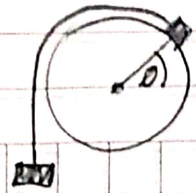
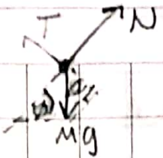


DCL

$\boxed{P_1}$



$\boxed{P_2}$

a) $\vec{l}_1 = m_1 \times \vec{r}_1 \times v_1 = m_1 R\hat{r} \times R\dot{\phi}\hat{\phi} = mR^2\dot{\phi}\hat{k}$

$\Rightarrow \dot{\vec{l}}_1 = mR^2\ddot{\phi}\hat{k}$

$\vec{\tau}_1 = \vec{r}_1 \times \sum \vec{F}_1 = R\hat{r} \times \left(\cancelto{0}{(N - m_1 g\,sen\,\phi)\hat{r}} + (T - mg\cos\phi)\hat{\phi} \right)$

$\Rightarrow \tau_1 = R(T - mg\cos\phi)\hat{k}$ / Porque $\hat{r} \times \hat{r} = 0$.

$\Rightarrow \dot{l}_1 = \tau_1 \iff m_1 R^2 \ddot{\phi} = R(T - m_1 g\cos\phi)$

b) Para m_1:

$\hat{\rho}]$ $m_1(\cancelto{0}{\ddot{\rho}} - \rho\dot{\phi}^2) = -m_1 R\dot{\phi}^2 = N - m_1 g\,sen\,\phi$

$\hat{\phi}]$ $m_1(\rho\ddot{\phi} - 2\cancelto{0}{\dot{\rho}}\dot{\phi}) = m_1 R\ddot{\phi} = T - m_1 g\cos\phi$

Para m_2:

$\hat{y}]$ $m_2\ddot{y} = m_2 g - T$

c) Igualamos T

$\Rightarrow -m_2\ddot{y} + m_2 g = m_1 R\ddot{\phi} + m_1 g\cos\phi$

Temos que

$$y = R\phi \Rightarrow \dot{y} = R\dot{\phi} \Rightarrow \boxed{\ddot{y} = R\ddot{\phi}}$$

$$m_2 g - m_2 R\ddot{\phi} = m_1 R\ddot{\phi} + m_1 g \cos\phi$$

$$\Rightarrow m_2 g - m_1 g \cos\phi = R\ddot{\phi}\,(m_1 + m_2)$$

$$\Rightarrow \ddot{\phi} = \frac{g}{R} \cdot \frac{(m_2 - m_1 \cos\phi)}{(m_1 + m_2)}$$

Temos $\ddot{\phi} = \dot{\phi}\,\dfrac{d\dot{\phi}}{d\phi}$

$$\Rightarrow \dot{\phi}\, d\dot{\phi} = \frac{g}{R(m_1 + m_2)} \cdot (m_2 - m_1 \cos\phi)\, d\phi \;/ \int$$

$$\Rightarrow \frac{\dot{\phi}^2}{2} = \frac{g}{R(m_1 + m_2)} \cdot (m_2 \phi - m_1 \operatorname{sen}\phi)$$

$$\Rightarrow \dot{\phi} = \sqrt{\frac{2g}{R(m_1 + m_2)} (m_2 \phi - m_1 \operatorname{sen}\phi)}$$

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