Example 7.1

Problem 1

All problem solutions must include an FBD.

Determine the tension developed in wires CA and CB required for equilibrium of the 10-kg cylinder. Take $\theta = 40^\circ$.

\[ W = \left(\frac{10\text{ kg}}{g}\right)\left(9.81 \text{ m/s}^2\right) = 98.1 \text{ N} \]

1. \[ -T_a \cos 30^\circ + T_b \cos 40^\circ = 0 \]
2. \[ T_a \sin 30^\circ + T_b \sin 40^\circ = 98.1 \]

\[ T_a = T_b \frac{\cos 40^\circ}{\cos 30^\circ} \]
\[ T_b \left[ \cos 40^\circ \sin 30^\circ + \sin 40^\circ \right] = 98.1 \]
\[ T_b = \frac{98.1 \text{ N}}{\cos 40^\circ \sin 30^\circ + \sin 40^\circ} = 60.4 \text{ N} \]
\[ T_a = 90.4 \frac{\cos 40^\circ}{\cos 30^\circ} = 82.0 \text{ N} \]
Example 7.2

Problem 7.2

Members of a truss are connected to the gusset plate. If the forces are concurrent at point O, determine the magnitudes of F and T for equilibrium. Take $\theta = 30^\circ$.

\[ F_x = 6 \text{ kN} \]
\[ F_y = 5 \text{ kN} \]

\[ T = 6 \cos 30^\circ \left[ 8 + 5 \cos 45^\circ \right] = 12.3 \text{ N} \]

\[ F = 5 \sin 45^\circ + (12.3) \sin 30^\circ = 10.2 \text{ N} \]
Example 7.3

If cylinder $E$ weighs 30 lb and $\theta = 15^\circ$, determine the weight of cylinder $F$.

4 Eqs. = 4 unknowns $T_D$, $T_C B$, $T_A$, $W_F$

Solving Eq. set yields $000$

$T_D = 112 \text{ lb}$

$T_A = 137 \text{ lb}$

$T_C B = 100 \text{ lb}$

$W_F = 183 \text{ lb}$
Example 7.4

Problem 5

Determine the mass of each of the two cylinders if they cause a sag of $s = 0.5 \text{ m}$ when suspended from the rings at $A$ and $B$. Note that $s = 0$ when the cylinders are removed.

Assume system is "massless" without cylinders.

Problem is symmetric so $W_A = W_B$.

**Solution:**

Unstretched length of spring is...

$$L_{SB} = \left[ 1.5^2 + 2^2 \right]^{\frac{1}{2}} = 2.5 \text{ m}$$

At position shown $L = \left[ (1.5+0.5)^2 + 2^2 \right]^{\frac{1}{2}} = 2.83$

Spring force is then $f = k \left[ L - L_{SB} \right] = 100 \text{ N/m} \left[ 2.83 - 2.5 \right] \text{ m} = 32.8 \text{ N}$

**FBD's of $A$ & $B$:**

\[ \begin{align*}
W_A & = 32.8 \text{ N} \\
T_A & = \frac{2}{1} = 1 \\
\theta & = 45^\circ \\
W_B & = 32.8 \text{ N}
\end{align*} \]

**FBD A:**

\[ \begin{align*}
-2f_x &= -32.8 \text{ N} - T_{AB} = 0 \\
T_{AB} &= 32.8 \text{ N}
\end{align*} \]

**FBD B:**

\[ \begin{align*}
-2f_x &= -T_{AB} + 32.8 \text{ N} = 0 \\
W_B &= 32.8 \text{ N}
\end{align*} \]

\[ \begin{align*}
W_A &= 32.8 \text{ N} \\
W_B &= 32.8 \text{ N}
\end{align*} \]