# Applications of Sinusoidal Functions

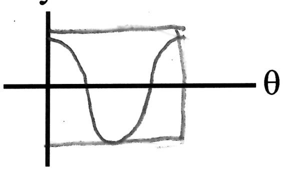
The equation of a sinusoidal function can be determined from its graph:

1. Draw a box around one cycle of a sinusoidal.
2. The value for 'k' can be determined from the period (one cycle) of the sinusoidal of measured from peak to peak. Then use the equation $k = \frac{360^o}{T}$
3. The value 'c' is the location of the line of equilibrium or use $c = \frac{\max + \min}{2}$
4. The phase shift 'd' is the horizontal distance to the left of the box.
5. The value of 'a', the vertical expansion/compression, is closely related to the amplitude since the amplitude $= |a|$; use the amplitude for a then assign a negative if the graph is a reflected sine or cosine curve about the independent axis.

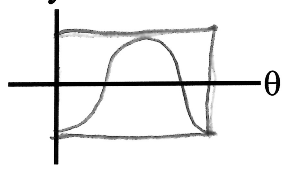
## Activity

Create a simple basic sketch of the following sinusoidal functions:

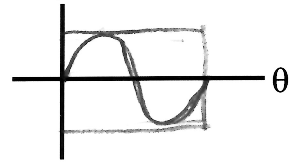
$y = \cos\theta$



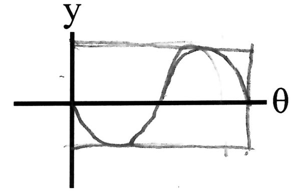

$y = -\cos\theta$




$y = \sin\theta$



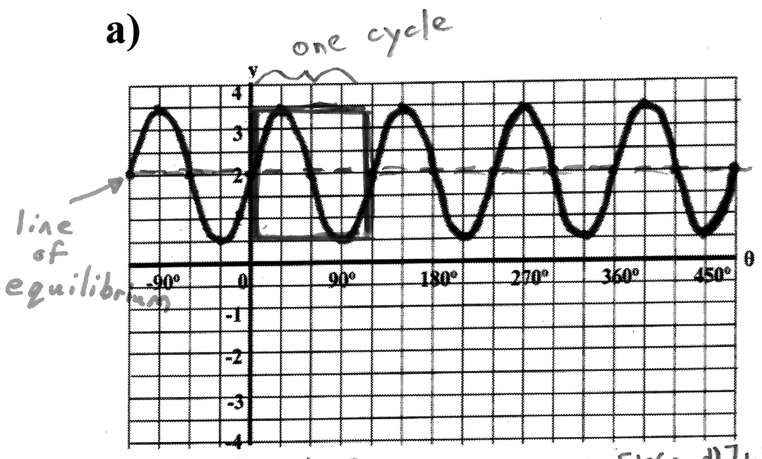

$y = -\sin\theta$




## Example 1

Determine an equation for each sinusoidal graph below:

**a)**



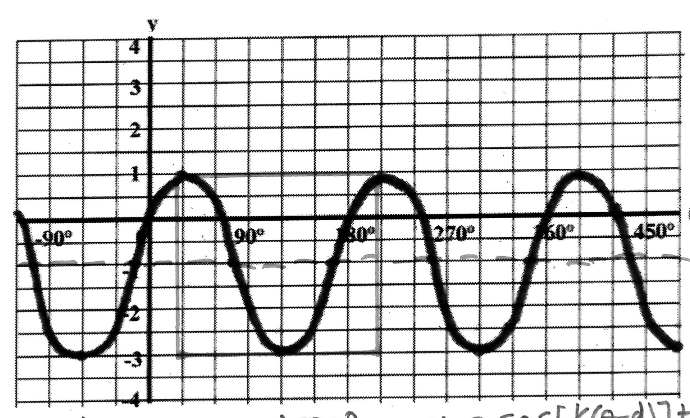

$k = \frac{360^\circ}{T}$ $d = 0$ $y = a\sin[k(\theta - d)] + c$

$= \frac{360^\circ}{120^\circ}$ $a = 1.5$ $y = 1.5\sin(3\theta) + 2$

$c = 2$

$k = 3$

**b)**




$k = \frac{360^\circ}{T}$ $d = 30^\circ$ $y = a\cos[k(\theta - d)] + c$

$= \frac{360^\circ}{180^\circ}$ $a = 2$ $y = 2\cos[2(\theta - 30^\circ)] - 1$

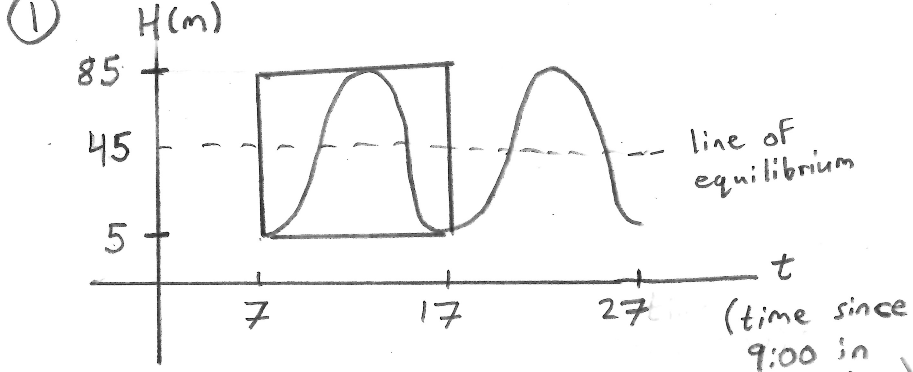
$c = -1$

$k = 2$

## Example 2

The first Ferris wheel built in 1893 had a diameter of 80 m. The base of the wheel was 5 m above the ground. It took 20 minutes to do 2 full revolutions. If Milton boarded the bottom of the wheel at 9:07, how high from the ground would he be at 9:20?

1




2 $K = \frac{360°}{T}$ $= \frac{360°}{10}$ $k = 36$

$d = 7$

$a = -40$

$c = 45$

3 $H = a\cos[K(t-d)] + c$

$H = -40\cos[36(t-7)] + 45$

4 set $t = 20$

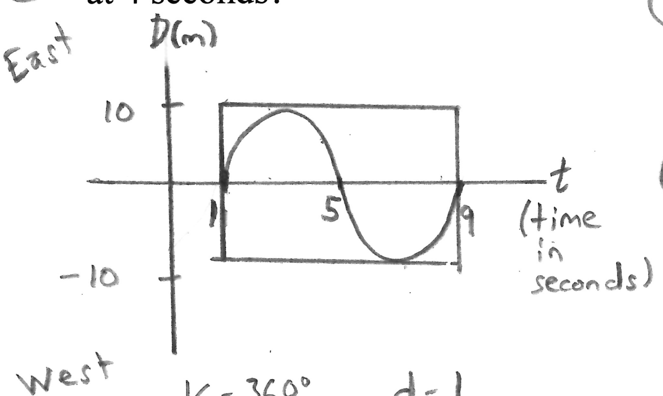
$H = -40\cos[36(20-7)] + 45$

$H \cong 57.4\text{m}$

## Example 3

The top of a building designed by Fractals Incorporated sways East (10 m) then West (-10 m) of its stable equilibrium position. One full swing from equilibrium to the East, to the West then back to equilibrium takes 8 seconds. At t = 1s, the building is at equilibrium and about to swing East. What is the displacement at the top of the building at 4 seconds?

1




2 $K = \frac{360°}{T}$ $= \frac{360°}{8}$ $= 45$

$d = 1$

$a = 10$

$c = 0$

3 $D = a\sin[K(t-d)] + c$

$D = 10\sin[45(t-1)] + 0$

set $t = 4$

4 $D = 10\sin[45(4-1)]$

$= 10\sin[135°]$

$= 7.1\text{m}$ [East]

* careful

If $D = -8$m, then you can't write $-8$m [West] as that would imply East. Instead, you should write 8m [West]

Homework: pg398 # 1, 2, 4, 5, 11, 13ab