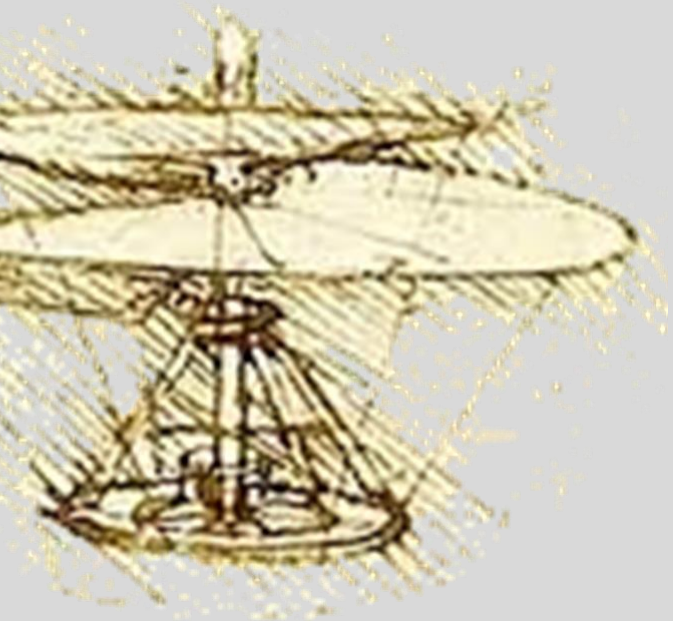
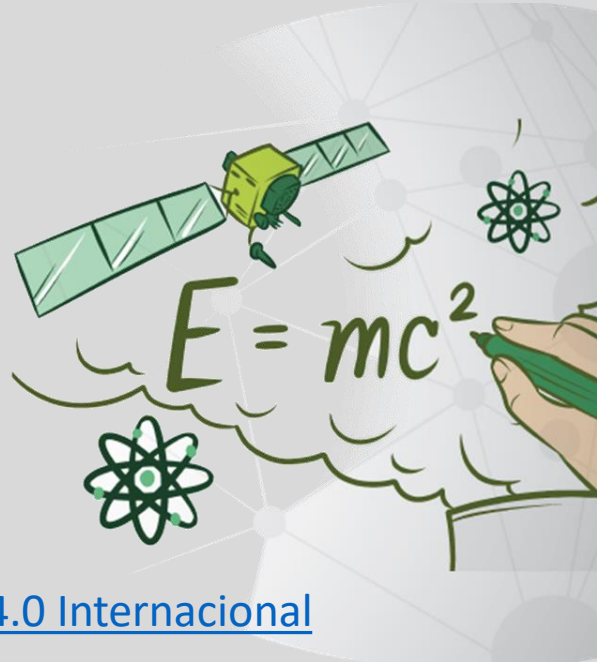
Física I
Unidad 9: Algunas propiedades de las ondas

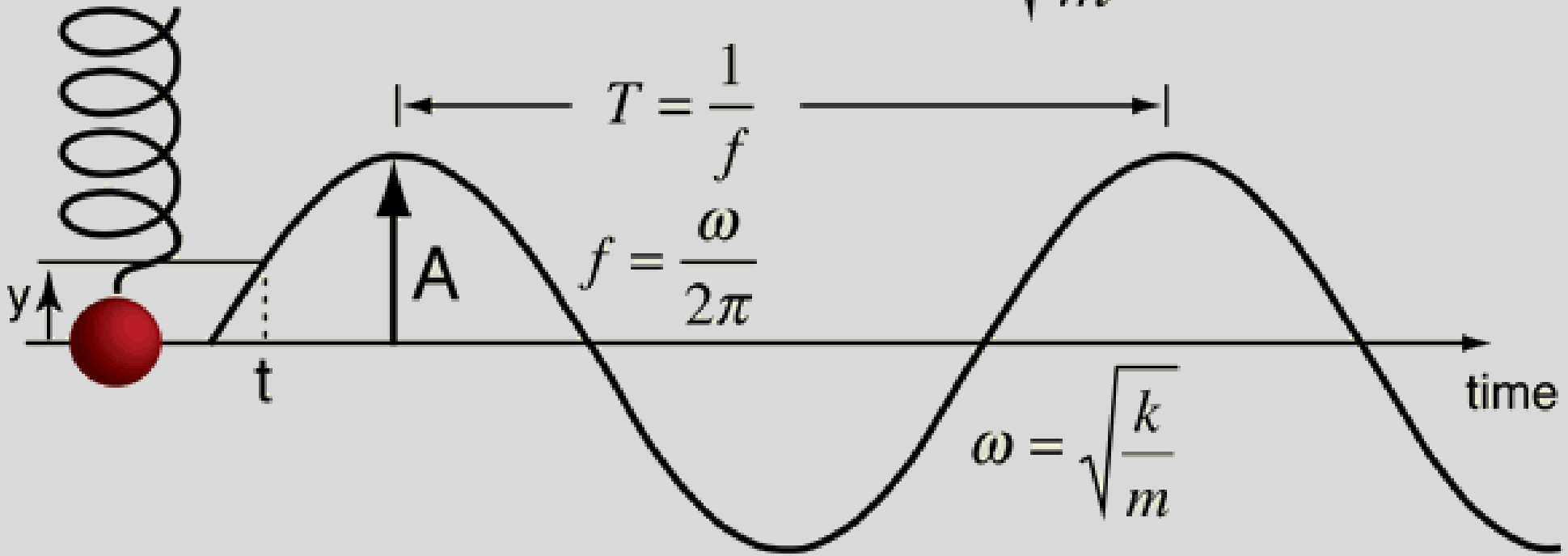


Ing. Javier Martín - 2024

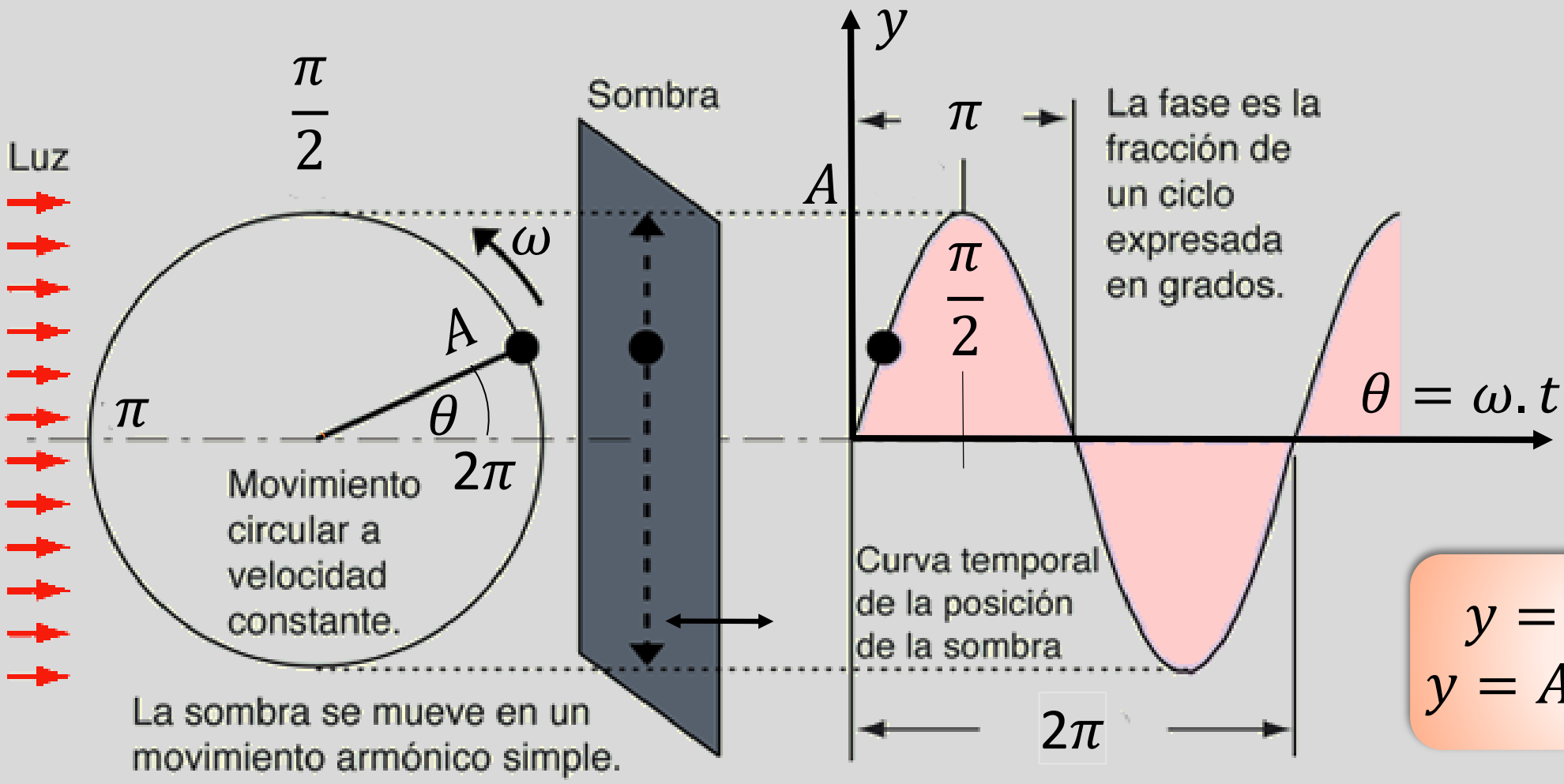


Movimiento Armónico Simple

$$y = A\,\mathrm{sen}\,\omega t = A\,\mathrm{sen}\sqrt{\frac{k}{m}}\,t$$



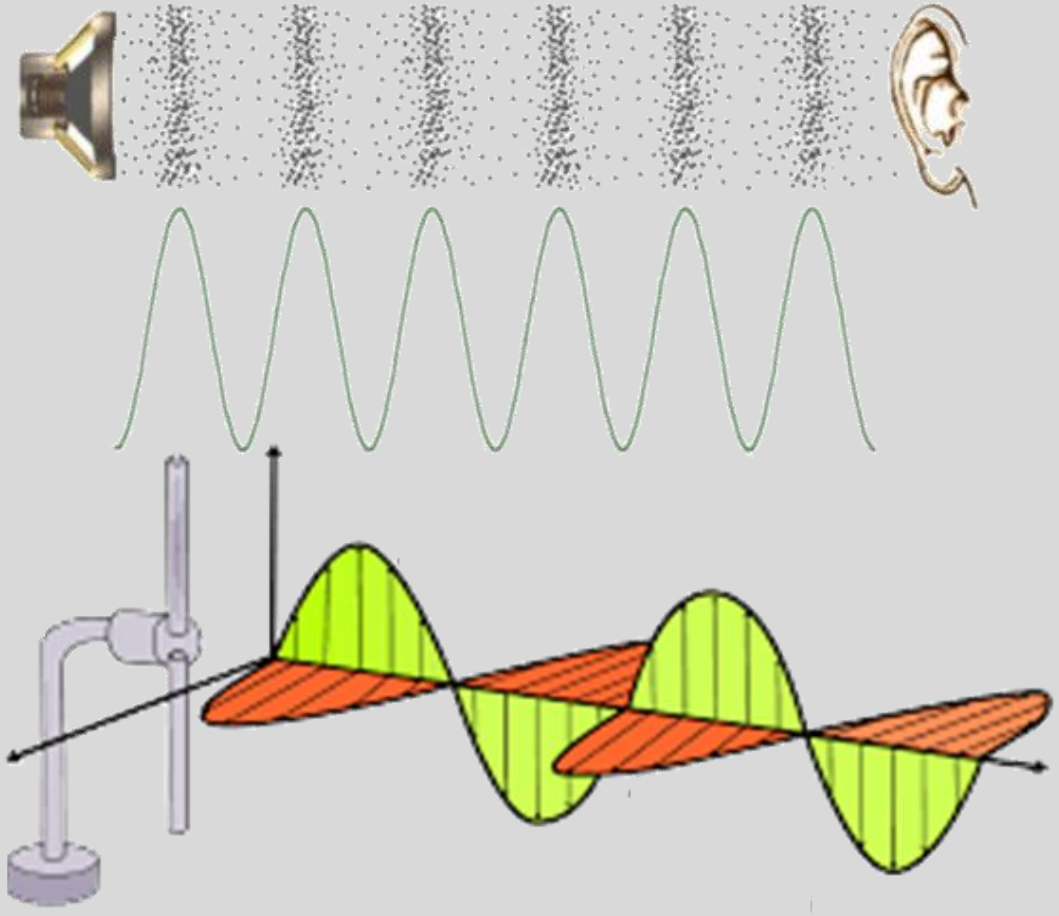
Movimiento Armónico Simple

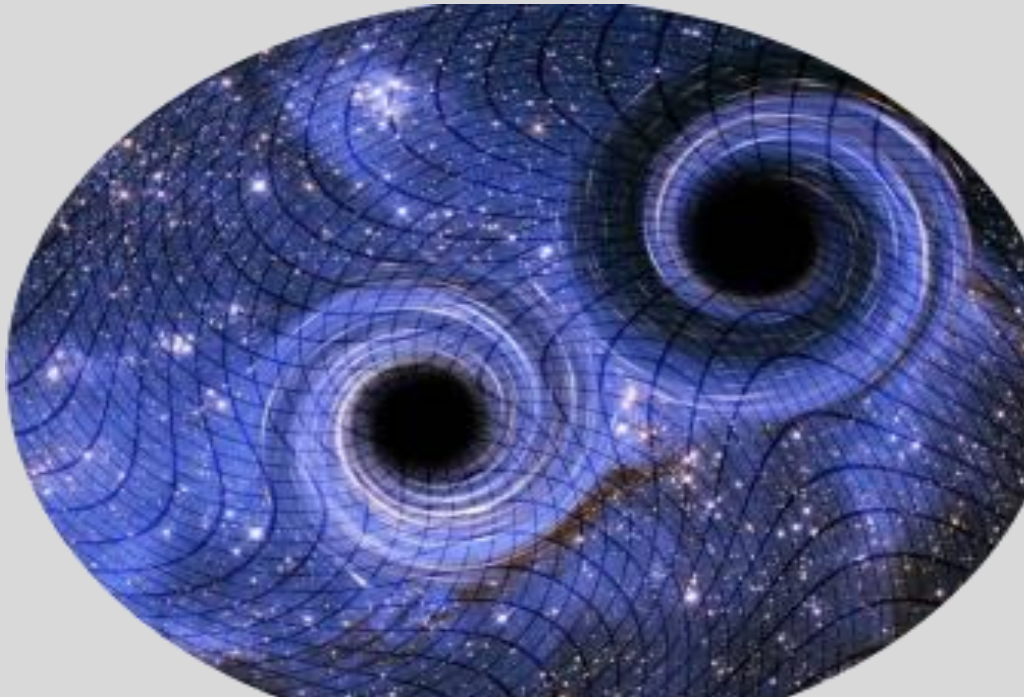


$$y = A\ sen\ \theta$$
$$y = Asen(\omega . t)$$

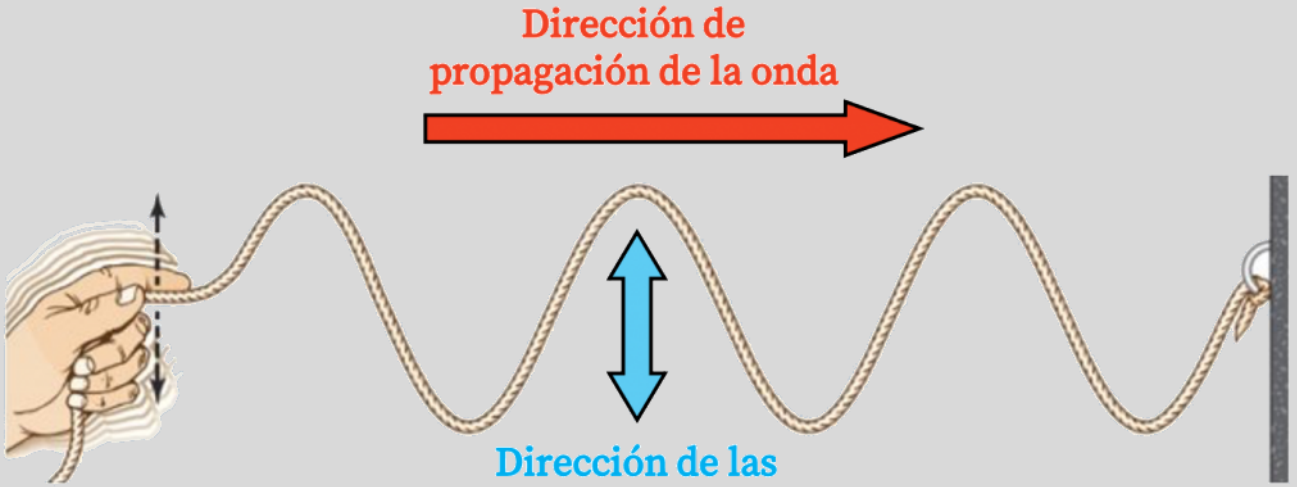
Tipo de Ondas

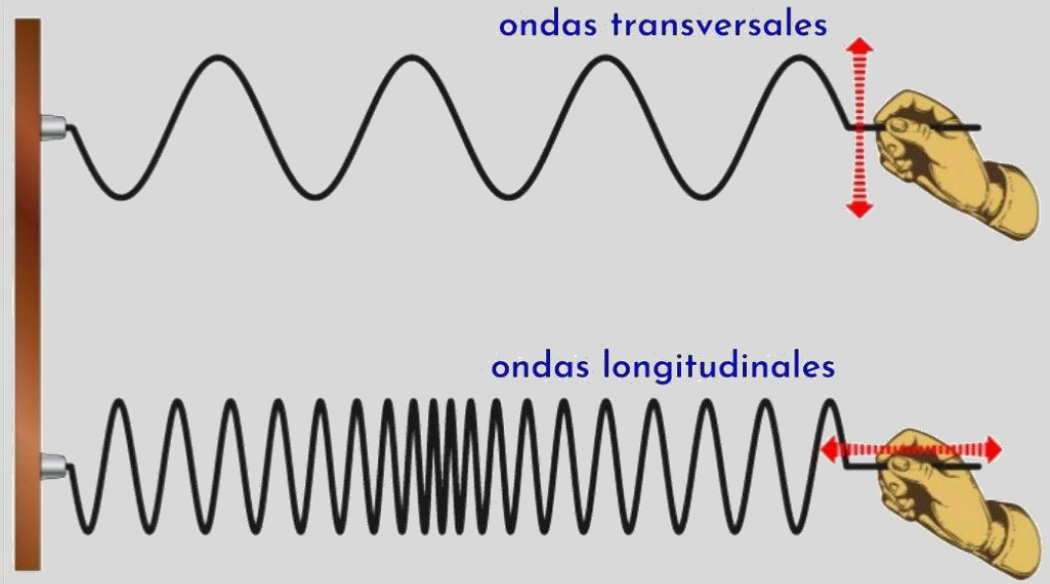
Variaciones en la presión del aire y forma de onda correspondiente

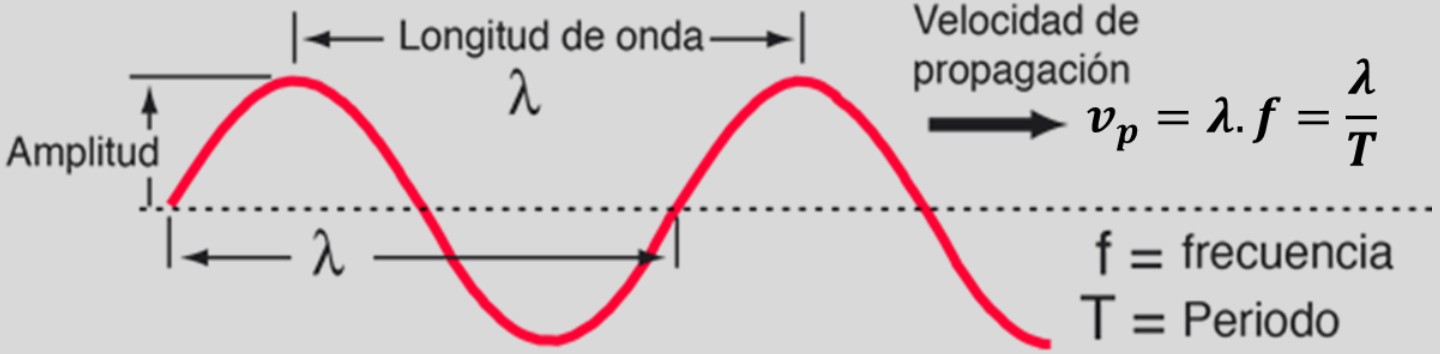




Características de las ondas







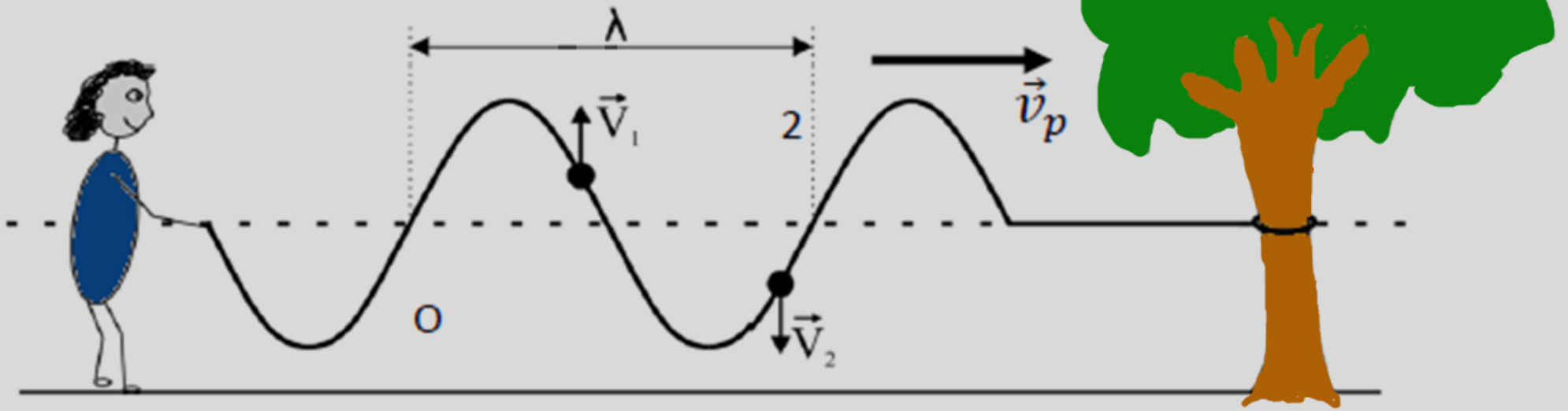
Velocidad de propagación

$$v_p = \lambda . f = \frac{\lambda}{T}$$

f = frecuencia

T = Periodo

Función de onda



$$y_{(x)} = A.sen\left[\left(\frac{2.\pi}{\lambda}\right).x\right]$$

$$y_{(x,t)} = A.sen\left[\left(\frac{2.\pi}{\lambda}\right)(x - v_p.t)\right]$$

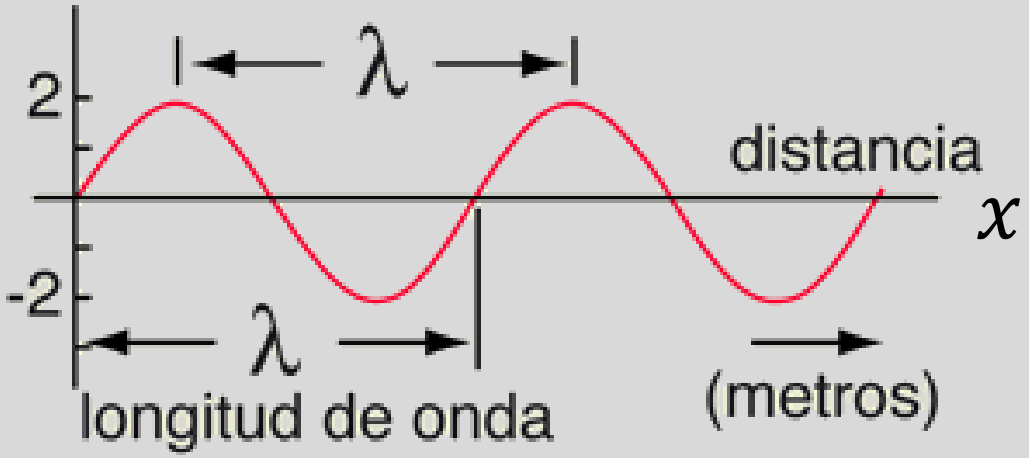
$$y_{(x,t)} = A.sen\left[2.\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right)\right]$$

Características de las ondas

$$y_{(x,t)} = A.sen\left[2.\pi\left(\frac{x}{\lambda} - \frac{t}{T}\right)\right]$$

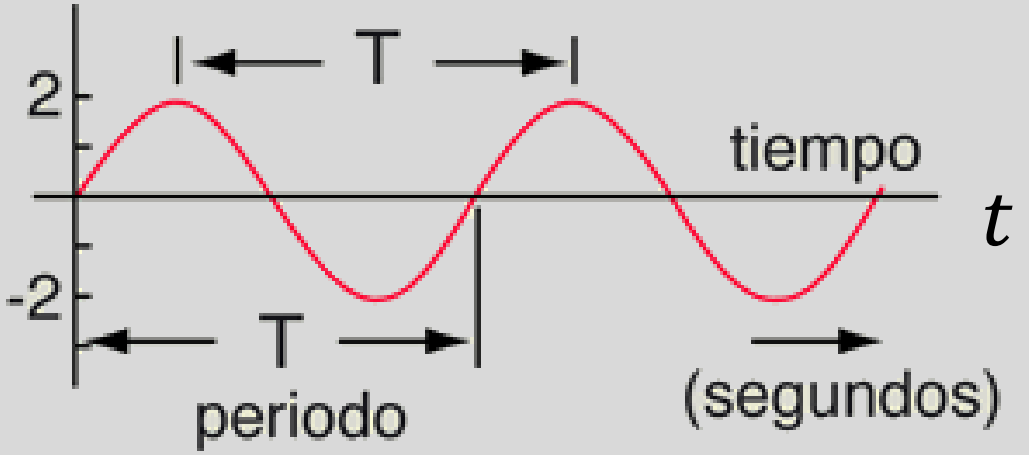
$t = constante$

$y_{(x)} = A.sen(b.x)$

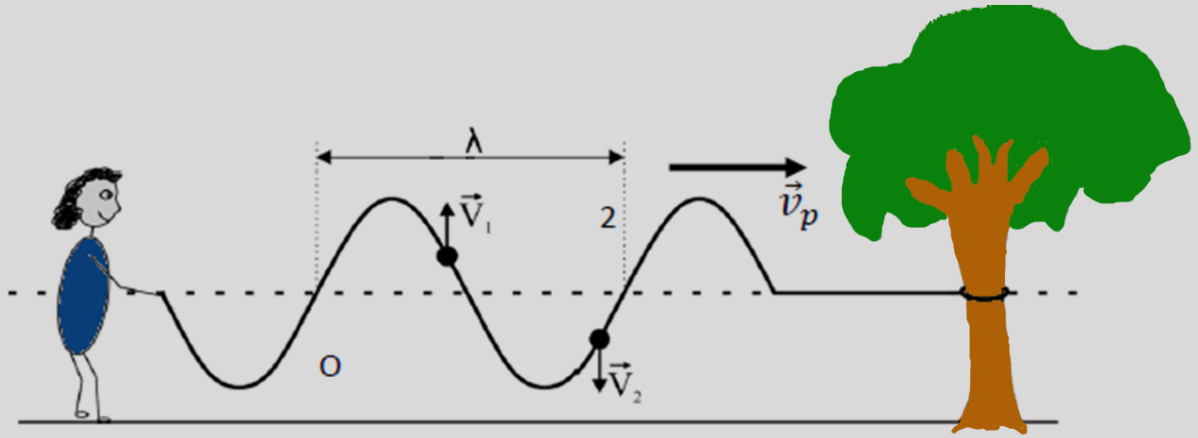


$x = constante$

$y_{(t)} = A.sen(b.t)$



Velocidad de propagación



$$v_p = \sqrt{\frac{T}{\mu}}$$

$$\mu = \frac{m}{l}\left[\frac{kg}{m}\right]$$

Velocidad de propagación en un sólido

$$v_s = \sqrt{\frac{E}{\rho}}$$

Velocidad de propagación en un líquido

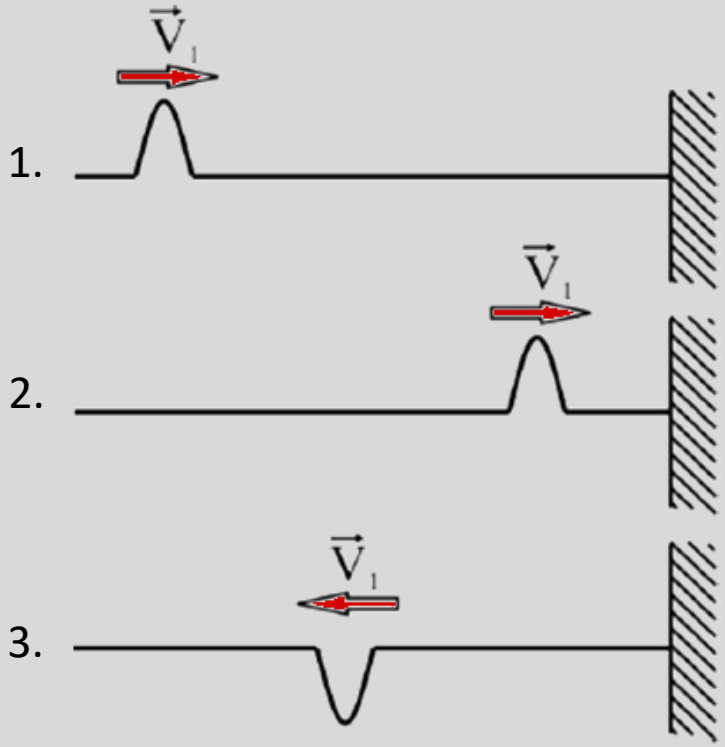
$$v_l = \sqrt{\frac{B}{\rho}}$$

Velocidad de propagación en un gas

$$v_g = \sqrt{\frac{\gamma . p}{\rho}}$$

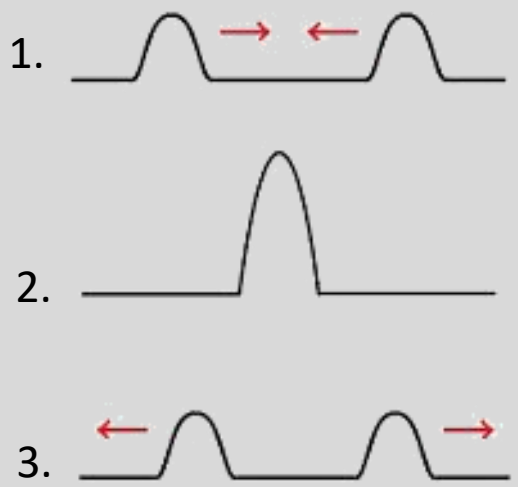
Reflexión, transmisión e interferencia

Reflexión de ondas

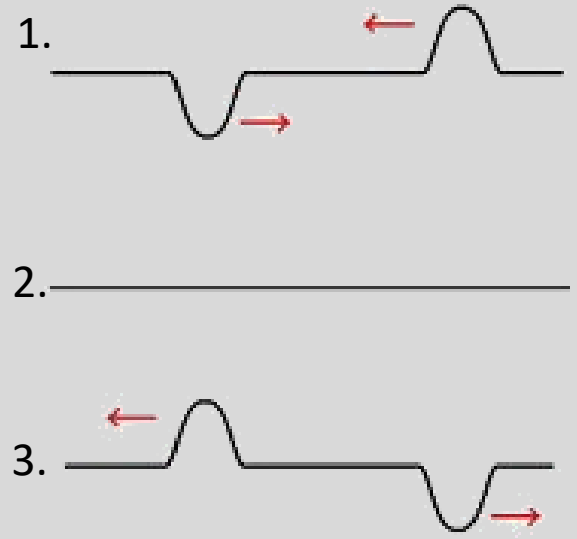


Interferencia de ondas

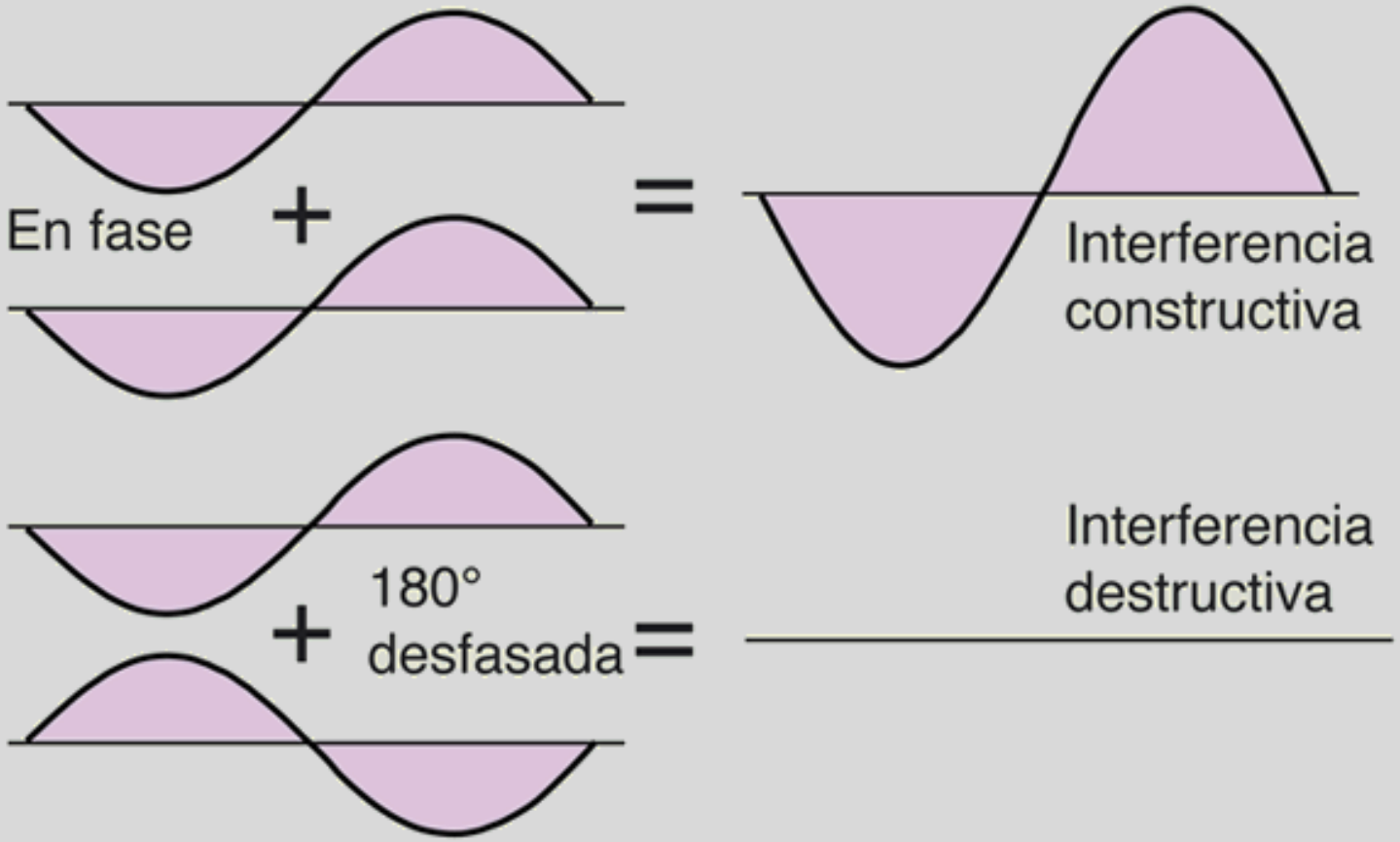
Interferencia constructiva



Interferencia destructiva



Interferencia

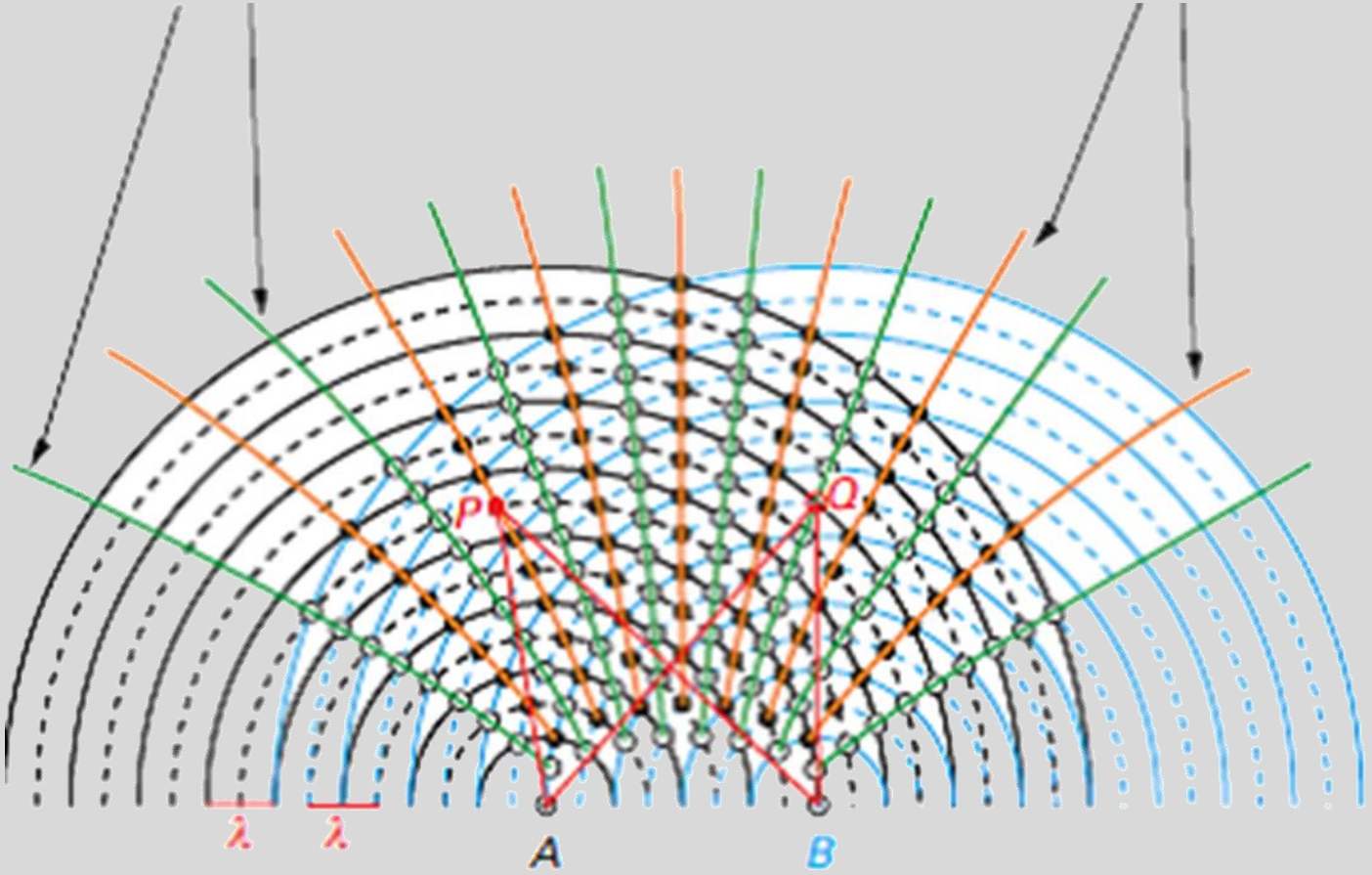


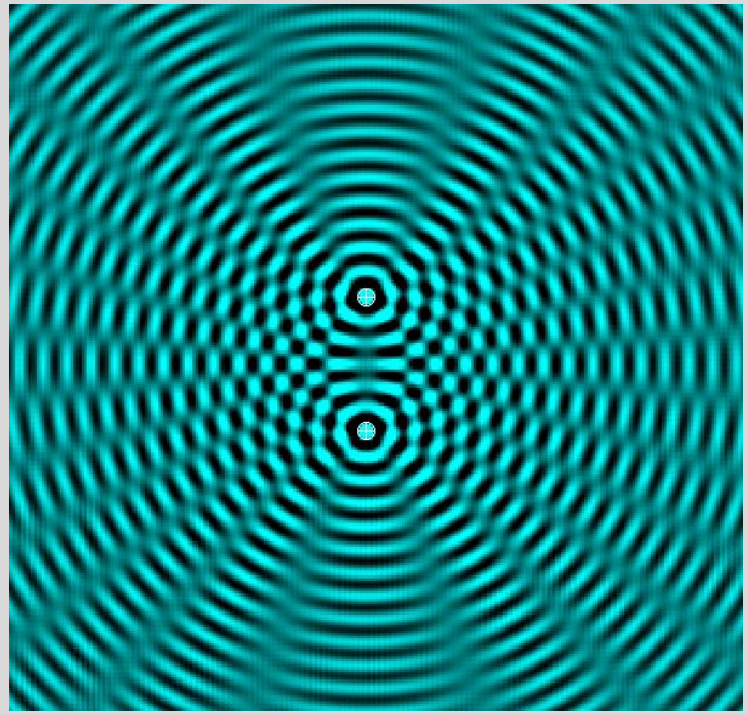
$$y_{(total)} = y_{(1)} + y_{(2)}$$

Interferencia

Líneas de Interferencia destructiva

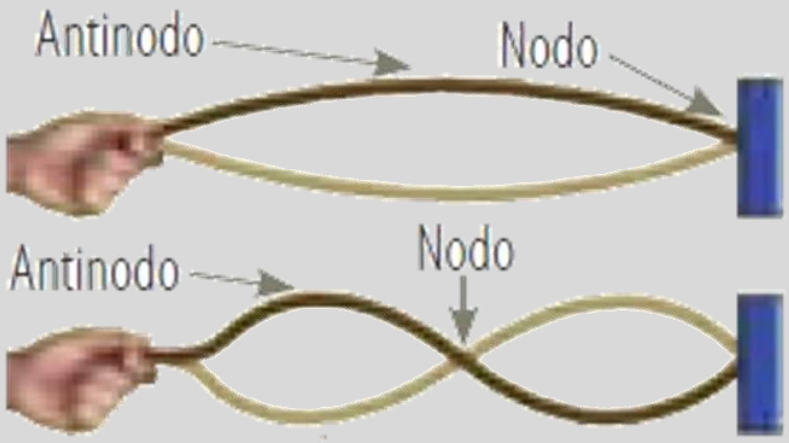
Líneas de Interferencia constructiva

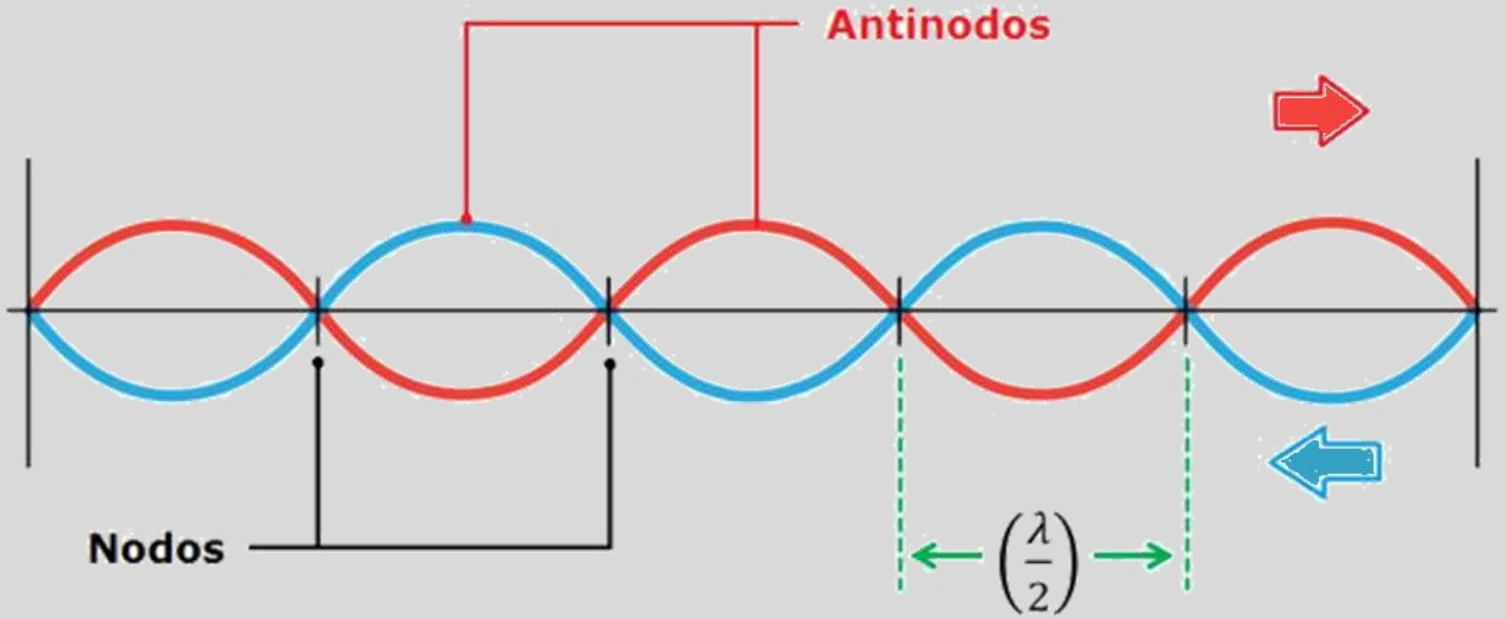




Ondas estacionarias

Resonancia en una cuerda

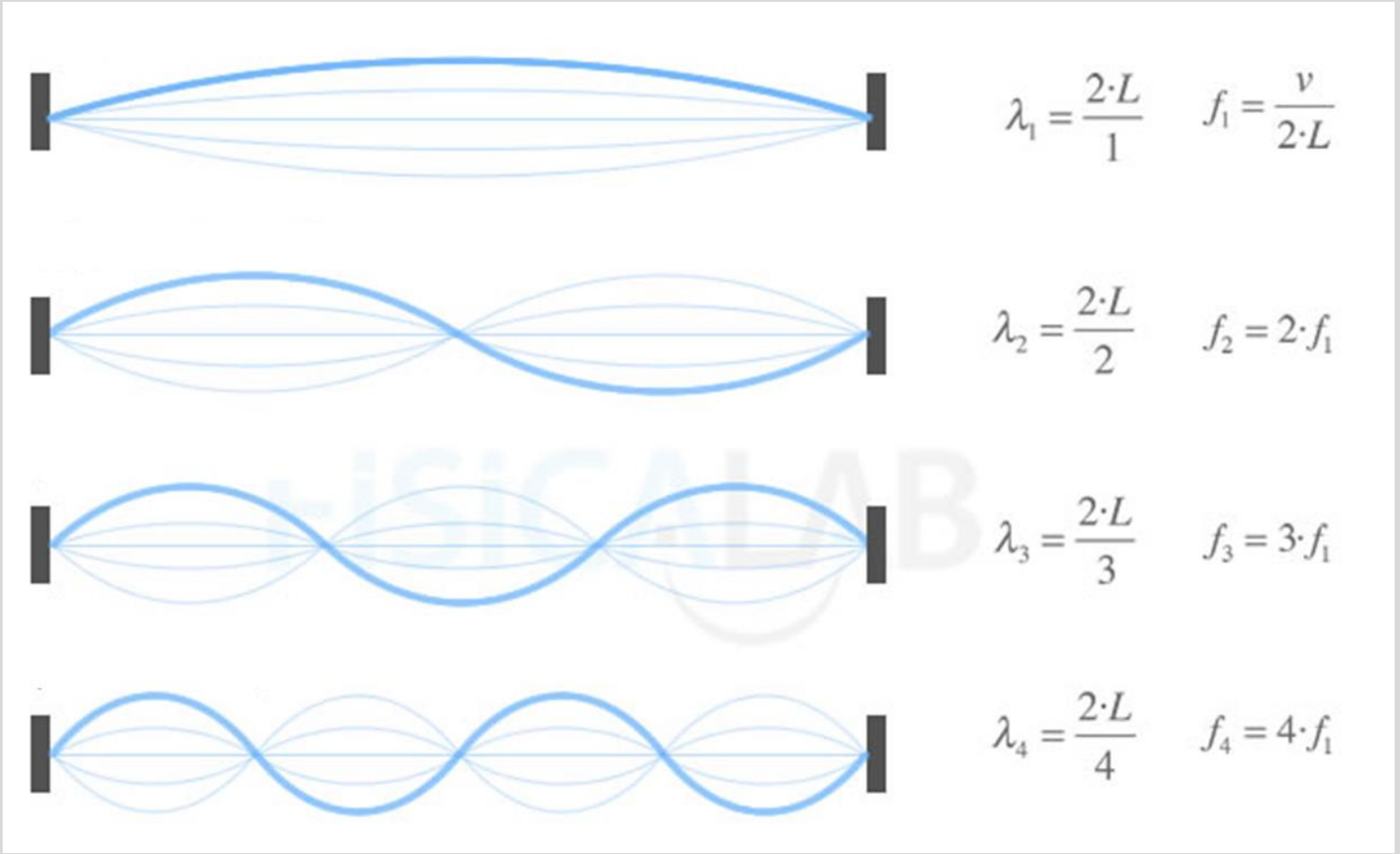




La distancia entre dos nodos es igual a $\left(\frac{\lambda}{2}\right)$

Resonancia en una cuerda

Cuerda fija por ambos extremos



$$\lambda_n = \frac{2}{n} L$$

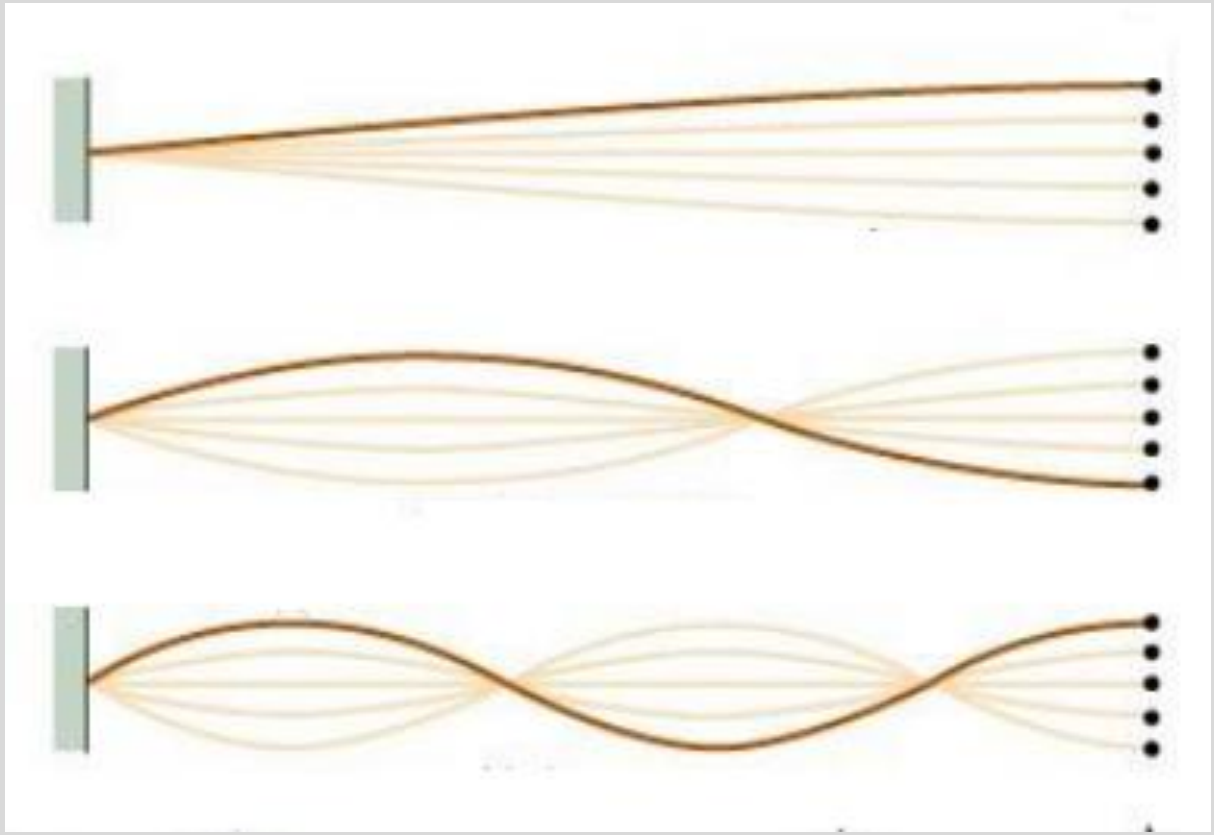
$$f_n = \frac{v}{\lambda} = \frac{n.v}{2.L}$$

$$f_n = \mathrm{n}.f_1$$

$$n = 1,2,3 \ldots$$

Resonancia en una cuerda

Cuerda fija por ambos extremos



$$\lambda_1 = 4.L$$

$$f_1 = \frac{v}{\lambda_1} = \frac{v}{4.L}$$

$$\lambda_3 = \frac{4}{3}L$$

$$f_3 = \frac{3.v}{4.L} = 3.f_1$$

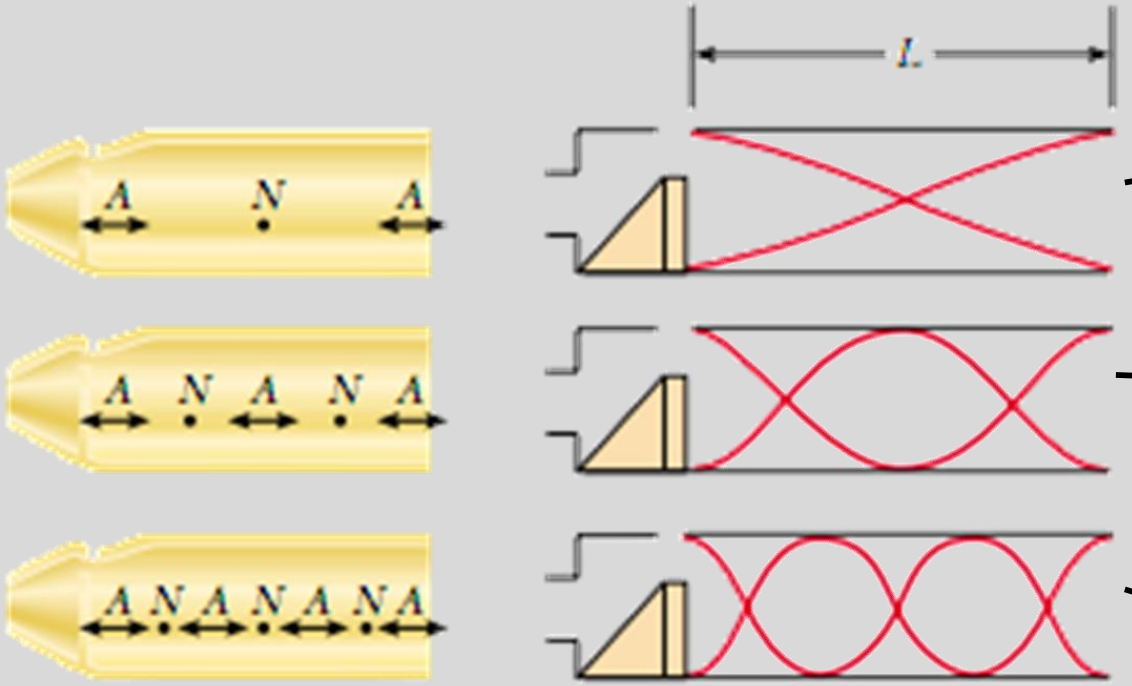
$$\lambda_5 = \frac{5}{4}L$$

$$f_5 = \frac{5.v}{4.L} = 5.f_1$$

$$\lambda_m = \frac{4}{m}L \rightarrow f_m = \frac{m.v}{4.L} = \text{m}.f_1 \rightarrow m = 1,3,5 \ldots$$

Resonancia en un tubo

Abierto por ambos extremos



$$\lambda_1 = 2.L$$

$$f_1 = \frac{v}{\lambda_1} = \frac{v}{2.L}$$

$$\lambda_2 = L$$

$$f_2 = \frac{v}{\lambda_2} = \frac{v}{L} = 2.f_1$$

$$\lambda_3 = \frac{2.L}{3}$$

$$f_3 = \frac{v}{\lambda_3} = \frac{3.v}{2.L} = 3.f_1$$

$$\lambda_n = \frac{2}{n}L \rightarrow f_n = \frac{n.v}{2.L} \rightarrow f_n = \mathrm{n}.f_1 \rightarrow n = 1,2,3 \ldots$$

Resonancia en un tubo

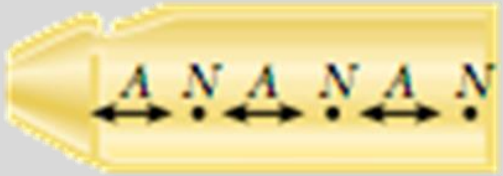
Abierto por un extremo

$$\lambda_1 = 4.L$$

$$f_1 = \frac{v}{\lambda_1} = \frac{v}{4.L}$$

$$\lambda_3 = \frac{4}{3}L$$

$$f_3 = \frac{3.v}{4.L} = 3.f_1$$

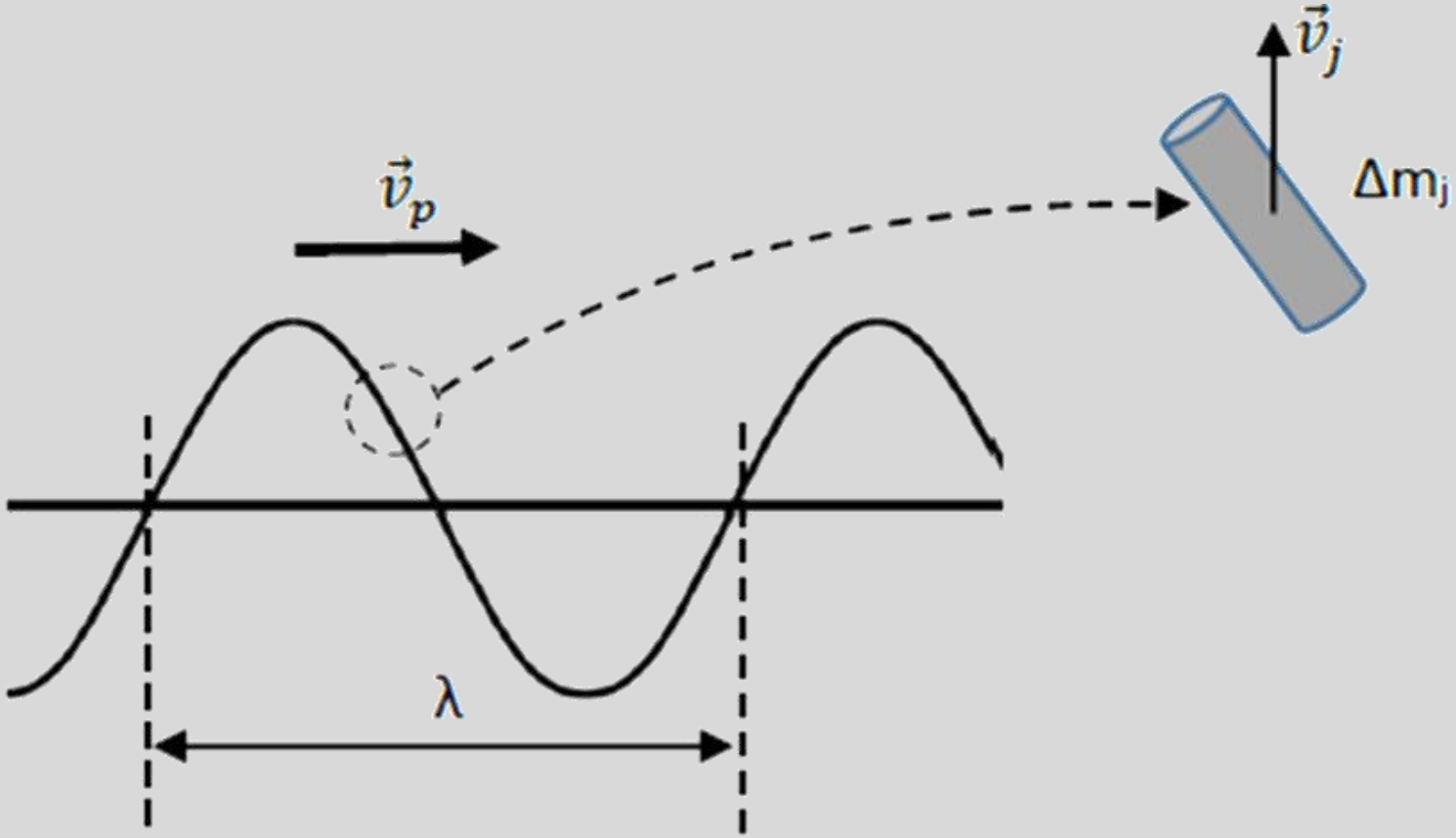


$$\lambda_5 = \frac{5}{4}L$$

$$f_5 = \frac{5.v}{4.L} = 5.f_1$$

$$\lambda_m = \frac{4}{m}L \rightarrow f_m = \frac{m.v}{4.L} = \mathrm{m}.f_1 \rightarrow m = 1,3,5 \ldots$$

Energía y potencia (cuerda)



$$\Delta Ec_j = \frac{1}{2}\Delta m_j . v_j^2$$

$$E(\lambda) = \frac{1}{2}\mu . \lambda . v_{max}^2$$

$$E(\lambda) = \frac{1}{2}\mu . \lambda . \omega^2 . A^2$$

$$P = \frac{E}{T} = \frac{1}{2}\mu . \frac{\lambda}{T} . \omega^2 . A^2$$

$$P = \frac{E}{T} = \frac{1}{2}\mu . v_p . \omega^2 . A^2$$

Energía, potencia, intensidad (sonido)

$$\Delta E_T = \Delta Ec_{max} = \frac{1}{2}\Delta m.v_{max}^2 \qquad \Delta m = \delta.\Delta V$$

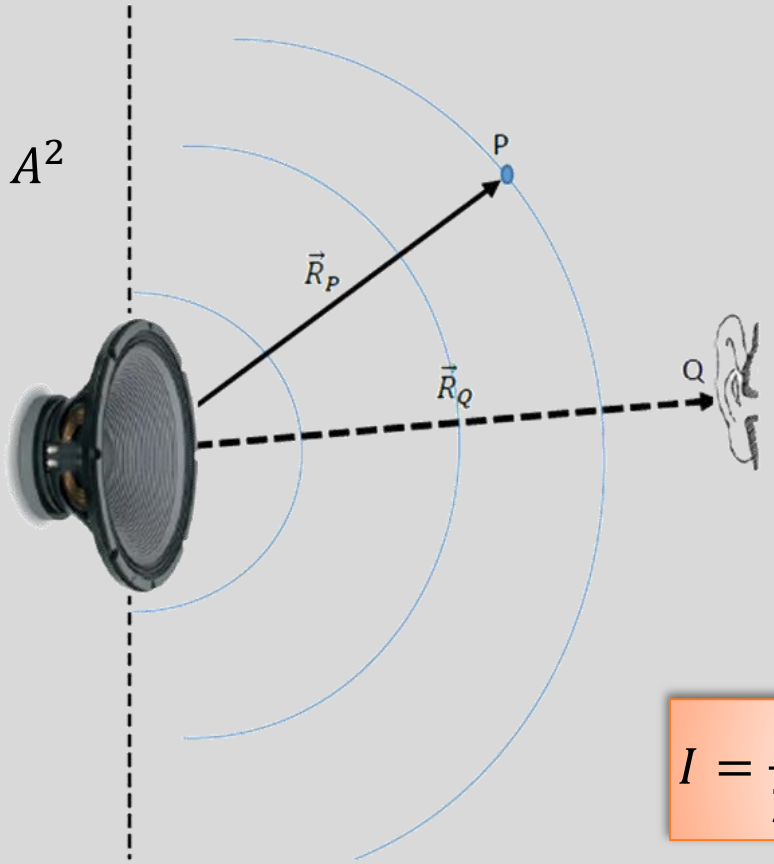
$$\Delta E_T = \frac{1}{2}\delta.\Delta V.v_{max}^2 \qquad \Delta E_T = \frac{1}{2}\delta.\Delta S.\Delta\lambda.\omega^2.A^2$$

$$E = \frac{1}{2}\delta.V.\omega^2.A^2$$

$$P = \frac{E}{T} = \frac{1}{2}\delta.S.\frac{\lambda}{T}.\omega^2.A^2$$

$$P = \frac{E}{T} = \frac{1}{2}\delta.S.v_p.\omega^2.A^2 \quad [W]$$

$$I = \frac{P}{S} = \frac{1}{2}\delta.v_p.\omega^2.A^2 \quad [W/m^2]$$



$$I = \frac{P}{2.\pi.R_p^2} \quad [W/m^2]$$

Bibliografía

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