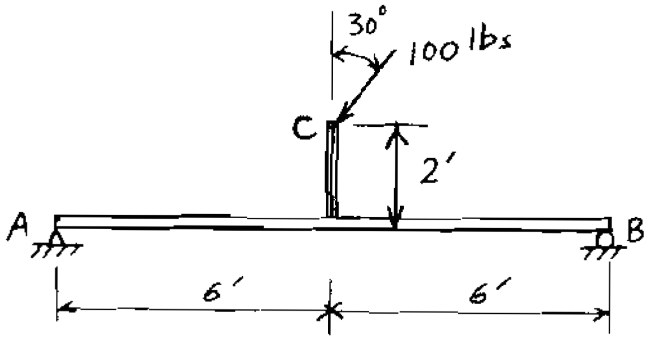
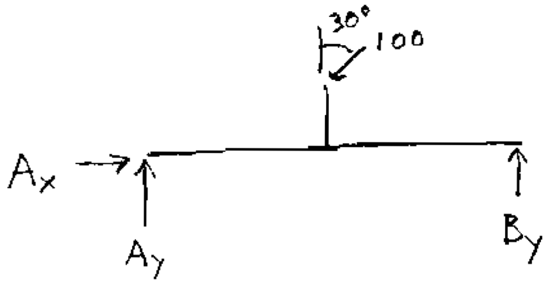
1. A beam is supported by a hinged support at the left and a roller support at the right. A force of 100 lbs in magnitude and skewed at 30° from vertical is loaded at C as shown in the figure. Calculate the reaction forces at A and B. (Note: numbers with an apostrophe represent length in feet.)





$$\Sigma M_{A\circlearrowleft +} = 0 = B_y(12') + (100\,\text{lbs})\sin 30°(2') - (100\,\text{lbs})\cos 30°(6')$$

$$\rightarrow \boxed{B_y = 35.0\ \text{lb} \uparrow}$$

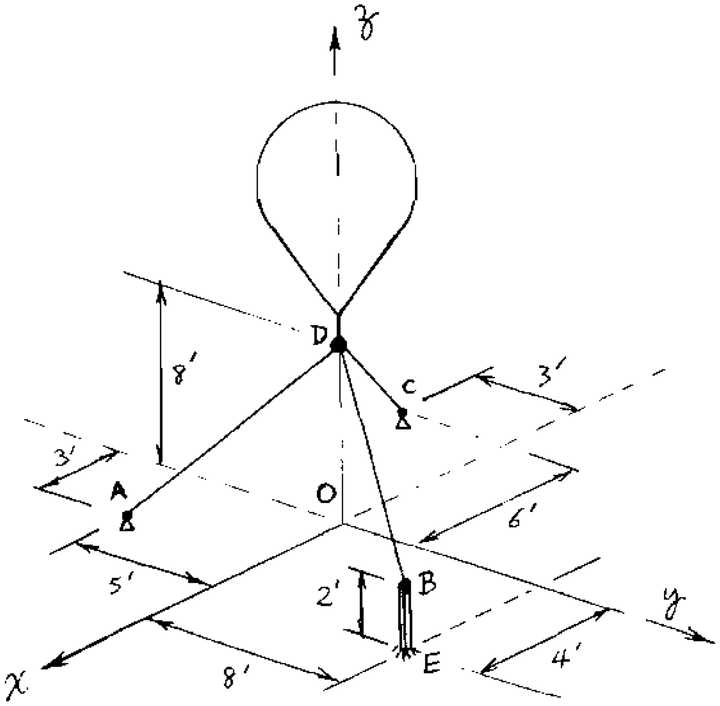
$$\Sigma F_x = 0 = A_x - (100\,\text{lbs})\sin 30°$$

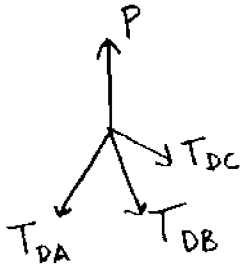
$$\rightarrow \boxed{A_x = 50\ \text{lb} \rightarrow}$$

$$\Sigma F_y = 0 = A_y + B_y - (100\,\text{lbs})\cos 30°$$

$$\rightarrow \boxed{A_y = 51.6\ \text{lb} \uparrow}$$

2. A balloon is exerting an upward force of 250 lbs at point D, which is located **8 feet** above ground and tied down by three cables as shown in the figure. The anchor points A and C are at ground level, where the coordinate x- and y-axes lie as shown. Cable DB is tied to a vertical stake EB at Point B, which is located **2 feet** above the ground point E. The axis of the balloon force is in the vertical z-axis. Calculate the forces in the three cables. (Note: numbers with an apostrophe represent length in feet.)





$$\vec{P} = 250\text{ lb}\ \hat{k}$$

$$\vec{T}_{DC} = T_{DC}\vec{\lambda}_{DC} = T_{DC}\frac{-6\hat{\imath} - 3\hat{\jmath} - 8\hat{k}}{\sqrt{(-6)^2 + (-3)^2 + (-8)^2}}$$

$$= T_{DC}\left(\frac{-6}{\sqrt{109}}\hat{\imath} - \frac{3}{\sqrt{109}}\hat{\jmath} - \frac{8}{\sqrt{109}}\hat{k}\right)$$

$$\vec{T}_{DB} = T_{DB}\vec{\lambda}_{DB} = T_{DB}\frac{4\hat{\imath} + 8\hat{\jmath} - 6\hat{k}}{\sqrt{4^2 + 8^2 + (-6)^2}}$$

$$= T_{DB}\left(\frac{4}{\sqrt{116}}\hat{\imath} + \frac{8}{\sqrt{116}}\hat{\jmath} - \frac{6}{\sqrt{116}}\hat{k}\right)$$

$$\vec{T}_{DA} = T_{DA}\vec{\lambda}_{DA} = T_{DA}\frac{3\hat{\imath} - 5\hat{\jmath} - 8\hat{k}}{\sqrt{3^2 + (-5)^2 + (-8)^2}}$$

$$= T_{DA}\left(\frac{3}{\sqrt{98}}\hat{\imath} - \frac{5}{\sqrt{98}}\hat{\jmath} - \frac{8}{\sqrt{98}}\hat{k}\right)$$

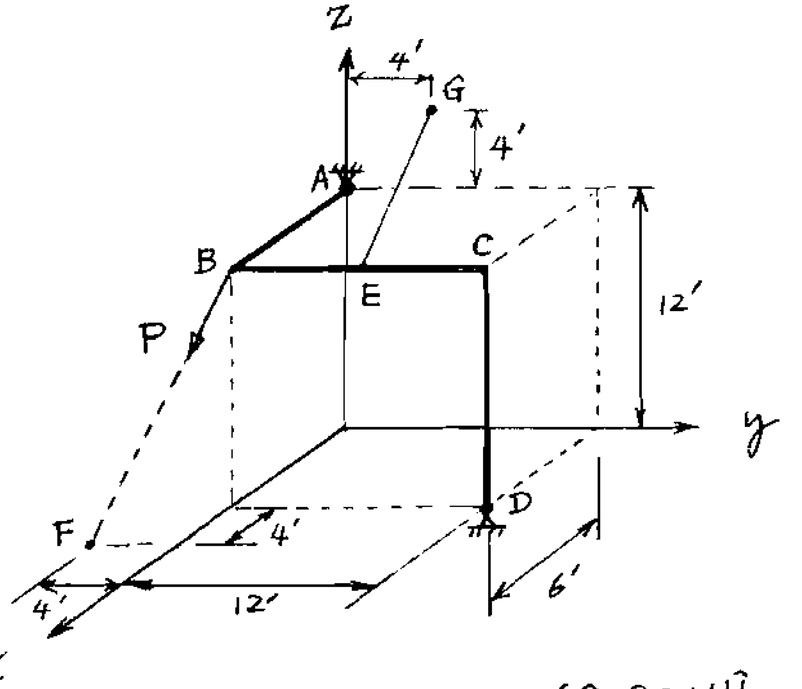
$$\Sigma F_x = 0 = T_{DC}\left(\frac{-6}{\sqrt{109}}\right) + T_{DB}\left(\frac{4}{\sqrt{116}}\right) + T_{DA}\left(\frac{3}{\sqrt{98}}\right)$$

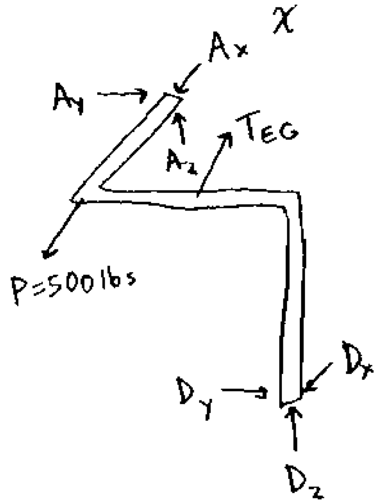
$$\Sigma F_y = 0 = T_{DC}\left(\frac{-3}{\sqrt{109}}\right) + T_{DB}\left(\frac{8}{\sqrt{116}}\right) + T_{DA}\left(\frac{-5}{\sqrt{98}}\right)$$

$$\Sigma F_z = 0 = T_{DC}\left(\frac{-8}{\sqrt{109}}\right) + T_{DB}\left(\frac{-6}{\sqrt{116}}\right) + T_{DA}\left(\frac{-8}{\sqrt{98}}\right) + 250$$

$$\rightarrow \boxed{\begin{array}{l} T_{DC} = 131.4 \text{ lb} \\ T_{DB} = 120.2 \text{ lb} \\ T_{DA} = 102.0 \text{ lb} \end{array}}$$

3. As shown in the figure, the x-z and y-z planes are walls, while the x-y plane is the floor. The ABCD frame is supported by the ball-and-socket joints A and D, which are fastened to, respectively, the intersection of the walls and the floor, and by a cable attached at the midpoint E of the portion BC of the frame and Point G on the y-z wall. A force P of 500 lbs in magnitude is applied at Point B in the direction from B to Point F on the floor. Calculate the force in Cable FG. (Note: numbers with an apostrophe represent length in feet.)





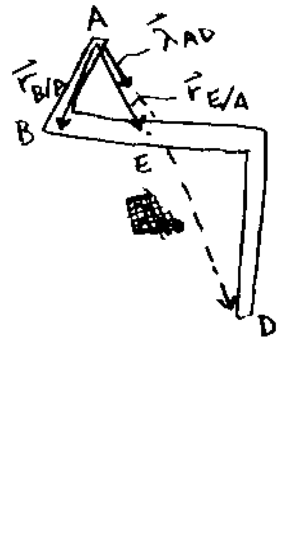
$$\vec{T}_{EG} = T_{EG}\vec{\lambda}_{EG} = T_{EG}\frac{-6\hat{i}-2\hat{j}+4\hat{k}}{\sqrt{(-6)^2+(-2)^2+4^2}} = T_{EG}\left(\frac{-6}{\sqrt{56}}\hat{i}-\frac{2}{\sqrt{56}}\hat{j}+\frac{4}{\sqrt{56}}\hat{k}\right)$$

$$\vec{P} = P\vec{\lambda}_{BF} = 500\,\frac{4\hat{i}-4\hat{j}-12\hat{k}}{\sqrt{4^2+(-4)^2+(-12)^2}} = (500\,\text{lbs})\left(\frac{4}{\sqrt{176}}\hat{i}-\frac{4}{\sqrt{176}}\hat{j}-\frac{12}{\sqrt{176}}\hat{k}\right)$$

$$\vec{r}_{E/A} = 6\hat{i}+6\hat{j}$$

$$\vec{r}_{B/A} = 6\hat{i}$$

$$\vec{\lambda}_{AD} = \frac{6\hat{i}+12\hat{j}-12\hat{k}}{\sqrt{6^2+12^2+(-12)^2}} = \frac{6}{18}\hat{i}+\frac{12}{18}\hat{j}-\frac{12}{18}\hat{k}$$



$$\Sigma M_{AD} = 0 = \vec{M}_A\cdot\vec{\lambda}_{AD} = \left[(\vec{r}_{E/A}\times\vec{T}_{EG}) + (\vec{r}_{B/A}\times\vec{P})\right]\cdot\vec{\lambda}_{AD}$$

$$0 = \Big[(6\hat{i}+6\hat{j})\times T_{EG}\left(\frac{-6}{\sqrt{56}}\hat{i}-\frac{2}{\sqrt{56}}\hat{j}+\frac{4}{\sqrt{56}}\hat{k}\right) + (6\hat{i})\times 500\left(\frac{4}{\sqrt{176}}\hat{i}-\frac{4}{\sqrt{176}}\hat{j}-\frac{12}{\sqrt{176}}\hat{k}\right)\Big]\cdot\left(\frac{6}{18}\hat{i}+\frac{12}{18}\hat{j}-\frac{12}{18}\hat{k}\right)$$

$$\rightarrow \boxed{T_{EG} = 752\ \text{lb}}$$