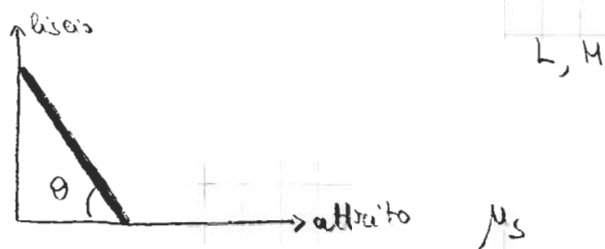
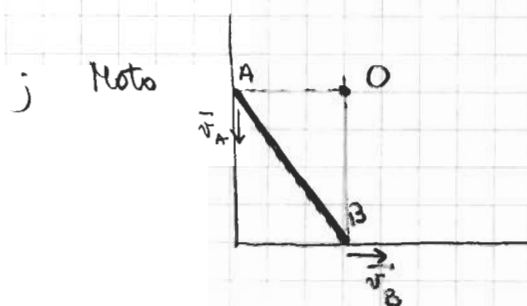
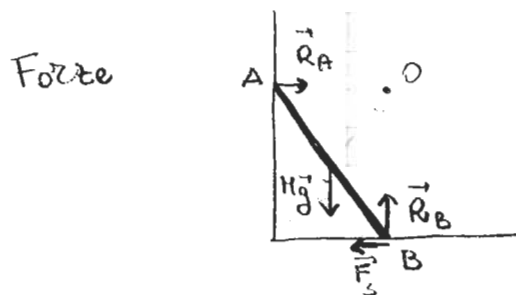


Esercizio della scala

1



1) Trovare θ_{min} prima di scivolare.



$\Rightarrow$ centro istantaneo di rotazione è O.

Se ho equilibrio $\sum \vec{F} = 0$ forze
 $\sum \vec{H} = 0$ mom delle forze

Calcolo $\vec{H}$ rispetto ad O $\Rightarrow$ rimane solo momento del peso e della forza di attrito:

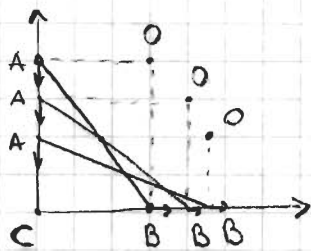
$$\frac{L}{2} Hg \cos \theta_{min} - F_s L \sin \theta_{min} = 0$$

$$\begin{cases} R_A = F_s \\ R_B = Hg \end{cases} ; \text{ se } F_s = R_B \mu_s \Rightarrow F_s = \mu_s Hg$$

$$\Rightarrow \frac{L}{2} Hg \cos \theta_{min} - Hg \mu_s L \sin \theta_{min} = 0$$

$$\boxed{\tan \theta_{min} = \frac{1}{2\mu_s}}$$

2) Tolgo l'attito. Descriviamo il moto:

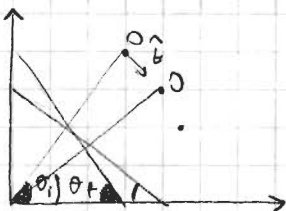


• Rapporto v_A e v_B : $v_A = L \cos \theta \dot{\theta}$
 $v_B = L \sin \theta \dot{\theta} \Rightarrow \boxed{\frac{v_A}{v_B} = \frac{1}{\tan \theta}}$

• Che moto fa il centro istantaneo di rotazione O?

Moto circolare intorno a C: $\overline{CO}$ è sempre costante = L

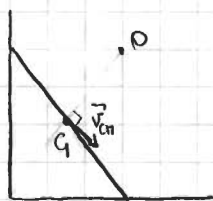
Inoltre $\dot{\theta}_O = \dot{\theta}$:



$$d\theta = \theta_f - \theta_i = d\theta$$

$$\Rightarrow \boxed{\vec{v}_O = L \dot{\theta} \hat{t}}$$

Nota che se O è il centro istantaneo di rotazione, allora anche CM ruota intorno ad O $\Rightarrow \vec{v}_{cm} \perp \overline{GO}$



$$\frac{d\vec{L}_O}{dt} = \vec{H}_O - \vec{v}_O \times \vec{P}$$

Troviamo $\ddot{\theta}$: $I_O(-\ddot{\theta}) = H_O$

$$H_O = Mg \frac{L}{2} \cos \theta + |\vec{v}_O \times \vec{P}|$$

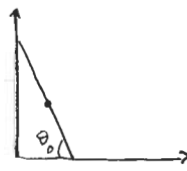
$$\Rightarrow I_O \ddot{\theta} = -Mg \frac{L}{2} \cos \theta$$

$$I_O = I_{cm} + M \frac{L^2}{4} = \frac{1}{12} ML^2 + \frac{1}{4} ML^2$$

$$\Rightarrow \boxed{\ddot{\theta} = -Mg \frac{L}{2} \frac{\cos \theta}{\frac{1}{3} ML^2} = -\frac{3}{2} \frac{g}{L} \cos \theta}$$

$$= \frac{1}{3} ML^2$$

Troviamo $\dot{\theta}$:



$t=0$

$$E_{\text{int}} = M g \frac{L}{2} \sin \theta_0$$

$$= E = \frac{1}{2} I_0 \dot{\theta}^2 + M g \frac{L}{2} \sin \theta$$

$$\Rightarrow \dot{\theta} = \sqrt{\frac{2 E_0 - M g L \sin \theta}{I_0}}.$$