

# Trigonometry Refresher

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# What it's used for:

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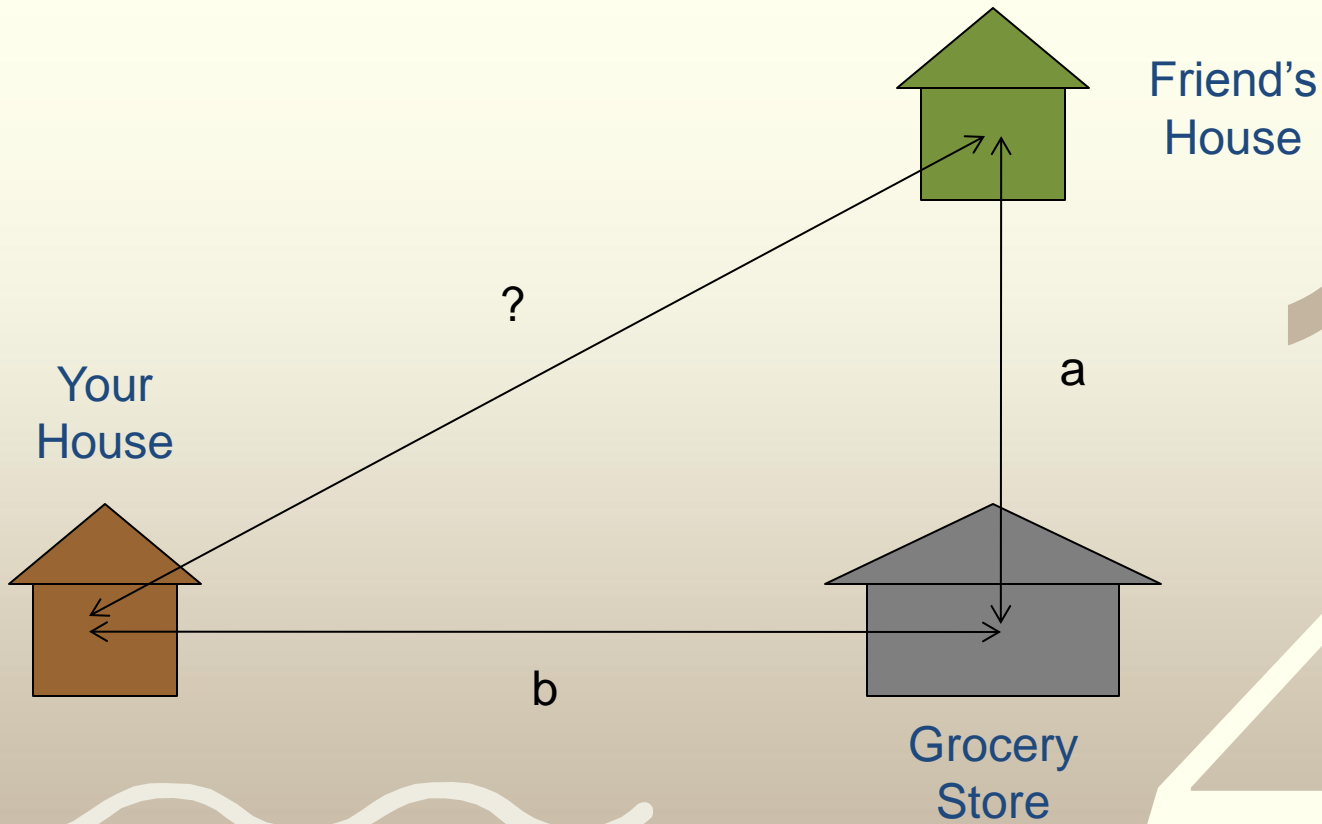
Trigonometry is best applied to:

- Geometry
- Astronomy
- Physics
- Advanced mathematics
- Almost any engineering field



# How far to your friend's house from your house?

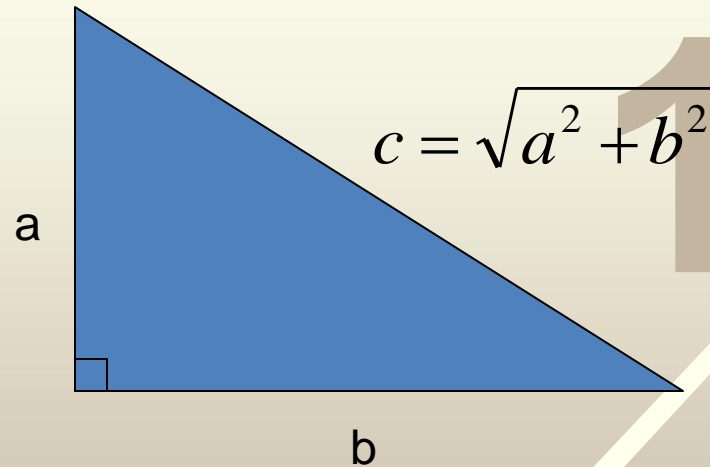
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# Triangles and Pythagorean Theorem:

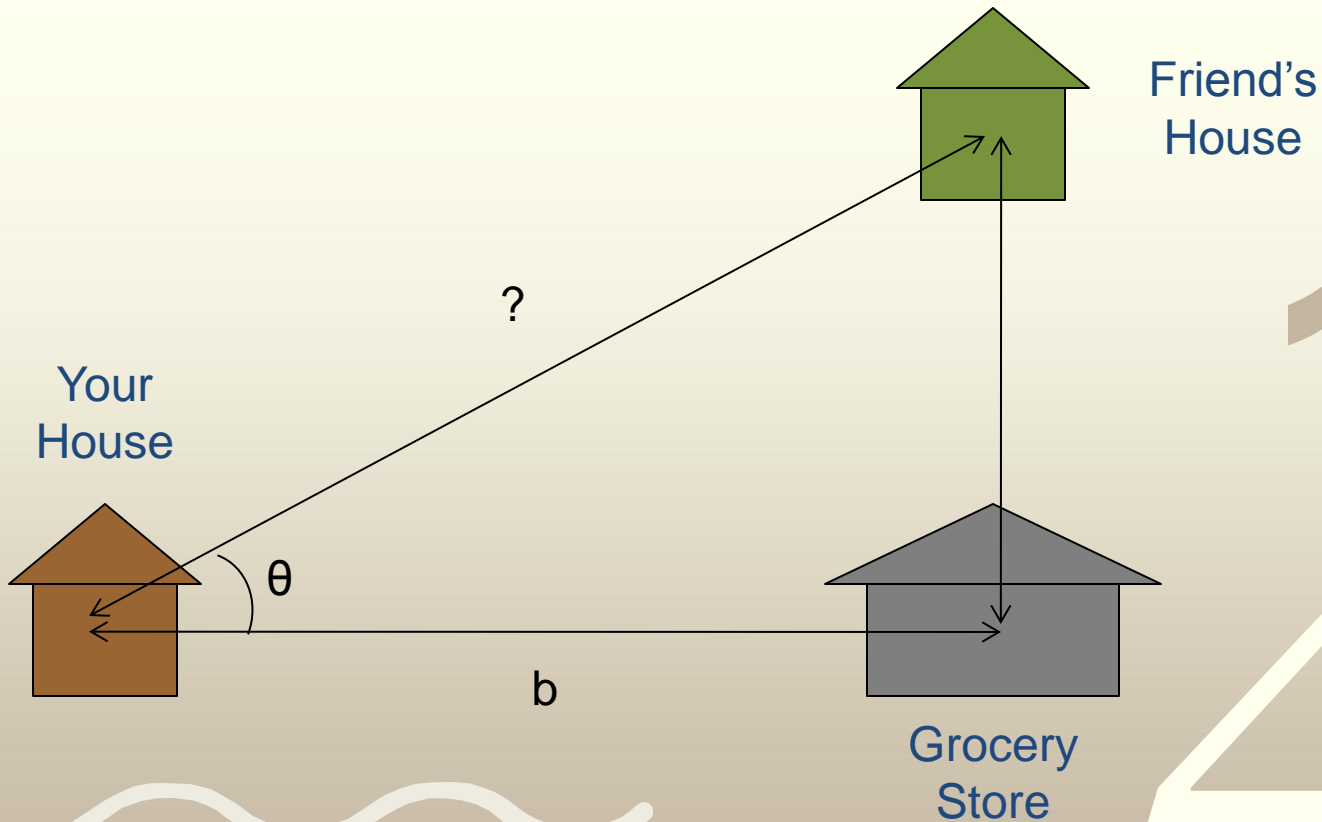
Pythagorean theorem:  $c^2 = a^2 + b^2$

This rule works  
only when using a  
right triangle.  
(Special case of  
the law of cosines).



# How far to your friend's house from your house?

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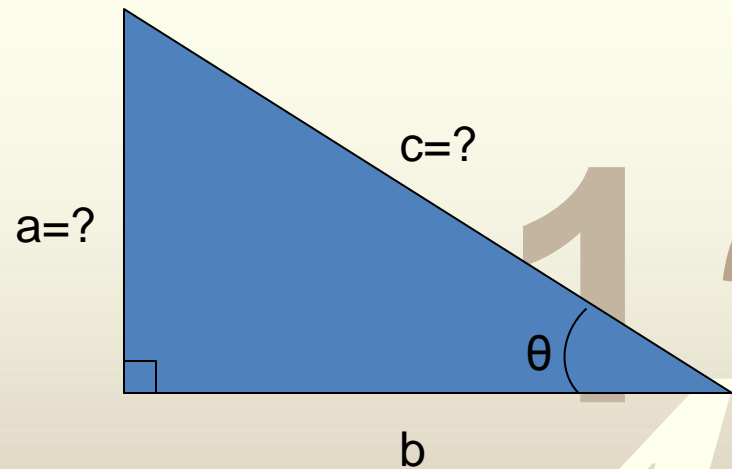
1 2

4 5

# Triangles and Pythagorean Theorem:

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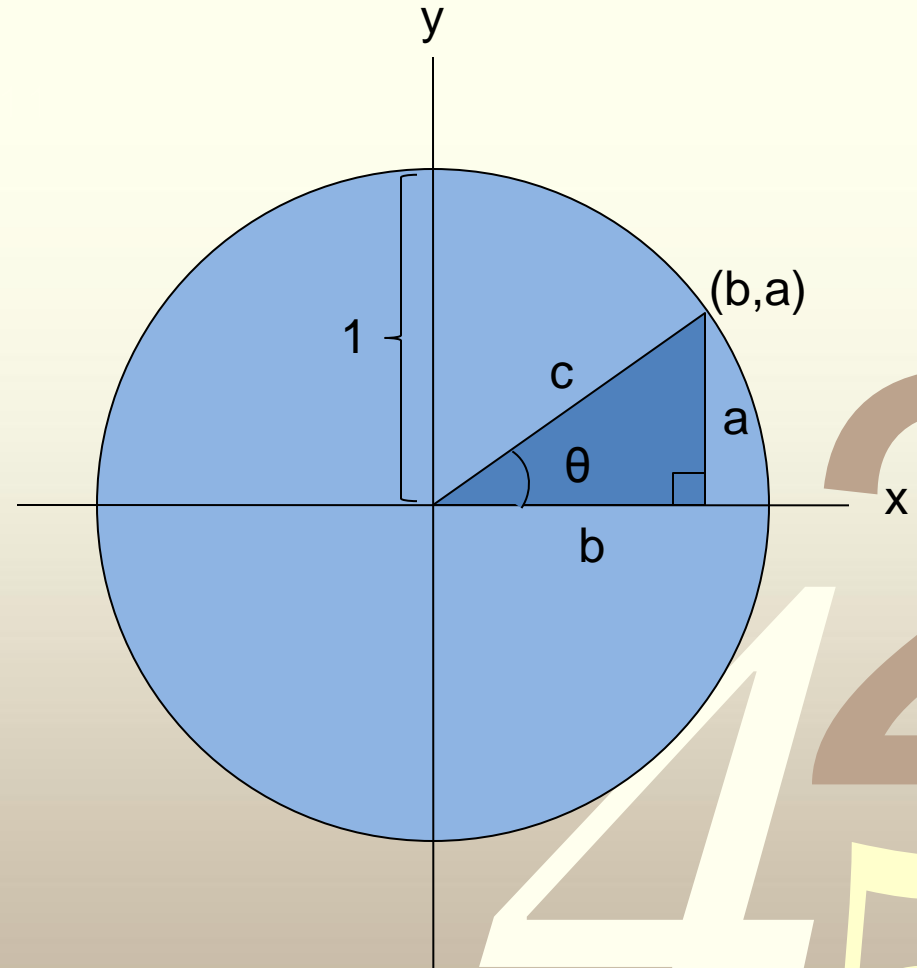
Only know the length of one side and the value of one angle.



Use trigonometry to solve for either of the unknown sides (again *only* for a right triangle)

# Unit Circle

- “b” = length of the right triangle on the x-axis (x-value)
- “a” = height of the right triangle on the y-axis (y-value)
- “c” = distance between the origin and our point (b,a). (c = 1 for unit circle).



# Trig Functions: SOHCAHTOA

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$$\sin(\theta) = \text{opp/hyp} = a/c$$

$$\cos(\theta) = \text{adj/hyp} = b/c$$

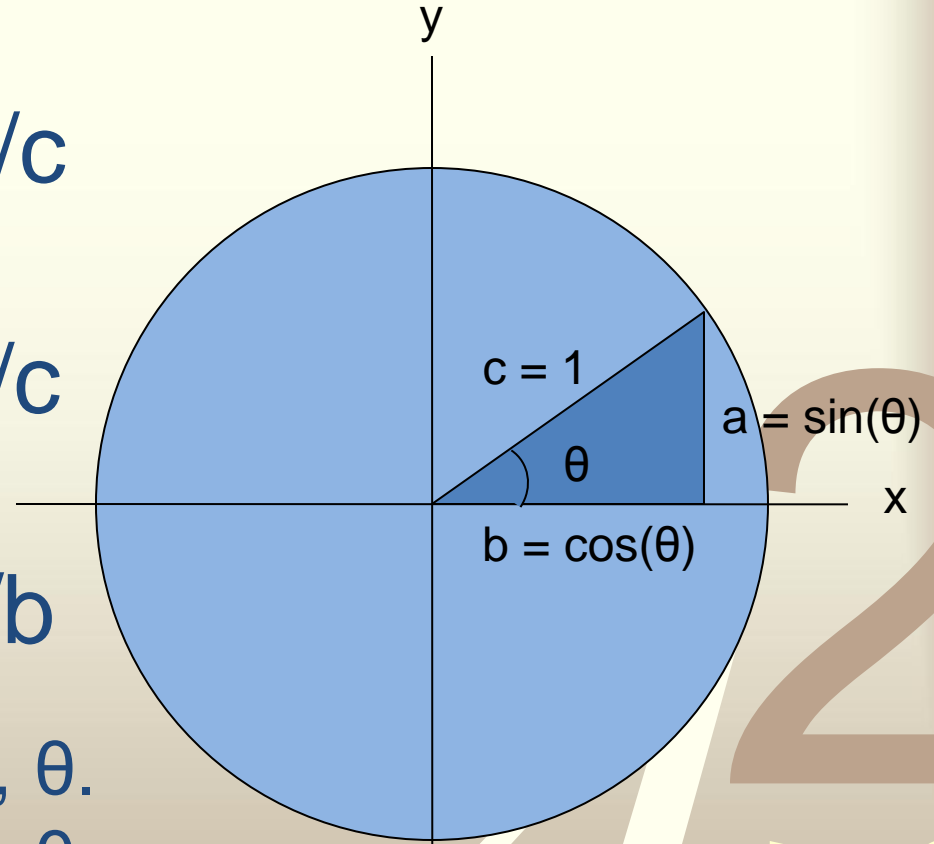
$$\tan(\theta) = \text{opp/adj} = a/b$$

a = opposite side to angle,  $\theta$ .

b = adjacent side to angle,  $\theta$ .

c = hypotenuse side to angle,  $\theta$ .

$$\tan(\theta) = \sin(\theta)/\cos(\theta)$$





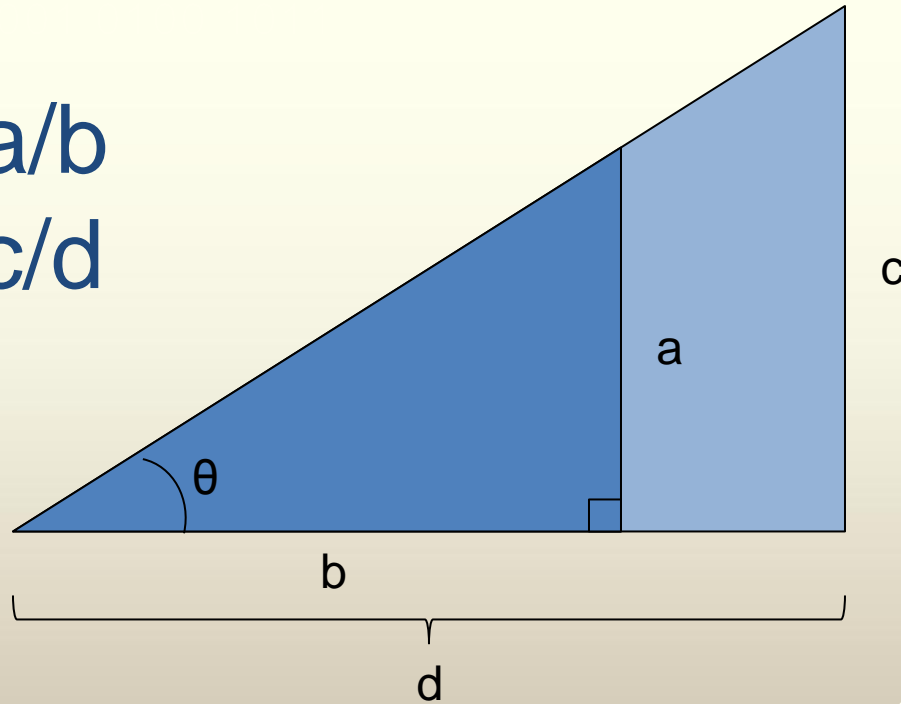
# Similar Triangles

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$$\tan(\theta) = a/b$$

$$\tan(\theta) = c/d$$

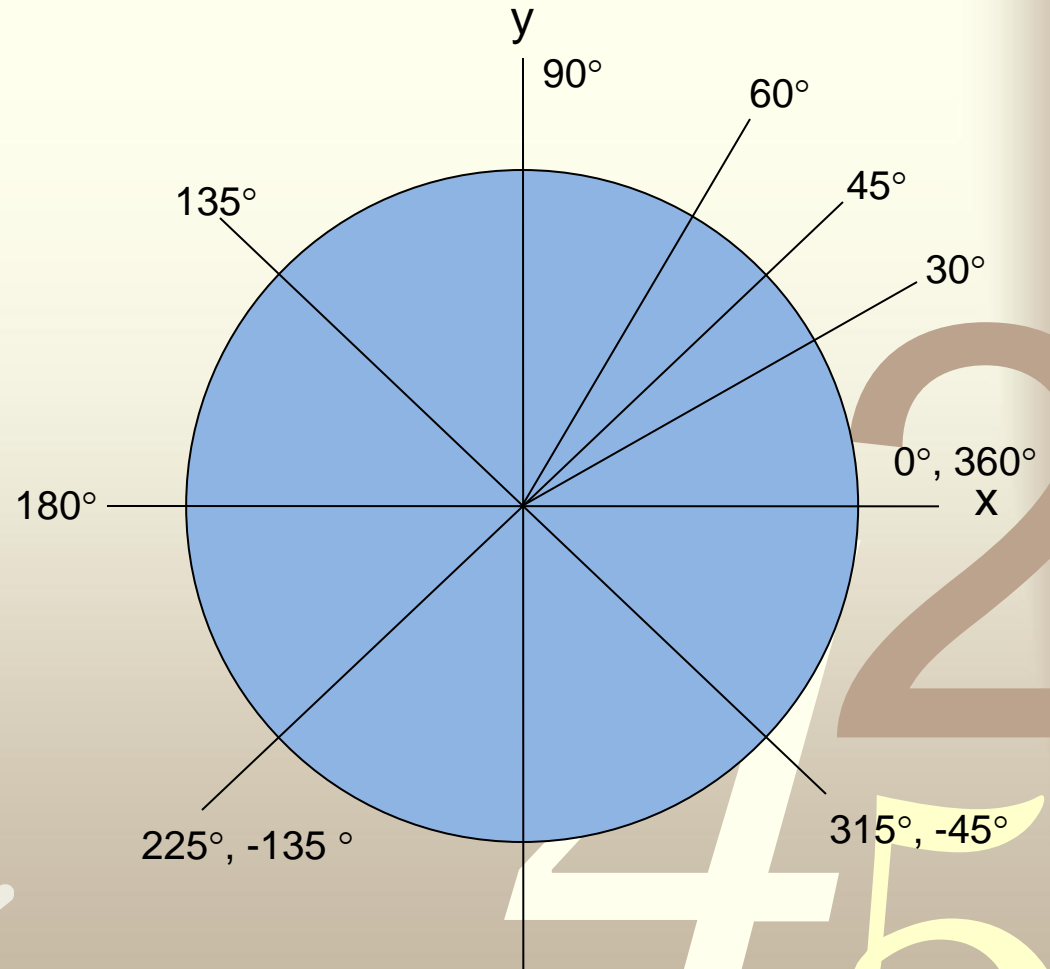
$$a/b = c/d$$



Same angle: ratio of sides must be the same!

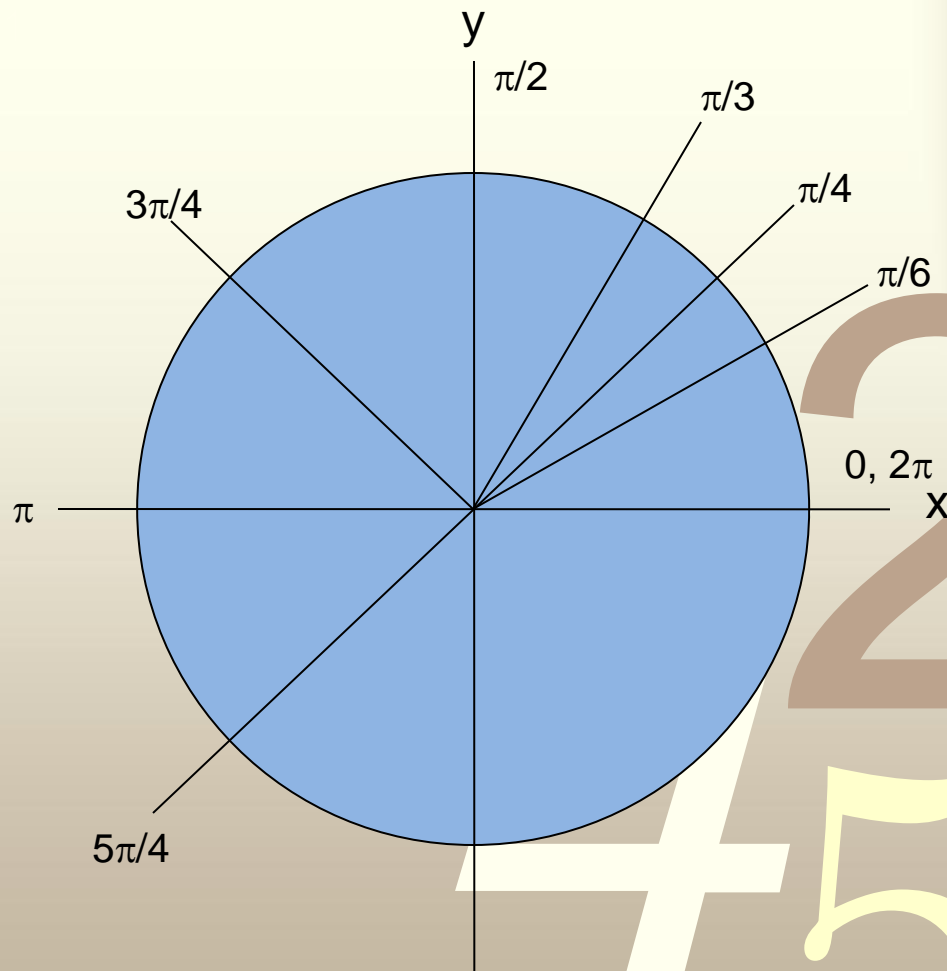
# Angles in degrees:

- There are 360 degrees in a circle.
- Some of the common angles are shown to the right.
- All positive angles start from the x-axis.



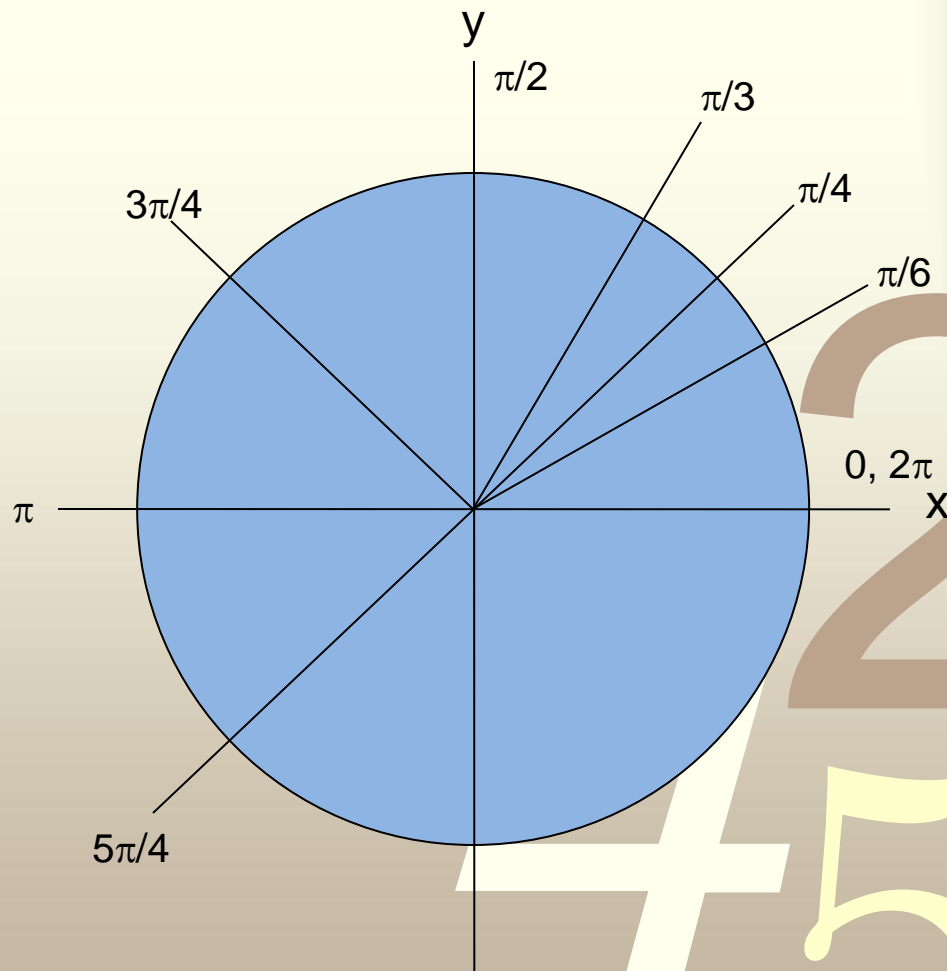
# Angles in radians (standard unit):

- There are  $2\pi$  radians in a circle.
- Some of the common angles are shown to the right.
- All angles start from the x-axis.



# Angles in radians (standard unit):

- $2\pi = 360^\circ \Rightarrow \pi = 180^\circ$
- Calculator has radian and degree mode, so check before you calculate!



# Convert these:

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From degrees to radians:

From radians to degrees:

- $25^\circ$

- $\pi/7$

- $-140^\circ$

- 4



# Convert these:

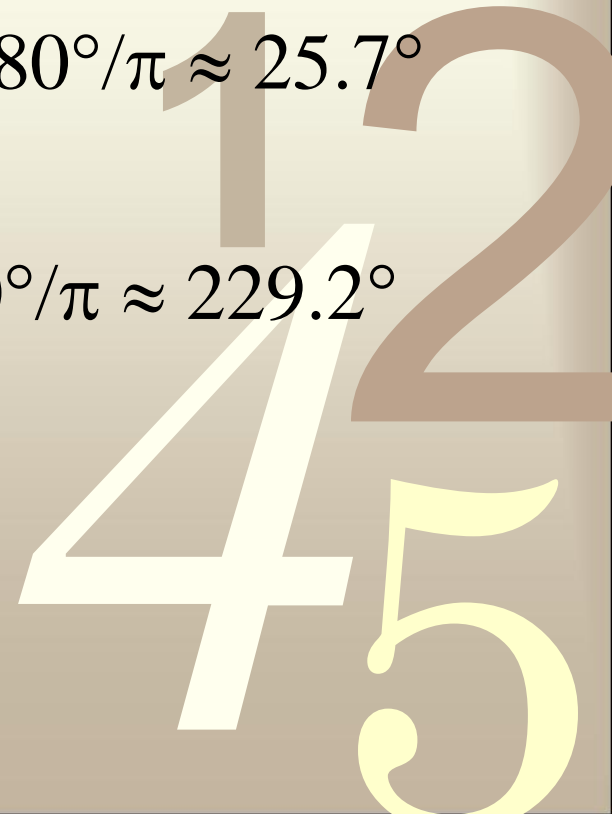
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From degrees to radians:

- $25^\circ \times \pi/180^\circ = 5\pi/36$
- $-140^\circ \times \pi/180^\circ = -7\pi/9$
- or:  $-140^\circ + 360^\circ = 220^\circ$   
 $220^\circ \times \pi/180^\circ = 11\pi/9$

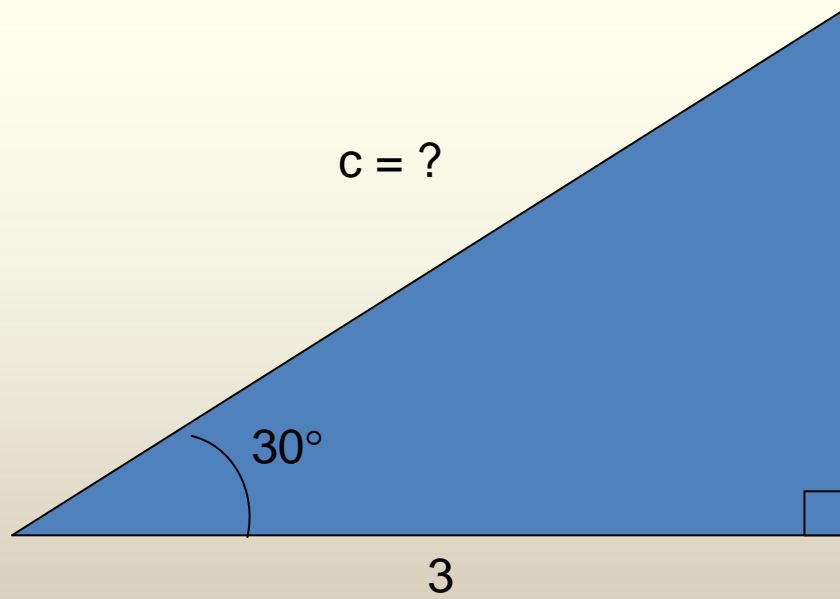
From radians to degrees:

- $\pi/7 \times 180^\circ/\pi \approx 25.7^\circ$
- $4 \times 180^\circ/\pi \approx 229.2^\circ$



# Try these:

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$a = ?$

1 2  
4 5



# Try these:

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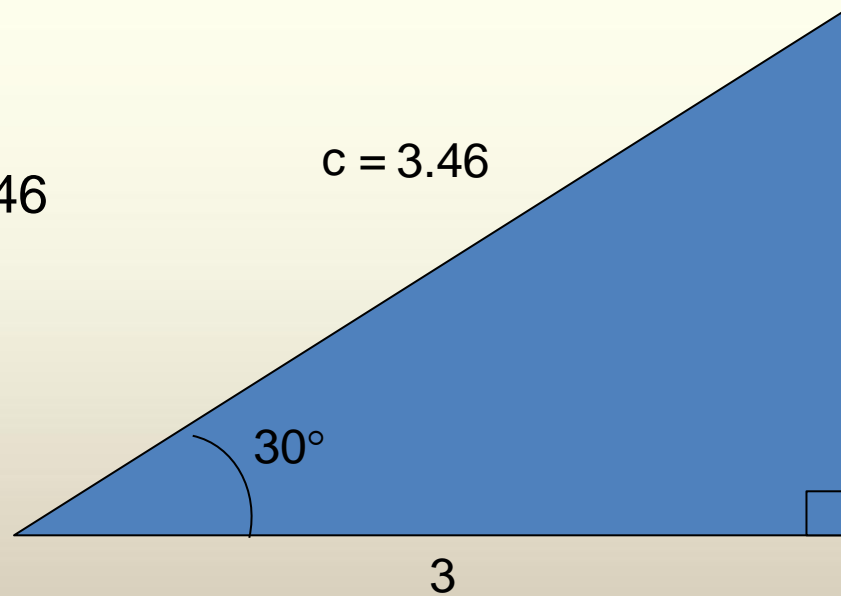
$$\cos(30^\circ) = 3/c$$

$$c \cdot \cos(30^\circ) = 3$$

$$c = 3/\cos(30^\circ) = 3.46$$

$$\tan(30^\circ) = a/3$$

$$a = 3\tan(30^\circ) = 1.73$$





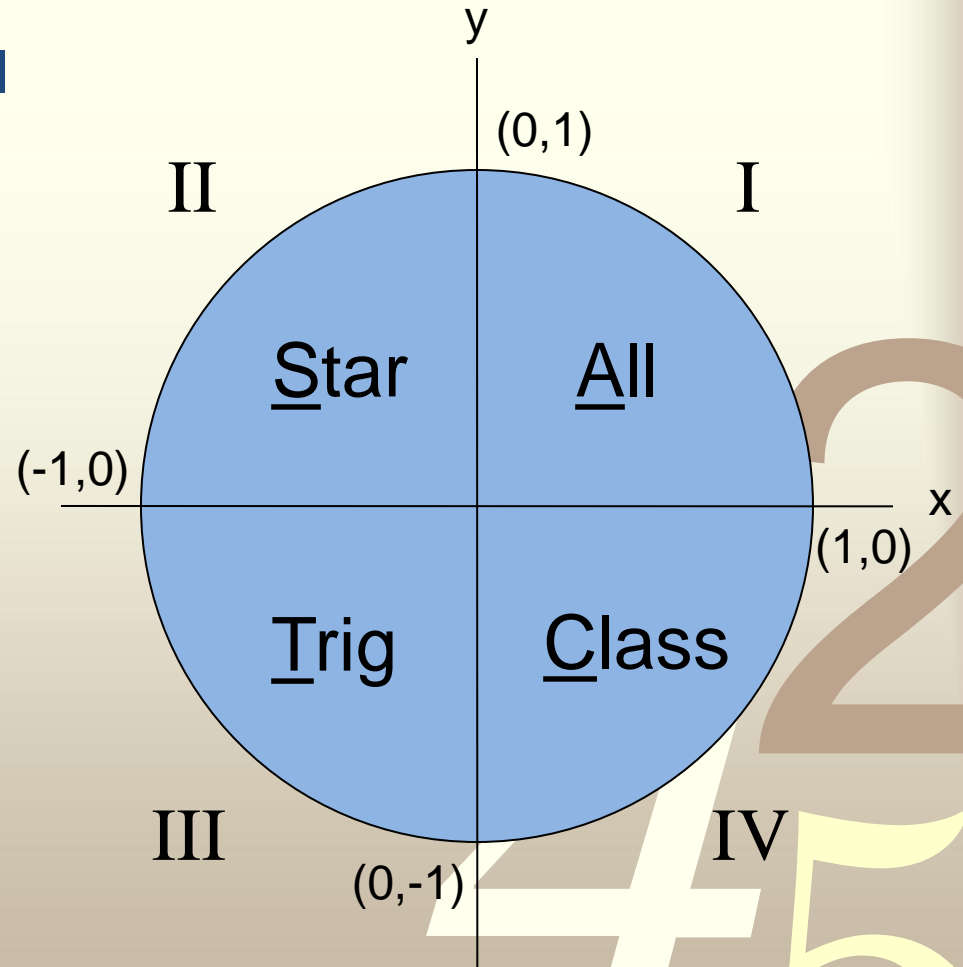
# All Star Trig Class

All: sine, cosine, and tangent all have positive values in this quadrant.

Star: only sine has positive values in this quadrant.

Trig: only tangent has positive values in this quadrant.

Class: only cosine has positive values in this quadrant.



# Calculating Angle

Use Inverse functions to “undo” the trig functions:

- $\sin(\theta) = 0.5$ 
  - $\sin^{-1}(\sin(\theta)) = \sin^{-1}(0.5)$   
 $\theta = \sin^{-1}(0.5) = 30^\circ$
- $\cos(\theta) = 0.5$ 
  - $\cos^{-1}(\cos(\theta)) = \cos^{-1}(0.5)$   
 $\theta = \cos^{-1}(0.5) = 60^\circ$
- $\tan(\theta) = 0.5$ 
  - $\tan^{-1}(\tan(\theta)) = \tan^{-1}(0.5)$   
 $\theta = \tan^{-1}(0.5) = 26.57^\circ$

$\sin^{-1}(c) = \arcsin(c) = \text{asin}(c)$

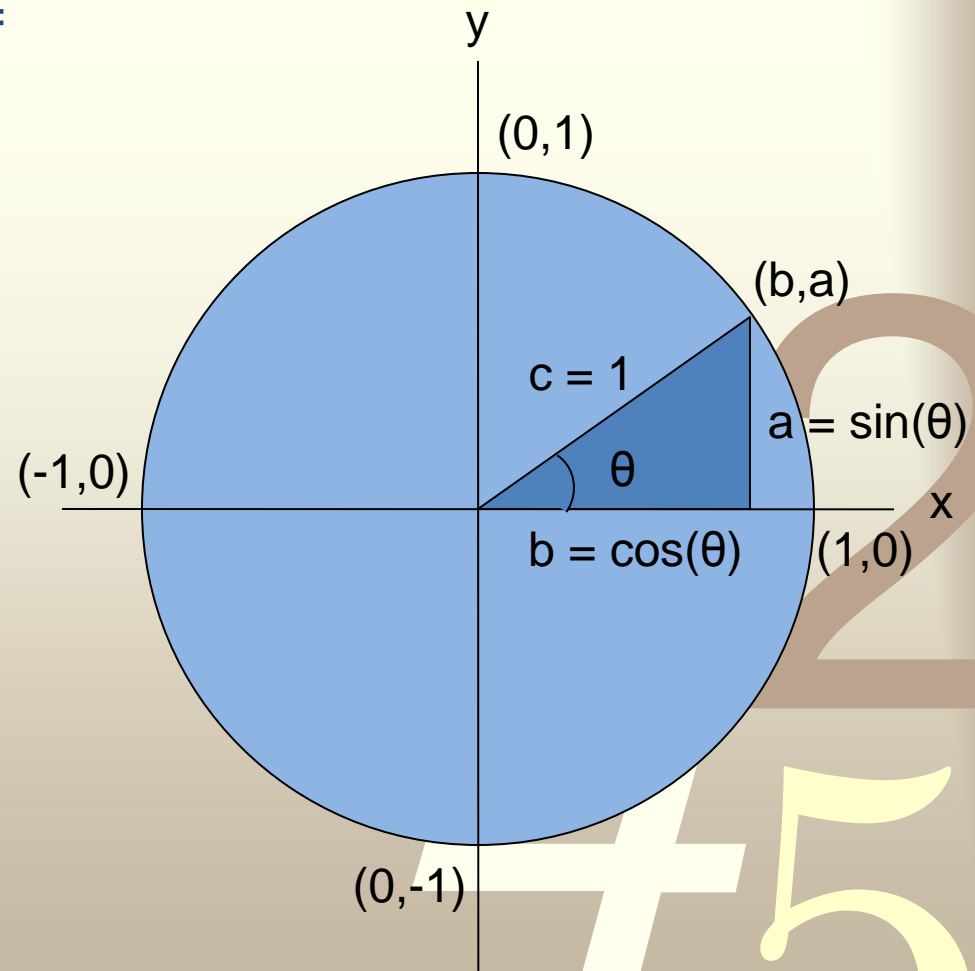
# Trig Functions: Periodic

$\theta = 0^\circ \Rightarrow \cos(\theta) = 1$  and  $\sin(\theta) = 0$ : point on circle is on x-axis.

$\theta = 90^\circ \Rightarrow \cos(\theta) = 0$  and  $\sin(\theta) = 1$ : point on circle is on y-axis.

$\theta = 180^\circ \Rightarrow \cos(\theta) = -1$  and  $\sin(\theta) = 0$ : point on circle is on (-x)-axis.

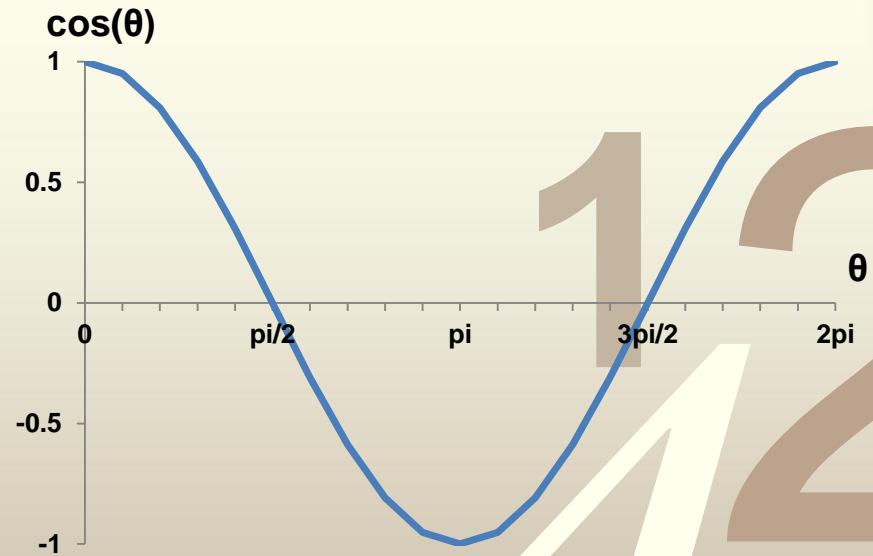
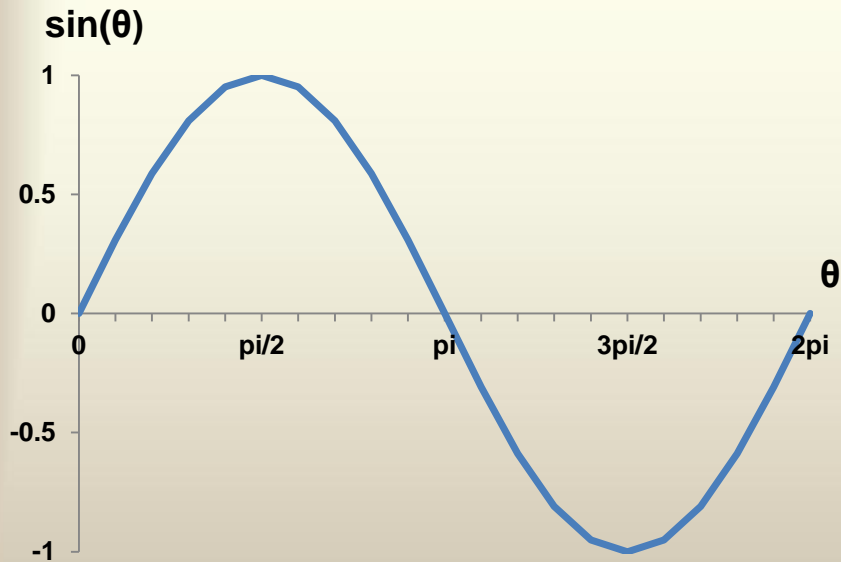
$\theta = 270^\circ \Rightarrow \cos(\theta) = 0$  and  $\sin(\theta) = -1$ : point on circle is on (-y)-axis.



Sine and cosine increase and decrease as you go around the circle

# Trig Functions: Periodic

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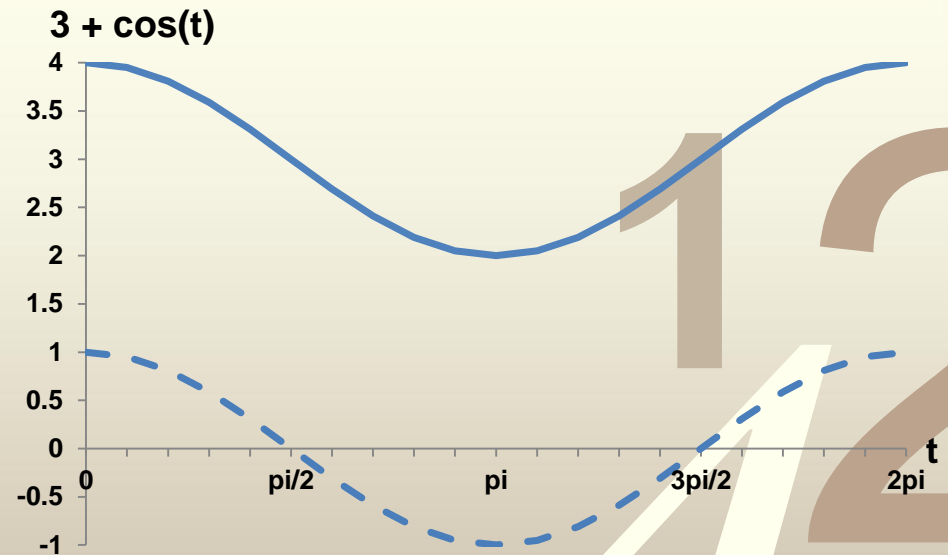
# y-axis Shift

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General form:

$$A + B\cos(\omega t + \varphi)$$

- A: Shifts the function up (+) or down (-) along the y-axis.



Dotted line represents the original  $\cos(t)$  function.

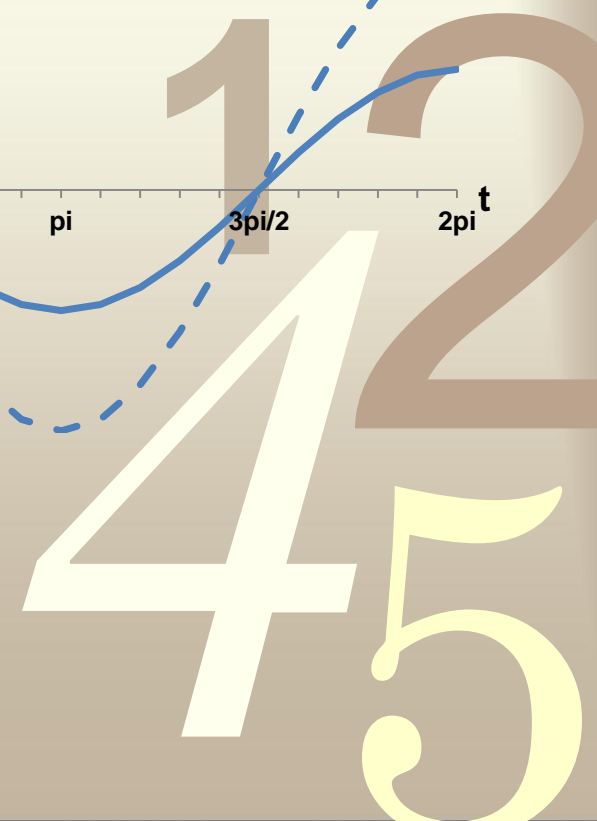
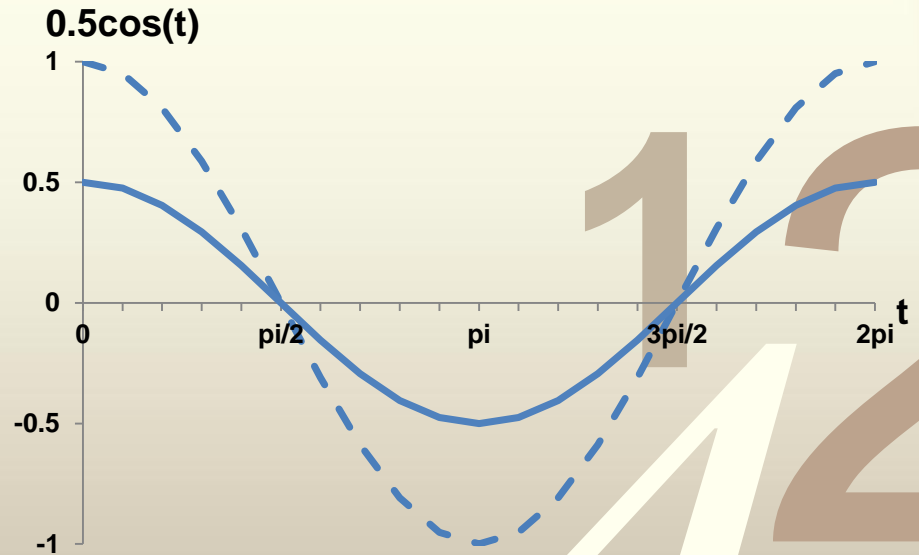
# Amplitude

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General form:

$$A + B\cos(\omega t + \varphi)$$

- B (Amplitude): Shrinks (small #) or stretches (large #) along the y-axis.

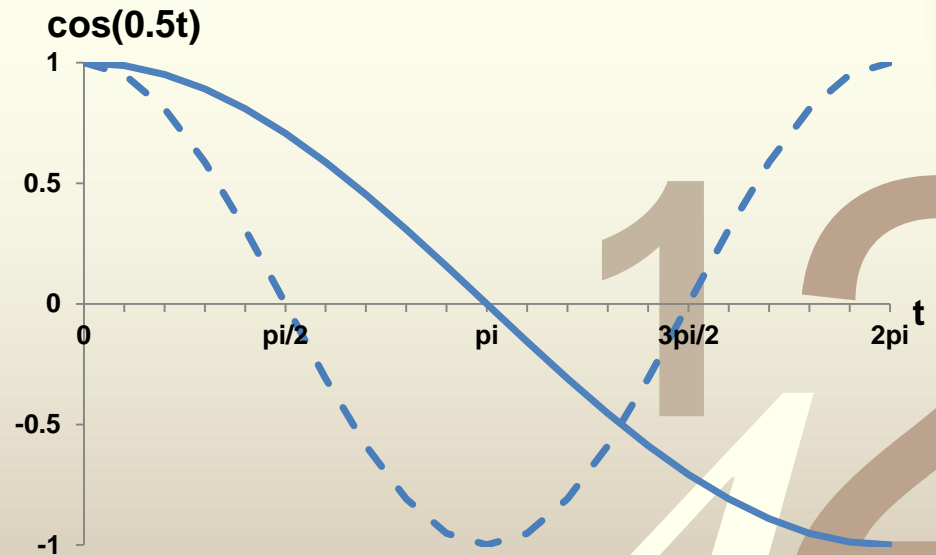


# Frequency

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General form:

$$A + B\cos(\omega t + \varphi)$$

- $\omega$  (frequency): Shrinks (large #) or stretches (small #) along the x-axis. ( $1/\text{s} = \text{Hz}$ )
- $T$  (period) =  $2\pi/\omega$ : Time it takes for the wave to complete one full cycle. (s)

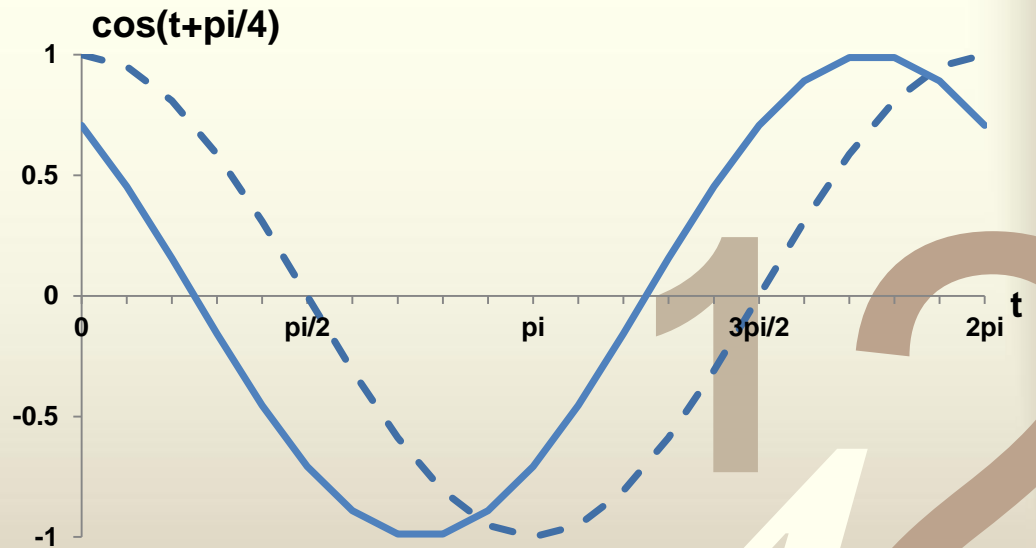


# Phase Shift

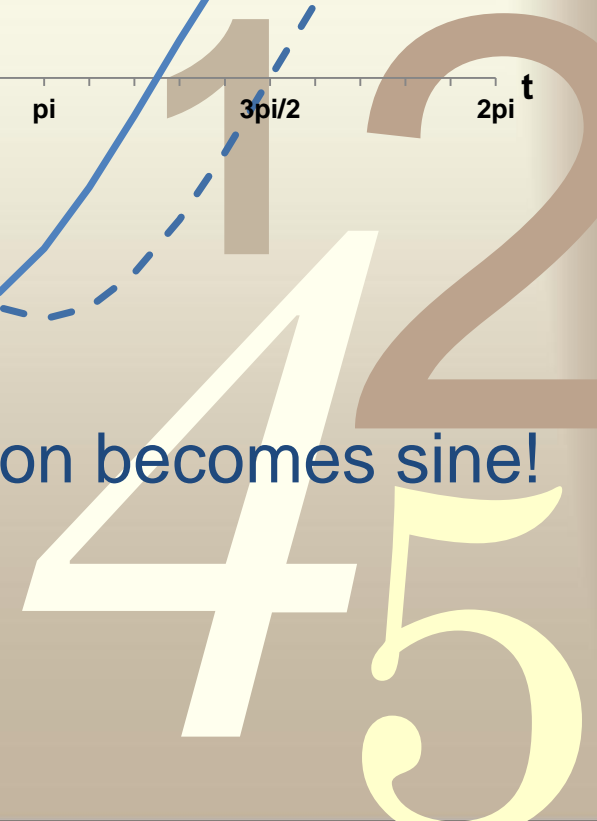
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General form:  
 $A + B\cos(\omega t + \varphi)$

- $\varphi$ : Shifts right (-) or left (+) along the x-axis.



If you shift cosine by  $\varphi = -\pi/2$ , your function becomes sine!





# Common Trig Mistakes

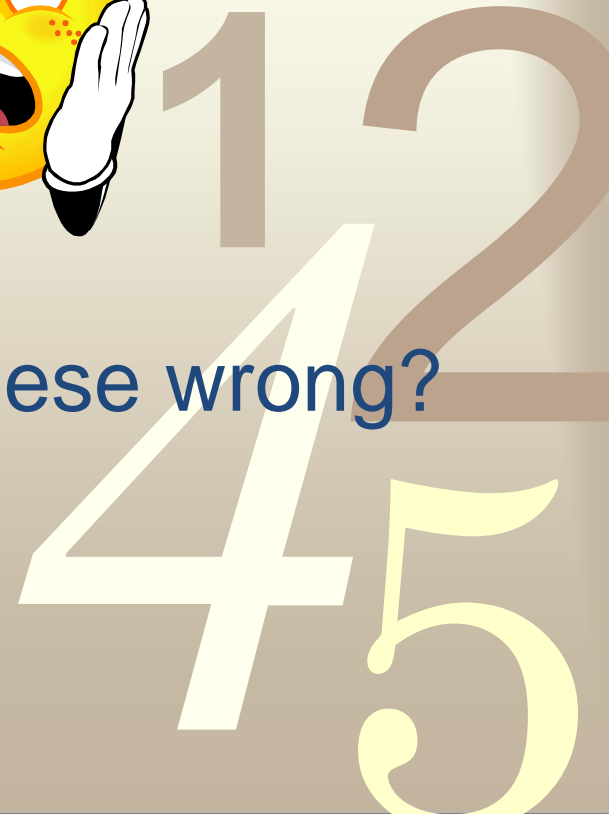
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- $\theta = x/\sin$

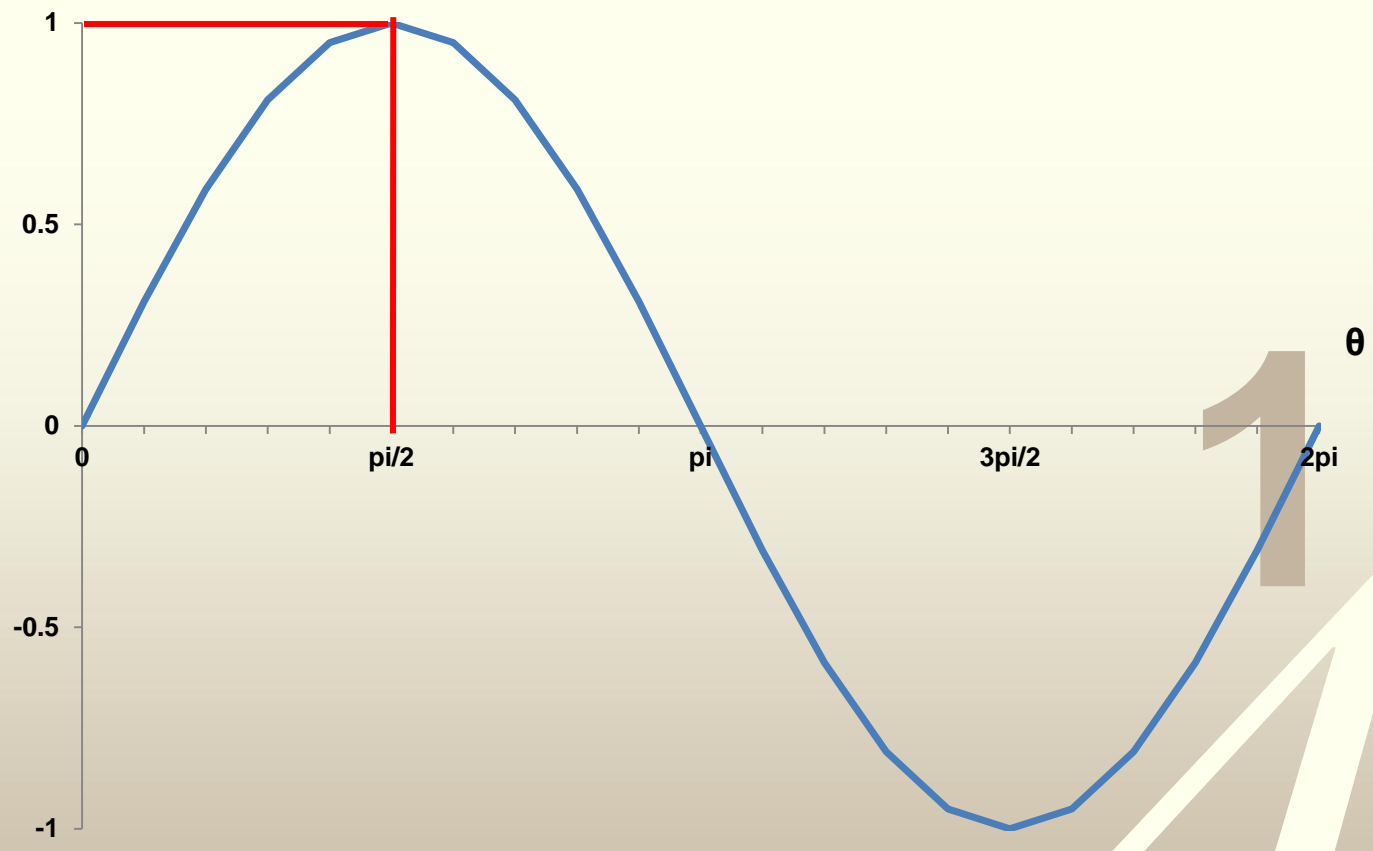


- $\sin(90^\circ) = 0.894$

Why are these wrong?



$\sin(\theta)$

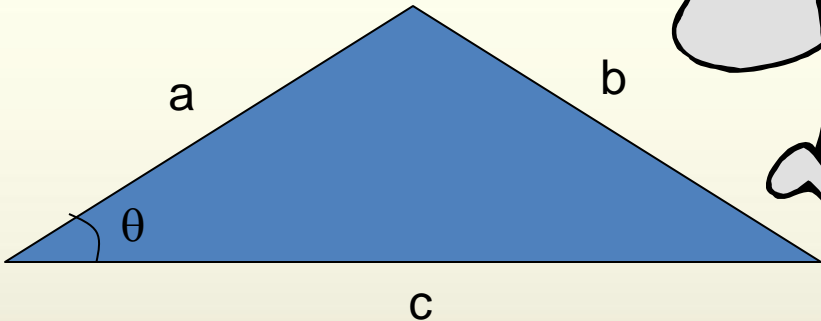


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$\theta$   
1  
2  
4  
5

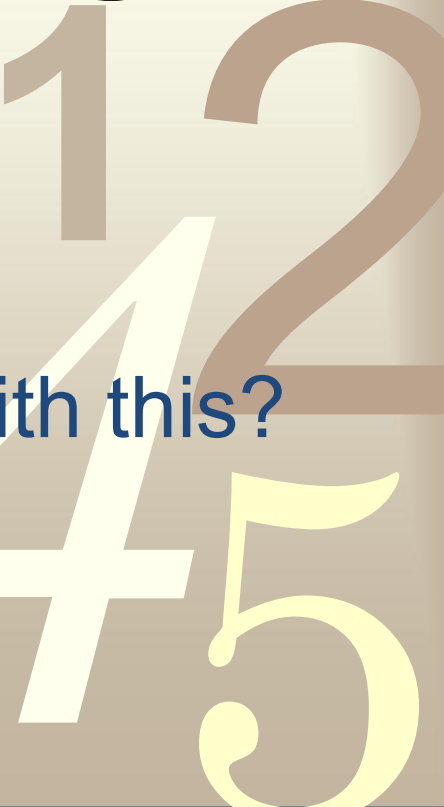


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- ~~$\sin(\theta) = b/c$~~

What's wrong with this?

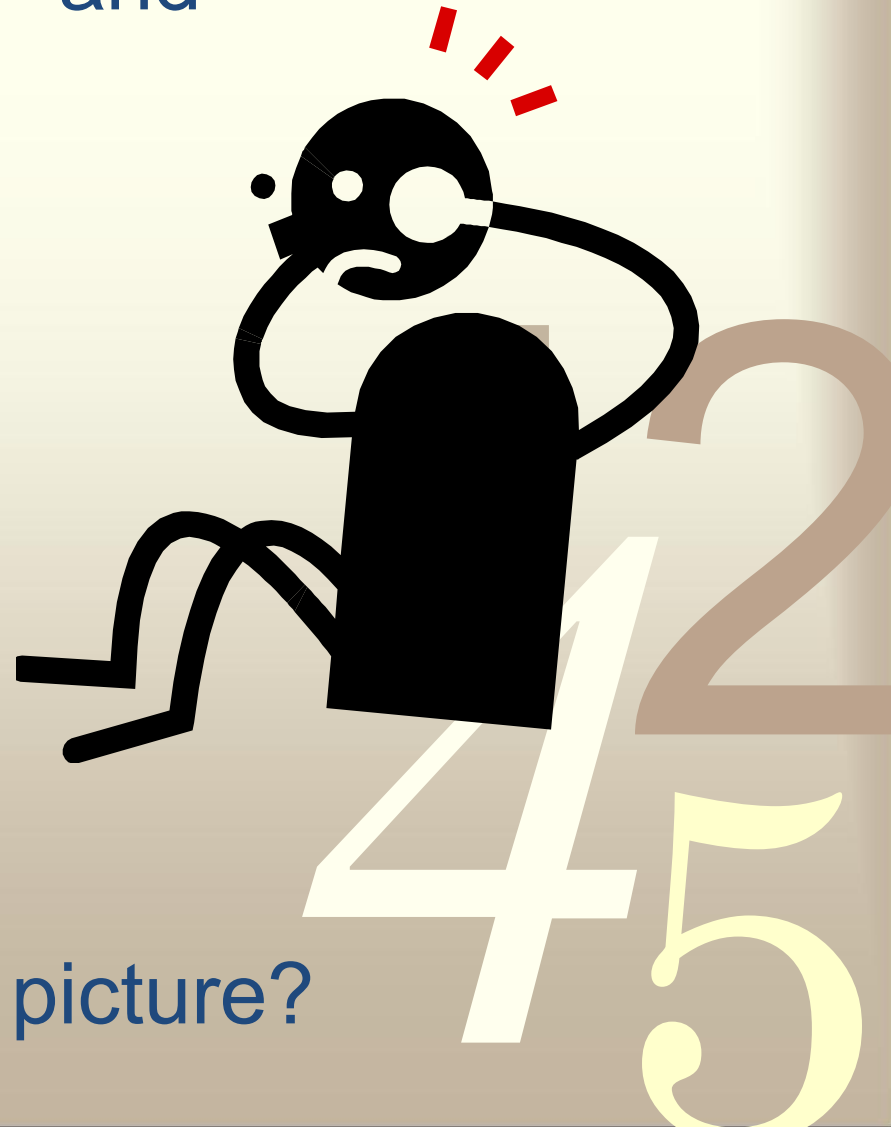


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- $\sin(\theta^2) = \sin^2(\theta)$

and

- $\sin^{-1}(\theta) = 1/\sin(\theta)$



What's wrong with this picture?

# Trigonometric Identities

00 More commonly, you have a circle of radius,  $r$ .

$$x^2 + y^2 = r^2$$

$$r^2 \cos^2(\theta) + r^2 \sin^2(\theta) = r^2$$

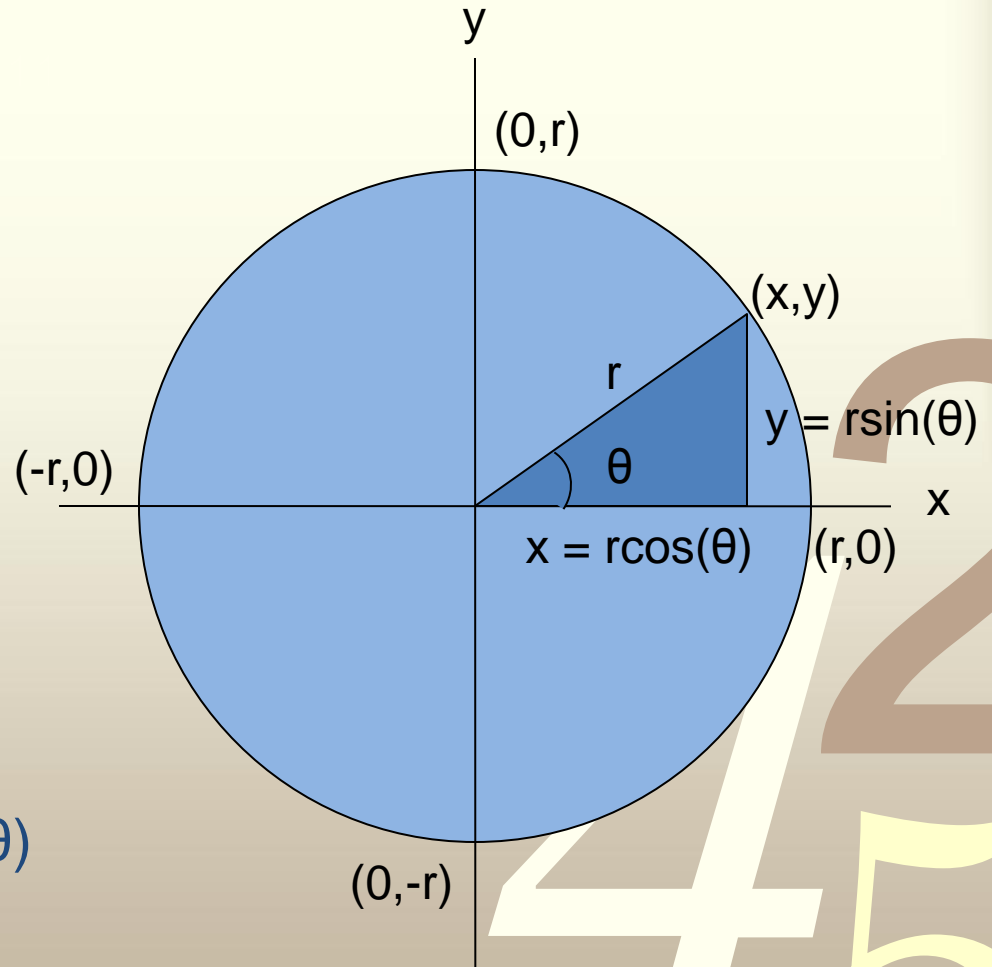
$$\underline{\cos^2(\theta) + \sin^2(\theta) = 1}$$

divide by  $\cos^2(\theta)$ :

$$1 + \sin^2(\theta)/\cos^2(\theta) = 1/\cos^2(\theta)$$

$$\underline{1 + \tan^2(\theta) = \sec^2(\theta)}$$

$$\sec(\theta) = 1/\cos(\theta), \csc(\theta) = 1/\sin(\theta), \cot(\theta) = 1/\tan(\theta)$$



For more trig help...

Come to the QSC!

UW2-030

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