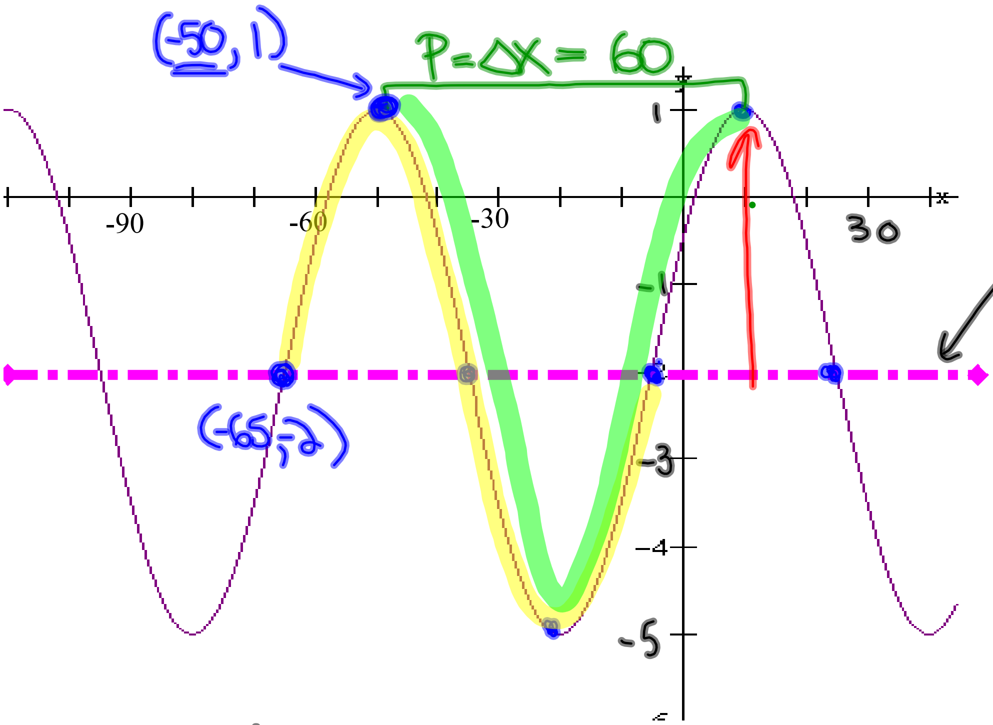
Warm Up

Determine both a sine and a cosine equation to describe the graph:



$y = \frac{min + max}{2}$

$y = \frac{-5 + 1}{2}$

$y = -2$

$a = 3$

$P = 60$

$b = \frac{360}{60} = 6$

$d = -2$

$y = \sin x$

$C = -65$

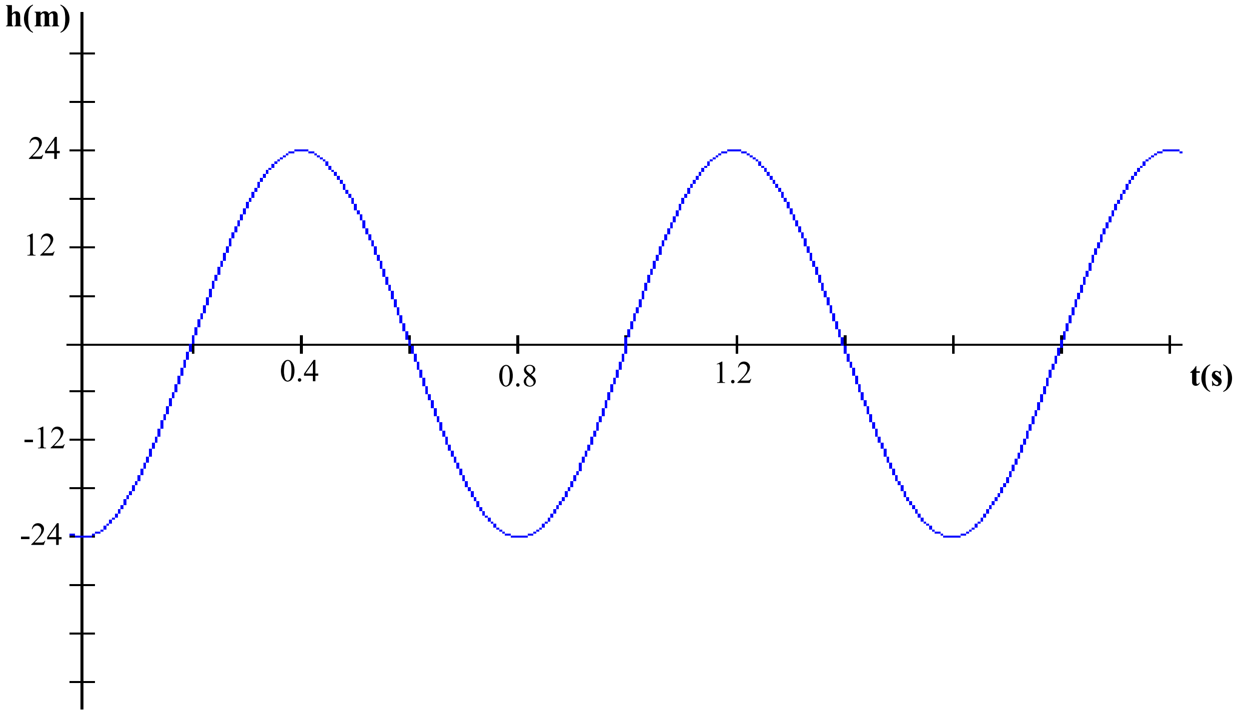
$y = 3\sin[6(x + 65)] - 2$

$y = \cos x$

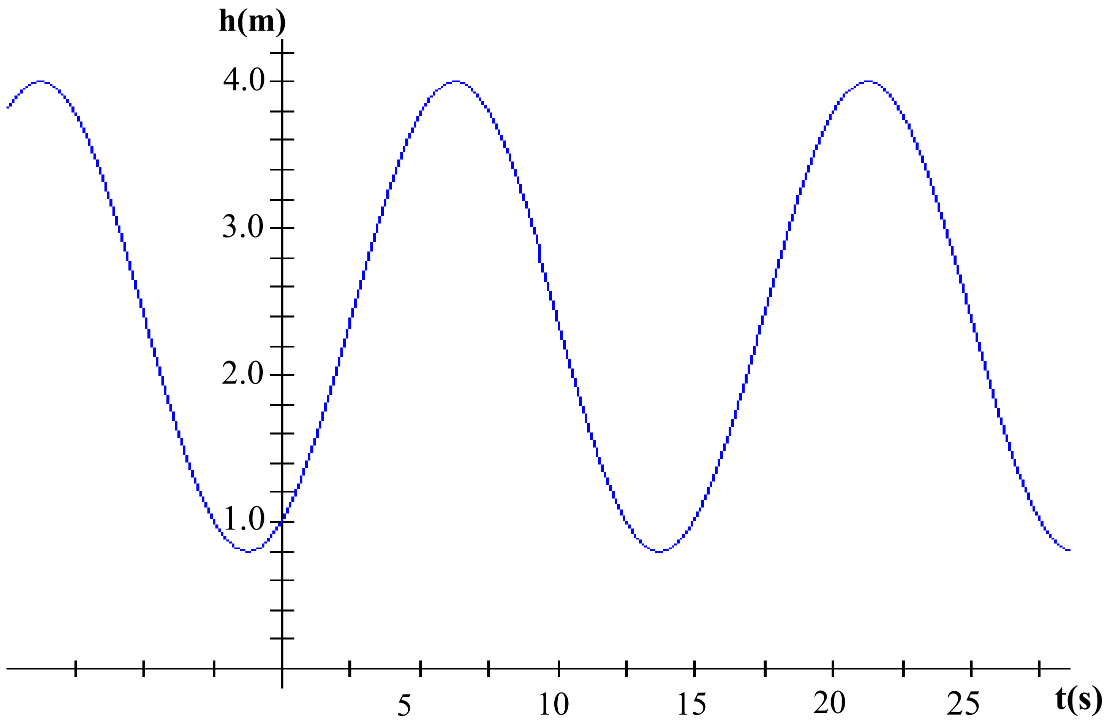
$C = -50$

$y = 3\cos[6(x + 50)] - 2$

Sinusoidal Functions with Different Axes



What about those not centered around the x-axis?



Applications of Sinusoidal Functions

A carnival Ferris wheel with a radius of 14 m makes one complete revolution every 16 seconds. The bottom of the wheel is 1.5 m above the ground. If a person is at the top of the wheel when a stop watch is started, determine how high above the ground that person will be after 1 minute and 7 seconds? Sketch one period of this function.

$a = 14$ $\quad P = 16$ $\quad b = \frac{360}{16} = 22.5$ $\quad d = \text{min} + \text{radius}$

$= 1.5 + 14$

$= 15.5$

$\text{min} = 1.5$ $\quad \text{max} = \text{min} + \text{diameter}$

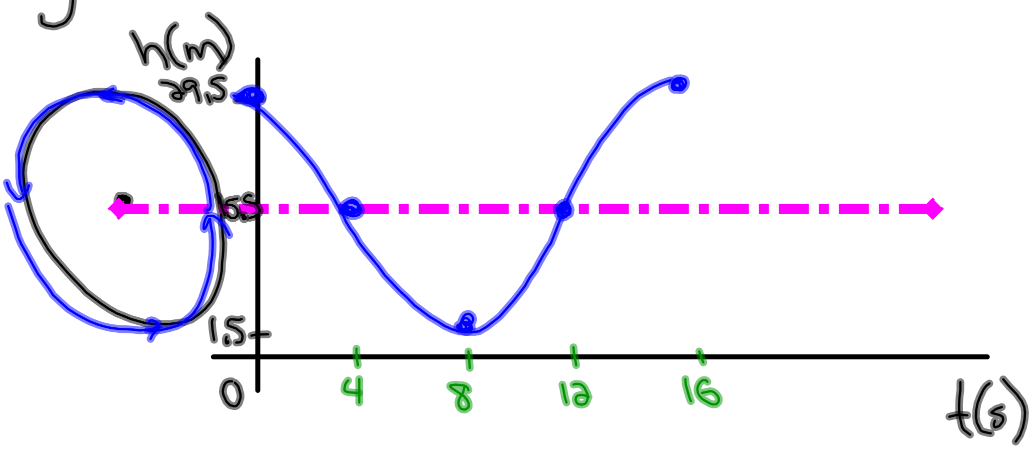
$= 1.5 + 28$

$= 29.5$

$y = 14\cos[22.5(x)] + 15.5$

$y = 14\cos[22.5(67)] + 15.5$

$y = 20.86\text{ m}$



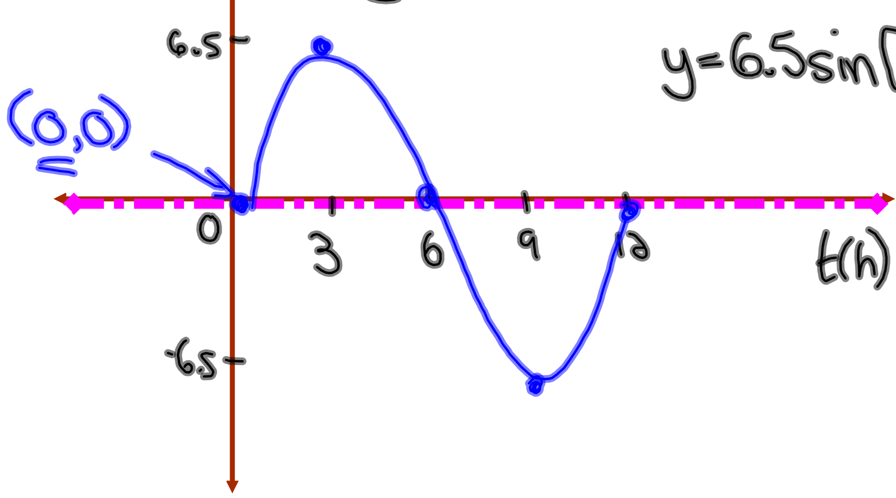
Ocean Tides

The alternating half-daily cycles of the rise and fall of the ocean are called tides. Tides in one section of the Bay of Fundy caused the water level to rise 6.5m above mean sea-level and to drop 6.5m below. The tide completes one cycle every 12 h. Assuming the height of water with respec to mean sea-level to be modelled by a sine function,

(a) draw the graph for a the motion of the tides for one complete day;
(b) find an equation for the graph in (a).

max = 6.5m
min = -6.5

$y = 6.5\sin[30(x-0)]+0$



$y=6.5\sin[30(x)]$

a = 6.5

P = 12

$b = \frac{360}{12} = 30$

Homework

Solutions to Homework

1. A Ferris wheel has a radius of 12m and makes one complete revolution every 12 seconds. The bottom of the wheel is 2m above the ground. ***If a person gets on at the bottom and goes up,*** determine the following:

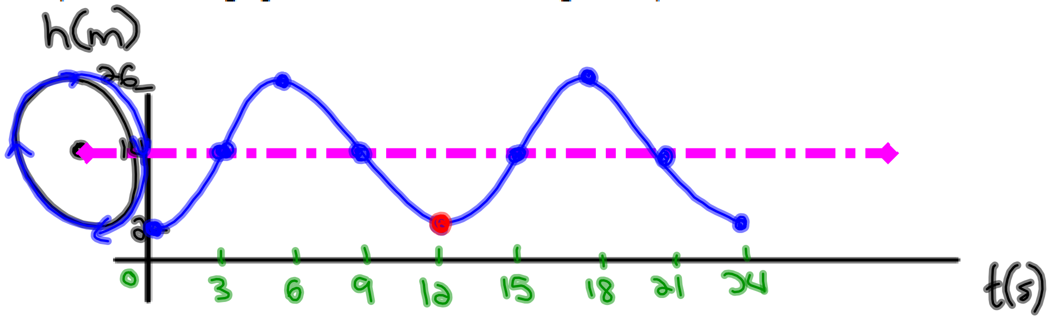
$-\cos$

a) Amplitude: $= 12m$ b) Period: $\boxed{= 12s}$ c) ~~k~~ b: $= \frac{360}{12} = 30$ d) D: $= 14m$

e) Maximum Height $= 26$ f) Minimum Height: $= 2m$

g) Equation: $y = -12\cos[30(x)] + 14$

h) Sketch the graph for two revolutions (periods):



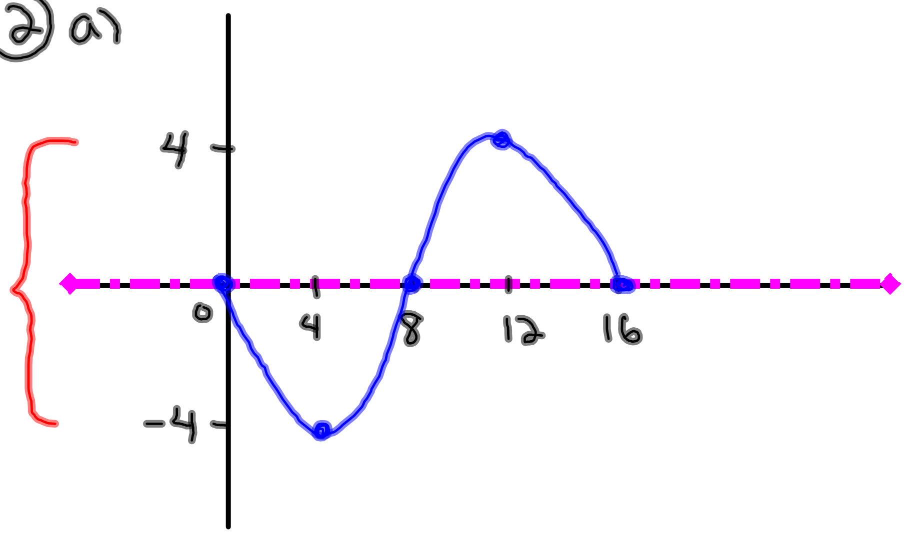
i) How high is the person at these times?

i) 12 seconds $= 2m$

ii) 5 minutes $= 2m$
(300 s)

2. The tide on the Miramichi River has a range of 8m. At time 0 the tide is midway and at 4 hours the tide is low. The tide completes one full cycle in 16 hours.

② a)



P = 16
b = 22.5
A = 4
D = 0
C = 0

b) $y = -4\sin[22.5(x)]$

3. A water wheel has a radius of 10m. 3m of the wheel is submerged under water. If the wheel makes one revolution in 360 degrees and the bucket starts at the center and goes up, find:

a) $A = 10m$

b) $P = 360°$

c) $b = \frac{360}{360} = 1$

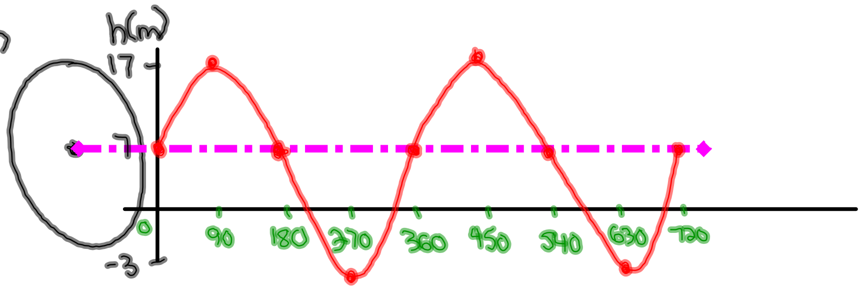
d) $D = 7m$

e) max = 17m

f) min = -3m

g) $y = 10\sin[1(x)] + 7$

h)



i) ① 40° → $y = 10\sin[1(40)] + 7$

$y = 13.43m$

② 110° → $y = 10\sin[1(110)] + 7$

$y = 16.39m$

③ 200° → $y = 10\sin[1(200)] + 7$

$y = 3.58m$

j) $y = 11$

$11 = 10\sin[1(x)] + 7$

$\frac{4}{10} = \frac{10\sin[x]}{10}$

* $0.4 = \sin x$ * $\sin^{-1}(0.4) = 23.58°$

$23.58° = x$

4. A water wheel is defined by the equation $y = 7\cos[18(x)] + 4$

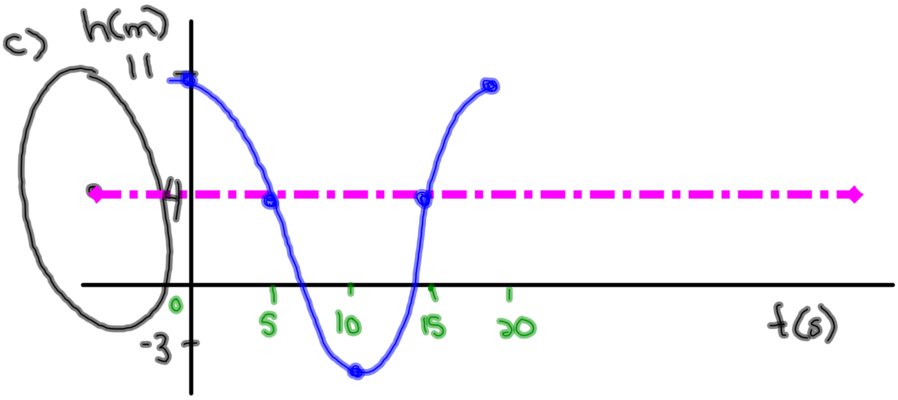
$A = 7$ $\quad b = 18$ $\quad C = 0$ $\quad D = 4$

$P = \frac{360}{18} = 20$

a) Amp $= 7$ $\quad$ max: $4 + 7 = 11$

b) Period $= 20$ $\quad$ min: $4 - 7 = -3$

c)



d) 3m is submerged

e) Radius = Amp = 7

f) $y = 7\cos[18(x)] + 4$

$5 = 7\cos[18x] + 4$

$\frac{1}{7} = \frac{7\cos(18x)}{7}$

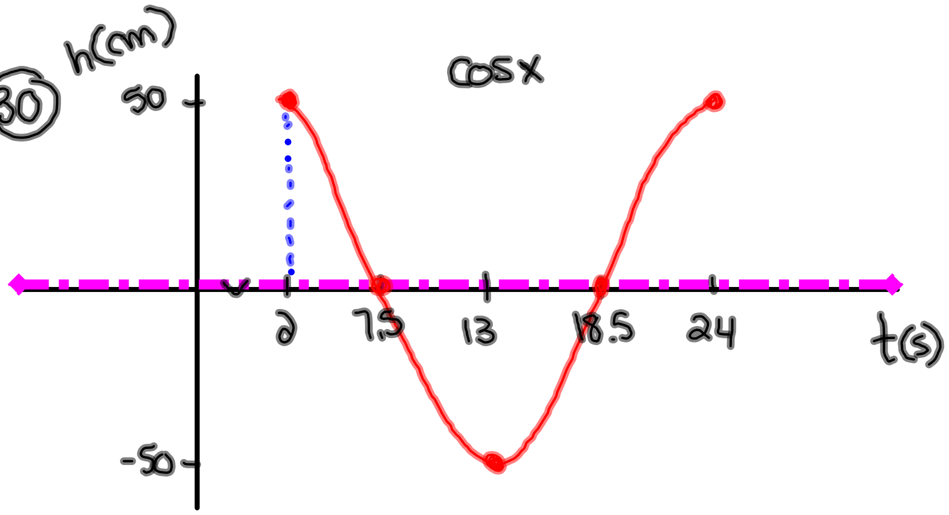
$0.1428 = \cos(18x)$

$\cos^{-1}(0.1428) = 18x$

$\frac{81.8}{18} = \frac{18x}{18}$

$\boxed{4.5s = x}$

30



$A = 50$

$P = 22$

$B = 16.36$

$C = 2$

$D = 0$

a) $y = 50\cos[16.36(x-2)]$

b) $y = \underline{\underline{15}}\cos[16.36(x-2)]$ * $50 \times 0.3 = 15$

31

$a = 4.5$

$b = 360 \div \frac{1}{60}$

$= 360 \times 60$

$= 21600$

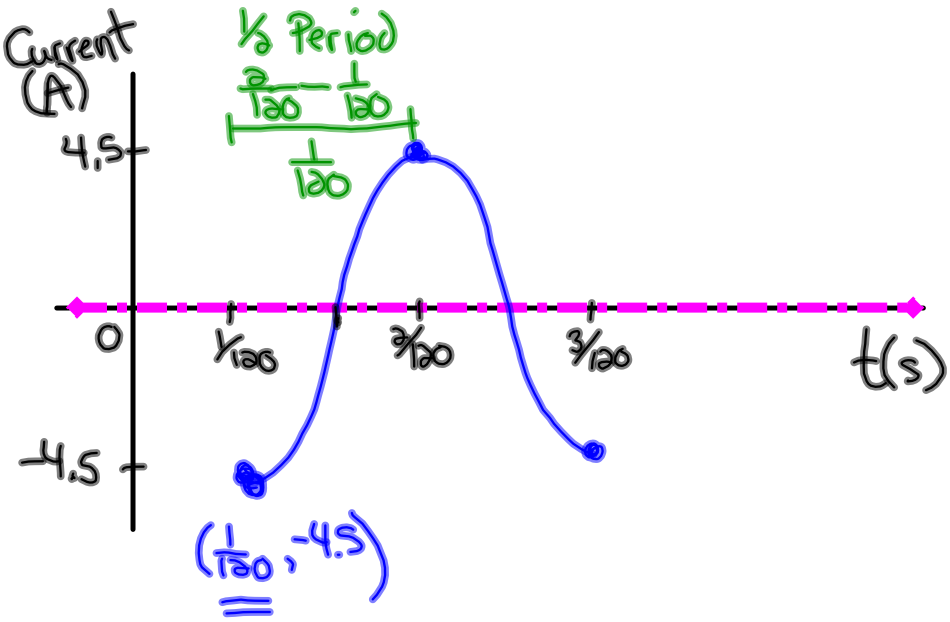
$c = \frac{1}{120}$

$d = 0$

$P = \frac{1}{120} \times \frac{2}{1}$

$= \frac{2}{120}$

$= \frac{1}{60}$



$y = -4.5\cos\left[21600\left(x - \frac{1}{120}\right)\right]$

$y = -4.5\cos\left[21600\left(4 - \frac{1}{120}\right)\right]$

$\boxed{y = 4.5A}$