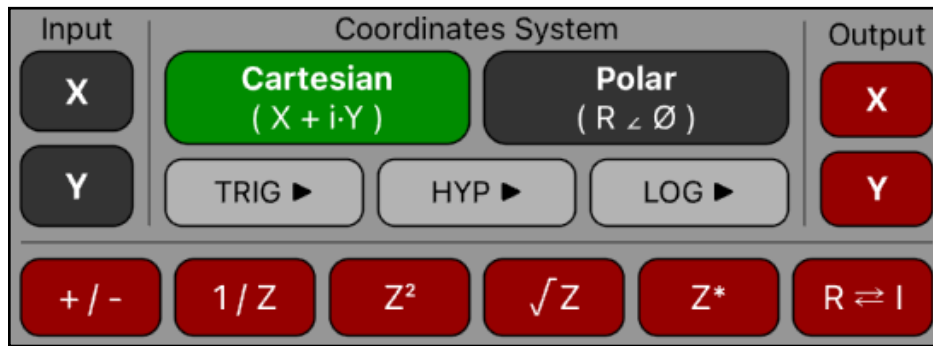


Complex Numbers Worksheet



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 | |
|--|---|
| <p>[Cartesian]</p> <p>Input: [X][Y]</p> <p>Output: [X][Y]</p> | <p>Set Cartesian coordinates system.</p> <p>Input the calculator's displayed number in the cartesian 'X' or 'Y' coordinate.</p> <p>Recalls to the calculator the corresponding 'X' or 'Y' coordinate.</p> |
| <p>[Polar]</p> <p>Input: [R][Ø]</p> <p>Output: [R][Ø]</p> | <p>Set Polar coordinates system.</p> <p>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.</p> <p>Recalls to the calculator the corresponding 'R' or 'Ø' coordinate.</p> |
| [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. |
| Z² | 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: $[i \cdot 2 \cdot (-8 + i \cdot 6)^3] / [(2 + i \cdot 3) \cdot (4 + i \cdot 5)]$

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 $(-8 + 6 \cdot i)^3$. Result: Zx = 352.00 + i·936.00 |
| [x] | Calculate $2 \cdot i \cdot (-8 + 6 \cdot i)^3$. 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 $(2 - i \cdot 3) \cdot (4 - i \cdot 5)$. 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: $2 \angle 65^\circ + 3 \angle 40^\circ$ 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 1 st phasor -> Zx = 2.00∠65.00 |
| 3 [R] 40 [Ø] | Enter the 2 nd 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 $150 - i \cdot 106.1033$ and $100 + i \cdot 24.5044$.

Solution:

| Keystrokes | Description |
|----------------------------------|--|
| [Cartesian] | Set Polar coordinates system. |
| 150 [X] 106.1033 [+/-] [Y] | Enter the 1 st 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 2 nd 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 $Z = 3 + i \cdot 4$ **Solution:**

| Keystrokes | Description |
|---------------------------|---|
| [Cartesian] | Set Polar coordinates system. |
| 3 [X] 4 [Y] | Enter the Z in polar coordinates -> $Zx = 3.00 + i \cdot 4.00$ |
| [TRIG ►] Sin | Calculates the sine -> $Zx = 3.8537 - i \cdot 27.0168$ |
| ■ [LST] [TRIG ►] Cos | Calculates the cosine -> $Zx = -27.0349 - i \cdot 3.8512$ |
| ■ [LST] [TRIG ►] Tan | Calculates the cosine -> $Zx = -0.0002 + i \cdot 0.9994$ |
| ■ [LST] [TRIG ►] ASin | Calculates the sine ⁻¹ -> $Zx = 0.6340 + i \cdot 2.3055$ |
| ■ [LST] [TRIG ►] ACos | Calculates the cosine ⁻¹ -> $Zx = 0.9368 + i \cdot 2.3055$ |
| ■ [LST] [TRIG ►] ATan | Calculates the cosine ⁻¹ -> $Zx = 1.4483 + i \cdot 0.1590$ |

Example 5: (Hyperbolic Functions)Calculate all the hyperbolic function for of $Z = 1 + i \cdot 2$ **Solution:**

| Keystrokes | Description |
|---------------------------|---|
| [Cartesian] | Set Polar coordinates system. |
| 1 [X] 2 [Y] | Enter the Z in polar coordinates -> $Zx = 1.00 + i \cdot 2.00$ |
| [HYP ►] Sinh | Calculates the HYP sine -> $Zx = -0.4891 + i \cdot 1.4031$ |
| ■ [LST] [HYP ►] Cosh | Calculates the HYP cosine -> $Zx = -0.6421 + i \cdot 1.0686$ |
| ■ [LST] [HYP ►] Tanh | Calculates the HYP cosine -> $Zx = 1.1667 - i \cdot 0.2435$ |
| ■ [LST] [HYP ►] ASinh | Calculates the HYP sine ⁻¹ -> $Zx = 1.4694 + i \cdot 1.0634$ |
| ■ [LST] [HYP ►] ACosh | Calculates the HYP cosine ⁻¹ -> $Zx = 1.5286 + i \cdot 1.1437$ |
| ■ [LST] [HYP ►] ATanh | Calculates the HYP cosine ⁻¹ -> $Zx = 0.1733 + i \cdot 1.1781$ |