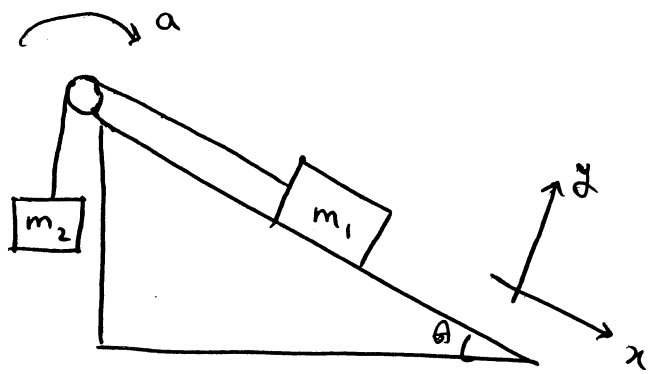
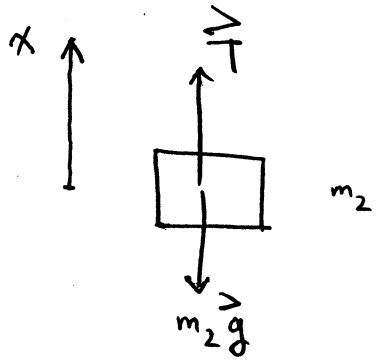
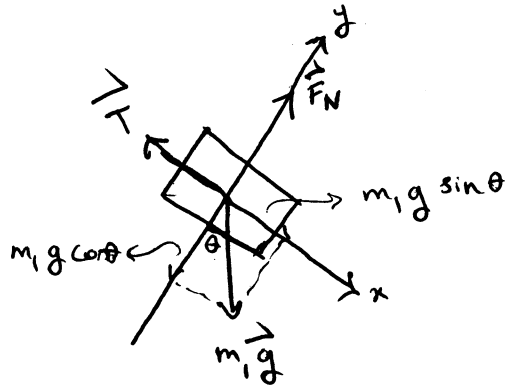
The first step in solving this type of problems is choosing the right coordinate system.

If we chose the x axis parallel and the y axis perpendicular to the ground, the equations would be more complicated (b/c we will have acceleration in both x and y directions). To get simpler equations the coordinate system should be tilted; x axis is parallel to incline and y axis is perpendicular to that

pulley is changing the direction of the tension force







$\sum \vec{F} = m\vec{a}$ → second Newton's law

$m_2 \Rightarrow$ x: There is no force in the x direction

y: $T - m_2 g = m_2 a_2$

$m_1 \Longrightarrow$ x: $m_1 g \sin\theta - T = m_1 a_x$

y: $m_1 g \cos\theta - F_N = m_1 a_y$

direction of movement

m_1 does not move perpendicular to the inclined surface, so $a_y = 0$

Since the cord is massless and frictionless $\Rightarrow$ $a_2 = a_x = a$

$\Longrightarrow$ The equations change to:

$$\begin{cases} T - m_2 g = m_2 a \\ m_1 g \sin\theta - T = m_1 a \\ m_1 g \cos\theta - F_N = 0 \end{cases}$$

To find "a" we need to solve the following system of equations:

$$\begin{cases} T - m_2 g = m_2 a \\ m_1 g \sin\theta - T = m_1 a \end{cases}$$

$$m_1 g \sin\theta - \cancel{T} + \cancel{T} - m_2 g = m_2 a + m_1 a$$

$$\Rightarrow m_1 g \sin\theta - m_2 g = a(m_1 + m_2) \Rightarrow a = \frac{m_1 g \sin\theta - m_2 g}{m_1 + m_2}$$

$$\Rightarrow a = \frac{g(m_1 \sin\theta - m_2)}{m_1 + m_2}$$

b) If $a > 0$ → then the assumed direction is correct

$$a > 0 \Rightarrow \frac{g(m_1 \sin\theta - m_2)}{m_1 + m_2} > 0 \Rightarrow g(m_1 \sin\theta - m_2) > 0$$

$$\Rightarrow m_1 \sin\theta - m_2 > 0 \Rightarrow m_1 \sin\theta > m_2 \Rightarrow m_1 \text{ moves down the inclined surface}$$

$m_1 \sin\theta = m_2 \Rightarrow$ No movement

$m_1 \sin\theta < m_2 \longrightarrow m_1$ moves up the inclined surface