GROUP PROBLEM SET 1: OSCILLATIONS REVIEW AND GRAPHING WAVES

You and a friend decide to spend your spring break surfing in Hawaii to escape the Minnesota winters. You are sitting on your surf board, riding up and down on the swells. Since you just got out of physics class before you left, realize that the board's vertical displacement is given by:

\[ y = (1.2m) \cos \left( \frac{1}{2.0s} t + \frac{\pi}{6} \right) \]

Since you are bored waiting for the next big wave, you decide to find the position of the surf board at \( t = 1.0 \) seconds. Along the way you find the amplitude, angular frequency, phase constant, frequency and period for the motion.

\[ y(x,t) = (1.2m) \cos \left( \frac{1}{2s} t + \frac{\pi}{6} \right) \]

\[ t = 1s \rightarrow y(x,t) = (1.2m) \cos \left( \frac{1}{2} + \frac{\pi}{6} \right) \]

\[ y(x,t) = 0.624m \]

\[ A = 1.2m \]
\[ \omega = \frac{1}{2s} \text{ rad/s} \]
\[ \omega = \frac{1}{2s} \cdot \frac{m}{s} \]
\[ f = \frac{\omega}{2\pi} = \frac{1}{4\pi} \text{ Hz} \]
\[ T = 4\pi s \]
Military specifications often call for electronic devices to be able to withstand accelerations of $a = 98.1 \text{ m/s}^2$. To make sure that their products meet this specification, manufacturers test them using a shaking table that can vibrate a device at various frequencies and amplitudes. If a device is given a vibration of amplitude $1.5\text{cm}$, what should its frequency be in order to test for compliance with the $10g$ military standard?

\[
a = 98.1 \text{ m/s}^2 = 10g
\]

\[
A = 1.5\text{cm} = 0.015\text{m}
\]

\[
a(t) = -\omega^2 A \cos(\omega t + \phi)
\]

Max value is when $\cos(\omega t + \phi) = 1$

So

\[
a(t) = -\omega^2 A \quad \text{take an absolute value to find } \omega.
\]

\[
\omega = \sqrt{\frac{a}{A}} = \sqrt{\frac{98.1 \text{ m/s}^2}{0.015\text{m}}} = 80.9 \frac{\text{rad}}{\text{s}}
\]

\[
f = \frac{\omega}{2\pi} = \frac{80.9 \frac{\text{rad}}{\text{s}}}{2\pi} = \sqrt{12.9 \text{ Hz}} = f
\]