Experimento 1 · Determinação da constante de mola K

$$K = (K_a \pm \Delta K)\ \frac{N}{m} \quad \text{- objetivo}$$

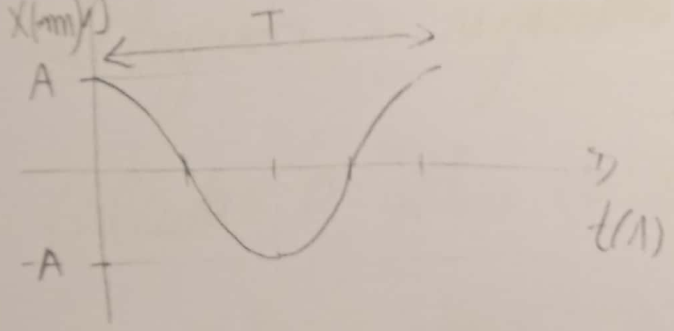
Força da mola $F = -KX = m\dfrac{d^2x}{dt^2}$

$$\frac{d^2x}{dt^2} = -\frac{K}{m}X = -\omega^2 X \quad \text{- EDO}$$

$$\omega = \sqrt{\frac{K}{m}} = 2\pi f = \frac{2\pi}{T}$$

Solução da E.D.O

$$X(t) = A\cos(\omega t + \delta)$$



T - período de 1 oscilação

$$\omega = \sqrt{\frac{K}{m}} = \frac{2\pi}{T}$$

$$\boxed{T = \frac{2\pi}{\sqrt{K}}\sqrt{m}}$$ não é linear

N	m	T_{10}	T_1
1			
2			
⋮			

Linearização do Período $\quad T = \frac{2\pi}{\sqrt{K}} \sqrt{m} = \frac{2\pi}{\sqrt{K}} m^{1/2}$

Supor o período $T = p\, m^{n}$ e tomar o $\log_{10}$

$$T = p\, m^{n} \qquad \log T = \log p + n \log m$$

$$T = \frac{2\pi}{\sqrt{K}} \cdot m^{1/2} \qquad \log T = \log \frac{2\pi}{\sqrt{K}} + \frac{1}{2} \log m$$

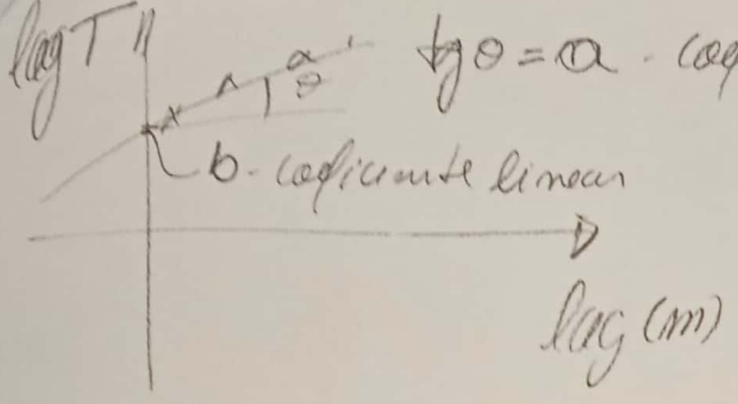
$$y = b + a\, x$$

Calcular os coeficientes linear (b) e angular (a) da reta $\log T = \log p + n \log m$ utilizando a regressão linear

Calcular o valor de K_a

$$10^{b} = 10^{\log p} = 10^{\log \frac{2\pi}{\sqrt{K_a}}} = \frac{2\pi}{\sqrt{K_a}}$$

$$\sqrt{K_a} = \frac{2\pi}{10^{b}} \quad \therefore \quad K_a = \left(\frac{2\pi}{10^{b}}\right)^{2}$$



Calcular o valor de ΔK

Lembrando: $V = f(a, b, c, \ldots h)$,

$\sigma_a, \sigma_b, \sigma_c, \ldots \sigma_h$ - Desvios padrão de $(a, b, c,$

$$\sigma_V^2 = \left(\frac{\partial V}{\partial a}\right)^2 \cdot \sigma_a^2 + \left(\frac{\partial V}{\partial b}\right)^2 \sigma_b^2 + \cdots + \left(\frac{\partial V}{\partial h}\right)^2 \sigma_h^2$$

$\frac{\partial V}{\partial a}$ - derivada parcial de V em relação à grandeza a

$$\frac{\sigma_x}{\sqrt{n}} = \Delta x$$

para $K = \frac{(2\pi)^2}{T^2} \cdot m$ temos:

$$\Delta K^2 = \left(\frac{\partial K}{\partial m}\right)^2 \Delta m^2 + \left(\frac{\partial K}{\partial T}\right)^2 \cdot \Delta T^2$$

$$\Delta K^2 = \left[\frac{\partial K}{\partial m}\right]^2 \Delta m^2 + \left(\frac{\partial K}{\partial T}\right)^2 . \Delta T^2$$

$$\Delta K^2 = \left[\left(\frac{2\pi}{T}\right)^2\right]^2 . \Delta m^2 + \left(\frac{-2(2\pi)^2 . m}{T^3}\right)^2 . \Delta T^2$$

$$\frac{\Delta K^2}{K^2} = \frac{\left[\left(\frac{2\pi}{T}\right)^2\right]^2 . \Delta m^2}{\left[\left(\frac{2\pi}{T}\right)^2\right]^2 m^2} + \frac{\left(\frac{2(2\pi)^2}{T^3} . m\right)^2 . \Delta T^2}{\left[\left(\frac{2\pi}{T}\right)^2 m\right]^2}$$

$$\frac{\Delta K^2}{K^2} = \left(\frac{\Delta m}{m}\right)^2 + \left(\frac{2\Delta T}{T}\right)^2$$

$$\Delta K = \pm\sqrt{\left[\left(\frac{\Delta m}{m}\right)^2 + \left(\frac{2\Delta T}{T}\right)^2\right] K_g^2}$$

Tabela 1

$\Delta m = 0{,}0005$ kg
$\Delta T = 0{,}0005$ s

				X	Y	Y.X	X^2
N	m (kg)	T_{10} (s)	T_1 (s)	log m	log T_1	log m log T_1	log m log m
1							
2							
3							
⋮							