

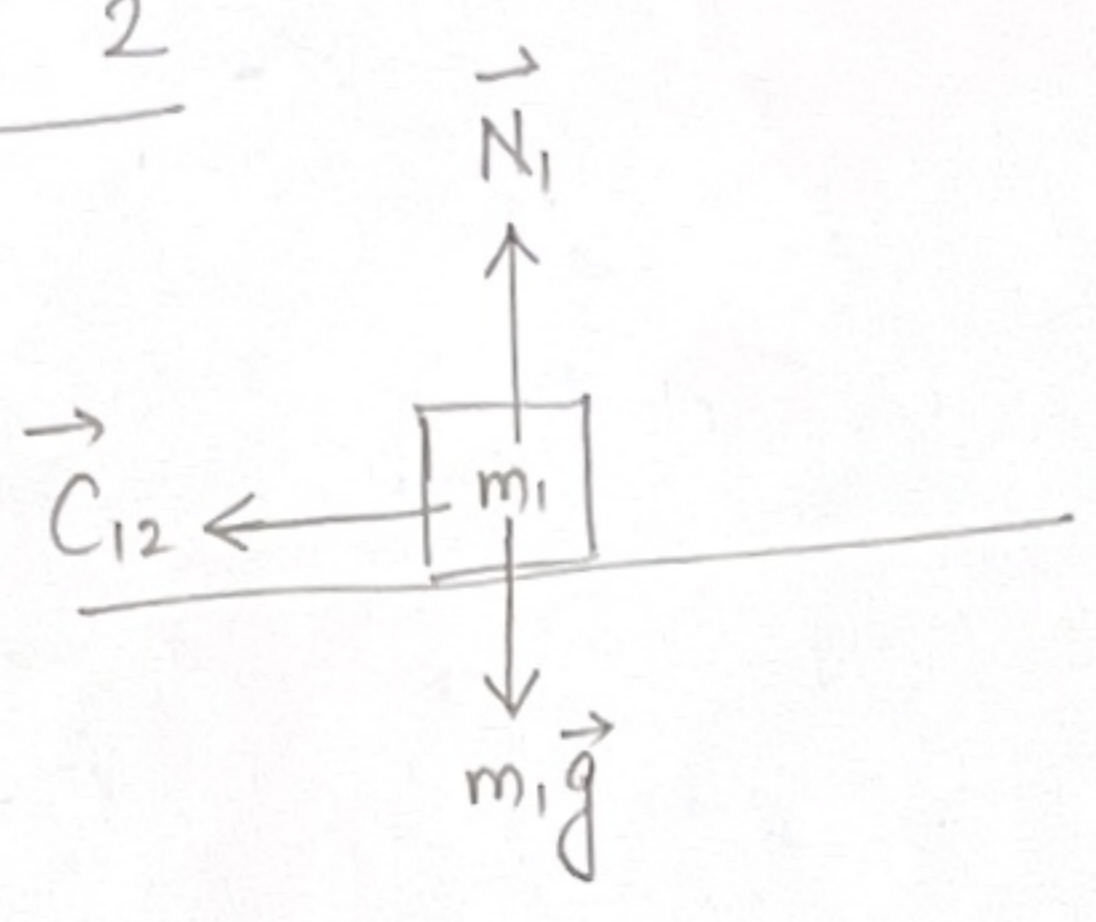
# Solutions

## Problem 1

$$\vec{a} = \vec{g} = -\hat{z} 9.8 \frac{m}{s^2}$$

$\hat{z}$  pointing upwards

## Problem 2



$\vec{N}_1$  - normal force on  $m_1$   
 $m_1 \vec{g}$  - gravitational force on  $m_1$   
 $\vec{C}_{12}$  - contact force on  $m_1$ , due to  $m_2$ , which is not equal to  $\vec{F}$

## Problem 3

$$\Delta K = \sum_i W_i$$

$$\begin{aligned} \sum_i W_i &= \frac{1}{2} m v_f^2 - \frac{1}{2} m v_i^2 \\ &= \frac{1}{2} (25) (10^2) - \frac{1}{2} (25) (5.0^2) \\ &= 940 \text{ J} \end{aligned}$$

$$\begin{aligned} v_i &= \sqrt{4.0^2 + 3.0^2} = 5.0 \frac{m}{s} \\ v_f &= \sqrt{6.0^2 + 8.0^2} = 10. \frac{m}{s} \end{aligned}$$

## Problem 4

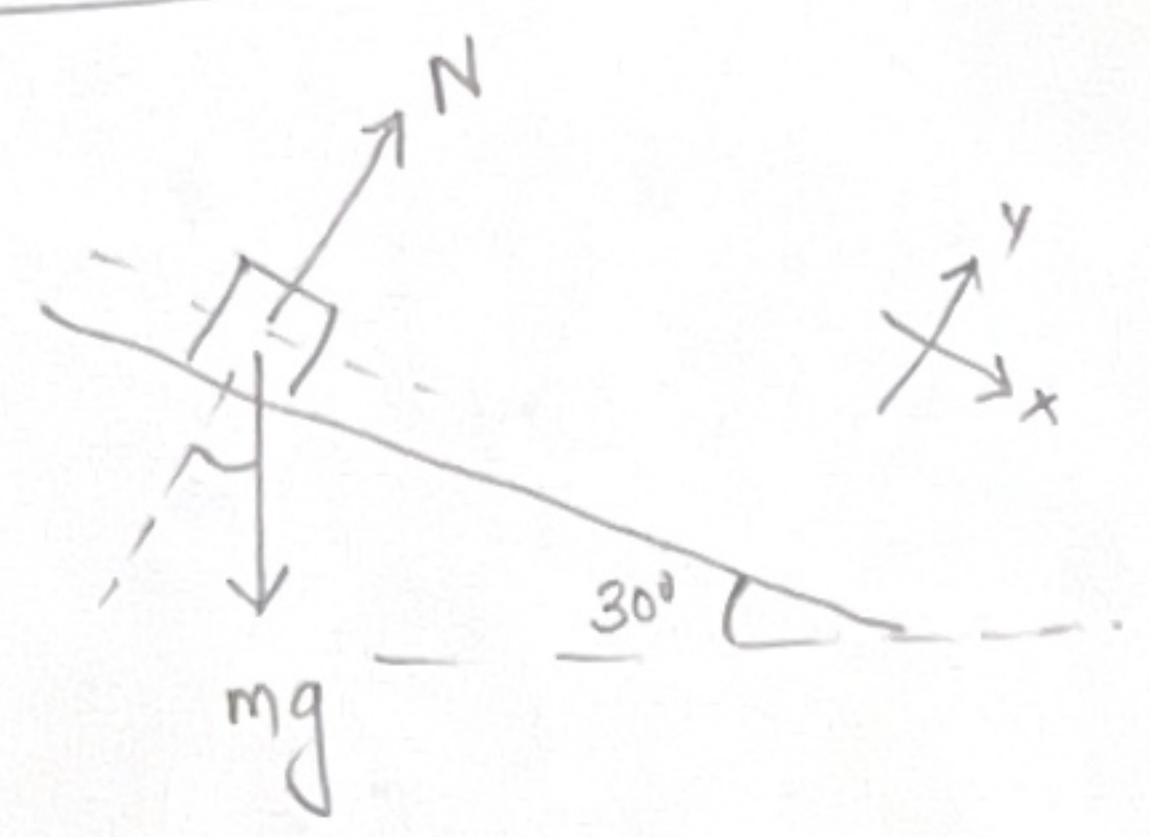
$$\frac{d}{dt} \vec{L} = \vec{\tau}_1 + \vec{\tau}_2 + \dots$$

$$\Rightarrow 0 = \vec{\tau}_1 + \vec{\tau}_2 + \dots$$

(since  $\vec{L}$  does not change)

$\Rightarrow$  total torque is zero.

Problem 5



$$m\vec{a} = m\vec{g} + \vec{N}$$

$$ma = mg \sin \theta$$

$$a = g \sin \theta$$

$$= 9.8 \sin(30)$$

$$= 4.9 \text{ m/s}^2$$

$$0 = -mg + N$$

$$N = mg$$

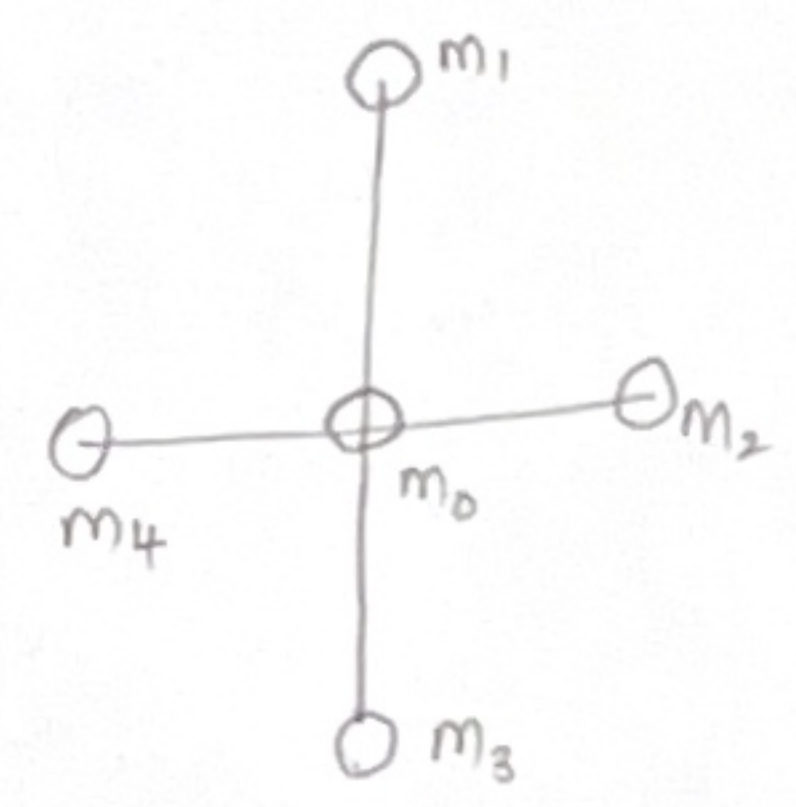
Problem 6

$$I = m_2 a^2 + m_4 a^2$$

$$= (2.0)(0.10)^2 + (4.0)(0.10)^2$$

$$= 0.060 \text{ kg m}^2$$

( $m_0, m_1, m_3$  are on the axis.)



Problem 7

$$\vec{g}_1 = \frac{Gm}{(\frac{L}{\sqrt{2}})^2} [-\cos 45 \hat{i} - \sin 45 \hat{j}]$$

$$\vec{g}_2 = \frac{Gm}{(\frac{L}{\sqrt{2}})^2} [+ \cos 45 \hat{i} - \sin 45 \hat{j}]$$


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$$\vec{g} = \frac{2GM}{L^2} [0 \hat{i} - 2 \frac{1}{\sqrt{2}} \hat{j}]$$

$$= -\hat{j} \frac{4GM}{\sqrt{2} L^2}$$

