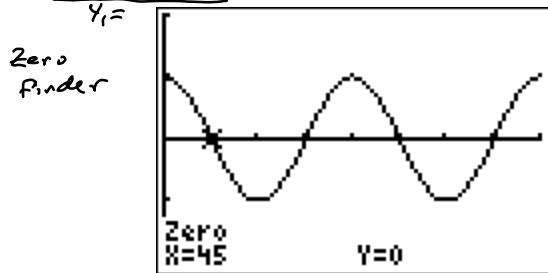# Unit 5: Trigonometry & The Unit Circle
5.4 Equations & Graphs of Trigonometric Funtions

**Ex.** Use your graphing calculator to determine the solutions for the trigonometric equation $2\cos^2 x - 1 = 0$ in the interval [0°, 360°]. Verify algebraically.

$y_1 =$

Zero
finder

Zero
X=45   Y=0

$2\cos^2 x - 1 = 0$

$\cos^2 x = \frac{1}{2}$

$\cos x = \pm\frac{1}{\sqrt{2}}$

$x = 45°, 135°,$
$225°, 315°$

$\theta_R = 45°$

180-45   180+45   360-45
$45°, 135°, 225°, 315°$

Ex. Determine the general solutions for the trigonometric equation $16 = 6\cos\frac{\pi}{6}x + 14$. Express your answer to the nearest hundredth.

$y_1 =$ $y_2 =$

$period = \frac{2\pi}{\pi/6}$
$= 2\pi \times \frac{6}{\pi}$
$= 12$

intersect
finder
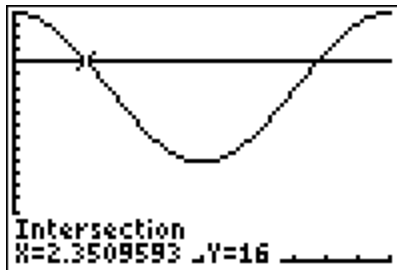
Intersection
X=2.3509593 Y=16

$x = 2.35 + 12n$
$\& \quad x = 9.65 + 12n$; $n \in I$

$n \in \mathbb{Z}$

Ex. The depth of water (d in meters) at dock by the Bay of Fundy at a certain time (t in hours after midnight) varies according to the function:

$d(t) = 3\cos\frac{2\pi}{12.4}(t - 4.5) + 5$

amp = 3 m   change in depth from the mean

vert. disp. = 5 m   the mean

low 2m
high 8m

phase shift = $4.5h$ 1st high tide (cosine) at 4:30 AM

period = $\frac{2\pi}{2\pi/12.4}$ $= 2\pi \times \frac{12.4}{2\pi}$ $= 12.4$ h   time between high tides

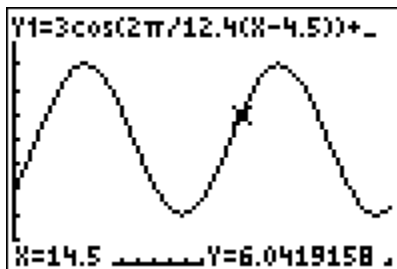At what time is the first low tide?

high tide time + $\frac{1}{2}$ period = $4.5 + 6.2 = 10.7h$ 10:42 AM

Graph in calculator for a 24 hour period.
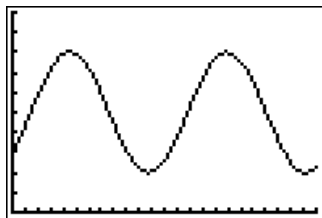
Find the depth at 2:30 PM to the nearest tenth.

$t = 14.5$

Y1=3cos(2π/12.4(X-4.5))+_

X=14.5   Y=6.0419158

6.0 m

A ship can dock safely if the depth of water is at least 6.9 m. For how many hours in a 24 hour cycle is it safe to dock?

$d(t) = 6.9$

Intersection
X=2.7535454 Y=6.9

$t = 2.75 h$

$t = 6.25 h$

$2(6.25 - 2.75)$
$2(3.5)$
$= \boxed{7 \text{ h·s}}$

Ex. A Ferris wheel has a radius of 20 m. It rotates once every 40 seconds. Passengers get on at the lowest point 1 m above the ground. Determine a function that represents the height (h in meters) of a passenger at time (t in seconds) after it starts to rotate.

Graph (sketch) the height of a passenger above the ground for one rotation:

amp = $\underline{20}$

period = $\underline{40}$

$\therefore b = \underline{\dfrac{2\pi}{40}}$

vert. disp. = $\underline{21}$

possible functions:

#1 + cosine $h(t) = 20\cos \frac{2\pi}{40}(t - 20) + 21$

#2 − cosine $\boxed{h(t) = -20\cos \frac{2\pi}{40}t + 21}$ ☺   easiest to graph

#3 + sine $h(t) = 20\sin \frac{2\pi}{40}(t - 10) + 21$

#4 − sine $h(t) = -20\sin \frac{2\pi}{40}(t - 30) + 21$

                                $t + 10$ ✓

Find the height after 5 seconds? After 22 seconds? (nearest tenth)

Y1=-20cos(2π/40X)+21

X=5   Y=6.8578644

$h(5) = 6.9 m$

$h(22) = 40.0 m$

When is a passenger at 30 m height during one rotation of the wheel?

Intersection
X=12.97152 Y=30

$t = 13.0 s$

       & 27.0 s

Practice: pg. 275/# 1, 3 − 6, 8 − 11, 13, 15, 17 − 20