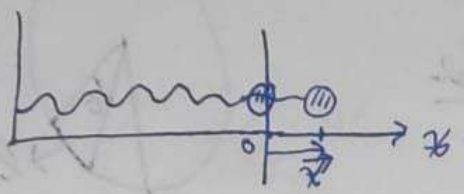
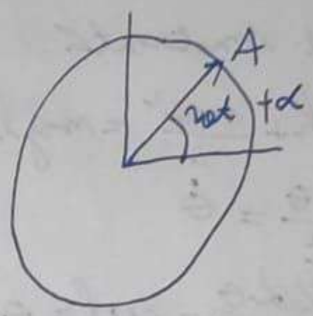
Curs Fizică 2





$$x(t) = A\cos(\omega t + \alpha)$$

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

$\vec{x} = x \cdot \vec{i}$ → versor
→ componenta scalar

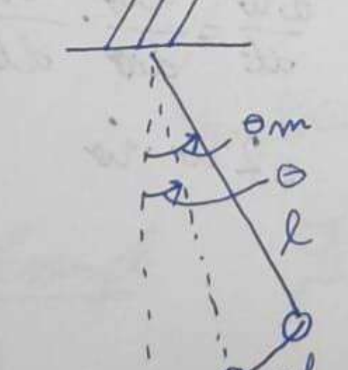
$$a_x = \boxed{\ddot{x} = -\omega^2 \cdot x}$$

$$\frac{d^2 x}{(dt)^2} \rightarrow x''(t)$$

Pendulul matematic este o problemă ideală:

- corp punctiform
- fir ideal (fără masă, inextensibil)

Pendulul matematic — θ - teta



θ_m - unghi maxim

θ - unghi

l - lungime

$g = |\vec{g}|$

$T = ?$

$\ddot{\theta} + \omega^2 \theta = 0\ ?$

$T = \frac{2\pi}{\omega}$

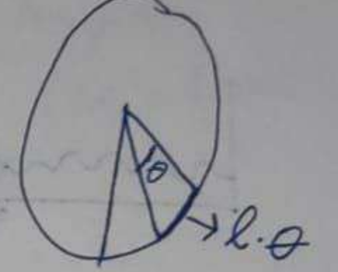
I Varianta Dinamică:

$$\vec{T} + \vec{G} = m \cdot \vec{a}$$

(II) Valianta. ~~Dinamica~~ Energetică:

energia e constantă

$$E = mgh + \frac{mv^2}{2} = mgl(1-\cos\theta) + \frac{mv^2}{2}$$



$$\omega = \frac{d\theta}{dt} = \dot{\theta}$$

$$v = \frac{l\, d\theta}{dt} = \omega l = \theta \cdot l$$

$$E = mgl(1-\cos\theta) + \frac{m}{2}\omega^2 l^2$$

$$E = ct \Rightarrow \dot{E} = 0$$

$$\dot{E} = \cancel{m}g\cancel{l}(0 + \cancel{\omega}\sin\theta) + \frac{\cancel{m}}{\cancel{2}} l^{\cancel{2}}\cancel{2}\cancel{\omega}\cdot\dot{\omega} = 0$$

$$\frac{g}{l}\sin\theta + \dot{\omega} = 0$$

$$\frac{g}{l}\sin\theta + \ddot{\theta} = 0$$

$$\boxed{\ddot{\theta} + \frac{g}{l}\sin\theta = 0}$$

$$\frac{g}{l} = \omega^2$$

$$\ddot{\theta} + \omega^2 \sin\theta = 0$$

$$\theta \in (0, 6^\circ) \Rightarrow \ddot{\theta} + \frac{g}{l}\theta = 0$$

$$T = \frac{2\pi}{\omega} = \frac{2\pi}{\sqrt{\frac{g}{l}}} = 2\pi\sqrt{\frac{l}{g}}$$

$$f(x) = f[u(x)]\,;\ f(x) = \sin x^2$$

$$= \sin[\underbrace{u(x)}_{x^2}] = f([u(x)])$$

$$\frac{df(x)}{dx} = \frac{d f(u)}{du} \cdot \frac{du(x)}{dx}$$

$$\cos\theta = \cos(t) = \cos[\theta(t)]$$

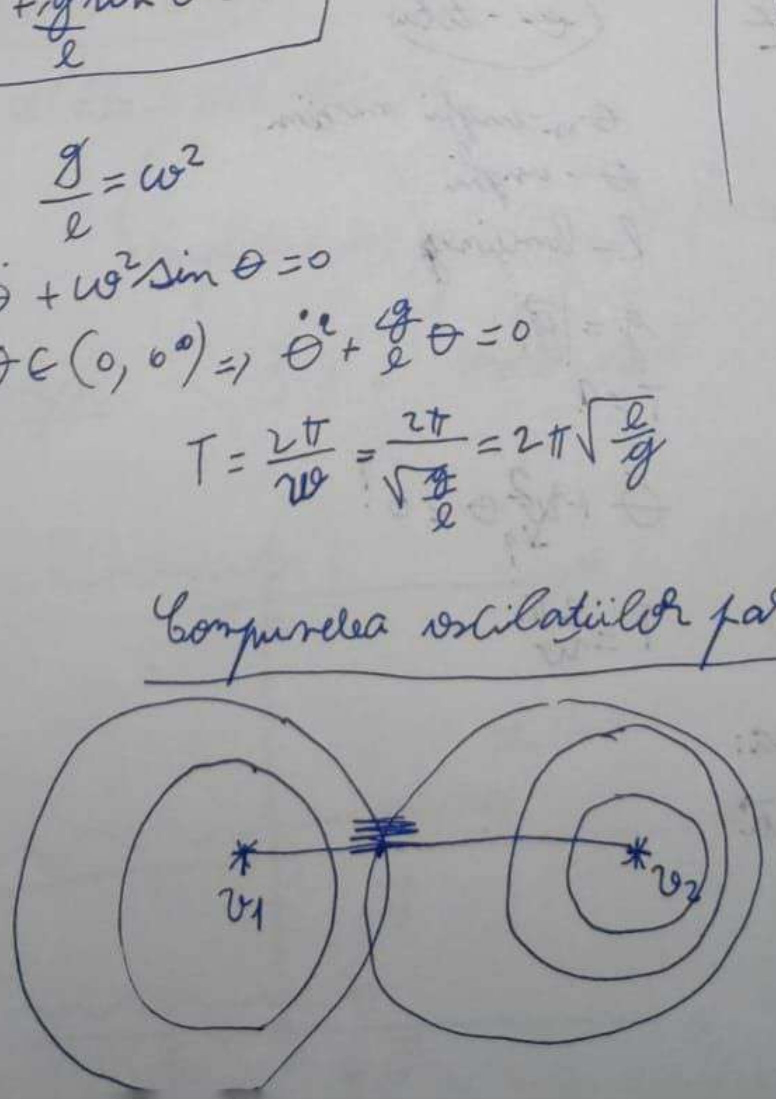
$$\frac{d\cos\theta}{dt} = \frac{d\cos\theta}{dt} \cdot \frac{d\theta}{dt} =$$

$$= -\sin\theta \cdot \dot{\theta} = -\omega \sin\theta$$

$$\frac{d\omega^2}{dt} = \frac{d\omega^2}{d\omega} \cdot \frac{d\omega}{dt} =$$

$$= 2\omega \cdot \dot{\omega}$$

Compunerea oscilațiilor paralele

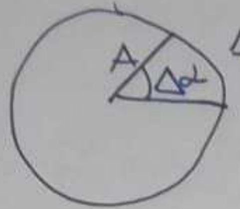


Este $v = \omega A$?

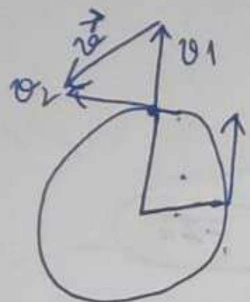
l - lungime

$[\Delta\alpha] = 1\,rad$

$$v_m = \frac{\Delta l}{\Delta t} = \frac{A\Delta\alpha}{\Delta t} \to \omega$$



$\Rightarrow v = \omega A$ $\Rightarrow$ în loc de geometrie vectorială, putem să calculăm derivând.



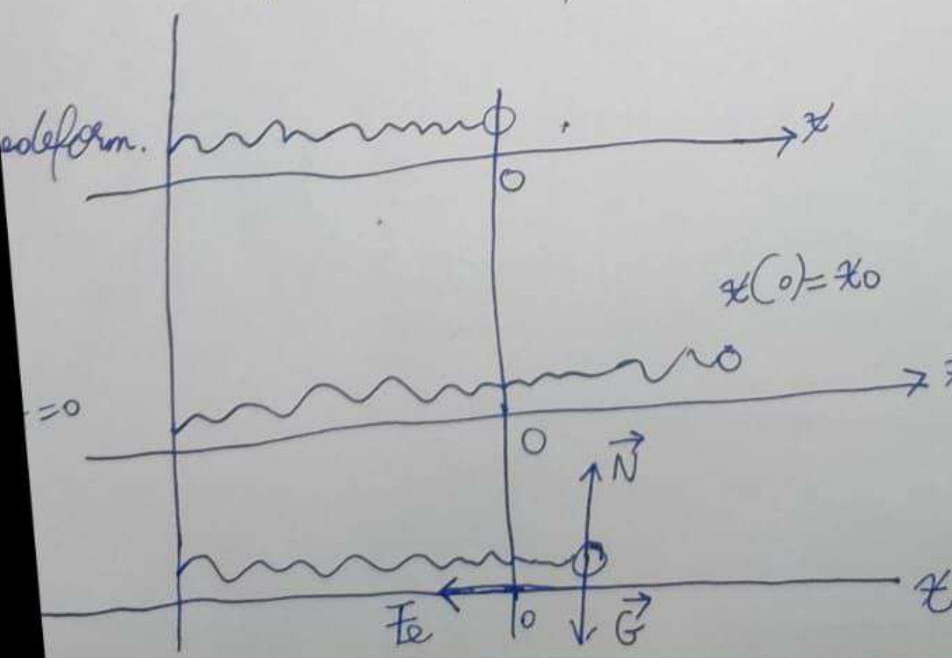
$$\vec{a} = \frac{\Delta\vec{v}}{\Delta t}\Big|_{\Delta t\to 0} = \frac{\vec{v_2}-\vec{v_1}}{\Delta t}\Big|_{\Delta t \to 0}$$

$\boxed{a = -\omega^2 x}$ - def mișcării OLA

$$x(t) = \underbrace{A}_{\text{amplitudinea}} \cos(\underbrace{\omega}_{\text{pulsație}} t + \underbrace{\varphi_0}_{\text{faza inițială}})$$

Exemple $\nexists$ f.f ; resort ideal

k - constantă elasticitate



$$\underbrace{\vec{N}+\vec{G}}_{0} + \vec{F_e} = m\vec{a}$$

$$\vec{F_e} = m\vec{a}$$

$$\vec{F_e} = -k\vec{x}$$

$$m\vec{a} = -k\vec{x}$$

$$\vec{x} = x\vec{i}$$

$$\boxed{\vec{a} = \ddot{\vec{x}}} \Rightarrow \vec{a} = \ddot{\vec{x}} = \frac{d^2(x\vec{i})}{dt^2} = \frac{d}{dt}\left[\frac{d}{dt}(x\vec{i})\right] = \vec{i}\,\frac{d^2x}{dt^2} = \vec{i}\cdot\ddot{x}$$

$$m\ddot{x}\vec{i} = -kx\vec{i}$$

$$\ddot{x} + \underbrace{\frac{k}{m}}_{w^2} x = 0$$

$$x(t) = A\cos(wt)$$

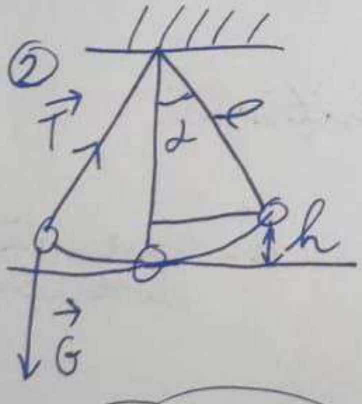
$$x(t+T) \overset{?}{=} x(t)$$

$$T = ?$$

$$A\cos[w(t+T)] = A\cos wt$$

$$\cos(wt + wT) = \cos wt \Rightarrow wT = 2\pi$$

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

② 

$$\boxed{T = 2\pi\sqrt{\frac{l}{g}}}$$

$$h = l(1-\cos\alpha)$$

$$v = \dot{\alpha}\, l \quad ???$$

$$\vec{G} + \vec{T} = m\vec{a}$$

o. paralele

$$A(t) = \sqrt{A_1^2 + A_2^2 + 2A_1A_2 \cos((\omega_1 - \omega_2)t + (\alpha_1 - \alpha_2))}$$

$$\alpha(t) = \arccos \frac{A_1 \cos(\omega_1 t + \alpha_1) + A_2 \cos(\omega_2 t + \alpha_2)}{A(t)}$$

$\dot{x} = v = a$

$$x(t) = x_1(t) + x_2(t) = A(t) \cdot \cos(\alpha(t))$$

(B) $A_1 = A_2$

$$= x(t) = 2A \underbrace{\cos\left(\frac{\omega_1 + \omega_2}{2} t + \frac{\alpha_1 + \alpha_2}{2}\right)}_{\text{purtator}} \cdot \underbrace{\cos\left(\frac{\omega_1 - \omega_2}{2} t + \frac{\alpha_1 - \alpha_2}{2}\right)}_{\text{modulator}}$$

$$\omega_p = \frac{\omega_1 + \omega_2}{2}; \ \omega_m = \frac{\omega_1 - \omega_2}{2}$$

$$T_b = \frac{\pi}{\omega_m}; \ T_p = \frac{2\pi}{\omega_p} \qquad N = \frac{T_b}{T_p}$$

~~o. amprenei pelgantudine~~

o. cuplate

$\nu \cdot T = 1$

$\omega = \nu \cdot 2\pi$

$$\omega_1 = \sqrt{\frac{k}{m}}; \ \omega_2 = \sqrt{\frac{k + 2k_c}{m}}$$