85. (First problem in **Cluster 2**)

The last line of the problem indicates our choice of positive directions: up for m_2, down for m_1 and counterclockwise for the two-pulley device. This allows us to write $R_2\alpha = a_2$ and $R_1\alpha = a_1$ with all terms positive. We apply Newton's second law to the elements of this system:

$$\begin{aligned}
T_2 - m_2 g &= m_2 a_2 = m_2 R_2 \alpha \\
m_1 g - T_1 &= m_1 a_1 = m_1 R_1 \alpha \\
T_1 R_1 - T_2 R_2 &= I\alpha
\end{aligned}$$

Multiplying the first equation by R_2, the second by R_1 and adding the equations leads to

$$\alpha = \frac{m_1 g R_1 - m_2 g R_2}{I + m_1 R_1^2 + m_2 R_2^2} \quad .$$

(a) Therefore, again using $R_1\alpha = a_1$, we obtain

$$a_1 = \frac{m_1 g R_1^2 - m_2 g R_1 R_2}{I + m_1 R_1^2 + m_2 R_2^2} \quad .$$

(b) Once more, we use $R_2\alpha = a_2$ and find

$$a_2 = \frac{m_1 g R_1 R_2 - m_2 g R_2^2}{I + m_1 R_1^2 + m_2 R_2^2} \quad .$$