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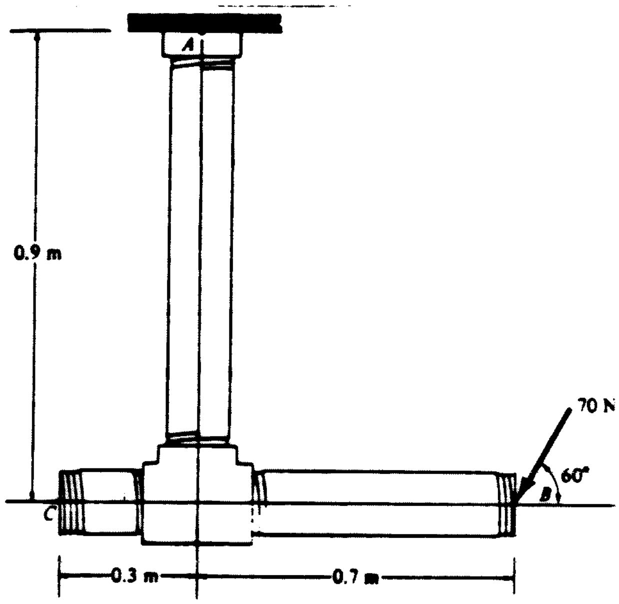
Examples

Moment of a Force (Scalar Formulation)

Example 1:



Given:

The force on the pipe shown

Reqd.:

a) M_A

b) The horizontal force at C which produces the same moment

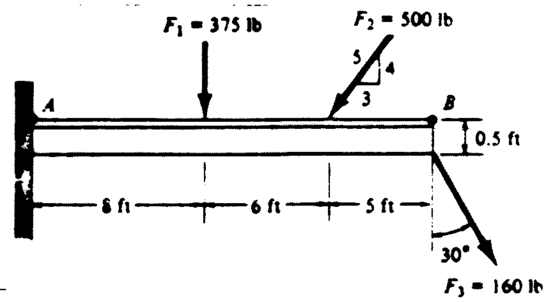
Soln.:

a) $\circlearrowleft{+}$ $M_A = -70\cos 60°(0.9) - 70\sin 60°(0.7)$

$\Rightarrow$ $\boxed{M_A = -73.9 \text{ N.m} = 73.9 \text{ N.m} \circlearrowright}$

b) $M_A = F_c d \Rightarrow 0.9\,F_c = 73.9$ (cw) $\Rightarrow$ $\boxed{F_c = 82.2 \text{ N} \leftarrow}$

Example 2:



Given:

The beam with the forces shown

Reqd.:

The moment about A of each force

Soln.:

$\circlearrowleft{+}$ (ccw M is pos.)

$\circlearrowright{-}$ (cw M is neg.)

$M_{A_1} = F_1 d \Rightarrow M_{A_1} = -375(8) \Rightarrow$ $\boxed{M_{A_1} = -3000 \text{ ft-lb} = 3 \text{ ft-k} \circlearrowright}$

$M_{A_2} = F_2 d = F_{2x}\,y + F_{2y}\,x$

$= \frac{3}{5}(500)(0) - \frac{4}{5}(500)(14) \Rightarrow$ $\boxed{M_{A_2} = -5.6 \text{ ft-k} = 5.6 \text{ ft-k} \circlearrowright}$

$M_{A_3} = F_3 d = F_{3x}\,y + F_{3y}\,x$

$= 160\sin 30°(0.5) - 160\cos 30°(19) \Rightarrow$ $\boxed{M_{A_3} = -2.59 \text{ ft-k} = 2.59 \text{ ft-k} \circlearrowright}$

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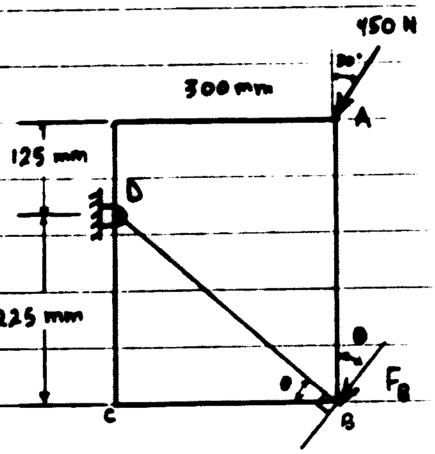
Example 3:



Given:
The figure shown

Req.d.:
a) The moment about D
b) The smallest force applied at B which produces the same moment about D (as the 450-N force)

Soln.:

a) $M_D = F_x\,(125) - F_y\,(300)$ (+↻)
$= 450 \sin 30^\circ\,(125) - 450 \cos 30^\circ\,(300) \Rightarrow$ $\boxed{M_D = 88.9 \text{ N.m} \circlearrowright}$

b) In order to have the smallest force, we need the longest arm (distance).
$\Rightarrow$ We need DB to be $\perp$ the line of action of F_B.

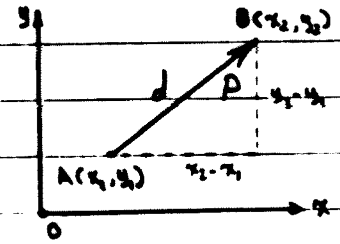
$DB = \sqrt{(225)^2 + (300)^2} = 375$ mm

$M_D = 88.9 = 375\, F_{B\,min} \Rightarrow$ $\boxed{F_{B\,min} = 237 \text{ N}}$

$\tan\theta = \frac{225}{300} \Rightarrow$ $\boxed{\theta = 36.9^\circ}$

"reasonable" answers?

Example 4:



If the line of action of a force P passes through the two points $A(x_1, y_1)$ and $B(x_2, y_2)$, establish an expression for the moment of P about the origin. P is directed from A to B.

Soln.:

$d = \sqrt{(x_2-x_1)^2 + (y_2-y_1)^2}$

$P_x = P\left(\frac{x_2-x_1}{d}\right)$

$P_y = P\left(\frac{y_2-y_1}{d}\right)$

$$M_o = M_z = x_1 P\left(\frac{y_2-y_1}{d}\right) - y_1 P\left(\frac{x_2-x_1}{d}\right)$$

$\Rightarrow$ $\boxed{M_o = \frac{P}{d}(x_1 y_2 - x_2 y_1)}$ and $\boxed{\vec{M}_o = \frac{P}{d}(x_1 y_2 - x_2 y_1)\vec{k}}$