

Writing Sine and Cosine Equations Based off of Graphs

$$y = a \sin b(x + c) + d$$

$$y = a \cos b(x + c) + d$$

a= amplitude

b = helps find the period

c = shift left/right

d=shift up/down

1. Find the **period** → and in turn **find the “b” value**

○ 2 ways:

- Look to see how far the graph travels before it starts to repeat itself
- Or, identify the measurement horizontally from max to max or from min to min

○ If the period *is not* 2π , then there is a b value (that is not 1). Find this by plugging in the period into the equation $\frac{2\pi}{b} = \text{period}$, and solve for b. If the period is 2π , b is 1

2. Find the **d value**:

○ 2 ways:

- $d = \frac{\text{max} + \text{min}}{2}$

- Or, if the graph looks like it was picked up and moved/shifted up or down, look to see where the new x axis would be (if the graph moves, this axis moves with it) by seeing where the graph splits in half horizontally. That horizontal line is your d value

3. Find the **amplitude (a value)**:

○ 2 ways:

- $\text{amplitude} = \frac{\text{max} - \text{min}}{2}$

- Or, measure the distance from the x axis to the max or from the x axis to the min

○ Remember that x axis isn't always the most basic x axis where $y=0 \rightarrow$ if the graph is shifted up or down, the x axis is in a new place because the entire (*symmetrical*) graph was shifted. You can easily see this by splitting the graph in half horizontally

○ **How to know if the a value is positive or negative:** based off of your c value you picked (starting point- which you can change as you want to write different equations) (the negative really shows a flip over the x axis)

	Sine	Cosine
a > 0	Intercept (c), max, intercept, min	Max, intercept, min, intercept
a < 0	Intercept (c), min, intercept, max	Min (c), intercept, max, intercept

4. Find the **c value** → your c value is where your starting point is. You can choose this! Choose one of the first 2 points on the graph that is easy to see. The x value of this point is your c value. Depending on which of the first 2 points you choose, your function could be different, yet their graphs will end up looking the same

- Since we know if we're writing a sine or cosine function based on step 3, we also know our functions parent function. So, if our graph seems to shift to the right, the c value will be negative, and if it shifts to the left, it will be positive