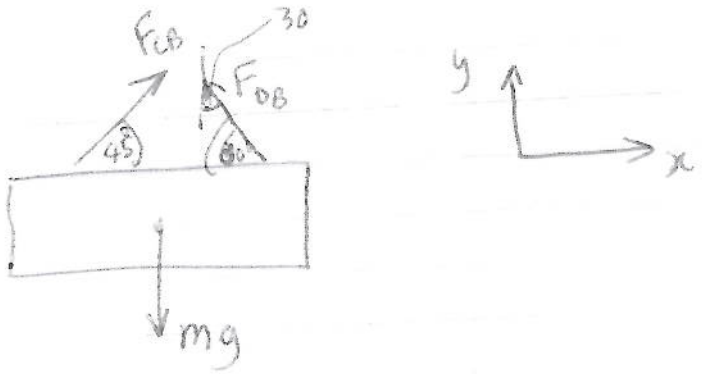
3-4



$\Sigma F_y = 0$

$$F_{CB} \sin 45 + F_{DB} \sin 60 - mg = 0$$

$$0.707 F_{CB} + 0.866 F_{DB} - 9.81 m = 0 \quad \text{—(1)}$$

$\Sigma F_x = 0$

$$F_{CB} \cos 45 - F_{DB} \cos 60 = 0$$

$$0.707 F_{CB} = 0.5 F_{DB}$$

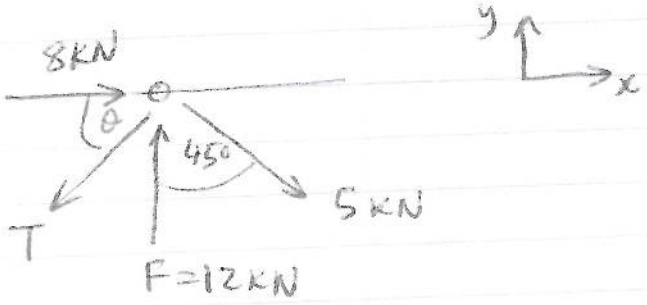
$$F_{DB} = 1.414 F_{CB} \quad \text{—(2)}$$

maximum force in either cable can be 20 KN
so if $F_{DB} = 20$ KN $\Rightarrow F_{CB} = 14.14$ KN

from Eqn (1):

$$m = \frac{14.14 \sin 45 + 20 \sin 60}{9.81} = 2.78 \text{ KN}$$

3-6



Apply Equations of Equilibrium for x and y components seperately

$\Sigma F_x = 0$

$$8 - T\cos\theta + 5\sin 45 = 0$$
$$T\cos\theta = 11.54 \quad \text{—(1)}$$

$\Sigma F_y = 0$

$$-T\sin\theta + 12 - 5\cos 45 = 0$$
$$T\sin\theta = 8.46 \quad \text{—(2)}$$

(2)/(1): $\tan\theta = \frac{8.46}{11.54} = 0.733$

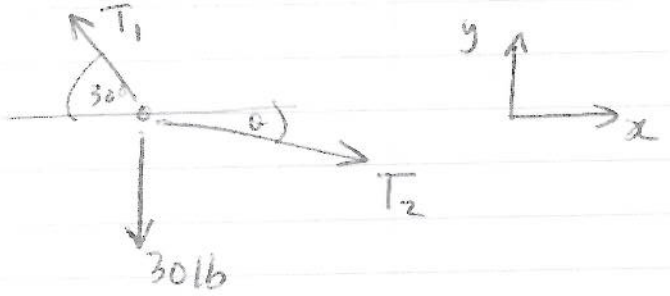
$$\theta = 36.24^\circ$$

from (1)

$$T = \frac{11.54}{\cos 36.24^\circ} = 14.3^\circ$$

3-27

First draw free body diagram of ring C,



$$\Sigma F_x = 0$$

$$-T_1 \cos 30 + T_2 \cos 15 = 0$$

~~$T_1 \cos\theta = 25.98$ — (1)~~

$$-0.866\,T_1 + 0.965\,T_2 = 0 \quad \text{— (1)}$$

$$\Sigma F_y = 0$$

$$T_1 \sin 30 - T_2 \sin 15 - 30 = 0$$

$$0.5\,T_1 - 0.258\,T_2 = 30 \quad \text{— (2)}$$

$$\frac{(1)}{0.866} + \frac{(2)}{0.5} : \qquad -T_1 + 1.11\,T_2 = 0$$

$$T_1 - 0.516\,T_2 = 60$$

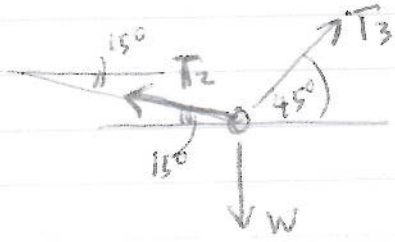
~~$1.114\,T_2$~~

$$0.594\,T_2 = 60 \Rightarrow T_2 \doteq 101.01 \text{ lb}$$

from (1)

$$T_1 = \frac{0.965(101.01)}{0.866} = 112.55 \text{ lb}$$

Next we analyze free body diagram of B



$\Sigma F_x = 0$

$-101.01 \cos 15 + T_3 \cos 45 = 0$

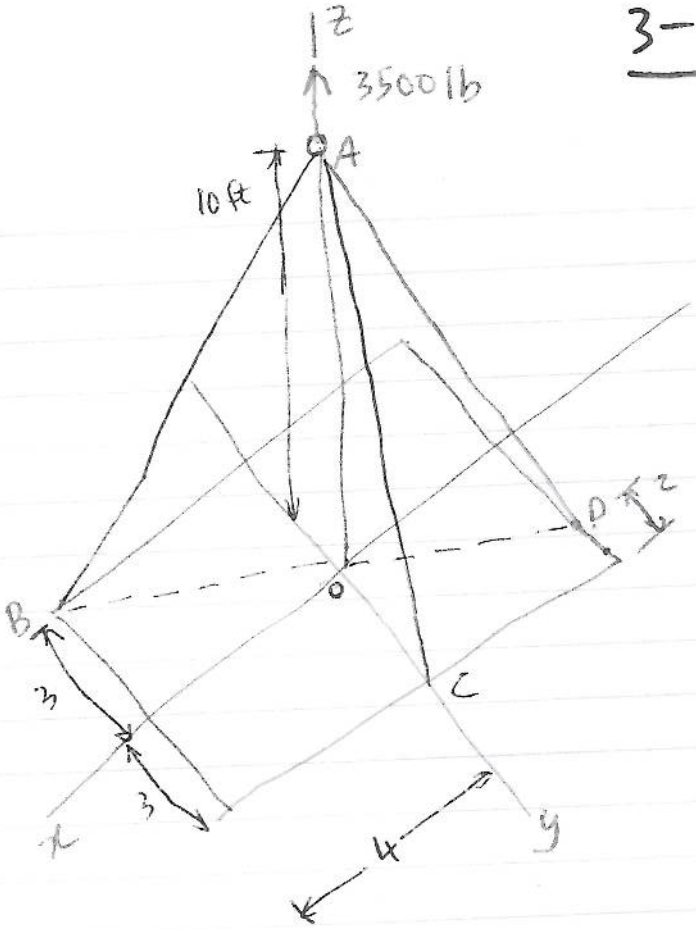
$0.707 T_3 = 97.57$

$T_3 = 138.0 \text{ lb}$

$\Sigma F_y = 0$ $\quad 101.01 \sin 15 + 138 \sin 45 - W = 0$

$W = 123.72 \text{ lb}$

3-51



$OB = \sqrt{3^2 + 4^2} = 5$ ft

$AB = \sqrt{5^2 + 10^2} = 11.18$ ft

$AC = \sqrt{10^2 + 3^2} = 10.44$ ft

$OC = 3$

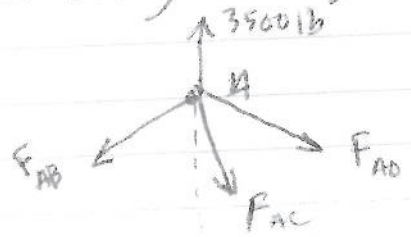
$OD = \sqrt{4^2 + 1^2} = 4.12$ ft

$AD = \sqrt{10^2 + 4.12^2} = 10.81$ ft

Now we apply equilibrium condition to the components of the forces in the cables.

Draw free body diagram of the ring A.

$\Sigma F_x = 0$



3-d

Note that I arbitrarily chose directions of forces in members. I could have put them in the opposite. NO problem. Just make sure your calculations are consistent with the direction you chose. If you get a negative answer it means the actual direction of action of the force is opposite what you selected.

So now Equilibrium

$\Sigma F_x = 0$

$$F_{AB} \frac{5}{11.18} \cdot \frac{4}{5} + F_{AC} \cdot^{0} - F_{AD} \frac{4.12}{10.81} \cdot \frac{4}{4.12} = 0$$

$$0.358 F_{AB} - 0.37 F_{AD} = 0 \quad \text{— (1)}$$

$\Sigma F_y = 0$

$$-F_{AB} \cdot \frac{5}{11.18} \cdot \frac{3}{5} + F_{AC} \cdot \frac{3}{10.44} - F_{AD} \cdot \frac{4.12}{10.81} \cdot \frac{1}{4.12} = 0$$

$$-0.27 F_{AB} + 0.29 F_{AC} + 0.092 F_{AD} = 0 \quad \text{— (2)}$$

$\Sigma F_z = 0$

$$-F_{AB} \cdot \frac{10}{11.18} - F_{AC} \cdot \frac{10}{10.44} - F_{AD} \cdot \frac{10}{10.81} = 0$$

$$0.089 F_{AB} + 0.096 F_{AC} + 0.093 F_{AD} = 0 \quad \text{— (3)}$$

At this point the Statics is over. We now have Simultaneous Equations with 3 unknowns. You may use your preferred method to solve; Substitution, Elimination, Matrix Row Reduction, Eigen values, Cramer's rule, ...

If you have such in your project use Matlab, Mathcad or any program you are comfortable with. Solving simultaneous equations is not a focus of this class. Rather setting them up from the Statics analysis is the focus in this course.