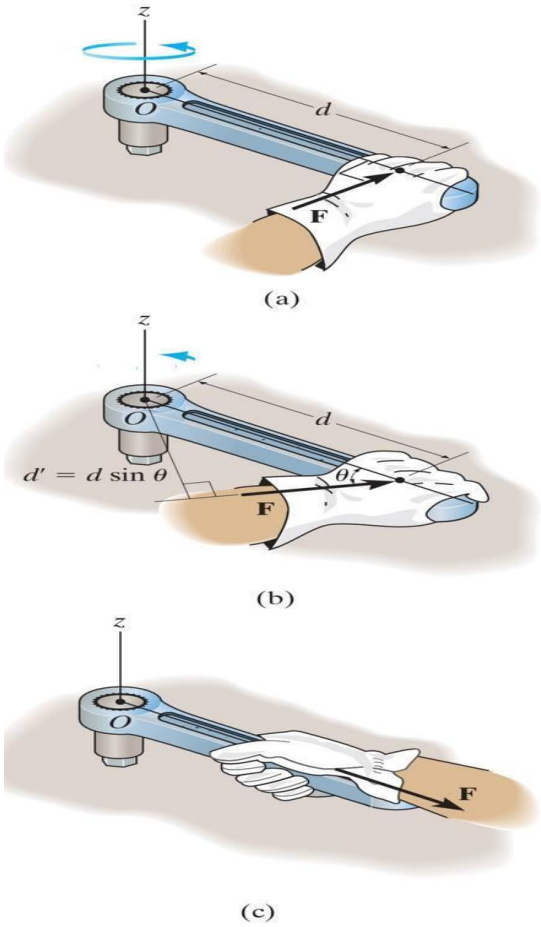
Al-Mustaqbal University / College of Engineering & Technology
Mechanical Power Techniques Engineering Department Class (1st)
Subject (Engineering Mechanics) / Code (UOMU021028)
Lecturer (Assist.Lec.Teeb Basim Abbas)
1st term – Lecture No.4

Force System Resultants

Moment of a Force



In addition to the tendency to move a body in the direction of its application, a force can also tend to rotate a body about an axis. The axis may be any line which neither intersects nor is parallel to the line of action of the force. This rotational tendency is known as the moment M of the force. Moment is also referred to as torque.

E-mail: teeb.basim@uomus.edu.iq

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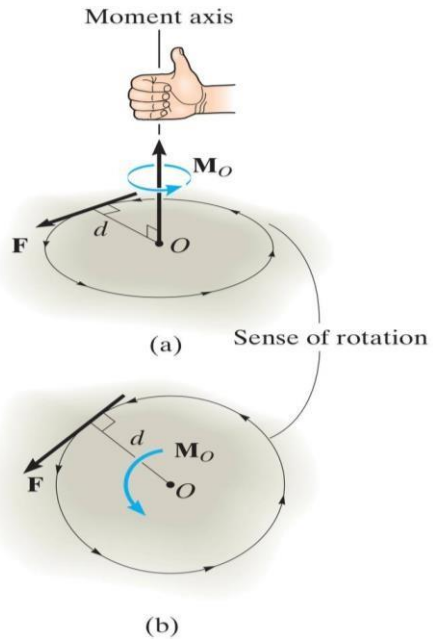
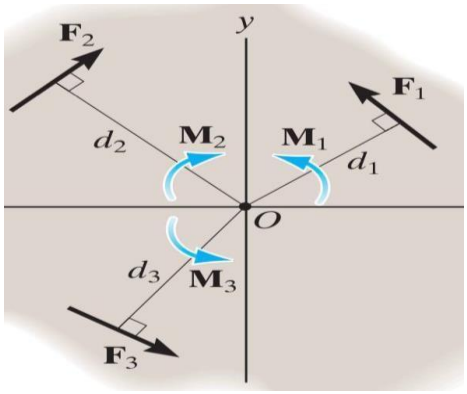
Where d is the moment arm or perpendicular distance from the axis at point $_O$ to the line of action of the force. Units of moment are N.m or lb.ft.



$M_O = F\,d$

As a convention, we will generally consider positive moments as counterclockwise since they are directed along the positive z axis. Clockwise moments will be negative. Therefore:



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

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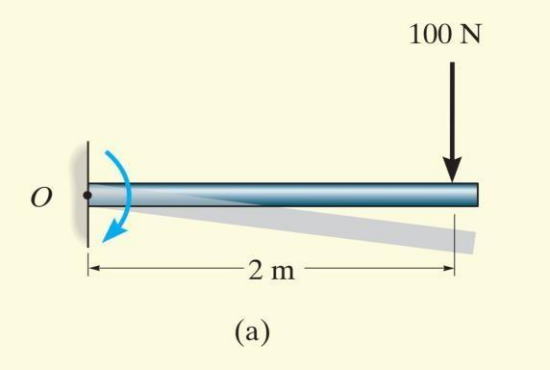
Example 1

For each case illustrated in Fig. 4–4, determine the moment of the force about point O.



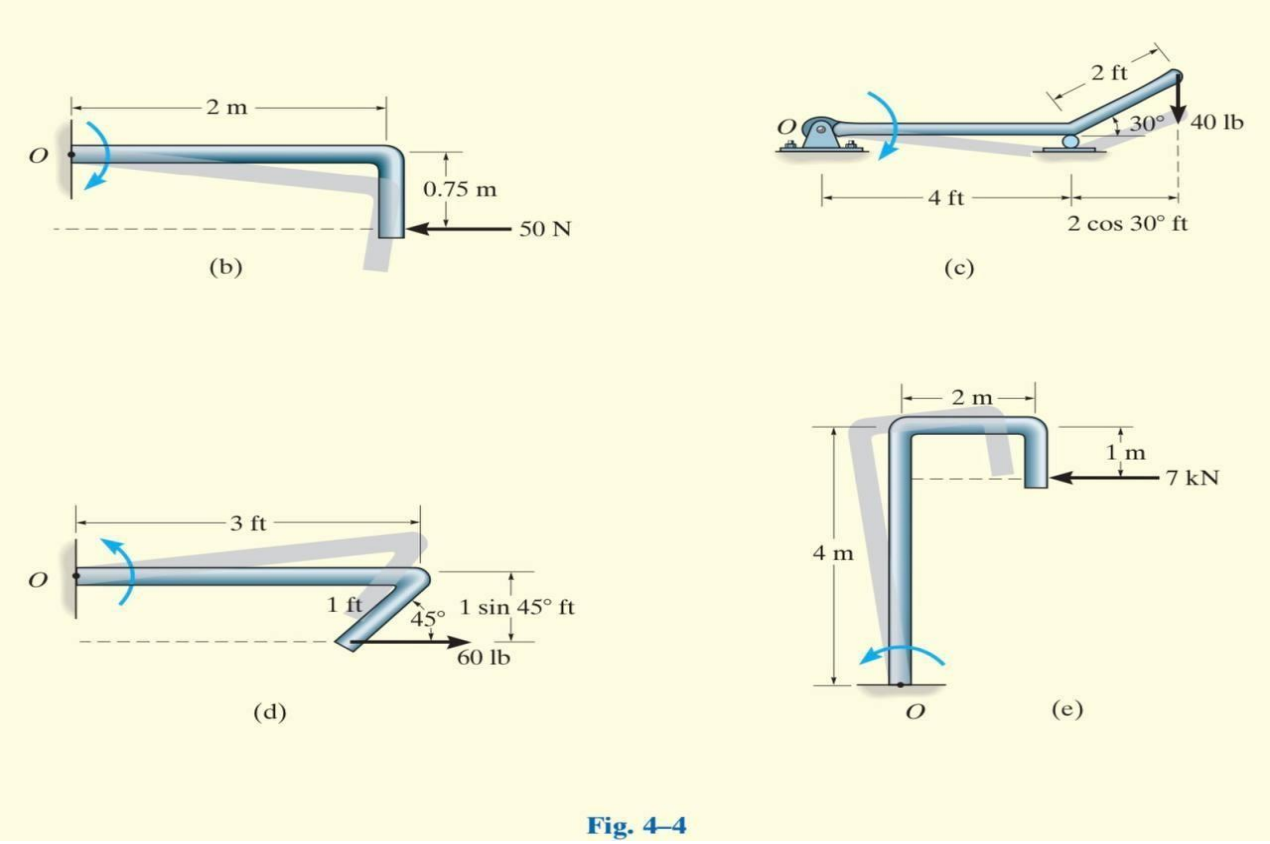


Fig. 4–4

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Fig. 4–4*a* $M_O = (100\ \text{N})(2\ \text{m}) = 200\ \text{N}\cdot\text{m}$ ↷ *Ans.*

Fig. 4–4*b* $M_O = (50\ \text{N})(0.75\ \text{m}) = 37.5\ \text{N}\cdot\text{m}$ ↷ *Ans.*

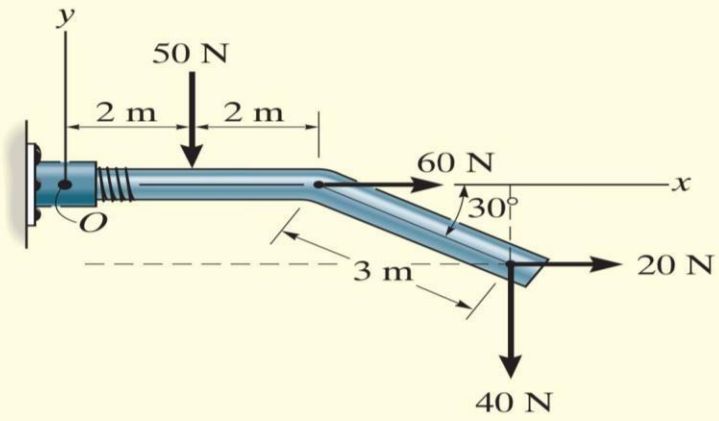
Fig. 4–4*c* $M_O = (40\ \text{lb})(4\ \text{ft} + 2\cos 30°\ \text{ft}) = 229\ \text{lb}\cdot\text{ft}$ ↷ *Ans.*

Fig. 4–4*d* $M_O = (60\ \text{lb})(1\sin 45°\ \text{ft}) = 42.4\ \text{lb}\cdot\text{ft}$ ↶ *Ans.*

Fig. 4–4*e* $M_O = (7\ \text{kN})(4\ \text{m} - 1\ \text{m}) = 21.0\ \text{kN}\cdot\text{m}$ ↶ *Ans.*

Example 2

Determine the resultant moment of the four forces acting on the rod shown in Fig, about point O



$$\circlearrowleft + M_{R_O} = \Sigma Fd;$$

$$M_{R_O} = -50\ \text{N}(2\ \text{m}) + 60\ \text{N}(0) + 20\ \text{N}(3\sin 30°\ \text{m}) - 40\ \text{N}(4\ \text{m} + 3\cos 30°\ \text{m})$$

$$M_{R_O} = -334\ \text{N}\cdot\text{m} = 334\ \text{N}\cdot\text{m}\ \circlearrowright$$

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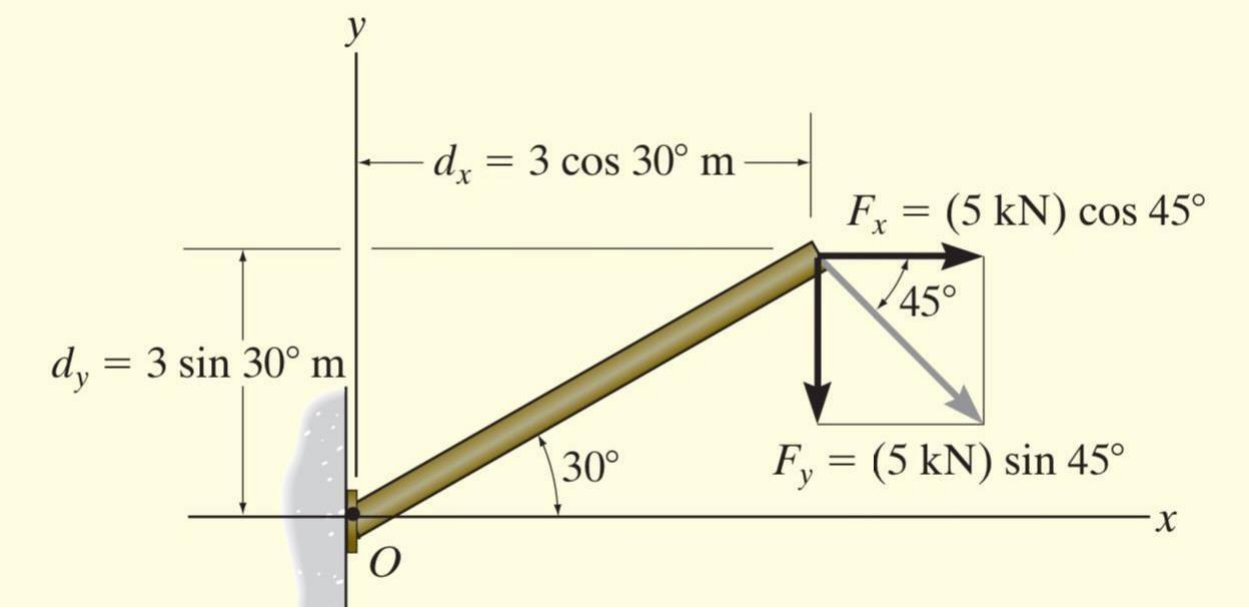
Example 3

Determine the moment of the force in Fig, about point O



$$\zeta + M_O = -F_x d_y - F_y d_x$$
$$= -(5 \cos 45° \text{ kN})(3 \sin 30° \text{ m}) - (5 \sin 45° \text{ kN})(3 \cos 30° \text{ m})$$
$$= -14.5 \text{ kN} \cdot \text{m} = 14.5 \text{ kN} \cdot \text{m} \circlearrowright \quad \textit{Ans.}$$

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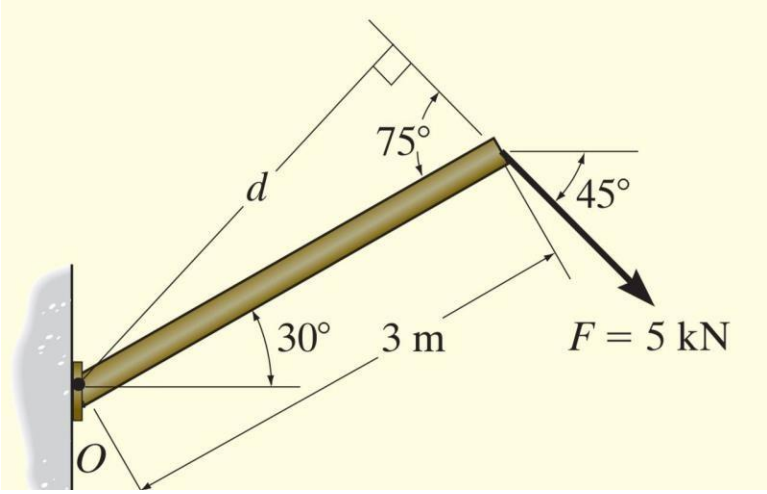
Home work

Determine the moment of the force in Fig, about point O



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