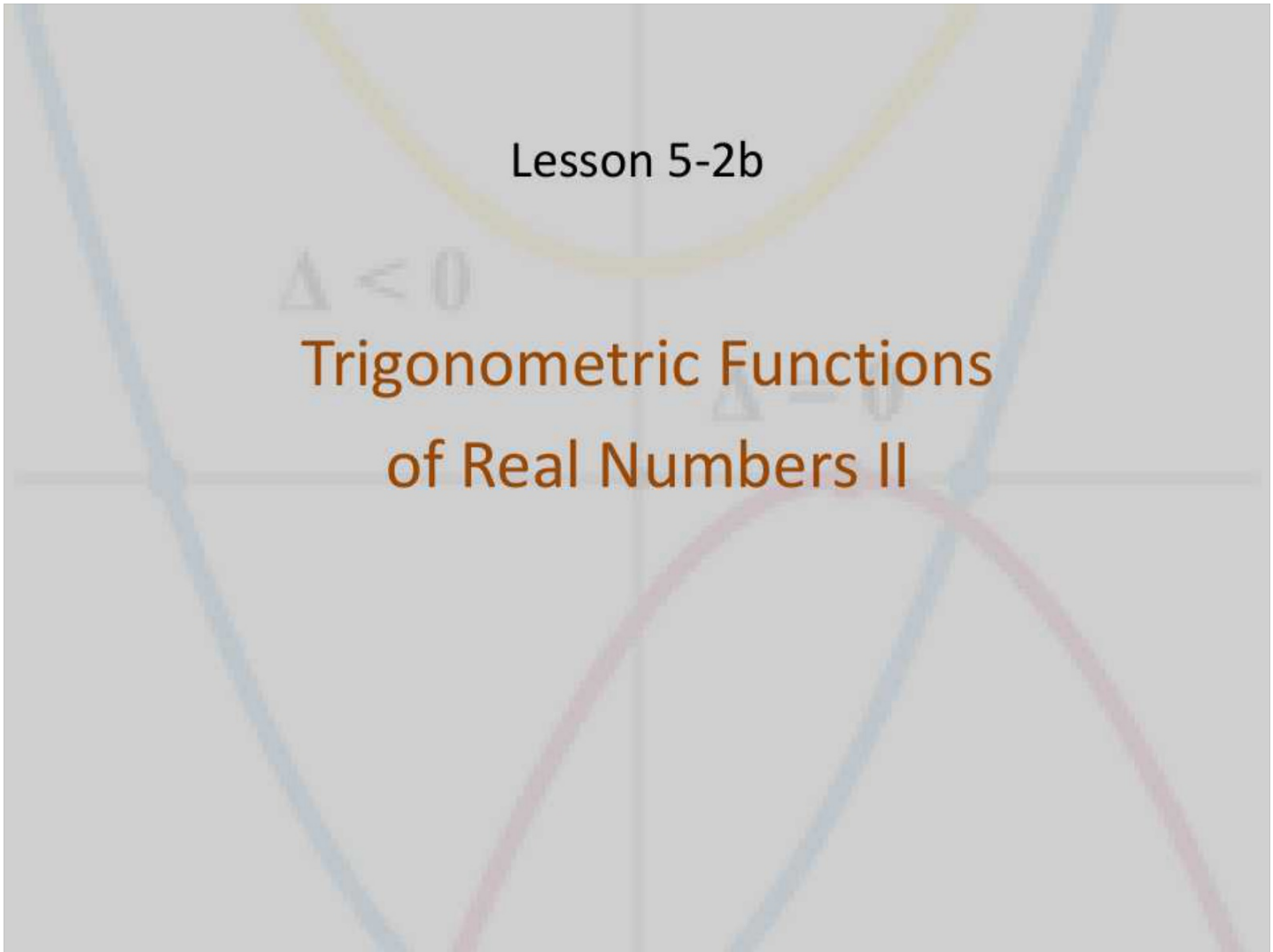


Lesson 5-2b

$\Delta < 0$

Trigonometric Functions  
of Real Numbers II

$\Delta = 0$



## Objective

Students will...

- Be able to use a calculator to evaluate trigonometric functions (both radians and degree)
- Be able to know and apply the even-odd properties of trigonometric functions.

## Trigonometric Functions

The concept of trigonometric functions can be defined in terms of the unit circle. The **definition of trigonometric functions** is as follows:

$$\cos t = x$$

$$\sin t = y$$

$$\tan t = \frac{y}{x} \quad (x \neq 0)$$

$$\sec t = \frac{1}{\cos t} = \frac{1}{x}$$

$(x \neq 0)$

$$\csc t = \frac{1}{\sin t} = \frac{1}{y}$$

$(y \neq 0)$

$$\cot t = \frac{1}{\tan t} = \frac{x}{y}$$

$(y \neq 0)$



## Evaluating Trigonometric Functions

The previous definitions of trigonometric functions are only helpful to us if  $t$  happens to be one of the values on the unit circle. Consider for example,  $\cos \frac{\pi}{7}$

Since  $\frac{\pi}{7}$  is not on the unit circle, we would have to use a calculator to evaluate this function.

One thing to keep in mind is that trigonometric functions can be evaluated using both degrees and radians. It is **CRUCIAL** that the calculator is in the right mode. For most calculators, DEG=Degrees, and RAD=Radians.

So, going back to our problem, since  $\frac{\pi}{7}$  is a value in radians (no degree sign), we need to put our calculator in radian mode.

$$\cos \frac{\pi}{7} \approx 0.9$$

Try doing these problems. Note that they are all in radians.

$$\sin \frac{\pi}{5} \approx 0.588 \quad \tan \frac{7\pi}{9} \approx -0.859 \quad \cos \frac{6\pi}{31} \approx 0.821$$

$$\tan \frac{11\pi}{8} \approx 2.414 \quad \sin \frac{7\pi}{5} \approx -0.951$$

Now, let's try a couple problems in degree mode.

|| | ||  
x

$$\sin 33^\circ \approx 0.545 \quad \cos 67^\circ \approx 0.391 \quad \tan 0.889^\circ \approx 0.016$$

Also, remember that  $\sec t = \frac{1}{\cos t}$ ,  $\csc t = \frac{1}{\sin t}$ , and  $\cot t = \frac{1}{\tan t}$ .

$$\text{Thus, } \csc 67^\circ = \frac{1}{\sin 67} \approx 1.086 \quad \text{and} \quad \sec \frac{\pi}{8} = \frac{1}{\cos \pi/8} \approx 1.082$$

Try these. Make sure you're in the right mode.

$$\cot \frac{\pi}{19} \approx 5.993 \quad \csc 65.98^\circ \approx 1.095 \quad \sec \frac{27\pi}{16} \approx 1.79995$$

## Even-Odd Properties

Consider the following.

odd

$$\sin \frac{\pi}{3} = \frac{\sqrt{3}}{2}$$

$$\sin \left(-\frac{\pi}{3}\right) = \sin \left(\frac{5\pi}{3}\right) = -\frac{\sqrt{3}}{2}$$

Now, what about...

even

$$\cos \frac{\pi}{3} = \frac{1}{2}$$

$$\cos \left(-\frac{\pi}{3}\right) = \cos \left(\frac{5\pi}{3}\right) = \frac{1}{2}$$

Turns out, these results can be generalized.

**Even-Odd Properties:**

odd is stronger

even

$$\cos(-t) = \cos t$$

odd

$$\sin(-t) = -\sin t$$

odd

$$\tan(-t) = -\tan t$$

$$\csc(-t) = -\csc(t)$$

odd

$$\sec(-t) = \sec t$$

even

$$\cot(-t) = -\cot t$$

odd

## Examples

Use the Even-Odd Properties to evaluate the following.

$$\sin\left(-\frac{\pi}{6}\right) = -\sin\left(\frac{\pi}{6}\right)$$

$$-\frac{1}{2}$$

$$\cot\left(-\frac{5\pi}{6}\right) = -\cot\left(\frac{5\pi}{6}\right)$$

$$\sqrt{3}$$

$$\tan\left(-\frac{11\pi}{6}\right) = -\tan\left(\frac{11\pi}{6}\right)$$

$$-\frac{\sqrt{3}}{3}$$

$$\cos\left(-\frac{\pi}{4}\right) = \cos\left(\frac{\pi}{4}\right)$$

$$\frac{\sqrt{2}}{2}$$

$$\csc\left(-\frac{2\pi}{3}\right) = -\csc\left(\frac{2\pi}{3}\right)$$

$$-\frac{3}{2}$$

$$\sec\left(-\frac{\pi}{2}\right) = \sec\left(\frac{\pi}{2}\right)$$

$$\text{und.}$$



## Homework 12/3

Worksheet