# Warm-up

Discuss with your table partner:

Think of $y = a(x - h)^2 + k$ and the transformations it does to $y = x^2$.

What effects do you think $y = A\sin(bx - c) + d$ have on the graph of $y = \sin x$? Specifically, how does it affect amplitude and period?

Graphing Trigonometric Functions

# Vocab

Sinusoidal Axis - the axis that is the midpoint of a sine or cosine curve.

General Form of Periodic Functions

$$y = A \sin(bx - c) + d$$

or

$$A\sin\left(b\left(x - \frac{c}{b}\right)\right) + d$$

Amplitude = $A$

Period = $\frac{\text{original}}{b}$

*tan $\frac{\pi}{b}$

*sin/cosine $\frac{2\pi}{b}$

Phase Shift = $\frac{c}{b}$

Vertical Shift = $d$

(Sinusoidal Axis. $y = d$ )

Example 1: $y = 4 \cos (3x)$

Amplitude: 4

Period: $\frac{2\pi}{3}$

Phase Shift: none

Vertical Shift: none

S.A.: $y = 0$

Example 2: $y = 3 \sin (x) - 2$

Amplitude: 3

Period: $2\pi$

Phase Shift: none

Vertical Shift: Down 2

S.A.: $y = -2$

Max: 1

Min: -5

Example 3: $y = \frac{1}{2}\cos(\underbrace{2x - \frac{\pi}{3}}_{\boxed{2(x-\frac{\pi}{6})}}) - 1$

Amplitude: $\frac{1}{2}$ Period: $\frac{2\pi}{2} = \boxed{\pi}$

Phase Shift: Right $\frac{\pi}{6}$ Vertical Shift: Down 1

S.A.: $y=-1$

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

Min $-\frac{3}{2}$ or $-1.5$

Example 4: $y = -5\sin(\underbrace{\frac{1}{3}x - \frac{\pi}{6}}_{\boxed{\frac{1}{3}(x-\frac{\pi}{2})}})$

reflection over x-axis!

Amplitude: 5 Period: $6\pi$

Phase Shift: Right $\frac{\pi}{2}$ Vertical Shift: none

S.A.: $y=0$

Determine the amplitude and period of the following functions. Then, describe any phase or vertical shifts.

1. $4 \sin (x)$
2. $3 \cos (x) - 2$
3. $4 \sin (3x)$
4. $-3 \cos (x - \pi/4)$
5. $1/2 \sin (2x) + 5$
6. $5/2 \cos (2x - \pi/3)$
7. $\tan (2x)$
8. $\tan (3x + \pi/4)$
9. $2 \sin (4x + \pi) - 1$
10. $8 \cos (1/2x - \pi/3)$

Amplitude = Period =
**Phase Shift =** Vertical Shift =

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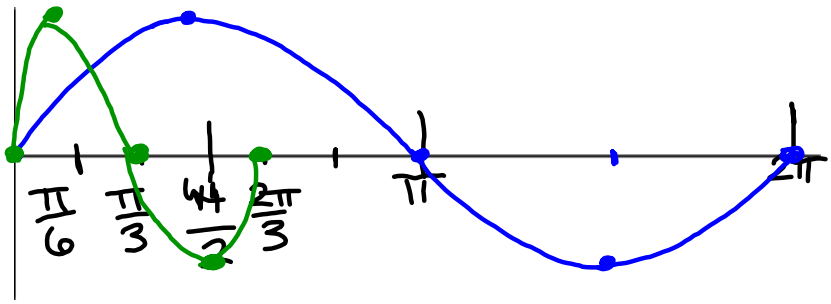
Graph the following function:

$\boxed{y = \sin(3x)}$

Amplitude: 1 Period: $\frac{2\pi}{3}$

Sinusoidal Axis: $y = 0$ Phase Shift: none

| | x | y | |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | 1 | 1 |
| $\frac{\pi}{3}$ | $\pi$ | 0 | 0 |
| $\frac{\pi}{2}$ | $\frac{3\pi}{2}$ | -1 | -1 |
| mult $\frac{1}{3}$ | $2\pi$ | 0 | 0 |




Graph the following function:

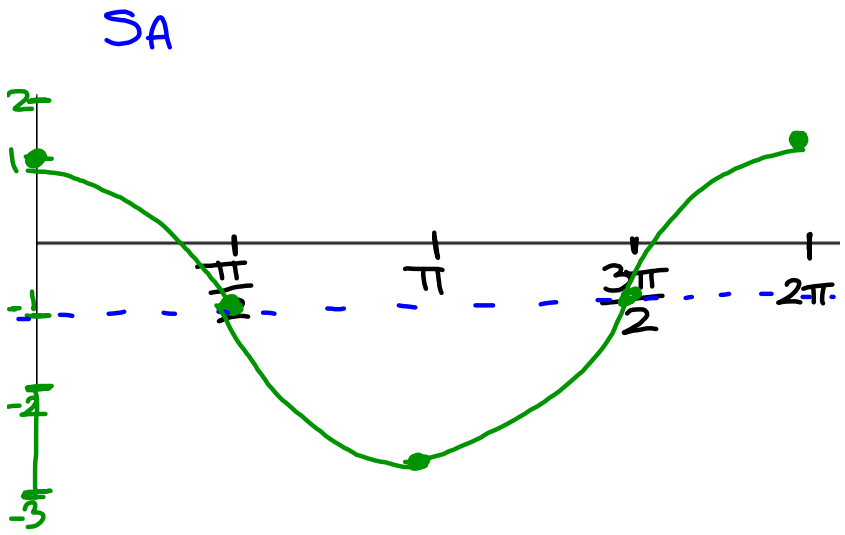
$$y = 2\cos(x) - 1$$

Amplitude: 2 Period: $2\pi$

Sinusoidal Axis: $y = -1$ Phase Shift: none

| x | y | | |
|---|---|---|---|
| 0 | 1 | 2 | 1 |
| $\frac{\pi}{2}$ | 0 | 0 | -1 |
| $\pi$ | -1 | -2 | -3 |
| $\frac{3\pi}{2}$ | 0 | 0 | -1 |
| $2\pi$ | 1 | 2 | 1 |

mult. 2 Down 1



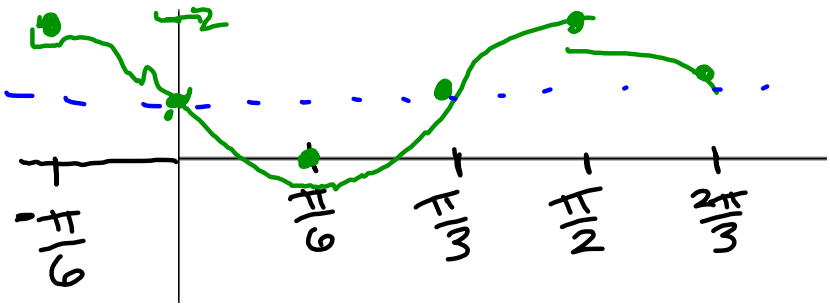

Graph the following function:

$$y = \cos\underbrace{(3x+\pi/2)}_{3\left(x+\frac{\pi}{6}\right)} + 1$$

Amplitude: 1 Period: $\frac{2\pi}{3}$

Sinusoidal Axis: $y=1$ Phase Shift: left $\frac{\pi}{6}$

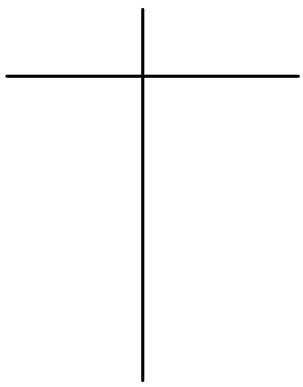
| | | x | y | |
|---|---|---|---|---|
| $-\frac{\pi}{6}$ | 0 | 0 | 1 | 2 |
| 0 | $\frac{\pi}{6}$ | $\frac{\pi}{2}$ | 0 | 1 |
| $\frac{\pi}{6}$ | $\frac{\pi}{3}$ | $\pi$ | -1 | 0 |
| $\frac{\pi}{3}$ | $\frac{\pi}{2}$ | $\frac{3\pi}{2}$ | 0 | 1 |
| $\frac{\pi}{2}$ | $\frac{2\pi}{3}$ | $2\pi$ | 1 | 2 |
| $-\frac{\pi}{6}$ | mult $\frac{1}{3}$ | | up 1 | |




Graph the following function:

$$y = \tan\left(2x - \pi/2\right) + 1$$

$2\left(x - \frac{\pi}{4}\right)$

Amplitude: Period:

Sinusoidal Axis: Phase Shift: