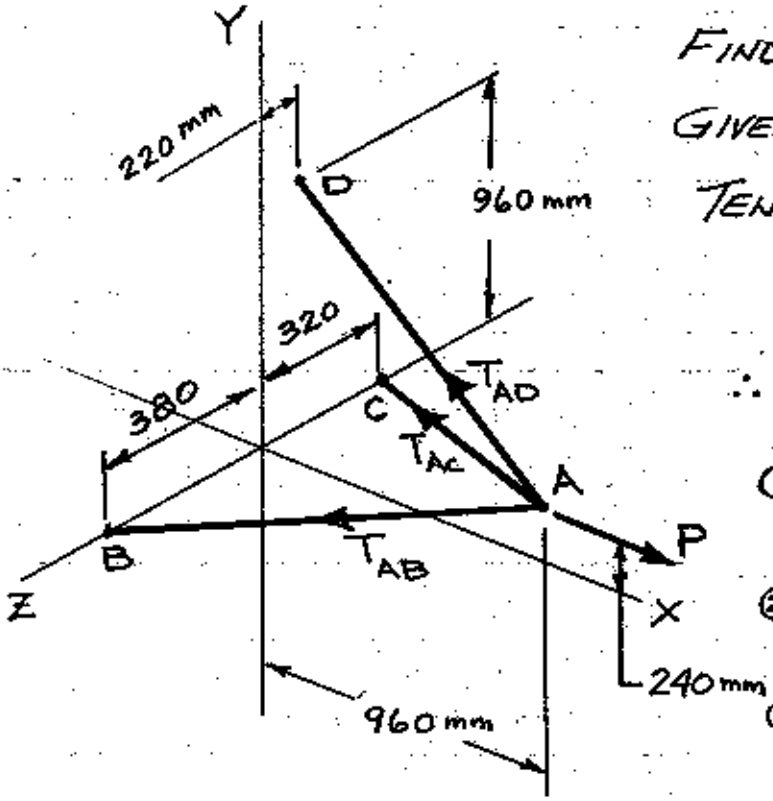

FIND: force $\vec{P}$ at pt. A

GIVEN: $Q = 0$ (ignore)

TENSION, $T_{AD} = 305$ N.

$\Sigma F = 0$

$\therefore \vec{P} = \vec{T}_{AB} + \vec{T}_{AC} + \vec{T}_{AD}$

① USE POSITION VECTORS FOR AB, AC, AD

② TENSION $\propto$ LENGTH

③ $\Sigma F_x = 0$, $\Sigma F_y = 0$, $\Sigma F_z = 0$

① $\overline{AB} = -960\hat{i} - 240\hat{j} + 380\hat{k}$, $\sqrt{960^2 + 240^2 + 380^2} = 1060$ mm.

$\overline{AC} = -960\hat{i} - 240\hat{j} - 320\hat{k}$, $\sqrt{960^2 + 240^2 + 320^2} = 1040$ mm.

$\overline{AD} = -960\hat{i} + (960 - 240)\hat{j} - 220\hat{k}$, $\sqrt{960^2 + 720^2 + 220^2} = 1220$ mm.

② $\vec{T}_{AB} = T_{AB}\lambda_{AB} = T_{AB}\left[\frac{-960}{1060}\hat{i} - \frac{240}{1060}\hat{j} + \frac{380}{1060}\hat{k}\right]$

$= -.91 T_{AB}\hat{i} - .23 T_{AB}\hat{j} + .36 T_{AB}\hat{k}$

$\vec{T}_{AC} = T_{AC}\lambda_{AC} = T_{AC}\left[\frac{-960}{1040}\hat{i} - \frac{240}{1040}\hat{j} - \frac{320}{1040}\hat{k}\right]$

$= -.92 T_{AC}\hat{i} - .23 T_{AC}\hat{j} - .31 T_{AC}\hat{k}$

$\vec{T}_{AD} = T_{AD}\lambda_{AD} = 305^{N}\left[\frac{-960}{1220}\hat{i} + \frac{720}{1220}\hat{j} - \frac{220}{1220}\hat{k}\right]$

$= -240\hat{i} + 180\hat{j} - 55\hat{k}$

GROUP LIKE TERMS:

SET COEFFICIENTS of $\hat{i}$, $\hat{j}$, $\hat{k}$ EQUAL TO 0.

DON'T FORGET ABOUT $\vec{P}$.

STEP ③

$$\Sigma F_x = 0 = -.91\,T_{AB} - .92\,T_{AC} - 240 + P \quad \text{I.}$$

$$\Sigma F_y = 0 = -.23\,T_{AB} - .23\,T_{AC} + 180 \quad \text{II.}$$

$$\Sigma F_z = 0 = .36\,T_{AB} - .31\,T_{AC} - 55 \quad \text{III.}$$

3 EQ., 3 UNKNOWNS, T_{AB}, T_{AC}, P ∴ SOLVE SIMULTANEOUS

BEGIN WITH EQ. II + III to eliminate T_{AB} and solve for T_{AC}

$$\text{II} + \text{III}\left(\frac{.23}{.36}\right) \begin{cases} \text{II} & -.23\,T_{AB} - .23\,T_{AC} + 180 = 0 \\ \frac{.23}{.36}\left[\right. & .36\,T_{AB} - .31\,T_{AC} - 55 = 0 \left.\right] \end{cases}$$

$$-.43\,T_{AC} + 144.86 = 0$$

$$\boxed{T_{AC} = 336.89\ \text{N.}}$$

SUB. INTO EITHER II or III. TO SOLVE T_{AB}

II. $-.23\,T_{AB} - .23(336.89) + 180 = 0$

$$\therefore \boxed{T_{AB} = 445.72\ \text{N.}}$$

SUB. INTO EQ. I., SOLVE FOR P

$$-.91(445.72) - .92(336.89) - 240 + P = 0$$

$$\therefore \boxed{P = 955.55\ \text{N.}}$$