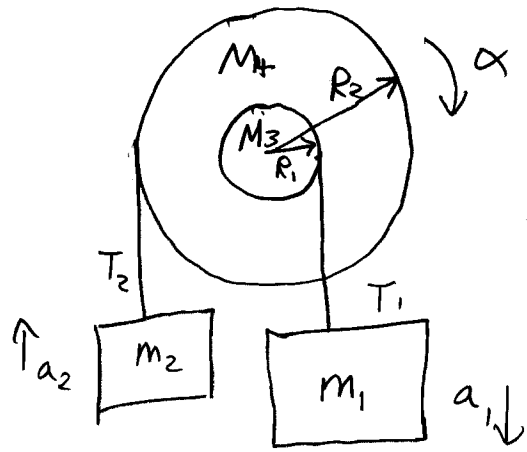
Problem: find the acceleration of block m_1.



Solution:

① $\Sigma \tau = I\alpha$

② $T_1R_1 - T_2R_2 = \left(\frac{1}{2}M_3R_1^2 + \frac{1}{2}M_4R_2^2\right)\alpha$

③ $\Sigma F_1 = m_1 a_1$

④ $m_1 g - T_1 = m_1 a_1$

⑤ $\Sigma F_2 = m_2 a_2$

⑥ $T_2 - m_2 g = m_2 a_2$

⑦ $a_1 = \alpha R_1$, $a_2 = \alpha R_2$

⑧ $\Rightarrow \alpha = \frac{a_1}{R_1}$ $\Rightarrow a_2 = \frac{a_1 R_2}{R_1}$

⑨ $T_1 = m_1 g - m_1 a_1$

⑩ $T_2 = m_2 \frac{a_1 R_2}{R_1} + m_2 g$

⑪ $(m_1 g - m_1 a_1)R_1 - \left(m_2 a_1 \frac{R_2}{R_1} + m_2 g\right)R_2 = \left(\frac{1}{2}M_3R_1^2 + \frac{1}{2}M_4R_2^2\right)\frac{a_1}{R_1}$

⑫ $R_1\left[m_1 g R_1 - m_1 a_1 R_1 - m_2 a_1 \frac{R_2^2}{R_1} - m_2 g R_2\right] = \left(\frac{1}{2}M_3R_1^2 + \frac{1}{2}M_4R_2^2\right)a_1$

⑬ $-\left(m_1R_1^2 + m_2R_2^2\right)a_1 + \left(m_1R_1 - m_2R_1R_2\right)g = \left(\frac{1}{2}M_3R_1^2 + \frac{1}{2}M_4R_2^2\right)a_1$

⑭ $\left(m_1R_1 - m_2R_1R_2\right)g = \left(\frac{1}{2}M_3R_1^2 + \frac{1}{2}M_4R_2^2 + m_1R_1^2 + m_2R_2^2\right)a_1$

⑮ $$a_1 = \frac{R_1(m_1 - m_2R_2)}{\frac{1}{2}M_3R_1^2 + \frac{1}{2}M_4R_2^2 + m_1R_1^2 + m_2R_2^2}\, g$$