

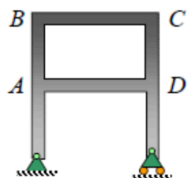
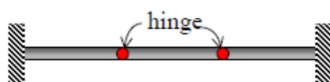
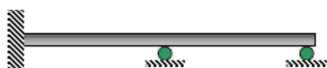
# ENGG 202

## Feb 6 Week 5

### Problems

### Equilibrium Recap Example:

Classify the following structures as statically determinate, statically indeterminate or statically undetermined.



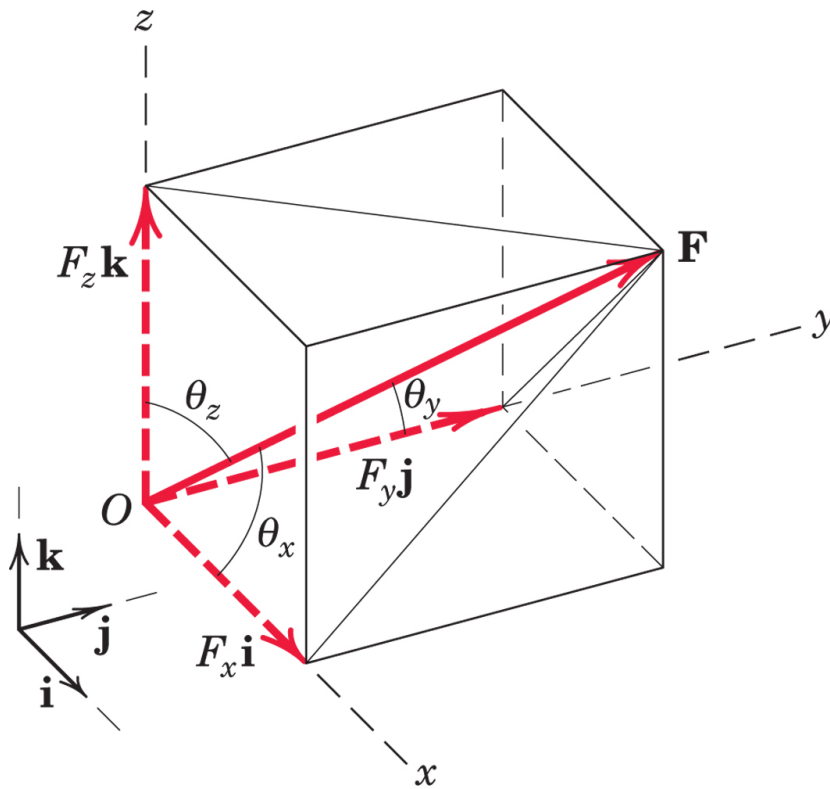
## 2/7 THREE DIMENSIONAL FORCE SYSTEMS

$$F_x = F \cos \theta_x \quad F = \sqrt{F_x^2 + F_y^2 + F_z^2}$$

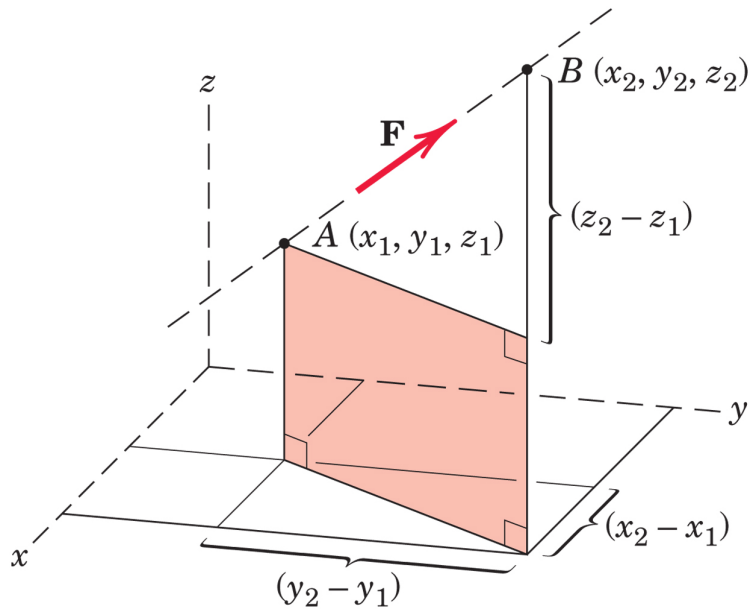
$$F_y = F \cos \theta_y \quad \mathbf{F} = F_x \mathbf{i} + F_y \mathbf{j} + F_z \mathbf{k}$$

$$F_z = F \cos \theta_z \quad \mathbf{F} = F(\mathbf{i} \cos \theta_x + \mathbf{j} \cos \theta_y + \mathbf{k} \cos \theta_z)$$

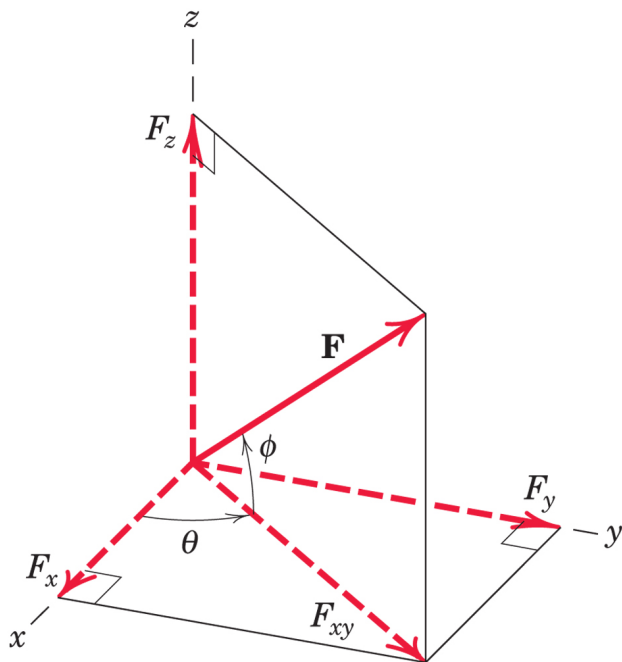
(2/11)



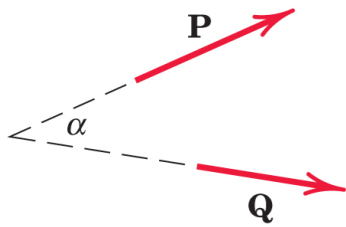
Specification of the direction of a force by two points on the line of action



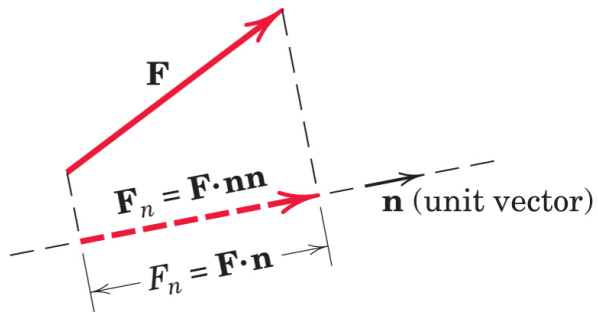
Specification of the direction of a force by two angles, which orient the line of action of the force



## DOT PRODUCT



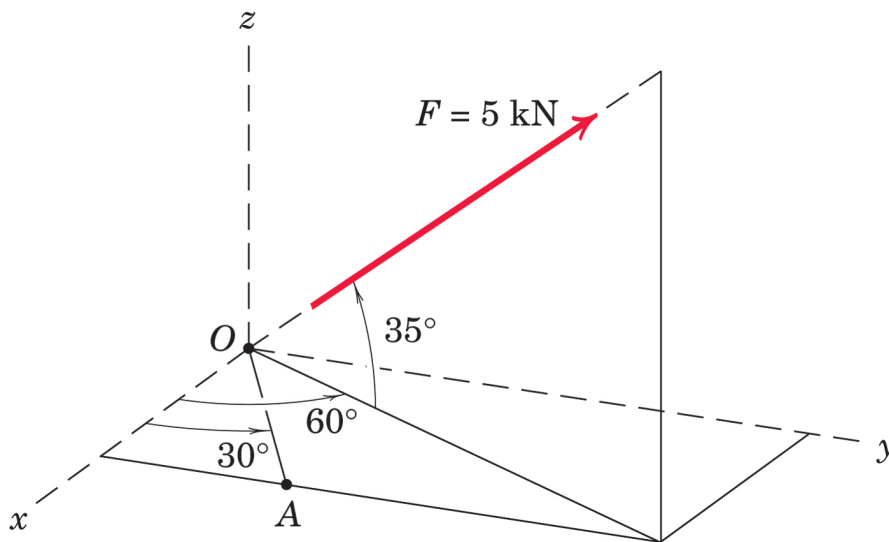
(a)



(b)

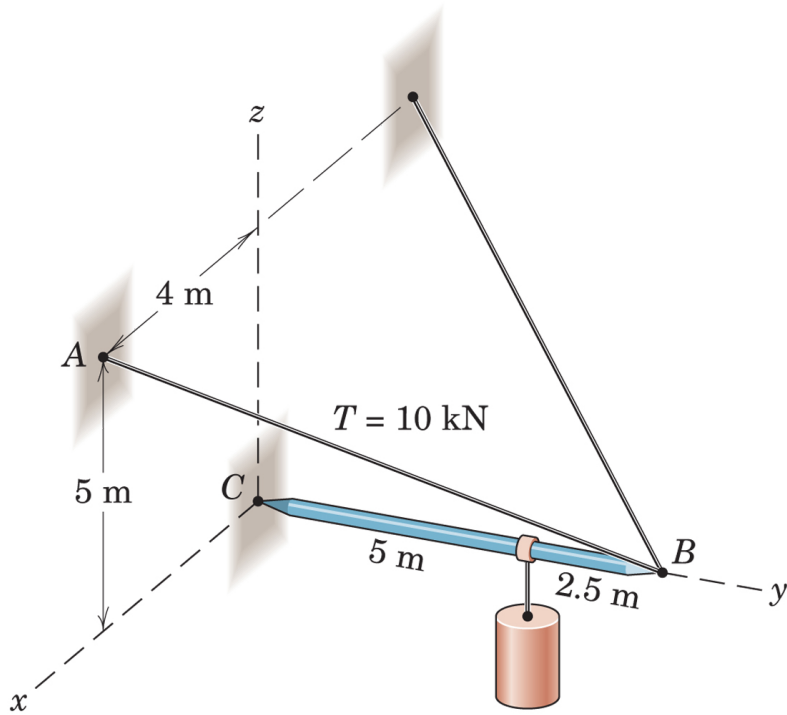
Problem 2/103

Express the 5 kN force  $\mathbf{F}$  as a vector in terms of  $\mathbf{i}$ ,  $\mathbf{j}$ ,  $\mathbf{k}$ . Determine the projection of  $\mathbf{F}$  onto the  $x$ -axis and onto the line  $OA$ .

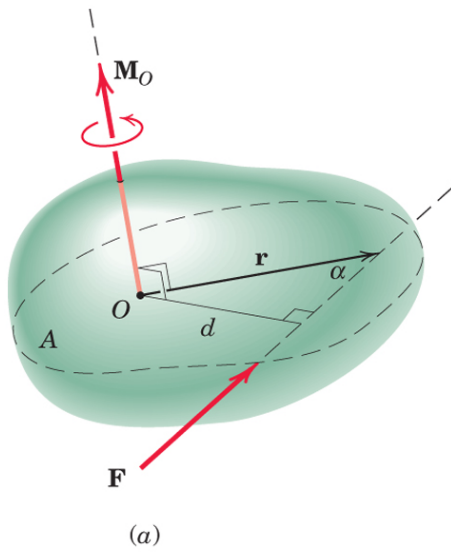


Problem 2/110

The tension in the supporting cable AB is 10 kN. Write the force that the cable exerts on the boom BC as a vector  $T$ . Determine the angles that the line of action of  $T$  forms with  $x$ ,  $y$ , and  $z$ .

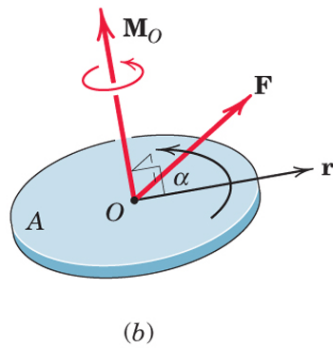


## 2/8 MOMENT AND COUPLE



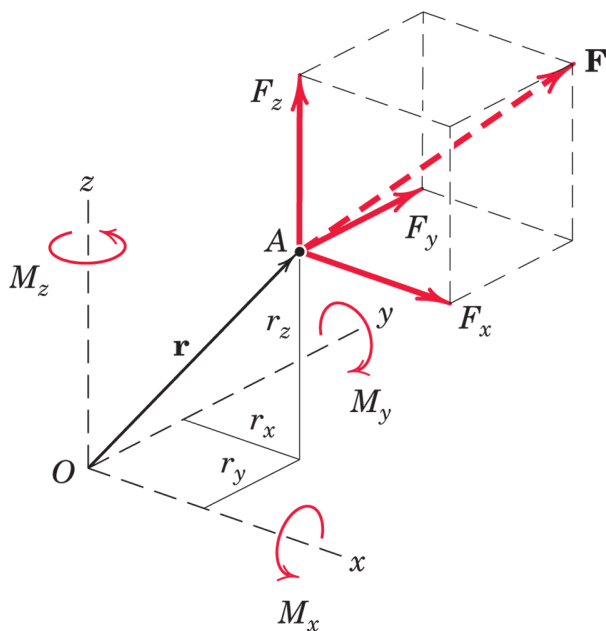
$$\mathbf{M}_O = \mathbf{r} \times \mathbf{F}$$

(2/14)



$$\mathbf{M}_O = \begin{vmatrix} \mathbf{i} & \mathbf{j} & \mathbf{k} \\ r_x & r_y & r_z \\ F_x & F_y & F_z \end{vmatrix}$$

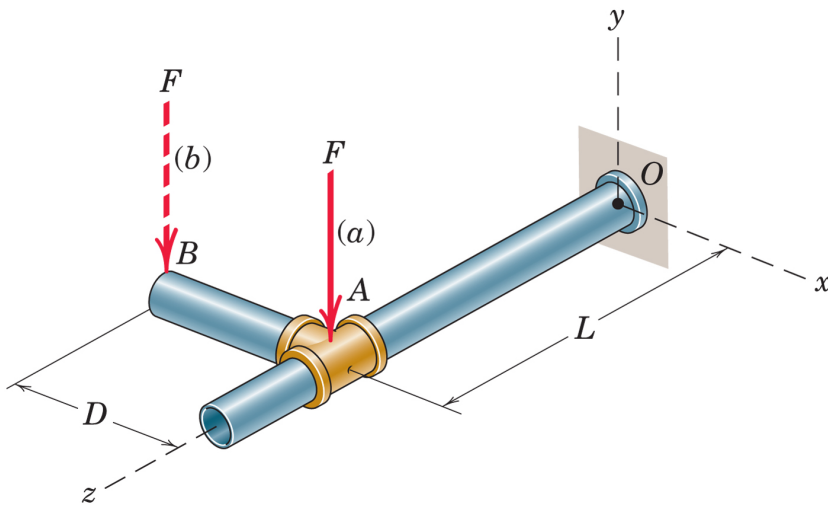
(2/15)



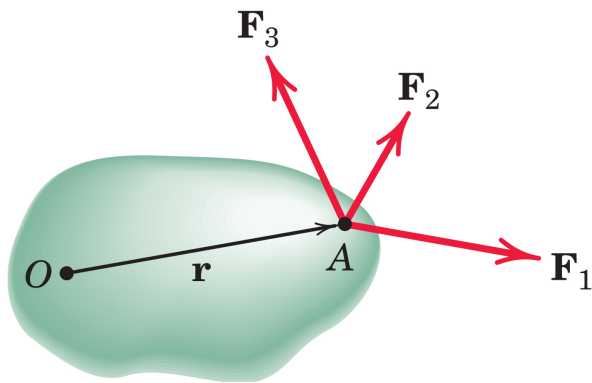


Problem 2/123

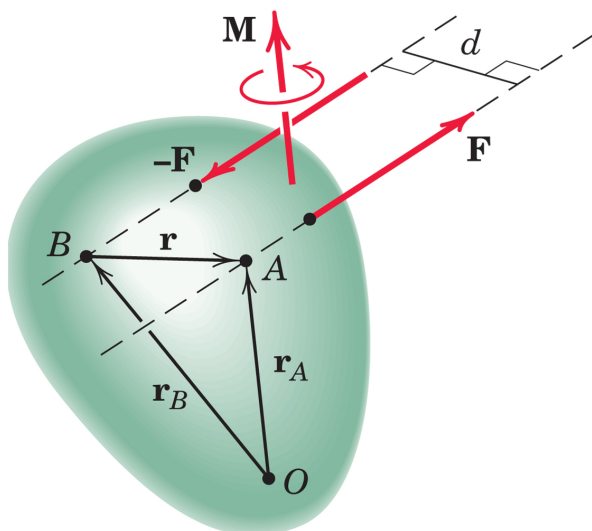
Determine the moment about  $O$  of the force of magnitude  $F$  for the case (a) when the force is applied at  $A$  and for the case (b) when the force is applied at  $B$ .



Varignon's theorem in three dimensions.



Couples in three dimensions

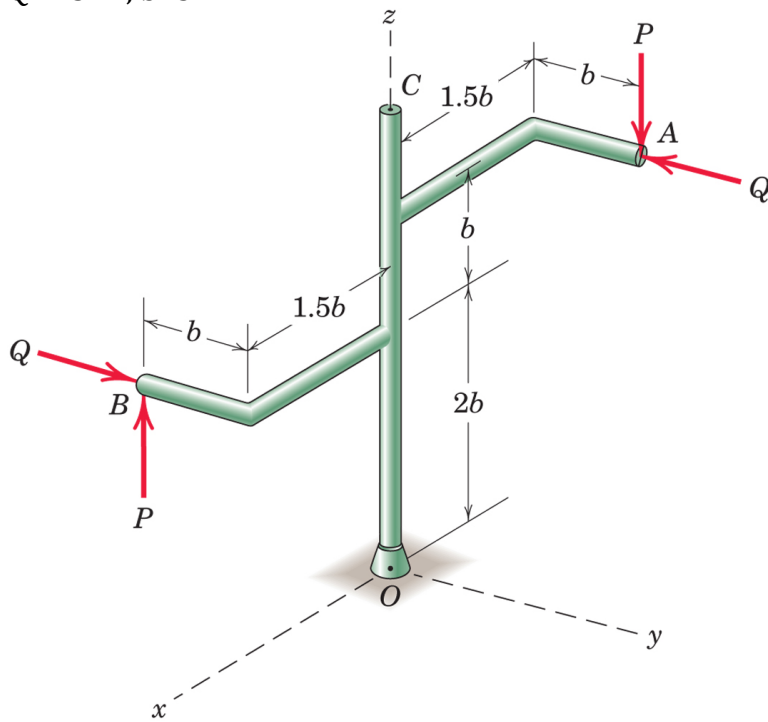


$$\mathbf{M} = \mathbf{r} \times \mathbf{F}$$

(2/19)

Problem 2/131

Determine the combined moment made by the two pair of forces about point  $O$ .  $P=4\text{kN}$ ,  $Q=7.5\text{kN}$ ,  $b=3\text{m}$



Problem 2/146

The special purpose milling cutter is subjected to the force of 1200 N and a couple of 240 N·m as shown. Determine the moment of this system about point O.

