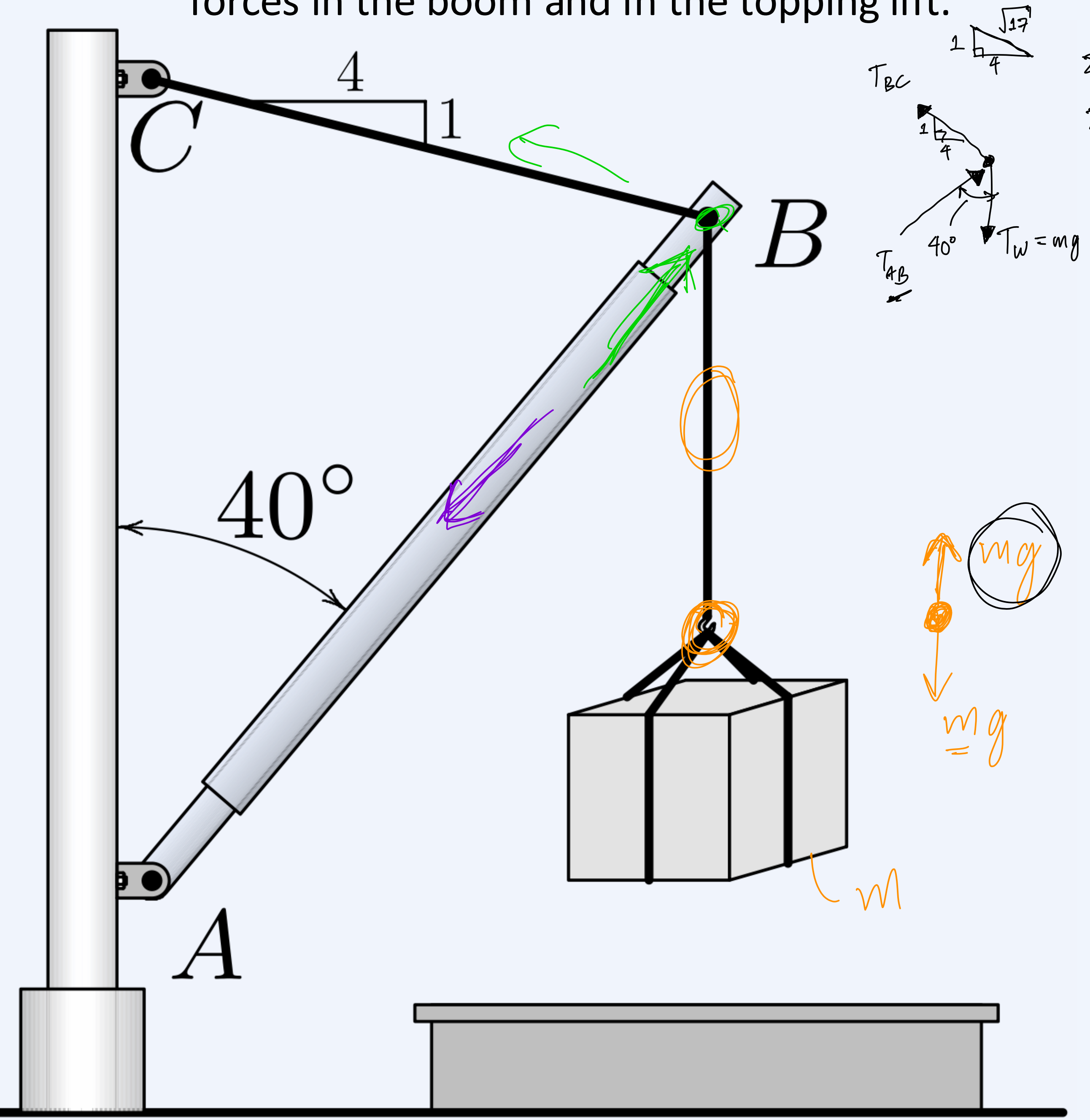
The 0.1-Mg crate is suspended through a 20-m long boom AB held by a topping lift BC. Determine the forces in the boom and in the topping lift.



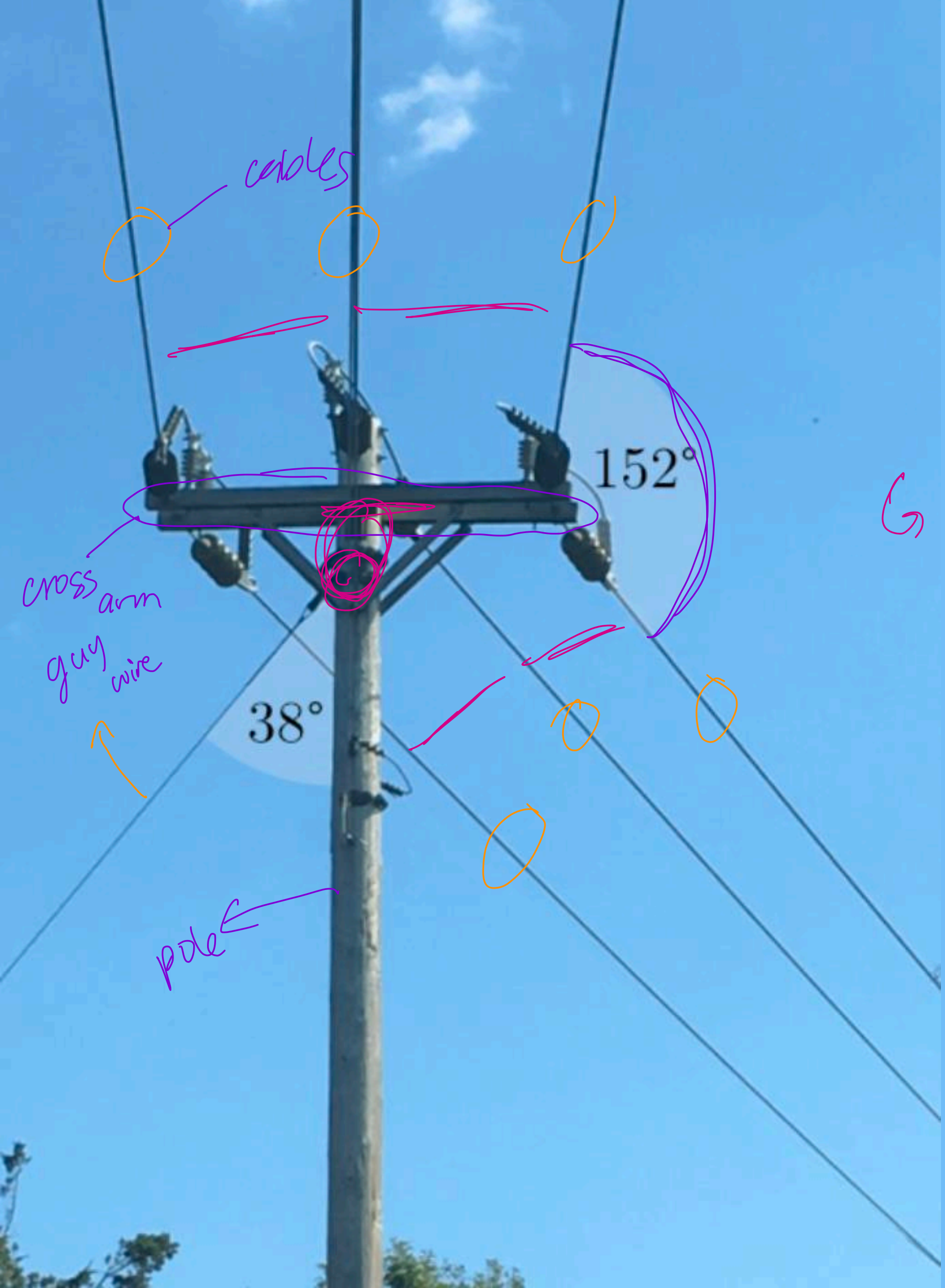
$$\Sigma F_x = 0 : \; T_{AB} \sin(40°) - T_{BC} \frac{4}{\sqrt{17}} = 0$$

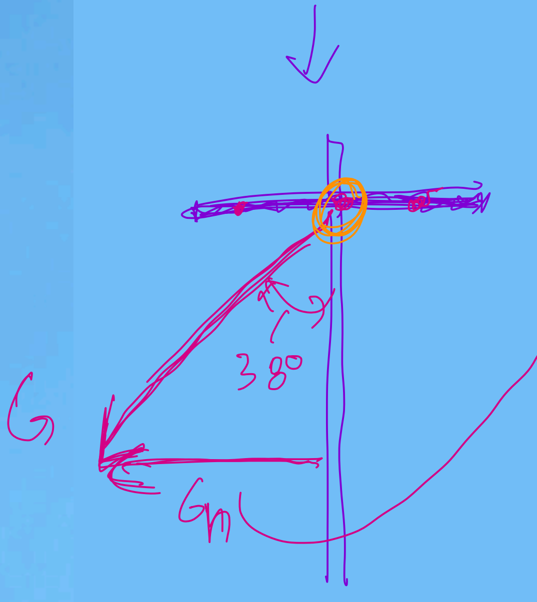
$$\Sigma F_y = 0 : \; T_{BC} \frac{1}{\sqrt{17}} + T_{AB} \cos(40°) = mg$$

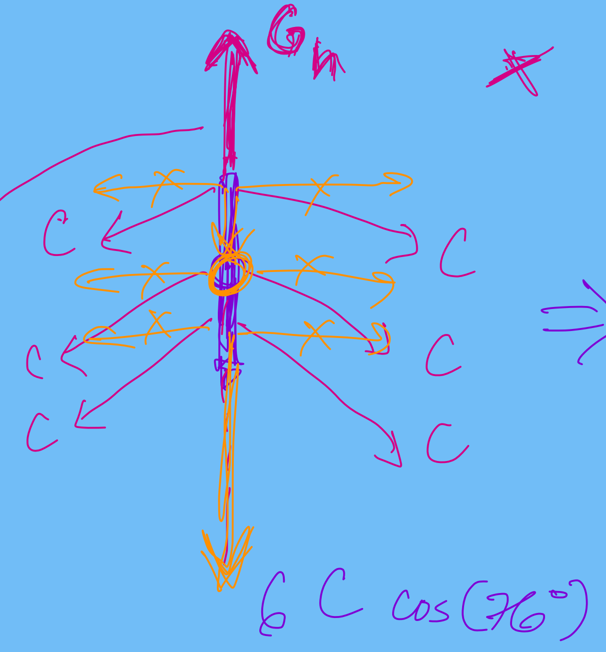
T_w

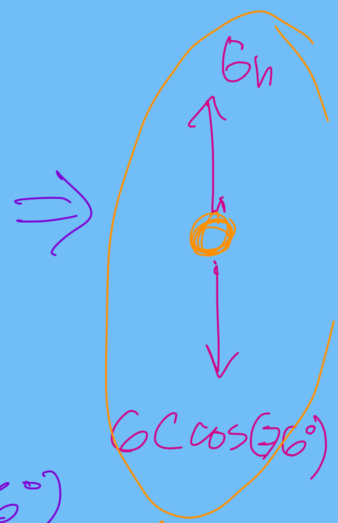
$T_{AB} < 0$?

The power cables are symmetric about the cross arm. Each cable pulls with a 7-kN force. Estimate the tension in the guy wire.

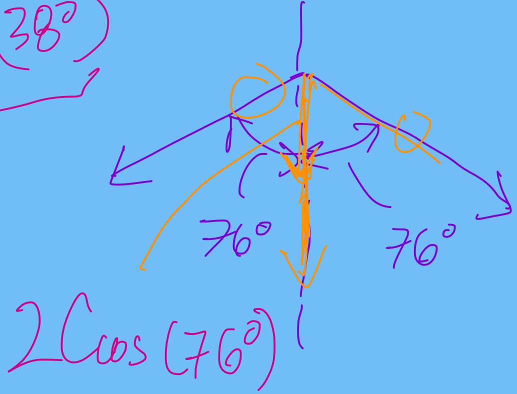








$G_n = G \sin(38°)$

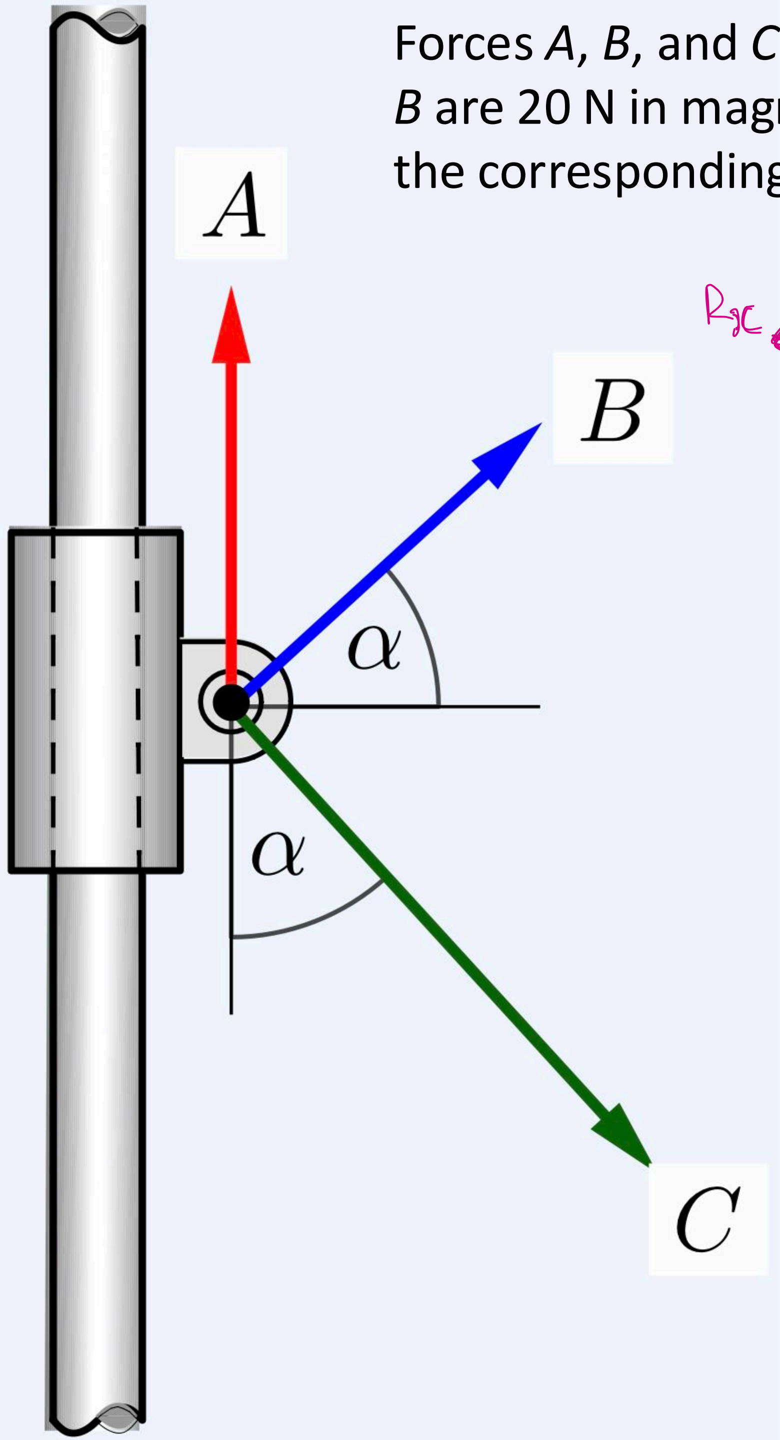


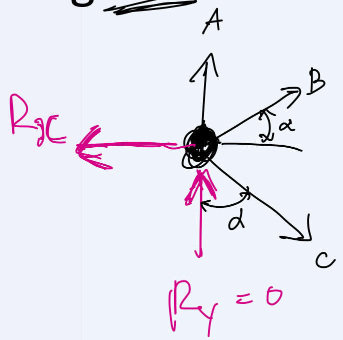
$G_n = 6C\cos(76°)$

$C = 7\text{ kN}$

$= G \sin(38°)$

Forces *A*, *B*, and *C* act on a machine part that is free to slide along a vertical, frictionless rod. *A* and *B* are 20 N in magnitude, while *C* is 30 N. Determine the value α required for static equilibrium, and the corresponding reaction on the slider.





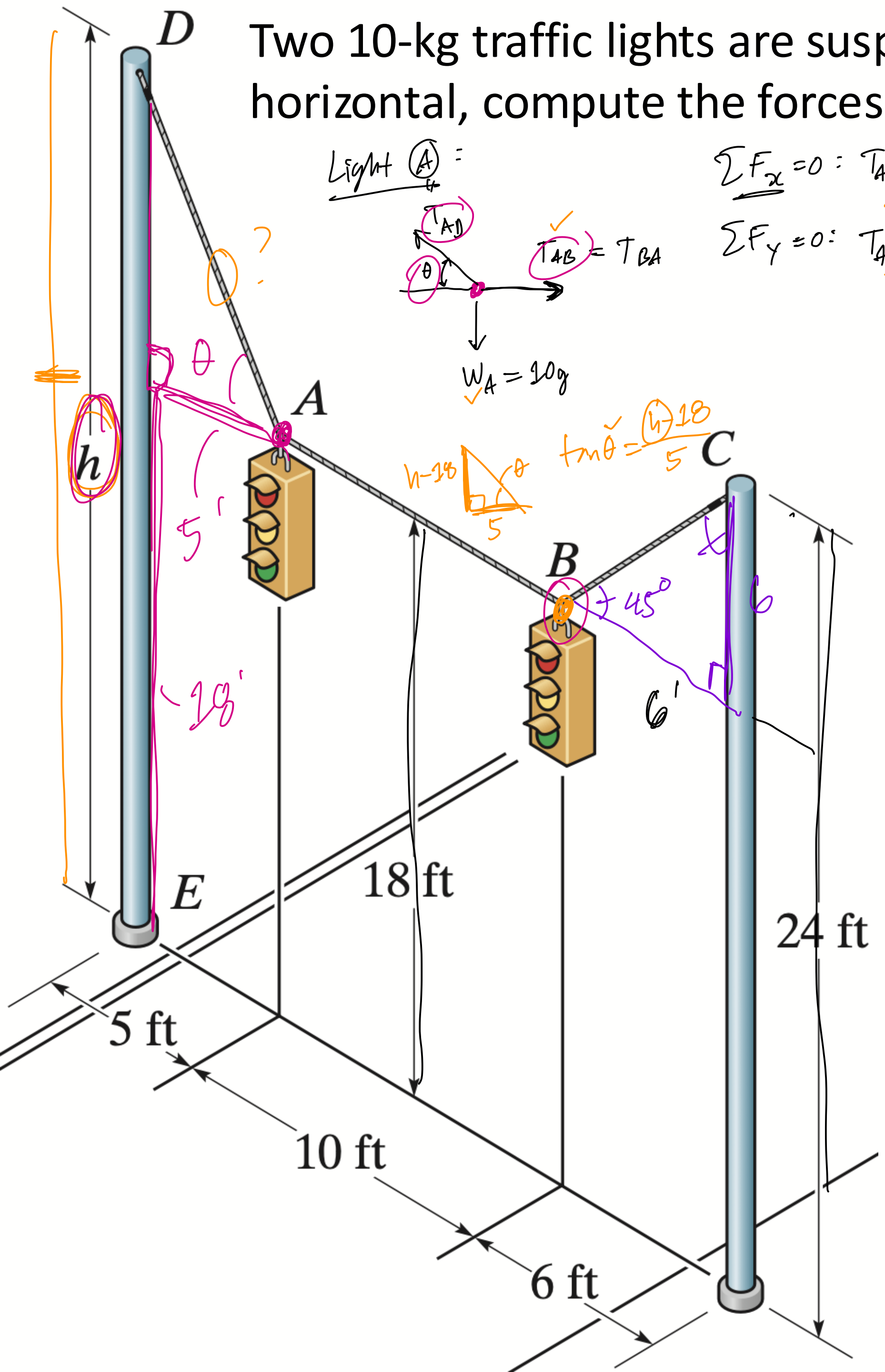
$\Sigma F_x = 0$: $B\cos\alpha + C\sin\alpha = R_x$

$\Sigma F_y = 0$: $A + \cancel{R_y}^{0} + B\sin\alpha = C\cos\alpha$

$20 + 20\sin\alpha - 30\cos\alpha = 0$

α

Two 10-kg traffic lights are suspended from two poles through three cables. If cable *AB* is perfectly horizontal, compute the forces in the cables.



Light Ⓐ :

T_{AD}

$T_{AB} = T_{BA}$

$W_A = 10g$

$\Sigma F_x = 0 : T_{AD}\cos\theta = T_{AB} = T_{BA}$

$\Sigma F_y = 0 : T_{AD}\sin\theta = W_A$

$$\frac{\cancel{T_{AD}}\sin\theta}{\cancel{T_{AD}}\cos\theta} = \frac{W_A}{T_{AB}} = \tan\theta$$

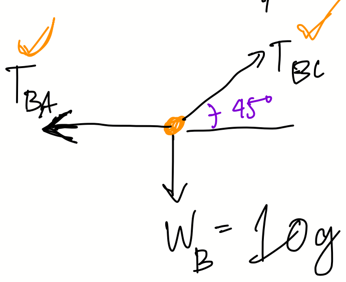
$T_{AD}^2\cos^2\theta = T_{AB}^2$

$+ \quad T_{AD}^2\sin^2\theta = W_A^2 \quad +$

$T_{AD}^2\cos^2\theta + T_{AD}^2\sin^2\theta = T_{AB}^2 + W_A^2$

$T_{AD}^2\underbrace{(\cos^2\theta + \sin^2\theta)}_{1}$

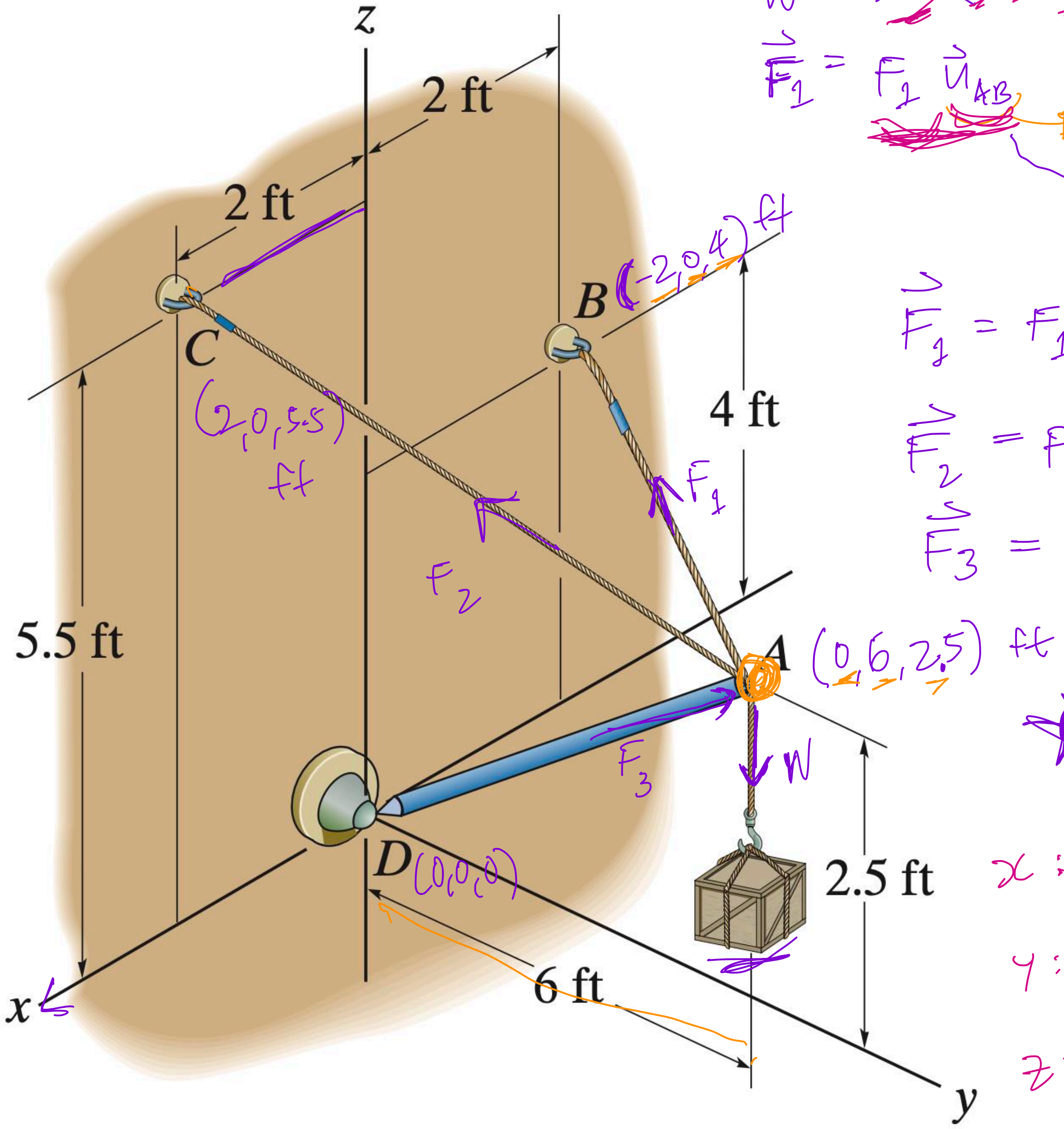
Light Ⓑ



$\Sigma F_x = 0 : T_{BC}\cos(45°) = T_{BA}$

$\Sigma F_y = 0 : T_{BC}\sin(45°) = W_B$

Determine the forces developed in the cables and in the strut as the 300-lb crate hangs still.



$$\vec{W} = 300\langle 0,0,-1\rangle \text{ lb}$$

$$\vec{F}_1 = F_1 \vec{u}_{AB}$$

$$\vec{u}_{AB} = \frac{\vec{r}_{AB}}{r_{AB}} = \frac{\langle -2,-6,1.5\rangle \text{ ft}}{\sqrt{4+36+1.5^2}}$$

$$\vec{u}_{AC} = \frac{\vec{r}_{AC}}{r_{AC}} = \frac{\langle 2,-6,3\rangle}{7}$$

$$\vec{F}_1 = F_1\left\langle \frac{-2}{6.5}, \frac{-6}{6.5}, \frac{1.5}{6.5}\right\rangle \text{ lb}$$

$$\vec{F}_2 = F_2\left\langle \frac{2}{7}, \frac{-6}{7}, \frac{3}{7}\right\rangle \text{ lb}$$

$$\vec{F}_3 = F_3\left\langle \frac{0}{6.5}, \frac{6}{6.5}, \frac{2.5}{6.5}\right\rangle \text{ lb}$$

$$\vec{u}_{DA} = \frac{\vec{r}_{DA}}{r_{DA}} = \frac{\langle 0,6,2.5\rangle}{6.5}$$

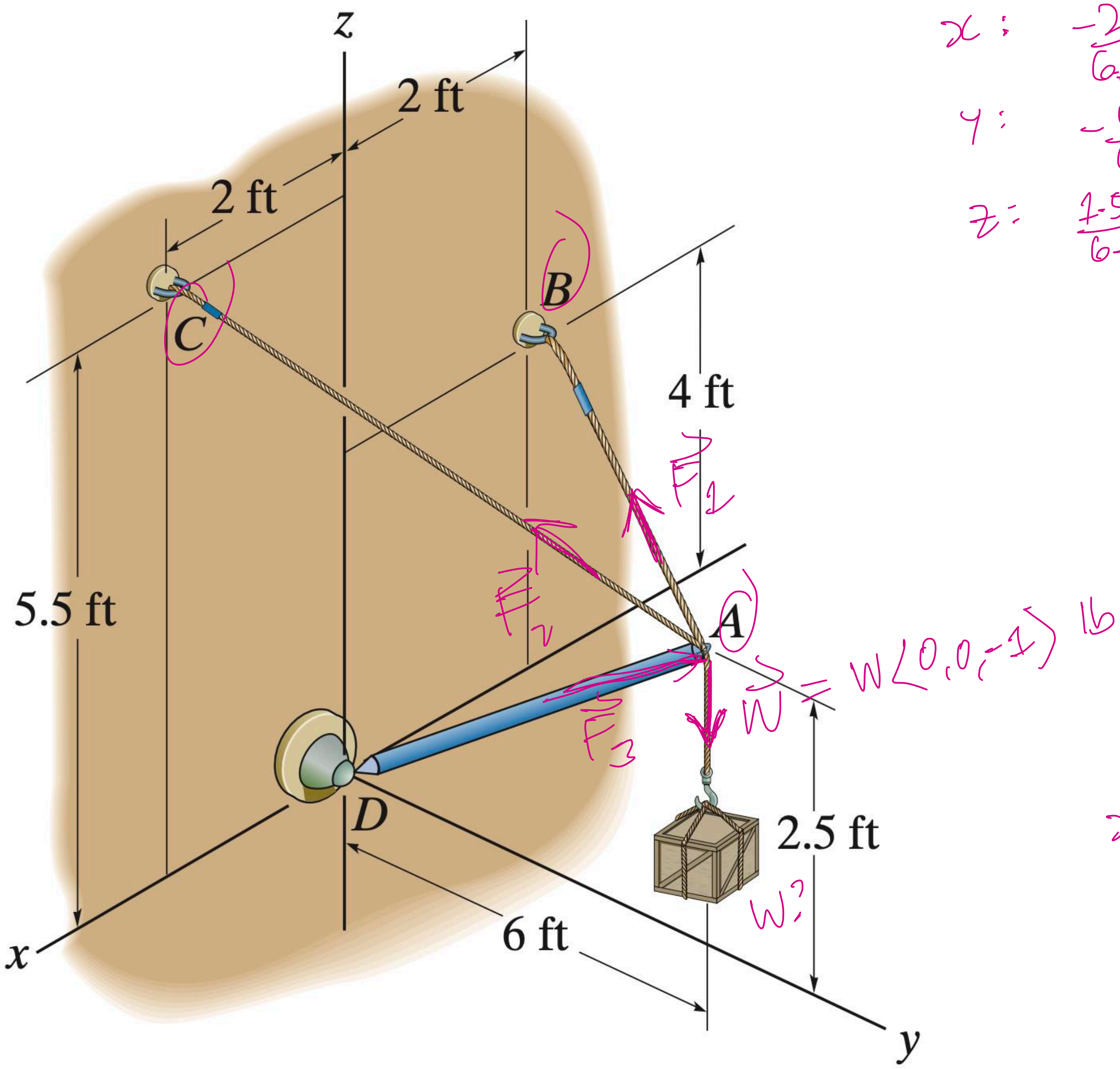
$$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{W} = \langle 0,0,0\rangle$$

$$x:\quad -\frac{2}{6.5}F_1 + \frac{2}{7}F_2 + 0F_3 + 0 = 0$$

$$y:\quad -\frac{6}{6.5}F_1 - \frac{6}{7}F_2 + \frac{6}{6.5}F_3 + 0 = 0$$

$$z:\quad \frac{1.5}{6.5}F_1 + \frac{3}{7}F_2 + \frac{2.5}{6.5}F_3 - 300 = 0$$

If each cable can sustain up to a 300-lb tension, determine the largest crate weight that can be supported and the corresponding force developed along the strut.



$\vec{F}_1 + \vec{F}_2 + \vec{F}_3 + \vec{W} = \langle 0,0,0\rangle$

x: $-\frac{2}{6.5}F_1 + \frac{2}{7}F_2 + 0F_3 + 0 =$

y: $-\frac{6}{6.5}F_1 - \frac{6}{7}F_2 + \frac{6}{6.5}F_3 + 0 = 0$

z: $\frac{1.5}{6.5}F_1 + \frac{3}{7}F_2 + \frac{2.5}{6.5}F_3 - W = 0$

- AC fails: $F_2 = 300$

x: $-\frac{2}{6.5}F_1 + \frac{2}{7}F_2 + 0F_3 + 0 =$

y: $-\frac{6}{6.5}F_1 - \frac{6}{7}F_2 + \frac{6}{6.5}F_3 + 0 = 0$

z: $\frac{1.5}{6.5}F_1 + \frac{3}{7}F_2 + \frac{2.5}{6.5}F_3 - W = 0$

$\Rightarrow$ F_1 275 OK!
F_3
W

- If AB fails: $F_1 = 300$; $F_2 = ?$

x: $-\frac{2}{6.5}F_1 + \frac{2}{7}F_2 + 0F_3 + 0 =$

y: $-\frac{6}{6.5}F_1 - \frac{6}{7}F_2 + \frac{6}{6.5}F_3 + 0 = 0$

z: $\frac{1.5}{6.5}F_1 + \frac{3}{7}F_2 + \frac{2.5}{6.5}F_3 - W = 0$

$\Rightarrow$ F_2
F_3
W