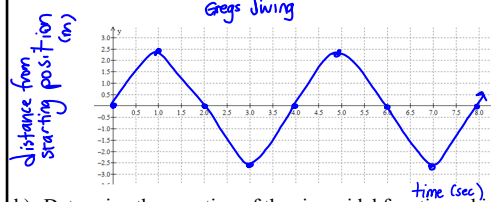


Unit 5, Lesson 5: Solving Problems with Sinusoidal Functions

Many periodic situations can be modeled by a sinusoidal function. If this is the case, then developing an equation for that function can help make predictions.

Ex 1) Greg is swinging on a swing at a steady rate. He swings forward a distance of 2.5 meters and back a distance of 2.5 meters from the original resting position during each swing. At $t = 0$, he is at resting position and then swings forward. He is able to complete 15 swings forward and back in 1 minute.

a) Sketch a graph of the function



$$\frac{15 \text{ swings}}{60 \text{ sec}} = \frac{1 \text{ swing}}{x} \\ x = 4 \text{ sec per swing}$$

b) Determine the equation of the sinusoidal function which describes Greg's distance (in meters) to the resting position at each time, t (in seconds).

$$a = 2.5 \\ k = 90 \quad k = \frac{360}{\text{period}} \\ d = 0 \quad \frac{360}{4} = 90 \\ c = 0 \\ y = 2.5 \sin 90x$$

c) What is Greg's distance from the starting point at 12.5s?

$$y = 2.5 \sin [90(12.5)] \\ y = 1.77 \text{ m}$$

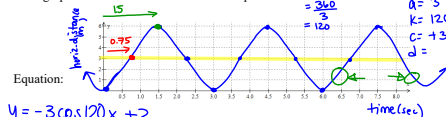
d) At what time(s) will Greg be the farthest away from his resting position?

$$\text{at } 1, 3, 5, 7, \text{ etc} \\ (\text{seconds})$$

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Ex 2) Joe's mom, Helen, is pushing him on a swing. At $t = 0$ seconds she gives him a big push. At $t = 1.5$ seconds Joe is the furthest away from his mom at 6m. Determine an equation that models Joe's horizontal distance from his mother in terms of time seconds/degrees.

Sketch a graph of the function. Determine an equation.



Equation:

$$y = -3 \cos 120x + 3 \\ y = 3 \sin [120(x - 0.75)] + 3 \\ y = 3 \cos [120(x - 1.5)] + 3$$

a) What is Joe's distance from his mom after 13 seconds?

$$y = -3 \cos [120(13)] + 3 \\ y = 4.5 \text{ m}$$

b) How long does it take him to be 1m away from his mom on his 3rd swing?

$$1 = -3 \cos (120x) + 3 \\ 1 - 3 = -3 \cos (120x) \\ -2 = -3 \cos (120x) \\ -\frac{2}{3} = \cos 120x \\ \cos^{-1} \left(-\frac{2}{3} \right) = 120x \\ \frac{\cos^{-1} \left(-\frac{2}{3} \right)}{120} = x \\ 0.4 = x$$

First 2 swings are 6 seconds, so add 0.4 seconds.

$$6.4 \text{ seconds}$$

c) How long does it take him to be 1m away from his mom again on his 3rd swing?

But, he is also going to be 1m away at the end of the 3rd swing, so

$$9 \text{ sec} - 0.4 \text{ sec} = 8.6 \text{ seconds}$$

3/2 = 2.6 sec

$$6 \text{ seconds} + 2.6 \text{ sec} = 8.6 \text{ sec}$$

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HW U4L5:

1. p.398 #1, 3, 4, 6, 8, 9^{*hard!}1d) $d = 0.5\sin(180t) + 1.5$, 9a) $-30\cos(1.43x) + 40$