Quiz 1, Engrd 202, Feb 7, 2003 | Name: RUINA

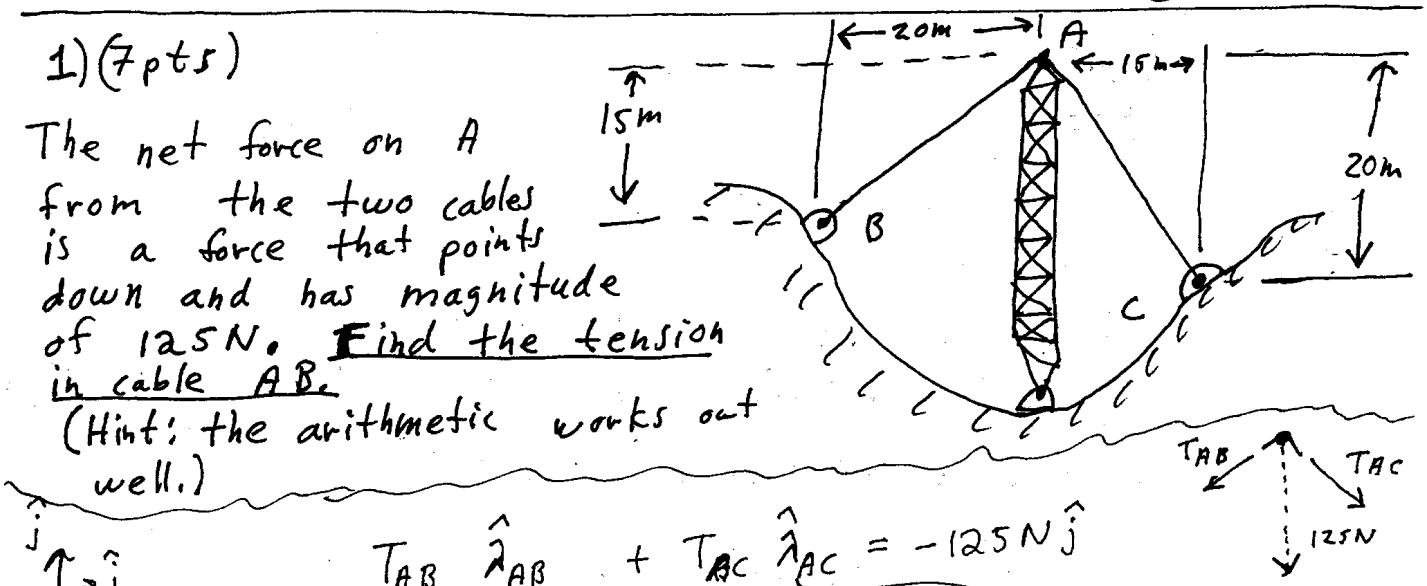
Section day & time: _____ TA: "SOLUTION"

Closed book. No notes. No Calculators.

1) (7pts)

The net force on A from the two cables is a force that points down and has magnitude of 125N. Find the tension in cable AB.

(Hint: the arithmetic works out well.)



$$T_{AB}\,\hat{\lambda}_{AB} + T_{AC}\,\hat{\lambda}_{AC} = -125\,\text{N}\,\hat{j}$$

$$\left\{ T_{AB}\left(-\tfrac{4}{5}\hat{i} - \tfrac{3}{5}\hat{j}\right) + T_{AC}\left(\tfrac{3}{5}\hat{i} - \tfrac{4}{5}\hat{j}\right) = -125\,\text{N}\,\hat{j} \right\}$$

$\{\}\cdot(4\hat{i}+3\hat{j}) \Rightarrow$ ($4\hat{i}+3\hat{j}$ is a vector $\perp$ to $\hat{\lambda}_{AC}$)

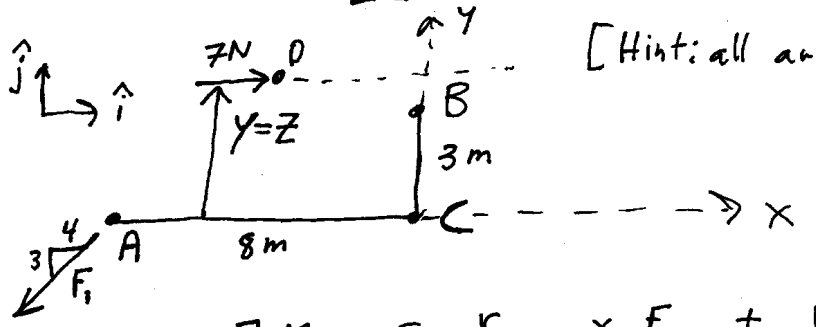
$$T_{AB}\left(\frac{-16}{5} - \frac{9}{5}\right) = -375\,\text{N}$$

$$T_{AB} = \frac{375}{5}\,\text{N}$$

$$\boxed{T_{AB} = 75\,\text{N}}$$

$T_{AB} = 75\,\text{N}$

2) (10 pts) $\underline{F}_1$ at A and $\underline{F}_2 = 7N\,\hat{i}$ (unknown location) together are equivalent to a force $\underline{F}_B$ and moment $\underline{M}_B = 48Nm\,\hat{k}$ at B and (also) to a force $\underline{F}_C$ and moment $\underline{M}_C = 75Nm\,\hat{k}$ at C. Find $\underline{F}_C$ and the line of action of $\underline{F}_2$.



[Hint: all arithmetic ends up tidy.]

"Solutions"

$$\Sigma \underline{M}_{/B} = \underline{r}_{BA} \times \underline{F}_1 + \underline{r}_{BD} \times \underline{F}_2$$

$$48Nm\,\hat{k} = (-8m\,\hat{i} - 3m\,\hat{j}) \times \left(\tfrac{-4}{5}\hat{i} - \tfrac{3}{5}\hat{j}\right) F_1 + (z-3m)7N\,(-\hat{k})$$

$$\{48Nm\,\hat{k} = \tfrac{24-12}{5}\,m F_1\,\hat{k} - 7zN\,\hat{k} + 21Nm\,\hat{k}\}$$

$\{\}\cdot\hat{k} \Rightarrow$ $\quad 27Nm = \tfrac{12}{5}\,m F_1 - 7zN \quad (1)$

$$\Sigma \underline{M}_{/C} = \underline{r}_{CA} \times \underline{F}_1 + \underline{r}_{CD} \times \underline{F}_2$$

$$\{75Nm\,\hat{k} = \left(\tfrac{3}{5}F_1\right)(8m)\,\hat{k} + -z\,7N\,\hat{k}\}$$

$\{\}\cdot\hat{k} \Rightarrow$ $\quad 75Nm = \tfrac{24}{5}\,m F_1 - 7zN \quad (2)$

$75Nm = 96Nm - 7zN \Rightarrow 21m = 7z$

$\boxed{z = 3m}$

$(2) - (1) \Rightarrow$ $\quad 48Nm = \tfrac{12}{5}\,m F_1 \Rightarrow F_1 = 20N$

$$\Rightarrow \underline{F}_1 = 20N\left(\tfrac{-4}{5}\hat{i} - \tfrac{3}{5}\hat{j}\right)$$

$$= -16N\,\hat{i} - 12N\,\hat{j}$$

$$\underline{F}_C = \underline{F}_1 + \underline{F}_2$$

$$= (-16N\,\hat{i} - 12N\,\hat{j}) + 7N\,\hat{i}$$

$$\boxed{\underline{F}_C = -9N\,\hat{i} - 12N\,\hat{j}}$$

$$\boxed{\underline{F}_C = (-9N)\hat{i} + (-12N)\,\hat{j}}$$

The line of action of $\underline{F}_2$ is defined by the equation:

$\boxed{y = z = 3m}$