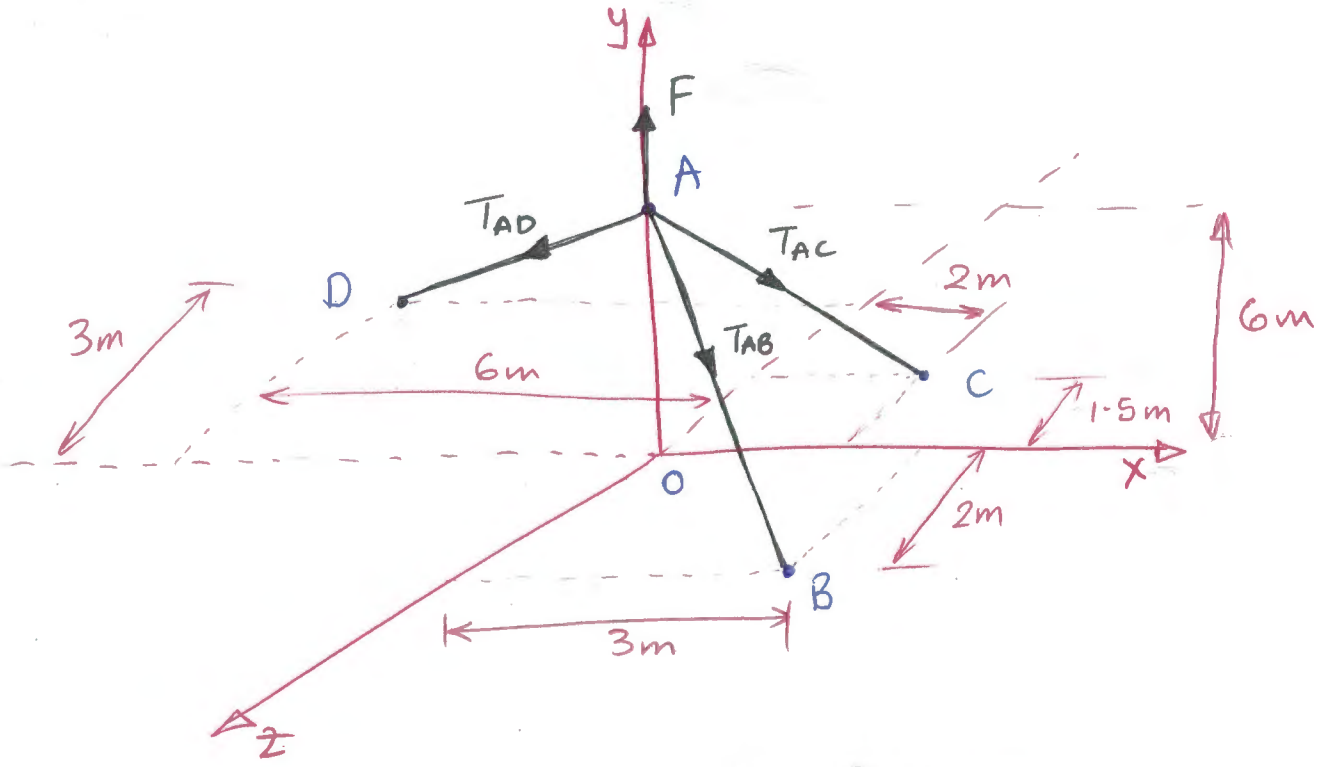
Problem 1



FREE-BODY DIAGRAM

(b) A (0, 6, 0) B(3, 0, 2) C(2, 0, −1·5) D(−6, 0, −3)

$\bar{AD} = [D] - [A] = -6m\,\bar{i} - 6m\,\bar{j} - 3m\,\bar{k}$

$|\bar{AD}| = \sqrt{(-6)^2 + (-6)^2 + (-3)^2} = 9m$

$\bar{\lambda}_{AD} = \frac{1}{9}(-6\bar{i} - 6\bar{j} - 3\bar{k})$

$\bar{AB} = [B] - [A] = 3m\,\bar{i} - 6m\,\bar{j} + 2m\,\bar{k}$

$|\bar{AB}| = \sqrt{(3)^2 + (-6)^2 + (2)^2} = 7m$

$\bar{\lambda}_{AB} = \frac{1}{7}(3\bar{i} - 6\bar{j} + 2\bar{k})$

$\bar{AC} = [C] - [A] = 2m\,\bar{i} - 6m\,\bar{j} - 1{\cdot}5m\,\bar{k}$

$|\bar{AC}| = \sqrt{(2)^2 + (-6)^2 + (-1{\cdot}5)^2} = 6{\cdot}5m$

$\bar{\lambda}_{AC} = \frac{1}{6{\cdot}5}(2\bar{i} - 6\bar{j} - 1{\cdot}5\bar{k})$

$$\bar{T}_{AB} = T_{AB}\,\bar{\lambda}_{AB} = \frac{700N(3\bar{i} - 6\bar{j} + 2\bar{k})}{7}$$

$$= +300N\,\bar{i} - 600N\,\bar{j} + 200N\,\bar{k}$$

$$\bar{T}_{AC} = T_{AC}\,\bar{\lambda}_{AC} = \frac{T_{AC}}{6.5}(2\,\bar{i} - 6\,\bar{j} - 1.5\,\bar{k})$$

$$\bar{T}_{AD} = T_{AD}\,\bar{\lambda}_{AD} = \frac{T_{AD}}{9}(-6\,\bar{i} - 6\,\bar{j} - 3\,\bar{k})$$

$$\bar{F} = F\,\bar{j}$$

(c)

$$\Sigma F_x = 0 : +300 + \frac{2T_{AC}}{6.5} - \frac{2T_{AD}}{3} = 0 \quad \text{— [1]}$$

$$\Sigma F_y = 0 : -600 - \frac{6T_{AC}}{6.5} - \frac{2T_{AD}}{3} + F = 0 \quad \text{— [2]}$$

$$\Sigma F_z = 0 : +200 - \frac{1.5T_{AC}}{6.5} - \frac{T_{AD}}{3} = 0 \quad \text{— [3]}$$

* Multiply Eq^n [3] by -2 & add to Eq^n [1]

$$-100 + 5\frac{T_{AC}}{6.5} = 0 \;;\; \Rightarrow T_{AC} = \frac{100 * 6.5}{5} = 130N$$

* → substitute into Eq^n [1]

$$+300 + \frac{2(130)}{6.5} - \frac{2T_{AD}}{3} = 0 \;;\; \Rightarrow T_{AD} = \frac{\left[300 + \frac{2(130)}{6.5}\right]3}{2} = 510N$$

* → substitute into Eq^n [2]

$$-600 - \frac{6(130)}{6.5} - \frac{2(510)}{3} + F = 0 \;;\; F = 600 + \frac{6(130)}{6.5} + \frac{2(510)}{3}$$

$$F = 1{,}060N$$

Problem 2

$$R_x = F_1\left(\frac{4}{5}\right) + F_2 \cos 60 = 500\left(\frac{4}{5}\right) + 600\cos 60$$

$$= 700\,N$$

$$R_y = F_1\left(\frac{3}{5}\right) - F_2 \sin 60 = 500\left(\frac{3}{5}\right) - 600\sin 60$$

$$= -219.6\,N$$

$$R = \sqrt{(700)^2 + (-219.6)^2} = 733.6\,N$$

$$\theta = \tan^{-1}(R_y/R_x) = 17.4^\circ$$

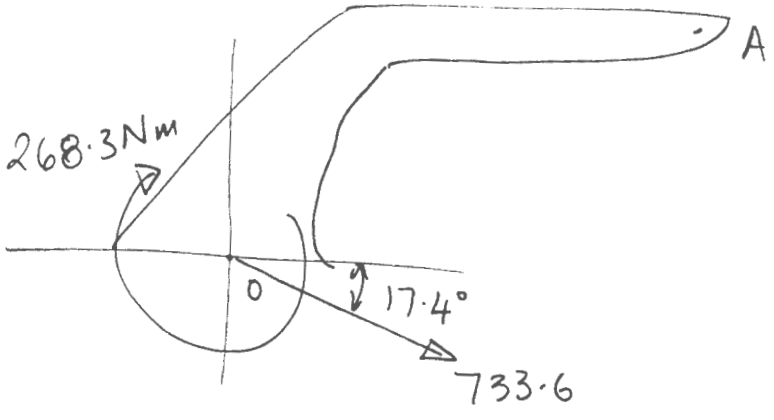
+ve ccw

$$M_0 = -F_1\left(\frac{4}{5}\right)(0.25) - \left(F_2\cos 60\right)(0.25) + F_1\left(\frac{3}{5}\right)(0.125+0.3) - \left(F_2 \sin 60\right)(0.125+0.3)$$

$$= \left(-500*\frac{4}{5} - 600\cos 60\right)(0.25) + (0.4125)\left(500*\frac{3}{5} - 600\sin 60\right)$$

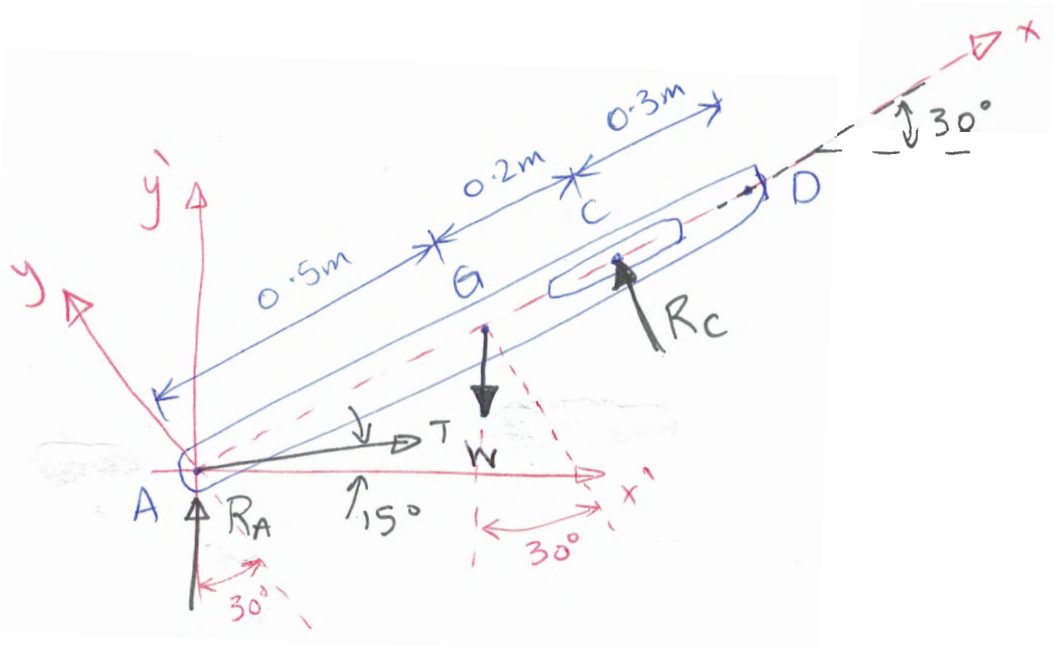
$$= -175 - 93.34$$

$$= -268.3\,Nm \Rightarrow \text{(i.e. cw moment)}$$



Problem 3

$W = mg = 25 * 9.81$
$= 245.25 N$



FREE-BODY DIAGRAM

(b) $\circlearrowleft + \sum M_A = 0$; $-(W\cos 30)(0.5) + R_C(0.5+0.2) = 0$

$$R_C = \frac{(W\cos 30) * 0.5}{0.7} = \frac{245.25\cos 30}{2(0.7)}$$

$$R_C = 151.7 N$$

$+\rightarrow \sum F_x = 0$; $R_A \sin 30 + T\cos 15 - W\sin 30 = 0$

$$\frac{R_A}{2} + 0.966T = 122.625 \quad \text{— [1]}$$

$+\uparrow \sum F_y = 0$; $R_A \cos 30 - T\sin 15 - W\cos 30 + R_C = 0$

$$\frac{R_A\sqrt{3}}{2} - 0.2588T = +60.69 \quad \text{— [2]}$$

Multiply Eqn [1] by $-\sqrt{3}$ & add to Eqn [2]

$-1.93T = -157.1 N \Rightarrow T = 78.5 N$

substitute in Eqn [1]

$\frac{R_A}{2} + 0.966(78.5) = 122.625 \Rightarrow R_A = 93.56 N$