Finding the Zeros

Examples 1) $f(x) = 2\cos(x-5) - 1$

$0 = 2\cos(x-5) - 1$

$1 = 2\cos(x-5)$

$\frac{1}{2} = \cos(x-5)$

$\cos^{-1}\left(\frac{1}{2}\right) = x-5$

$b = 1 \Rightarrow p = 2\pi$

$\frac{\pi}{3} = x-5$ or $\frac{5\pi}{3} = x-5$

$5+\frac{\pi}{3} = x$ $5+\frac{5\pi}{3} = x$

$\frac{15+\pi}{3} = x$ $\frac{15+5\pi}{3} = x$

$\left\{\frac{15+\pi}{3}+2\pi n, \frac{15+5\pi}{3}+2\pi n\right\}$

$, n \in \mathbb{Z}$

2) $f(x) = 2\cos(\pi x) + \frac{3}{2}$

$0 = 2\cos(\pi x) + \frac{3}{2}$

$-\frac{3}{2} = 2\cos(\pi x)$

$-3/4 = \cos(\pi x)$

$\cos^{-1}\left(\frac{-3}{4}\right) = \pi x$ ← calculator in Rad mode

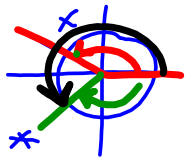
$2.4189 = \pi x$

OR

$2\pi - 2.4189 = \pi x$

$3.8643 = \pi x$

$x = \{0.7699, 1.2301\}$



$b = \pi/p = \frac{2\pi}{\pi} = 2$

$\text{Zeros}: \{0.7699 + 2n, 1.2301 + 2n\}, n \in \mathbb{Z}$

Determine...

a) the rule

i) as a cosine function,

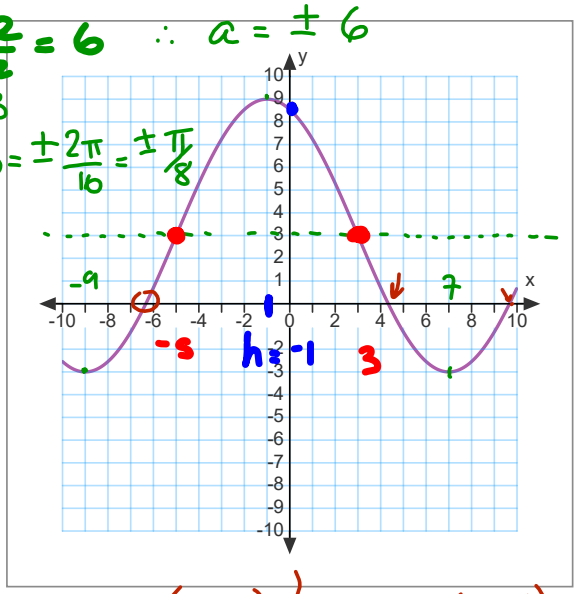
ii) as a sine function.

b) the zeros of the function.

A : $\frac{9-(-3)}{2} = \frac{12}{2} = 6$ $\therefore a = \pm 6$

k : $9 - 6 = 3$

P : 16 $\therefore b = \pm\frac{2\pi}{16} = \pm\frac{\pi}{8}$



$y = 6\cos \pi/8 (x+1) + 3$

$0 = 6\cos \pi/8 (x+1) + 3$

$-1/2 = \cos\left(\pi/8 (x+1)\right)$

$\cos^{-1}\left(\frac{-1}{2}\right) = \frac{\pi}{8}(x+1)$

$\frac{2\pi}{3} = \frac{\pi}{8}(x+1)$ | $\frac{4\pi}{3} = \frac{\pi}{8}(x+1)$

$\frac{16}{3} = x+1$ | $\frac{32}{3} = x+1$

$\frac{13}{3} = x$ | $\frac{29}{3} = x$

$\left\{\frac{13}{3} + 16n, \frac{29}{3} + 16n\right\}, n \in \mathbb{Z}$

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12 The eye of a sewing needle is the hole through which thread is pulled. The rule $H = 10\cos 10\pi x + 5$ allows you to calculate the height H (in mm) of the eye of a sewing machine needle as a function of time x (in s). The eye of the needle goes through the fabric when $H = 0$ mm. During the first 10 seconds, how many times does the eye of the needle go through the fabric?

$0 = 10\cos 10\pi x + 5$

$-\frac{1}{2} = \cos 10\pi x$

$\cos^{-1}\left(-\frac{1}{2}\right) = 10\pi x$

$b = 10\pi$

$p = \frac{2\pi}{10\pi} = \frac{1}{5}$

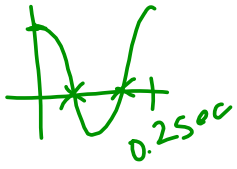
$\frac{2\pi}{3} = 10\pi x$ $\quad$ $\frac{4\pi}{3} = 10\pi x$

$0.0\bar{6} = \frac{1}{15} = \frac{2}{30} = x$ $\quad$ $0.1\bar{3} = \frac{2}{15} = \frac{4}{30} = x$

In one second: 5 cycles

In 10 seconds: 50 cycles

$\therefore$ 2 zeros/cycle x 50 cycles = 100 zeros



Ans: 100 times

THE FERRIS WHEEL

The seats on a Ferris wheel are positioned 20 m from its centre. The bottom of the wheel is located 2 m above the ground.

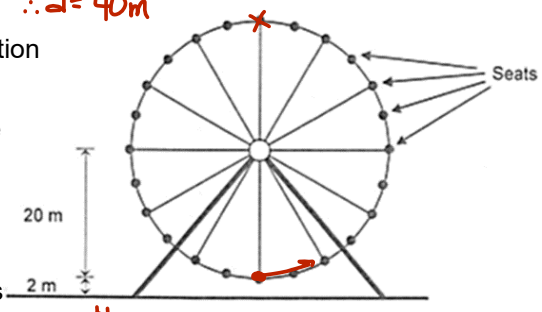
Radius $\therefore d = 40m$

The wheel turns at a constant speed. It completes one rotation in 16 minutes.

You get on the ride by taking a seat when it is located at the bottom of the wheel.

Karen took a seat on the Ferris wheel; it continued to rotate and then it stopped exactly 10 minutes after she sat down.

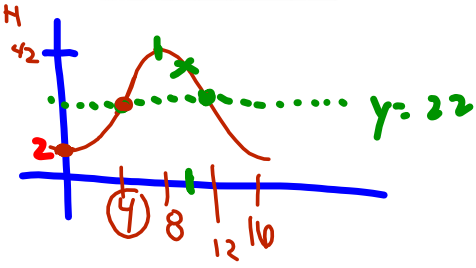
How far above the ground was Karen's seat when the Ferris wheel stopped?



$A: \frac{42-2}{2} = 20 \quad a = \pm 20$

$k = 22$

$P = 16 \quad b = \pm\frac{2\pi}{16} = \pm\frac{\pi}{8}$



$h = 0 \Rightarrow \cos$ if a^-

$f(x) = -20\cos\left(\frac{\pi}{8}x\right) + 22$

$f(10) = -20\cos\left(\frac{10\pi}{8}\right) + 22 = 36.14m$