Answer on Question #44762 – Math - Trigonometry

Model equation for tide: $h=2\cos(\pi/6\ t-2\pi/3)+4$

Given the above, a large boat needs at least 4 meters of water to secure it at the end of the pier. Determine what span of time after noon, including both a starting and ending time, the boat can first safely be secured, justifying your answer.

So far, I have gotten this, but I'm stuck!

$4=2\cos(\pi/6\ t-2\pi/3)+4$

$0=2\cos(\pi/6\ t-2\pi/3)$

$0=\cos(\pi/6\ t-2\pi/3)$

$0=\cos(\pi/6\ t)\cos(2\pi/3)+\sin(\pi/6\ t)\sin(2\pi/3)$

Answer.

A large boat needs at least 4 meters of water, so h must be not less than 4.

So our first goal is to solve $2\cos\left(\frac{\pi}{6}t-\frac{2\pi}{3}\right)+4=4$ **or**

$\cos\left(\frac{\pi}{6}t-\frac{2\pi}{3}\right)=0$ **for 't'**

$\frac{\pi}{6}t-\frac{2\pi}{3}=\frac{\pi}{2}+k\pi$, **$k$ is integer;**

$\frac{\pi}{6}t=\frac{3\pi}{6}+\frac{4\pi}{6}+k\pi$; $\frac{\pi}{6}t=\frac{7\pi}{6}+k\pi$; $t=7+6k$, **k is integer.**

We should get the solutions $t=1$, $t=7$, $t=13$, $t=19$ **etc. (i.e. add 6 hours to each solution to get another one).**

Since we only care about hours after noon, this means that $t\geq 12$.

So at $t=13$ **(1 pm), the height is 4 meters. As time goes on, the water rises . When it reaches** $t=19$ **(7 pm), the water comes back to 4 meters, which then starts to dip below that mark. So the water is at least 4 meters high from the hours of 1 pm to 7 pm.**

The water will eventually come back up, but it will reach the 4 meter mark at 1 am the next day.