Entering Complex Numbers

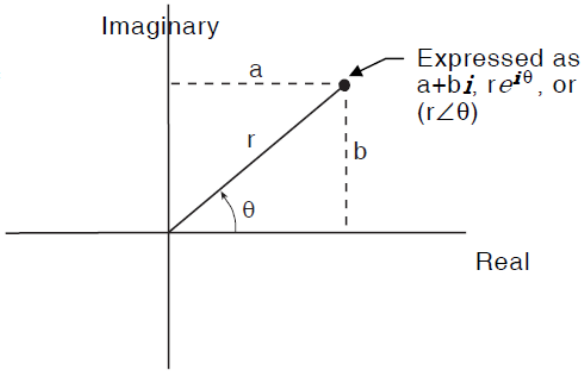
You can enter complex numbers in the polar form (r∠θ), where r is the magnitude and θ is the angle, or polar form $re^{i\theta}$. You can also enter complex numbers in rectangular form a+b*i*

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 forms.

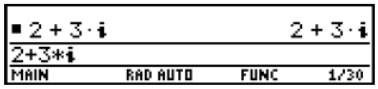
The *i* symbol represents the imaginary number $\sqrt{-1}$.



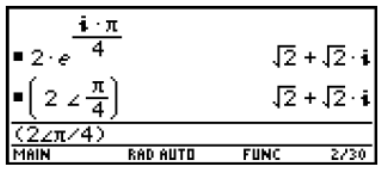
As shown below, the form that you can enter depends on the current Angle mode.

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

Use the following methods to enter a complex number.

To enter the:	Do this:
Rectangular form a+b*i*	Substitute the applicable values or variable names for a and b. a [+] b [2nd] [¿] For example: 

Note: *To get the* ***i*** *symbol, press* [2nd] [¿], *do not simply type an alphabetic i.*

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]) **Voyage™ 200:** R 2nd [e^x] 2nd [i] [θ]) – or – (R 2nd [∠] [θ]) For example:  Results are shown in rectangular form, but you can select polar form.

Important: *Do not use the $re^{i\theta}$ polar form in* Degree *angle mode. It will cause a* Domain error.

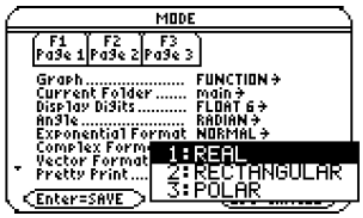
Note: *To get the e symbol, press:*
TI-89 Titanium: ◆ [e^x].
Voyage™ 200: 2nd [e^x]
Do not simply type an alphabetic e.

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 $re^{i\theta}$.*

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.
RECTANGULAR	Displays complex results as a+b*i*.
POLAR	Displays complex results as: • $re^{i\theta}$ if the Angle mode = Radian – or – • $(r\angle\theta)$ if the Angle mode = Degree or Gradian

Note: *You can enter complex numbers in any form (or a mixture of all forms) depending on the* Angle *mode.*

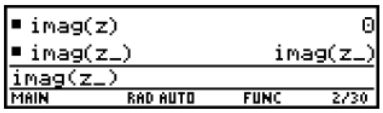
Using Complex Variables in Symbolic Calculations

Regardless of the Complex Format mode setting, variables that have no stored value and 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:

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

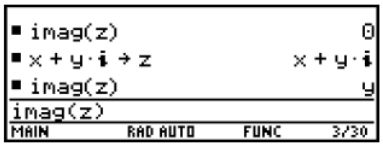
z_ is treated as a complex variable if it does not have a stored value.



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

x+y*i*→z

Then z is treated as a complex variable.



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.

Note: *If you use* Degree or Gradian *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.*

In Degree and Gradian angle modes, complex identities such as $e^{(i\theta)} = \cos(\theta) + i\sin(\theta)$ are not generally true because the values for cos and sin are converted to radians, while those for $e^{(\ )}$ are not. For example, $e^{(i45)} = \cos(45) + i\sin(45)$ is treated internally as $e^{(i45)} = \cos(\pi/4) + i\sin(\pi/4)$. Complex identities are always true in Radian angle mode.