

Solutions

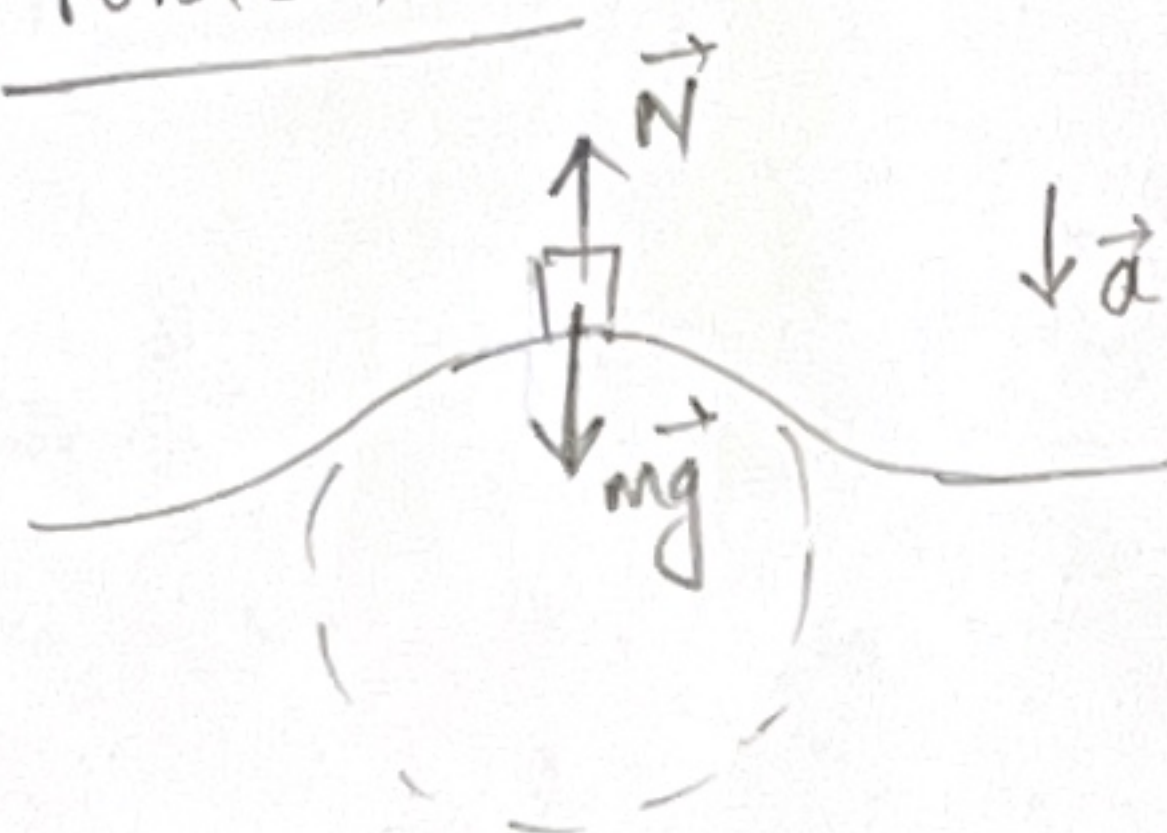
PHYS-205A-002

(Midterm Exam 02)

Fall 2025

(1)

Problem 1



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

$$a = \frac{v^2}{R}$$

(circular motion)

$$-m\frac{v^2}{R} = -mg + N$$

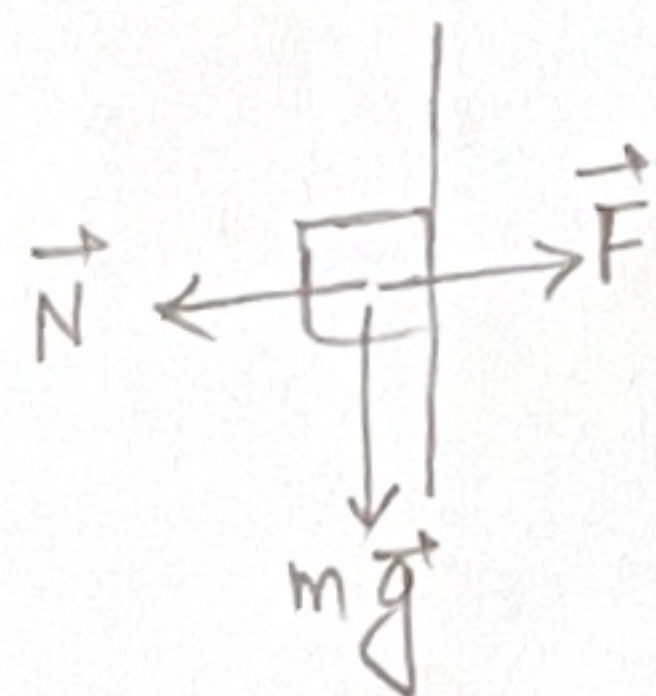
$$N = mg - m\frac{v^2}{R} < mg$$

$$N < mg \quad (\text{weighs lighter})$$

Problem 2

For massless strings and massless frictionless pulley the equations of motion for both systems are identical. Thus, $a' = a$.

Problem 3



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

$$x: 0 = 0 - N + F$$

$$F = N$$

$$y: ma = -mg + 0 + 0$$

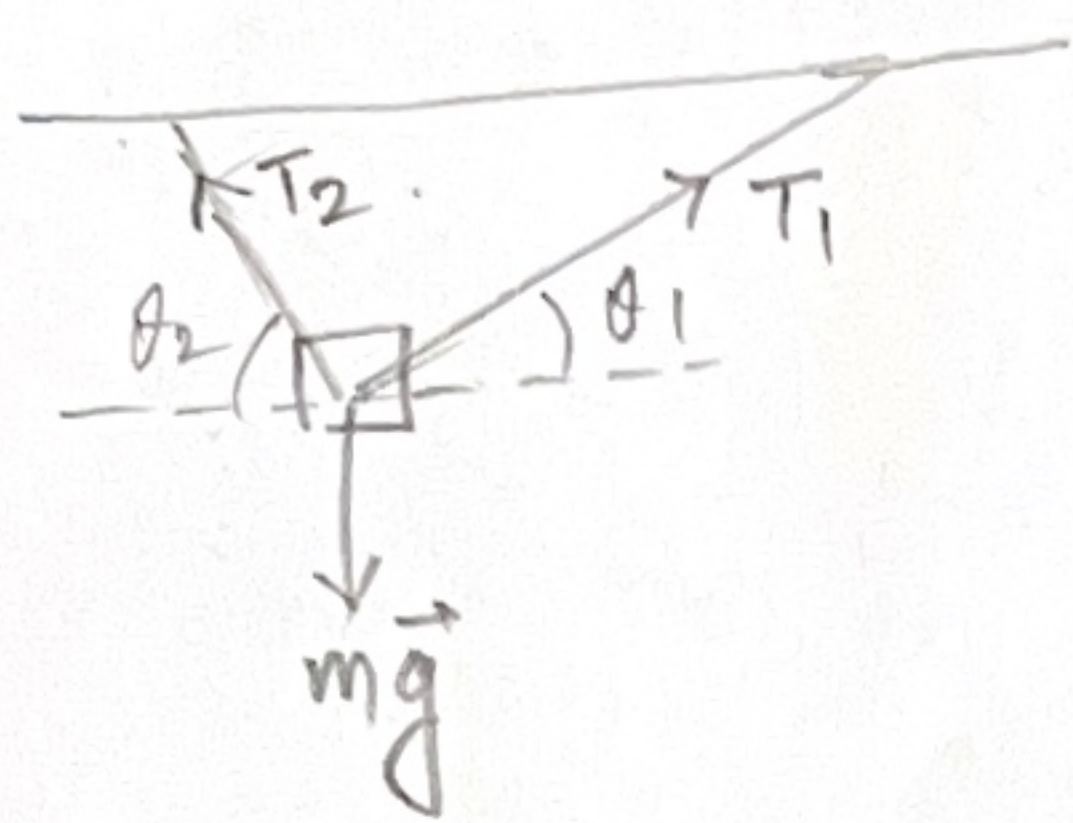
$$a_y = -g$$

It cannot be pinned, because $a_y = -g$.

Problem 4

Helium balloon moves opposite to traditional objects. So, it will move radially inward.

Problem 5



$$m\vec{a} = m\vec{g} + \vec{T}_1 + \vec{T}_2$$

x:

$$0 = 0 + T_1 \cos \theta_1 - T_2 \cos \theta_2$$

$$T_1 \cos \theta_1 = T_2 \cos \theta_2$$

$$T_1 \cos 30.0 = T_2 \cos 60.0$$

$$T_1 = 0.58 T_2$$

y:

$$0 = -mg + T_1 \sin \theta_1 + T_2 \sin \theta_2$$

$$T_1 \sin \theta_1 + T_2 \sin \theta_2 = mg$$

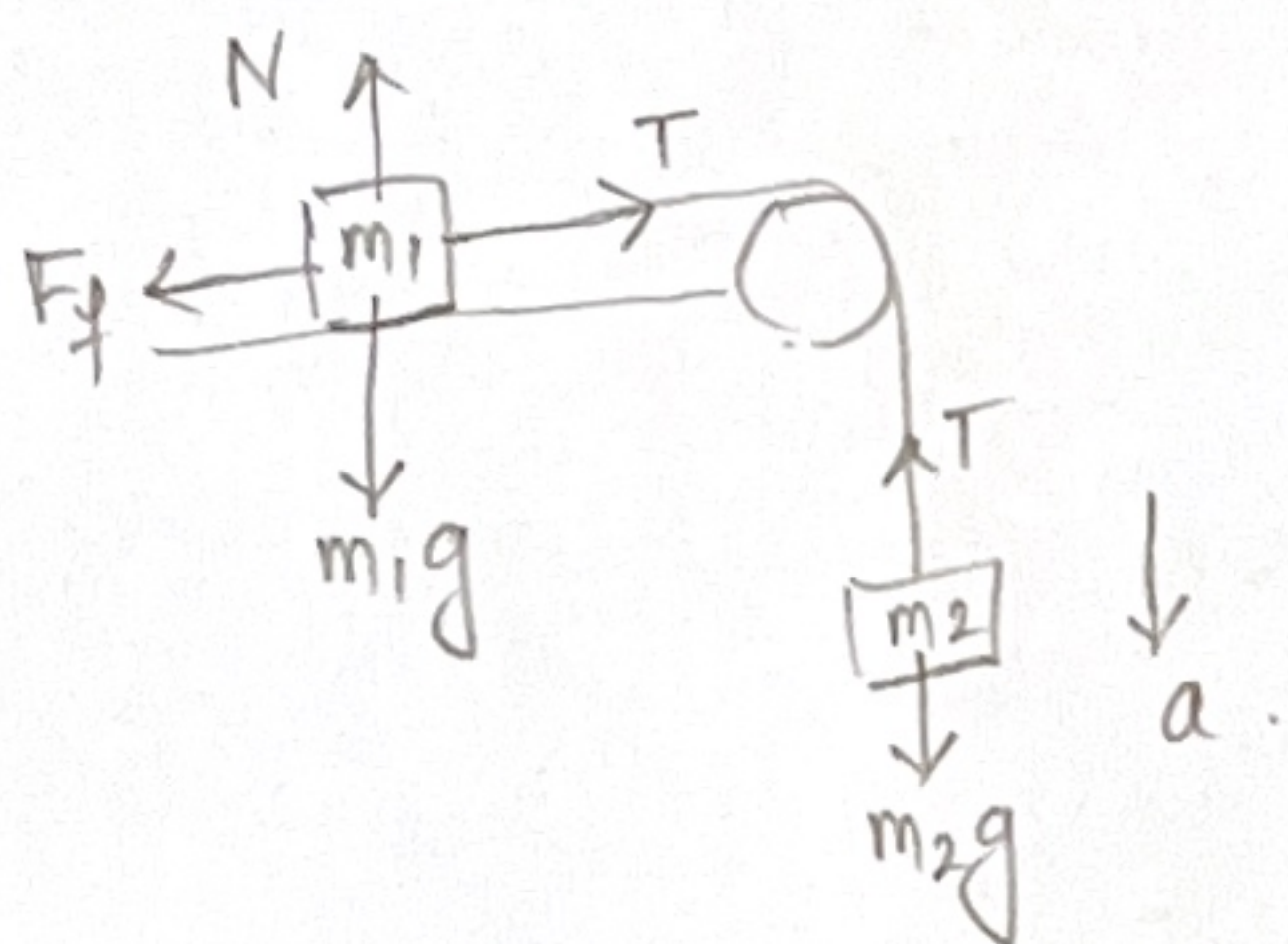
$$T_1 (0.50) + T_2 (0.87) = 196$$

$$(0.58) T_2 (0.50) + T_2 (0.87) = 196$$

$$T_2 = 170 \text{ N}$$

$$T_1 = 99 \text{ N}$$

Problem 6



$$m_2 \vec{a} = m_2 \vec{g} + \vec{T}$$

$$-m_2 a = -m_2 g + T$$

$$m_2 a = m_2 g - T$$

$$(m_1 + m_2) a = m_2 g - F_f$$

$$= 19.6 - 19.6$$

$$= 0$$

$$m_1 \vec{a} = m_1 \vec{g} + \vec{N} + \vec{T} + \vec{F}_f$$

$$N = m_1 g$$

$$m_1 a = T - F_f$$

$$F_f \leq \mu_s N$$

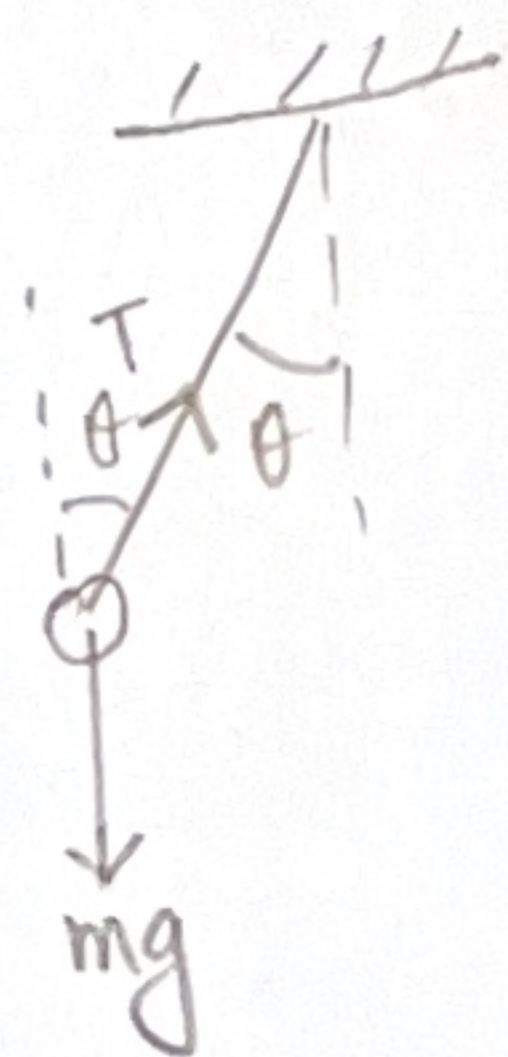
$$\leq \mu_s m_1 g$$

$$\leq 19.6 \text{ N}$$

max. value.

Thus, masses do not move.
So, $T = F_f = m_2 g = 196 \text{ Newtons}$

Problem 7



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

$$ma = T \sin \theta$$

$$0 = -mg + T \cos \theta$$

$$mg = T \cos \theta$$

Divide the two equations

$$a = g \tan \theta$$

$$= (9.8) \tan 30 = 5.7 \frac{\text{m}}{\text{s}^2}$$