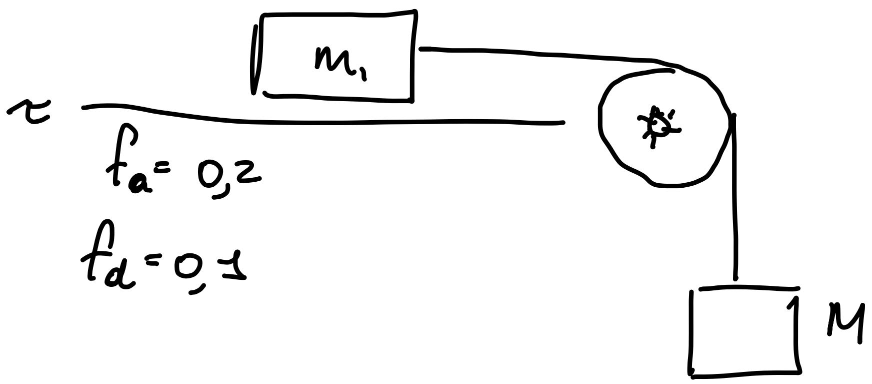
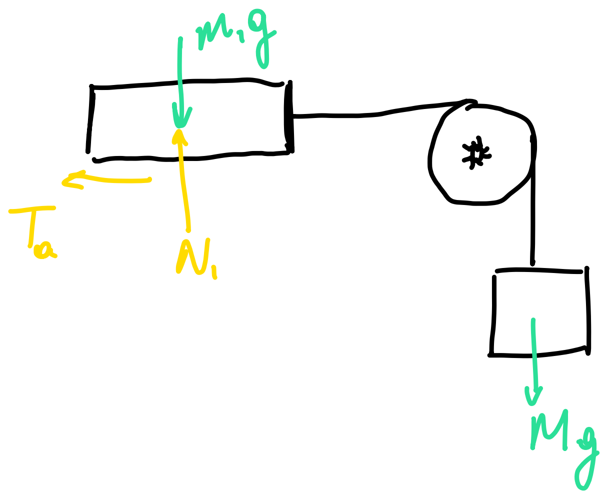
Esercitazione 15 -

Iniziamo con l'attrito statico e dinamico

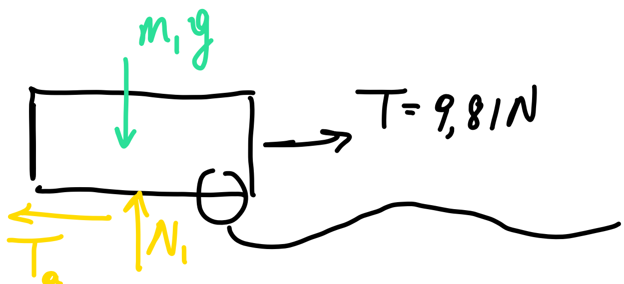
$m_1 = 10\,kg \qquad M = ?$ tale che

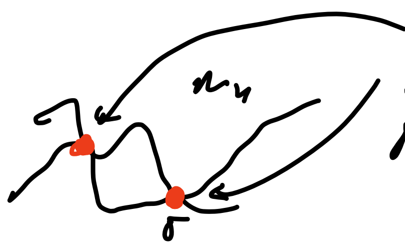




$T_{a\,lim} = f_a \cdot N_1$

$M = 1\,kg \rightarrow Mg = 9{,}81\,N$





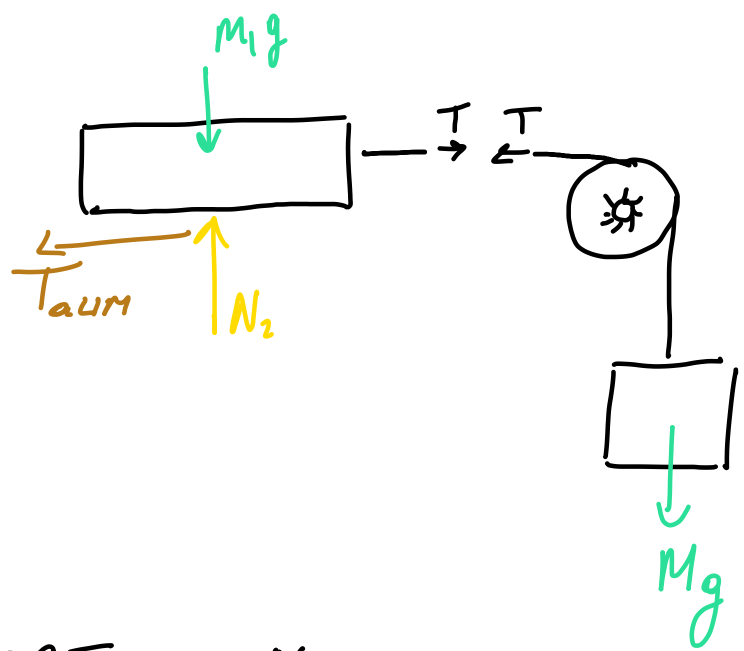
Microsaldature da rompere per non avere aderenza.

$\sum F_y = 0 \Rightarrow N_1 = m_1 g \qquad \sum F_o = 0 \Rightarrow T_a = T = 9{,}81\,N$

$T_{alim} = f_a N_1 = 0,2 \cdot m_1 \cdot 9,81 = 19,62\ N$

$T = 9,81$ non è abbastanza per superare l'aderenza.

M? Tale per rompere aderenza → Ci mettiamo alle condizioni limite di aderenza



$\sum F_v = 0 \rightarrow N_2 = m_1 g$

$T_{aLIM} = f_a N_1 = 0,2\, m_1 g = 19,62\, N$

$\sum F_o = 0 \rightarrow T = T_{aLIM} = 19,62$

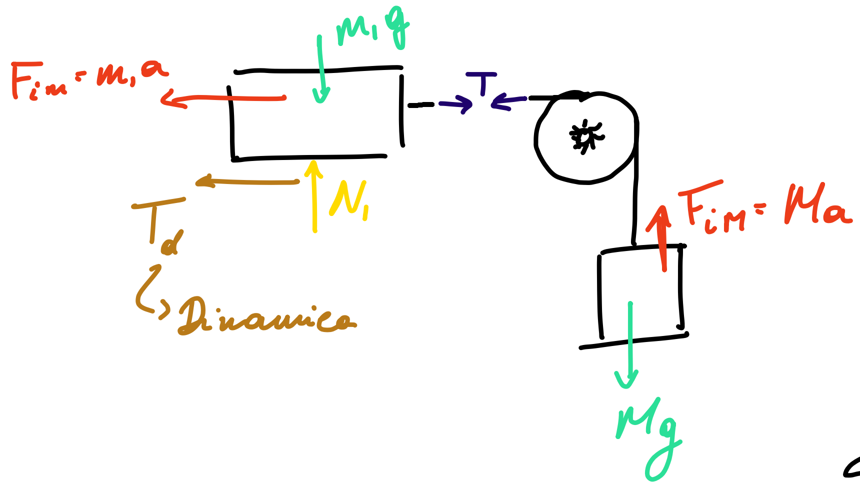
$\sum M_o^{PULEG} = 0 \rightarrow TR = MgR \rightarrow T = Mg$

$M = \frac{T}{g} = \frac{19,62}{9,81} = 2kg$

Supponiamo che sistema inizia a muoversi sempre a $M=2kg$

CONDIZIONE LIMITE DINAMICA a $M=2kg$

Schema Dinamico



$$|T_d| = f_d \cdot |N_1|$$

$$\sum F_V^{m_1} = 0 \to N_1 = m_1 g$$

$$\sum F_O^{m_1} = 0 \to T = m_1 a + T_d$$
$$= m_1 a + f_d m_1 g$$

$$\sum M_O^{M} = 0$$
$$\hookrightarrow T\cancel{R} = Mg\cancel{R} - F_{iM}\cancel{R}$$

$$Mg - Ma = m_1 a + f_d m_1 g$$

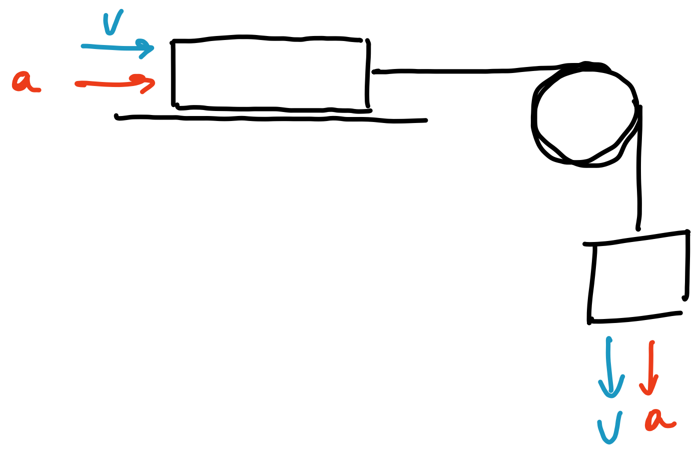
$$\hookrightarrow a(M+m) = Mg - f_d m_1 g$$

$$\hookrightarrow a = \frac{Mg - f_d m_1 g}{M + m_1}$$

$$= \frac{2 \cdot 9{,}81 - 0{,}1 \cdot 10 \cdot 9{,}81}{12}$$

$$= 0{,}82 \frac{m}{s^2}$$

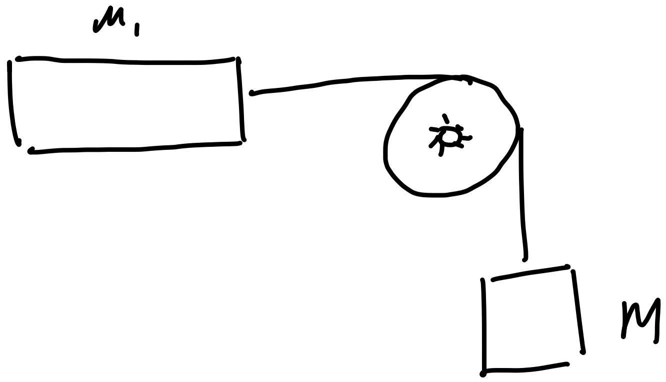
Schema Cinematico



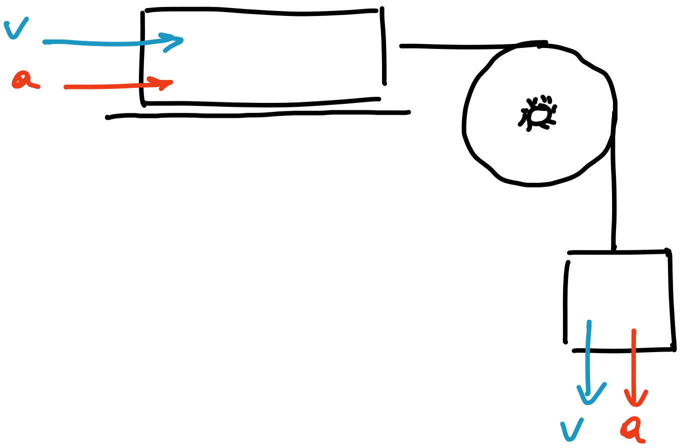
Stesso esercizio ma $M = 20kg$

$f_a = 0,2$

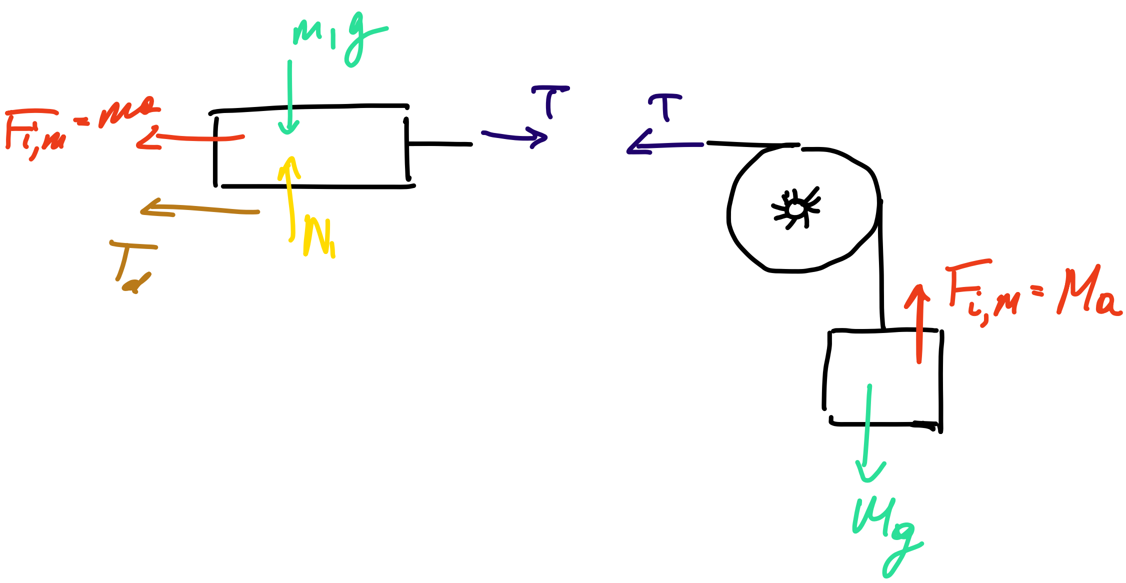
$f_d = 0,1$



Schema Cinematico



Schema Dinamico



1) $|T_d| = f_d |N_1|$ Relazione attrito dinamico

2) $\sum_i F_v^{m_1} = 0 \rightarrow N_1 = m_1 g$

$$T_d = f_d m_1 g$$

3) $\sum_i F_o^{m_1} = 0 \rightarrow T = ma + f_d m_1 g$

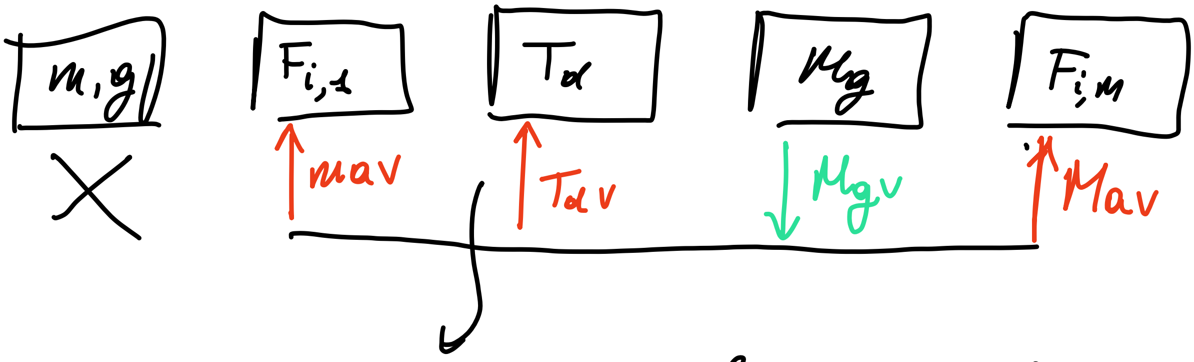
4) $\sum_i M_0^{pu2} = 0 \rightarrow T\cancel{R} = Mg\cancel{R} - Ma\cancel{R}$

$$Mg - Ma = ma + f_d m_1 g$$

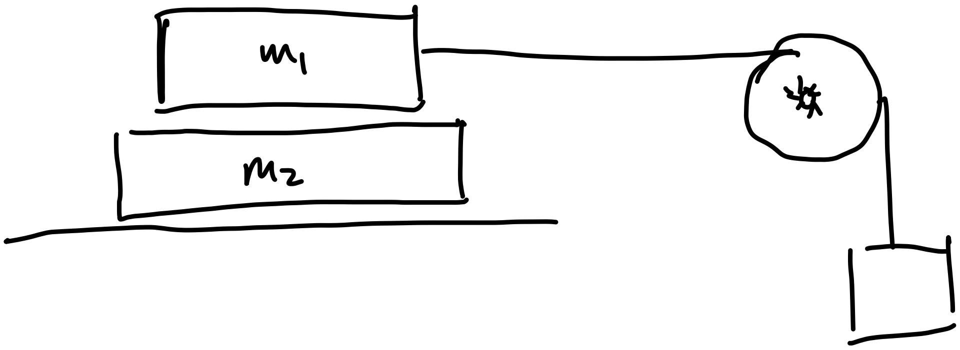
$$Ma + ma = Mg - f_d m_1 g$$

$$a = \frac{Mg - f_d m_1 g}{M+m} =$$

<u>Grafico Rappresentativo</u>



Prende in energia e la dissipa in calore



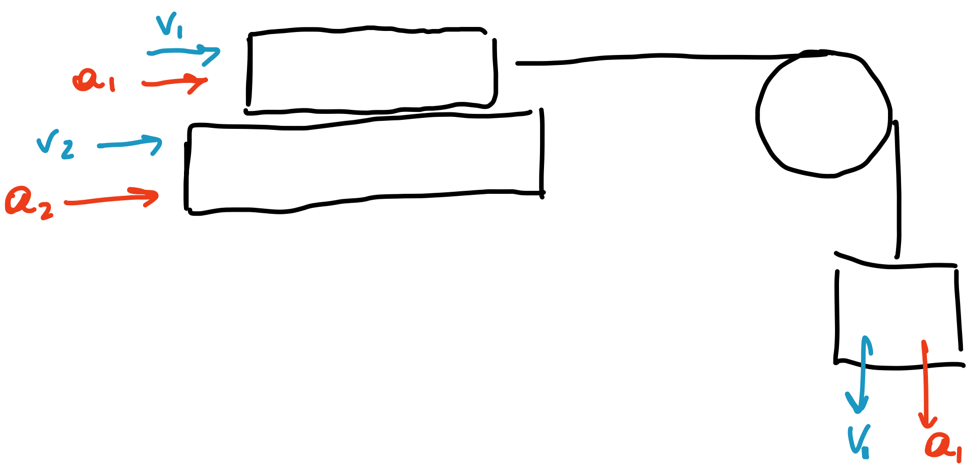
$M = 20\,kg$
$m_1 = 10\,kg$
$m_2 = 1\,kg$

$f_{a1,2} = 0{,}2$ $f_{d1,2} = 0{,}1$

$f_a = 0{,}1$ $f_d = 0{,}05$

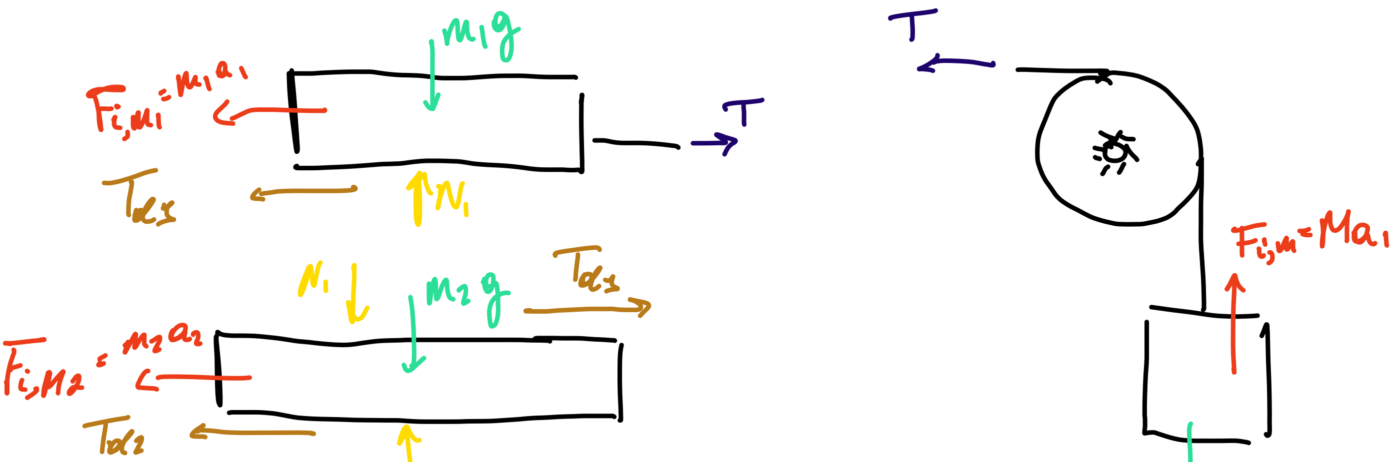
Supponiamo sia dinamico

Schema Cinematico



Ci possiamo aspettare che $v_1 > v_2$ e $a_1 > a_2$

Schema Dinamico



N_2

N_2 $\quad T_{d2}$ $\quad Mg$

O

Potenza al filo l'ha già presa Ma_1

T_{d1} è utile per il corpo m_2 e inutile nel corpo m_1

T_{d1} assorbe energia, in parte la trasforma in calore, in parte va a battere l'inerzia e l'altra l'ha nel corpo 2 che la converte in calore

$$\sum M_O^{EWL} = 0 \qquad TR - Mg R - M a_1 R$$

$$\sum F_y^{m_1} = 0 \qquad N_1 = m_1 g$$

$$\sum F_y^{m_2} = 0 \qquad N_2 = N_1 + m_2 g = (m_1 + m_2) g$$

$$T_{d1} = f_{d_{12}} N_1 = f_{d1} m_1 g$$

$$T_{d_2} = f_d N_2 = f_{d_2} m_2 g$$

$$\sum F_0^{m_1} = 0 \qquad T = m_1 a_1 + T_{d1} = m_2 a_2 + f_{d1} m_1 g$$

$$\sum F_0^{m_2} = 0 \qquad T_{d1} = m_2 a_2 - T_{d2}$$

Incognite a_1 e a_2

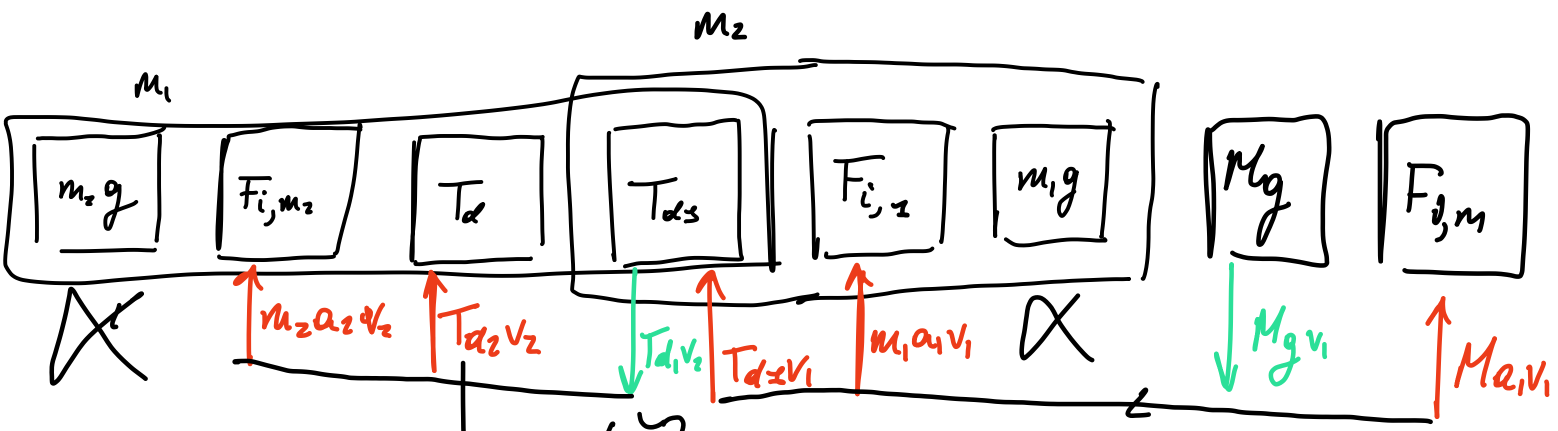
$$Mg - M a_1 = m_1 a_1 + f_{d12} m_1 g$$

$$a_1 (M+m) = Mg - f_{d12}\, m_1 g$$

$$a_1 = \frac{Mg - f_{d12}\, m_1 g}{M + m_1} = \frac{19}{30} g = 6{,}21 \frac{m}{s^2}$$

$$m_1 g f_{d12} = m_2 a_2 + f_d (m_1 + m_2) g$$

$$a_2 = \frac{m_1 g f_{d12} - f_d (m_1+m_2) g}{m_2} = \frac{9{,}81 - 5{,}39}{1} = 4{,}42$$

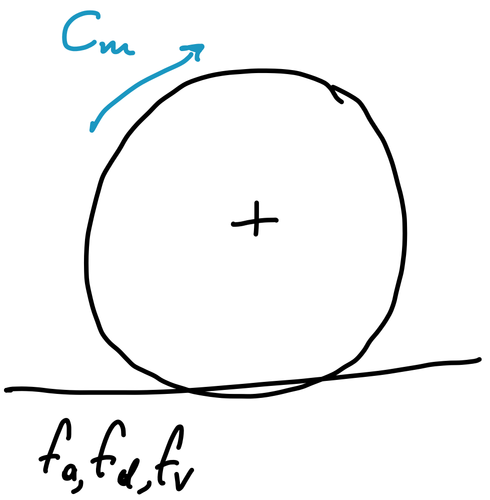


Calore

Quantità che va in calore è:

$T_{d1} (v_1 - v_2)$

Assorbe potenza e una parte la restituisce, il resto è assorbito



$m = 20kg$ $\quad r = 0,3m$

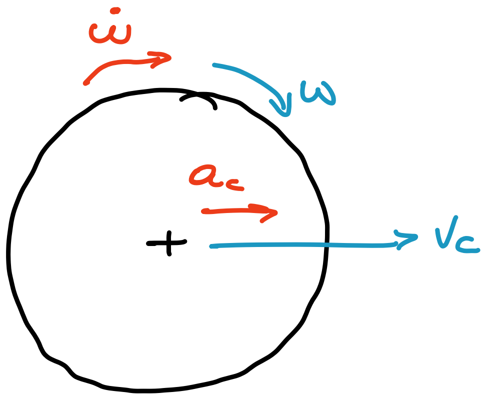
$J = 0,8\ kgm^2$ $\quad C_m = 10Nm$

$f_a = 0,2$ $\quad f_d = 0,05$ $\quad f_v = 0,05$

Determinare a?

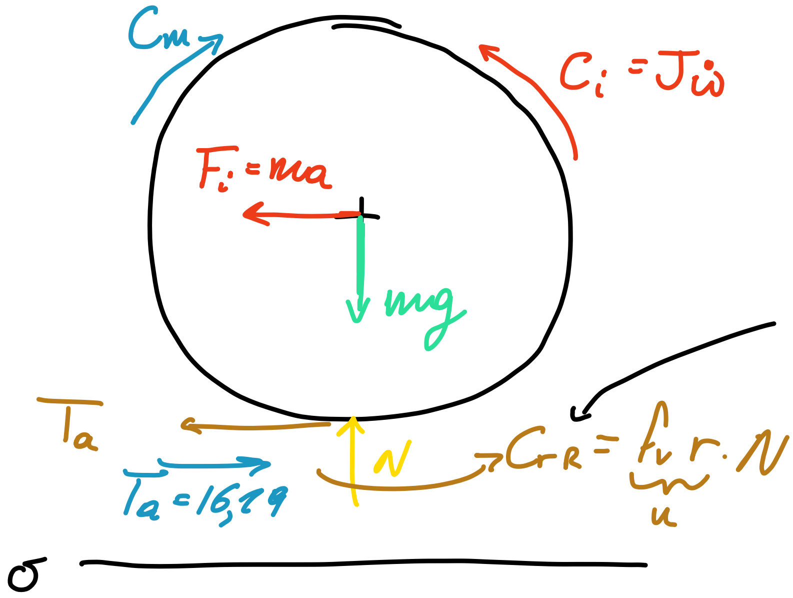
3gdl - 2gdv = 1gdl

Schema Cinematico



$\left.\begin{array}{l} v_c = \omega r \\ a_c = \dot{\omega} r \end{array}\right\}$ Perché è puro rotolamento

Schema Dinamico



Coppia di resistenza al rotolamento

$$\sum F_v^{TUTTO} \rightarrow N = Mg$$

$$\sum F_o^{TUTTO} = 0 \rightarrow ma + T_a = 0$$

$$\sum M_E = 0 \quad C_m - F_i\, r - C_i - C_{rR} = 0$$

$$mar + J\dot{\omega} = C_m - f_v r m g$$

$$m\dot{\omega} r^2 + J\dot{\omega} = C_m - f_v r m g$$

$$\dot{\omega} = \frac{C_m - f_v r m g}{m r^2 + J} = \frac{10 - 0{,}05 \cdot 0{,}3 \cdot 20 \cdot 9{,}81}{20(0{,}3)^2 + 0{,}8} = \frac{10 - 2{,}94}{1{,}8 + 0{,}8} = 2{,}71 \frac{rad}{}$$

$$a_c = \dot{\omega} r = 0{,}81 \frac{m}{s^2}$$

$$F_i = m a_c = 16{,}29\ N$$

$$16{,}29\ N \lesseqgtr 0{,}2 \cdot 20 \cdot 9{,}81 \ ?$$

$$16{,}29 \lesseqgtr 39{,}24$$

$$\underset{T_{chiesta}}{16{,}29} < \underset{T_{MAX}}{39{,}24}$$

Il vincolo crea abbastanza attrito per battere l'aderenza.