Two blocks are suspended from the ceiling of an elevator using ideal ropes as shown. Block A has a given mass $m_a$ and Block B has given mass $m_b$ kg. The elevator is accelerating downward with constant acceleration given by: $a_y = -A$ where $0 < A < g$.

Reminder: If a rope has tension $T$, then it acts so that this same force $T$ is applied to bodies both ends of the rope. Tension always pulls toward the rope. The two ropes do not have the same tension.

Part (a) Draw Free Body Diagrams for both blocks that clearly indicate all forces on each block.

Part (b) Use Newton’s Second Law to determine the tension in each of the two pieces of rope. Be sure to show your work and do not skip steps.
Solution to Practice Problem P02:

We label the upper rope “1” and the lower rope “2”. These are two different ropes so we expect two different tensions.

We set up two FBDs, one for each block:

All of the forces are vertical. We apply Newton’s Second Law to each body, starting with Block B since the FBD is a little simpler:

\[ F_B = m_B a_y \]

There are two forces on Block B:

\[ T_2 - W_B = m_B a_y \]

And since we are in an elevator, we know \( a_y = -A \):

\[ T_2 - W_B = m_B (-A) \]

Solving for the one unknown, \( T_2 \) we get:

\[ T_2 = W_B + m_B (-A) \]
\[ T_2 = m_B g - m_B A \]
\[ T_2 = m_B (g - A) \]

Next, we apply Newton’s Second Law to Block A:

\[ F_A = m_A a_y \]

Using the FBD we see there are three forces, one up, two down:
\[ T_1 - W_A - T_2 = m_A a_y \]

And we know the acceleration:

\[ T_1 - W_A - T_2 = m_A (-A) \]

Solving for the unknown tension \( T_1 \) and using our result for \( T_2 \):

\[ T_1 = W_A + T_2 - m_A A \]

\[ T_1 = m_A g + m_B (g - A) - m_A A \]

\[ T_1 = (m_A + m_B) (g - A) \]