

Degrees and Radians

Setting the calculator's angle mode:

1. Press **MODE**.
2. The fourth option sets whether commands that returns angles return them in degrees or radians.
3. Set this to Radians.

The **MATH ANGLE** Submenu:

First, enter this submenu by typing **2nd MATH 2:ANGLE**.

The items are

- $^{\circ}$:converts the previous number from degrees to the current units.
- r :converts the previous number from radians to the current units.
- ' :separates entries for degrees'minutes'seconds' for conversion to degrees.
- P>Rx**(:finds the x-coordinate of a polar point.
- P>Ry**(:finds the y-coordinate of a polar point.
- R>Pr**(:finds the positive r-coordinate of a rectangular point, the distance to the origin.
- R>P θ** (:finds the θ -coordinate in the interval $(-\pi, \pi]$ of a rectangular point.
- \sphericalangle :for entering angles.
- DMS** :converts to degrees°minutes'seconds".
- DD** :converts to degrees°.

Example#1: Convert π to degrees.

1. Try typing π^r and press **ENTER**. It returned "3.14159265359" because the calculator is in radian mode.
2. Insead enter π **DMS** by typing **2nd π 2nd MATH 2:Angle 9:DMS ENTER**.
3. Now the calculator returns "180°".

Example#2: Convert 330° to radians.

1. Type **330°** and press **ENTER**. Note **2nd D** will also print the degree symbol on the TI-92.
2. It returns " $11\pi/6$ ".

I strongly suggest leaving the calculator in radian mode and using the $^{\circ}$ function when using degree measurements. This will simplify trying to remember what mode the calculator is in and reinforce the use of the $^{\circ}$ symbol which is required for degree measurements.

Example#3: Convert 57.762° to DMS.

1. Type **57.762°DMS** and press **ENTER**.
2. It returns " 57°45'43.1999999856" ".

Example#4: Convert 8°34'6.5" to degrees rounded to the 5th decimal place.

1. Type **8°34'6.5"DMS** and **ENTER**. Note, on the TI-92 **2nd B** will print the ' and **2nd L** will print the ".
2. It returns "8.56847222222°". Thus, the answer is 8.56847°.

Example#5: Convert 8°34'6.5" to radians rounded to the 5th decimal place.

1. Type **8°34'6.5"** and **ENTER**.
2. It returns ".149548052143". Thus, the answer is 0.14955 .

Trigonometric Functions

Sine, Cosine, & Tangent:

Example#6: Evaluate $\cos(3\pi/4)$ on the calculator.

0. By hand, the answer is $\frac{-\sqrt{2}}{2} = -0.707106781187$.

1. Type **COS(3 π /4)** **ENTER**. The parenthesis are needed so that the division is done before the cosine function.
2. It returns " $\frac{-\sqrt{2}}{2}$ ". If you didn't get this, make sure you're in radian mode or use the r function.

Example#7: Approximate $\tan 35^\circ$ on the calculator.

1. Type **TAN(35°)** \blacklozenge **ENTER**.
2. It returns ".70020753821" no matter what mode the calculator is in.

Example#8: Approximate $\sin^2(-30^\circ)$.

1. Type **SIN(-30°)^2** \blacklozenge **ENTER**.
2. It returns ".25".

Secant, Cosecant, & Cotangent:

Example#9: Approximate $\csc(4\pi)$.

0. By hand, $\csc(4\pi)$ is undefined.
1. Type **1/SIN(4 π)** \blacklozenge **ENTER**. DON'T USE SIN^{-1} . That's the inverse sine function.
2. It returns "-5E12". Why?
3. How might you tell when to trust the calculator and when not to?

Cosecant and cotangent are evaluated in similar ways.

Inverse Trig. Functions:

Example#10: Find $\cos^{-1}(-.5)$ in radians.

0. By hand, $\cos^{-1}(-.5) = 2\pi/3$.
1. Type **COS⁻¹(-.5)** **ENTER**. Note **COS⁻¹** is in yellow over the **COS** key.
2. It returns "2.09439510239". Note it didn't give me the exact answer since I typed in a decimal number, $-.5$, and it assumed that I wanted a decimal answer.
3. Type **COS⁻¹(-1/2)** **ENTER**.
4. It returns " $2\pi/3$ ".

Example#11: Approximate $\tan^{-1}(1)$ in degrees.

1. If you just type **TAN⁻¹(1)** \blacklozenge **ENTER**, you'll get ".785398163397" because inverse trig. functions return an angle in the current setting, radians.
2. Execute the command **TAN⁻¹(1)▶DD** \blacklozenge **ENTER**.
3. It now returns "45°". Thus, the answer is 45° .
4. Change back to radian mode.

Inverse sine is used the same way.

Polar and Rectangular forms: Complex numbers & Vectors

Mode Setting:

1. Press **MODE**.
2. The sixth option sets whether any commands that returns complex numbers returns them in **REAL**, **RECTANGULAR** or **POLAR** form.
3. Set this to **RECTANGULAR**.
4. The 7th option determines if any command that returns a vector returns it in **RECTANGULAR** or **POLAR(CYLINDRICAL)** form. It's **CYLINDRICAL** instead of **POLAR** for 3D vector's and cylindrical coordinates are the two polar coordinates, r and θ , with a z coordinate for the 3rd dimension when a 3rd coordinate is given. **SPHERICAL** will not be used in this class.
5. Set this to **RECTANGULAR**.

Calculator's notation:

- $x+yi$:The complex number in rectangular form, $x+yi$.
- $e^{i\theta} \cdot r$:The complex number in polar(trigonometric) form, $r(\cos\theta + i\sin\theta) = r \text{ cis}\theta$ with θ in radian mode.
- $(r \angle \theta)$:The complex number in polar(trigonometric) form, $r(\cos\theta + i\sin\theta) = r \text{ cis}\theta$ with θ in degree mode.
- $[x,y]$:The vector in rectangular form, $x\mathbf{i} + y\mathbf{j}$.
- $[r, \angle \theta]$:The vector in polar form, $(r \cos\theta)\mathbf{i} + (r \sin\theta)\mathbf{j}$.

The symbol \angle is a 2nd function on the F key on the TI-92.

Conversion:

Example#12: Use the calculator to convert $6-4i$ to polar form rounded to the 4th decimal place.

1. Set the calculator's Complex Mode to POLAR mode
2. Type $6-4i$ \blacklozenge **ENTER**.
3. It returns " $e^{-.588002603548i} \cdot 7.21110255093$ ". Thus, the answer is $7.2111cis(-0.5880)$.
4. To get θ in degrees, put the calculator in degree mode and type $6-4i$ \blacklozenge **ENTER**.
Now it will return " $(7.21110255093 \angle -33.690067526)$ " and the answer in degrees is $7.2111cis(-33.6901^\circ)$.
5. Go back to radian mode and rectangular mode.

The calculator will always return angles, θ , in the interval $(-180^\circ, 180^\circ]$ or $(-\pi, \pi]$.

Example#13: $-3cis(250^\circ)$ to rectangular form with the calculator. Appr. to the thousandths

1. Type $(-3 \angle 250^\circ)$ \blacklozenge **ENTER**.
2. It returns " $1.02606042998+2.81907786236i$ ". So, the answer is $1.026+2.819i$.

Example#14: Find the magnitude and direction in degrees of the vector $-5i+j$. Round to the hundredths.

1. Switch to degree mode.
2. Type $[-5,1] \blacktriangleright$ **Polar** \blacklozenge **ENTER**. On the TI-92, **Polar** can be found in **2nd MATH** **4:Matrix L:Vector ops 4:** **Polar**.
3. It returns " $[5.09901951359 \angle 168.690067526]$ ".
4. Thus, the magnitude is 5.10 and the direction is 168.69° counter-clockwise from the positive x-axis.
5. Go back to radian mode.

Example#15: For the vector whose magnitude is 10 and makes an angle of $3\pi/5$ clock-wise from the positive x-axis, write it in the form $xi+yj$. Round to the tenths.

1. From the problem, $r=10$ and $\theta=-3\pi/5$. Why is θ negative?
2. Type $[10, \angle -3\pi/5]$ \blacklozenge **ENTER**. Again, **Rec** isn't needed since we are in RectV mode.
3. It returns " $[-3.09016994375, -9.51056516295]$ ". Thus the answer is $-3.1i-9.5j$.

Polar Graphing:

Example#16: Graph $r=9\cos(5\theta)$ on the calculator.

1. Enter polar graphing mode.
Go to the mode screen, and set the 1st option to POLAR.
2. Enter the polar equation editor by pressing \blacklozenge **Y=**.
3. Set $r1=9\cos(5\theta)$. Note θ is on the keyboard.
4. Set viewing window. Press \blacklozenge **WINDOW**.
Besides the regular variables(xMin, etc.) there are 3 new ones.
 θ_{min} :Minimum value for θ .
 θ_{max} :Maximum value for θ .
 θ_{step} :Amount to increment θ between points.
These are needed because the calculator still can only plot points and connect them with lines. In other words, to graph the equation the calculator first sets θ to θ_{min} , finds the corresponding $r=9\cos(5\theta)$, and plots that point. It then adds θ_{step} to θ , finds r , plots this new point, and connects this point to the previous point with a line. It then adds θ_{step} to θ , ... It repeats this process until $\theta + \theta_{step} > \theta_{max}$.
Set θ_{min} to 0, θ_{max} to 2π , and θ_{step} to $\pi/24$. These are the default settings. Thus, ZoomStd would set these variables to these values.
5. Graph the curve by pressing \blacklozenge **GRAPH**. This is automatically done if you used ZoomStd.
6. You should now see a 5 pointed rose.
7. Reset back to the regular settings.
Press \blacklozenge **Y=** (cursor up) **CLEAR MODE** (cursor right) **1:FUNCTION** **ENTER**.

Parametric Equation Graphing

Example#17: Graph the set of parametric equations $x=t+2$ and $y=t^2+1$ for $-1 \leq t \leq 2$ on the calculator.

1. Enter Parametric graphing mode.
Go to the mode screen, and set the 1st option to PARAMETRIC.

2. Enter the parametric equation editor by pressing **◆ Y=**.

3. Set $x_1=t+2$ and $y_1=t^2+1$.

4. Set the viewing window. Press **◆ WINDOW**.

Besides the regular variables (x_{Min} , etc.) there are 3 new ones.

tmin :Minimum value for t.

tmax :Maximum value for t.

tstep :Amount to increment t between points.

These are needed because the calculator still can only plot points and connect them with lines. In other words, to graph the set of parametric equations the calculator first sets t to tmin, finds the corresponding $x=t+2$ and $y=t^2+1$, and plots that point, (x,y). It then adds tstep to t, finds x and y, plots this new point, and connects this point to the previous point with a line. It then adds tstep to t, ... It repeats this process until $t + tstep > tmax$.

Set tmin to -1 and tmax to 2 as stated in the problem. While tstep needs to be a relatively small number. Since, it's probably already set to $\pi/24=0.130899693...$ Let's try this value.

5. Graph the curve by pressing **◆ GRAPH**.

6. You should now see a section of a parabola. You only get a section of the parabola because of the restrictions on t.

7. Let's play with tstep.

Set tstep to 1 and regraph. See any difference? In this case only the points where $t=-1,0,1,2$ were plotted then connected with lines. What were the points plotted?

Set tstep to 2 and regraph. How many points were plotted? Was one plotted when $t=2$? Why?

What would you expect when tstep=3? When tstep=4?

8. Reset back to the regular settings.

Press **◆ Y= (cursor up) CLEAR (cursor up) CLEAR MODE (cursor right)**

1:FUNCTION ENTER.