

$$1) \quad \mu \equiv \frac{\Delta m}{\Delta x}$$

$$(2) \quad y = f(x, t):$$

$$(3) \quad \frac{\Delta t}{t} \cdot \frac{\Delta x}{x} \cdot \frac{\Delta \theta}{\theta} \rightarrow 0$$

$$(4) \quad \lim_{x \rightarrow \infty} m = 0 = \lim_{x \rightarrow -\infty} m$$

$$(5) \quad \sum \Delta \vec{F} = \Delta m \vec{a}$$

$$\vec{T}_2 - \vec{T}_1 = \Delta m \vec{a}$$

$$T_{2x} - T_{1x} = \Delta m a_x$$

$$T_{2x} - T_{1x} = \Delta m a_x \rightarrow 0$$

$$T_{2x} = T_{1x}$$

$$T_{2y} - T_{1y} = \Delta m a_y$$

$$T_2 \sin \theta_2 - T_1 \sin \theta_1 = \Delta m a_y$$

$$T_2 \equiv \|\vec{T}_2\| = \|\vec{T}_1\| \equiv T_1$$

$$\text{Let } T \equiv T_2 = T_1$$

$$T(\sin \theta_2 - \sin \theta_1) = \Delta m a_y$$

$$\lim_{\Delta x \rightarrow 0} \left(\frac{\sin \theta}{\theta} \right) = 1$$

$$T(\sin \theta_2 - \sin \theta_1) = \Delta m a_y$$

$$T(\theta_2 - \theta_1) \approx \Delta m a_y$$

$$\lim_{\Delta x \rightarrow 0} \left(\frac{\tan \theta}{\theta} \right) \approx 1$$

$$\tau(\theta_2 - \theta_1) \approx \Delta m a_y$$

$$\tau(\tan \theta_2 - \tan \theta_1) \approx \Delta m a_y$$

$$\tau \left(\frac{\sin \theta_2}{\cos \theta_2} - \frac{\sin \theta_1}{\cos \theta_1} \right) \approx \Delta m a_y$$

$$\tau \left(\frac{L \sin \theta_2}{L \cos \theta_2} - \frac{L \sin \theta_1}{L \cos \theta_1} \right) \approx \Delta m a_y$$

$$\tau \left(\frac{L \sin \theta_2}{L \cos \theta_2} - \frac{L \sin \theta_1}{L \cos \theta_1} \right) \approx \mu \Delta x a_y$$

$$\tau \left(\left. \frac{\Delta y}{\Delta x} \right|_{x+\Delta x} - \left. \frac{\Delta y}{\Delta x} \right|_x \right) \approx \mu \Delta x a_y$$

$$\tau \left(\left. \frac{dy}{dx} \right|_{x+\Delta x} - \left. \frac{dy}{dx} \right|_x \right) \approx \mu \Delta x a_y$$

$$\tau \left(\left. \frac{dy}{dx} \right|_{x+\Delta x} - \left. \frac{dy}{dx} \right|_x \right) \approx \mu \Delta x \frac{d^2 y}{dt^2}$$

$$\frac{\tau \left(\left. \frac{dy}{dx} \right|_{x+\Delta x} - \left. \frac{dy}{dx} \right|_x \right)}{\Delta x} \approx \frac{\mu \Delta x}{\tau} \frac{d^2 y}{dt^2}$$

$$\frac{\left. \frac{dy}{dx} \right|_{x+\Delta x} - \left. \frac{dy}{dx} \right|_x}{\Delta x} \approx \frac{\mu}{\tau} \frac{d^2 y}{dt^2}$$

$$\frac{\left. \frac{dy}{dx} \right|_{x+\Delta x} - \left. \frac{dy}{dx} \right|_x}{\Delta x} \approx \left(\frac{\mu}{\tau} \right) \frac{d^2 y}{dt^2}$$

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$$\frac{\left. \frac{dy}{dx} \right|_{x+\Delta x} - \left. \frac{dy}{dx} \right|_x}{\Delta x} \approx \left(\frac{\mu}{\tau} \right) \frac{d^2 y}{dt^2}$$

$$\text{Let } y' \equiv f(x) \equiv \frac{dy}{dx}$$

$$\frac{f(x + \Delta x) - f(x)}{\Delta x} \approx \left(\frac{\mu}{\tau} \right) \frac{d^2 y}{dt^2}$$

$$\lim_{\Delta x \rightarrow 0} \left[\frac{f(x + \Delta x) - f(x)}{\Delta x} \right] = \lim_{\Delta x \rightarrow 0} \left[\left(\frac{\mu}{\tau} \right) \frac{d^2 y}{dt^2} \right]$$

$$\dots \frac{d}{dx} (f(x)) = \left(\frac{\mu}{\tau} \right) \frac{d^2 y}{dt^2}$$

$$\frac{d}{dx} y' = \left(\frac{\mu}{\tau} \right) \frac{d^2 y}{dt^2}$$

$$\frac{dy'}{dx} = \left(\frac{\mu}{\tau} \right) \frac{d^2 y}{dt^2}$$

$$y' \equiv \frac{dy}{dx}$$

$$\left(\frac{d^2 y}{dx^2} \right) = \left(\frac{\mu}{\tau} \right) \frac{d^2 y}{dt^2}$$

$$\frac{\partial^2 y}{\partial x^2} = \left(\frac{\mu}{\tau} \right) \frac{\partial^2 y}{\partial t^2}$$

$$\boxed{\frac{\partial^2 y}{\partial t^2} = \left(\frac{\tau}{\mu} \right) \frac{\partial^2 y}{\partial x^2}}$$