$$Alcance = \frac{|v_0|^2 . sen(2\theta)}{g}$$

$$\theta = tan^{-1}\left(\frac{v_y}{v_x}\right)$$

$$T = \frac{2.|v_0|. sen(\theta)}{g}$$

$$F_g = G\frac{m_T . m}{r^2}$$

$$F(x) = \frac{\mathrm{d}E_p}{\mathrm{d}x}$$

$$Fa_{estatico} = N \cdot \mu_{estatico}$$

$$Fa_{cinetico} = N. \mu_{cinetico}$$

Num plano inclinado:

$$\mu_s = tg\theta$$

Sistema com uma roldana e dois corpos

$$\mu_s = \frac{m_2}{m_1}$$

$$I = \Delta p = F. \Delta t = m. v_f - m. v_i$$

$$F = \frac{\mathrm{d}p}{\mathrm{d}t}$$

$$I = \int_{t_i}^{t_f} F(t)dt$$

$$p = m. v \;\; \Delta p = F. \Delta t$$

Momento das forças(torque)

$$\tau = F \cdot d$$

$$\tau = |r|. |F|. \; sen(r, F)$$

Momento de uma força tangencial a trajetória circular

$$\tau = I. \alpha$$

$$\alpha = aceleração\, da\, massa$$

Momento de inércia

$$I = m. r^2$$

momento angular

$$l = m. r. v$$

$$|v| = \frac{2\pi. r}{T} = w. r$$

$$w = \frac{2\pi}{T} = 2\pi. f$$

$$a = w^2. r = w. v = \frac{v^2}{r}$$

$$a_n = \frac{v^2}{r}$$

$$a_t = \frac{\mathrm{d}|v|}{\mathrm{d}t}$$

Dois corpos colidem na horizontal:

$$v_1' = \frac{m_1 - m_2}{m_1 + m_2}. v_1 + \frac{2m_2}{m_1 + m_2}. v_2$$

$$v_2' = \frac{2m_1}{m_1 + m_2}. v_1 + \frac{2m_2}{m_1 + m_2}. v_2$$

$$W = \int_{x_i}^{x_f} F(x)dx$$

$$W = F. d. \cos\theta$$

$$W = \Delta E_c$$

$$W = -\Delta E_p$$

$$x_{CM} = \frac{m_1 \cdot x_1 + m_2 \cdot x_2 + \cdots + m_N \cdot x_N}{m_1 + m_2 + \cdots + m_N}.$$

$$\vec{r}_{CM} = x_{CM}\,\vec{e}_1 + y_{CM}\,\vec{e}_2 + z_{CM}\,\vec{e}_3$$

$$x_{CM} = \frac{1}{M}\int x\, dm$$

$$a_T = |\vec{\alpha} \wedge \vec{r}| = |\vec{\alpha}| \cdot |\vec{r}| \cdot sen(\vec{\alpha}, \vec{r}) = \alpha \cdot R$$

$$a_c = |\vec{\omega} \wedge \vec{v}| = |\vec{\omega}| \cdot |\vec{v}| \cdot sen(\vec{\omega}, \vec{v}) = \omega \cdot v$$

Completando a analogia cinemática linear e rotação de CR:

Cinemática de uma partícula		Rotação de um CR	
Posição	x	Ângulo	θ
Velocidade	v_x	Velocidade angular	ω_z
Aceleração	a_x	Aceleração angular	α_z
Massa	m	Momento de inércia	I
Energia cinética	$\frac{1}{2}mv_x^2$	Energia cinética	$\frac{1}{2}I\omega_z^2$
Força	F_x	Torque	τ_z
2a. Lei	$\sum F_{x,ext} = ma_x$	2a. Lei	$\sum \tau_{z,ext} = I\alpha_z$
Trabalho	$dW = F_x dx$	Trabalho	$dW = \tau_z d\theta$
Potência	$P = F_x v_x$	Potência	$P = \tau_z \omega_z$
Momento linear	$\vec{p} = m\vec{v}$	Momento angular	$\vec{L} = I\vec{\omega}$
2a. Lei	$\vec{F} = \frac{d\vec{p}}{dt}$	2a. Lei	$\vec{\tau} = \frac{d\vec{L}}{dt}$

MHS

$$F_s = -k \cdot x$$
$$F_s = m \cdot a = -k \cdot x$$
$$\frac{d^2x}{dt^2} = -\frac{k}{m} \cdot x$$

$$x(t) = A \cdot cos\left(\frac{2\pi}{T} \cdot t\right)$$
$$x(t) = A \cdot sen\left(\frac{2\pi}{T} \cdot t\right)$$

K- Constante de elasticidade

$$v = \frac{dx}{dt} = \frac{d}{dt}\left(A \cdot sen\left(\frac{2\pi}{T} \cdot t\right)\right) = A \cdot \frac{2\pi}{T} \cdot cos\left(\frac{2\pi}{T} \cdot t\right)$$

$$a = \frac{dv}{dt} = \frac{d}{dt}\left(A \cdot \frac{2\pi}{T} \cdot cos\left(\frac{2\pi}{T} \cdot t\right)\right)$$

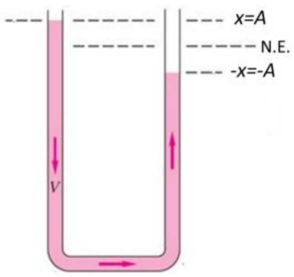
$$\frac{d^2x}{dt^2} = -\frac{4\pi^2}{T^2} \cdot x$$
$$\frac{d^2x}{dt^2} = -\frac{k}{m} \cdot x$$

$$-\frac{4\pi^2}{T^2} \cdot x = -\frac{k}{m} \cdot x$$

$$T = 2\pi \cdot \sqrt{\frac{m}{k}}.$$

$$\omega = \sqrt{\frac{k}{m}} \qquad \frac{d^2x}{dt^2} = -\frac{k}{m} \cdot x \qquad \frac{d^2x}{dt^2} = -\omega^2 \cdot x$$

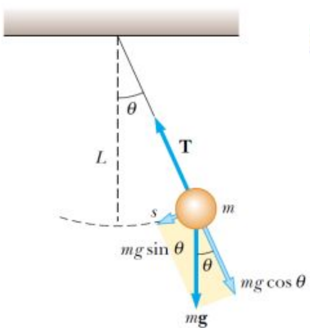
Ex:



$$F_r = -g \cdot 2x \cdot A \cdot \rho$$
$$-g \cdot 2x \cdot A \cdot \rho = m_t \cdot a$$
$$\frac{d^2x}{dt^2} = -\frac{2g}{L} \cdot x$$
$$\omega = \sqrt{2g/L}.$$

$$\omega^2 = \frac{2g}{L} = \left(\frac{2\pi}{T}\right)^2$$
$$T = 2\pi \cdot \sqrt{\frac{L}{2g}}$$
$$x(t) = A \cdot cos(\omega \cdot t) = A \cdot cos\left(\sqrt{\frac{2g}{L}} \cdot t\right)$$

Ex:



$$T = mg \cdot cos\theta$$
$$F = -mg \cdot sen\theta$$
$$F = m \cdot a = m \cdot \frac{d^2s}{dt^2} = -mg \cdot sen\theta$$
$$\frac{d^2s}{dt^2} = L \cdot \frac{d^2\theta}{dt^2}$$
$$m \cdot L \cdot \frac{d^2\theta}{dt^2} = -mg \cdot sen\theta$$

$$\frac{d^2\theta}{dt^2} = -\frac{g}{L} \cdot \theta$$
$$\theta(t) = \theta_0 \cdot cos(\omega \cdot t + \varphi)$$
$$\omega^2 = \frac{g}{L} = \left(\frac{2\pi}{T}\right)^2$$
$$T = 2\pi \cdot \sqrt{\frac{L}{g}}.$$

MHS com atrito

$$R = -b \cdot v = -b \cdot \frac{dx}{dt}$$

$$\sum F.Apl. = m \cdot a = m \cdot \frac{d^2x}{dt^2} = -k \cdot x - b \cdot \frac{dx}{dt}$$

$$x(t) = A \cdot e^{\left(-\frac{b}{2m} \cdot t\right)} \cdot cos(\omega t + \varphi)$$

$$x(t) = A \cdot e^{(-\lambda \cdot t)} \cdot cos(\omega t + \varphi)$$

λ-Coeficiente de amortecimento

$$\omega = \sqrt{\frac{k}{m} - \left(\frac{b}{2m}\right)^2} = \sqrt{\frac{k}{m} - (\lambda)^2}$$

$$x(t) = A \cdot cos(\omega \cdot t + \varphi) = A \cdot cos(\omega_0 \cdot t + \varphi)$$

$$\omega = \omega_0 = \sqrt{\frac{k}{m}}$$

$$\omega = \sqrt{{\omega_0}^2 - \left(\frac{b}{2m}\right)^2} \quad \omega = \sqrt{{\omega_0}^2 - (\lambda)^2}$$

$$F = F_0 \cdot \cos \omega t$$

$$\sum F.Apl. = m \cdot \frac{d^2x}{dt^2} = -b \cdot \frac{dx}{dt} - k \cdot x + F_0 \cdot \cos \omega t$$

$$x(t) = A \cdot cos(\omega \cdot t + \varphi)$$

$$A = \frac{F_0/m}{\sqrt{(\omega^2 - {\omega_0}^2)^2 + \left(\frac{b\omega}{m}\right)^2}}$$

$$E = E_C + E_P = \frac{1}{2} \cdot m \cdot v^2 + \frac{1}{2} \cdot k \cdot x^2$$

$$\frac{dE}{dt} = \frac{d}{dt}\left(\frac{1}{2} \cdot m \cdot v^2 + \frac{1}{2} \cdot k \cdot x^2\right)$$

$$= m \cdot v \cdot \frac{d^2x}{dt^2} + k \cdot x \cdot v$$

$$= v \cdot \left(-k \cdot x - b \cdot \frac{dx}{dt}\right) + k \cdot x \cdot v$$

$$= -v \cdot k \cdot x - bv^2 + k \cdot x \cdot v = -bv^2$$

$$y(x,t) = A \cdot sen\left(\frac{2\pi}{\lambda} \cdot (x - v \cdot t)\right)$$

$$y(x,t) = A \cdot sen\left(\frac{2\pi}{\lambda} \cdot (x + v \cdot t)\right)$$

$$v = \frac{\lambda}{T}$$

$$T = \frac{1}{f}$$

$v = \lambda \cdot f$ ou $\lambda = v \cdot T$

$$\begin{aligned} y(x,t) &= A \cdot sen\left(2\pi \cdot \left(\frac{x}{\lambda} - \frac{v \cdot t}{\lambda}\right)\right) \\ &= A \cdot sen\left(2\pi \cdot \left(\frac{x}{\lambda} - \frac{t}{T}\right)\right). \end{aligned}$$

$$y(x,t) = A \cdot sen(k \cdot x - \omega \cdot t)$$

$$y(x,t) = A \cdot sen(k \cdot x - \omega \cdot t - \varphi)$$

$$y(x,t) = f(x \pm v \cdot t)$$