Q: Standing waves from wave collision

$$y = 7\sin\left(2\pi\left(\frac{t}{T} - \frac{2x}{\pi}\right)\right)$$

(z and x in centimeters; t in seconds)

And its reflection occurs in an environment where its absorption can be ignored. Determine the amplitude, wavelength, length of a loop, speed, and period for the resultant wave.

Sol:

$$y = Asin\big(k(x \pm vt)\big) = Asin(kx \pm \omega t) = 7\sin\left(-4x + \frac{2\pi}{T}t\right)$$

$$\begin{cases} A = 7 \\ k = 4 \rightarrow \dfrac{2\pi}{\lambda} = 4 \rightarrow \lambda = \dfrac{\pi}{2} \\ L = \dfrac{\lambda}{2} = \dfrac{\pi}{4} \\ v = \dfrac{1}{T} \\ T = T \end{cases}$$

- *In the context of waves, the speed typically refers to the rate at which a wave propagates through a medium. For a stationary wave, the individual points in the medium do not appear to be moving. However, this doesn't mean that the wave itself has zero speed. A stationary wave is formed by the interference of two waves traveling in opposite directions with the same frequency and amplitude. Each individual wave in the pair has its own speed, but they are traveling in opposite directions. As a result, the wave pattern appears to be stationary, with points of constructive and destructive interference giving rise to the characteristic pattern.So, while the points in a stationary wave appear to be still, the waves themselves are moving at their respective speeds. Therefore, a stationary wave does not have a zero speed; rather, it is a result of waves with opposing velocities interfering with each other.*
- *The "length of a loop" refers to the distance between two adjacent points on the wave that are in phase with each other. In other words, it's the distance between corresponding points on a wave that are in the same stage of oscillation, such as two consecutive crests or two consecutive troughs.*