

## Chapter 8 / Example 10

# Complex numbers

The TI-84 Plus C will not work directly in degrees with the complex number operations of modulus and argument. Enter angles in degrees using the degree symbol.

The voltage of an AC electrical sources can be modelled by the equation  $V = a \sin(bt + c)$ , where  $c$  is the phase shift. Two AC sources with equal frequencies are combined. One has a maximum voltage of 60V and the other of 80V. The amplitude of the sine function gives the maximum voltage of each electrical source. The first electrical source has a phase shift of  $30^\circ$  and the other of  $120^\circ$ . Find the maximum voltage and the phase difference of the combined source.

$$\text{amplitude} = |60e^{30i} + 80e^{120i}|$$

To enter the modulus function press **MATH** **▸** NUM 1:abs(

To type  $60e^{30^\circ i}$

Type 60, press **2nd** **LN** **[e<sup>x</sup>]**,

Type 30, press **2nd** **APPS** **[ANGLE]** 1:  $^\circ$  and press **2nd** **[.]** **[i]**

Press **▸**

Type  $+80e^{120^\circ i}$  and press **ENTER**.

$$|60e^{30i} + 80e^{120i}| = 100$$

$$|60e^{30^\circ i} + 80e^{120^\circ i}| = 100$$

$$\text{Phase shift} = \arg 60e^{30i} + 80e^{120i}$$

Press **MATH** **▸** **▸** CMPLX 4:angle(

Type  $60e^{30^\circ i} + 80e^{120^\circ i}$  and press **ENTER**.

$$|60e^{30^\circ i} + 80e^{120^\circ i}| = 100$$

$$\arg(60e^{30^\circ i} + 80e^{120^\circ i}) = 1.450893994$$

Since the GDC is in radian mode by default, this argument is in radians.

There is a function to convert answers in radians into degrees, but to use this, the calculator must be in degree mode.

An easier method is to multiply by  $\frac{180}{\pi}$

Type  $\times 180 \div \pi$  and press **ENTER**.

$$\arg 60e^{30i} + 80e^{120i} = 83.1^\circ$$

$$|60e^{30^\circ i} + 80e^{120^\circ i}| = 100$$

$$\arg(60e^{30^\circ i} + 80e^{120^\circ i}) = 1.450893994$$

$$\text{Ans} \times 180 / \pi = 83.13010235$$