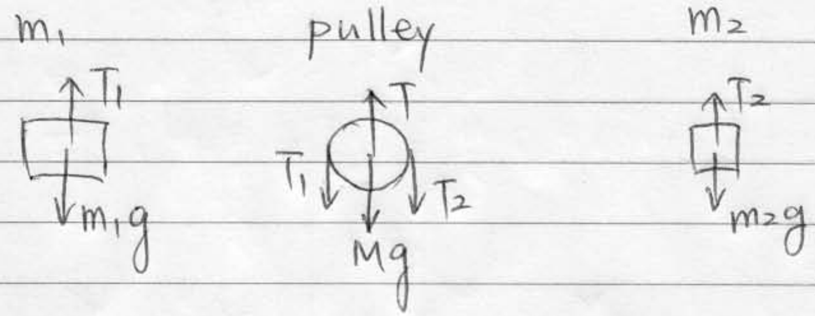
3. (a)



T_1 & T_2 give rise to nonzero torques.

(b) The pulley has moment of inertia $I = \frac{M}{2}R^2$

for m_1

$m_1 a_1 = m_1 g - T_1$

for pulley

$$\begin{cases} \tau = I\alpha \\ \tau = (T_1 - T_2)R \\ I = \frac{M}{2}R^2 \end{cases}$$

for m_2

$m_2 a_2 = T_2 - m_2 g$

$a_1 = a_2 = \alpha R = a$

So, we'll have $a_1 = \dfrac{m_1 - m_2}{\frac{M}{2} + m_1 + m_2} g$

(c) $E_{m_1} + E_{m_2} + E_{pulley} = E_{m_1}' + E_{m_2}' + E_{pulley}'$

$\Delta E_{m_1} = E_{m_1}' - E_{m_1} = -m_1 g h + \frac{1}{2} m_1 v^2$

$\Delta E_{m_2} = +m_2 g h + \frac{1}{2} m_2 v^2$

$\Delta E_{pulley} = \frac{I}{2}\left(\frac{v}{R}\right)^2 = \frac{1}{2} \cdot \frac{MR^2}{2} \cdot \frac{v^2}{R} = \frac{Mv^2}{4}$

$\Delta E_{m_1} + \Delta E_{m_2} + \Delta E_{pulley} = 0$

$\cancel{mgh}$ $-m_1 g h + \frac{1}{2} m_1 v^2 + m_2 g h + \frac{1}{2} m_2 v^2 + \frac{Mv^2}{4} = 0$

$v = \sqrt{\dfrac{4(m_1 - m_2)gh}{M + 2(m_1 + m_2)}}$