Concepts
Using the Calculator in Trigonometry

Based on power point presentations by Pearson Education, Inc.
Revised by Ingrid Stewart, Ph.D.

Learning Objectives

1. Introduction to the use of calculators in trigonometry.
2. Find values of trigonometric ratios of any angles on the calculator in degrees and radians.
3. Some calculator “oddities”.

NOTE: This lesson contains some examples. You can find more examples in the “Examples” document also located in the appropriate MOM Learning Materials folder.

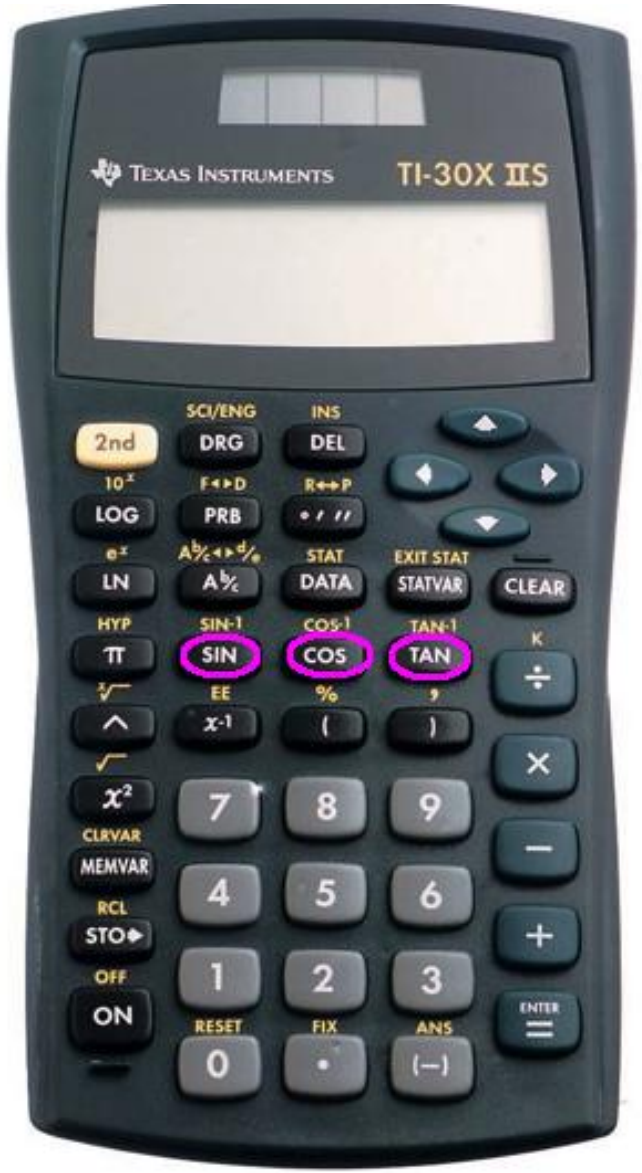
1. Introduction to the Use of Calculators in Trigonometry

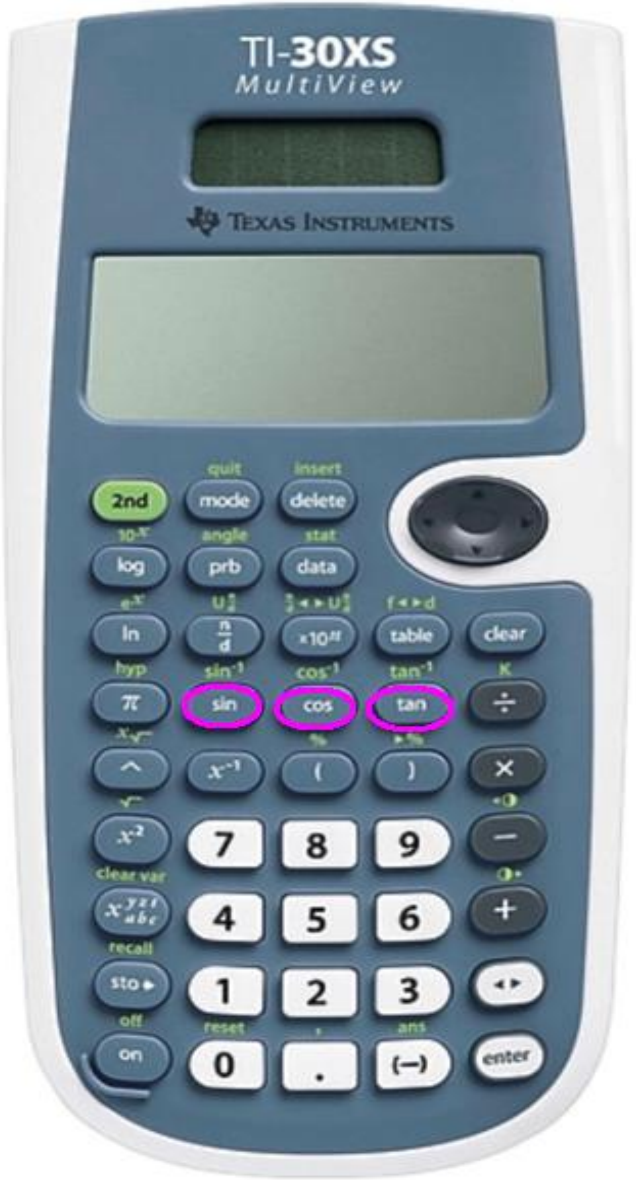
(1 of 8)

In previous lessons, we did not use a calculator. From now on, we will use the calculator for various tasks. Calculators utilize a program using concepts from advanced calculus.

On the next slide, we will look at two different Scientific Calculators, the TI-30X IIS and the TI-30XS MultiView. Those are the two calculators which are used in all examples in this course. If you plan on using a different calculator, YOU must know how to use it.

Introduction to the Use of Calculators in Trigonometry (2 of 8)



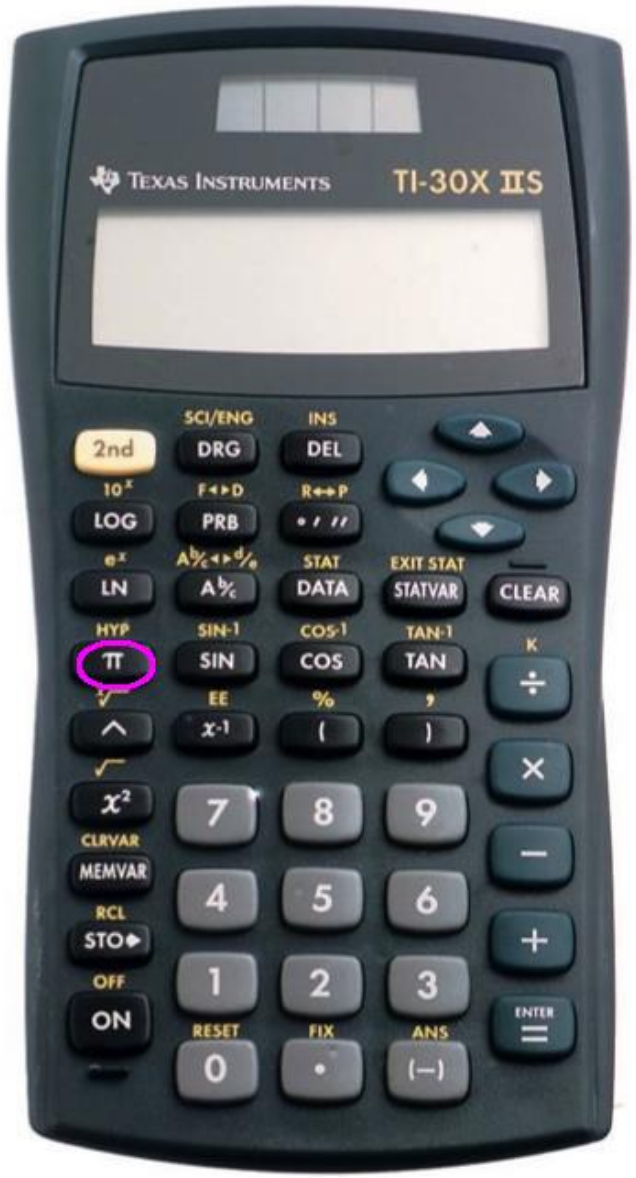


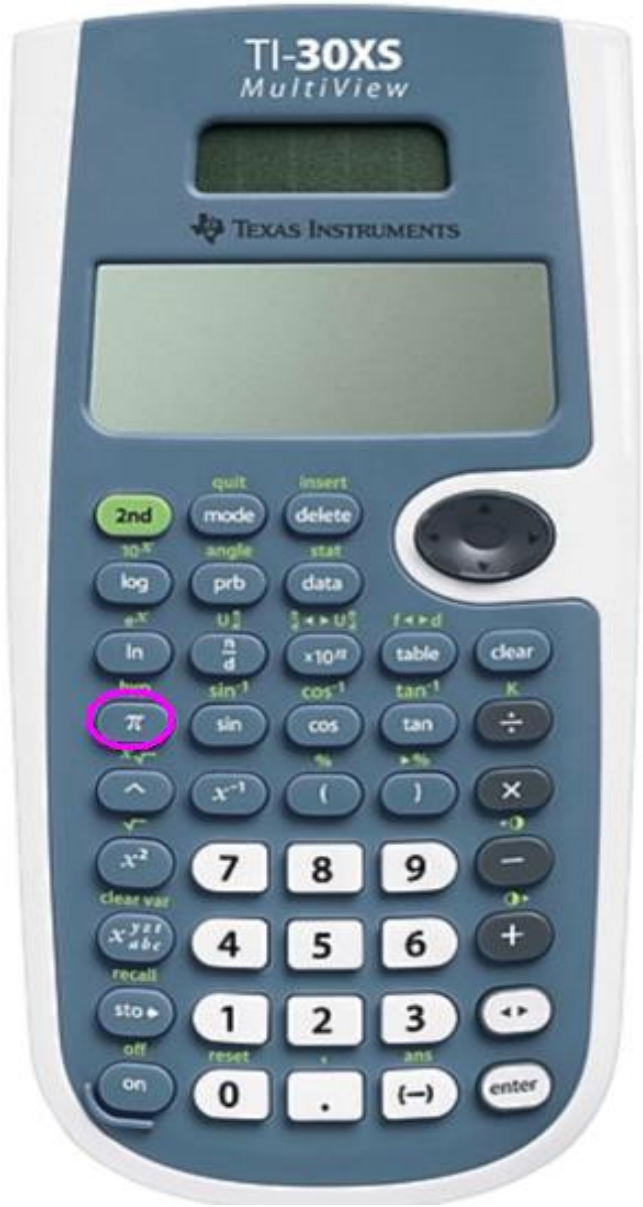
All calculators have a sin, cos, and tan button.

Calculators do NOT have a button for csc, sec, and cot !!!

We MUST find the values of secant, cosecant, and cotangent on the calculator by using *the Reciprocal* and/or *Quotient Identities*.

Introduction to the Use of Calculators in Trigonometry (3 of 8)





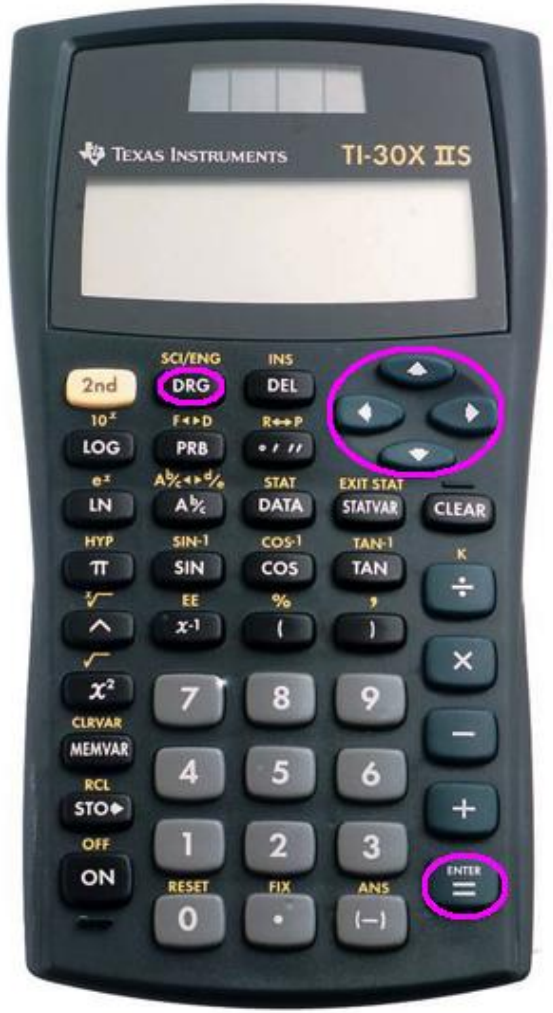
All calculators have a (Pi) **π** button. Press it and then press the **ENTER** button.

You will see 3.141592654 … which actually has infinitely many decimal places. This makes it an irrational number.

NOTE: The calculator does not tell us that we are dealing with an irrational number. It simply fills up all available slots on its screen with decimal places. YOU must know that it is an irrational number with infinitely many decimal places.

Introduction to the Use of Calculators in Trigonometry (4 of 8)

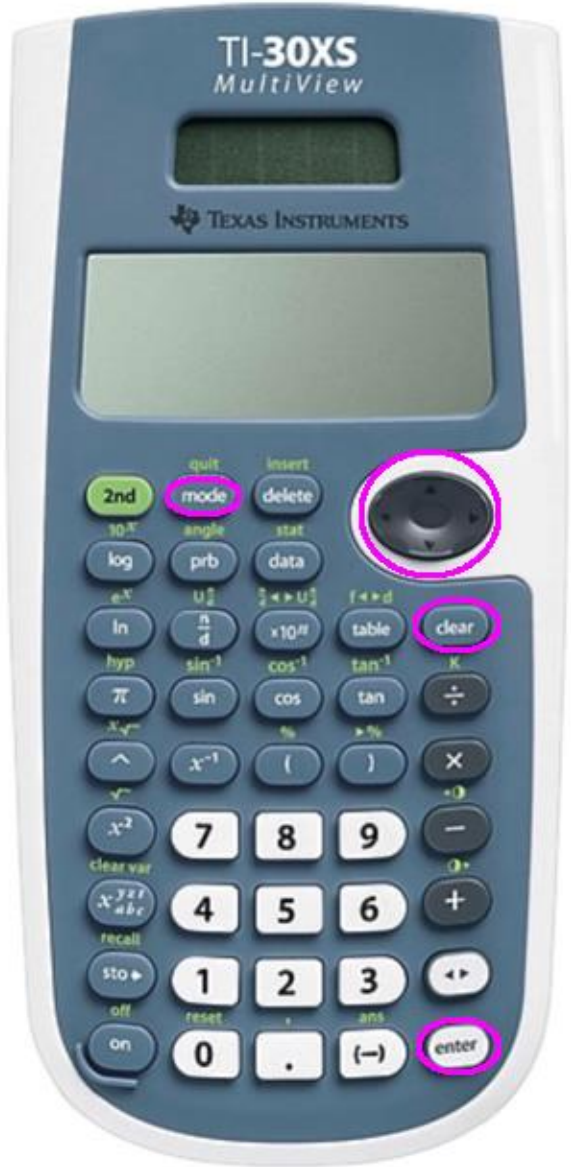
A calculator must be told to evaluate radians or degrees. Using the wrong mode will give you false information!!!



Given the *TI-30X IIS* calculator, we must locate the ***DRG*** button. It is in the first button row under the display window.

- Press it and observe the modes *DEG*, *RAD*, or *GRD* in the display window.
- Use the **arrow** buttons (located under the display window) to highlight the desired mode.
- Then press the ***Enter*** button to exit. In the lower right-hand corner of the display window, we will then see what mode we are in. It will either display DEG or RAD.

Introduction to the Use of Calculators in Trigonometry (5 of 8)



Given the *TI-30XS MultiView* calculator you must locate the ***mode*** button. It is in the first button row under the display window.

- Press it and observe the modes *DEG*, *RAD*, or *GRD* in the display window.
- Use the **arrow** buttons (located under the display window) to highlight the desired mode.
- Then press the ***enter*** button.
- Finally, press the ***clear*** button to exit mode. In the upper right-hand corner of the display window, we will then see what mode we calculator is in. It will either display DEG or RAD.

Introduction to the Use of Calculators in Trigonometry (6 of 8)

Example 1:

Express ***164°*** in radians using the calculator. If necessary, round your answer to 3 decimal places if the answer is an irrational number.

NOTE: Always use the π button and never 3.14.

We will use the conversion $1^\circ \equiv \frac{\pi}{180}$, and we simply multiply both sides by ***164°***.

$$164^\circ \equiv 164\left(\frac{\pi}{180}\right) = \frac{164\,\pi}{180}$$

Inputting the radian answer into the calculator we get the following:

164° ≡ 2.862339973 … which is an irrational number that we can round to 3 decimal places to get 2.862 (radians).

Introduction to the Use of Calculators in Trigonometry (7 of 8)

Example 2:

Change $\frac{11\pi}{36}$ to degrees using the calculator. If necessary, round your answer to 3 decimal places if the answer is an irrational number.

NOTE: Always use the π button and never 3.14.

Since we do not see a degree symbol, we must assume that we are dealing with radians.

Therefore, we will use the conversion $\left(\frac{180}{\pi}\right)^{\circ} \equiv 1$. We will multiply both sides by $\frac{11\pi}{36}$.

$$\frac{11\pi}{36}\left(\frac{180}{\pi}\right)^{\circ} \equiv \frac{11\pi}{36}$$

Introduction to the Use of Calculators in Trigonometry (8 of 8)

Example 2 continued:

Inputting the degree answer $\frac{11\pi}{36}\left(\frac{180}{\pi}\right)^{\circ}$ into the calculator we get the following:

$\frac{11\pi}{36}\left(\frac{180}{\pi}\right)^{\circ} \equiv 0.959931089\ldots$ which is an irrational number that we can round

to 3 decimal places to get 0.960^{o}.

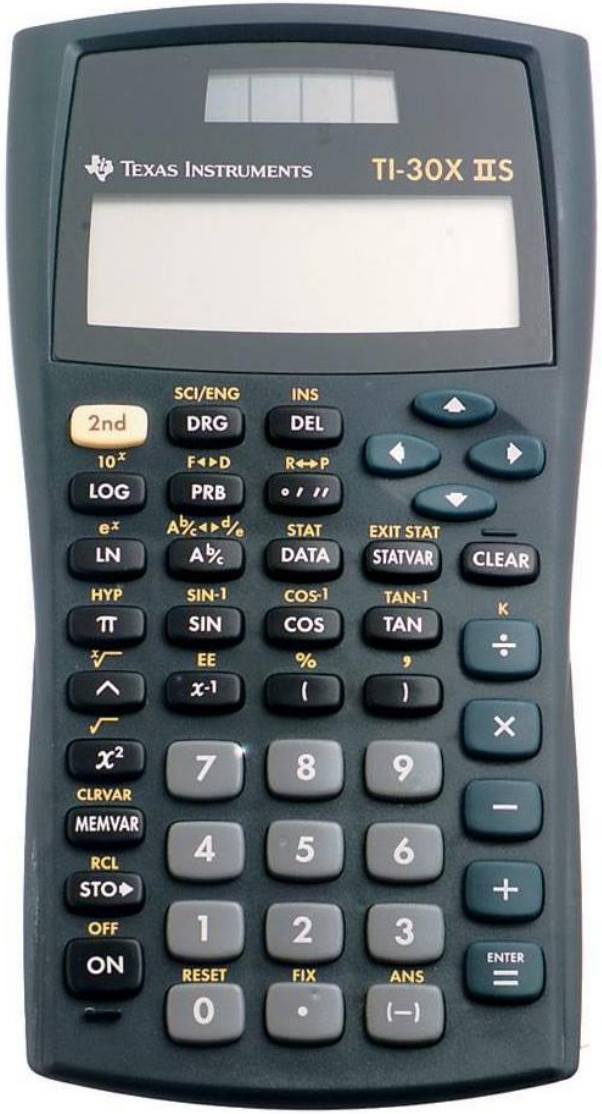
2. Find the Values of Trigonometric Ratios Using a Calculator (1 of 9)

In previous lessons, we found the values of the six trigonometric ratios of special angles and their integer multiples without a calculator.

In this lesson, we will use the calculator to find values of trigonometric ratios given angles of any size.

Find the Values of Trigonometric Ratios Using a Calculator

(2 of 9)



Example 3:

Find the value of ***sec 60º***.

We will use the TI-30X IIS in DEGREE mode.

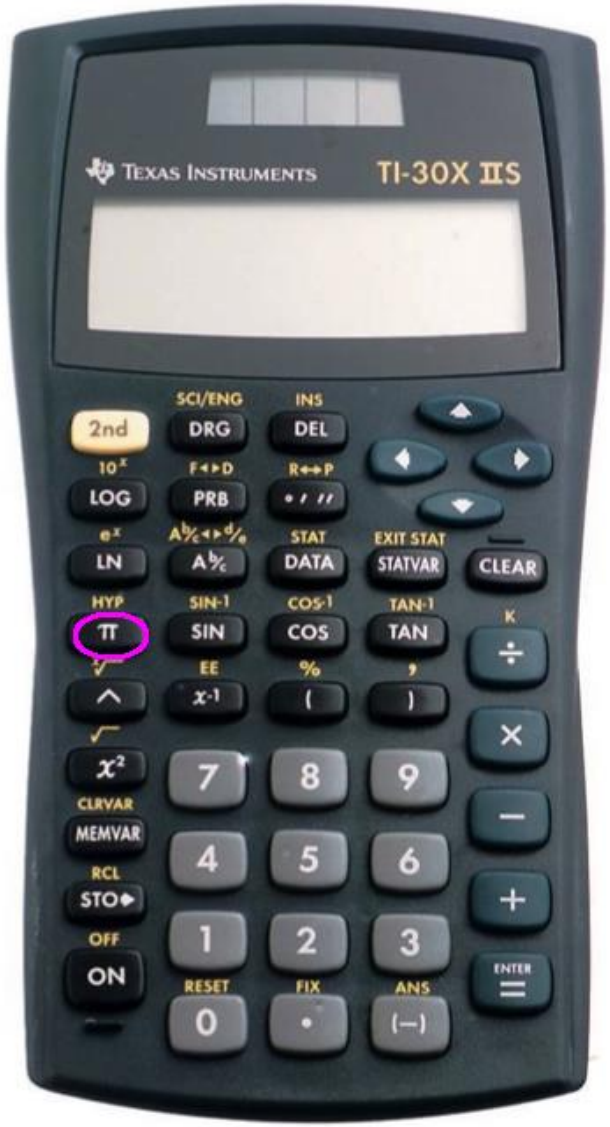
Here we must use the *Reciprocal Identity* $\sec\theta = \frac{1}{\cos\theta}$ because calculators do not have secant, cosecant, and cotangent buttons.

- Type **1** and press the (divided) ÷ button.
- Press the **cos** button. We will see **1/cos (** .
- Type **60** and press the right parenthesis **)** button to close the set.
- Press the **ENTER** button.

The answer is **2** which is an integer.

Find the Values of Trigonometric Ratios Using a Calculator

(3 of 9)



Example 4:

Find the value of $\cos\left(\frac{\pi}{3}\right)$.

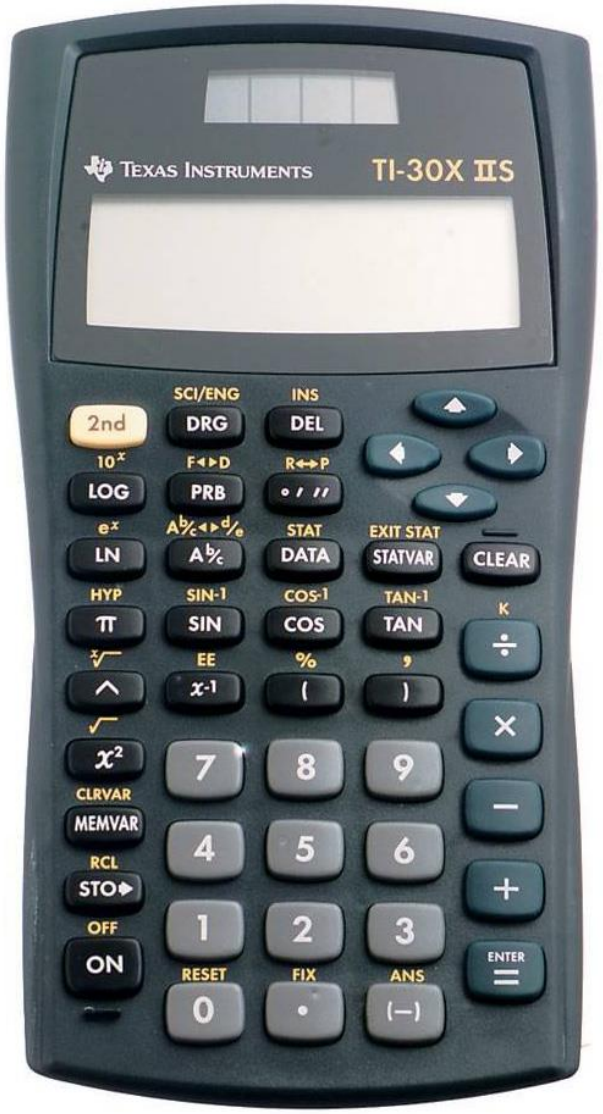
We will use the TI-30X IIS in RADIAN mode because there is no "circle" symbol indicating degrees.

- Press the **cos** button. We will see **tan (** .
- Press the (Pi) **π** button. (DO NOT USE 3.14!!!)
- Press the (divided) ÷ button.
- Type **3** and press the right parenthesis **)** button to close the set.
- Press the **ENTER** button.

The answer is **0.5** or $\frac{1}{2}$ which is a rational number because it has a finite number of decimal places.

Find the Values of Trigonometric Ratios Using a Calculator

(4 of 9)



Example 5:

Find the value of **sin 78º**.

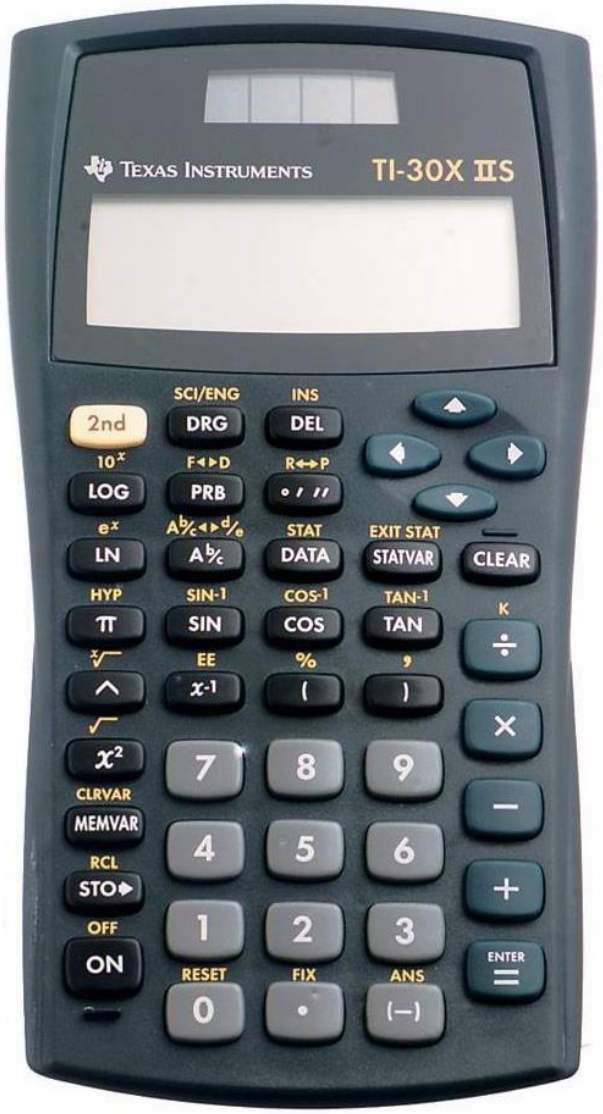
We will use the TI-30X IIS in DEGREE mode.

- Press the **sin** button. We will see **sin (** .
- Type **78** and press the right parenthesis **)** button to close the set.
- Press the **ENTER** button.

The answer is **0.978147601 …** which actually has infinitely many decimal places. This makes it an irrational number.

NOTE: The calculator does not tell us that we are dealing with an irrational number. It simply fills up all available slots on its screen with decimal places. YOU must know that it is an irrational number with infinitely many decimal places.

Find the Values of Trigonometric Ratios Using a Calculator



Example 6:

Find the value of ***tan 4***.

We will use the TI-30X IIS in RADIAN mode because there is no "circle" symbol indicating degrees.

- Press the **tan** button. We will see **tan (** .
- Type **4** and press the right parenthesis **)** button to close the set.
- Press the **ENTER** button.

The answer is **1.557407725 …** which actually has infinitely many decimal places. This makes it an irrational number.

Find the Values of Trigonometric Ratios Using a Calculator
(6 of 9)

Help-Yourself Hints:

Should you forget the EXACT value of a trigonometric ratio of a "special" angle or one of its integer multiples the calculator can help. Unfortunately, most calculators display these values in decimal form.

For example, instead of $\frac{\sqrt{3}}{2}$ most calculators will state
sin 60° = 0.866025404 … which is an irrational number.

Therefore, it is a good idea to know the decimal approximations of the following numbers:

$$\frac{\sqrt{3}}{2} \approx 0.866 \qquad \frac{\sqrt{2}}{2} \approx 0.707 \qquad \frac{\sqrt{3}}{3} \approx 0.577 \qquad \sqrt{3} \approx 1.732 \qquad \sqrt{2} \approx 1.414$$

Find the Values of Trigonometric Ratios Using a Calculator
(7 of 9)

Help-Yourself Hints Continued:

Now, there are a few calculators that have a feature called **MATHPRINT**. When it is engaged, it will display $\frac{\sqrt{3}}{2}$ when asked to evaluate ***sin 60^o***.

For example, the TI-30XS Multiview has the **MATHPRINT** feature. It is engaged as follows:

- Press the **mode** button and observe the words **CLASSIC** or **MATHPRINT** in the last row of the display window.
- Use the arrow buttons (located under the display window) to highlight the **MATHPRINT** mode.
- Press the **enter** button and then the **clear** button.

Find the Values of Trigonometric Ratios Using a Calculator

Example 7:

Find the EXACT value of ***sin 240°*** with the help of a TI-30X IIS calculator.

240° is a multiple of the special angle 60° (hint: graph it and look at the reference angle).

We memorized that ***sin 60°*** = $\frac{\sqrt{3}}{2}$. If you forgot, you should at least remember that $\frac{\sqrt{3}}{2} \approx 0.866$!!!

Find the Values of Trigonometric Ratios Using a Calculator
(9 of 9)

Example 7 continued:

With the TI-30X IIS calculator in **degree mode**, we find that
$\boldsymbol{\sin 240^o = -0.866025404 \ldots}$.

Given the trigonometric value of the reference angle, we can now state that

$\boldsymbol{\sin 240^o = -\frac{\sqrt{3}}{2}}$.

NOTE: The TI-30X MultiView in **MathPrint** mode would have immediately given us the EXACT value of $\boldsymbol{\sin 240^o}$.

3. Some Calculator ”Oddities” (1 of 4)

Some of the values of trigonometric ratios of quadrantal angles are undefined. When we evaluate these ratios with a calculator, most will tell us ”Domain Error." Some calculators show the infinity symbol .

The biggest issue arises when we want to evaluate the cotangent of some quadrantal angles. When we use the *Reciprocal Identity*, most calculator will incorrectly state "domain error" even though the value of the cotangent is actually 0. Therefore, it is best to use the *Quotient Identity* when evaluating the cotangent with the calculator!

Some Calculator ”Oddities”(2 of 4)

Example 8:

Find the EXACT value of ***tan 270^o*** with the help of a TI-30X IIS calculator.

270^o is a quadrantal angle. We memorized that ***tan 270^o*** is undefined. You might have forgotten this.

With the TI-30X IIS calculator in **degree mode**, we try to find ***tan 270^o*** and the calculator tells us **“Domain Error”**. Some calculators show an infinity symbol ∞ .

This is the calculator’s way of telling us that ***tan 270^o*** are undefined.

Some Calculator "Oddities" (3 of 4)

Example 9:

Find the EXACT value of ***cot 270°*** with the help of a TI-30X IIS calculator.

270° is a quadrantal angle. We memorized that ***cot 270°*** equals ***0***. You might have forgotten this.

With the TI-30X IIS calculator in **degree mode**, we try to find ***cot 270°*** using the *Reciprocal Identity* $\cot\theta = \frac{1}{\tan\theta}$.

But the calculator tells us "Domain Error". So, does this mean that ***cot 270°*** is undefined ???

NO! SEE NEXT SLIDE!

Some Calculator "Oddities" (4 of 4)

Example 9 continued:

Most calculators do not know how to handle ***1 ÷ undefined*** given that ***tan 270°*** is undefined. That's why it is always better to use the *Quotient Identity* for cotangent AT ALL TIMES.

Therefore, with the TI-30X IIS calculator in **degree mode**, we find ***cot 270°*** using the *Quotient Identity* $\cot\theta = \frac{\cos\theta}{\sin\theta}$.

Now the calculator correctly tells us that ***cot 270°*** equals ***0***.

NOTE: The TI-30X MultiView would have reacted in the very same way.