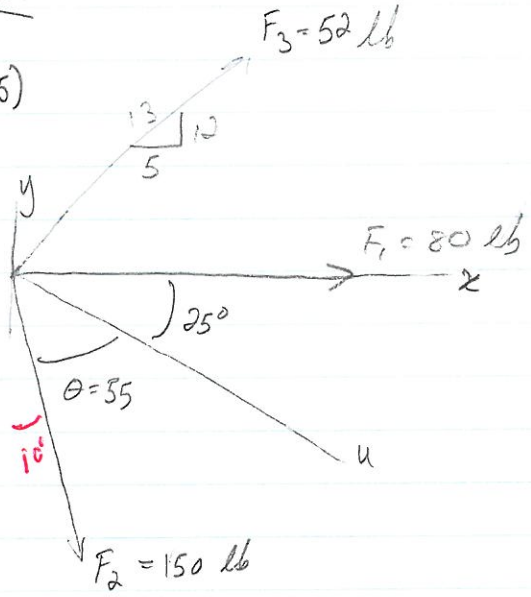
Midterm

1. (2.55)



- draw scalistically
- show axis
- show forces

(10)

$F_1 = 80\,\hat{i} + 0\,\hat{j}$

$F_2 = 150(\cos 80\,\hat{i} - \sin 80\,\hat{j})$

$F_3 = 52(5/13\,\hat{i} + 12/13\,\hat{j})$

- Resolving Forces (30)

$F_R = \sum F \Rightarrow F_{Rx} = 80 + \overbrace{(\cos 80)150}^{26} + \overbrace{52(5/13)}^{20} = 126.0$ lb

$F_{R,y} = 0 + \underbrace{(-\sin 80)150}_{147} + \underbrace{52(12/13)}_{48} = -99.72$ lb

- Finding Resultant (40)

$F_R = 126.0\,\hat{i} - 99.72\,\hat{j}$

$\|F_R\| = \sqrt{126^2 + 99.72^2} = 160.9$

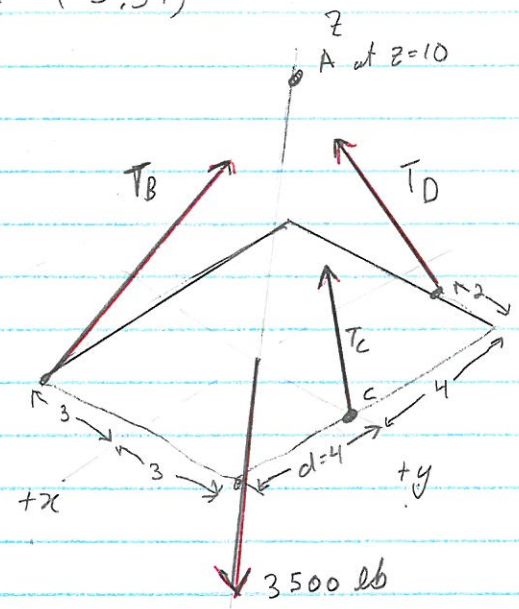
$\measuredangle F_R = \arctan\left(\frac{99.72}{126}\right)$

$= 38.2°$ CW from +x axis

- answering in the (20)

Main issues
- Solving
- Numerical precision
- diagram
- Unit conversion (don't +1)

2. (3.51)



- draw Realistically
- axis
- dimensions
- showing C on y axis

(10)

Using latter diagram,

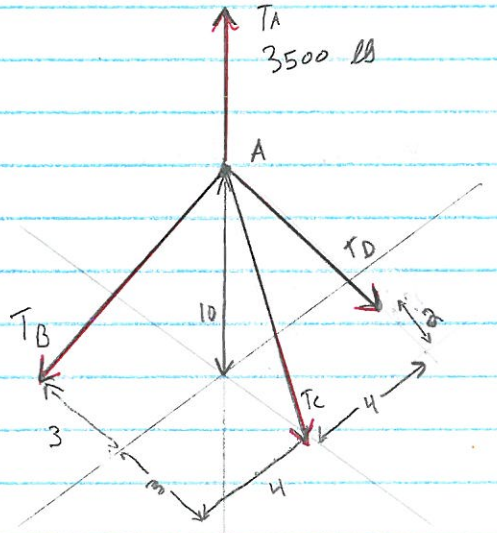
- Resolve Forces

(30)

$T_A = 3500\,\hat{\jmath}$

note, $T_A = T_B + T_C + T_D$

OR



$$\begin{cases} \hat{u}_{T_B} = \dfrac{+4\hat{\imath} - 3\hat{\jmath} - 10\hat{k}}{\sqrt{4^2+3^2+10^2}} = 0.3378\hat{\imath} - 0.2683\hat{\jmath} - 0.8944\hat{k} \\ \qquad \sqrt{4^2+3^2+10^2} = \sqrt{125} = 5\sqrt{5} \\ T_B = \|T_B\|\,\hat{u}_{T_B} \end{cases}$$

$$\begin{cases} \hat{u}_{T_C} = \dfrac{(+3\hat{\jmath} - 10\hat{k})}{\sqrt{3^2+10^2}} = 0.2873\hat{\jmath} - 0.9578\hat{k} \\ \qquad \sqrt{3^2+10^2} = \sqrt{109} \\ T_C = \|T_C\|\,\hat{u}_{T_C} \end{cases}$$

$$\begin{cases} \hat{u}_{T_D} = \dfrac{(-4\hat{\imath} + 1\hat{\jmath} - 10\hat{k})}{\sqrt{4^2+1+10^2}} = -0.3698\hat{\imath} + 0.0924\hat{\jmath} - 0.9245\hat{k} \\ \qquad \sqrt{4^2+1+10^2} = \sqrt{117} = 3\sqrt{13} \\ T_D = \|T_D\|\,\hat{u}_{T_D} \end{cases}$$

Equations of Equilibrium

(45)

- Equ Equil

$$\sum F_x = 0 \Rightarrow 0.3378\,T_B - 0.3698\,T_D = 0$$
$$\sum F_y = 0 \Rightarrow -0.2683\,T_B + 0.2873\,T_C + 0.0924\,T_D = 0$$
$$\sum F_z = 0 \Rightarrow -0.8944\,T_B - 0.9578\,T_C - 0.9245\,T_D + 3500 = 0$$

Solve

- Answers

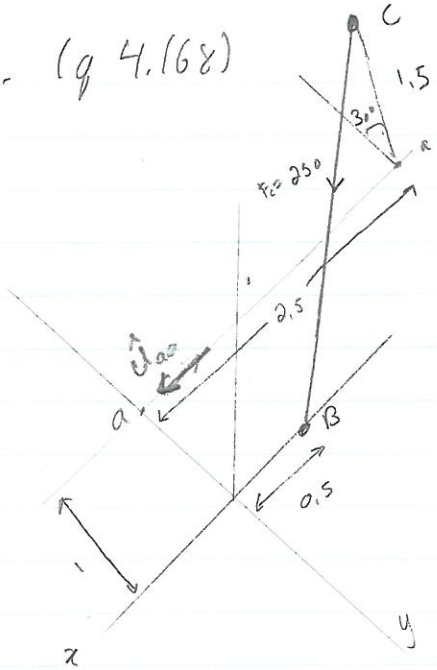
(15)

$T_B = 1467.42$ lb, $T_C = 913.5$ lb, $T_D = 1419.69$ lb

~ 6527.6 N, ~ 4063.6 N, ≈ 6315.3 N

Midterm

3. (q 4.168)



- Reaction
- axis
- forces
- dimensions

10

A = (-0.5, -1, 0)

B = (-0.5, 0, 0), C = (-2.5, -(1 + 1.5cos30), 1.5 sin 30)

= (-2.5, -2.30, 0.75)

$r_{CB} = B - C = (-0.5 + 2.5)\hat{i} + (0 + 2.30)\hat{j} + (0 - 0.75)\hat{k}$

$= 2.0\hat{i} + 2.30\hat{j} - 0.75\hat{k}$

$\hat{u}_{CB} = \frac{2.0\hat{i} + 2.30\hat{j} - 0.75\hat{k}}{\sqrt{2.0^2 + 2.30^2 + 0.75^2}} = 0.568\hat{i} + 0.795\hat{j} + 0.213\hat{k}$

$2.0^2 + 2.30^2 + 0.75^2 = 9.85$, $\sqrt{9.85} = 3.13$

$F = 250\,\hat{u}_{CB} = 159.3\hat{i} + 183.7\hat{j} - 59.75\hat{k}$

Getting Force (30)

$\hat{u}_{aa} = \hat{i}$ ← axis as a vector

- Getting axis (20)

$r_{AB} = 1\hat{j}$ ← B is in the line of action (property of transmissibility)

Moment about axis

$M_{aa} = \hat{u}_{aa} \cdot (r_{AB} \otimes F) = \hat{i} \cdot (\hat{j} \otimes F) = \begin{vmatrix} 1 & 0 & 0 \\ 0 & 1 & 0 \\ 159.3 & 183.7 & -59.75 \end{vmatrix}$

$= -59.7$ N·m

- Setting up equation, getting r (30)

Answer (10)