$$f(a,b) \qquad \cancel{f'}$$

$$\frac{\partial f(a,b)}{\partial a} \qquad \frac{\partial f(a,b)}{\partial b}$$

$$\frac{\partial^2 f(a,b)}{\partial a^2} \qquad \frac{\partial f(a,b)}{\partial b^2}$$

$$\frac{\partial^2 f(a,b)}{\partial a \partial b} \qquad \frac{\partial f(a,b)}{\partial b \partial a}$$

$$f'(x_0) = \lim_{\Delta x \to 0} \frac{f(x_1) - f(x_0)}{\Delta x}$$

$$\Delta x = x_1 - x_0$$

$\Delta x \to 0$ $\cancel{\lim}$

$$f'(x_0) = \frac{f(x_1) - f(x_0)}{\Delta x}$$

$$f'(x_i) = \frac{f(x_{i+1}) - f(x_i)}{\Delta x}$$

x_{i-1} x_i x_{i+1}

$$f(x_{i+1}) - f(x_i) =$$

$$f(x_i) - f(x_{i-1})$$

$$f'(x_i) = \frac{f(x_i) - f(x_{i-1})}{\Delta x}$$

$$f(a,b)$$

$$6'$$

$$\frac{\partial^2 f(a_i, b)}{\partial a^2} = \quad \frac{f(a_i)}{}$$

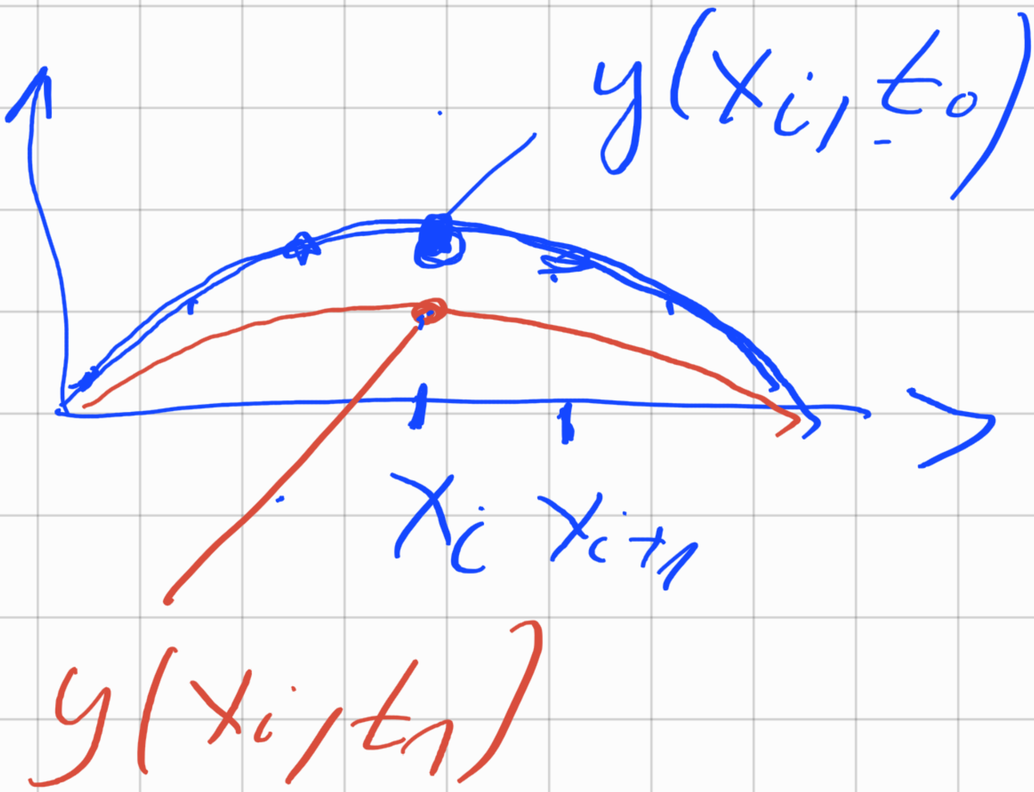
$$\frac{\partial}{\partial a}\left(\frac{\partial f(a_i,b)}{\partial a}\right) =$$

$$\frac{\partial}{\partial a}\left(\frac{f(a_{i+1},b)-f(a_i,b)}{\Delta a}\right) =$$

$$\frac{\dfrac{\partial f(a_{i+1},b)}{\partial a} - \dfrac{\partial f(a_i,b)}{\partial a}}{\Delta a}$$

$$\frac{\dfrac{f(a_{i+1},b)-f(a_i,b)}{\Delta a} - \dfrac{f(a_i,b)-f(a_{i-1},b)}{\Delta a}}{\Delta a} =$$

$$\frac{f(a_{i+1}, b) - 2f(a_i, b) + f(a_{i-1}, b)}{\Delta a^2}$$

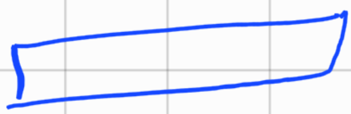


$$\frac{\partial y(x_i,t)}{\partial t} = v(x_i,t)$$

$$\frac{\partial^2 y(x_i,t)}{\partial t^2} = a(x_i,t)$$

a

$$\frac{\partial^2 y(x_i,t)}{\partial t^2} = w^2 \frac{\partial^2 y(x_i,t)}{\partial x^2}$$



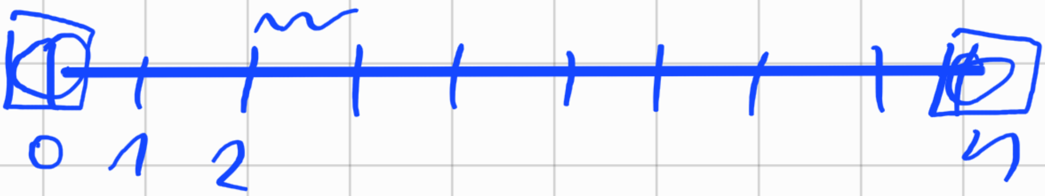
w – const

$w = 1 \frac{m}{s}$

$$\frac{\partial^2 f(x_i,t)}{\partial x^2} =$$

$$\frac{f(x_{i+1},t) - 2f(x_i,t) + f(x_{i-1},t)}{\Delta x}$$

$$\Delta x = \frac{L}{n}$$



$L \qquad n$

$y(x_0, t_0) = \ldots$

$y(x_1, t_0) = \ldots$

$$\ddot{y}(x_n, t_0) = \cdot \quad -$$

$$v(x_0, t_0) = 0$$

$$v(x_1, t_0) = \cdot \quad -$$

$$\dot{v}(x_n, t_0) = 0$$

$$a(x_0, t_0) = 0$$

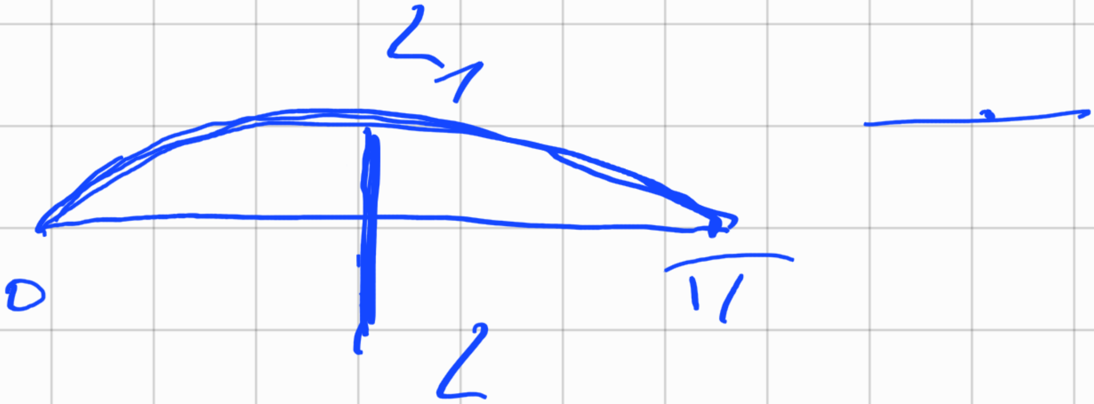
$$a(x_1, t_0) =$$

$$\frac{y(x_2, t_0) - 2y(x_1, t_0) + y(x_0, t_0)}{\Delta x^2}$$

$$y(x_i, t_1) = y(x_i, t_0) + v(x_i, t_0) \cdot \Delta t$$

$$v(x_i, t_1) = v(x_i, t_0) + a(x_i, t_0) \cdot \Delta t$$

$$a(x_i, t_1) = \ldots$$

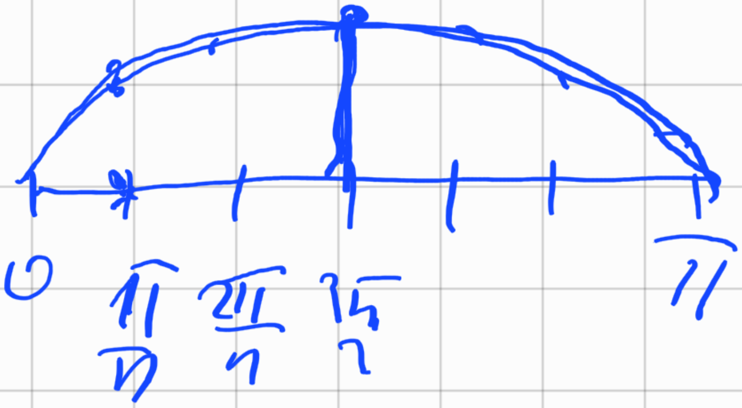


$$L_1 = L$$

$L = \pi$

$\Delta x = \frac{L}{n}$

n



$1 \; \pi$

$\Delta x = \frac{\pi}{n}$

$y(x_i, t_0)$ | 0 | | | | | | | 0 |

$v(x_i, t_0)$ | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |

$$E_k = \sum E_{k_i}$$

$$E_{k_i} = \frac{m_i V_i^2}{2}$$

$$W = 1 \frac{m}{s}$$

$$W = \sqrt{\frac{T}{\rho}} = 1$$

$$T = q = 1$$

$$m = \rho \cdot \overline{V}$$

$\rho = 1$ $\quad \bar{V} = \rho \cdot L$

$\bar{V} = L$

$$\frac{L}{n} = \Delta x$$

$\rho = 1$

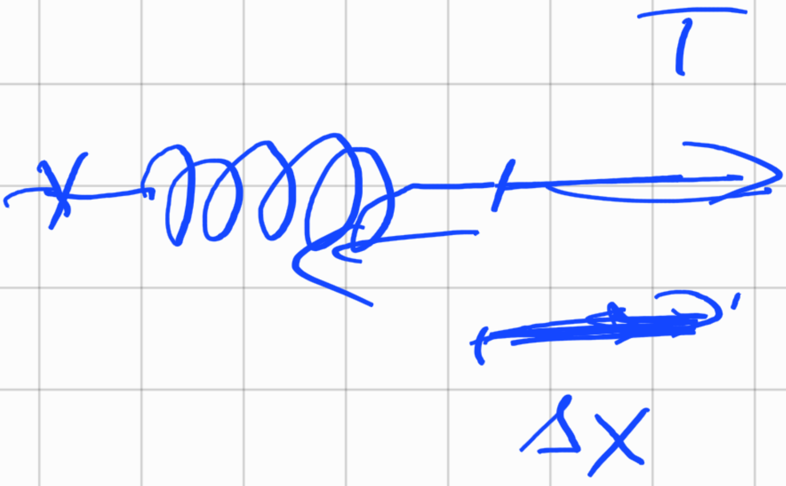
$m_i = \Delta x$

$$E_{k_i} = \frac{\Delta x \, v_i^2}{2}$$

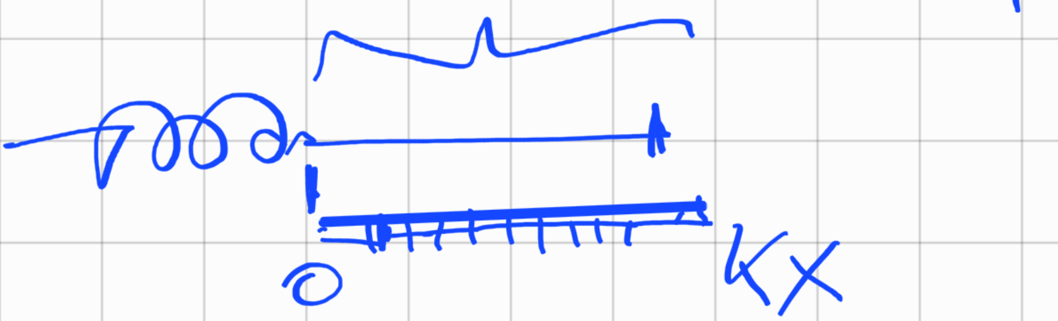
$$E_k = \sum_{i=0}^{n} \frac{\Delta x \, v_i^2}{2}$$

$$E_k = \frac{\Delta x}{2} \sum_{i=1}^{n} v_i^2$$

E_p



$$F = -k\Delta x$$

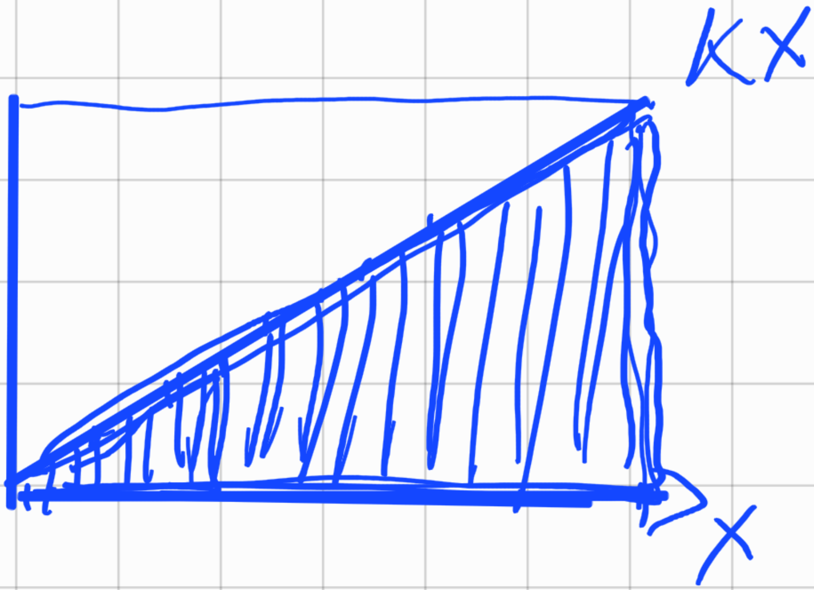


$$W = F_s \cdot \Delta x$$

$$F_s = \frac{0 + kx}{2}$$

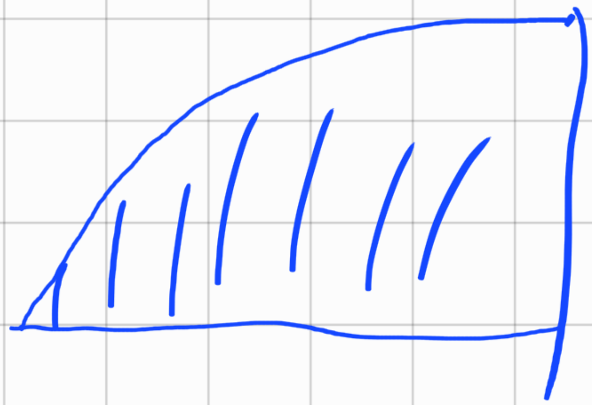
$\overline{R}$?

$$W = \frac{kx^2}{2}$$



$$\int kx\,dx$$

$$k \int x\,dx = k\frac{x^2}{2}$$



$$E_p = \frac{k \Delta y}{2}$$

$$T = k \Delta x$$

$$1 = k \Delta x \rightarrow k = \frac{1}{\Delta x}$$

$$E_{p_i} = \frac{1}{\Delta x} \cdot \frac{\Delta y_i^2}{2}$$

$$E_p = \sum_{i=0}^{n} \frac{\Delta y_i^2}{2\Delta x}$$

$$E_p = \frac{1}{2\Delta x} \sum_{i=0}^{n} \Delta y_i^2$$

$$\Delta y_i = y(x_i) - y(x_{i-1})$$