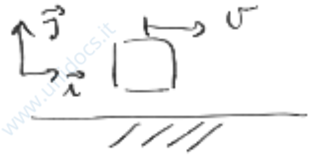
Ese23



$v(t=0) = v_0 = 100\ km/h$

$v(t=10s) = 0\ km/h$

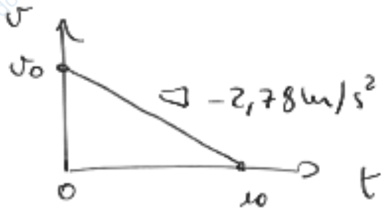
$a = \frac{F}{m} = \text{costante}$

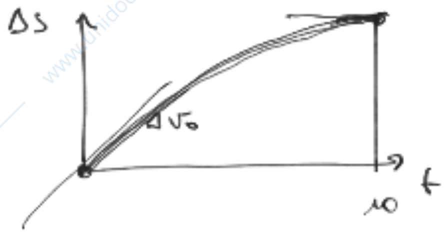
$\underline{v = v_0 + at}$ $\quad a = -\frac{v_0}{t} = -\frac{100/3.6\ m/s}{10\ s} = -2,78\ m/s^2$

$\vec{F} = ma = -4167\ N\ \vec{i}$

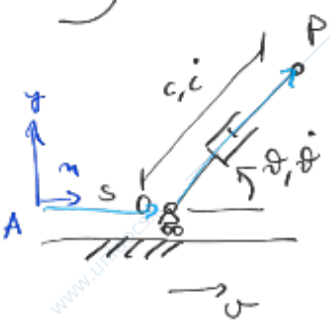
$s = s_0 + v_0 t + \frac{1}{2} a t^2$

$\Delta s = v_0 t + \underline{\underline{\frac{1}{2} a t^2}} = 277 - 138,5 = 138,5\ m$





1.2



$\vec{v}_p$?

$\vec{a}_p$?

$(P-A) = (O-A) + (P-O)$

$(P-A) = s + c\, e^{i\theta} = \begin{cases} x_p \\ y_p \end{cases}$

$$\begin{Bmatrix} \dot{x}_p \\ \dot{y}_p \end{Bmatrix} = \dot{s} + \dot{c}\, e^{i\theta} + c\,\dot{\theta}\, e^{i(\theta+\pi/2)}$$

$$= \begin{cases} v + \dot{c}\cos\theta + c\,\dot{\theta}\cos(\theta+\pi/2) = 2 + 0,4\cdot\frac{1}{2} + 1\cdot 0,25\left(-\frac{\sqrt{3}}{2}\right) \\ \dot{c}\sin\theta + c\,\dot{\theta}\sin(\theta+\pi/2) = 0,4\cdot\frac{\sqrt{3}}{2} + 1\cdot 0,25\cdot\frac{1}{2} \end{cases}$$

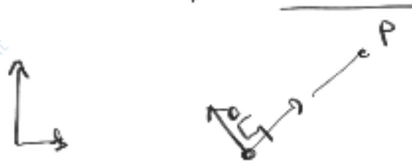
$$= \begin{cases} 2 + 0,2 - \frac{\sqrt{3}}{8} = \\ 0,2\sqrt{3} + \frac{1}{8} = \end{cases}$$

$\vec{v}_p = \dot{x}_p \vec{i} + \dot{y}_p \vec{j}$

$$\begin{Bmatrix} \ddot{x}_p \\ \ddot{y}_p \end{Bmatrix} = \underline{\ddot{s}} + \overset{a_{rel}}{\underline{\ddot{c}\, e^{i\theta}}} + \underline{\dot{c}\,\dot{\theta}\, e^{i(\theta+\pi/2)} + \dot{c}\,\dot{\theta}\, e^{i(\theta+\pi/2)}} + \underline{c\,\ddot{\theta}\, e^{i(\theta+\pi/2)}}$$

$a_{tr,rad} + c\dot{\theta}\, e^{i \ldots}$ $\quad a_{cor}$

$\underbrace{}$ $\quad a_{tr,rot,normale}$

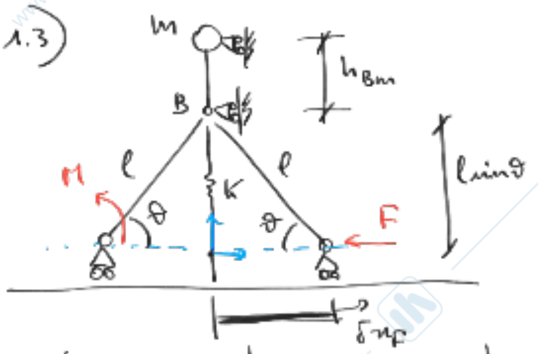


$$\begin{Bmatrix} \ddot{x}_p \\ \ddot{y}_p \end{Bmatrix} = 2\dot{c}\dot{\theta}e^{i(\theta+\pi/2)} + c\dot{\theta}^2 e^{i(\theta+\pi)}$$

$$= \begin{cases} 2\dot{c}\dot{\theta}\cos(\theta+\pi/2) + c\dot{\theta}^2\cos(\theta+\pi) & \leftarrow \ddot{x}_p \\ 2\dot{c}\dot{\theta}\sin(\theta+\pi/2) + c\dot{\theta}^2\sin(\theta+\pi) & \leftarrow \ddot{y}_p \end{cases}$$

$$\vec{a}_p = \ddot{x}_p\,\vec{i} + \ddot{y}_p\,\vec{j}$$

1.3)



$$\cancel{\frac{d}{dt}\frac{\partial E_c}{\partial\dot\theta}} - \cancel{\frac{\partial E_c}{\partial\theta}} + \cancel{\frac{\partial D}{\partial\dot\theta}} + \frac{\partial V}{\partial\theta} = Q$$

$$\frac{\partial V}{\partial\theta} = Q$$

$V_g = mg\,h_m \qquad h_m = h_{Bm} + \ell\sin\theta$

$\frac{\partial V_g}{\partial\theta} = mg\,\ell\cos\theta$

$V_K = \frac{1}{2}K\,\Delta\ell^2 \qquad \Delta\ell = \ell\sin\theta \;\underline{\underline{(+\Delta\ell_0)}}$

$\frac{\partial V_K}{\partial\theta} = K\ell^2\sin\theta\cos\theta$

$\mathcal{L}_F = -F\,\delta x_F \qquad x_F = \ell\cos\theta \qquad \delta x_F = \frac{\partial x_F}{\partial\theta}\delta\theta$

$\delta x_F = -\ell\sin\theta\,\delta\theta$

$\mathcal{L}_F = F\ell\sin\theta\,\delta\theta$

$$Q = \frac{\delta\mathcal{L}}{\delta\theta}$$

$\mathcal{L}_M = M\,\delta\theta$

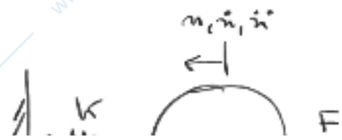
Eq equilibrio statico

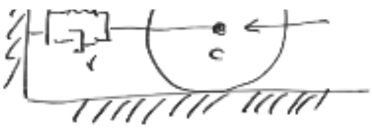
$$mg\,\ell\cos\theta + K\ell^2\sin\theta\cos\theta = F\ell\sin\theta + M$$

1.4)

$F = 10\cos(100t)$

$F = F_0\cos(\Omega t) \qquad F_0 = 10\ \text{N}$





$\Omega = 100 \ rad/s$

$$E_c = \frac{1}{2} m \dot{x}^2 + \frac{1}{2} J \omega^2 \qquad \omega = \frac{\dot{x}}{R} \qquad J = \frac{1}{2} MR^2$$

$$= \frac{1}{2}\left(m + \frac{1}{2} m\right) \dot{x}^2$$

$$= \frac{1}{2}\left(\frac{3}{2} m\right) \dot{x}^2$$

$$\Delta l = -x$$

$$V_k = \frac{1}{2} k \Delta l^2 = \frac{1}{2} k x^2$$

$$\boxed{\frac{\partial V_k}{\partial x}} = kx$$

$$\frac{3}{2} m \ddot{x} + r \dot{x} + kx = F_0 \cos(\Omega t)$$

$x_p(t)$?

$$\frac{3}{2} m \ddot{x} + r\dot{x} + kx = F_0 e^{i\Omega t}$$

$$x_p = X_p e^{i\Omega t}$$

$$\dot{x}_p = i\Omega X_p e^{i\Omega t}$$

$$\ddot{x}_p = -\Omega^2 X_p e^{i\Omega t}$$

$$\left(-\frac{3}{2} m\Omega^2 + i\Omega r + k\right) X_p = F_0$$

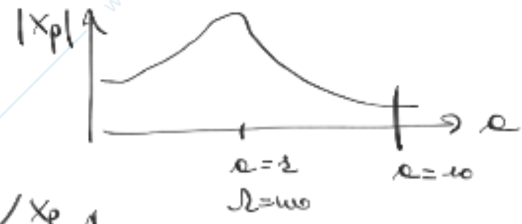
$$X_p = \frac{F_0}{-\frac{3}{2} m\Omega^2 + i\Omega r + k}$$

$$x_p = |X_p| \cos(\Omega t + \varphi) \qquad |X_p| = \frac{F_0}{\sqrt{\left(k - \frac{3}{2} m\Omega^2\right)^2 + \Omega^2 r^2}} = \underline{0{,}7 \ 10^{-3}} \ m$$

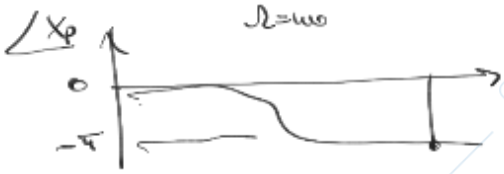
$$\omega_0 = \sqrt{\frac{k}{\frac{3}{2} m}} = \sqrt{\frac{150}{1.5}} = 10 \ rad/s$$

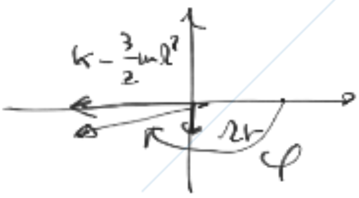
$$\Omega = 100 \ rad/s$$

$$a = \frac{\Omega}{\omega_0} = 10$$



$$\varphi = \operatorname{atan}\left(\frac{-\Omega r}{k - \frac{3}{2} m\Omega^2}\right) = \underline{-174°}$$





2015-07-23

1.1) $\begin{cases} x(t) = 2t \end{cases}$ $\qquad$ b? t.c. $|\vec{v}|(t = 2s) = 20 \ m/s$

$$\frac{d}{dt}\left(\begin{cases} y(t) = 4bt^2 \end{cases}\right)$$

$$\begin{cases} \dot{x}(t) = 2 \\ \dot{y}(t) = 8bt \end{cases} \qquad \begin{cases} \dot{x}(t=2) = 2 \ m/s \\ \dot{y}(t=2) = 16b \ m/s \end{cases}$$

$$\sqrt{\dot{x}(t=2)^2 + \dot{y}(t=2)^2} = 20 \ m/s$$

$$4 + 256 b^2 = 400$$

$$b^2 = \frac{396}{256} \qquad b = \pm\sqrt{\frac{396}{256}}$$

$$\begin{cases} x = 2t \\ y = 4bt^2 \end{cases} \Rightarrow \begin{cases} t = x/2 \\ y = \cancel{4}b\,\frac{x^2}{\cancel{4}} \end{cases}$$

$$y = bx^2$$

1.2)

$$m\ddot{x} + r\dot{x} + kx = F_0 \cos \Omega t$$

$$\omega_0 = \Omega$$

$$\sqrt{\frac{k}{m}} = \Omega \qquad k = m\Omega^2 = 200 \ \frac{N}{m}$$

$$(-\Omega^2 m + i\Omega r + k)\, X_p = F_0$$

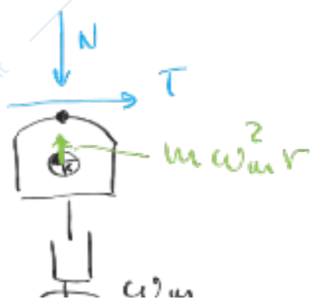
$$|X_p| = \frac{F_0}{\sqrt{\underbrace{(k - m\Omega^2)}_{0} + \Omega^2 r^2}} = \frac{F_0}{r\Omega} = 0{,}01 \ m$$

$$F_0 = 0{,}01\, r\Omega = 1 \ N$$

$$V_g = mg x \qquad \frac{\partial V_g}{\partial x} = mg$$

$$m\ddot{x} + r\dot{x} + kx + \cancel{k \delta_0} = F_0 \cos \Omega t + \cancel{mg}$$

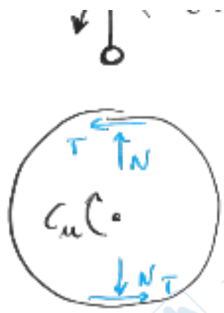
1.3)



$$N = m\omega_m^2 r = 0{,}1 \cdot 400\pi^2 \cdot 0{,}15 =$$

$$= 6\pi^2 \ N$$

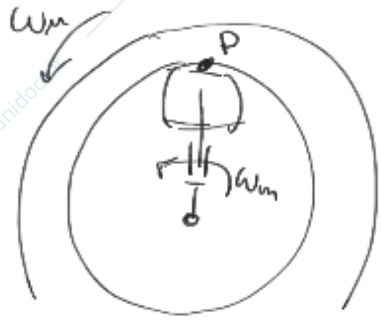
$$= 59{,}22 \ N$$



$$C_\mu = 2TR \begin{cases} < 2 f_s N R & (1) \\ 2 f_d N R & (2) \end{cases}$$

$$\begin{cases} (1) \quad \omega_\mu = \omega_m & \underline{T = T_{MAX} = f_s N} \\ (2) \quad \omega_\mu \neq \omega_m & \underline{T = T_d = f_d N} \end{cases}$$

$$C_\mu = \begin{cases} 21.32 \cdot 0,5 = 10,66 \text{ Nm} \\ 21.32 \cdot 0,45 = 9,59 \text{ Nm} \end{cases}$$



$v_{P_m} = \omega_m R$

$v_{P_\mu} = \omega_\mu R$

$\omega_m = \omega_\mu \Rightarrow v_{P_m} = v_{P_\mu}$

⇓

NO STRISCIAMENTO

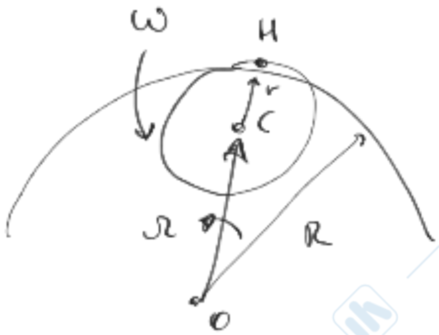
⇓

ATTRITO STATICO

$\omega_m \neq \omega_\mu \quad v_{P_m} \neq v_{P_\mu} \Rightarrow$ STRISCIAM.

⇓

ATTRITO DINAMICO



$$\begin{rcases} \vec{v}_C = \vec{\omega} \wedge (C-H) \\ \vec{v}_C = \vec{\Omega} \wedge (C-O) \end{rcases}$$

Ultima modifica: 10:32