Example

Two cables are tied together as shown. If the largest allowable tension in either cable is 800 N,

a) what is the largest force $P$ that can be applied at $C$?
b) What is the corresponding angle $\alpha$?

\[
\begin{align*}
\text{For any } \alpha > 0 \text{, } P \text{ is larger if both } T_{CA} \text{ and } T_{CB} \\
\Rightarrow P = \frac{800 \sin 35^\circ + 800 \sin 50^\circ}{\sin \alpha}
\end{align*}
\]
\[ \begin{align*}
\text{SUB IN (1)} & \quad -800 \cos 35^\circ + 800 \cos 50^\circ + \left[ \frac{800 \sin 35^\circ + 800 \sin 50^\circ}{\sin \alpha} \right] \cos \alpha = 0 \\
\tan \alpha &= \frac{800 \sin 35^\circ + 800 \sin 50^\circ}{800 \cos 35^\circ - 800 \cos 50^\circ} = 7.596 \\
\alpha &= 82.5^\circ
\end{align*} \]

FROM (2)
\[ p = \frac{800 \sin 35^\circ + 800 \sin 50^\circ}{\sin (82.5^\circ)} = 1081 \text{ N} \]
Example

A gorilla of mass 160 kg is suspended from a light, inextensible cable making use of two massless, frictionless pulleys as shown in the figure. Find the magnitude of the force $P$ that must be applied to keep the gorilla stationary as well as the angle $\alpha$.

\[ \begin{align*}
\sum F_x &= 0 \\
P \sin \beta + P \sin \beta - P \cos \alpha &= 0 \\
(1) \\
\sum F_y &= 0 \\
P \sin \alpha + P \cos \beta + P \cos \beta &= mg = 0 \\
(2)
\end{align*} \]

From (1):

\[ 2 \sin \beta = \cos \alpha \]

\[ \alpha = \cos^{-1} \left( \frac{2 \sin \beta}{\sin \alpha} \right) \]

\[ = \cos^{-1} \left( \frac{2 \sin (20^\circ)}{\sin 46.8^\circ} \right) = 46.8^\circ \]

From (2):

\[ P = \frac{mg}{\sin \alpha + 2 \cos \beta} = \frac{160 \text{ kg} \cdot 9.81 \frac{\text{m}}{\text{s}^2}}{\sin 46.8^\circ + 2 \cos 20^\circ} \]

\[ = 602 \text{ N} \]