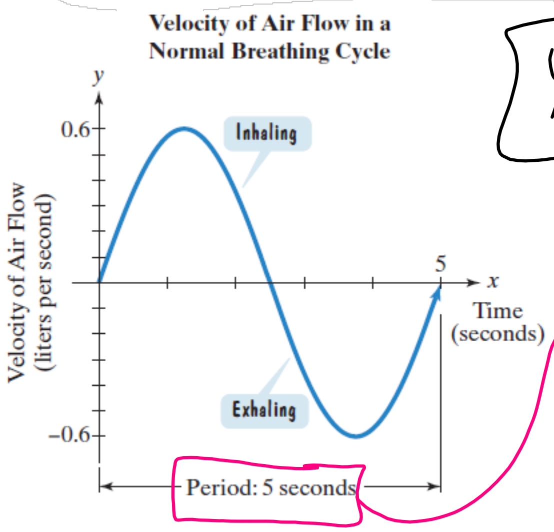
9.3 - Graphing Trig. Functions - Day 4

Using Sin / Cos Functions to Model Real-Life Situations

Ex1.)

A Trigonometric Breath of Life

The graph in **Figure 4.76** shows one complete normal breathing cycle. The cycle consists of inhaling and exhaling. It takes place every 5 seconds. Velocity of air flow is positive when we inhale and negative when we exhale. It is measured in liters per second. If y represents velocity of air flow after x seconds, find a function of the form $y = A \sin Bx$ that models air flow in a normal breathing cycle.



$y = 0.6 \sin \frac{2\pi}{5}x$

$5 = \frac{2\pi}{B}$

$5B = 2\pi$, $B = \frac{2\pi}{5}$

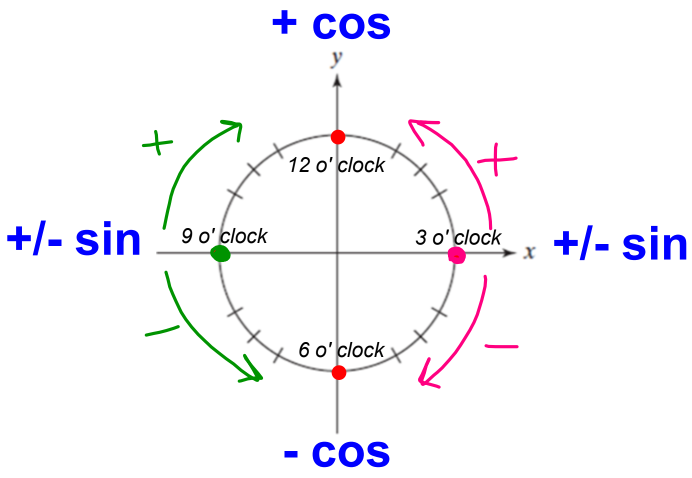
y = A sin/cos Bx + K

A = **amplitude** of the situation. Can be found by finding the difference between the max and min, then dividing by two. Often times it is the **radius** of a "wheel-problem."

B involves remembering that the **Period** = time for 1 revolution. Find B, by setting the period given equal to $\frac{2\pi}{B}$ then solve for **B**.

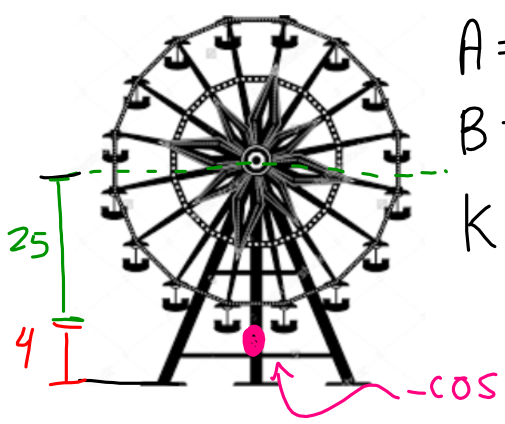
K = the **distance the center** (*midline*) **is above zero** (the ground in "wheel-problems"). Easily found by adding the distance given to the amplitude.

When to use Sin, Cos, -Sin, or -Cos ???



- Starts at 12 o'clock position (the top) use: +cos
- Starts at 6 o'clock position (the bottom) use: -cos
- Starts at 3 o'clock position (the right) with counterclockwise rotation use: +sin
  with clockwise rotation use: -sin
- Starts at 9 o'clock position (the left) with counterclockwise rotation use: -sin
  with clockwise rotation use: +sin

Ex.2) A Ferris wheel has a diameter of 50 feet and the bottom of the wheel is 4 feet above the ground. The wheel rotates at a constant speed, and takes 40 seconds to complete one revolution. Write the equation that models the height, h, of the Ferris wheel in terms of t, time in seconds, and assuming it starts at the bottom.



$A = 25$

$B = \frac{\pi}{20}$

$K = 29$

Period: 40s.

$40 = \frac{2\pi}{B}$

$40B = 2\pi$

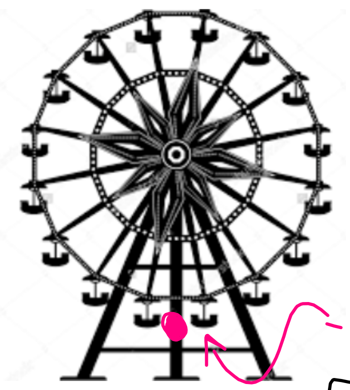
$B = \frac{2\pi}{40}$

$B = \frac{\pi}{20}$

$$h = -25\cos\left(\frac{\pi}{20}\right)t + 29$$

You Try!

Ex.3) A Ferris wheel has a diameter of 80 feet and the bottom of the wheel is 3 feet above the ground. The wheel rotates at a constant speed, and *takes 5 minutes to complete six revolutions*. Write the equation that models the height, *h*, of the Ferris wheel in terms of *t*, time in seconds, and assuming it starts at the bottom.



$-\cos$

$A = 40$

$B = \frac{\pi}{25}$

$K = 43$

Period: 50s

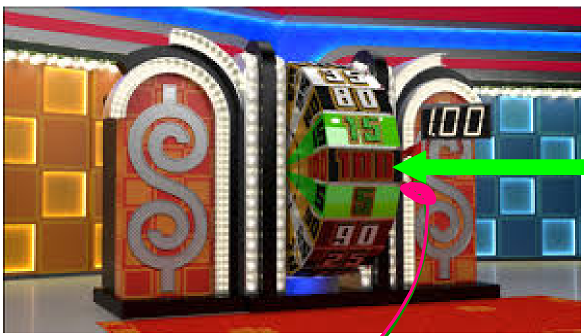
$50s. = \frac{2\pi}{B}$

$50B = 2\pi$

$B = \frac{2\pi}{50}$

$$h = -40\cos\left(\frac{\pi}{25}\right)t + 43$$

Ex.4) The wheel from The Price is Right is 8 feet in diameter and rotates clock-wise. The center axle of the wheel is 5 feet from the ground. Assume the $1.00 is in line with the arrow (*like the picture*) and you spin the wheel with two revolutions over 6 seconds. Write the equation that models the height, *h*, of the wheel in terms of *t*, time in seconds.



Starts here

$-\sin$

$A = 4$

$B = \frac{2\pi}{3}$

$K = 5$

Period: 3 s.

$\frac{2\pi}{B} = 3$

$3B = 2\pi$

$B = \frac{2\pi}{3}$

$$h = -4\sin\left(\frac{2\pi}{3}\right)t + 5$$