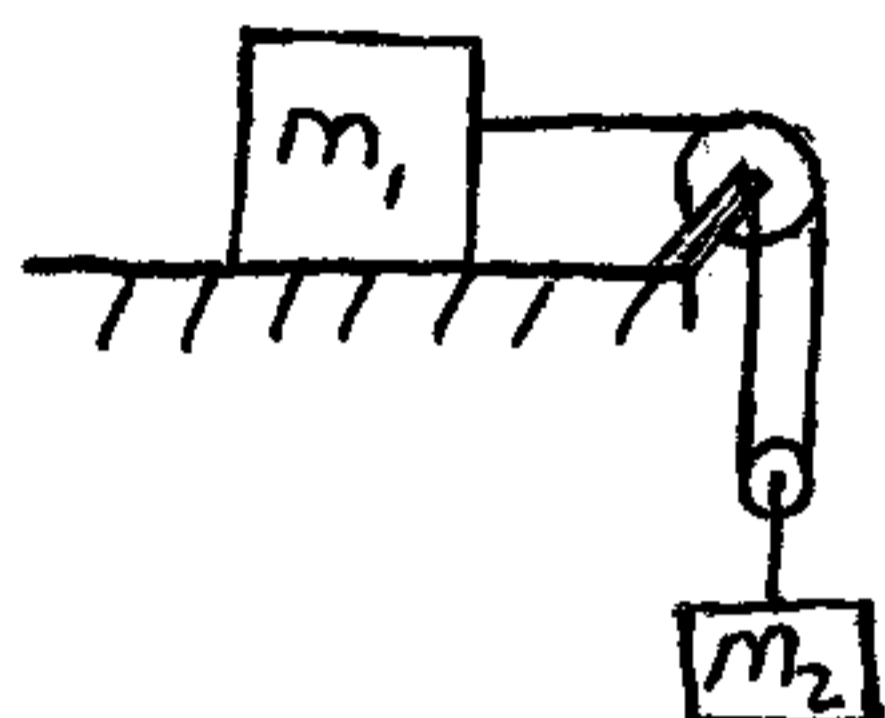


This is a force and motion problem involving pulleys.

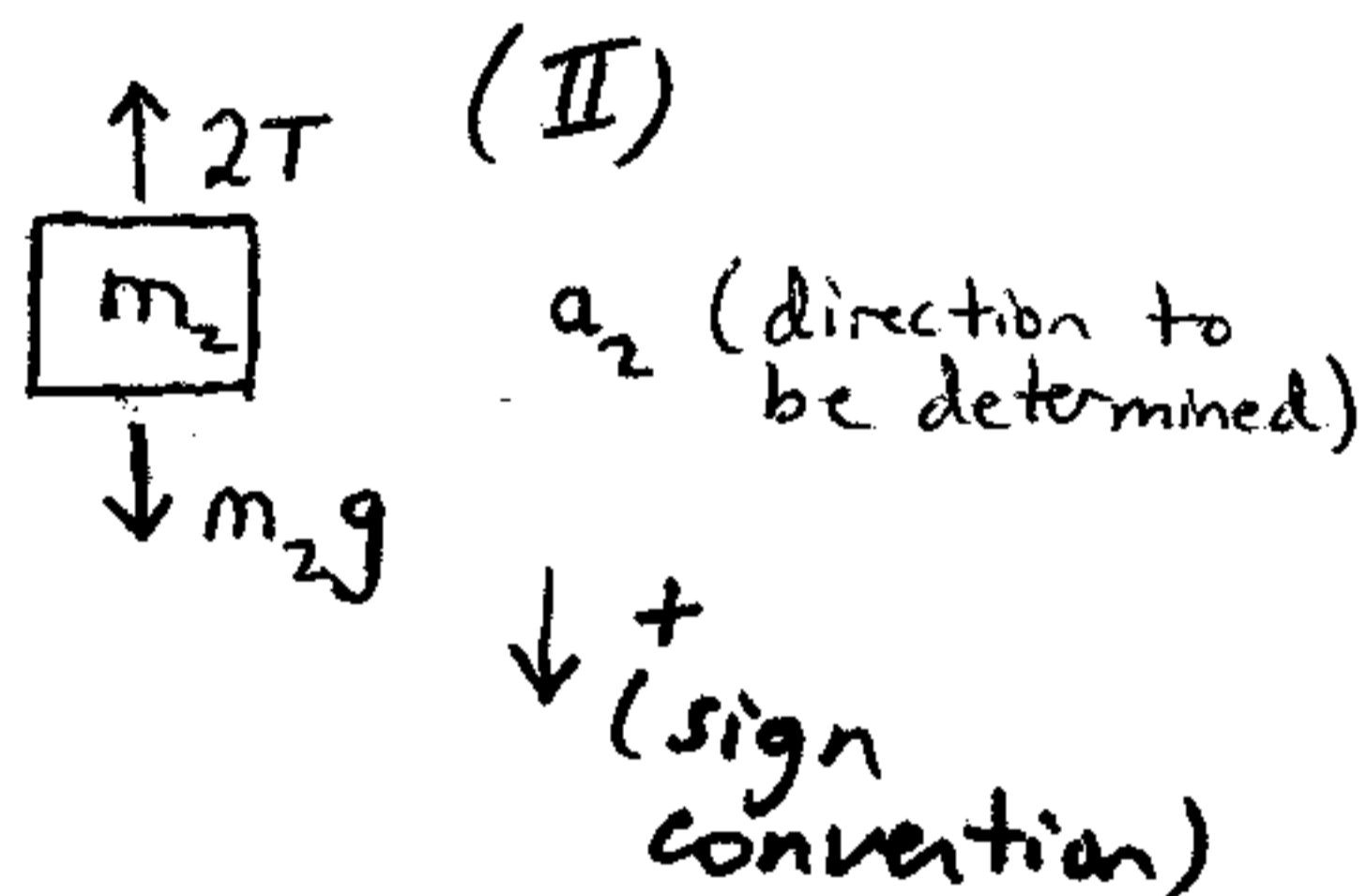
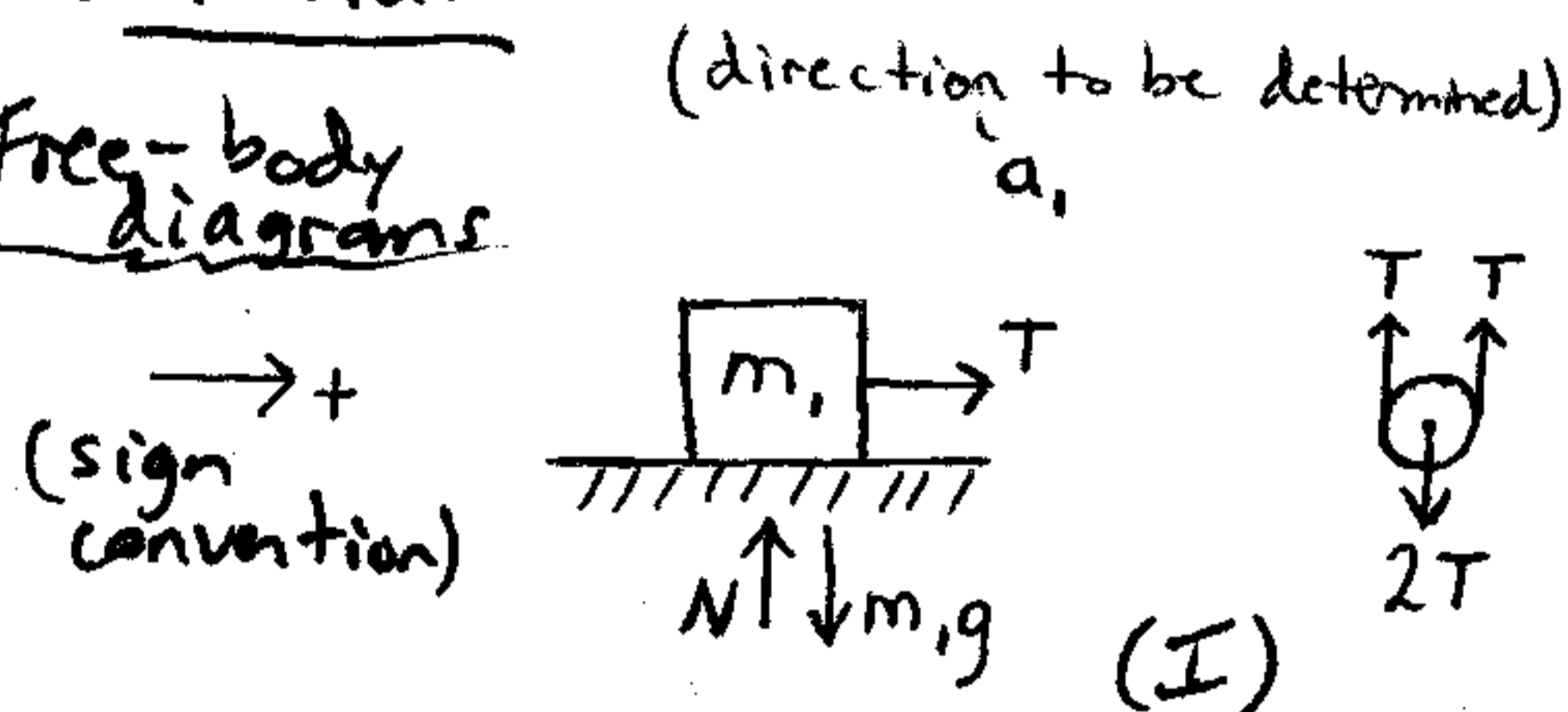


In the pulley system shown, the two blocks are released from rest. The sliding surface is frictionless, and the mass of the rope and pulleys is negligible. Determine the acceleration of each block and the tension in the rope.

Note that $m_1 = 10 \text{ kg}$
 and $m_2 = 20 \text{ kg}$.

Solution:

Free-body diagrams



From the kinematics of the problem, $a_2 = \frac{1}{2} a_1$ (1)

(I) Apply Newton's second law:

$$T = m_1 a_1 \quad (2)$$

(II) Apply Newton's second law:

$$m_2 g - 2T = m_2 a_2 \quad (3)$$

Substitute equation (2) into equation (3):

$$m_2 g - 2m_1 a_1 = m_2 a_2$$

Substitute equation (1) into above equation:

$$m_2 g - 4m_1 a_2 = m_2 a_2$$

$$\rightarrow a_2 = \frac{m_2 g}{4m_1 + m_2}$$

$$\rightarrow a_1 = \frac{2m_2 g}{4m_1 + m_2}$$

$$\rightarrow T = \frac{2m_1 m_2 g}{4m_1 + m_2}$$

Substitute given values:

$$\begin{aligned} a_2 &= 3.27 \text{ m/s}^2 \\ a_1 &= 6.53 \text{ m/s}^2 \\ T &= 65.3 \text{ N} \end{aligned} \quad (\text{answer})$$