Entering Complex Numbers

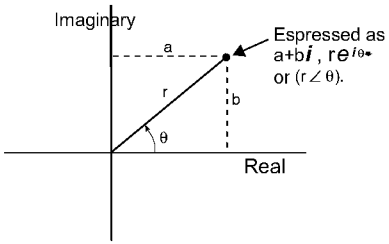
You can enter complex numbers in the polar form ($r\angle\theta$), where r is the magnitude and θ is the angle, or polar form $re^{i\theta}$. You can also enter complex numbers in rectangular form $a+bi$.

Overview of Complex Numbers

A complex number has real and imaginary components that identify a point in the complex plane. These components are measured along the real and imaginary axes, which are similar to the x and y axes in the real plane.

The point can be expressed in rectangular form or in either of two polar

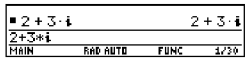
The *i* symbol represents the imaginary number $\sqrt{-1}$.

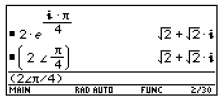


As shown below, the form that you can enter depends on the current Angle mode.

You can use the form:	When the Angle mode setting is:
$a+bi$	Radian, Degree or Gradian
$re^{i\theta}$	Radian only (In Degree or Gradian angle mode, this form causes a Domain error.)
$(r\angle\theta)$	Radian, Degree or Gradian

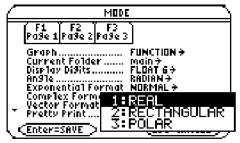
Use the following methods to enter a complex number.

To enter the:	Do this:
Rectangular form $a+bi$	Substitute the applicable values or variable names for a and b. a [+] b [2nd] [i] **Note:** To get the *i* symbol, press [2nd] [i], do not simply type an alphabetic i. For example: 

To enter the:	Do this:
Polar form $re^{i\theta}$ or $(r\angle\theta)$ Parentheses are required for the $(r\angle\theta)$ form.	Substitute the applicable values or variable names for r and θ, where θ is interpreted according to the Angle mode setting. **TI-89 Titanium:** [alpha] [R] [◆] [e^x] [2nd] [i] [◆] [θ] [)] – or – [(] [alpha] [R] [2nd] [∠] [◆] [θ] [)] **Important:** Do not use the $re^{i\theta}$ polar form in Degree angle mode. It will cause a Domain error. **Note:** To get the *e* symbol, press: TI89 Titanium: [◆] [e^x]. Voyage™ 200: [2nd] [e^x] Do not simply type an alphabetic e. **Tip:** To get the ∠ symbol, press [2nd] [∠]. **Tip:** To enter θ in degrees for $(r\angle\theta)$, you can type a ° symbol (such as 45°). To get the °symbol, press [2nd] [°]. You should not use degrees or Gradian for $re^{i\theta}$. **Voyage™ 200:** R [2nd] [e^x] [2nd] [i] [θ] [)] – or – [(] R [2nd] [i] [θ] [)] For example:  Results are shown in rectangular form, but you can select polar form.

Complex Format Mode for Displaying Results

Use [MODE] to set the Complex Format mode to one of three settings.



You can enter a complex number at any time, regardless of the Complex Format mode setting. However, the mode setting determines how results are displayed.

If Complex Format is:	The TI-89 Titanium / Voyage™ 200:

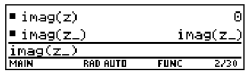
REAL	Will not display complex results unless you: • Enter a complex number. – or – • Use a complex function such as **cFactor()**, **cSolve()**, or **cZeros()**. If complex results are displayed, they will be shown in either a+b*i* or $re^{i\theta}$ form. **Note:** You can enter complex numbers in any form (or a mixture of all forms) depending on the Angle mode.
RECTANGULAR	Displays complex results as a+b*i*.
POLAR	Displays complex results as: • $re^{i\theta}$ if the Angle mode = Radian – or – • (r ∠ θ) if the Angle mode = Degree or Gradian

Using Complex Variables in Symbolic Calculations

Regardless of the Complex Format mode setting, variables that have no stored value and those that do not end with an underscore (_) are treated as real numbers. To perform complex symbolic analysis, you can use either of the following methods to set up a complex variable.

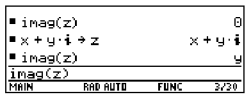
Method 1: Use an underscore _ (**TI-89 Titanium:** ♦ [_], **Voyage™ 200** 2nd [_]) as the last character in the variable name to designate a complex variable. For example:

z_ is treated as a complex variable if it does not have a stored value.



Method 2: Store an unreal value into any variable. For example:

x+y*i*→z
Then z is treated as a complex variable.



Note: For best results in calculations such as **cSolve()** and **cZeros()**, use Method 1.

Complex Numbers and Degree Mode

Radian angle mode is recommended for complex number calculations. Internally, the TI-89 Titanium / Voyage™ 200 converts all entered trig values to radians, but it does not convert values for exponential, logarithmic, or hyperbolic functions.

In Degree angle mode, complex identities such as e^(*i*θ) = cos(θ) + i sin(θ) are not generally true because the values for cos and sin are converted to radians, while those for e^( ) are not. For example, e^(*i*45) = cos(45) + *i* sin(45) is treated internally as e^(*i*45) = cos(π/4) + *i* sin(π/4). Complex identities are always true in Radian angle mode.

Note: If you use Degree angle mode, you must make polar entries in the form (r ∠ θ). In Degree or Gradian angle mode, an $re^{i\theta}$ entry causes an error.