**SOLUTION TO BLOCK & STRING PROBLEM IN LECTURE 3**

1) **FREEBODY DIAGRAMS**
   - \( m_1 = 1.8 \text{ kg} \)
   - \( m_2 = 10.2 \text{ kg} \)

2) **FIND MAGNITUDE OF ACCELERATIONS**
   - \( N = m_1 g \)
   - Block 1: \( T \neq m_2 g \) (NOT IN EQUILIBRIUM)
   - Block 2: \( T = m_2 g \)

**FREE BODY DIAGRAMS**

<table>
<thead>
<tr>
<th>Block 1</th>
<th>Block 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>NO NET VERTICAL FORCE</td>
<td>NO NET HORIZONTAL FORCE</td>
</tr>
<tr>
<td>( \downarrow N )</td>
<td>( \uparrow T )</td>
</tr>
<tr>
<td>( m_1 g )</td>
<td>( m_2 g )</td>
</tr>
</tbody>
</table>

**NOTE:** GOOD CHOICE OF SIGNS IN A BLOCK & STRING PROBLEM CAN AVOID CONFUSION.

**CHOICE OF SIGN CONVENTION:** BECAUSE STRING IS INVOLVED, THE MOTIONS OF THE TWO BLOCKS ARE CONNECTED SO WE MUST ENSURE THAT THE SIGNS USED FOR THE TWO BLOCKS ARE LOGICALLY CONSISTENT.

**FOR BLOCK 1:** SUPPOSE MOTION TO THE RIGHT IS \( + \text{VE} \).

**FOR BLOCK 2:** WHICH WILL ONLY MOVE VERTICALLY, IF BLOCK 1 MOVES IN THE \( + \text{VE} \) DIRECTION, BLOCK 2 MUST MOVE DOWN BECAUSE OF THE STRING.

**THEREFORE WE MUST MAKE \( + \text{VE} \) DIRECTION FOR BLOCK 2.**

**SIGN CONVENTION:** \( \uparrow \rightarrow \downarrow \) (WE COULD ALSO HAVE USED \( \downarrow \rightarrow \uparrow \))

<table>
<thead>
<tr>
<th>Block 1 HORIZONTAL</th>
<th>Block 2 VERTICAL</th>
</tr>
</thead>
<tbody>
<tr>
<td>( F_h = m_1 a = + T ) ( \rightarrow ) eqn 1</td>
<td>( F_v = m_2 a = m_2 g - T ) ( \rightarrow ) eqn 2</td>
</tr>
</tbody>
</table>

**SIMULTANEOUS EQUATION:**

\[
\begin{align*}
1) & \quad m_1 a + m_2 a = T + m_2 g - T \\
2) & \quad a(m_1 + m_2) = m_2 g \\
\end{align*}
\]

\[
\alpha = \frac{m_2 g}{m_1 + m_2} = \frac{10.2 \times 9.81}{1.8 + 10.2} = 8.339 \text{ m/s}^2 \approx 8.3 \text{ m/s}^2 \text{ (BLOCK 1 DOWN)}
\]

**TO FIND \( T \):**

\[
m_1 a = T = 1.8 \times 8.3 = 15.0 \text{ N} \approx 15 \text{ N} = T
\]