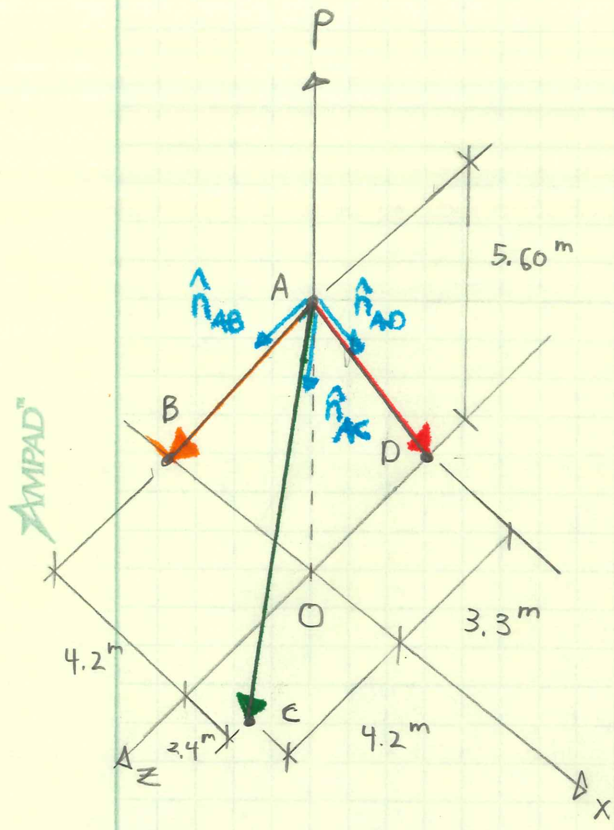

• POINT-TO-POINT METHOD

1) We need a unit vector to describe each force's direction

$$\vec{AB} = (X_B - X_A)\hat{i} + (Y_B - Y_A)\hat{j} + (Z_B - Z_A)\hat{k}$$
$$= (-4.2 - 0)\hat{i} + (0 - 5.6)\hat{j} + (0 - 0)\hat{k}$$

$$\vec{AB} = -4.2\hat{i} - 5.6\hat{j} \quad (m)$$

$$\vec{AC} = (X_C - X_A)\hat{i} + (Y_C - Y_A)\hat{j} + (Z_C - Z_A)\hat{k}$$
$$= (2.4 - 0)\hat{i} + (0 - 5.6)\hat{j} + (4.2 - 0)\hat{k}$$

$$\vec{AC} = 2.4\hat{i} - 5.6\hat{j} + 4.2\hat{k} \quad (m)$$

$$\vec{AD} = (X_D - X_A)\hat{i} + (Y_D - Y_A)\hat{j} + (Z_D - Z_A)\hat{k}$$
$$= (0 - 0)\hat{i} + (0 - 5.6)\hat{j} + (-3.3 - 0)\hat{k}$$

$\vec{AD} = -5.6\hat{j} - 3.3\hat{k}$ (m)

$\vec{P} = 0\hat{i} + 1\hat{j} + 0\hat{k}$

These vectors describe the magnitude & direction of the balloon's tethers, not the tension vectors.

2) We know the tension vectors act along the tethers, we need a unit vector of each tether to multiple by each tension vector's magnitude

$$\hat{n}_{AB} = \frac{\vec{AB}}{AB} = \frac{-4.2\hat{i} - 5.6\hat{j}}{\sqrt{(-4.2)^2 + (-5.6)^2}} = \frac{-4.2}{7}\hat{i} - \frac{5.6}{7}\hat{j}$$

$$= -0.6\hat{i} - 0.8\hat{j}$$

$$\hat{n}_{AC} = \frac{\vec{AC}}{AC} = \frac{2.4\hat{i} - 5.6\hat{j} + 4.2\hat{k}}{\sqrt{2.4^2 + (-5.6)^2 + 4.2^2}}$$

$$= 0.3243\hat{i} - 0.7568\hat{j} + 0.5676\hat{k}$$

$$\hat{n}_{AD} = \frac{\vec{AD}}{AD} = \frac{-5.6\hat{j} - 3.3\hat{k}}{\sqrt{(-5.6)^2 + (-3.3)^2}}$$

$$= -0.8615\hat{j} - 0.5077\hat{k}$$

SUMMARY:

$\hat{n}_{AB} = -0.6\hat{i} - 0.8\hat{j}$

$\hat{n}_{AC} = 0.3243\hat{i} - 0.7568\hat{j} + 0.5676\hat{k}$

$\hat{n}_{AD} = -0.8615\hat{j} - 0.5077\hat{k}$

$\hat{n}_P = 1\hat{j}$

3) We multiply these unit vectors by the tension force (magnitude) to describe the tension force vectors

$$\vec{T}_{AB} = \hat{n}_{AB} T_{AB} *$$

$$\vec{T}_{AC} = \hat{n}_{AC} T_{AC}$$

$$\vec{T}_{AD} = \hat{n}_{AD} T_{AD}$$

$$\vec{P} = \hat{n}_{P} P$$

$$\vec{T}_{AB} = -0.6\, T_{AB}\, \hat{i} - 0.8\, T_{AB}\, \hat{j}$$

$$\vec{T}_{AC} = 0.3243\, T_{AC}\, \hat{i} - 0.7568\, T_{AC}\, \hat{j} + 0.5676\, T_{AC}\, \hat{k}$$

$$\vec{T}_{AD} = \cancel{0.8615\, T_{AD}}\, 0\, \hat{i} - 0.8615\, \overset{492^N}{\cancel{T_{AD}}}\, \hat{j} - 0.5077\, \overset{492^N}{\cancel{T_{AD}}}\, \hat{k}$$

$$\vec{P} = 0\, \hat{i} + P\, \hat{j} + 0\, \hat{k}$$

* We are told $T_{AD} = 492^N$ in the problem

ΣF_x ΣF_y ΣF_z

4) We now sum the forces & apply equilibrium

(1) $-0.6\, T_{AB} + 0.3243\, T_{AC} = 0$

(2) $-0.8\, T_{AB} - 0.7568\, T_{AC} - 0.8615(492) + P = 0$

(3) $0.5676\, T_{AC} - 0.5077(492) = 0$

5) Now, we solve the equations simultaneously

We have 3 equations: (1), (2), & (3)

We have 3 unknowns: T_{AB}, T_{AC}, & P

I Get:

$$T_{AB} = 237.9 \text{ N}$$

$$T_{AC} = 440 \text{ N}$$

$$P = 947.2 \text{ N}$$