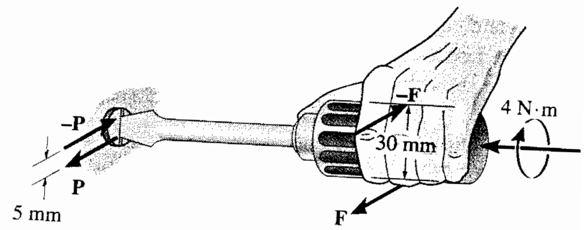
CE - 201 - 2 (041)

H.W # 5

Prob. 4-73 (P.-155)



Prob. 4–73

Given:

The Forces shown in Figure

Req.d:

Forces "F" exerted on the handle and "P" exerted on the blade.

Sol.n:

F * distance = 4N-m

$\Rightarrow$ F * 30 * 10^{-3} m = 4 N-m

$\therefore$ [F = 133.333 N]

Similarly

P * distance = 4 N-m

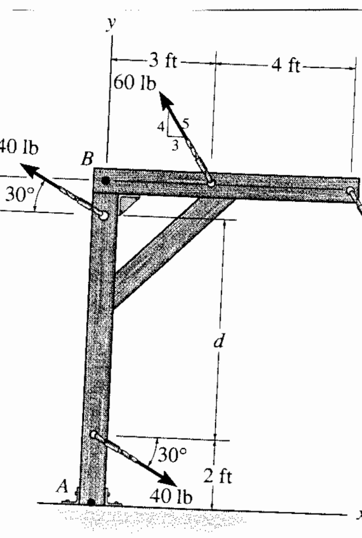
$\Rightarrow$ P * 5 * 10^{-3} m = 4 N-m

$\Rightarrow$ [P = 800 N]

Prob. 4-85 (P. 157)

Given: The forces are shown in Fig.

d = 4 ft.



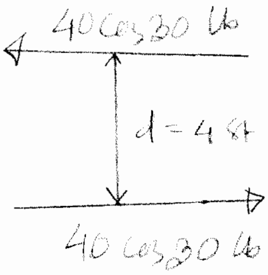
Probs. 4-

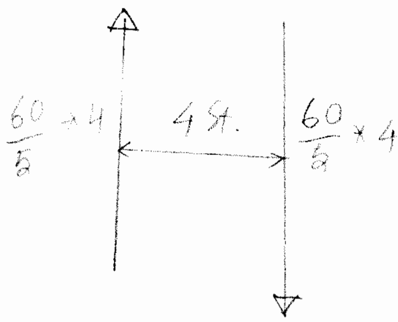
Reqd:

The resultant couple moment by resolving forces into x and y components and (a) finding the moment of each couple.

(b) summing the moments of all the force components about point B.

Soln:





(a) $\circlearrowright M = 40\cos 30 \times 4 - 60 \times \frac{4}{5} \times 4$

$= -53.436$ lb-ft

$= 53.436$ lb-ft $\circlearrowleft$

(b) $\circlearrowright M_B = 40 \times \cos 30 \times 5 - 40 \times \cos 30 \times 1 - 60 \times \frac{4}{5} \times 7 + 60 \times \frac{4}{5} \times 3$

$= -53.436$ lb-ft $= 53.436$ lb-ft $\circlearrowleft$

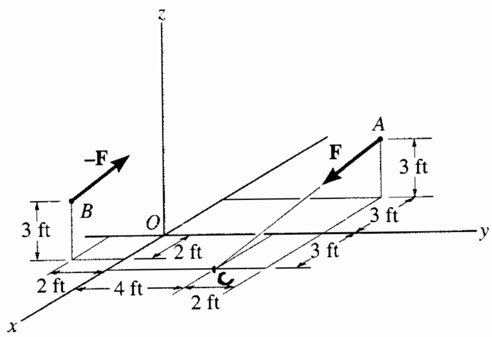
Prob 4-87 (P. 157)

The forces shown in Figure.

$F_{AC} = 120$ lb

Req.d:

The couple moment as a cartesian vector.



Sol^n

A (-3, 6, 3) B (2, -2, 3)

C (3, 4, 0)

$\vec{r}_{AC} = (3+3)\vec{i} + (4-6)\vec{j} + (0-3)\vec{k}$

$= (6\vec{i} - 2\vec{j} - 3\vec{k})$

$|r_{AC}| = \sqrt{(6)^2 + (-2)^2 + (-3)^2} = 7$ ft

$\vec{F}_{AC} = F_{AC} \cdot \dfrac{\vec{r}_{AC}}{r_{AC}} = F_{AC} \cdot U_{AC}$

$\vec{F}_{AC} = 120 \left\{ \dfrac{6\vec{i} - 2\vec{j} - 3\vec{k}}{7} \right\}$

$\vec{F}_{AC} = (102 \cdot 857\vec{i} - 34 \cdot 285\vec{j} - 51 \cdot 429\vec{k})$ lb-ft.

$\vec{r}_{AB} = (2+3)\vec{i} + (-2-6)\vec{j}$

$\vec{r}_{AB} = 5\vec{i} - 8\vec{j}$

Couple moment at point O

$$\vec{M}_O = \vec{r}_{BA} \times \vec{F}_{AC} = \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 5 & -8 & 0 \\ 102 \cdot 857 & -34 \cdot 285 & -51 \cdot 429 \end{vmatrix}$$

$= \vec{i}\{-8 * (-51 \cdot 429)\} - \vec{j}\{5 * (-51 \cdot 429)\}$

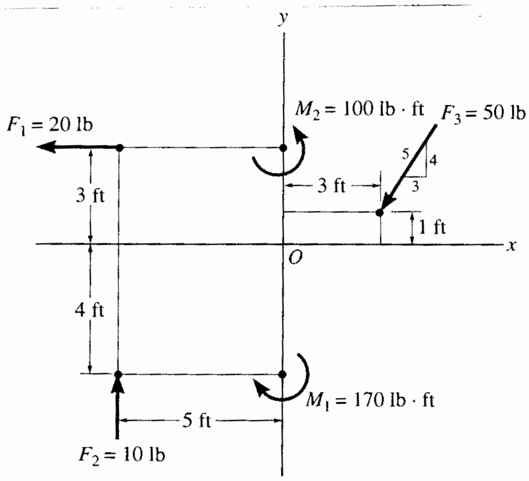
$+ \vec{k}\{5(-34 \cdot 285) + (8) 102 \cdot 857\}$

$= 411 \cdot 432\vec{i} + 257 \cdot 145\vec{j} + 651 \cdot 431\vec{k}$ lb-ft

Prob 4-109 (P. 175)

Given: The forces shown in Figure.

Reqd: Resultant force and the coordinate point of equivalent force.



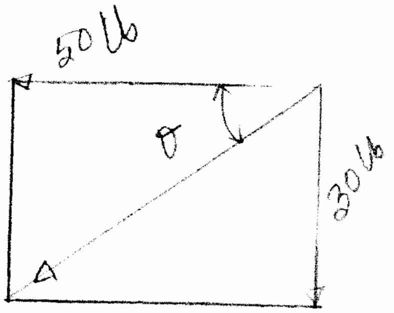
Sol.n:

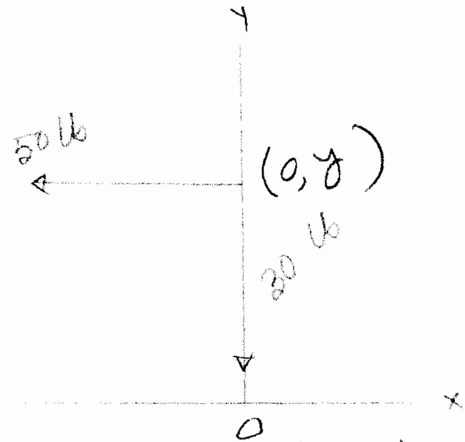
$\xrightarrow{+} F_{Rx} = \Sigma F_x$; $F_{Rx} = -50\left(\frac{3}{5}\right) - 20 = -50$ lb

$+\uparrow F_{Ry} = \Sigma F_y$; $F_{Ry} = -50\left(\frac{4}{5}\right) + 10 = -30$ lb

$F_R = \sqrt{(-50)^2 + (-30)^2} = \underline{58.3 \text{ lb}}$

$\theta = \tan^{-1}\left(\frac{30}{50}\right) = \underline{31.0°}$





$\circlearrowleft + M_{RO} = \Sigma M_O$; $50(y) = -50\left(\frac{4}{5}\right)(3) + 50\left(\frac{3}{5}\right)(1) + (20)(3) + 100 - 170 - 10(5)$

$\Rightarrow 50 y = -150$

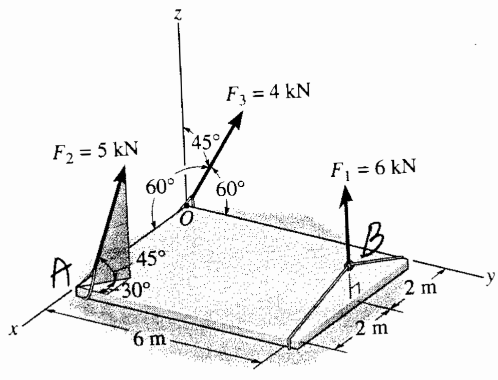
$\boxed{y = -3 \text{ ft}}$

Prob. 4-131 (P.-178)

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

Reqd:

An equivalant force of all forces and couple moment at point O.



Prob. 4–131

Sol.n:

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

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

$F_{3x} = 4 * \cos 60° = 2$ kN
$F_{3y} = 4 * \cos 60° = 2$ kN
$F_{3z} = 4 * \cos 45 = 2.828$ 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, $\vec{F_2} = (-1.767\vec{i} + 3.062\vec{j} + 3.533\vec{k})$ kN.

$\vec{M_o} = \sum \vec{r} \times \vec{F} = \vec{r_{OA}} \times \vec{F_2} + \vec{r_{OB}} \times \vec{F_1}$

$$= \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 4 & 0 & 0 \\ -1.767 & 3.062 & 3.533 \end{vmatrix} + \begin{vmatrix} \vec{i} & \vec{j} & \vec{k} \\ 2 & 6 & 0 \\ 0 & 0 & 6 \end{vmatrix}$$

$= 0\vec{i} - \vec{j}(4 * 3.533) + \vec{k}(4 * 3.062)] + [\vec{i} * 36 - \vec{j} * 12]$

$\vec{M_o} = 36\vec{i} - 26.132\vec{j} + 12.23\vec{k}$ kN-m