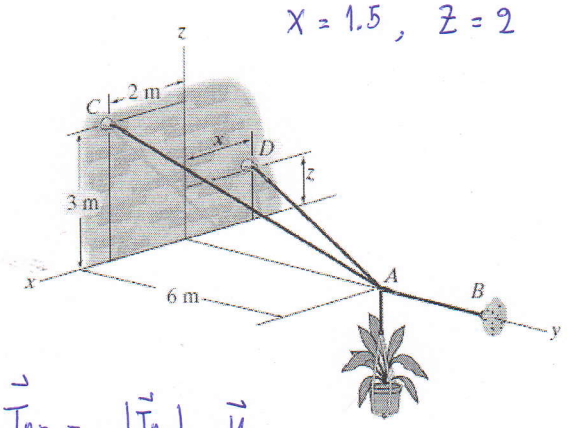
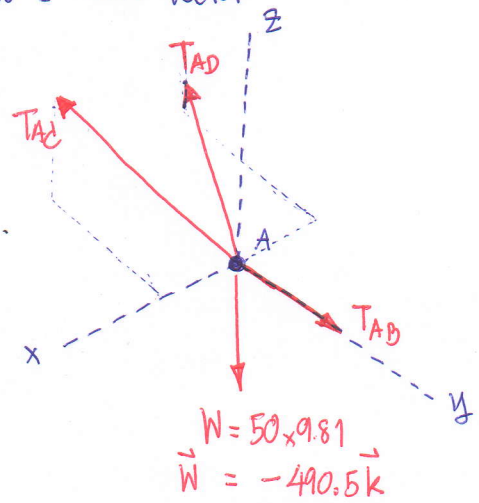
การบ้าน 1

3–54. If the mass of the flowerpot is 50 kg, determine the tension developed in each wire for equilibrium. Set $x = 1.5$ m and $z = 2$ m.

$X = 1.5, \quad Z = 2$



$\vec{u}$ = unit vector



$W = 50 \times 9.81$

$\vec{W} = -490.5\,\vec{k}$

$\vec{T}_{AD} = |\vec{T}_{AD}| \times \vec{u}_{AD}$

$\vec{r}_{AD} = -1.5\,\vec{i} - 6\,\vec{j} + 2\,\vec{k}$

$\vec{u}_{AD} = \frac{1}{|\vec{r}_{AD}|} \times \vec{r}_{AD}$

$\vec{u}_{AD} = \frac{1}{\sqrt{1.5^2+6^2+2^2}} \times \vec{r}_{AD}$

$\vec{u}_{AD} = -0.23\,\vec{i} - 0.92\,\vec{j} + 0.31\,\vec{k}$

$$\vec{T}_{AD} = -0.23\,T_{AD}\,\vec{i} - 0.92\,T_{AD}\,\vec{j} + 0.31\,T_{AD}\,\vec{k}$$

$\vec{T}_{AC} = |\vec{T}_{AC}| \times \vec{u}_{AC}$

$\vec{r}_{AC} = 2\,\vec{i} - 6\,\vec{j} + 3\,\vec{k}$

$\vec{u}_{AC} = \frac{1}{|\vec{r}_{AC}|} \times \vec{r}_{AC}$

$\vec{u}_{AC} = \frac{1}{\sqrt{2^2+6^2+3^2}} \times \vec{r}_{AC}$

$\vec{u}_{AC} = 0.28\,\vec{i} - 0.86\,\vec{j} + 0.43\,\vec{k}$

$$\vec{T}_{AC} = 0.28\,T_{AC}\,\vec{i} - 0.86\,T_{AC}\,\vec{j} + 0.43\,T_{AC}\,\vec{k}$$

$$\vec{T}_{AB} = T_{AB}\,\vec{j}$$

$$\vec{W} = -490.5\,\vec{k}$$

Static equilibrium

$\Sigma \vec{F} = 0 \Rightarrow \Sigma F_x = 0,\ \Sigma F_y = 0,\ \Sigma F_z = 0$

$\vec{T}_{AC} + \vec{T}_{AB} + \vec{T}_{AD} + \vec{W} = 0$

$\Sigma F_x = 0 \Rightarrow 0.28\,T_{AC} - 0.23\,T_{AD} = 0 \quad -(1)$

$\Sigma F_y = 0 \Rightarrow -0.86\,T_{AC} - 0.92\,T_{AD} + T_{AB} = 0 \quad -(2)$

$\Sigma F_z = 0 \Rightarrow 0.43\,T_{AC} + 0.31\,T_{AD} - 490.5 = 0$

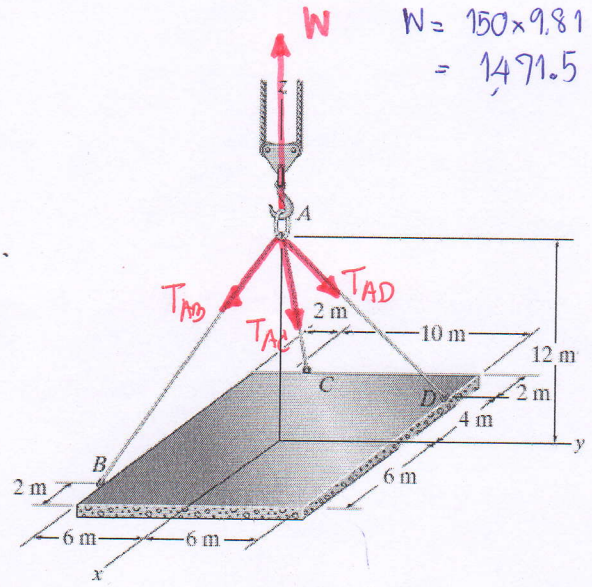
$0.43\,T_{AC} + 0.31\,T_{AD} = 490.5 \quad -(3)$

สมการ (1), (2), (3) ใช้วิธีดูปใช้อยู่ในรูปแบบสมการเมทริกซ์ $\Rightarrow Ax = b$

$$\begin{bmatrix} 0.28 & -0.23 & 0 \\ -0.86 & -0.92 & 1 \\ 0.43 & 0.31 & 0 \end{bmatrix} \begin{Bmatrix} T_{AC} \\ T_{AD} \\ T_{AB} \end{Bmatrix} = \begin{Bmatrix} 0 \\ 0 \\ 490.5 \end{Bmatrix}$$

หน้าที่ 2

***3–56.** The ends of the three cables are attached to a ring at A and to the edge of a uniform 150-kg plate. Determine the tension in each of the cables for equilibrium.



$W = 150 \times 9.81 = 1471.5$

$\vec{r}_{AD} = 4\vec{i} - 6\vec{j} - 12\vec{k}$, $|\vec{r}_{AD}| = 14$

$\vec{u}_{AD} = \frac{4}{14}\vec{i} - \frac{6}{14}\vec{j} - \frac{12}{14}\vec{k}$

$\vec{T}_{AD} = |\vec{T}_{AD}|\vec{u}_{AD}$

$$\vec{T}_{AD} = \frac{4}{14}T_{AD}\vec{i} - \frac{6}{14}T_{AD}\vec{j} - \frac{12}{14}T_{AD}\vec{k}$$

$\vec{r}_{AC} = -6\vec{i} - 4\vec{j} - 12\vec{k}$, $|\vec{r}_{AC}| = 14$

$\vec{u}_{AC} = -\frac{6}{14}\vec{i} - \frac{4}{14}\vec{j} - \frac{12}{14}\vec{k}$

$$\vec{T}_{AC} = -\frac{6}{14}T_{AC}\vec{i} - \frac{4}{14}T_{AC}\vec{j} - \frac{12}{14}T_{AC}\vec{k}$$

$\vec{r}_{AB} = -4\vec{i} + 6\vec{j} - 12\vec{k}$, $|\vec{r}_{AB}| = 14$

$\vec{u}_{AB} = -\frac{4}{14}\vec{i} + \frac{6}{14}\vec{j} - \frac{12}{14}\vec{k}$

$$\vec{T}_{AB} = -\frac{4}{14}T_{AB}\vec{i} + \frac{6}{14}T_{AB}\vec{j} - \frac{12}{14}T_{AB}\vec{k}$$

ตัวอย่างการแก้สมการ $\Rightarrow Ax = b$

$$\begin{bmatrix} \frac{4}{14} & -\frac{6}{14} & -\frac{4}{14} \\ -\frac{6}{14} & -\frac{4}{14} & \frac{6}{14} \\ -\frac{12}{14} & -\frac{12}{14} & -\frac{12}{14} \end{bmatrix} \begin{bmatrix} T_{AB} \\ T_{AC} \\ T_{AD} \end{bmatrix} = \begin{bmatrix} 0 \\ 0 \\ -1471.5 \end{bmatrix}$$

static equilibrium.

$$\Sigma \vec{F} = 0$$

$$\Sigma F_x = 0 \Rightarrow \frac{4}{14}T_{AB} - \frac{6}{14}T_{AC} - \frac{4}{14}T_{AD} = 0 \quad -(1)$$

$$\Sigma F_y = 0 \Rightarrow -\frac{6}{14}T_{AB} - \frac{4}{14}T_{AC} + \frac{6}{14}T_{AD} = 0 \quad -(2)$$

$$\Sigma F_z = 0 \Rightarrow -\frac{12}{14}T_{AB} - \frac{12}{14}T_{AC} - \frac{12}{14}T_{AD} = -1471.5 = 0 \quad -(3)$$