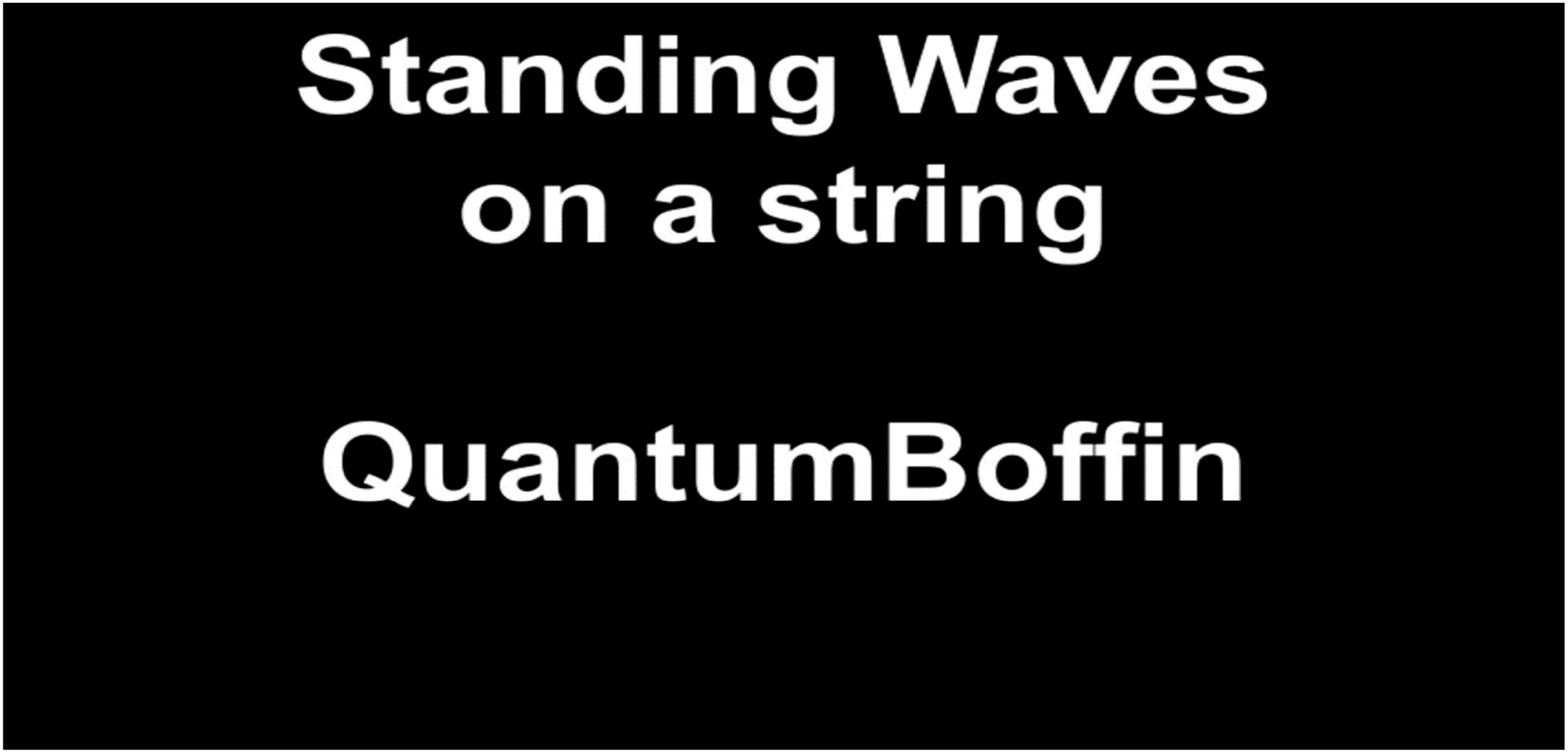
KEEP CALM AND STUDY PHYSICS

Ondas estacionárias em cordas

Apresentação, orientação e tarefa: **fisicasp.com.br**

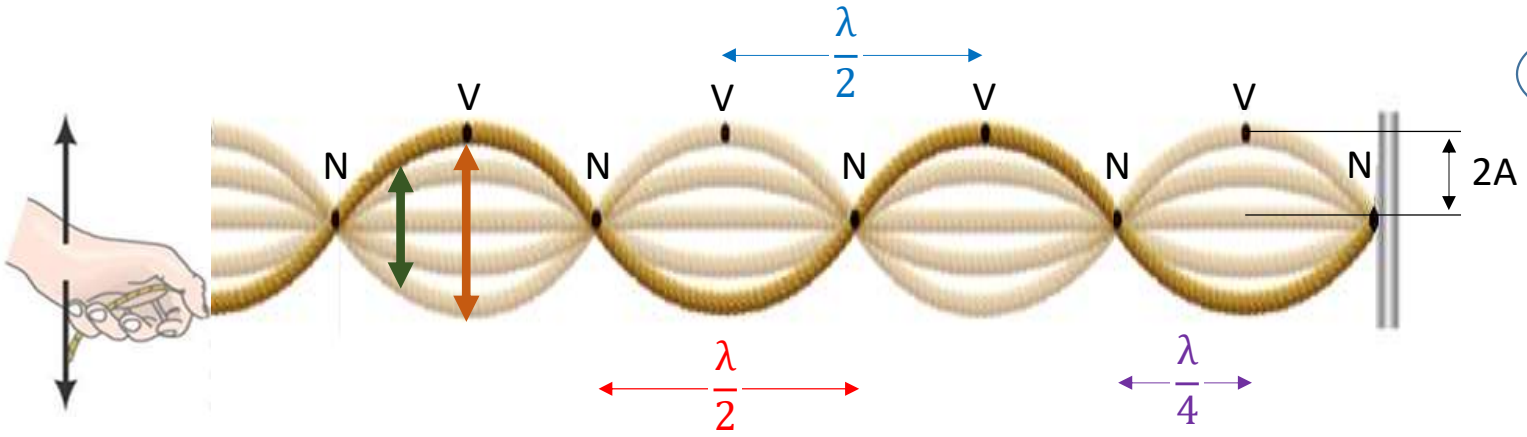
Professor **Caio Gomes**

https://www.youtube.com/watch?v=Ki-Kst3nO1U



2. Onda estacionária

- Nó: interferência destrutiva
- Ventre: interferência construtiva



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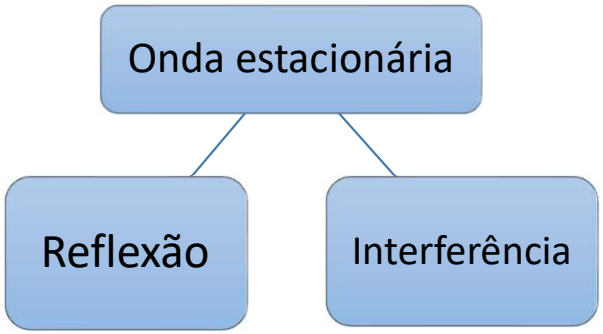
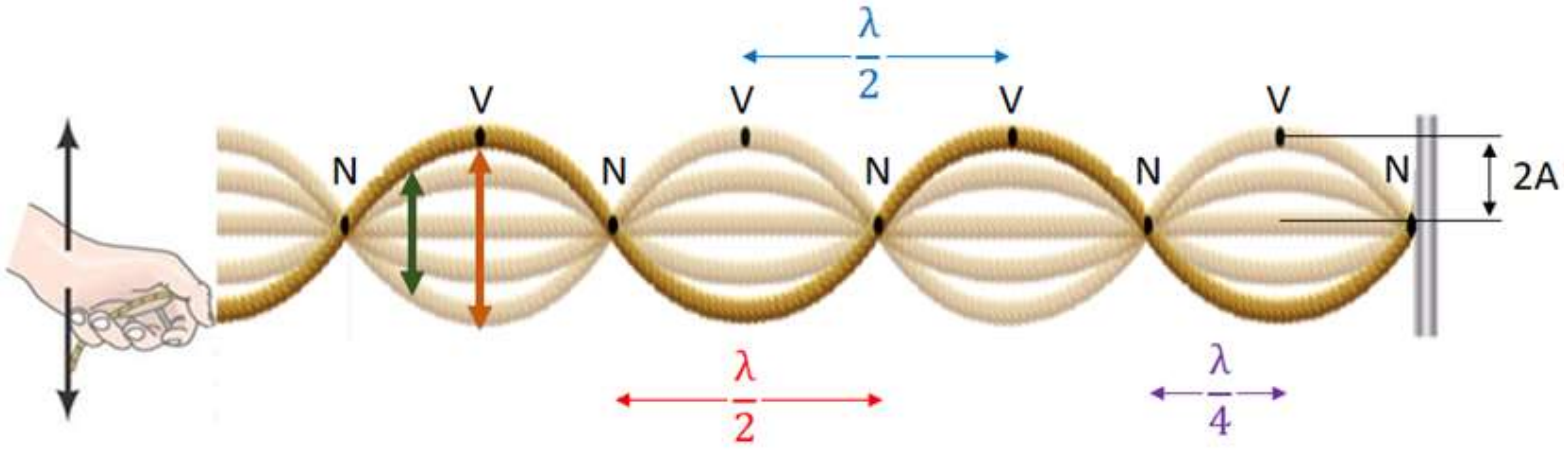
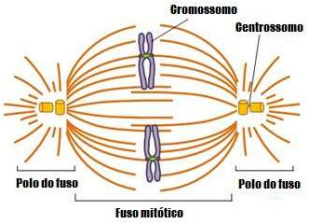


	Ondas originais	Onda estacionária
Amplitude	A	2A
Comp. de onda	λ	λ
Frequência	f	f

$$V = \lambda \, . \, f$$

- Nó: interferência destrutiva
- Ventre: interferência construtiva





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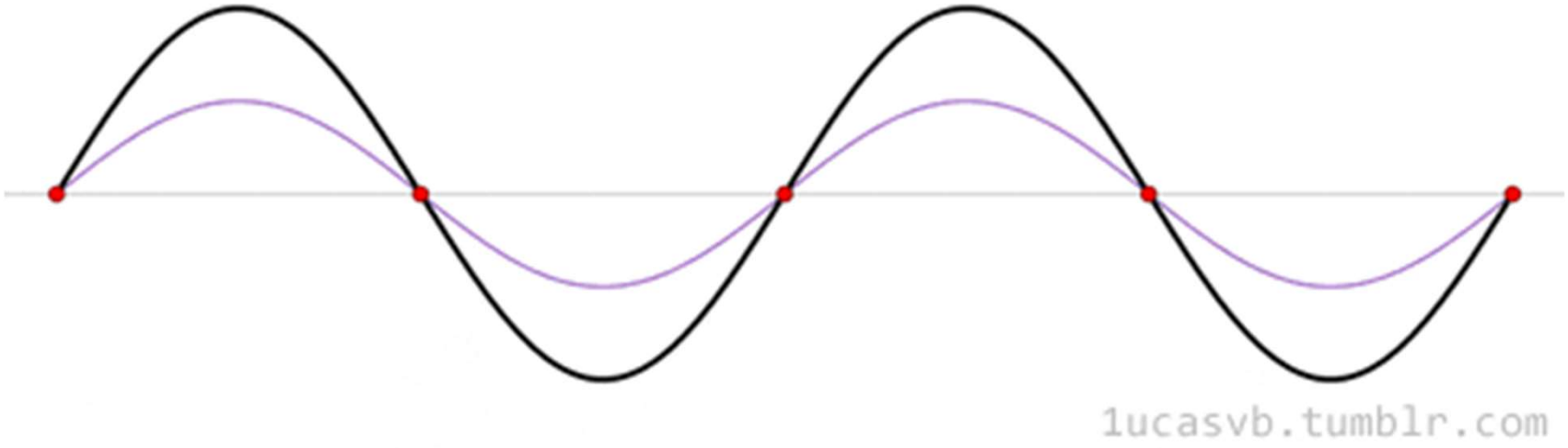
Simulador



https://iwant2study.org/lookangejss/04waves_11superposition/ejss_model_wave1d01/wave1d01_Simulation.xhtml

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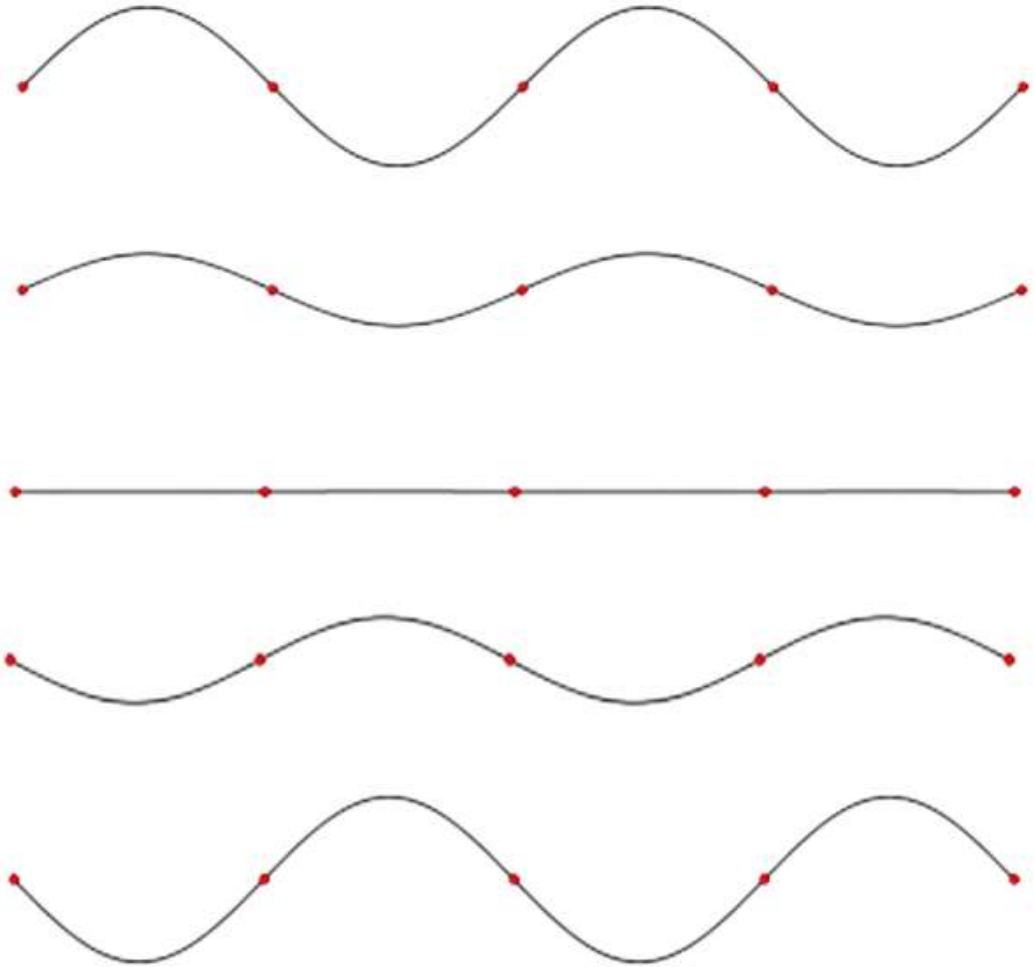
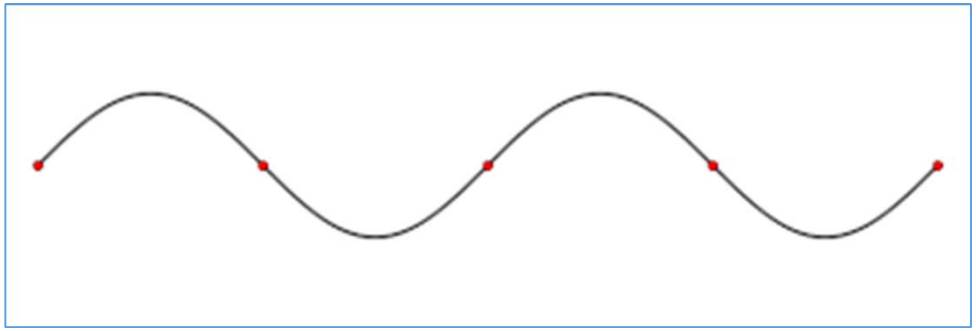
2. Onda estacionária





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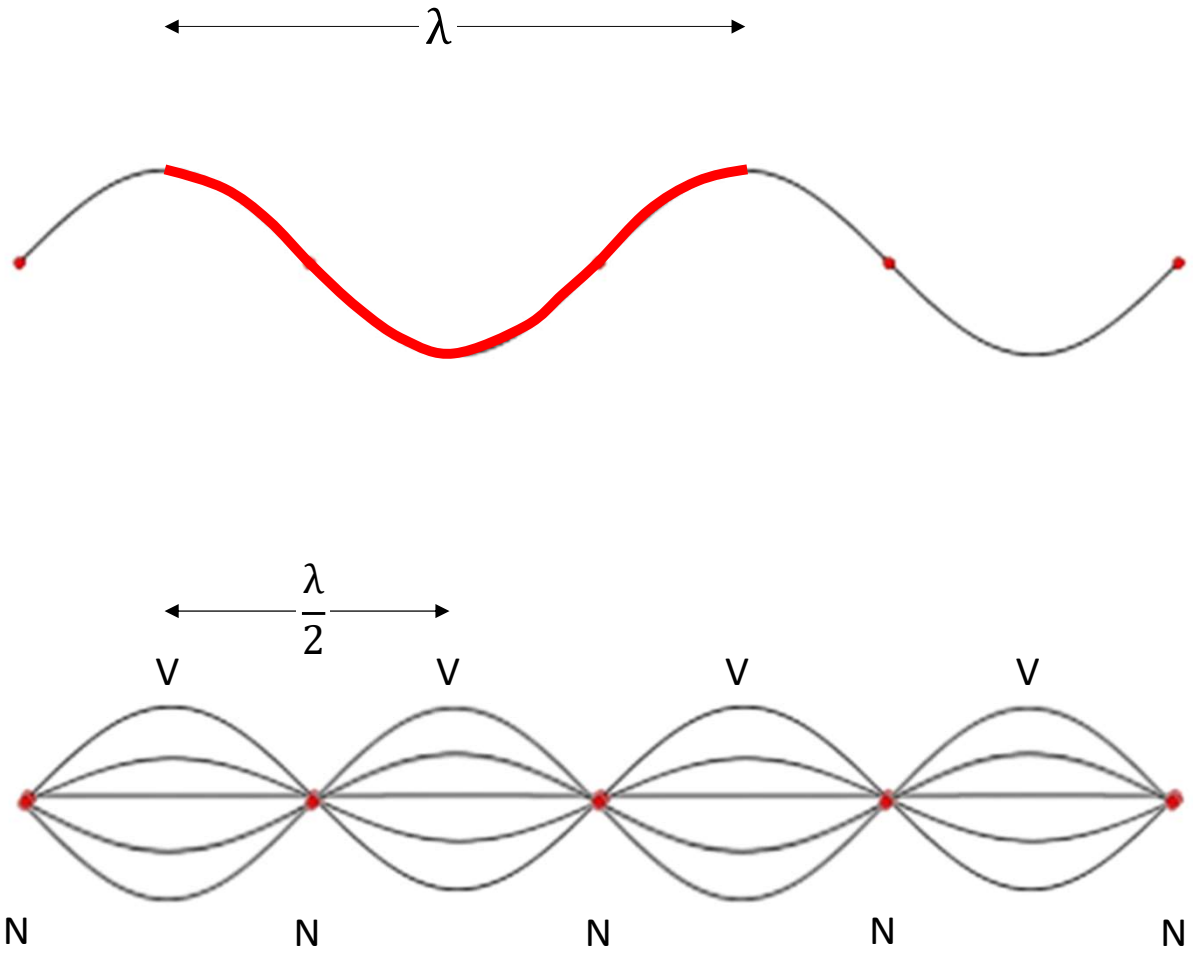

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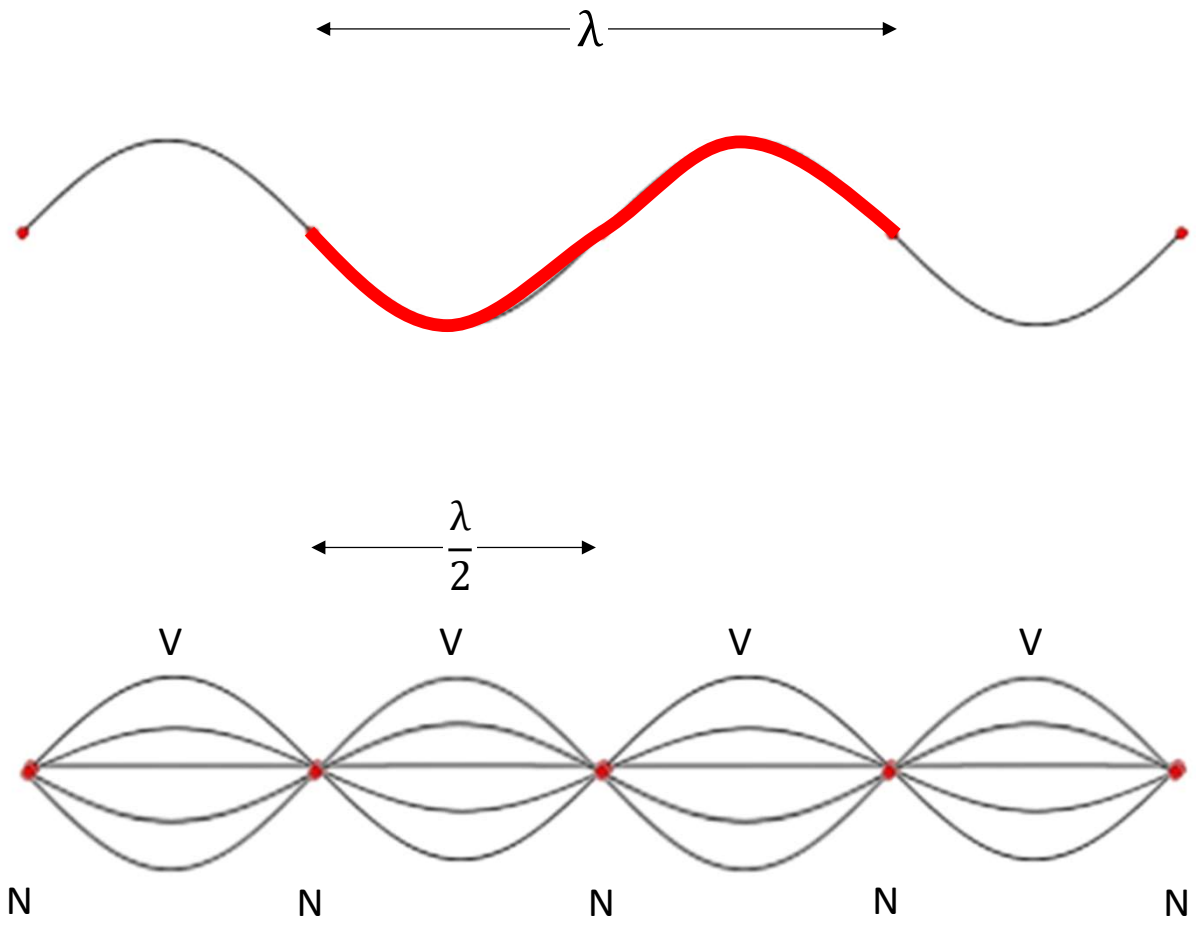

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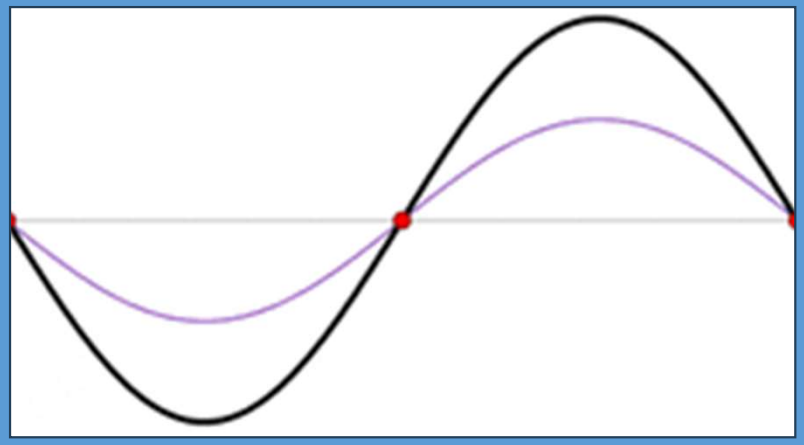
2. Onda estacionária



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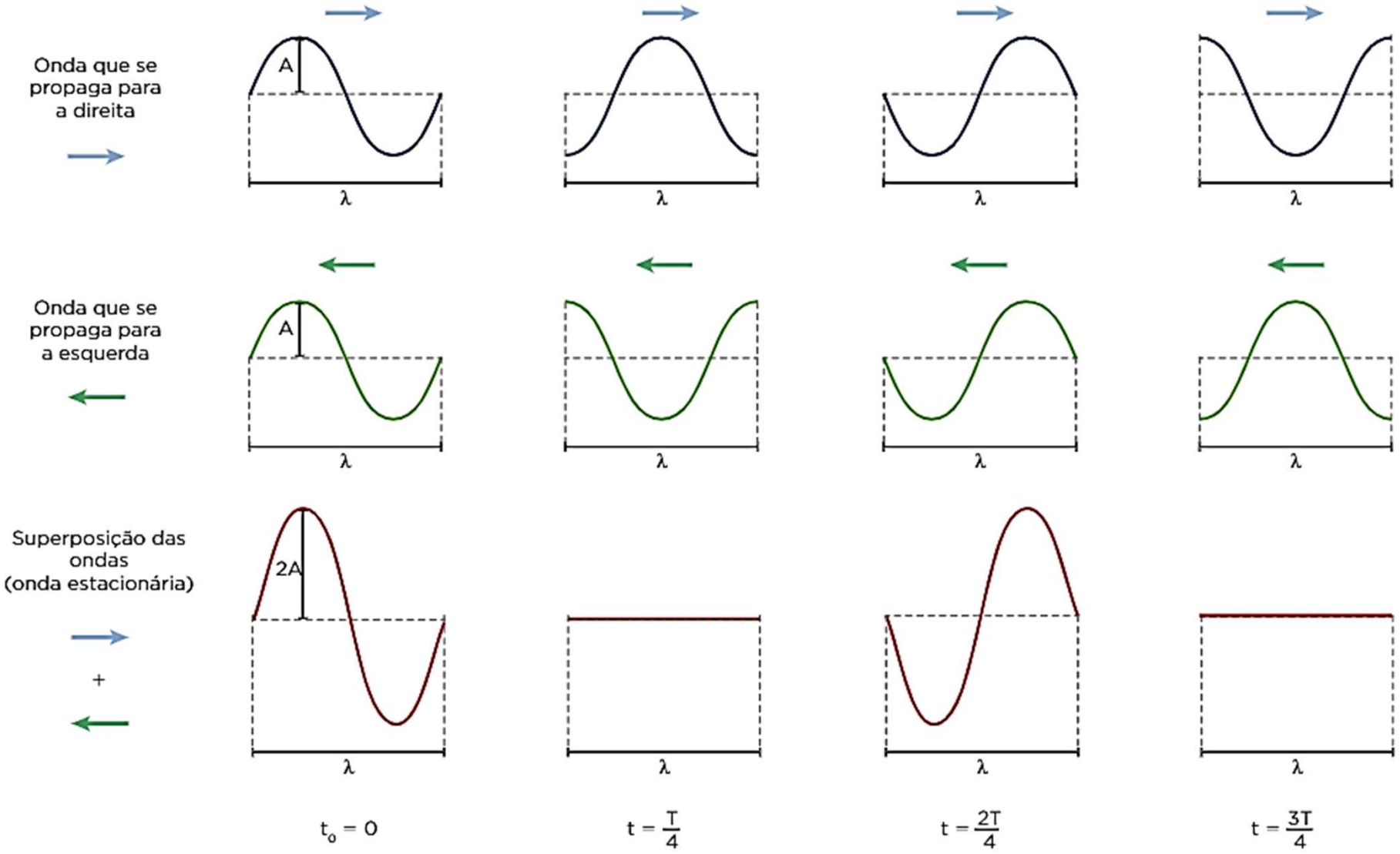

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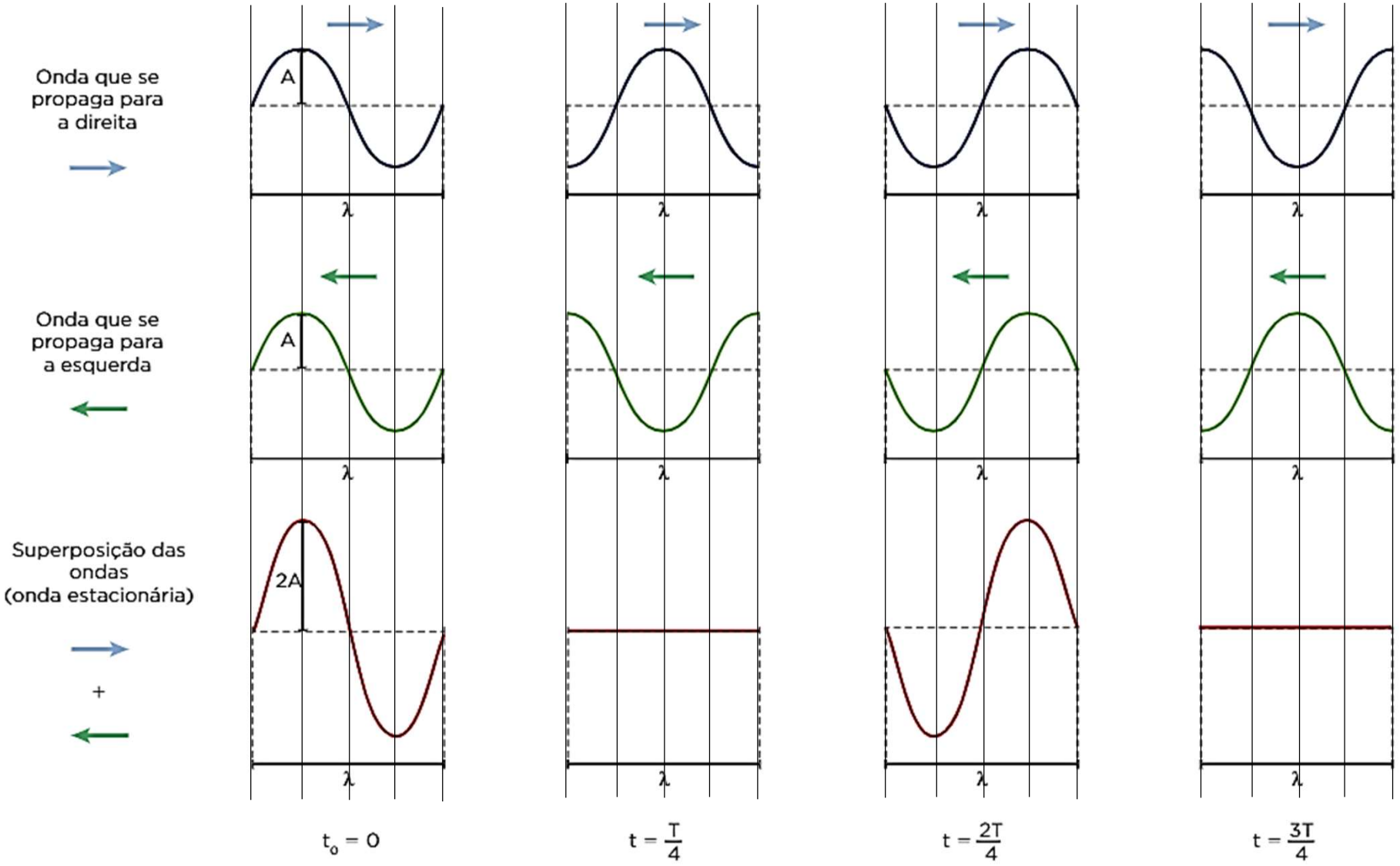
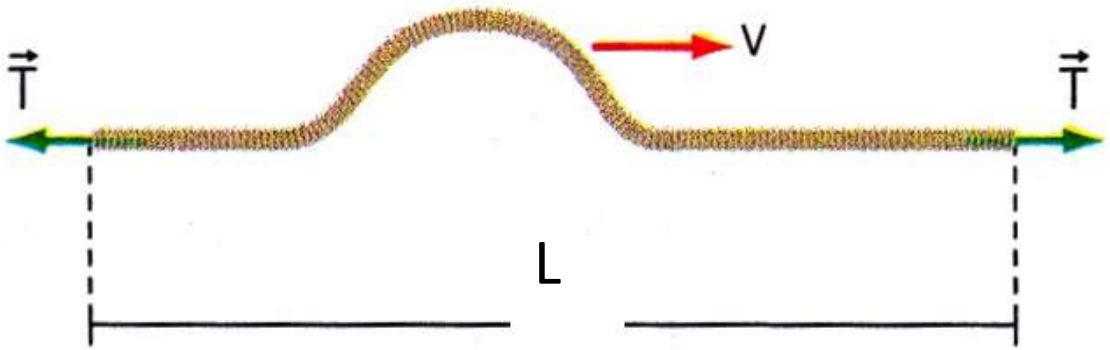
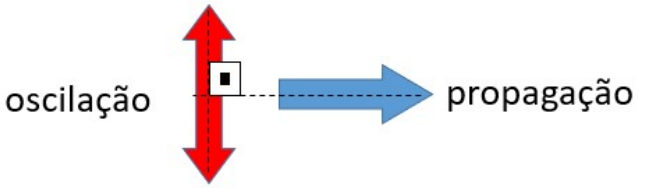
2. Onda estacionária



3. Equação de Taylor





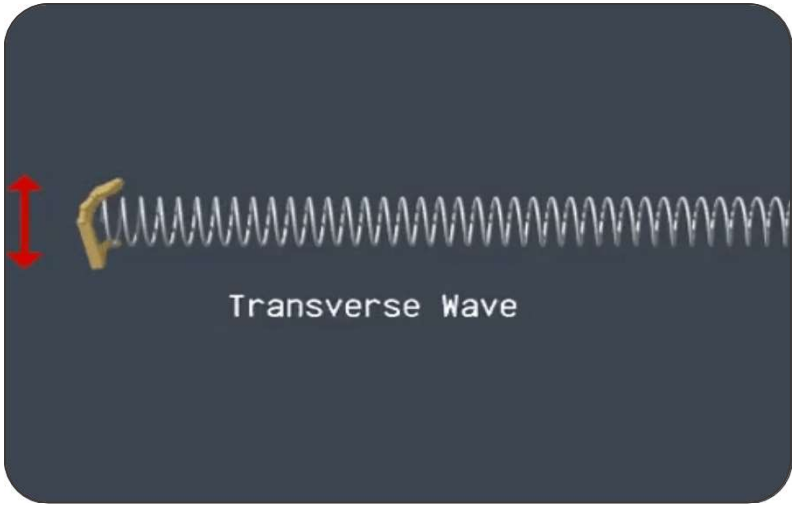
- v: velocidade de propagação – SI: (m/s)
- T: força de tração – SI: (N)
- L: comprimento da corda – SI: (m)
- μ: densidade linear da corda – SI: (kg/m)

Velocidade de propagação: equação de Taylor

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

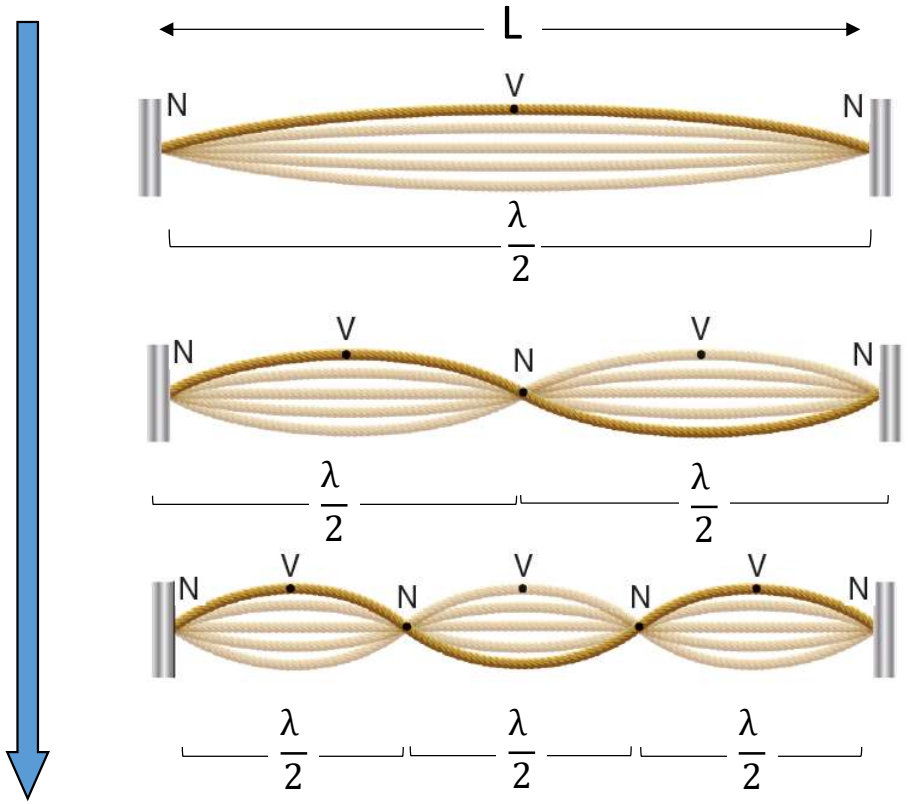
Densidade linear

$$\mu = \frac{m}{L}$$



4. Modos de vibração: duas extremidades fixas

n = 1, 2, 3, 4 ...



Primeiro harmônico (fundamental)

n = 1

$L = (1) \cdot \frac{\lambda_1}{2} \Rightarrow \lambda_1 = \frac{2L}{(1)}$

Segundo harmônico

n = 2

$L = (2) \cdot \frac{\lambda_2}{2} \Rightarrow \lambda_2 = \frac{2L}{(2)}$

Terceiro harmônico

n = 3

$L = (3) \cdot \frac{\lambda_3}{2} \Rightarrow \lambda_3 = \frac{2L}{(3)}$

$L = (n) \cdot \frac{\lambda_n}{2} \Rightarrow \lambda_n = \frac{2L}{(n)}$

f : aumenta
V: constante
λ: diminui

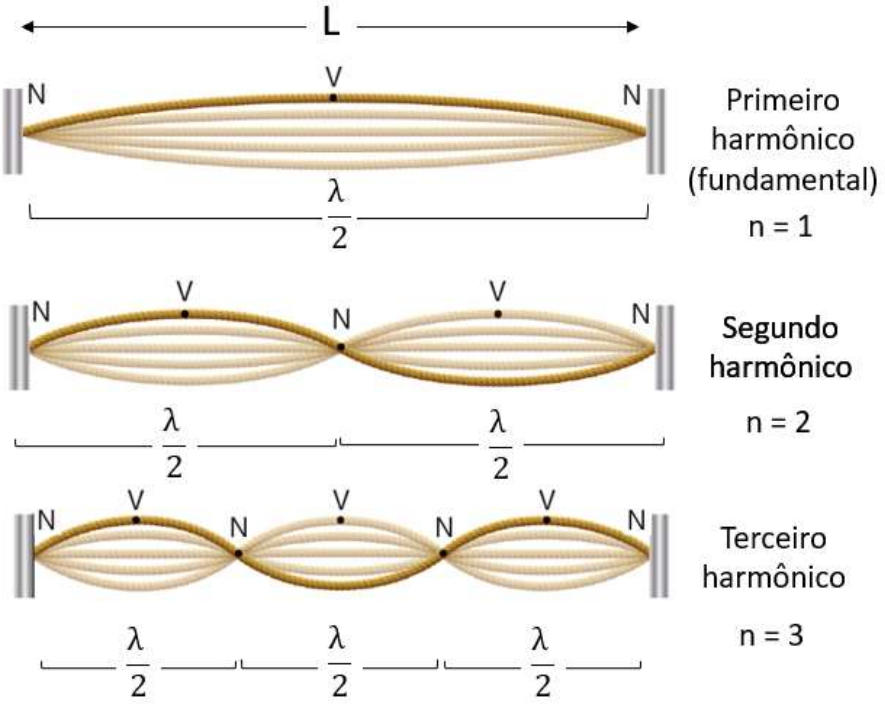
$\uparrow f_n = \frac{V_{cte}}{\lambda_n \downarrow}$

$\uparrow f_n = \uparrow(n) \underbrace{\frac{V}{2L}}_{\text{cte}}$

$f_n = \frac{V}{\lambda_n} \Rightarrow f_n = \frac{V}{\frac{2L}{(n)}} \Rightarrow f_n = (n)\frac{V}{2L}$

4. Modos de vibração: duas extremidades fixas

n = 1, 2, 3, 4 ...



$f_1 = (1)\frac{v}{2L}$

x 2

$f_2 = (2)\frac{v}{2L}$

x 3

$f_3 = (3)\frac{v}{2L}$

x n

$f_n = (n)\frac{v}{2L}$

$f_2 = (2)\, f_1$

$f_3 = (3)\, f_1$

$f_n = (n)\, f_1$

4. Modos de vibração: duas extremidades fixas

$$f = n \cdot \frac{1}{2L} \cdot \sqrt{\frac{T}{\mu}}$$

4. Modos de vibração – duas extremidades fixas

Primeiro harmônico (fundamental)

Segundo harmônico

Terceiro harmônico

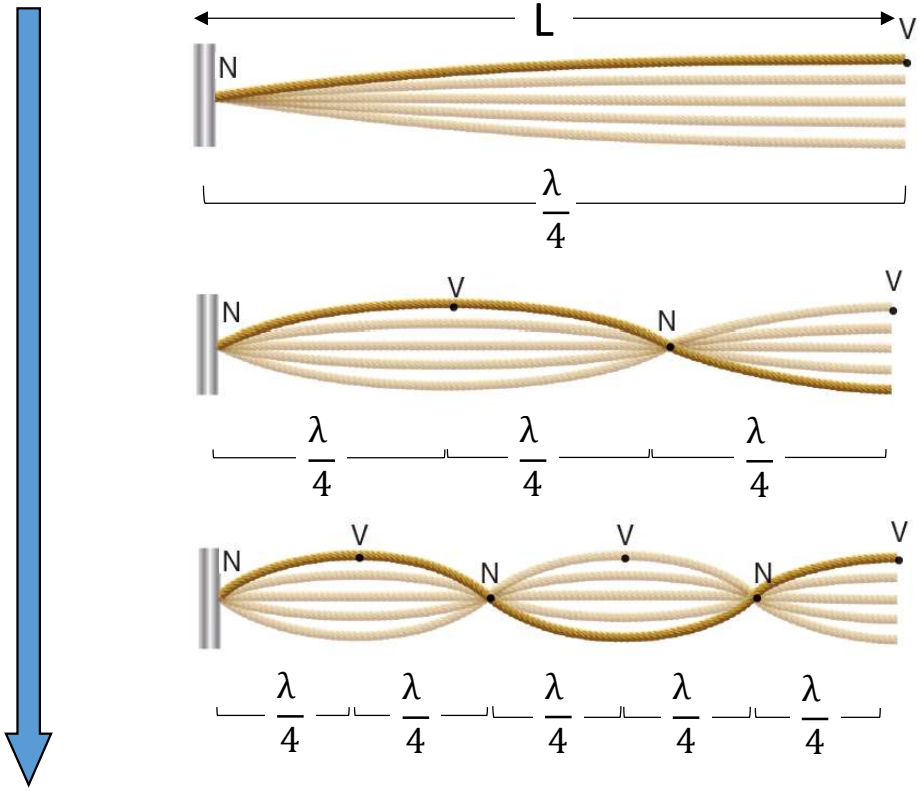
Quarto harmônico

Quinto harmônico

Sexto harmônico

5. Modos de vibração: uma extremidade livre

n = 1, 3, 5, 7 ... (ímpar)



Primeiro harmônico (fundamental)

n = 1

$L = (1) \cdot \frac{\lambda_1}{4} \Rightarrow \lambda_1 = \frac{4L}{(1)}$

Terceiro harmônico

n = 3

$L = (3) \cdot \frac{\lambda_3}{4} \Rightarrow \lambda_3 = \frac{4L}{(3)}$

Quinto harmônico

n = 5

$L = (5) \cdot \frac{\lambda_5}{4} \Rightarrow \lambda_5 = \frac{4L}{(5)}$

$L = (n) \cdot \frac{\lambda_n}{4} \Rightarrow \lambda_n = \frac{4L}{(n)}$

f : aumenta
V: constante
λ: diminui

$\uparrow f_n = \frac{V_{cte}}{\lambda_n \downarrow}$

cte

$\uparrow f_n = \uparrow (n) \frac{V}{4L}$

$f_n = \frac{V}{\lambda_n} \Rightarrow f_n = \frac{V}{\frac{4L}{(n)}} \Rightarrow f_n = (n) \frac{V}{4L}$