$\lambda = \frac{2\pi}{K}$, $\omega = K \cdot v_{\substack{vel \\ prop.}}$, $\lambda = \frac{v}{f}$, $f = \frac{\omega}{2\pi}$

Ondas Mecánicas

$$Y(x,t) = A \operatorname{sen} 2\pi (x/\lambda - t/T) \quad , \quad Y(x,t) = A \operatorname{sen}(kx - \omega t)$$

(9.4) $Y(x,t) = 2 \cdot 10^{-3} \operatorname{sen}(2x - 628 t)$

$A = 2 \cdot 10^{-3} m$, $f = \frac{\omega}{2\pi} = \frac{628}{2\pi} \simeq 100 Hz$, $v = \frac{\omega}{K} = \frac{628}{2} = 314 m/s$
$100\pi m/s$

(9.6) $Y(x,t) = 0{,}06 \operatorname{sen}(2\pi x + 4\pi t)$

$A = 0{,}06 m.$; $\lambda = \frac{2\pi}{K} = \frac{2\pi}{2\pi} m = 1m$; $v = \frac{\omega}{K} = \frac{4\pi}{2\pi} = 2m/s$

* Se propaga hacia la izquierda $(2\pi x + 4\pi t)$

$\dot{Y}(x,t) = \frac{\partial Y}{\partial t}(x,t) = 0{,}06 \cos(2\pi x + 4\pi t) \cdot 4\pi$

Para que sea el valor máximo, el cos( ) debe ser máximo también y eso se logra al considerar su módulo $|\cos()| = 1$

$$|\dot{y}(x,t)| = |0{,}06 \cdot \cos(2\pi x + 4\pi t) \cdot 4\pi| = 0{,}06 \cdot 4\pi = 0{,}75 m/s.$$

$$\Psi(x,t) = 2A \operatorname{sen}(kx) \cos(\omega t)$$

(9.9) $\Psi(x,t) = 2 \cdot 0{,}0025 \cdot \operatorname{sen}(0{,}75\pi x) \cos(942 t)$ (en el SI)

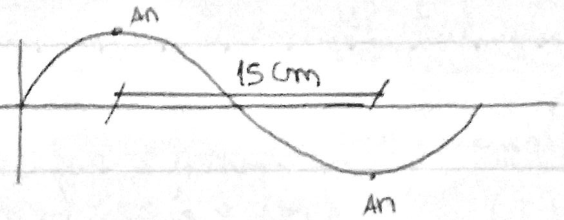
a) Posición de los nodos $X_{nodo} = n \cdot \frac{\pi}{K} = n \cdot \frac{\lambda}{2}$

$\lambda = \frac{2\pi}{K}$

b) Posición de los antinodos $X_{antinodo} = (2n+1) \frac{\lambda}{4} = (n + 1/2) \frac{\lambda}{2}$

$X_{nodo} = n \cdot 1{,}33$ $n = 0, 1, 2, \ldots$
$X_{antinodo} = (2n+1) \cdot 0{,}66$ $n = 0, 1, 2, \ldots$

(9.10)



$X_{An}^{2} - X_{An}^{1} = 0{,}15\,m$

$A = 0{,}85\,m \;,\; T = 0{,}075\,s$

a) $X_{nodo} = n \cdot \frac{\lambda}{2}$ $\quad X_n^2 - X_n^1 = (n+1)\frac{\lambda}{2} - n\frac{\lambda}{2} = \frac{\lambda}{2}$ ¿λ?

$X_{An}^{2} - X_{An}^{1} = (n+1+1/2)\frac{\lambda}{2} - (n+1/2)\frac{\lambda}{2} = \frac{\lambda}{2} = 0{,}15\,m \Rightarrow \underline{\lambda = 0{,}3\,m}$

$X_n^2 - X_n^1 = \frac{\lambda}{2} = \underline{0{,}15\,m}$

b) $\underline{\lambda = 0{,}3\,m}$, $A' = 2A = 0{,}85\,cm \Rightarrow \underline{A = 0{,}425\,cm}$

$V = \frac{\omega}{K}\,\frac{?}{?}$, $\omega = \frac{2\pi}{T}$, $K = \frac{2\pi}{\lambda} \Rightarrow V = \frac{\frac{2\pi}{T}}{\frac{2\pi}{\lambda}} = \frac{\lambda}{T} = \underline{4\,m/s}$

c) $\psi(x,t) = 2A\,\text{sen}(kx)\cos(\omega t)$
$\dot\psi(x,t) = -2A\,\text{sen}(kx)\,\text{sen}(\omega t)\cdot\omega$

$|\dot\psi(x,t)| = |\underset{\text{en el Anodo}}{2A\omega}| = |2 \cdot 0{,}00 85\,m \cdot \frac{2\pi}{0{,}075\,s}| = 0{,}71\,m/s \rightarrow \underline{V_{max}}$.
$|\text{sen}()| = 1$

$\dot\psi(x,t)$ es min si $|\text{sen}()|$ es min $\Rightarrow |\text{sen}()| = 0$ $\quad \underline{V_{min} = 0}$.

d) $|X_{nodo} - X_{anti\,nodo}| = \left| n\frac{\lambda}{2} - (n+1/2)\frac{\lambda}{2} \right| = \frac{\lambda}{4} = 0{,}075\,m$

(9.12) Para una cuerda $f = \frac{n}{2L} \cdot v$, con $v = \sqrt{T/\mu}$

$\mu = \rho \cdot A$ en este caso (ρ densidad del material)
$A = \pi \frac{d^2}{4}$

① $512 = \frac{n}{2L} \sqrt{\frac{T_1}{\frac{\rho\pi d^2}{4}}}$

② $256 = \frac{n}{2L} \sqrt{\frac{T_2}{\rho\pi\left(\frac{2d}{2}\right)^2}} = \frac{n}{2L}\sqrt{\frac{T_2}{4\rho\pi d^2}}$

$\frac{①}{②}$ $\frac{512}{256} = 2 = \sqrt{\frac{4T_1}{T_2}} = 2\sqrt{\frac{T_1}{T_2}}$

$\Rightarrow \underline{T_1/T_2 = 1}$

HOJA N°

FECHA

9.16 $L = 0{,}4\,m$, $T = 800\,N$, $m = 0{,}003\,kg$. $\mu = m/L = 7{,}5 \cdot 10^{-3}\,kg/m$.

a) $f = \frac{1}{2L}\sqrt{T/\mu} \simeq 408\,Hz \quad (n=1)$

b) $f = \frac{n}{2L}\sqrt{T/\mu}$ Si $f = 14000\,Hz \Rightarrow n = 2fL\sqrt{\frac{\mu}{T}} \simeq 34$.

9.19 $L = 0{,}8\,m$, $\mu = 50\,gr/m$ sujeto en ambos extremos, $f_0 = 60\,Hz$.
$A = 3\,mm$, $\omega = 2\pi f$

a) $f_0 = \frac{v}{2L} \rightarrow v = 2L f_0 = 96\,m/s$.

b) $T = \mu v^2 \rightarrow T = 460{,}8\,N$.

$v_{max} = |\dot{\psi}(x,t)|_{max} = A\,\omega = A\,2\pi f_0 = 1{,}13\,m/s$

$a_{max} = |\ddot{\psi}(x,t)|_{max} = A\,\omega^2 = A(2\pi f_0)^2 = 426\,m/s^2$.

Acústica

$$\underline{P_{max} = \rho v \omega A = k\,\rho v^2 A}$$

9.22 $f = 1000\,Hz$, $P_{max} = 30\,Pa$. ($\rho_{aire} = 1{,}2\,kg/m^3$, $v_{sonido} = 344\,m/s$)

$P = \rho v \omega A \rightarrow A = \frac{P}{\rho v \omega} \sim 1{,}17 \times 10^{-5}\,m$

con $f = \frac{\omega}{2\pi}$

NOTA