Trigonometry on the TI-83/84

Degrees and Radians

Setting the calculator's angle mode:

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

The ANGLE menu:

First, enter this submenu by typing **2nd ANGLE**.
Some if the items are (The rest will be discussed later.)

° :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.
►DMS :converts degrees to degrees°minutes'seconds"

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. Change the mode to degrees and execute the command again.
3. Now the calculator returns "180". So, the answer is 180°.
4. Set the calculator back to radian mode.

Example#2: Convert 330° to radians.

1. Type **330°** and press **ENTER**.
2. It returns "5.759586532".

I strongly suggest leaving the calculator in radian mode and using the ° function when using degree measurements (with 1 exception. see ex.3). This will simplify trying to remember what mode the calculator is in and reinforce the use of the ° symbol which is required for degree measurements. There are only a few cases that the calculator has to be switched to degree mode (see ex. 1,11,12&14).

Example#3: Convert 57.762° to DMS.

1. Type **57.762►DMS** and press **ENTER**. Don't use the ° function here since the ►DMS function expects degrees and the ° would convert it to radians.
2. It returns " 57°45'43.2" ".

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

1. Type **8°34'6.5"** and **ENTER**. The " symbols is in green over the + key.
2. It returns "8.568472222". Thus, the answer is 8.56847°.
3. Also, note that being in radian mode didn't matter.

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

1. Type **8°34'6.5"°** and **ENTER**. This works because the **8°34'6.5"** will return the angle in degrees. Then, the ° will convert that angle to the current units, radians.
2. It returns ".1495480521". Thus, the answer is 0.14955 .

Trigonometric Functions

Sine, Cosine, & Tangent:

Example#6: Approximate cos(3π/4) on the calculator.

0. By hand, the answer is $\frac{-\sqrt{2}}{2}$ = -0.707106781187 .
1. Type **COS(3π/4) ENTER**. The parenthesis are needed so that the division is done before the cosine function.
2. It returns "-.7071067812". If you didn't get this, make sure you're in radian mode or use the ^{r} function.

Example#7: Approximate tan35° on the calculator.

1. Type **TAN(35°) ENTER**.
2. It returns ".7002075382" no matter what mode the calculator is in.

Example#8: Appr. $\sin^2(-30°)$.

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

Secant, Cosecant, & Cotangent:

Example#9: Appr. csc(4π).

0. By hand, csc(4π) is undefined.
1. Type **1/SIN(4π) 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: Appr. $\cos^{-1}(-.5)$ in radians.

0. By hand, $\cos^{-1}(-.5)=2\pi/3=2.09439510239$.
1. Type **COS^{-1}(-.5) ENTER**. Note **COS^{-1}** is in yellow over the **COS** key.
2. It returns "2.094395102".

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

1. If you just type **TAN^{-1}(1) ENTER**, you'll get ".785398163397" because inverse trig. functions return an angle in the current setting, radians.
2. Change to degree mode.
3. Execute the command **TAN^{-1}(1)**. If it is the last command from step 1, you can just press **ENTER**.
4. It now returns "45". Thus, the answer is 45°.
5. Change back to radian mode.

As long as you use the ° function, this is one of the few times you will have to go to degree mode.

Inverse sine is used the same way.

<u>Polar and Rectangular forms: Complex numbers</u>

Mode Setting:

1. Press **MODE**.
2. The 7th option sets whether any commands can return complex numbers returns
   - Real : an error
   - a+b***i*** : rectangular mode, i.e. 5-7***i***
   - or re^θ***i*** : exponential polar form, i.e. 3(cos(0.56)+***i***sin(0.56))=3e^(.56***i***)
     This works because you would find it higher math classes that r*e^θ***i***=r(cos(θ)+***i***sin(θ)).
3. Set this to a+b***i***.

Conversion:

Conversion for complex numbers from polar to rectangular or vise-versa can be done with the functions P►Rx(, P ►Ry(, R ►Pr(and R►Pθ(.

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

1. The conversion functions are located on the second page of the ANGLE menu. So press **2nd ANGLE** before any of the 4 functions above.
2. Type **R ►Pr(6,-4) ENTER**. The calculator returns "7.211102551".
3. Then type **R ►Pθ(6,-4) ENTER**. The calculator returns "-.5880026035".
4. Thus, the answer is 7.2111cis(-0.5880).
5. To get θ in degrees, switch to degree mode and execute the 2nd command again. Now it will return "33.69006753" and the answer in degrees is 7.2111cis(-33.6901°).
6. Go back to radian mode.

R ►Pθ(will always return angles,θ, in the interval (-180°,180°] or (-π,π].

Example#13: -3cis(250°) to rectangular form with the calculator. Appr. to the thousandths

1. Type **P ►Rx(-3,250°) ENTER**. It returns "1.02606043".
2. Type **P ►Ry(-3,250°) ENTER**. It returns "2.819077862".
3. So the answer is 1.026+2.819***i***.

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 4th option to Pol for polar.
2. Enter the function editor by pressing **Y=**. Notice any difference?
3. Set $r1=9\cos(5\theta)$. The X,T,θ,n key now prints θ instead of X.
4. Set viewing window. Press **WINDOW**.
   Besides the regular variables(xMin, etc.) there are 3 new ones.
   θmin :Minimum value for θ.
   θmax :Maximum value for θ.
   θstep :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 θmin, finds the corresponding $r=9\cos(5\theta)$, and plots that point. It then adds θstep to θ, finds r, plots this new point, and connects this point to the previous point with a line. It then adds θstep to θ, ... It repeats this process until θ + θstep > θmax.
   Set θmin to 0, θmax to 2π, and θstep to $\pi/24$. These are the default settings. Thus, ZStandard would set these variables to these values.
5. Graph the curve by pressing **GRAPH**. This is automatically done if you used ZStandard .
6. You should now see a 5 pointed rose.
7. Reset back to the regular settings.
   Press **MODE ▼▼▼ ENTER 2nd QUIT**.

Parametric Equation Graphing

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

1. Enter Parametric graphing mode.
   Go to the mode screen, and set the 5th option to Par for parametric.
2. Enter the function editor by pressing **Y=**. Notice any difference?
3. Set $X_{1T}=T+2$ and $Y_{1T}=T^2+1$. The X,T,θ,n key now prints T instead of X.
4. Set the viewing window. Press **WINDOW**.
   Besides the regular variables(xMin, 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 **MODE ▼▼▼ ENTER 2nd QUIT**.