ENGG 202
Jan 23 Week 3

Problems

REVIEW MOMENTS

A **moment** of a force about a point can be computed using the vector (cross) product between the **position vector** and the **force.**

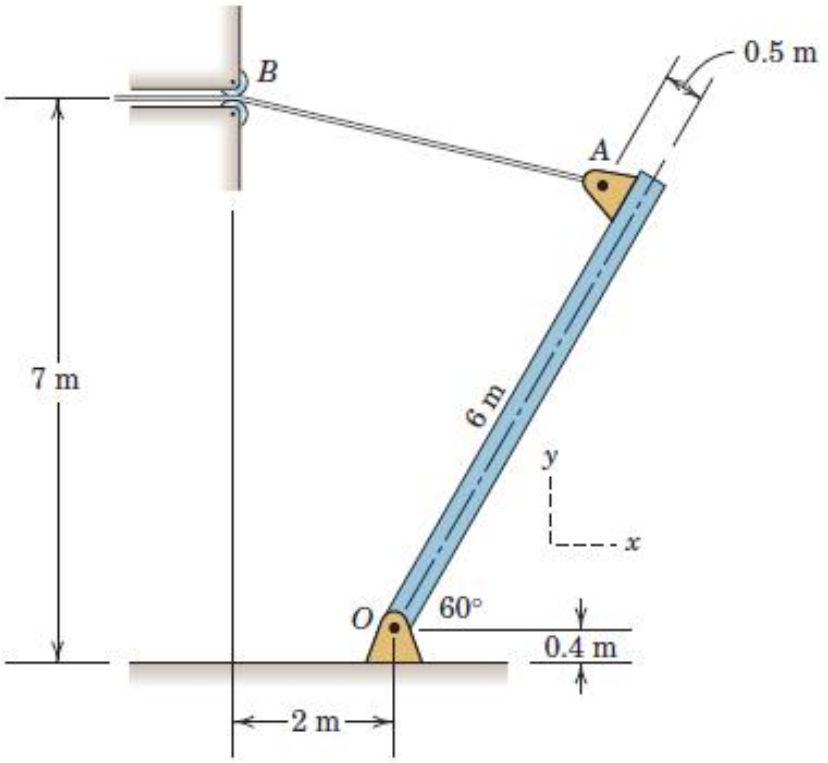
First, express the position vector and the Force in Cartesian components:

The moment of the force about the point 0 (origin of the position vector) is obtained by computing the determinant of the matrix built as follows:

In 2D the determinant is easily found as follows:

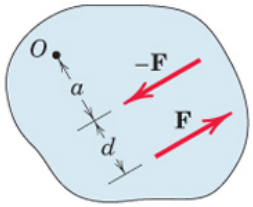
Review Problem 2/48

A gate is held in the position shown by cable AB. If the tension in the cable is 6.75 kN, determine the moment M_0 of the tension (applied to point A) about 0.

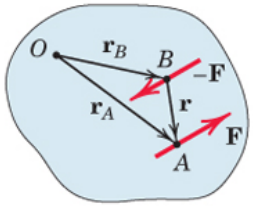


2/5 COUPLE

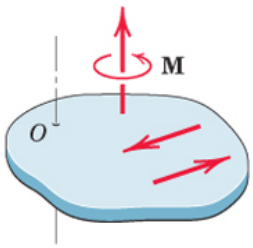
Consider the action of two equal and opposite forces **F** and **–F.** Their sum in every direction is zero, however their effect is to produce a rotation.



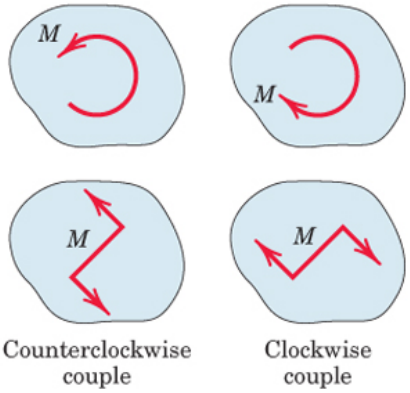
(*a*)



(*b*)



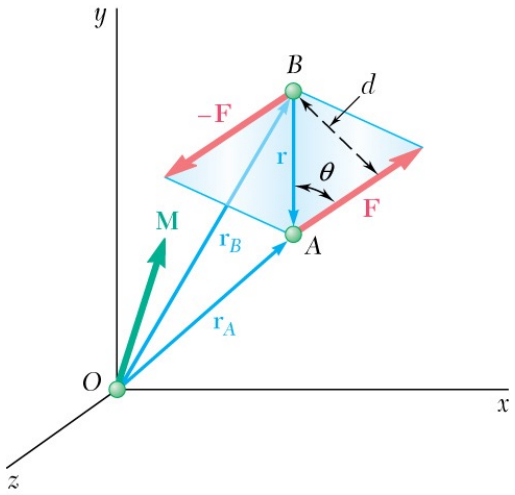
(*c*)



(*d*)

Vector algebra method

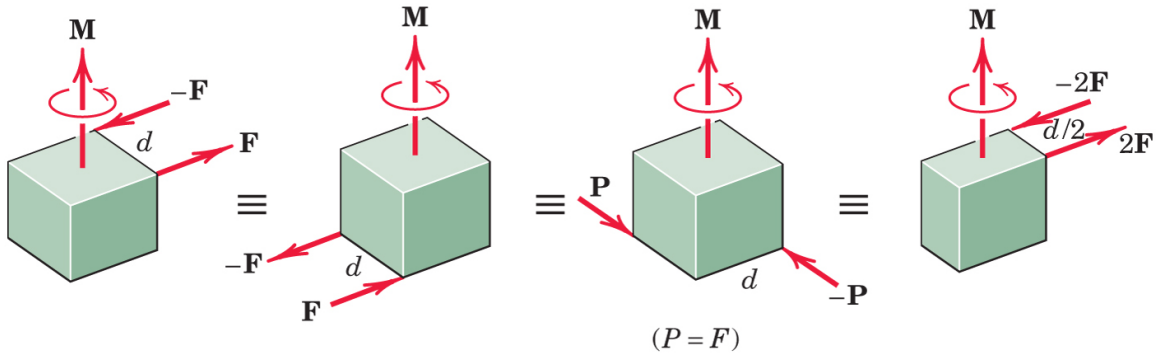
We may express the moment of a couple by using vector algebra.



Couple – a free vector

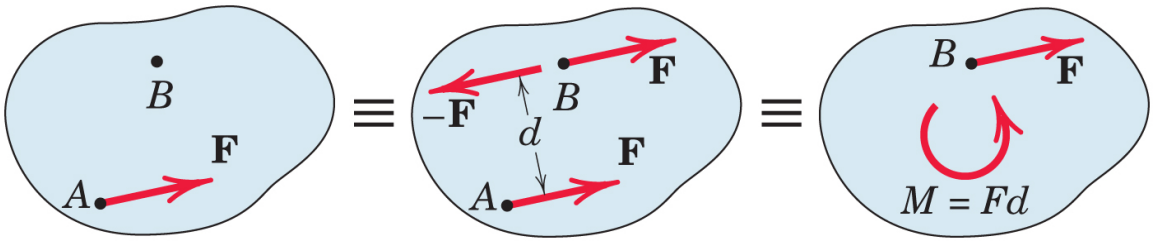
A couple is a free vector as it is independent of the location of the point on the body where we compute the effect of the two forces.

Equivalent Couples

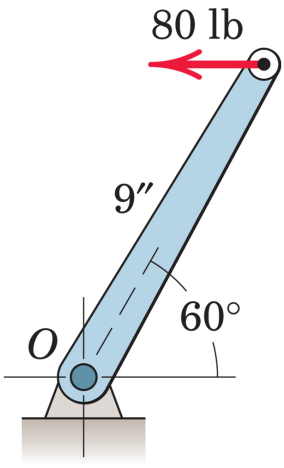


Force-couple systems

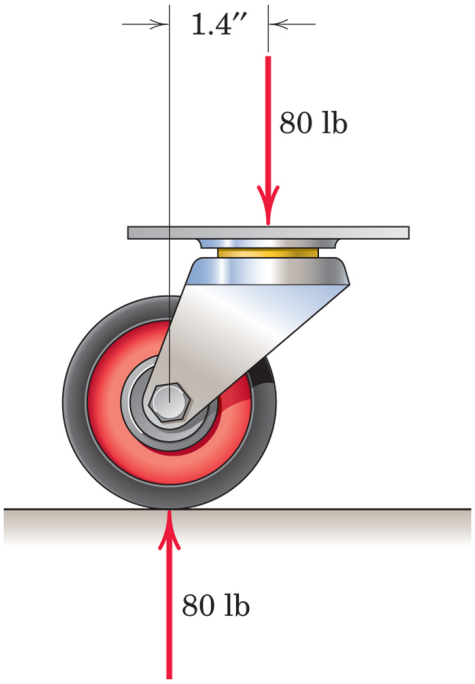
Given a force **F** acting on a body, and a point B, we can represent the action of the force as a force applied at B and a couple that has magnitude equivalent to the moment of the force about point B.



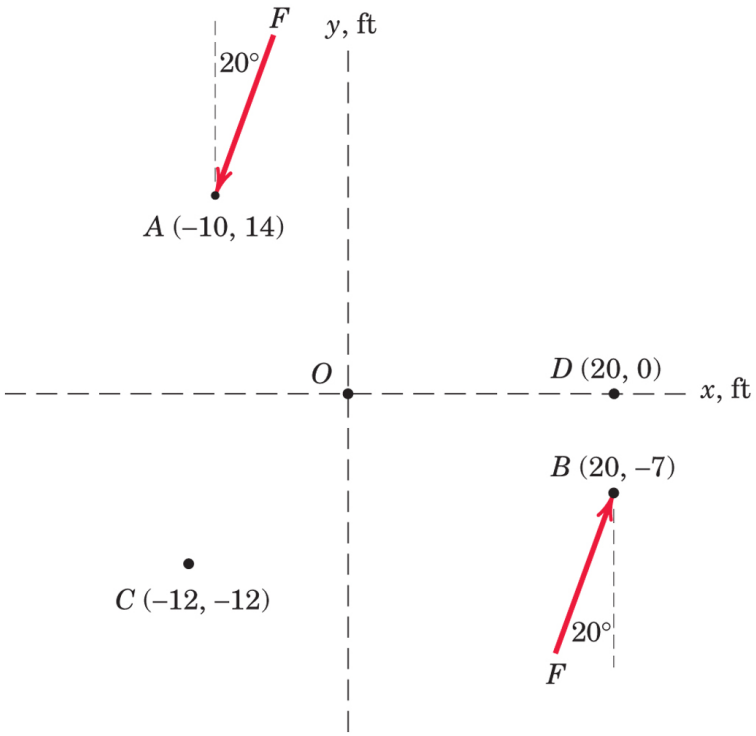
Sample problem 2/8
Replace the horizontal 80 lb force acting on the lever by an equivalent system consisting of a force at 0 and a couple.



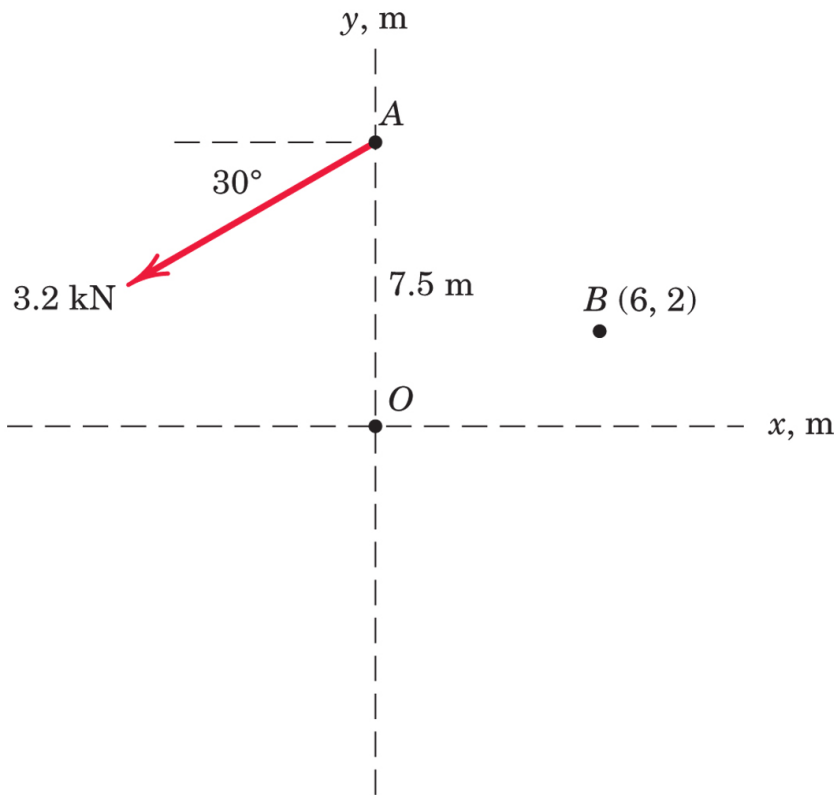
Problem 2/59
Determine the moment associated with the two forces acting on the caster



Problem 2/60
For F = 65 lb, compute the combined moment of the two forces about (a) point O, (b) point C, and (c) point D.



Problem 2/62
Replace the 3.2 kN force by an equivalent force-couple system at a) point 0 and b) point B. Record your answers in vector format.

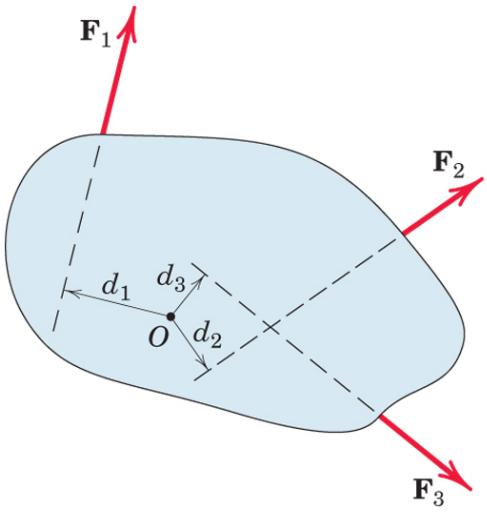


2/6 RESULTANT OF A SYSTEM OF FORCES

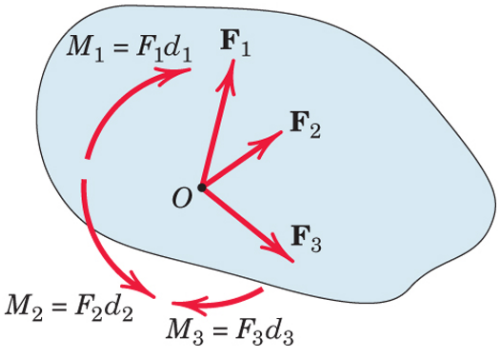
$$\mathbf{R} = \mathbf{F}_1 + \mathbf{F}_2 + \mathbf{F}_3 + \cdots = \Sigma\mathbf{F}$$

$$R_x = \Sigma F_x \qquad R_y = \Sigma F_y \qquad R = \sqrt{(\Sigma F_x)^2 + (\Sigma F_y)^2}$$

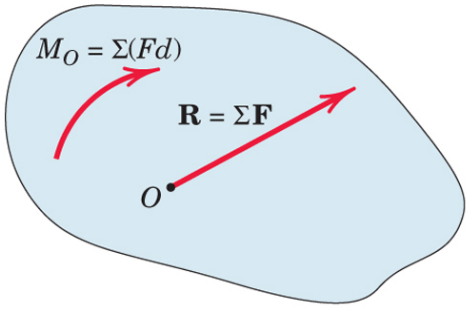
$$\theta = \tan^{-1}\frac{R_y}{R_x} = \tan^{-1}\frac{\Sigma F_y}{\Sigma F_x}$$



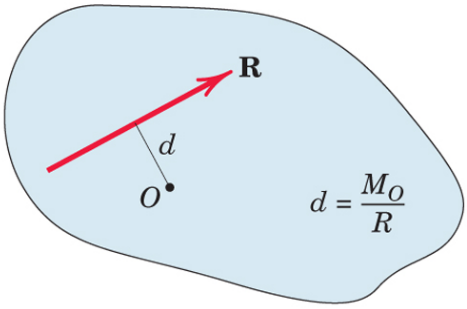
(a)



(b)

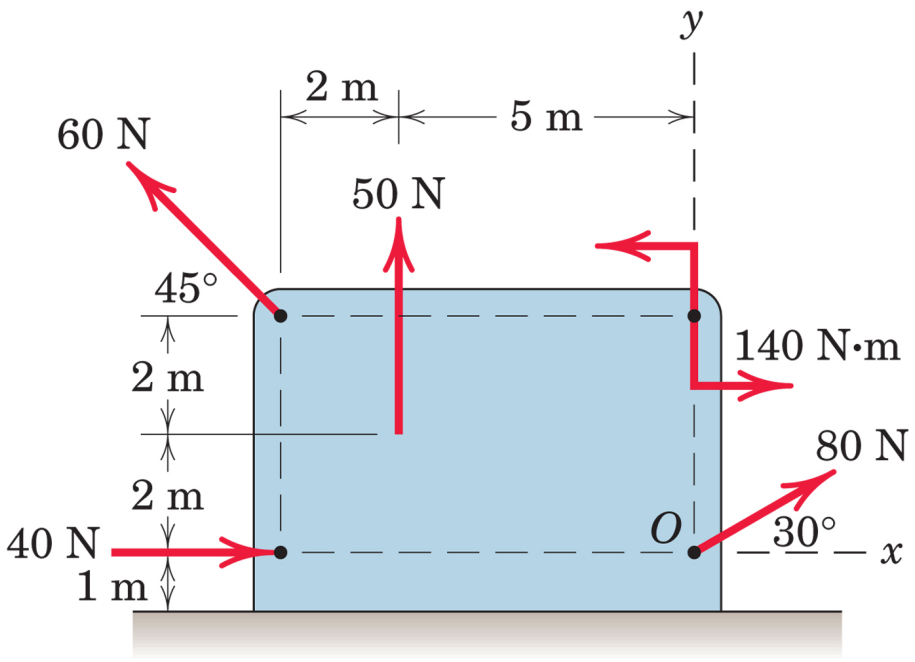


(c)



(d)

Sample Problem 2/9
Determine the resultant of the four forces and one couple acting on the plate.



Problem 2/84
Determine the height h above the base B at which the resultant of the three forces act.