø’ (angle with respect to X-axis) coordinate. Recalls to the calculator the corresponding ‘R’ or ‘Ø’ coordinate.
[TRIG ▶]	Shows a menu to apply Trigonometric functions to Zx.
[HYP ▶]	Shows a menu to apply Hyperbolic functions to Zx.
[LOG ▶]	Shows a menu to apply Logarithmic functions to Zx.
[+ / -]	Change the sign of Zx (real & imaginary part).
[1 / Z]	Calculates the reciprocal of Zx.
Z^2	Conjugates Zx (change the sign of the imaginary part).
√ Z	Calculates the square root of Zx.
Z*	Conjugates Zx (change the sign of the imaginary part).
[R ⇄ I]	Swaps the real and imaginary parts of Zx.

To manipulate the Complex stack, use the same keys for ‘Swap’, ‘Roll Up’, ‘Roll Down’, ‘Clear’, ‘INPUT’, ‘ENTER’, etc that may be available in the calculator’s keyboard.

When the Polar coordinates system is selected, the angles are entered and shown in the current angle unit.

The complex stack works with “RPN” logic independent from the calculator’s logic setting. This means all arithmetic operations are performed between the Y and X stack registers.

To better understand how this menu works, follow the next examples carefully.

Example 1: (Arithmetic calculation)
Evaluate the expression: [i·2 • (-8 + i·6)^3] / [(2 + i·3) • (4 + i·5)]

Solution:

Keystrokes	Description
[Cartesian]	Set the Cartesian coordinates.
0 **[X]** 2 **[Y]** **[INPUT]**	Enter the number “0 + i·2” -> **Zx = 0.00 + i·2.00**
8 **[+/-] [X]** 6 **[Y]** **[INPUT]**	Enter the complex number “-8 + i·6” -> **Zx = -8.00 + i·6.00**
3 **[X]** 0 **[Y]**	Enter the exponent number “3 + 0·i” -> **Zx = 3.00 + i·0.00**
[^]	Calculate (-8 + 6·i)^3. Result: **Zx** = **352.00 + i·936.00**
[x]	Calculate 2·i•(-8 + 6·i)^3. Result: **Zx = -1,872.00 + i·704.00**
2 **[X]** 3 **[Y]** **[INPUT]**	Enter the complex number “2 + i·3” -> **Zx = 2.00 + i·3.00**
4 **[X] 5 [Y]**	Enter the complex number “4 + i·5” -> **Zx = 4.00 + i·5.00**
[x]	Calculates (2-i·3)•(4-i·5). Result: **Zx = -7.00 + i·22.00**
[÷]	Calculate the final result. Result: **Zx = 53.64 + i·68.02**
[X] or **[Y]**	Enters the real or imaginary part of **Zx** in the calculator stack.

Example 2: (Arithmetic calculation)
Calculate the phasor expression: 2 ∠ 65º + 3 ∠ 40º and show the result in cartesian coordinates.

Solution: (DEG angular units)

Keystrokes	Description
[Polar]	Set Polar coordinates system.
2 **[R]** 65 **[Ø]** **[INPUT]**	Enter the 1st phasor -> **Zx = 2.00∠65.00**
3 **[R]** 40 **[Ø]**	Enter the 2nd phasor -> **Zx = 3.00∠40.00**
[+]	Adds the complex numbers phasors. Result: **Zx = 4.89∠49.96**
[R] or **[Ø]**	Enters the magnitude or angle of **Zx** in the calculator stack.
[Cartesian]	Set the Cartesian coordinates. Result: **Zx = 3.14 + I·3.74**
[X] or **[Y]**	Enters the real or imaginary part of **Zx** in the calculator stack.

Example 3: (Parallel impedance)
Calculate total impedance of two parallel loads of 150 - i·106.1033 and
100 + i·24.5044.

Solution:

Keystrokes	Description
[Cartesian]	Set Polar coordinates system.
150 **[X]** 106.1033 **[+/-] [Y]**	Enter the 1st impedance -> **Zx = 150.00 - i·106.1033**
[1 / Z]	Calculates the reciprocal -> **Zx = 0.0044 + i·0.0031**
100 **[X]** 24.5044 **[Y]**	Enter the 2nd impedance -> **Zx = 100.00 + i·24.5044**
[1 / Z]	Calculates the reciprocal -> **Zx = 0.0094 - i·0.0023**
[+]	Adds the reciprocals -> **Zx = 0.0139 + i·0.0008**
[1 / Z]	Total impedance -> **Zx = 71.8042 - i·4.3021**

Example 4: (Trigonometric Functions)
Calculate all the trigonometric functions for Z = 3 + i·4

Solution:

Keystrokes	Description
[Cartesian]	Set Polar coordinates system.
3 **[X]** 4 **[Y]**	Enter the Z in polar coordinates -> **Zx = 3.00 + i·4.00**
[TRIG ▶] Sin	Calculates the sine -> **Zx = 3.8537 - i·27.0168**
[LST] **[TRIG ▶]** Cos	Calculates the cosine -> **Zx = -27.0349 - i·3.8512**
[LST] **[TRIG ▶]** Tan	Calculates the cosine -> **Zx = -0.0002 + i·0.9994**
[LST] **[TRIG ▶]** ASin	Calculates the sine^{-1} -> **Zx = 0.6340 + i·2.3055**
[LST] **[TRIG ▶]** ACos	Calculates the cosine^{-1} -> **Zx = 0.9368 + i·2.3055**
[LST] **[TRIG ▶]** ATan	Calculates the cosine^{-1} -> **Zx = 1.4483 + i·0.1590**

Example 5: (Hyperbolic Functions)
Calculate all the hyperbolic function for of Z = 1 + i·2

Solution:

Keystrokes	Description
[Cartesian]	Set Polar coordinates system.
1 **[X]** 2 **[Y]**	Enter the Z in polar coordinates -> **Zx = 1.00 + i·2.00**
[HYP ▶] Sinh	Calculates the HYP sine -> **Zx = -0.4891 + i·1.4031**
[LST] **[HYP ▶]** Cosh	Calculates the HYP cosine -> **Zx = -0.6421 + i·1.0686**
[LST] **[HYP ▶]** Tanh	Calculates the HYP cosine -> **Zx = 1.1667 - i·0.2435**
[LST] **[HYP ▶]** ASinh	Calculates the HYP sine^{-1} -> **Zx = 1.4694 + i·1.0634**
[LST] **[HYP ▶]** ACosh	Calculates the HYP cosine^{-1} -> **Zx = 1.5286 + i·1.1437**
[LST] **[HYP ▶]** ATanh	Calculates the HYP cosine^{-1} -> **Zx = 0.1733 + i·1.1781**