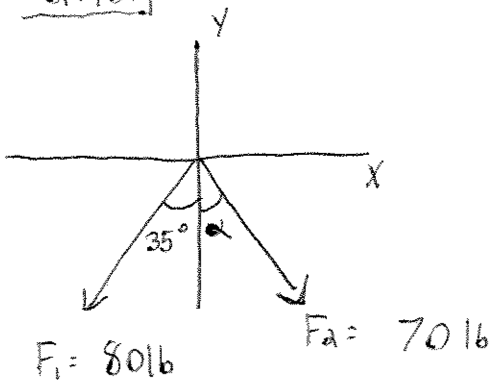
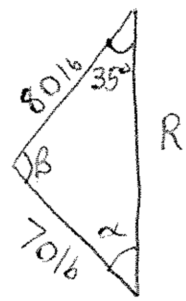
MAE 206 | HW #1 | 2.12

2.12





$$\frac{\sin 35°}{70\,lb} = \frac{\sin \alpha}{80\,lb} \qquad \alpha = \sin^{-1} \frac{8}{7} \sin 35°$$

$$\boxed{\alpha = 41.0°}$$

$$35° + \alpha + \beta = 180°$$

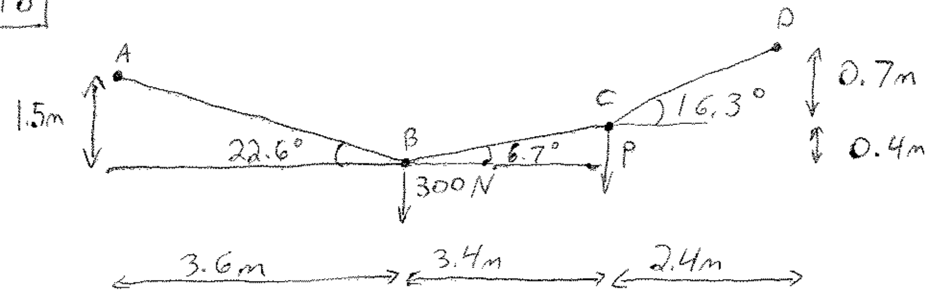
$$\beta = 104°$$

$$|R| = \sqrt{(70\,lb)^2 + (80\,lb)^2 - 2(70\,lb)(80\,lb)\cos 104°}$$

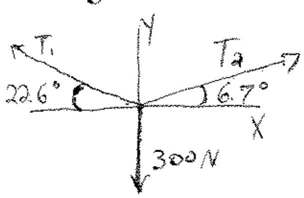
$$\boxed{|R| = 118\,lb}$$

MAE 206 HW # 1 2.48

2.48



Light at B



$$\Sigma F_x = 0 = T_2 \cos 6.7° - T_1 \cos 22.6°$$

$$\Sigma F_y = 0 = T_2 \sin 6.7° + T_1 \sin 22.6° - 300N$$

$$T_2 \cos 6.7° = T_1 \cos 22.6°$$

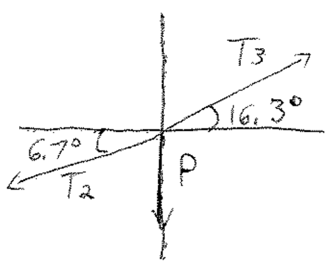
$$T_2 = \frac{T_1 \cos 22.6°}{\cos 6.7°} = T_1 \cdot 0.9296$$

$$T_1 \cdot 0.9296 \sin 6.7° + T_1 \sin 22.6° = 300N$$

$$T_1 = 608.83N$$

$$T_2 = 565.944N$$

Light at C



$$\Sigma F_x = 0 = -565.94N \cos 6.7° + T_3 \cos 16.3°$$

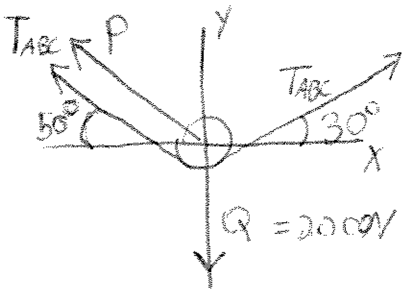
$$\Sigma F_y = 0 = -565.94N \sin 6.7° + T_3 \sin 16.3° - P$$

$$P = -565.94N \sin 6.7° + T_3 \sin 16.3°$$

$$T_3 = \frac{565.94 \cos 6.7°}{\cos 16.3°}$$

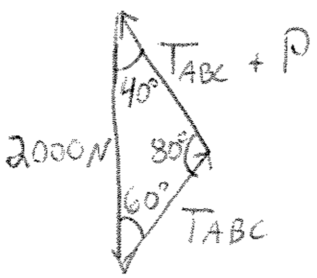
$\boxed{P = 98.3\ N = \text{Weight of stoplight at point C}}$

MAE 206 | HW # 1 | 2.71



P: 800 N
Q: 2000N

$$\frac{2000N}{\sin 80^\circ} = \frac{T_{ABC}}{\sin 40^\circ} \qquad \frac{2000N}{\sin 80^\circ} = \frac{T_{ABC}+P}{\sin 60^\circ}$$



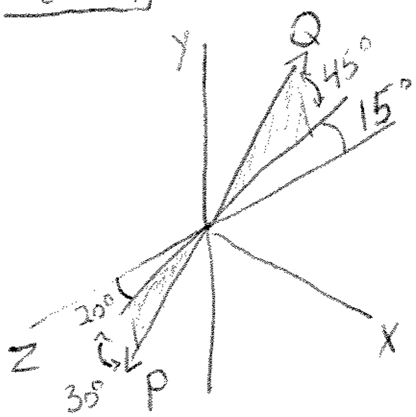
$$\boxed{T_{ABC} = 1310\ N}$$

$$P = \frac{2000N \cdot \sin 60^\circ}{\sin 80^\circ} - T_{ABC}$$

$$\boxed{|P| = 453\ N}$$

MAE 206 HW # 1 2.94

2.94



P = 6 Kips Q = 7 Kips

$F_x = -7\cos(45°)\sin(15°) + 6\sin(20°)\cos(30°) = 0.496\ \hat{\imath}$ Kips

$F_y = 7\sin(45°) - 6\sin(30°) = 1.95\ \hat{\jmath}$ Kips

$F_z = 6\cos(30°)\cos(20°) - 7\cos(15°)\cos(45°) = 0.102\ \hat{k}$ Kips

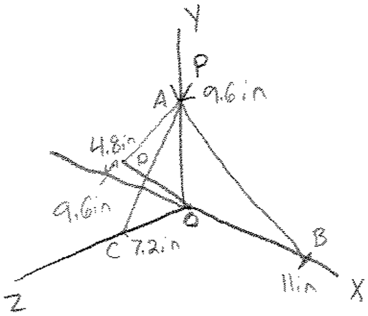
$|F| = \sqrt{F_x^2 + F_y^2 + F_z^2} = \boxed{2.01 \text{ Kips}}$

$\theta_x = \cos^{-1}\frac{F_x}{F} = 75.7° = \theta_x$

$\theta_y = \cos^{-1}\frac{F_y}{F} = 14.6° = \theta_y$

$\theta_z = \cos^{-1}\frac{F_z}{F} = 87.1° = \theta_z$

MAE 206 | HW # 1 | 2.106



$$|AB| = \sqrt{11^2 + 0^2 + 9.6^2} = 14.6 \text{ in}$$
$$|AC| = \sqrt{0^2 + 7.2^2 + 9.6^2} = 12.0 \text{ in}$$
$$|AD| = \sqrt{9.6^2 + 4.8^2 + 9.6^2} = 14.4 \text{ in}$$

$AB_x = 11\text{in}$ $\quad AB_y = 0\text{in}$ $\quad AB_z = 9.6\text{ in}$

$AC_x = 0\text{in}$ $\quad AC_y = 7.2\text{in}$ $\quad AC_z = 9.6\text{ in}$

$AD_x = -9.6\text{in}$ $\quad AD_y = -4.8\text{in}$ $\quad AD_z = 9.6\text{ in}$

$$\Sigma F_x = 0 = F_{AB} \cos \theta_{OBA} + F_{AD} \cos \theta_{ODA}$$

$$F_{AB} = -F_{AD} \frac{\cos \theta_{ODA}}{\cos \theta_{OBA}} = -F_{AD} \frac{\frac{9.6\text{in}}{14.4\text{in}}}{\frac{11\text{in}}{14.6\text{in}}}$$

$$F_{AB} = F_{AD} \cdot 0.8848$$

$$\Sigma F_z = 0 = F_{AC} \cos \theta_{OCA} - F_{AD} \cos_{ADZ}$$

$$F_{AC} = F_{AD} \frac{\cos \theta_{ADZ}}{\cos \theta_{OCA}} = F_{AD} \frac{\frac{4.8\text{in}}{14.4\text{in}}}{\frac{7.2\text{in}}{12.0\text{in}}}$$

$$F_{AC} = F_{AD} \cdot 0.5556$$

$$\Sigma F_y = F_{AB} \sin \theta_{OBA} + F_{AC} \sin \theta_{OCA} + F_{AD} \sin \theta_{ODA} - 45\text{lb} = 0$$

$$F_{AD} \left(0.8848 \sin \theta_{OBA} + 0.5556 \sin \theta_{OCA} + \sin \theta_{ODA} \right) = 45\text{lb}.$$

$$F_{AD} = \frac{45\text{lb}}{0.8848 \frac{9.6\text{in}}{14.6\text{in}} + 0.5556 \frac{9.6\text{in}}{12.0\text{in}} + \frac{9.6\text{in}}{14.4\text{in}}}$$

$$\boxed{F_{AD} = 26.6\text{lb} \qquad F_{AC} = 14.8\text{lb} \qquad F_{AB} = 23.5\text{lb}.}$$