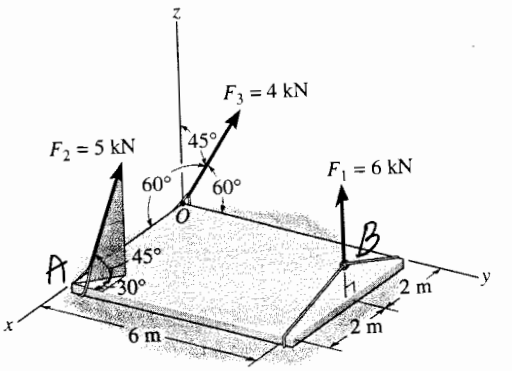
CE 201-2 (041)

Quiz # 4

Prob. 4-131 (P.-178)

Given: The forces are shown in figure. F_1 is vertical.

Req.d:
An equivalent force of all forces and couple moment at point O.



Prob. 4–131

Soln:

$F_{1x} = 0$
$F_{1y} = 0$
$F_{1z} = 6$ kN

$F_{2x} = -5 \times \cos 45 \times \sin 30 = -1.7677$ kN
$F_{2y} = 5 \times \cos 45 \times \cos 30 = 3.062$ kN
$F_{2z} = 5 \times \cos 45 = 3.535$ kN

$F_{3x} = 4 \times \cos 60 = 2$ kN
$F_{3y} = 4 \times \cos 60 = 2$ kN
$F_{3z} = 4 \times \cos 45 = 2.828$ kN

$\vec{F_1} = 0\vec{i} + 0\vec{j} + 6\vec{k}$ kN
$\vec{F_2} = -1.7677\vec{i} + 3.062\vec{j} + 3.535\vec{k}$ kN
$\vec{F_3} = 2\vec{i} + 2\vec{j} + 2.828\vec{k}$ kN

$\vec{F_R} = (F_{1x} + F_{2x} + F_{3x})\vec{i} + (F_{1y} + F_{2y} + F_{3y})\vec{j} + (F_{1z} + F_{2z} + F_{3z})\vec{k}$
$= (0 - 1.7677 + 2)\vec{i} + (0 + 3.062 + 2)\vec{j} + (6 + 3.535 + 2.828)\vec{k}$

$\vec{F_R} = 0.232\vec{i} + 5.06\vec{j} + 12.4\vec{k}$ kN

O(0,0), A(4,0), B(2,6)

$\vec{r_{OA}} = 4\vec{i}$, $\vec{r_{OB}} = (2-0)\vec{i} + (6-0)\vec{j} = 2\vec{i} + 6\vec{j}$

$\vec{F_1} = 6\vec{k}$ kN, $\vec{F_2} = (-1.767\vec{i} + 3.062\vec{j} + 3.535\vec{k})$ kN.

$\vec{M_O} = \Sigma \vec{r} \times \vec{F} = \vec{r_{OA}} \times \vec{F_2} + \vec{r_{OB}} \times \vec{F_1}$

$$= \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 4 & 0 & 0 \\ -1.767 & 3.062 & 3.535 \end{vmatrix} + \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 6 & 0 \\ 0 & 0 & 6 \end{vmatrix}$$

$= 0\vec{i} - \vec{j}(4 \times 3.535) + \vec{k}(4 \times 3.062) + [\vec{i} \times 36 - \vec{j} \times 12]$

$\vec{M_O} = 36\vec{i} - 26.152\vec{j} + 12.23\vec{k}$ kN-m