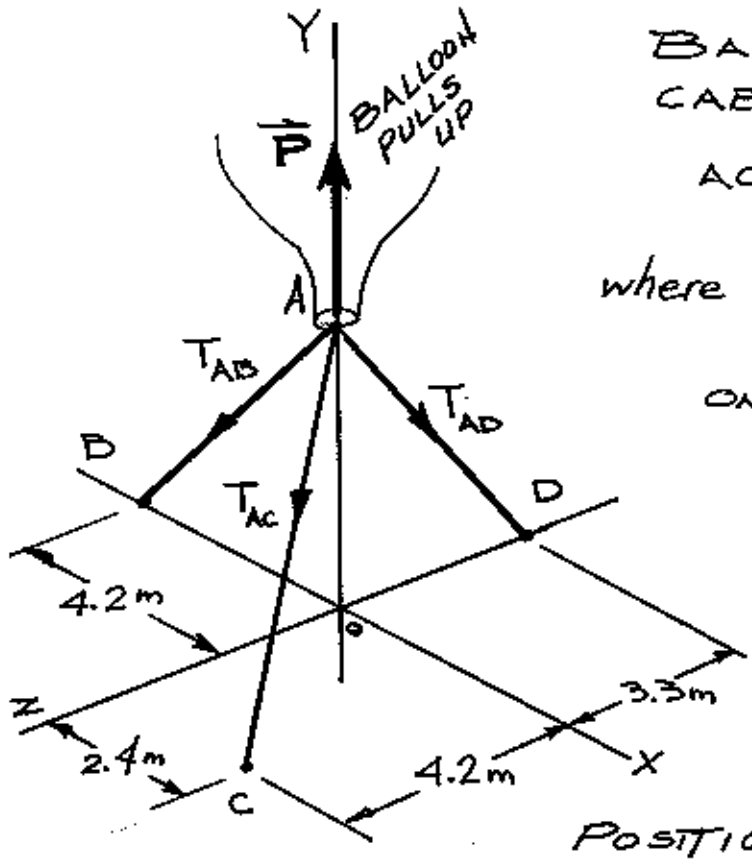

BALLOON PULLS UP ↑
CABLES HOLD IT DOWN ↓

ACTION = −REACTION

$\vec{P} = -\vec{R}$ IN Y-DIR.

where $\vec{R} = \vec{T}_{AB} + \vec{T}_{AC} + \vec{T}_{AD}$

ONLY $\vec{T}_{AB}$ IS KNOWN.

$|\vec{T}_{AB}| = 259\,N.$

BUT POSITIONS ARE GIVEN!

POSITION VECTORS ARE PROPORTIONAL TO FORCE VECTORS.

---

① USE X, Y, Z COORDINATES TO DETERMINE POSITION VECTORS.

② DETERMINE MAGNITUDE (OR LENGTH) FOR EACH POSITION VECTOR.

③ DIVIDE EACH COMPONENT OF POSITION VECTOR BY THIS MAGNITUDE (LENGTH) TO DETERMINE UNIT VECTORS.

④ MULTIPLY THE TENSION BY THIS UNIT VECTOR TO DETERMINE THE X, Y, Z COMPONENTS OF THIS TENSION.

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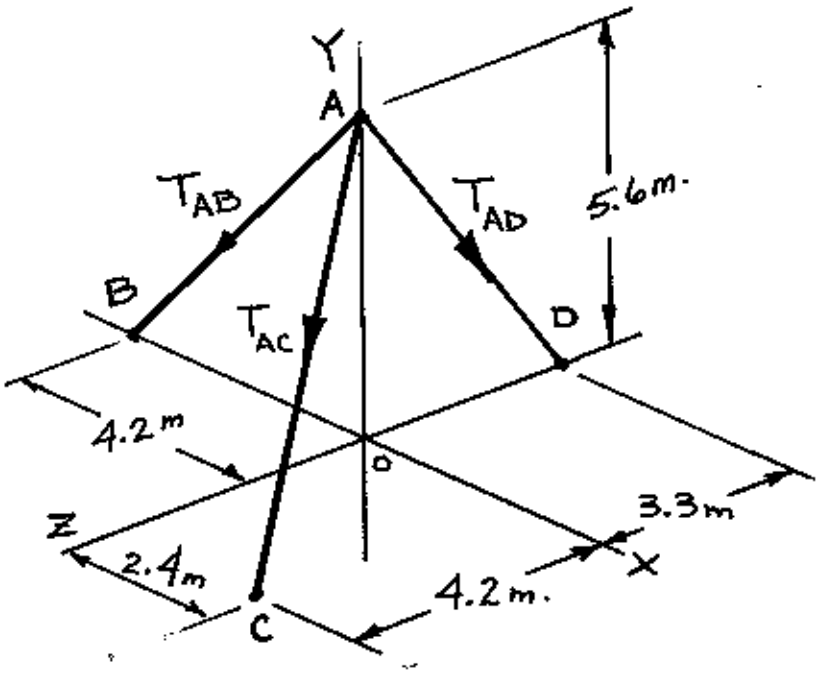
⑤ TO SOLVE T_{AC} and T_{AD}, THINK EQUILIBRIUM.

$\Sigma F_X = 0$, $\Sigma F_Y = 0$, $\Sigma F_Z = 0$

⑥ GROUP LIKE TERMS FOR THESE 3 EQUATIONS. SOLVE AS SIMULTANEOUS EQUATIONS.

G. MILANO



① POSITION VECTORS

$\overrightarrow{AB} = -4.2\hat{i} - 5.6\hat{j} + 0\hat{k}$

$\overrightarrow{AC} = 2.4\hat{i} - 5.6\hat{j} + 4.2\hat{k}$

$\overrightarrow{AD} = 0\hat{i} - 5.6\hat{j} - 3.3\hat{k}$

② MAGNITUDE

$\sqrt{5.6^2 + 4.2^2} = 7\text{m}.$

$\sqrt{2.4^2 + 5.6^2 + 4.2^2} = 7.4\text{m}.$

$\sqrt{5.6^2 + 3.3^2} = 6.5\text{m}.$

---

③ UNIT VECTORS

$\lambda_{AB} = -\frac{4.2}{7}\hat{i} - \frac{5.6}{7}\hat{j} = -0.6\hat{i} - 0.8\hat{j}$

$\lambda_{AC} = \frac{2.4}{7.4}\hat{i} - \frac{5.6}{7.4}\hat{j} + \frac{4.2}{7.4}\hat{k} = 0.324\hat{i} - .757\hat{j} + 0.568\hat{k}$

$\lambda_{AD} = \frac{-5.6}{6.5}\hat{j} - \frac{3.3}{6.5}\hat{k} = -0.861\hat{j} - 0.51\hat{k}$

---

④ MULTIPLY UNIT VECTORS BY TENSIONS

$\vec{T}_{AB} = T\lambda = 259^{N}[-0.6\hat{i} - 0.8\hat{j}] = -155.4\hat{i} - 207.2\hat{j}$

$\vec{T}_{AC} = 0.324\,T_{AC}\hat{i} - 0.757\,T_{AC}\hat{j} + 0.568\,T_{AC}\hat{k}$

$\vec{T}_{AD} = -0.861\,T_{AD}\hat{j} - 0.51\,T_{AD}\hat{k}$

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⑤ GROUP LIKE TERMS, SOLVE SIMULTANEOUSLY.
SEE NEXT SHEET FOR SET-UP & MATH.

I. GROUP $\hat{i}$ TERMS

$$\Sigma F_x = 0 = -155\hat{i} + 0.324\,T_{AC}\,\hat{i}$$

$$\therefore T_{AC} = \frac{155}{.324} = 478.395$$

$$\boxed{T_{AC} = 478.4^{N}}$$

II. GROUP $\hat{j}$ TERMS

$$\Sigma F_Y = -P\,\hat{j} = -207.2\,\hat{j} - 0.757\,T_{AC}\,\hat{j} - 0.861\,T_{AD}\,\hat{j}$$

(? over $-P\,\hat{j}$; ? over $T_{AD}\,\hat{j}$)

III. GROUP $\hat{k}$ TERMS

$$\Sigma F_z = 0 = 0.568\,T_{AC}\,\hat{k} - 0.51\,T_{AD}\,\hat{k}$$

$$\therefore .568\,(478.4^{N}) = .51\,T_{AD}$$

$$\frac{.568}{.51}(478.4) = \boxed{T_{AD} = 532.8^{N}.}$$

SUB. BACK INTO EQ. II.

II. $$-P = -207.2 - .757\,(478.4) - .861\,(532.8)$$

$$\boxed{P = 1028.1^{N}\uparrow}$$

ANSWER IN BACK OF BOOK = 1031^{N}.

SHORTCUT: SET UP PROPORTIONS

$$\frac{\text{TENSION}}{\text{LENGTH}} = \frac{(T_x\,\hat{i} + T_y\,\hat{j} + T_z\,\hat{k})}{(d_x\,\hat{i} + d_y\,\hat{j} + d_z\,\hat{k})}$$

$$\therefore T_x\,\hat{i} + T_y\,\hat{j} + T_z\,\hat{k} = \underbrace{\frac{|T|}{|d|}}_{\text{MAGNITUDES}}\ \underbrace{(d_x\,\hat{i} + d_y\,\hat{j} + d_z\,\hat{k})}_{\text{POSITION VECTOR FROM COORDINATES.}}$$

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