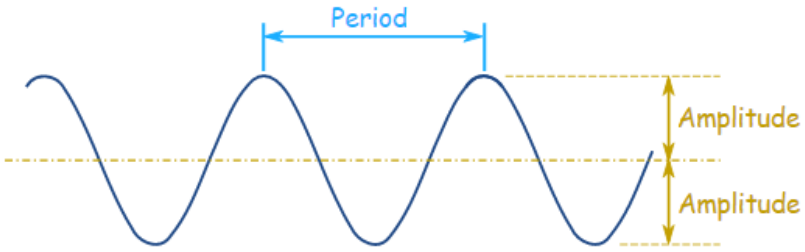
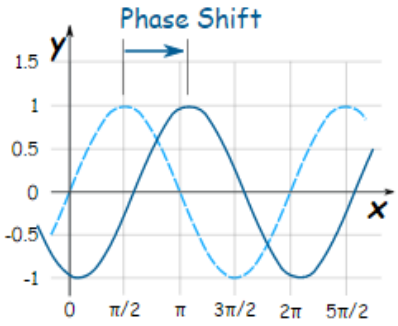
The **Period** goes from one peak to the next (or from any point to the next matching point):

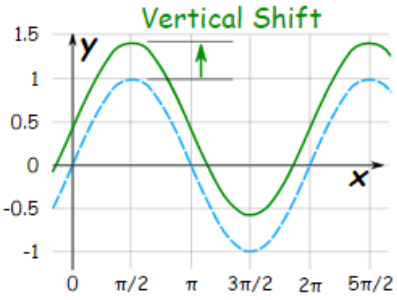


The **Amplitude** is the height from the center line to the peak (or to the trough). Or we can measure the height from highest to lowest points and divide that by 2.



The **Phase Shift** is how far the function is **horizontally** to the right of the usual position.

The **Vertical Shift** is how far the function is **vertically** up from the usual position.



We can have all of them in one equation:

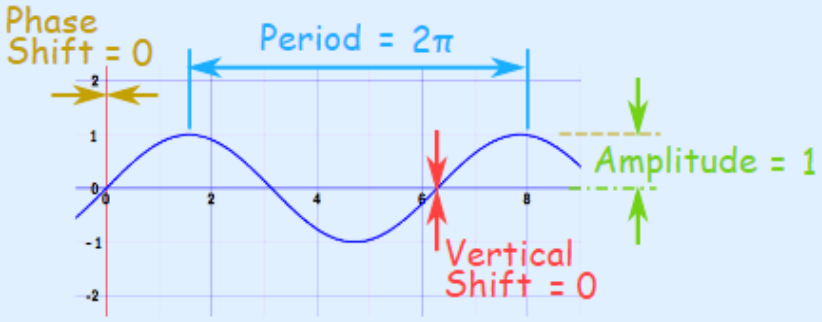
$$y = A \sin(Bx + C) + D$$

- amplitude is **A**
- period is $\mathbf{2\pi/B}$
- phase shift is $\mathbf{-C/B}$
- vertical shift is **D**

Example: sin(x)

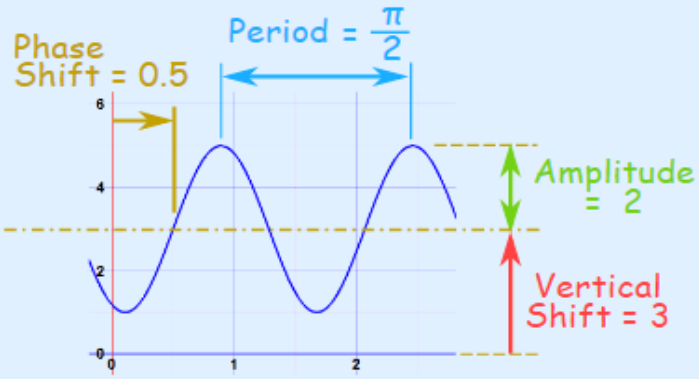
This is the basic unchanged sine formula. **A = 1, B = 1, C = 0 and D = 0**

So amplitude is **1**, period is $\mathbf{2\pi}$, there is no phase shift or vertical shift:



Example: 2 sin(4x − 2) + 3

- amplitude **A** = **2**
- period **2π/B** = **2π/4** = **π/2**
- phase shift **−C/B** = **−(−2)/4** = **1/2**
- vertical shift **D** = **3**



- the **2** tells us it will be 2 times taller than usual, so Amplitude = 2
- the usual period is 2**π**, but in our case that is "sped up" (made shorter) by the **4** in 4x, so Period = **π/2**
- and it will be shifted to the right because of the − 2 (positive goes left, negative goes right), but because it is also "sped up" by **4** then it is shifted by only **1/2**, so Phase Shift = **1/2**
- lastly the +3 tells us the center line is y = +3, so Vertical Shift = 3

State the amplitude, period, frequency, and phase shift of $y = \sin\left(3x - \frac{\pi}{2}\right)$. Then graph two periods of the function.

In this function, $a = 1$, $b = 3$, and $c = -\frac{\pi}{2}$.

Amplitude: $|a| = |1|$ or 1

Period: $\frac{2\pi}{|b|} = \frac{2\pi}{|3|}$ or $\frac{2\pi}{3}$

Frequency: $\frac{|b|}{2\pi} = \frac{|3|}{2\pi}$ or $\frac{3}{2\pi}$

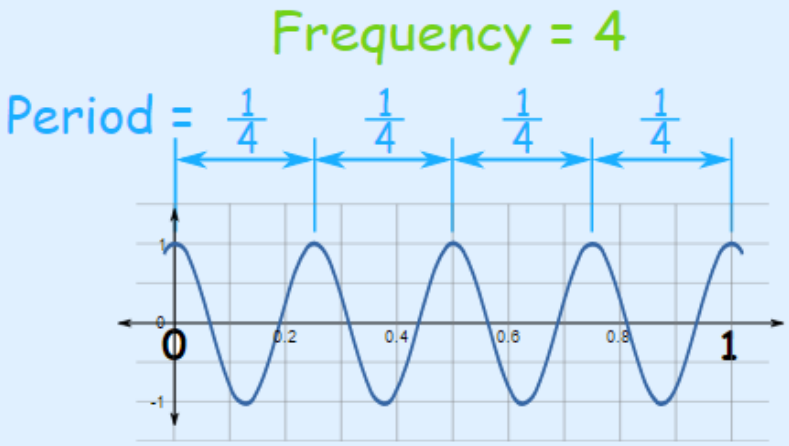
Phase shift: $-\frac{c}{|b|} = -\frac{-\frac{\pi}{2}}{|3|}$ or $\frac{\pi}{6}$

To graph $y = \sin\left(3x - \frac{\pi}{2}\right)$, consider the graph of $y = \sin 3x$. The period of this function is $\frac{2\pi}{3}$. Create a table listing the coordinates of key points of $y = \sin 3x$ on the interval $\left[0, \frac{2\pi}{3}\right]$. To account for a phase shift of $\frac{\pi}{6}$, add $\frac{\pi}{6}$ to the x-values of each of the key points for the graph of $y = \sin 3x$.

Function	x-intercept	Maximum	x-intercept	Minimum	x-intercept
$y = \sin 3x$	$(0, 0)$	$\left(\frac{\pi}{6}, 1\right)$	$\left(\frac{\pi}{3}, 0\right)$	$\left(\frac{\pi}{2}, -1\right)$	$\left(\frac{2\pi}{3}, 0\right)$
$y = \sin\left(3x - \frac{\pi}{2}\right)$	$\left(\frac{\pi}{6}, 0\right)$	$\left(\frac{\pi}{3}, 1\right)$	$\left(\frac{\pi}{2}, 0\right)$	$\left(\frac{2\pi}{3}, -1\right)$	$\left(\frac{5\pi}{6}, 0\right)$

Frequency

Frequency is how often something happens per unit of time (per "1").



So the Frequency is 4

And the Period is $\frac{1}{4}$