$kg := 1 \quad m := 1 \quad s := 1 \quad Hz := \frac{1}{s} \quad g := 9.807 \cdot \frac{m}{s^2} \quad t_e := 10 \cdot s$

$x_0 := 50 \cdot m \quad \lambda := 2 \cdot \frac{0.03064734}{m} \quad m_k := 1 \cdot kg \quad y_0 := \lambda \cdot x_0^{\,2} \quad \mu := 0.1 \quad t_e := 5 \cdot s$

$\delta_1 := 1.29 \cdot \frac{kg}{m^3} \quad c_w := 0.12 \quad d := 0.6 \cdot m \quad A_k := \frac{\pi}{4} \cdot d^2 \quad k := \frac{\delta_1}{2} \cdot c_w \cdot A_k$

Original equations with extra conditons disabled:

Given

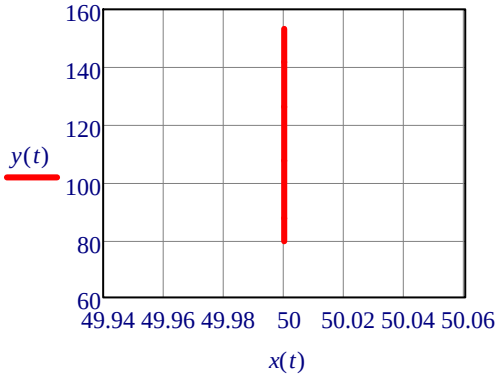
$y'(t) = 2 \cdot \lambda \cdot x(t) \cdot x'(t)$ DISABLED

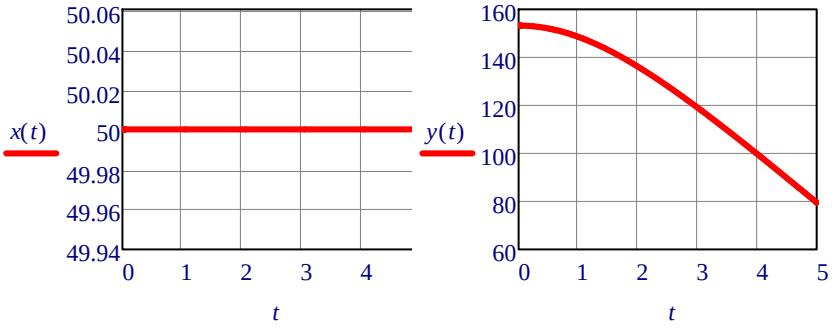
$$x''(t) + x'(t) \cdot \frac{k}{m_k} \cdot \sqrt{x'(t)^2 + y'(t)^2} + \mu \cdot \left[\frac{x'(t) \cdot g}{\sqrt{4 \cdot x(t)^2 \cdot \lambda^2 + 1} \cdot \sqrt{x'(t)^2 + y'(t)^2}} + 2 \cdot x'(t) \cdot \lambda \cdot \frac{\sqrt{x'(t)^2 + y'(t)^2}}{\sqrt{\left(4 \cdot x(t)^2 \cdot \lambda^2 + 1\right)^3}} \right] = 0$$

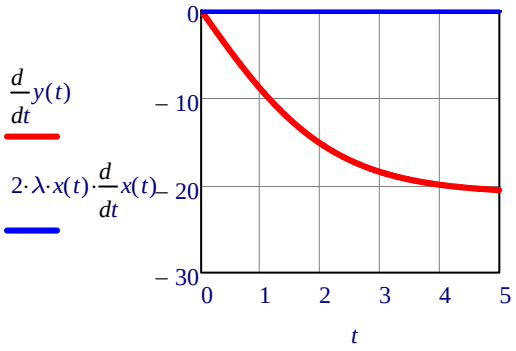
$$y''(t) + g + y'(t) \cdot \frac{k}{m_k} \cdot \sqrt{x'(t)^2 + y'(t)^2} + \mu \cdot \left[\frac{y'(t) \cdot g}{\sqrt{4 \cdot x(t)^2 \cdot \lambda^2 + 1} \cdot \sqrt{x'(t)^2 + y'(t)^2}} + 2 \cdot y'(t) \cdot \lambda \cdot \frac{\sqrt{x'(t)^2 + y'(t)^2}}{\sqrt{\left(4 \cdot x(t)^2 \cdot \lambda^2 + 1\right)^3}} \right] = 0$$

$x(0) = x_0 \quad x'(0) = 0 \quad y(0) = y_0 \quad y'(0) = 0 \quad x''(0) = 0$ DISABLED

$$\begin{pmatrix} x \\ y \end{pmatrix} := Odesolve\left[\begin{pmatrix} x \\ y \end{pmatrix}, t, t_e\right]$$







$y'(t) = 2 \cdot \lambda \cdot x(t) \cdot x'(t)$

condition not fulfilled

y'(t) substituted (like F.M. did):

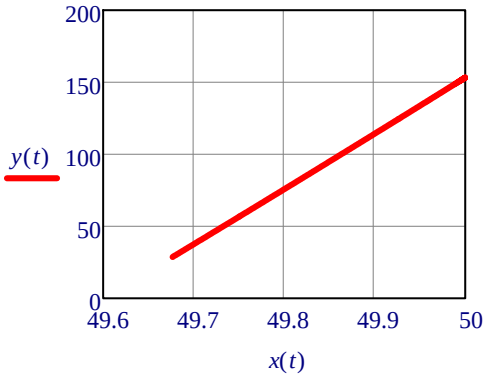
Given

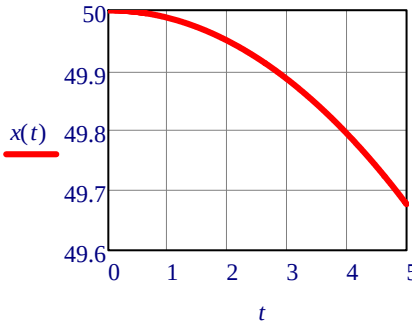
$$x''(t) + x'(t)^2 \cdot \frac{k}{m_k} \cdot \sqrt{1 + 4\lambda^2 x(t)^2} + \frac{\mu \cdot \left(g + 2 \cdot \lambda \cdot x'(t)^2\right)}{4 \cdot \lambda^2 \cdot x(t)^2 + 1} = 0$$

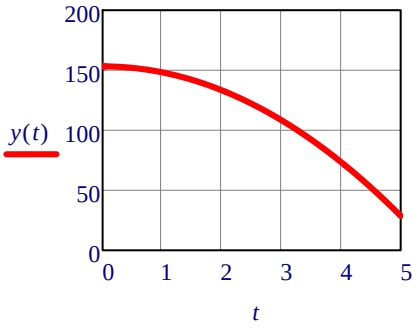
$$y''(t) + g + 2 \cdot \lambda \cdot x(t) \cdot x'(t)^2 \cdot \frac{k}{m_k} \cdot \sqrt{1 + 4\lambda^2 x(t)^2} + \frac{2\mu \cdot \lambda \cdot x(t) \cdot \left(g + 2 \cdot \lambda \cdot x'(t)^2\right)}{1 + 4\lambda^2 x(t)^2} = 0$$

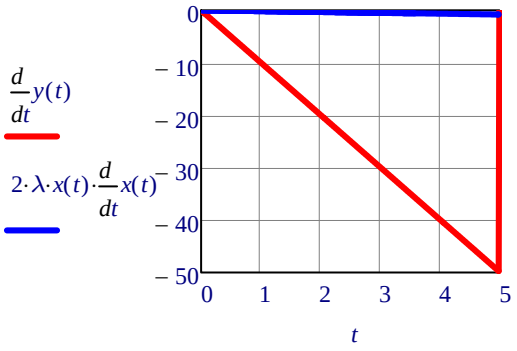
$x(0) = x_0 \qquad x'(0) = 0 \qquad y(0) = y_0 \qquad y'(0) = 0$

$\begin{pmatrix} x \\ y \end{pmatrix} := Odesolve\left[\begin{pmatrix} x \\ y \end{pmatrix}, t, t_e, 10^4\right]$ $\qquad t := 0s, 0.01s .. t_e \qquad t_e = 5 \cdot s$









$y'(t) = 2 \cdot \lambda \cdot x(t) \cdot x'(t)$

condition not fulfilled