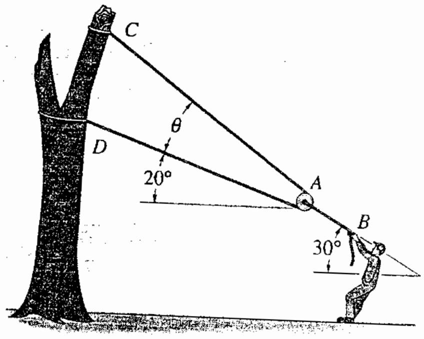
CE 201-2 (041)

H. W #3



Prob. 3-11 (P-92)

Given: System shown in Figure, which are in equilibrium.

Req.d:

The tension in cable CAD and the angle θ.

Sol.n:

$\Sigma F_{y'} = 0$

$\Rightarrow T_{AC}\sin\alpha - T_{AD}\sin\beta = 0$ | Assume the pully is small and Smooth, So $T_{AC} = T_{AD} = T$

$\therefore \sin\alpha = \sin\beta$

$\therefore \alpha = \beta = \theta/2$

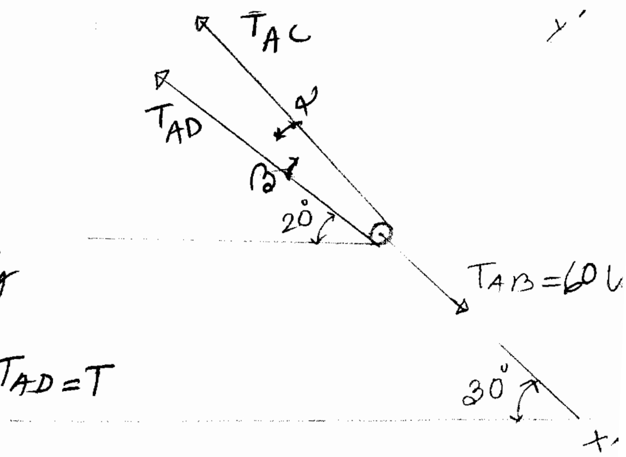
we get $\theta/2 + 20 = 30^\circ \therefore \boxed{\theta = 20}$

Again $\Sigma F_{x'} = 0$

$\Rightarrow 2T\cos\theta/2 - T_{AB} = 0$

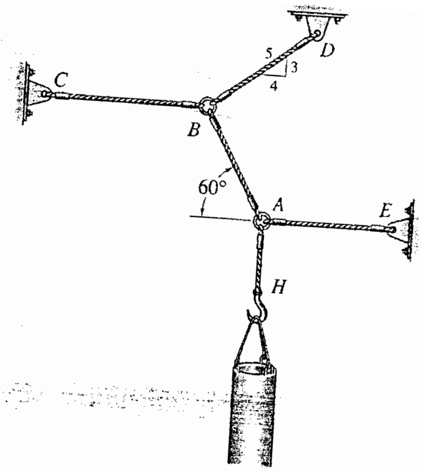
$\Rightarrow T = \dfrac{60}{2 * \cos 10^\circ}$

$\boxed{T = 30'46 \text{ lb}}$



FBD

Prob 3-19 (P.-93)



Given:
System is shown in figure. Each cord can sustain a maximum of 500 N.

Req.d: Largest mass of pipe.

Sol^{n}: Method 1

From FBD ③ $\Rightarrow \Sigma F_y = 0 \Rightarrow \boxed{T_{AH} = W}$

FBD ② $\Rightarrow \Sigma F_y = 0 \Rightarrow \boxed{T_{AB} = 1.155\, T_{AH} = 1.155 W}$

$\Sigma F_x = 0 \Rightarrow \boxed{T_{AE} = 0.577 W}$

From FBD ① $\Rightarrow$

$\Sigma F_y = 0 \Rightarrow \boxed{F_{BD} = 1.667 W}$

$\Sigma F_x = 0 \Rightarrow \boxed{F_{BC} = 1.91 W}$

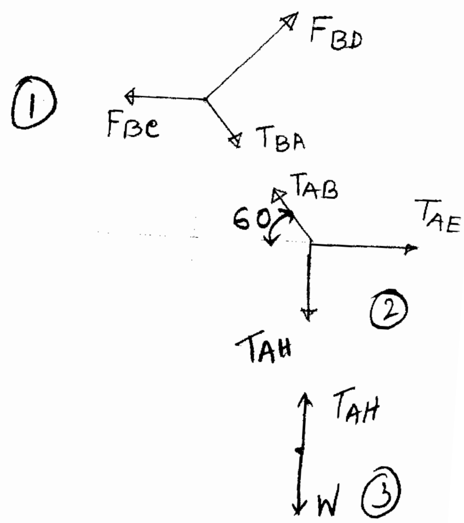
So Max. tension in BC.

so, $1.91 W = 500$

$\Rightarrow W = 261.68 N$

$m = \frac{w}{g} \Rightarrow \boxed{m = 26.7 kg}$

FBD



Method-2

Assume one of the cords controls, i.e the tension in it reaches 500 N before others.

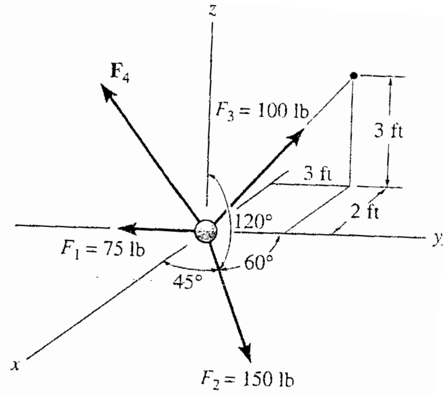
$\Rightarrow$ Check other cords.

if all < 500 N $\Rightarrow$ OK

if one cord or more > 500 $\Rightarrow$ not ok.

reassume & check.

Prob 3-45 (P. -105)



Given:
System is shown in Figure, which is in equilibrium.

Req.d.
the magnitude and the coordinate direction angles of F_4.

Sol. n.

$$\boxed{\vec{F_1} = -75\vec{j}}$$

$$\vec{F_2} = 150\cos 45\vec{i} + 150\cos 60\vec{j} + 150\cos 120\hat{k}$$

$$\Rightarrow \boxed{\vec{F_2} = 106'066 + 75\vec{j} - 75\vec{k}}$$

$$\vec{r_3} = -2\vec{i} + 3\vec{j} + 3\vec{k}$$

$$\boxed{\vec{F_3} = -42'64\vec{i} + 63'96\vec{j} + 63'96k}$$

$$\boxed{\vec{F_4} = \vec{F_{4x} i} + \vec{F_{4y} j} + F_{4z}\vec{k}}$$

$\Sigma Fx = 0$

$\Rightarrow -42'64 + 106'066 + F_{4x} = 0$

$\boxed{F_{4x} = -63 \cdot 426}$ lb

$\Sigma F_y = 0$

$63 \cdot 96 + 75 - 75 + F_{4y} = 0$

$\Rightarrow \boxed{F_{4y} = -63'96}$ lb

$\Sigma F_z = 0$

$63'96 - 75 + F_{4z} = 0$

$\Rightarrow \boxed{F_{4z} = 11'04}$

$\therefore F_4 = \sqrt{F_{4x}^2 + F_{4y}^2 + F_{4z}^2}$

$\boxed{F_4 = 90'75 \text{ lb}}$

$\cos\theta_{4x} = \dfrac{F_{4x}}{F_4}$ $\therefore$ $\boxed{\theta_{4x} = 134'34°}$

$\cos\theta_{4y} = \dfrac{F_{4y}}{F_4}$ $\therefore$ $\boxed{\theta_{4y} = 134'81}$

$\cos\theta_{4z} = \dfrac{F_{4z}}{F_4}$

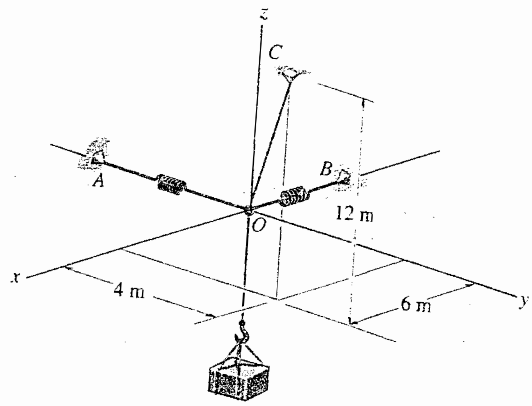
$\boxed{\theta_{4z} = 83'01°}$

Prob. 3-47 (P.-105)

Given:

$W = 20g$ N, stiffness, $k = 300$ N/m

System is shown in Figure as equilibrium.



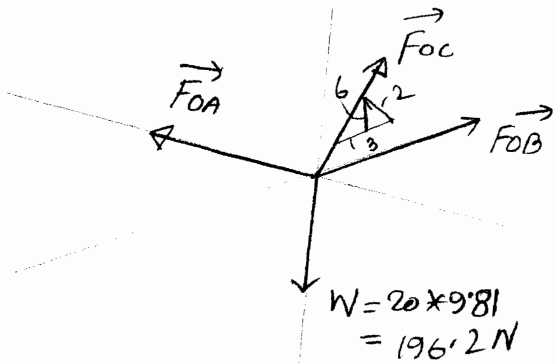
Req.d:

Stretch in each of the two springs (S_A & S_B).

Sol.n:

$\vec{F_{OC}} = \vec{F_{OC}x}\,\vec{i} + \vec{F_{OC}y}\,\vec{j} + \vec{F_{OC}z}\,\vec{k}$

$\therefore F_{OC} = \dfrac{-3F_{OC}\vec{i} - 2F_{OC}\vec{j} + 6F_{OC}\vec{k}}{\sqrt{6^2+2^2+3^2}}$



$\Rightarrow \boxed{\vec{F_{OC}} = -\frac{3}{7}\vec{F_{OC}}\,i - \frac{2}{7}\vec{F_{OC}}\,j + \frac{6}{7}\vec{F_{OC}}\,k}$

$\boxed{\vec{F_{OB}} = -F_{OB}\,\vec{i}}$

$\boxed{\vec{F_{OA}} = -F_{OA}\,\vec{j}}$

$\boxed{\vec{W} = -20 * g\,\vec{k}}$

$\Sigma F_z = 0 \Rightarrow \frac{6}{7}F_{OC} - 20*9.81 = 0 \Rightarrow \boxed{F_{OC} = 228.9\text{ N}}$

$\Sigma F_x = 0 \Rightarrow -\frac{3}{7}F_{OC} - F_{OB} = 0 \Rightarrow F_{OB} = -\frac{3}{7} * 228.9\text{ N}$

$\therefore \boxed{F_{OB} = -98.1\text{ N}}$

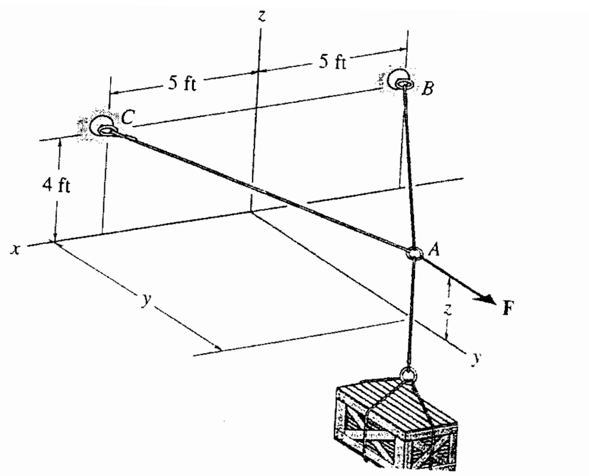
$\Sigma F_y = 0 \Rightarrow -\frac{2}{7}F_{OC} - F_{OA} = 0$

$\Rightarrow F_{OA} = -\frac{2}{7} * 228.9\text{N} \therefore \boxed{F_{OA} = -65.4\text{N}}$

Again $|F_{OB}| = S_B * 300 \Rightarrow S_B = 0.327\text{ m} \therefore \boxed{S_B = 327\text{ mm}}$

$|F_{OA}| = S_A * 300 \Rightarrow S_A = 0.218\text{ m} \therefore \boxed{S_A = 218\text{ mm}}$

Prob 3-58, P-107



Given: $F = 100$, $W = 400$, $T_{AC} = T_{AB} = 700$,
System is in equilibrium.

Req.d:
The coordinate of $A(0, y, z)$.

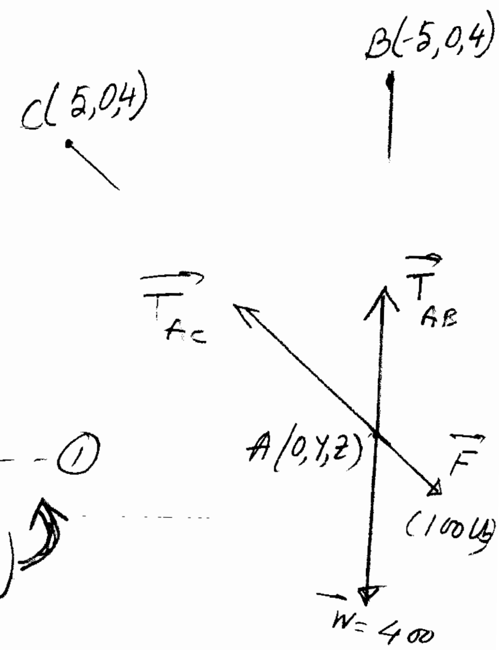
Sol.n:

$\vec{W} = -400\vec{k}$

$\vec{F} = 100\vec{j}$

$$\vec{T}_{AB} = \frac{\{5\vec{i} - y\vec{j} + (4-z)\vec{k}\}700}{\sqrt{5^2 + y^2 + (4-z)^2}}$$

$$\vec{T}_{AC} = \frac{\{-5\vec{i} - y\vec{j} + (4-z)i\}700}{\sqrt{5^2 + y^2 + (4-z)^2}}$$



$\Sigma F_x = 0$

$$\frac{3500}{\sqrt{5^2 + y^2 + (4-y)^2}} - \frac{3500}{\sqrt{5^2 + y^2 + (4-y)^2}} = 0 \quad \text{------ (1)}$$

(Trivial "useless")

Assume $\sqrt{5^2 + y^2 + (4-z)^2} = A$

$\therefore \Sigma F_y = 0$

$$-\frac{2y \times 700}{A} + 100 = 0 \Rightarrow 1400y = 100A \quad \text{(2)}$$

$\Sigma F_z = 0$

$$\frac{700(4-z)}{A} + \frac{700(4-z)}{A} - 400 \Rightarrow 1400(4-z) = 400A \quad \text{-- (3)}$$

$$(3) \div (2) \Rightarrow \frac{4-z}{y} = 4 \quad \therefore 4y = 4 - z \quad \text{------ (4)}$$

Use this value into (2)

$$1400y = 100\sqrt{5^2 + y^2 + (4-z)^2}$$

$$\Rightarrow 1400y = 100\sqrt{25 + y^2 + (4y)^2}$$

$$\Rightarrow 14y = \sqrt{25 + y^2 + 16y^2}$$

$$\therefore 179y^2 = 25 \quad \therefore \boxed{y = 0.3737 \text{ ft}}$$

Fr 4, $\boxed{z = 2.505 \text{ ft}}$