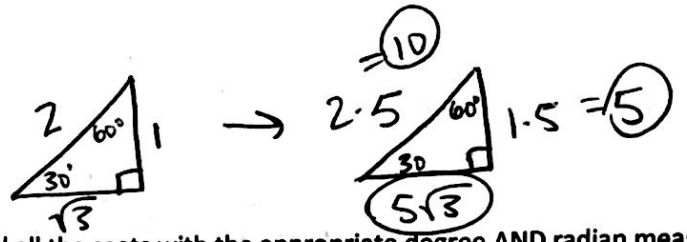
$5\sqrt{3} \approx 8.66$

DAY 3 - FERRIS WHEEL INVESTIGATION

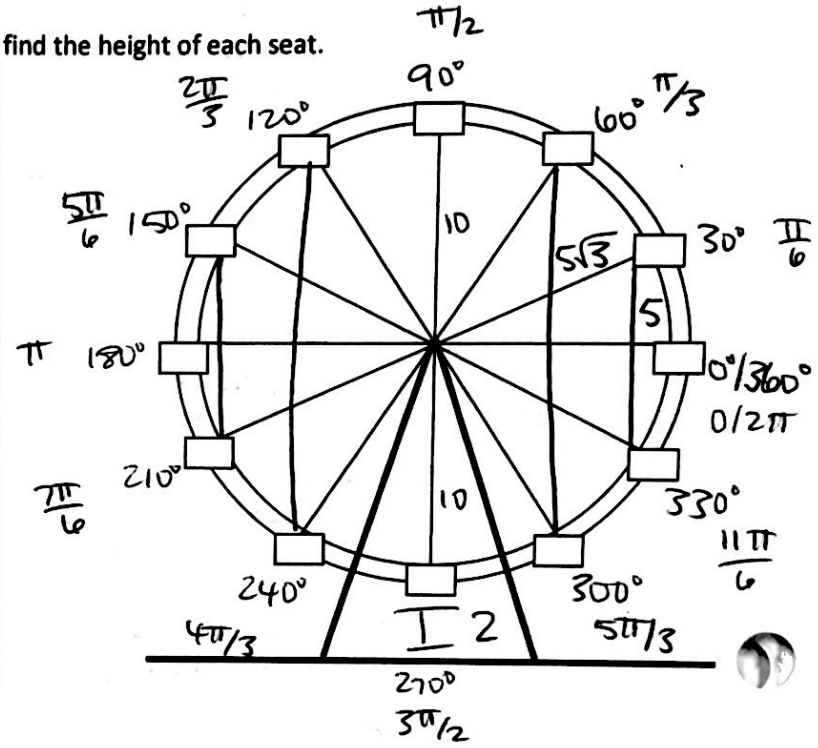
Discovering Sine and Cosine



SET UP: Consider the Ferris Wheel below. Label all the seats with the appropriate degree AND radian measures. The radius of the wheel is 10 meters and the wheel is 2 meters off the ground.

a) Use general special right triangle knowledge to find the height of each seat.

Seat (radian angle)	Exact Height	Decimal Approx. Height
0	10+2	12 m
π/6	10+5+2	17 m
π/3	10+5√3+2	20.66 m
π/2	10+10+2	22
2π/3	5√3+10+2	20.66 m
5π/6	5+10+2	17 m
π	10+2	12 m
7π/6	10-5+2	7 m
4π/3	10-5√3+2	3.34 m
3π/2	0+2	2 m
5π/3	10-5√3+2	3.34 m
11π/6	10-5+2	7 m
2π	10+2	12 m



b) What will happen to the heights as you continue to rotate around the Ferris wheel?

oscillate ∿∿

c) At what other angle would your seat be at the same height as the 30° seat?

150° seat

d) What will your height be when your seat is at an angle of 3000°?

3000° → 120° → 12+5√3 m

e) What would happen to the heights if the Ferris wheel started rotating in the opposite direction?

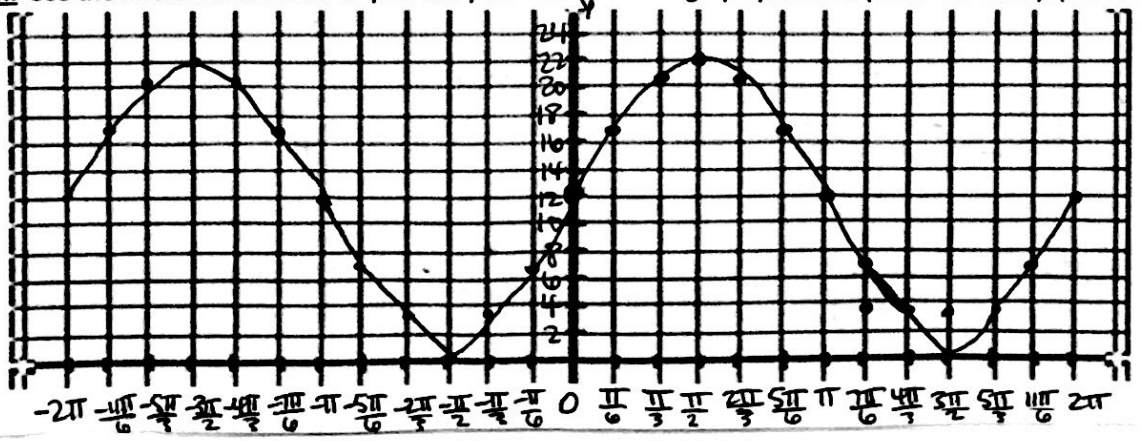
still oscillates ∿∿

f) What will your height be when your seat is at an angle of -1920°?

-1920° = 240°

↳ 12-5√3 m

GRAPH: Use the information above to plot out your results on the graph provided (from -2π to 2π). (LABEL AXES)

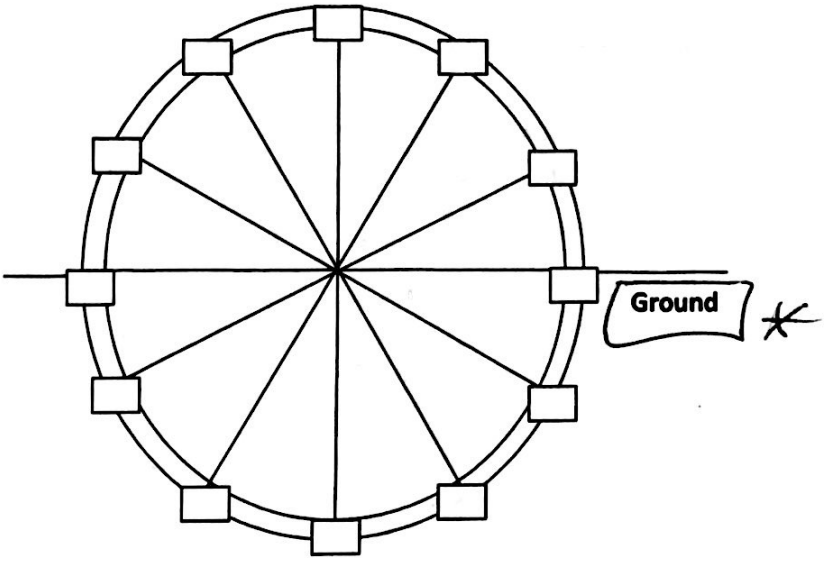


6

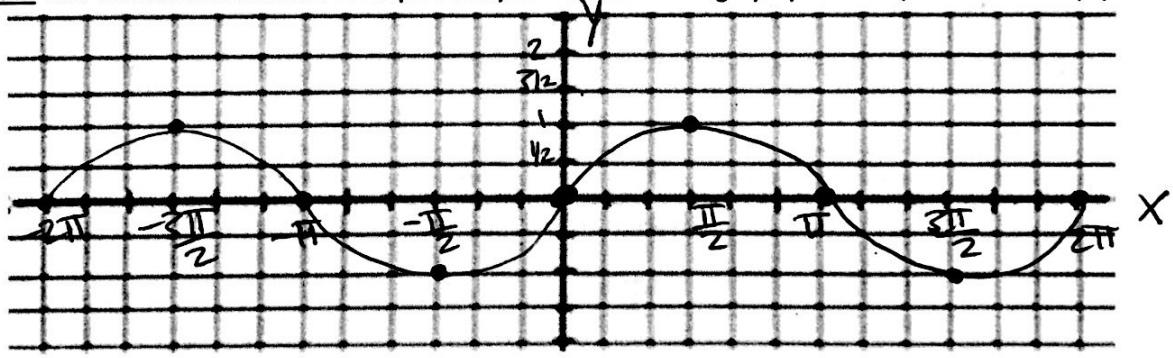
$\sqrt{3}/2 \approx 0.866$

What would the graph look like if the radius of the Ferris Wheel was 1 unit and the center of the Ferris wheel was at the origin?

Seat (radian angle)	Exact Height	Decimal Approx. Height
0	0	0
$\pi/6$	$0+1/2$	0.5
$\pi/3$	$0+\sqrt{3}/2$	0.866
$\pi/2$	1	1
$2\pi/3$	$0+\sqrt{3}/2$	0.866
$5\pi/6$	$0+1/2$	0.5
π	0	0
$7\pi/6$	$0-1/2$	-0.5
$4\pi/3$	$0-\sqrt{3}/2$	-0.866
$3\pi/2$	$0-1$	-1
$5\pi/3$	$0-\sqrt{3}/2$	-0.866
$11\pi/6$	$0-1/2$	-0.5
2π	0	0



GRAPH: Use the information above to plot out your results on the graph provided (from -2π to 2π). (LABEL AXES)



CONCLUSION:

You have just graphed **y = sin x** (where x represents the seat and y represents the height).

FOLLOW-UP QUESTIONS:

If you are given y = sin x and asked to find the sine of 30^0, you are really finding the height at that point (when the origin is the center of the Ferris Wheel and the radius = 1).

Find the following:

a) $\sin 30^0 = 1/2$ b) $\sin 390^0 = 1/2$ c) $\sin(-330)^0 = 1/2$ d) $\sin(-690)^0 = 1/2$

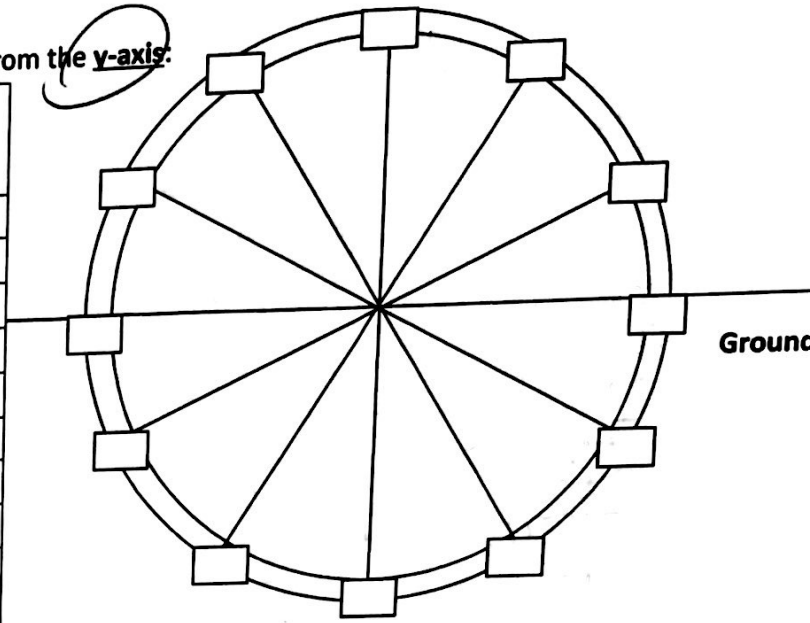
e) $\sin\frac{2\pi}{3} = \sqrt{3}/2$ f) $\sin\frac{8\pi}{3} = \sqrt{3}/2$ g) $\sin-\frac{4\pi}{3} = \frac{\sqrt{3}}{2}$ h) $\sin-\frac{10\pi}{3} = \frac{\sqrt{3}}{2}$

a-d and e-h are coterminal angles

SET-UP: Consider the Ferris Wheel below. Label the x- and y-axes by using the center of the Ferris wheel as the origin. Label the seats with the appropriate RADIAN measures. ***Consider the center of the wheel to be the origin and the radius of the wheel to be = 1 unit.***

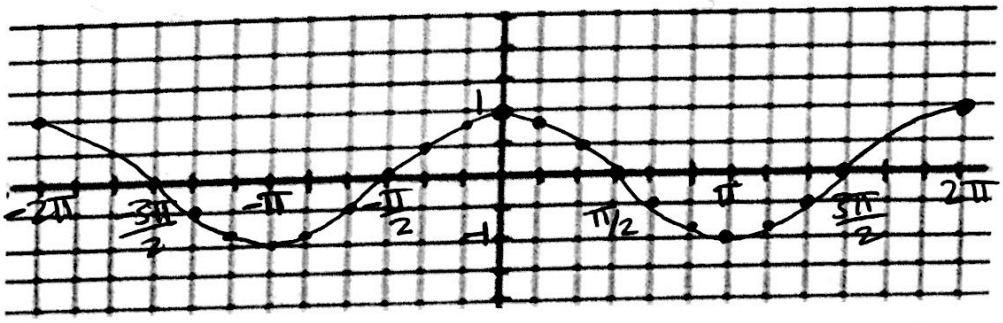
a) We are now going to look at how far each seat is from the **y-axis**:

Seat (radian angle)	Exact Displacement from y-axis	Decimal Approx. for Displacement from y-axis
0	1	1
$\pi/6$	$\sqrt{3}/2$	0.866
$\pi/3$	$1/2$	0.5
$\pi/2$	0	0
$2\pi/3$	$1/2$	−0.5
$5\pi/6$	$\sqrt{3}/2$	−0.866
π	1	−1
$7\pi/6$	$\sqrt{3}/2$	−0.866
$4\pi/3$	1	−0.5
$3\pi/2$	$1/2$	0
$5\pi/3$	0	0.5
$11\pi/6$	$\sqrt{3}/2$	0.866
2π	1	1



Make sure all of the displacements to the RIGHT of the y-axis are POSITIVE and that all of the displacements to the LEFT of the y-axis are NEGATIVE!!

GRAPH: Use the information above to plot out your results on the graph provided. (LABEL AXES)



CONCLUSION:

You have just graphed **y = cos x** (x represents the Seat and y represents the displacement (from y-axis)

EXTENSIONS:

a) The sine and cosine graphs ("waves") are very similar. State 3 similarities:

(answers vary ...)

b) State one difference:

y-intercept

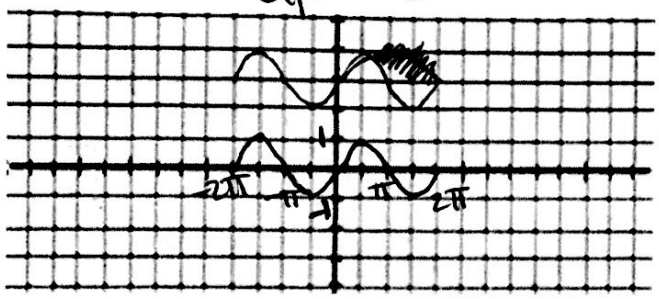
c) Use your knowledge of ***basic transformations*** to graph the following (LABEL THE AXES appropriately; use radian measures for the x-axis):

+/− on OUTSIDE → up/down

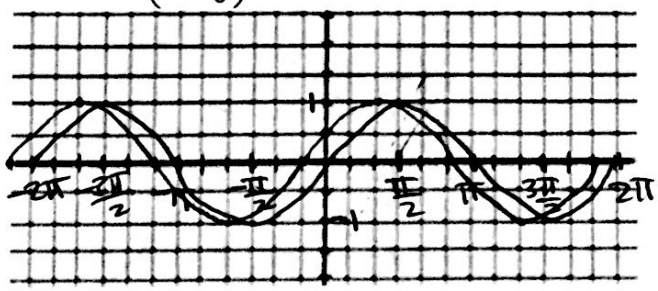
+/− on INSIDE → left/right

−trig → flip over x-axis

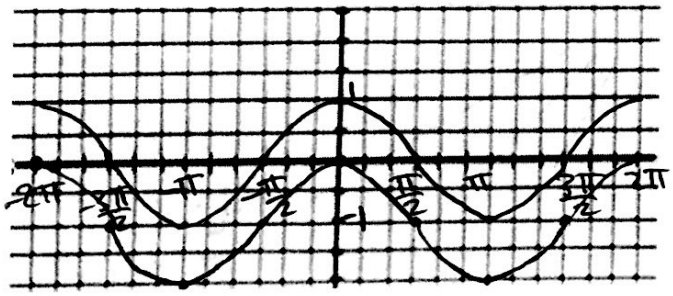
1) $y = \sin x + 3$ up 3



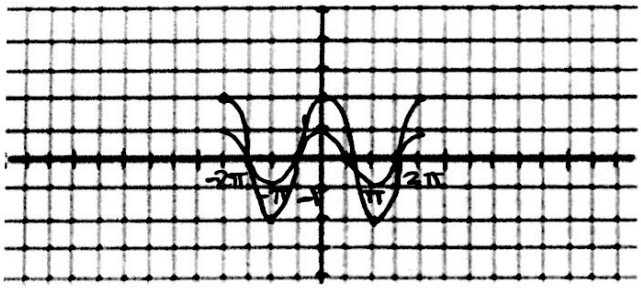
2) $y = \sin\left(x + \frac{\pi}{6}\right)$ left π/6



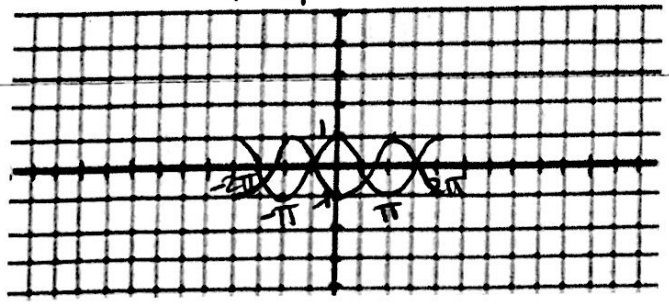
3) $y = \cos x - 2$ down 2



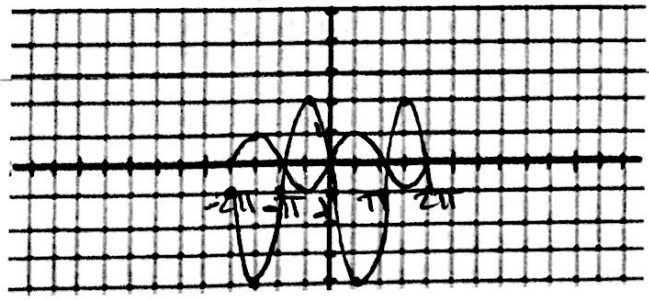
4) $y = 2\cos x$ vertical stretch



5) $y = -\cos x$ flip over x-axis



6) $y = -3\sin x - 1$ flip, stretch, down



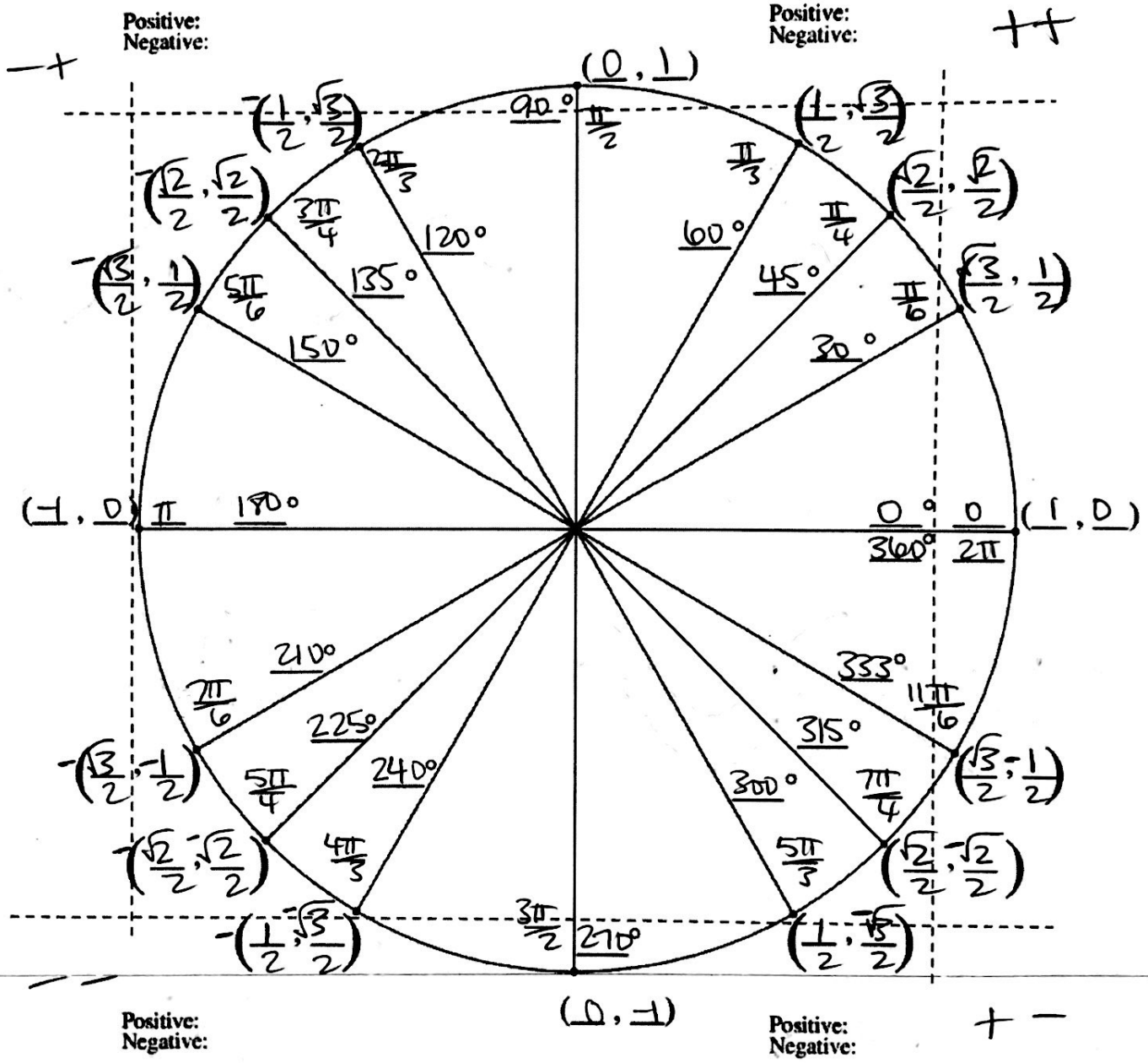
* BLACK → parent graph

* BLUE → w/ transformations

During class, we explored the idea of finding heights and distances along the edge of a Ferris Wheel and looked specifically at a wheel with a radius of 1. We found out that when the radius = 1:

sine represents heights. cosine represents displacements

If we were to plot the Ferris Wheel on a set of x- and y- axes, we would know all of the coordinates of the points shown. Fill in all degree values, radian values, heights, and displacements:



****STUDY all parts of this Unit Circle for tomorrow's quiz (10 minutes MAX.)!!****