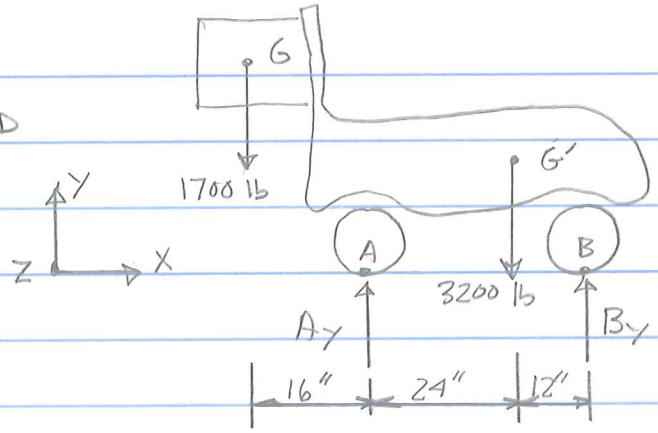
ME 35a HW #3 Solution

4.7 FBD



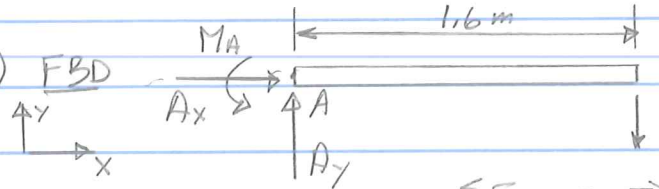
$\Sigma M_A = 0 = 1700\,lb \cdot 16\,in - 3200\,lb \cdot 24\,in + B_y \cdot 36\,in$

$\Rightarrow \boxed{B_y = 1378\,lb}$

$\Sigma F_y = 0 = -1700\,lb + A_y - 3200 + B_y = 0$

$\Rightarrow \boxed{A_y = 3522\,lb}$ Can check by $\Sigma M_B = 0$. OK

4.45 a) FBD

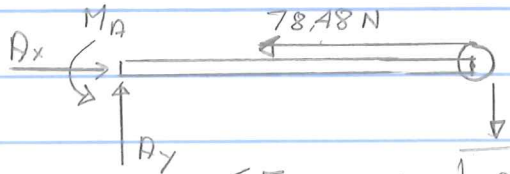


$\Sigma F_x = 0 \Rightarrow \boxed{A_x = 0}$

$\Sigma F_y = 0 \Rightarrow \boxed{A_y = 78.48\,N}$

$\Sigma M_A = 0 \Rightarrow M_A = 78.48\,N \cdot 1.6\,m = \underline{125.6\,Nm}$

b) FBD



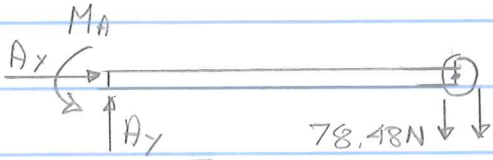
pulley radius = 0.1 m

$\Sigma F_x = 0 \Rightarrow \boxed{A_x = 78.48\,N}$

$\Sigma F_y = 0 \Rightarrow \boxed{A_y = 78.48\,N}$

$\Sigma M_A = 0 \Rightarrow M_A = 78.48N \cdot 1.7m - 78.48\,N \cdot 0.1m = \underline{125.6\,Nm}$

c) FBD

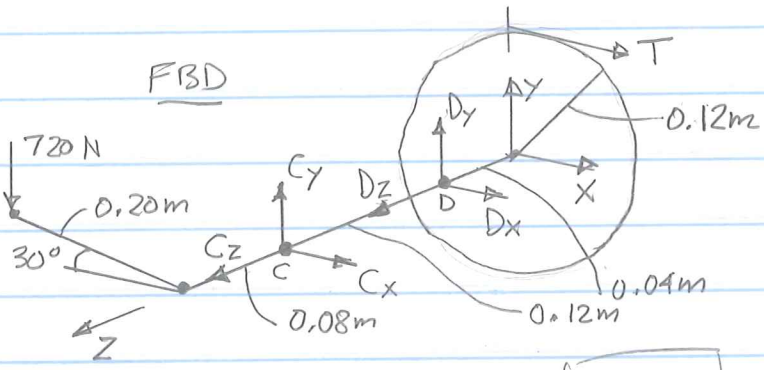


pulley radius = 0.1 m

$\Sigma F_x = 0 \Rightarrow \boxed{A_x = 0}$ $\Sigma F_y = 0 \Rightarrow A_y = 2 \cdot 78.48N = \underline{157.0\,N}$

$\Sigma M_A = 0 \Rightarrow M_A = 78.48N \cdot 1.7m + 78.48N \cdot 1.6m = \underline{251.1\,Nm}$

4.92 Assume no couple reactions at C and D.



$\cos 30° = \frac{\sqrt{3}}{2}$

Given that $D_z = 0$, $\Sigma F_z = 0 \Rightarrow \boxed{C_z = 0}$

a) Take moments about axis CD (+ in z direction)

$\Sigma M_{CD} = 0 = -T \cdot 0.12m + 720N \cdot \frac{\sqrt{3}}{2} 0.20m \Rightarrow \boxed{T = 1039.2\ N}$

b) $\Sigma M_{Dx} = 0 = -C_y \cdot 0.12m + 720N \cdot (0.12m + 0.08m)$

$\Rightarrow \boxed{C_y = 1200\ N}$

$\Sigma M_{Cx} = 0 = D_y \cdot 0.12m + 720\ N \cdot (0.08m)$

$\Rightarrow \boxed{D_y = -480\ N}$

check: $\Sigma F_y = 0 = C_y + D_y - 720N = 0$ ✓

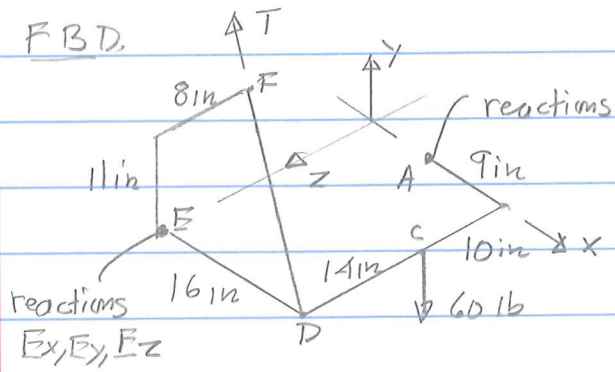
$\Sigma M_{Dy} = 0 = -T \cdot 0.04m + C_x \cdot 0.12m \Rightarrow \boxed{C_x = 346.4\ N}$

$\Sigma M_{Cy} = 0 = -T \cdot (0.12m + 0.04m) - D_x \cdot 0.12m$

$\Rightarrow \boxed{D_x = -1385.6\ N}$

check: $\Sigma F_x = 0 = T + D_x + C_x = 0$ ✓

4.140 FBD.



$L_{FD} = 21$ in

$L_{EA} = 25$ in

Take moments about axis EA so only T appears.

(continued)

$T_x = -\frac{16}{21} T$, $T_y = \frac{11}{21} T$, $T_z = -\frac{8}{21} T$

$$\Sigma \bar{M}_E = \det \begin{bmatrix} \bar{i} & \bar{j} & \bar{k} \\ 0 & 11\,in & -8\,in \\ -\frac{16}{21}T & \frac{11}{21}T & -\frac{8}{21}T \end{bmatrix} + \det \begin{bmatrix} \bar{i} & \bar{j} & \bar{k} \\ 16\,in & 0 & -14\,in \\ 0 & -60\,lb & 0 \end{bmatrix}$$

($\bar{r}$ from E to F; $\bar{T}$; $\bar{r}$ from E to C; applied load)

$$= -840\,in\text{-}lb\,\bar{i} + \frac{128\,in}{21} T\,\bar{j} + \left(\frac{176\,in}{21} T - 960\,in\text{-}lb\right)\bar{k}$$

unit vector from E to A: $\bar{\lambda} = \frac{7}{25}\bar{i} - \frac{24}{25}\bar{k}$

$$\Sigma \bar{M}_{EA} = (\Sigma \bar{M}_E \cdot \bar{\lambda})\,\bar{\lambda}$$

$$= \left(-840 \cdot \tfrac{7}{25}\,in\text{-}lb - \frac{176 \cdot 24\,in}{21 \cdot 25} T + 960 \cdot \tfrac{24}{25}\,in\text{-}lb\right)\bar{\lambda}$$

Must equal zero. $\Rightarrow T = 85.3\,lb$