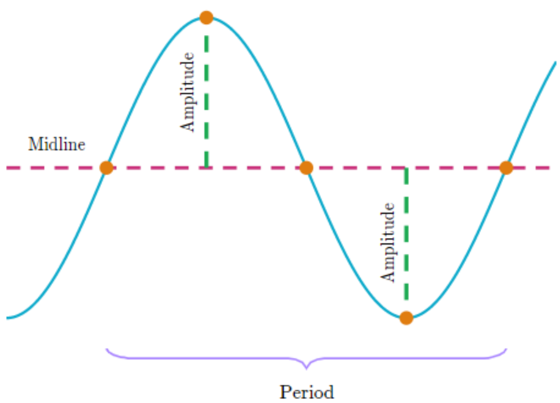
What are midline, amplitude, and period?

Midline, amplitude, and period are three features of sinusoidal graphs.



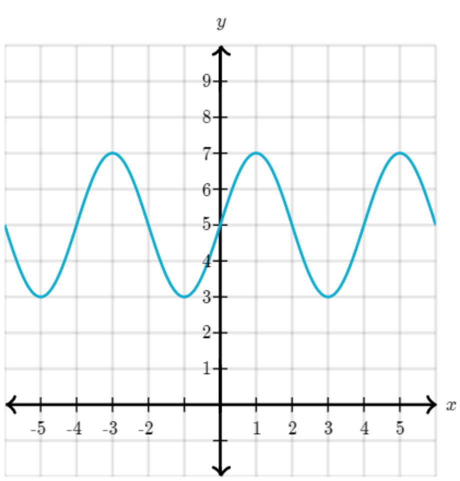
Midline is the horizontal line that passes exactly in the middle between the graph's maximum and minimum points.

Amplitude is the vertical distance between the midline and one of the extremum points.

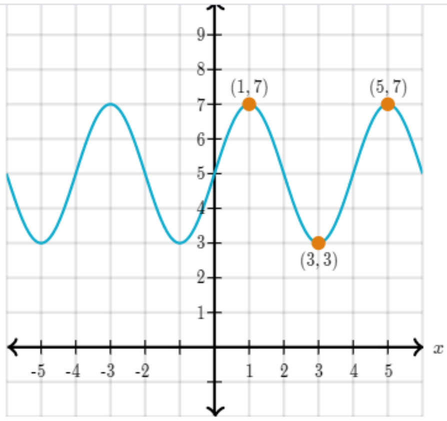
Period is the distance between two consecutive maximum points, or two consecutive minimum points (these distances must be equal).

Finding features from graph

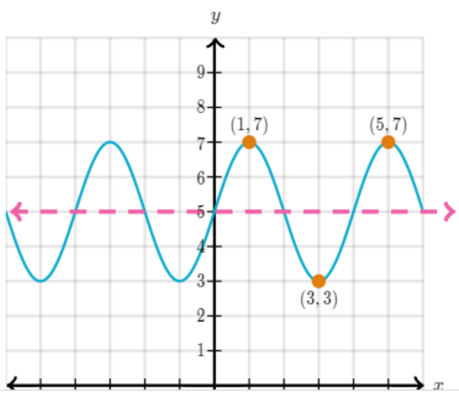
Given the graph of a sinusoidal function, we can analyze it to find the midline, amplitude, and period. Consider, for example, the following graph.



It has a maximum point at $(1, 7)$, then a minimum point at $(3, 3)$, then another maximum point at $(5, 7)$.



The horizontal line that passes exactly between $y = 7$ (the maximum value) and $y = 3$ (the minimum value) is $y = 5$, so that's the midline.

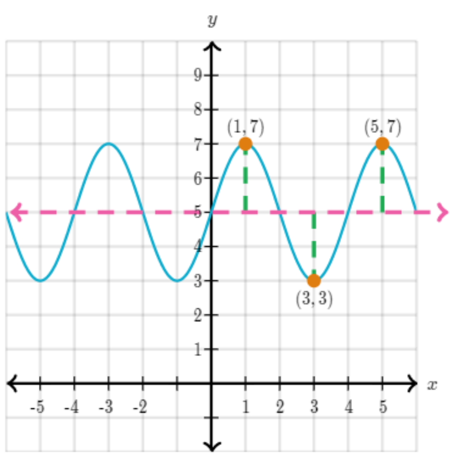


The Midline which is the vertical translation, can be calculated by:

Minimum plus the Amplitude (Min + A)

Ex. Min is 3, Amp is 2 therefore midline is y=5.

The vertical distance between the midline and any of the extremum points is 2, so that's the amplitude.



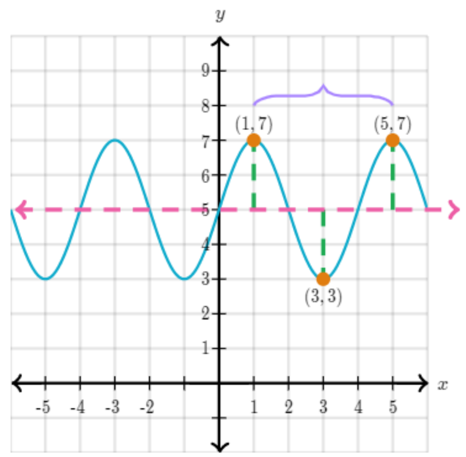
Amplitude can be calculated by the following:

(Max – Min)/2

Ex. (7-3)/2 = 2

So A=2

The distance between the two consecutive maximum points is 4, so that's the period.



You can find the period by measure from peak to peak, either the maximums or minimums.

Ex. From (1, 7) to (5, 7) it took 4 radians

Or

From (-1, 3) to (3, 3) it took 4 radians

*** Keep in mind that if on the axis you don't see the degree symbol next to the numbers, by default it is radians.

Graphing the sine function

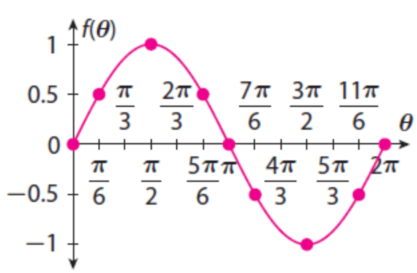
Now that you know the features of a sinusoidal graph, let's focus on graphing y=sinx .

Keep in mind that around the unit circle, the sine of an angle is the y-component of that point.

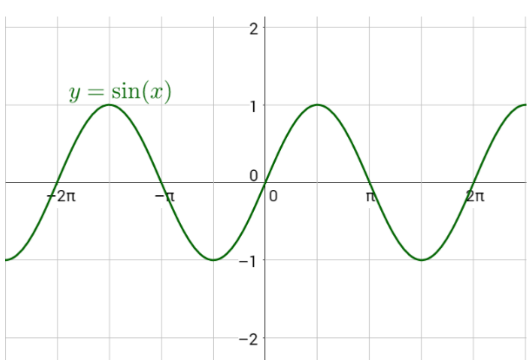
For example, for 30^o from the unit circle we have $(\frac{\sqrt{3}}{2},\frac{1}{2})$, the $\sin e$ of 30^o is the $\frac{1}{2}$. I will continue with the example in radians since radians is more commonly used in Trig.

x	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{3\pi}{4}$	π	$\frac{3\pi}{2}$	2π
$y=\sin x$	0	0.5	$\frac{\sqrt{2}}{2}\approx 0.7071$	$\frac{\sqrt{3}}{2}\approx 0.8660$	1	$\frac{\sqrt{2}}{2}\approx 0.7071$	0	-1	0

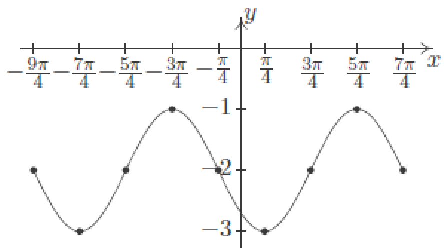
Now, if you plot these y-values over the x-values we have from the unwrapped unit circle, we get



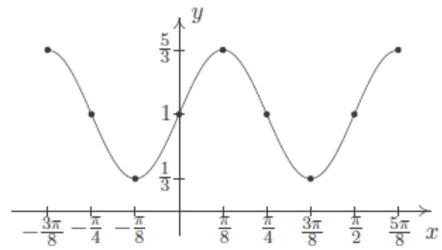
The above is one cycle of the sine function. Keep in mind that this is a wave and continues on the left of the y-axis as well, shown below. Please keep in mind that there are infinite cycles to the sine function.



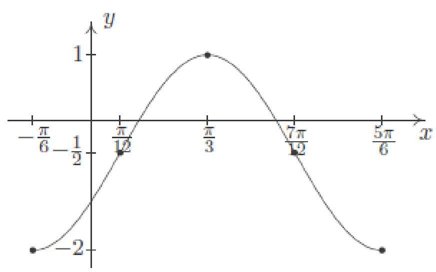
Assignment: For each of the following, determine what the midline (vertical shift), amplitude, and period is.

1. 

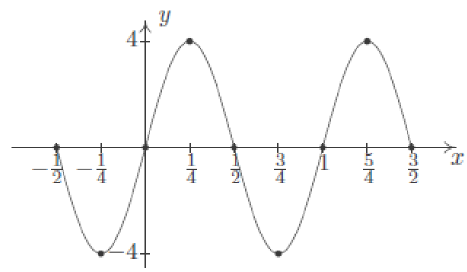
Midline: ______ Amp: _______ Period: _______

2. 

Midline: ______ Amp: _______ Period: ______

3. 

Midline: ______ Amp: _______ Period: _______

4. 

Midline: ______ Amp: _______ Period: ______

5. Complete the following table and use it to graph the cosine function similar to the notes on y=sin x.

x	0	$\frac{\pi}{6}$	$\frac{\pi}{4}$	$\frac{\pi}{3}$	$\frac{\pi}{2}$	$\frac{2\pi}{3}$	$\frac{3\pi}{4}$	$\frac{5\pi}{6}$	2π
y = Cos x									

6. Redo the graphs of sine and cosine function, but this time use a scale that is in degrees and not in radians. For example instead of labeling it as pi/6, we should see 30 degrees and so on.

7. **Investigate:** Using a TI-84 graphing calculator, DESMOS, or a similar app, investigate the following functions. Please use the following parameters:

i) Set your window between -360 to 360 degrees or -2pi to 2pi when working in radians

ii) Graph each along with its parent function. Provide an accurate sketch of the 2 functions.

iii) Describe what happened to the new function with respect to its parent function.

For A, B, C, your scale should be in degrees, for D, E, and F, it should be in radians. Show 2 cycles for each.

A) $y = 2\sin x$	B) $y = \cos 2x$	C) $y = \sin\frac{1}{2}x$
D) $y = 2\cos x + 1$	E) $y = \frac{1}{3}\sin 3x$	F) $y = 3\cos 2x - 1$

Remember you are comparing all of these with respect to the parent functions sin x or cos x, depending.