Vector Addition on the TI-83 Calculator

Introduction: This calculator does not have the vector friendly features of the **TI-85** and **TI-89** calculators. It does, however, have a feature that allows us to work with complex numbers. Vectors and complex numbers are very closely related. In fact, we can use addition of complex numbers to duplicate arithmetic with vectors. All you need is an introduction to the notation.

The **Rectangular Forms** look very similar;

For the vector $13\boldsymbol{i} + 18\,\boldsymbol{j}$

The complex equivalent $13 + 18\boldsymbol{i}$

That little ***i*** for the complex form is on the keyboard so you can enter these forms for yourself. See the bottom row of the calculator keyboard. It is not the same as the **i-hat** that appears in the vector form. They look the same here but they have very different meanings. Do not be fooled into thinking you can type in the vectors directly. You can only enter the complex numbers directly.

The **Polar Forms** of the equivalent vector and complex number seem to be very dissimilar. However, all the key pieces are included in both. Don't be distracted by the, to us, extraneous symbols. Just look passed the distractions to the values that matter to your vector.

One important limitation of using the **TI-83** calculator to do vector addition is that it must be in **RADIAN** mode. We can enter the angles in degrees, if we include the degree symbol (°), but if we expect an angle in the answer, we will always get that angle in radians. If the calculator is in **DEGREE** mode, we get nonsense answers.

The **Polar Forms** look very dissimilar;

For the vector **$17 \angle 50° = 17 \angle 0.872665$**

The complex equivalent **17 e^(50°*i*) = 17e^(0.872665*i*)**

As you will see, you can add the vectors in either form, even mixing forms works fine. The calculator always gives us the answer in rectangular form, however. When necessary, the rectangular form can be converted to the equivalent polar form.

Finally, if you need your answer in degrees, then you will need to convert the angle in radians given by the calculator to an angle in degrees. This is accomplished using the following conversion equation.

Angle in degrees = angle in radians x $180°/\pi$

Vector Addition on the TI-83 Calculator

The following instructions explain the key-by-key keystrokes necessary to add two vectors.

Before you begin, adjust the angular **MODE** of your calculator. You must set the calculator to **RADIAN** mode. If you want to enter angles in degrees instead of radians, even when the calculator is in **RADIAN** mode, follow the angle with the degree symbol (° =2nd **ANGLE ENTER**). Below I've entered only the degree symbol. You'll need to type these three keystrokes any time it appears.

Adding vectors in Polar Form

1. To add the vectors **[13∠120°]** and **[21∠ –45°],** press the following keys:

   13 2nd **LN** **120°** 2nd ***i*** **)** **+** **21** 2nd **LN** **-45°** 2nd ***i*** **)**

2. On the main screen you will see

   13 e^(**120°*i***)+ **21**e^(**–45°*i***)

3. Press **ENTER** and you will see the answer in rectangular complex number form.

   8.349242 –3.590912*i*

4. To convert the answer to the polar complex number form, type

   MATH **CPX** **7**

5. On the screen you will see

   Ans►Polar

6. Press **ENTER** to get your answer in polar form.

   9.088702e^(**–.406173*i***) which is equivalent to **[9.088702∠ –0.406173]** (in radians)

7. To convert the angle in radians to an angle in degrees, enter

   –0.406173*180 / π ENTER

   –23.271999 (this angle is now in degrees)

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Adding vectors in Rectangular Form

1. In this example we will add two rectangular-form vectors: [19, -3] and [-8, 16]

2. Press **19 + (-3 2nd *i*) + (–8 + 16 2nd *i*)**

3. On the main screen you will see

   19+(-3 *i*)+(–8+16 *i*)

4. Press **ENTER** to get the answer in rectangular form.

   11.000000+13.000000 *i*

5. Before you continue, make sure of the angular **MODE** of your calculator. Set the calculator to **RADIAN** mode if it is not already set that way.

6. To convert the answer to polar form, type

   MATH CPX 7

7. On the screen you will see

   Ans►**Polar**

8. Press **ENTER** to get your answer in polar form.

   [17.029386 e^(.868539 *i*) which is equivalent to **[17.029386∠ 0.868539** radians**]**

7. To convert the angle in radians to an angle in degrees, enter

   0.868539 *180/π **ENTER**

   On the screen you'll see

   49.763619 degrees