Chapter Four "Force System Resultants"

CHAPTER OBJECTIVES

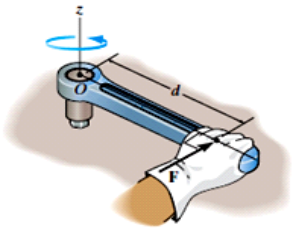
■to discuss the concept of the moment of a force and show how to calculate it in two and three dimensions.

■to provide a method for finding the moment of a force about a Specified axis.

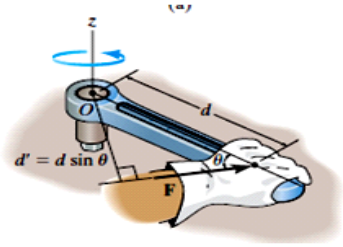
■to define the moment of a couple.

1. Moment of a Force- Scalar Formulation

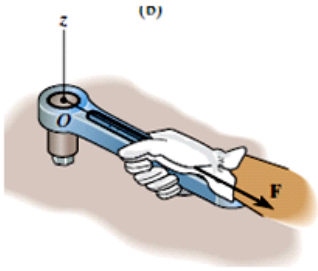
When a force is applied to a body it will produce a tendency for the body to rotate about a point that is not on the line of action of the force. This tendency to rotate is sometimes called a ***torque*** , but most often it is called the ***moment of a force* or *simply the moment.***



Mo=F. d

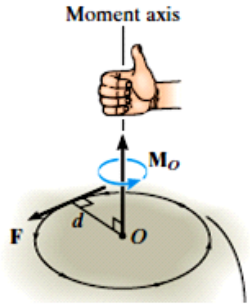


Mo=F.d΄=F.d.sinϴ



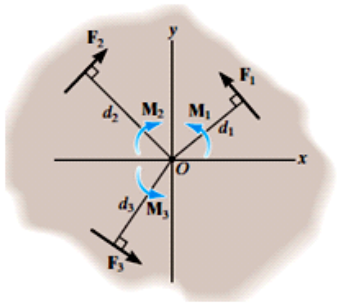
Mo=0

DIRECTION



Resultant Moment

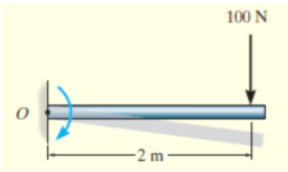
$$\zeta + (M_R)_o = \Sigma Fd; \qquad (M_R)_o = F_1 d_1 - F_2 d_2 + F_3 d_3$$



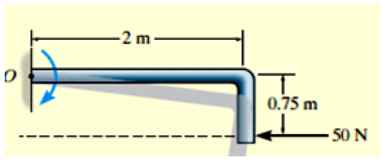
Example -1: For each case illustrated, determine the moment of the force about point O.

$$\zeta + (M_R)_o = \Sigma Fd; \qquad (M_R)_o = F_1 d_1 - F_2 d_2 + F_3 d_3$$

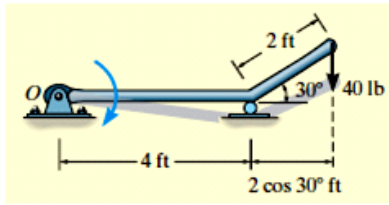
M_O=F. d = - 100*2=-200 N.m



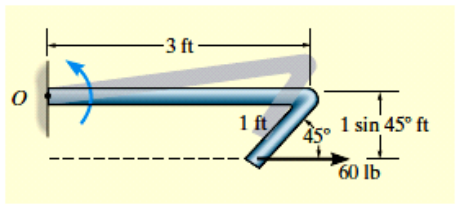
M_O=F. d = - 50*0.75= -37.5 N.m



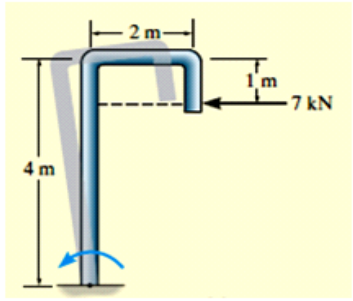
Mo=F. d $= -40 * (4 + 2 * \cos 30^0) =$ -229.28 Ib.ft



Mo=F. d $= 60 * (1 \sin 45^o) =$ 42.426 Ib.ft

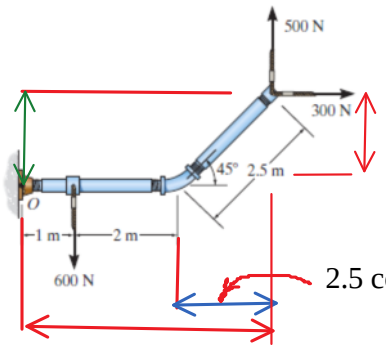


Mo=F. d =7*(4-1)= 21kN.m



Example -2:

Determine the resultant moment of the three forces acting on the rod shown in Fig. 4–5 about point O.



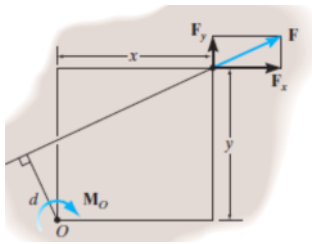
Ans:

$$\circlearrowleft +(M_R)_o = \Sigma Fd; \quad (M_R)_o = F_1d_1 - F_2d_2 + F_3d_3$$

$$= -600 * 1 - 300 * 2.5\sin 45 + 500(1 + 2 + 2.5\cos 45)$$

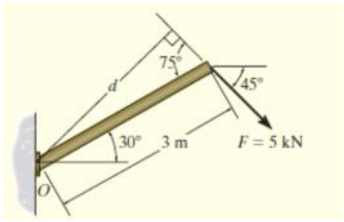
2. Principle of Moments

Varignon's theorem: the moment of a force about a point is equal to the sum of the moments of the components of the force about the point.

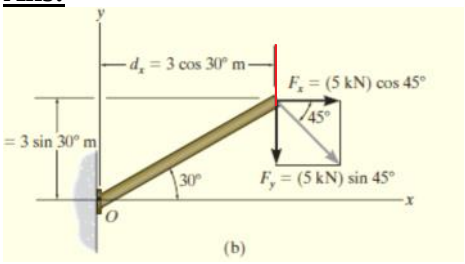


$$M_O = F_x y - F_y x$$

Example -3: Determine the moment of the force a about point O.



Ans:

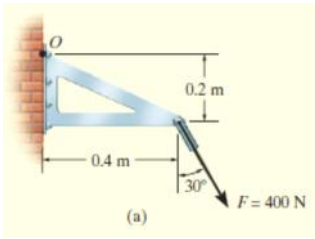


$$M_O = F_x y - F_y x$$

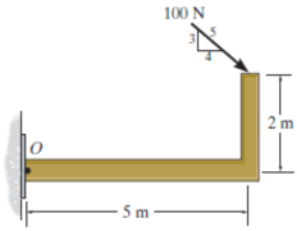
$$-5\sin 45^0 * 3\cos 30^0 + 5\cos 45^0 * 3\sin 30^0 = -3.88 \text{ kN.m}$$

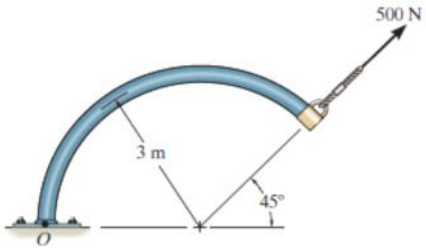
Problems:

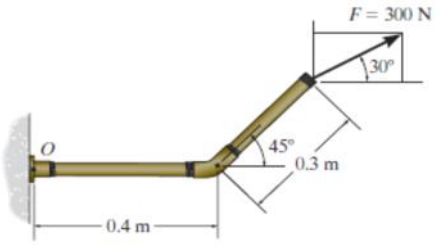
1.Force F acts at the end of the angle bracket. Determine the moment of the force about point O.

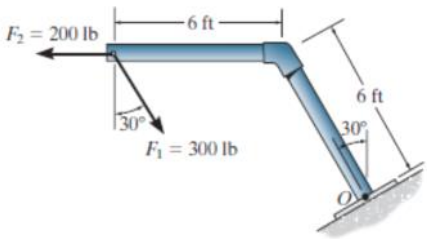


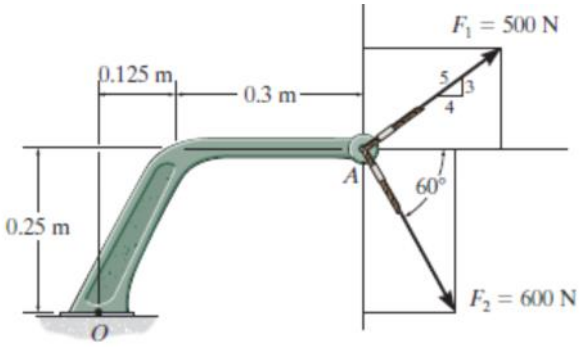
2- Determine the moment of the force about point O. Neglect the thickness of the member in figures ::

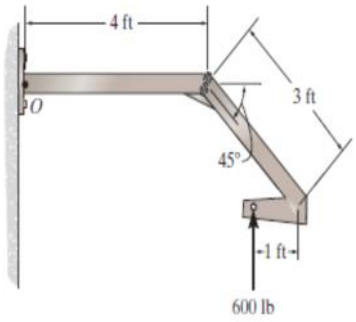


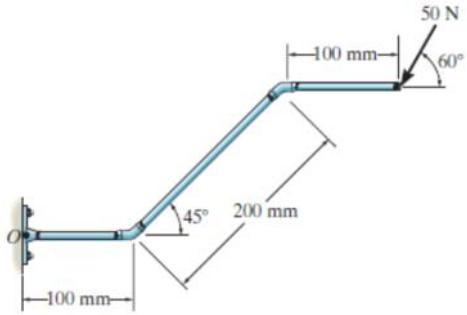







$F_1 = 500$ N
0.125 m
0.3 m
5
3
4
A
60°
0.25 m
$F_2 = 600$ N
O


4 ft
O
3 ft
45°
1 ft
600 lb


50 N
100 mm
60°
45°
200 mm
O
100 mm