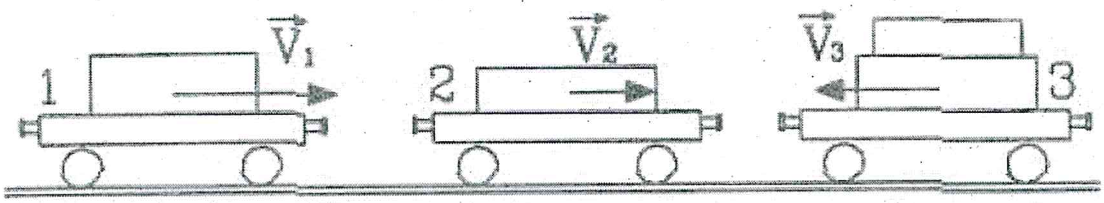
I carrelli 1, 2 e 3 viaggiano lungo una linea ferroviaria orizzontale. I carrelli 1 e 2 si muovono verso destra, il carrello 3 in verso opposto ai primi due. I tre carrelli urtano e, dopo l'urto, essendo presenti dispositivi di aggancio automatico, procedono vincolati con una stessa velocità V_d. Le velocità e le masse dei carrelli sono: $V_1=2\ km/h$, $V_2=1\ km/h$, $V_3=1.5\ km/h$ e $m_1=65\cdot10^3\ kg$, $m_2=50\cdot10^3\ kg$, $m_3=75\cdot10^3\ kg$ rispettivamente.

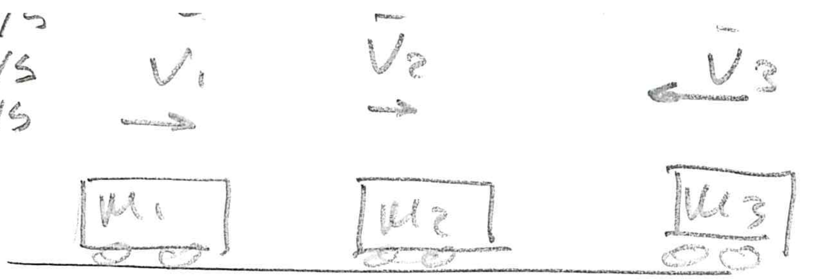
Nell'ipotesi di attriti nulli e di masse delle ruote trascurabili, determinare la velocità V_d dopo l'urto e l'energia persa durante l'urto.



$m_1 = 65 \cdot 10^3\ kg$ $\quad v_1 = 0,55\ m/s$

$m_2 = 50 \cdot 10^3$ $\quad v_2 = 0,28\ m/s$

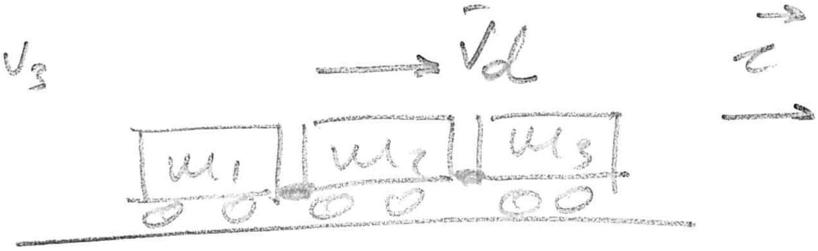
$m_3 = 75 \cdot 10^3$ $\quad v_3 = 0,42\ m/s$



$\sum F_{e_x} = 0$

$\Delta Q_x = 0$

$Q_{x_p} = m_1 v_1 + m_2 v_2 - m_3 v_3$



$Q_{x_d} = (m_1 + m_2 + m_3) V_d$

$65 \cdot \cancel{10^3} \cdot 0,55 + 50 \cdot \cancel{10^3} \cdot 0,28 - 75 \cdot \cancel{10^3} \cdot 0,42 = (65 + 50 + 75) \cdot \cancel{10^3} \cdot V_d$

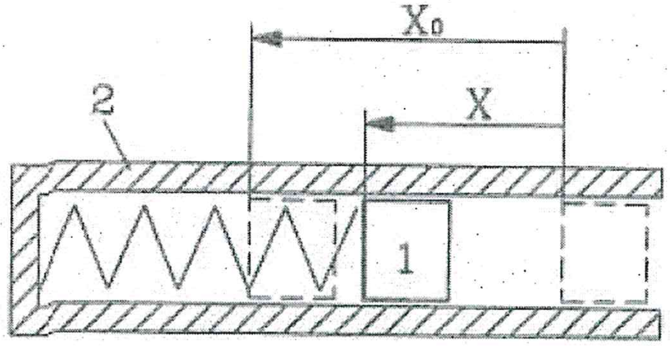
$\frac{18,25}{190} = V_d = 0,096\ m/s \sim 0,1\ m/s \ (+\vec{i})$

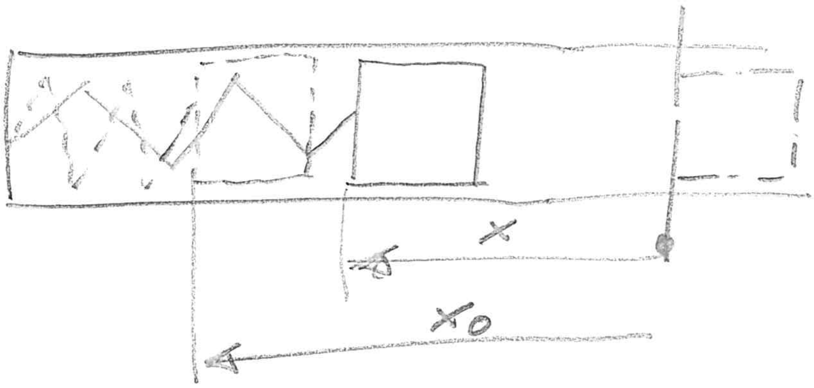
$\underbrace{L_e}_{=0} + L_i = \Delta E_c + \underbrace{E}_{=0}$

$L_i = \Delta E_c = \left[\frac{1}{2}(m_1 + m_2 + m_3) V_d^2\right] - \left[\frac{1}{2}(m_1 v_1^2 + m_2 v_2^2 + m_3 v_3^2)\right]$

$\{[0,95] - [18,40]\} \cdot 10^3 = -17,46\ kJ$

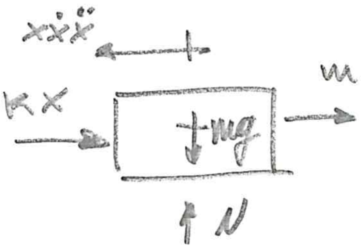
Il corpo 1, avente massa m, può scorrere all'interno della guida prismatica 2 priva di attrito. La massa viene spinta a comprimere la molla, di rigidezza k, di una quantità pari a x_0. Da tale posizione la massa viene lasciata libera. Determinare la massima potenza sviluppata dalla molla quando sposta il corpo 1 e la coordinata x in cui ciò avviene.





$$P = F \cdot V = kx \cdot \frac{dx}{dt} = kx\dot{x}$$

$$\left.\frac{dP}{dt}\right)_{P_{max}} = k\dot{x}^2 + kx\ddot{x} = k\left(\dot{x}^2 + x\ddot{x}\right) = 0$$



$$\times)\ kx + m\ddot{x} = 0$$

$$\ddot{x} = -\frac{kx}{m}$$

$$\dot{x}^2 + x\ddot{x} = 0 \quad E \quad \ddot{x} = -\frac{kx}{m}$$

$$*)\quad \dot{x}^2 - \frac{kx^2}{m} = 0$$

$$K_e + K_i = \Delta E_c + \Delta E_k + \Delta E$$

$$\frac{1}{2}kx_0^2 = \frac{1}{2}kx^2 + \frac{1}{2}m\dot{x}^2$$

$$*)\quad \dot{x}^2 = \frac{k}{m}\left(x_0^2 - x^2\right)$$

$$\frac{\cancel{k}}{\cancel{m}}\left(x_0^2 - x^2\right) - \frac{\cancel{k}x^2}{\cancel{m}} = 0$$

$$x_0^2 - 2x^2 = 0$$

$$x^2 = \frac{x_0^2}{2}$$

$$x = \pm\sqrt{\frac{x_0^2}{2}} = \pm\frac{x_0}{\sqrt{2}}$$

$x\big)_{P_M} = \pm \dfrac{x_0}{\sqrt{2}}$ $\quad x$ DI P_{MAX}

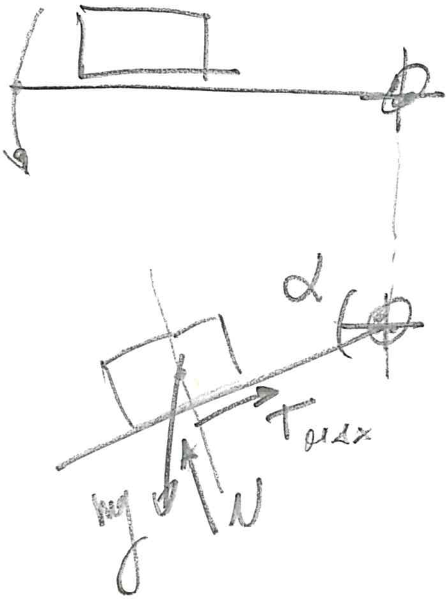
$\dot{x}^2 - \dfrac{k}{m} x^2 = 0 \qquad \dot{x}^2 = \dfrac{k}{m} x^2 \qquad \dot{x}\big)_{P_{MAX}} = \pm \sqrt{\dfrac{k}{m}}\, \dfrac{x_0}{2}$

$P = k x \dot{x}$

$* \; P_{MAX} = K \dfrac{x_0}{\sqrt{2}} \sqrt{\dfrac{k}{m}}\, \dfrac{x_0}{2}$

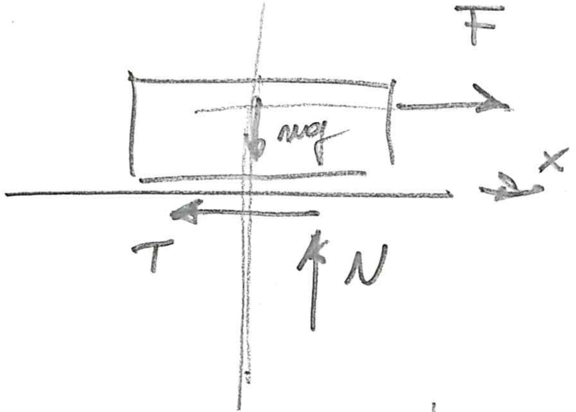
$T \propto N \quad f$

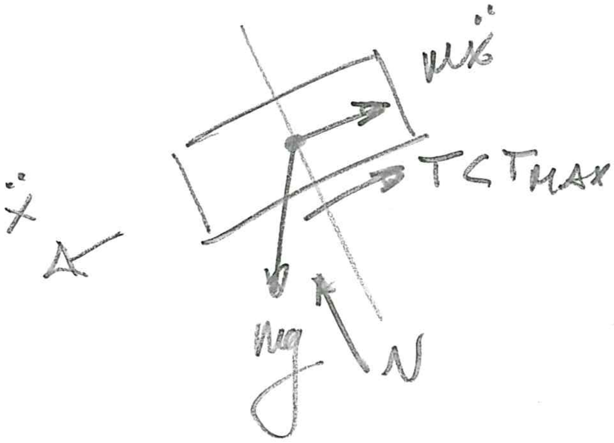
COULOMB

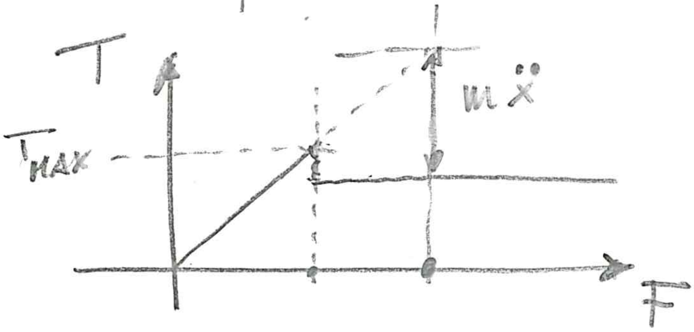


$T = f N$ DINAMICO

$T \leq f_{AD} N$ STATICO

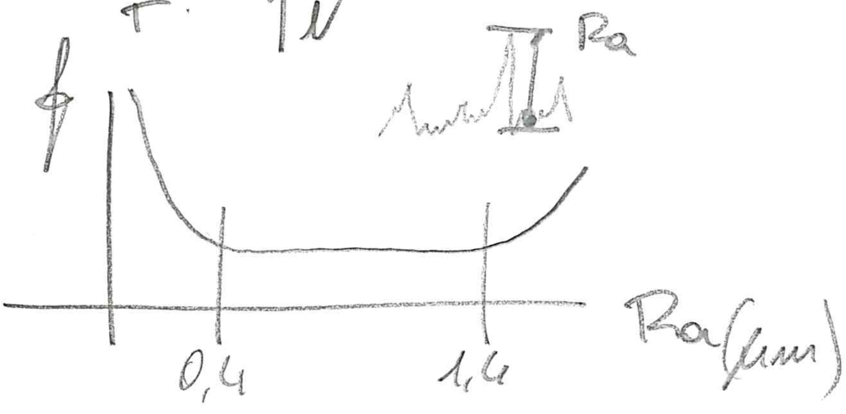


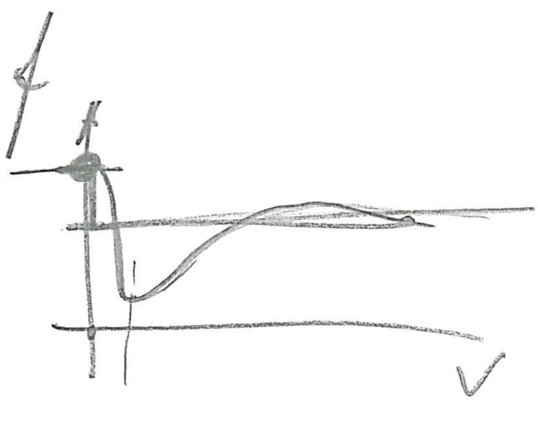


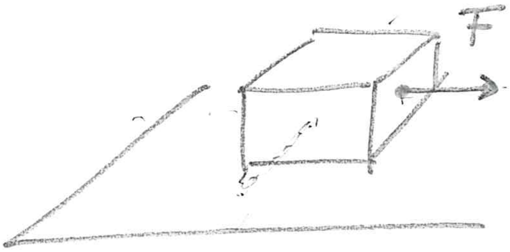


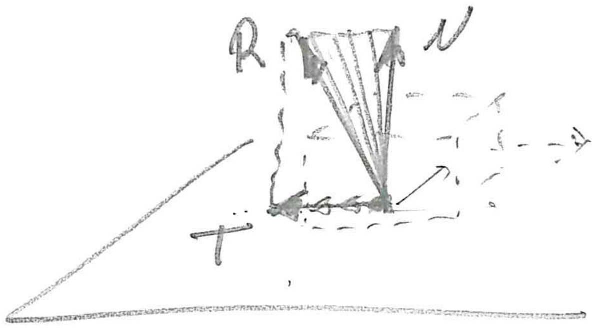
$$\begin{cases} \dot{x} = 0 \\ \ddot{x} = 0 \\ F - T = 0 \end{cases}$$

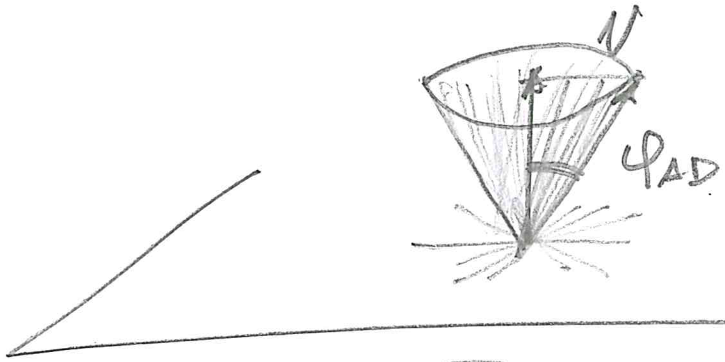
$F - T - m\ddot{x} = 0$



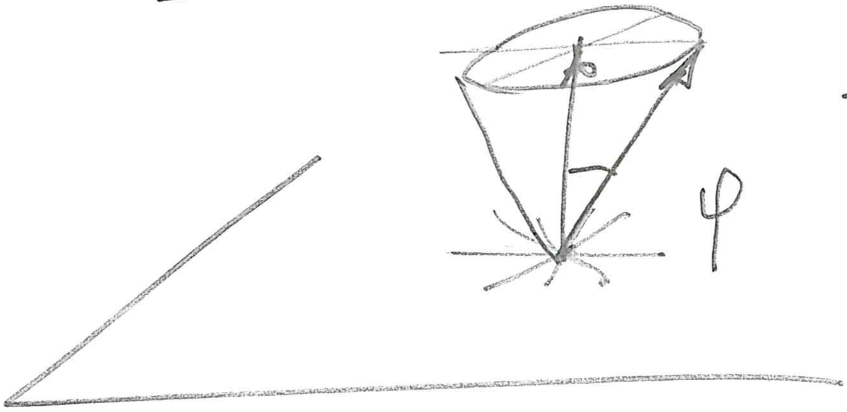




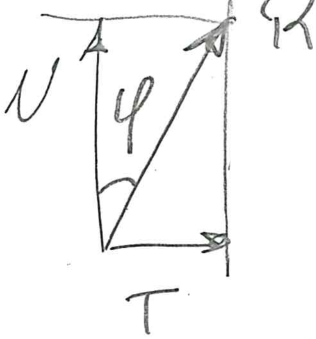




$T \leq f_{AD} N$



$T = f N$

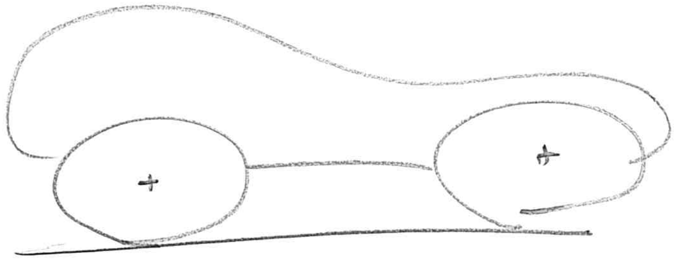


$T = f N$

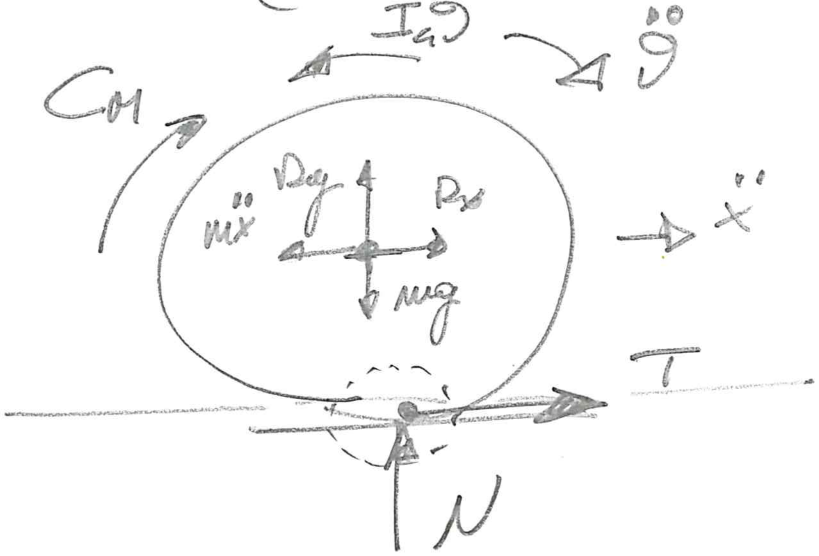
$\frac{T}{N} = f = tg\,\varphi$

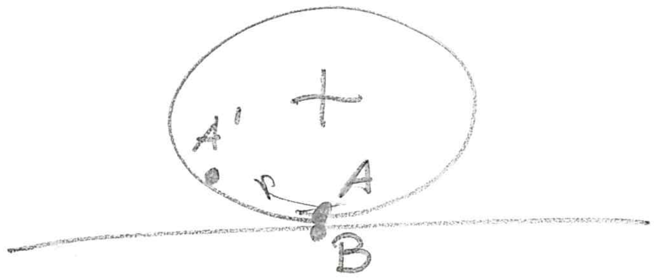
$V_R = 0 \quad T \leq f_{AD} N$

$V_R \neq 0 \quad T = f N$



RUOTA POSTERIORE (TRAZIONE)
MOTRICE





RUOTA ANTERIORE
CONDOTTA