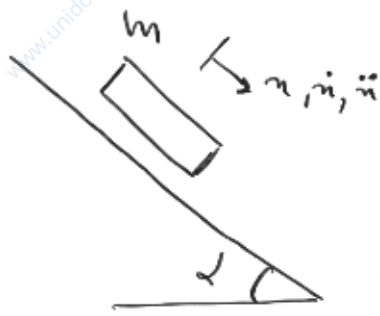
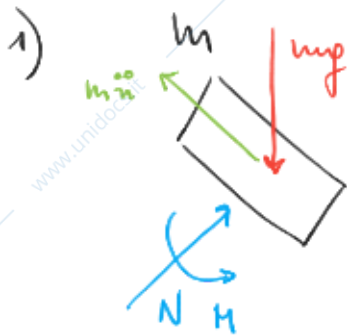


## Dinamica massa su piano inclinato



Calcolo dell'accelerazione

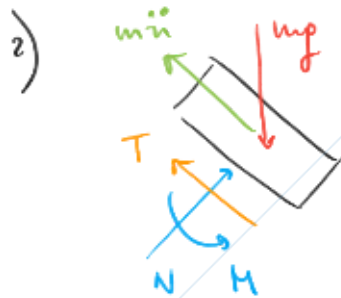
- 1) senza forze resistenti
- 2) con attrito radente
- 3) con resistenza aerodinamica



$$mg \sin \alpha - m \ddot{x} = 0$$

$$\ddot{x} = g \sin \alpha = \text{costante} > 0 \quad (\alpha > 0)$$

$$\dot{x}(t) = \dot{x}_0 + \ddot{x} t$$



In condizioni di moto ( $\dot{x} \neq 0$ )

$$\vec{T} = -f_d \frac{|\vec{N}|}{|\vec{v}|}$$

$$T = f_d N$$

$$\sum F_n = 0$$

$$\sum F_t = 0$$

$$N - mg \cos \alpha = 0 \quad N = mg \cos \alpha$$

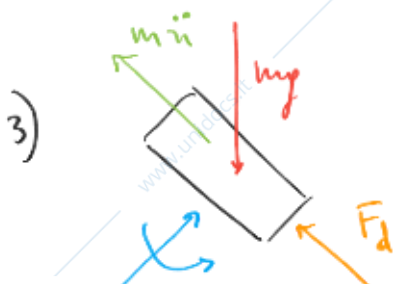
$$mg \sin \alpha - T - m \ddot{x} = 0$$

$$mg \sin \alpha - f_d mg \cos \alpha - m \ddot{x} = 0$$

$$\ddot{x} = g (\sin \alpha - f_d \cos \alpha) = \text{costante}$$

$> 0$  se  $\sin \alpha > f_d \cos \alpha$

$$\dot{x}(t) = \dot{x}_0 + \ddot{x} t$$



La resistenza aerodinamica (drag) è

$$F_d = \frac{1}{2} \rho C_d S v_{rel}^2$$

N M

$$\vec{F}_d = -\frac{1}{2} \rho C_d S |\vec{v}_{rel}| \vec{v}_{rel}$$

se l'aria è ferma  $\vec{v}_{rel} = \vec{v}$

$$\sum F_t = 0$$

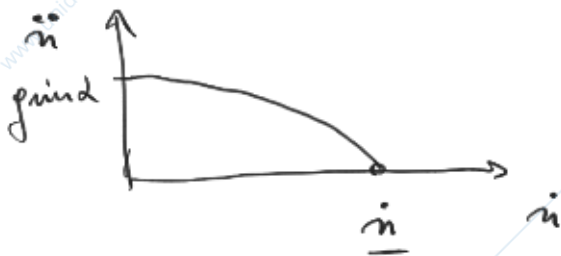
$$mg \sin \alpha - m\ddot{v} - F_d = 0$$

$$mg \sin \alpha - m\ddot{v} - \frac{1}{2} \rho C_d S v^2 = 0$$

$$mg \sin \alpha - m\ddot{v} - b v^2 = 0$$

$$\ddot{v} = g \sin \alpha - \frac{b}{m} v^2$$

$\ddot{v} \neq$  costante ma dipende da  $v$



$$\ddot{v} = 0 \quad \text{per} \quad \frac{b}{m} v^2 = g \sin \alpha$$

$$\underline{v} = \sqrt{g \sin \alpha \frac{m}{b}}$$

ovvero quando componente del peso e  $F_d$  si bilanciano

$$\ddot{v} = g \sin \alpha - \frac{b}{m} v^2$$

equazione differenziale non lineare