Example

A 200-kg mass is suspended from two light, inextensible cables tied together as shown. Find the tension in cable \( AC \) and \( BC \).

\[ \sum F_x = 0 \]  \[ T_{CB} \cos 75^\circ - T_{CA} \sin 75^\circ = 0 \]  \[ (1) \]

\[ \sum F_y = 0 \]  \[ T_{CB} \sin 75^\circ - T_{CA} \cos 75^\circ - mg = 0 \]  \[ 2 \text{ Eqs, 2 Unknowns} \]  \[ (2) \]

\[ T_{CB} = T_{CA} \tan 75^\circ \]

\[ T_{CA} \tan 75^\circ \cdot \sin 75^\circ = T_{CA} \cos 75^\circ = mg \]

\[ T_{CA} = \frac{mg}{\tan 75^\circ \cdot \sin 75^\circ - \cos 75^\circ} = \frac{200 \text{ kg} \cdot 9.81 \frac{\text{m}}{\text{s}^2}}{3.605 - 0.2588} \]

\[ = 586 \text{ N} \]

\[ T_{CB} = (586 \text{ N}) (\tan 75^\circ) = 2190 \text{ N} \]
Example

A light inextensible cable of total length 10 ft is stretched between two walls 8 ft apart. A 50-lb weight is suspended from a massless, frictionless pulley on the cable. Find the tension in the cable.

\[ \text{LET'S YOU} \]
\[ \text{ASSUME} \]
\[ \text{T SAME ON BOTH SIDES} \]

\[ \text{FBD:} \]
\[ T \]
\[ \theta \]
\[ 50 \text{lb} = W \]

\[ \sum F_x = 0 \]
\[ T \cos \theta - T \cos \phi = 0 \]
\[ \cos \phi = \cos \theta \quad \phi = \theta \]

\[ \sum F_y = 0 \]
\[ T \sin \theta + T \sin \phi - 50 \text{ lb} = 0 \quad (1) \]

1 EQN, 2 UNKNOWNS.
WHAT TO DO?

\[ L_{AB} + L_{BC} = 10' \quad (2) \]

\[ \cos \theta L_{AB} + \cos \theta L_{BC} = 8' \]

\[ \cos \theta (L_{AB} + L_{BC}) = 8' \quad (3) \]

\[ \cos \theta = 8' / (L_{AB} + L_{BC}) = 8/10 \quad \theta = 36.9^\circ \]
FROM (1)

\[ T = \frac{50}{2 \sin \theta} = \frac{50 \#}{2 \cdot \sin(36.9\degree)} = 41.7 \text{ lb} \]
Example

Two smooth steel pipes are stacked in a box. The masses and diameters of pipe \( A \) and \( B \) are, \( m_A = 5 \text{ kg} \), \( m_B = 20 \text{ kg} \), \( D_A = 100 \text{ mm} \) and \( D_B = 200 \text{ mm} \), respectively. If the distance between the walls is \( b = 250 \text{ mm} \), find

a) the magnitude of the two forces exerted on pipe \( A \), and
b) the force the bottom of the box exerts on pipe \( B \).

\[ \sum F_y = 0 \]
\[ \text{(WHY } y \text{ FIRST?)} \]
\[ -m_A g + \cos \theta N_{BA} = 0 \]
\[ N_{BA} = \frac{m_A g}{\cos \theta} = \frac{(5 \text{ kg}) \cdot 9.81 \text{ m/s}^2}{\cos (21.8^\circ)} = 65.81 \text{ N} \]

\[ \sum F_x = 0 \]
\[ N_A - N_{BA} \sin \theta = 0 \]
\[ N_A = N_{BA} \sin \theta = 65.81 \text{ N} \cdot \sin \theta = 43.87 \text{ N} \]

b) FBD of \( B \)

NOTE REVERSE DIRECTION

\[ \sum F_y = 0 \]
\[ N_B - N_{BA} \cos \theta - m_B g = 0 \]
\[ N_B = m_B g + N_{BA} \cos \theta \]
\[ = 20 \text{ kg} \cdot 9.81 \text{ m/s}^2 + 65.81 \text{ N} \cdot \cos (21.8^\circ) \]
\[ = 245.3 \text{ N} \]
DRAW ANOTHER FBD THAT GIVE SAME RESULT!