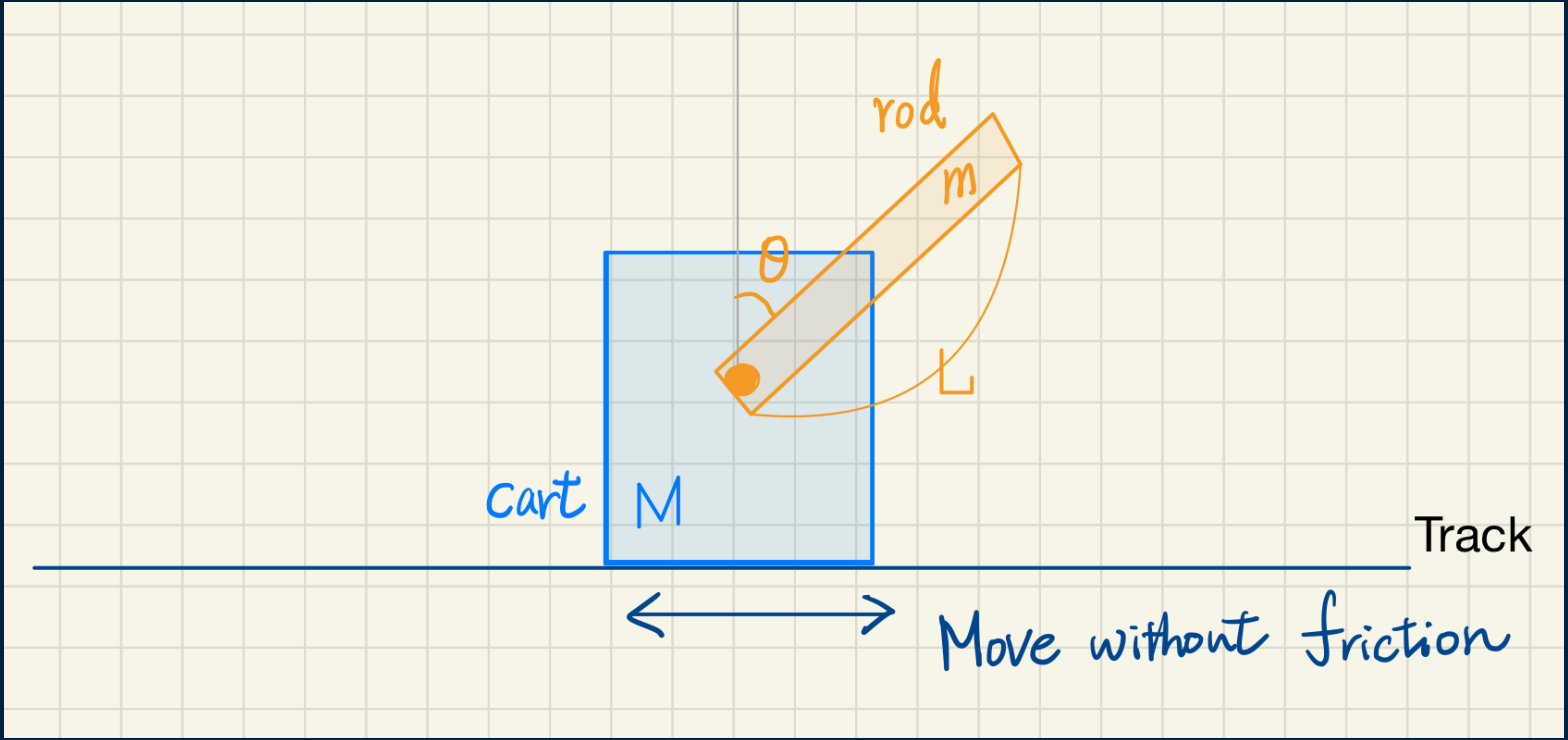
FINAL PROJECT 廖苡鈞 | 呂俐君 | 夏良語

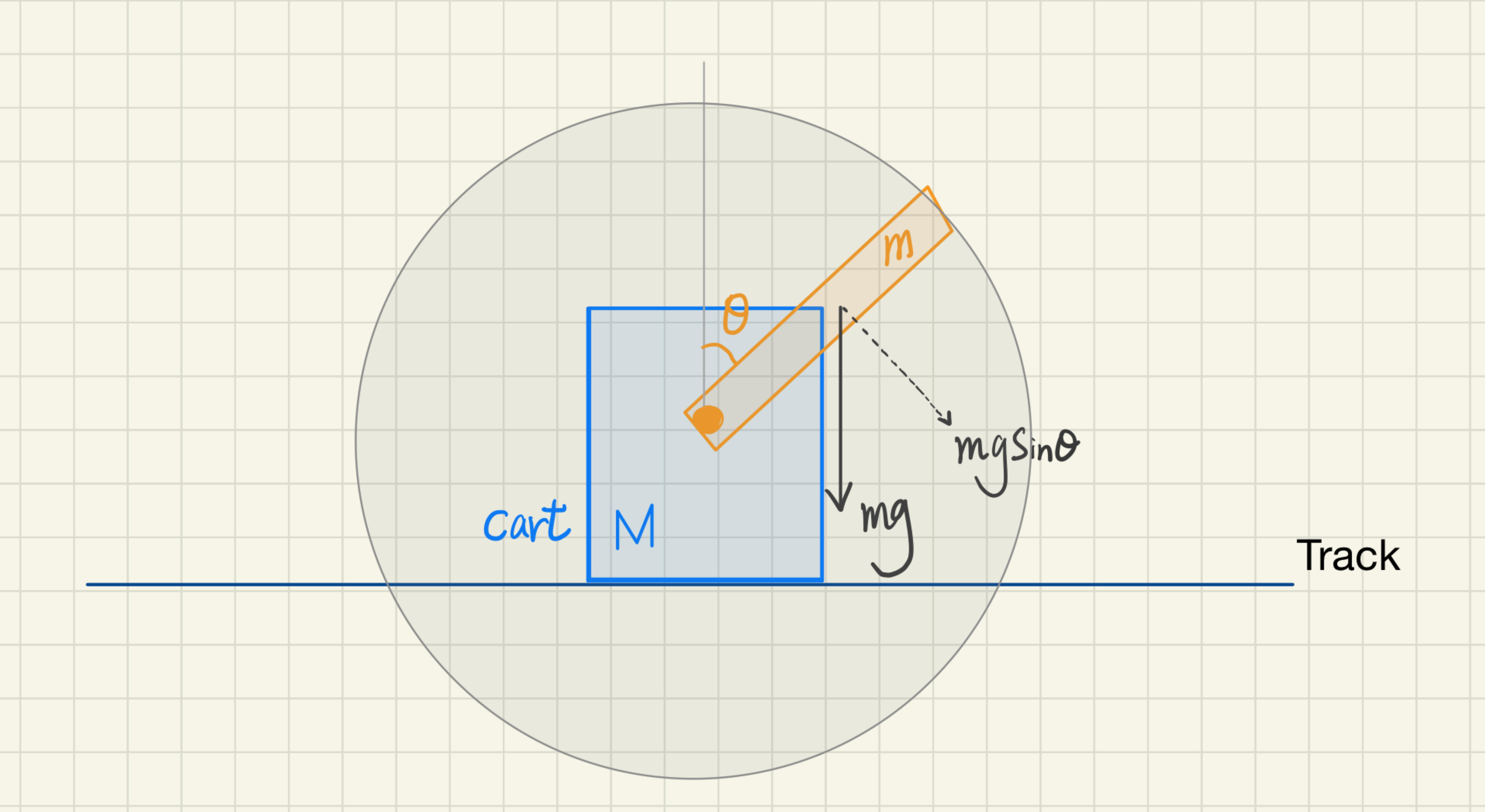
B09901014 B08901207 B09901049

INVERTED PENDULUM

裝置介紹



力學



(I) 看棒子與臺車的相對運動

$$\vec{\tau} = I\alpha = \left(\frac{1}{3}mL^2\right)\cdot\alpha$$

$$\vec{\tau} = \vec{r}\times\vec{F} = \frac{L}{2}\cdot mg\sin\theta$$

$$\Rightarrow \frac{L}{2}\cdot mg\sin\theta = \frac{1}{3}mL^2\alpha$$

(I) 看棒子與臺車的相對運動

$$\alpha = \frac{3g\sin\theta}{2L}$$

$$\omega += \alpha \cdot dt$$

$$\theta += \omega \cdot dt$$

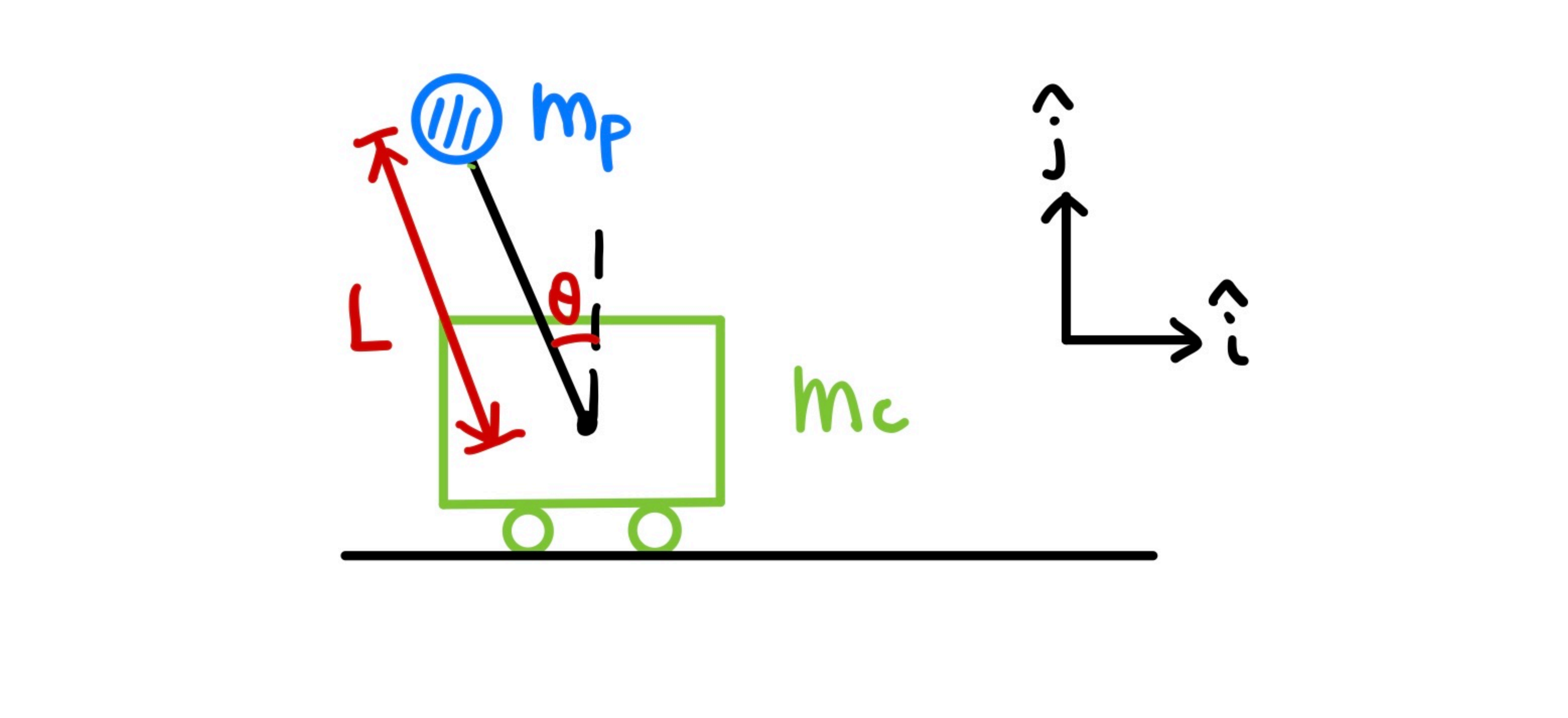
(II) 整體系統 計算質心位置

$$\Sigma F_x = 0 \Rightarrow C_{Mx} = \frac{M x_M + m x_m}{M+m} = \text{Fixed}$$

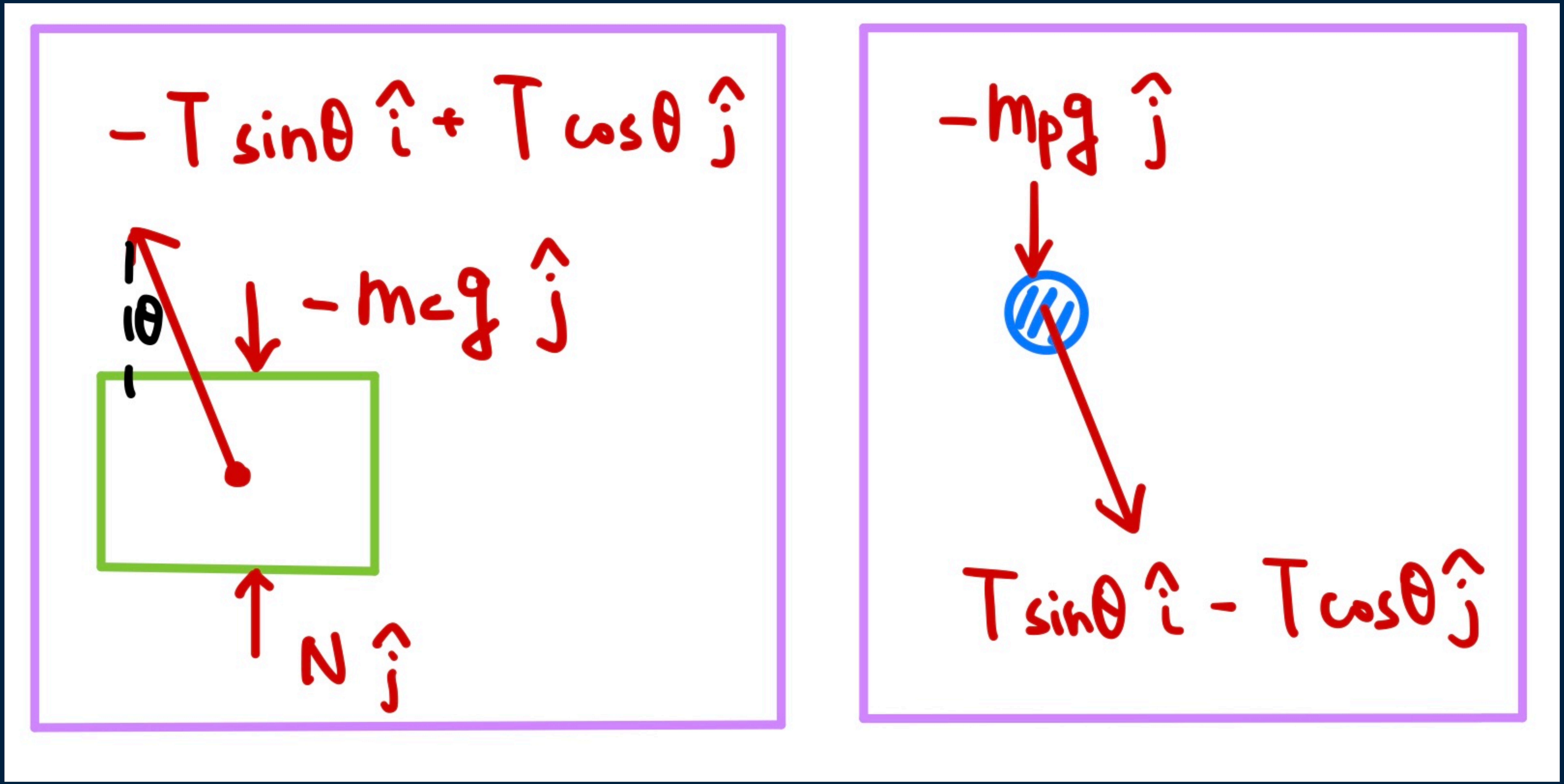
$$\Rightarrow x_M = \frac{C_{Mx_0}(M+m) - m x_m}{M}$$

$$\left(\text{where } C_{Mx_0} = \frac{M x_{M_0} + m x_{m_0}}{M+m} \right)$$

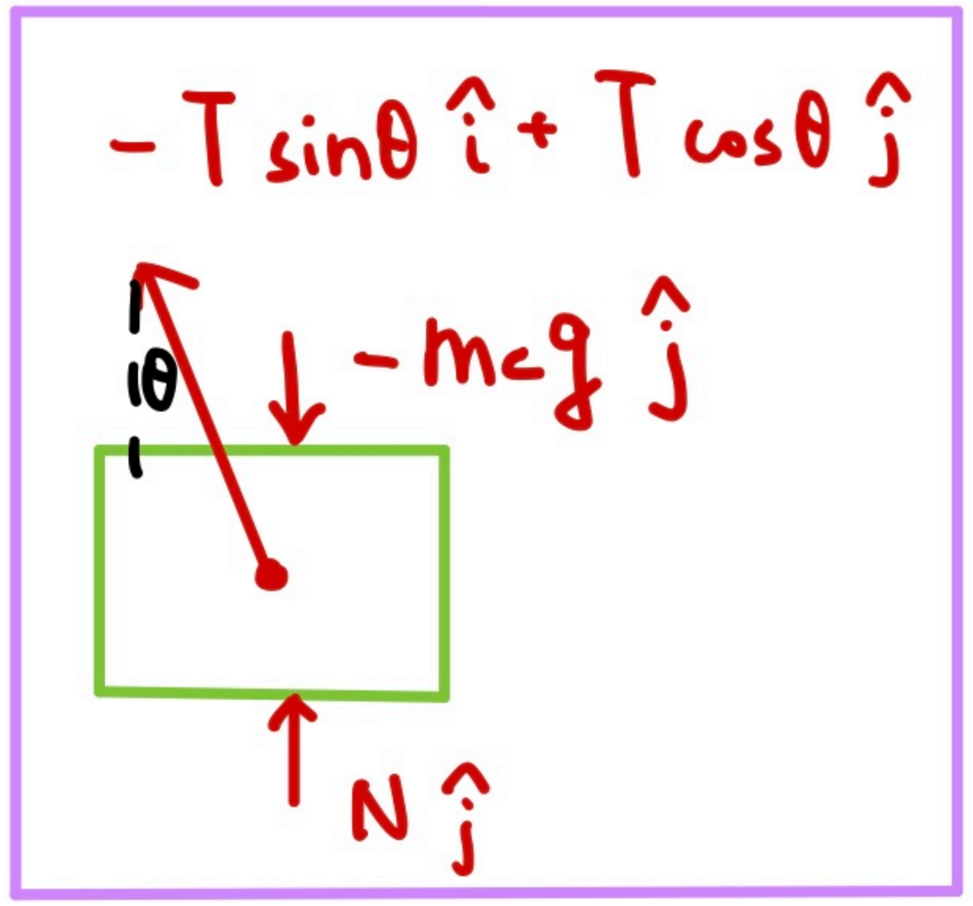
APPLICATIONS



APPLICATIONS

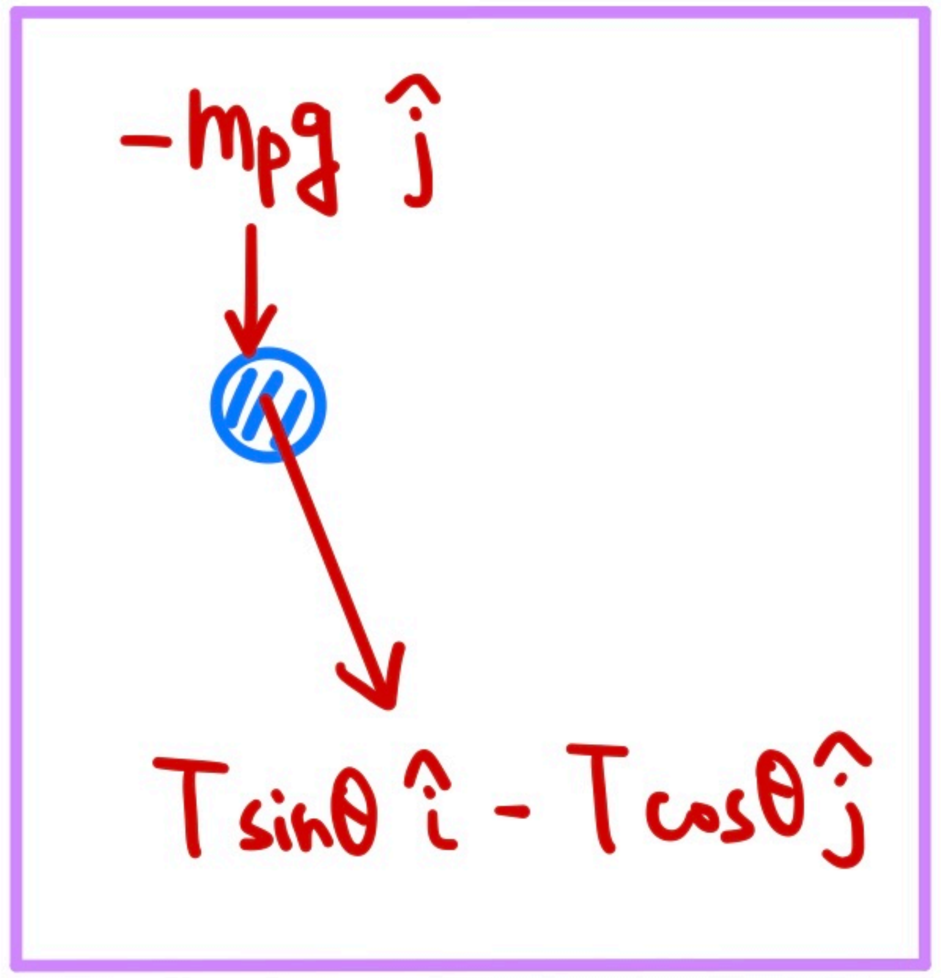


APPLICATIONS



$\hat{i}$:

$$-T\sin\theta = m_c a_{cx}$$



$\hat{i}$:

$$T\sin\theta = m_p a_{px}$$

$\hat{j}$:

$$-T\cos\theta - m_p g = m_p a_{py}$$

APPLICATIONS

```
T = -k*(rod.axis.mag-L) * rod.axis.norm()
cart.a.x = -T.x/cart.m
pendulum.a = vec(0,-g,0) + T/pendulum.m
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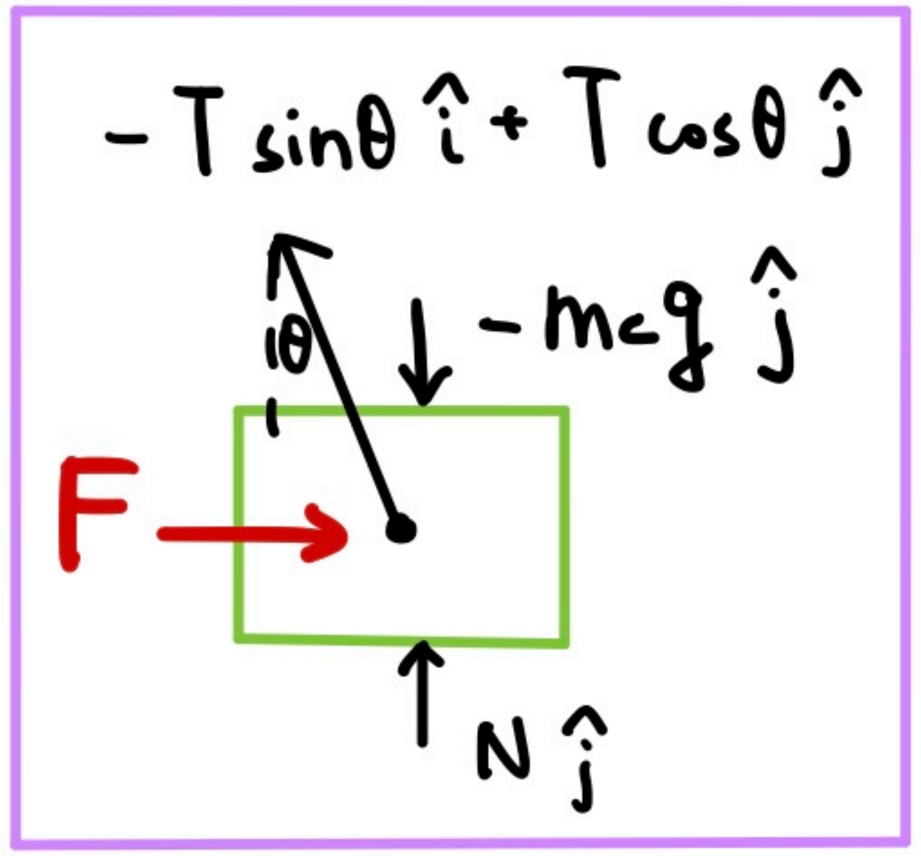
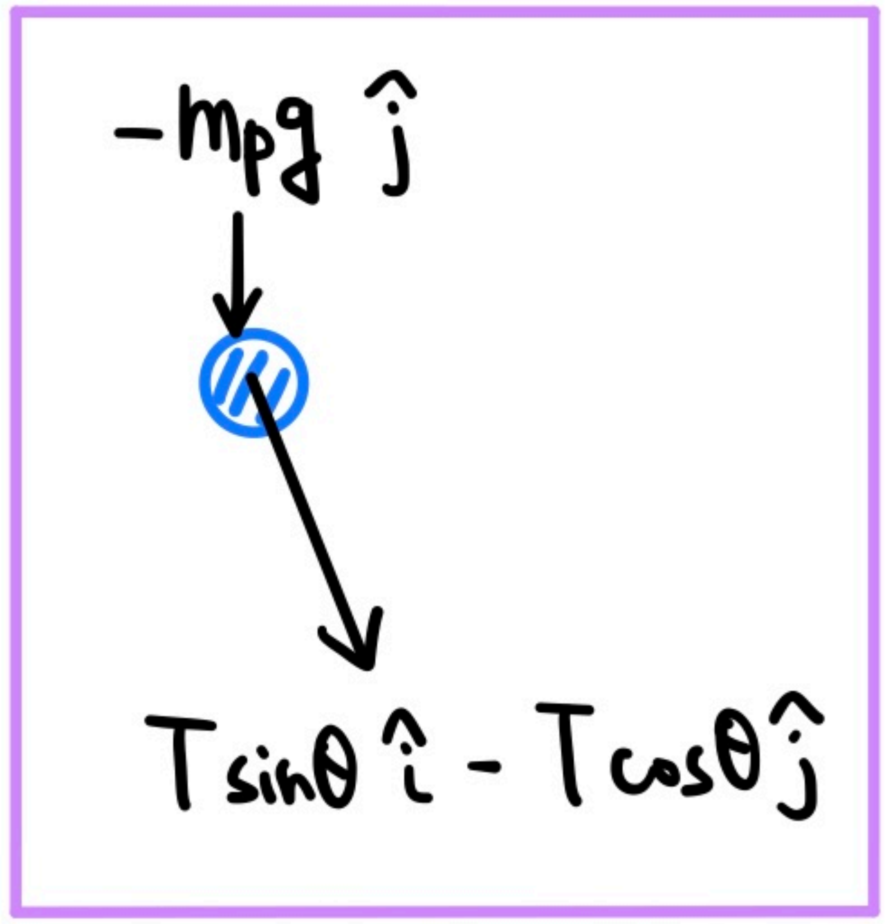
APPLICATIONS



$\hat{i}$:

$$F - T\sin\theta = m_c a_{cx}$$



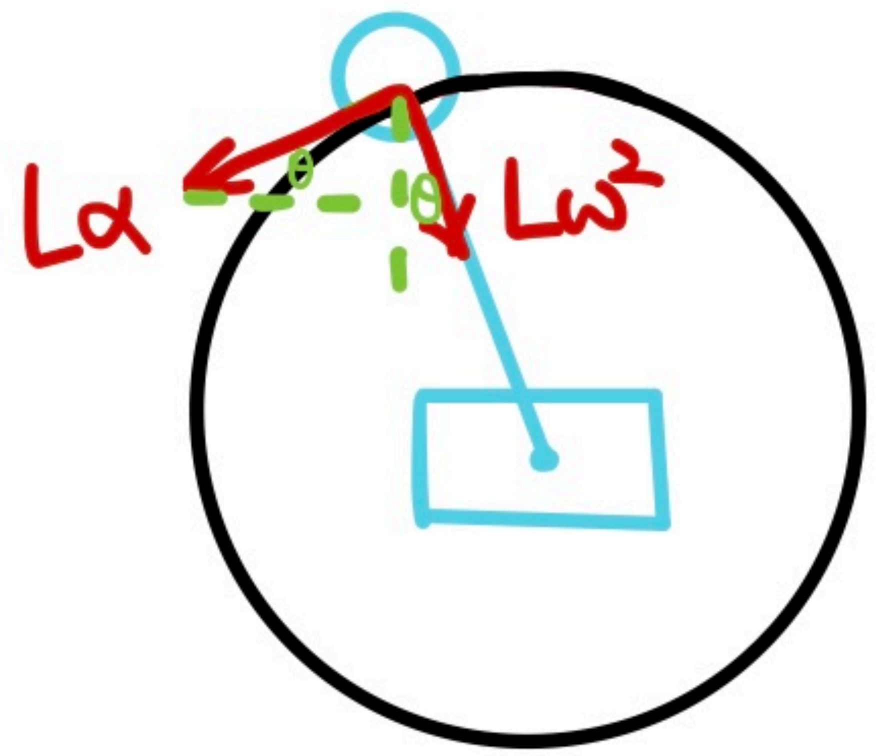
$\hat{i}$:

$$T\sin\theta = m_p a_{px}$$

$\hat{j}$:

$$-T\cos\theta - m_p g = m_p a_{py}$$

APPLICATIONS



$$a_p = a_c + a_{pc} = a_{cx}\hat{i} + (L\alpha - L\omega^2)$$

$$= a_{cx}\hat{i} + L\alpha[-\cos\theta\,\hat{i} - \sin\theta\,\hat{j}]$$

$$- L\omega^2[-\sin\theta\,\hat{i} + \cos\theta\,\hat{j}]$$

APPLICATIONS

1. $F - T\sin\theta = m_c a_{cx}$
2. $T\sin\theta = m_p a_{px}$
3. $-T\cos\theta - m_p g = m_p a_{py}$
4. $a_p = a_{cx}\hat{i} + L\alpha[-\cos\theta\,\hat{i} - \sin\theta\,\hat{j}] - L\omega^2[-\sin\theta\,\hat{i} + \cos\theta\,\hat{j}]$

$$\Rightarrow T\sin\theta = m_p a_{px}$$

$$= m_p a_{cx} - m_p L\alpha\cos\theta + m_p L\omega^2\sin\theta \quad (1)$$

$$-T\cos\theta - m_p g = -m_p L\alpha\sin\theta - m_p L\omega^2\cos\theta \quad (2)$$

APPLICATIONS

$(1)\cdot\cos\theta + (2)\cdot\sin\theta$:

$$-m_p g\sin\theta = m_p a_{cx}\cos\theta - m_p L\alpha$$

$F - T\sin\theta = m_c a_{cx}$:

$$F + m_p L\alpha\cos\theta - m_p L\omega^2\sin\theta = (m_p + m_c)\,a_{cx}$$

APPLICATIONS

ex:

自平衡滑行車

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THANK YOU