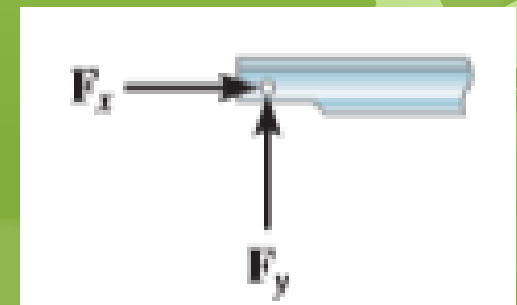
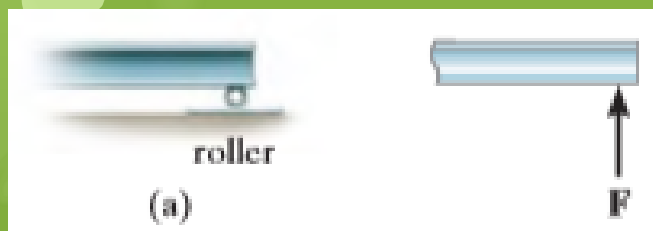


# Equilibrium Of Rigid Body

The body is subjected to an external force and couple moment system that is the result of the effects of gravitational , electrical, magnetic , or contact forces caused by adjacent bodies.

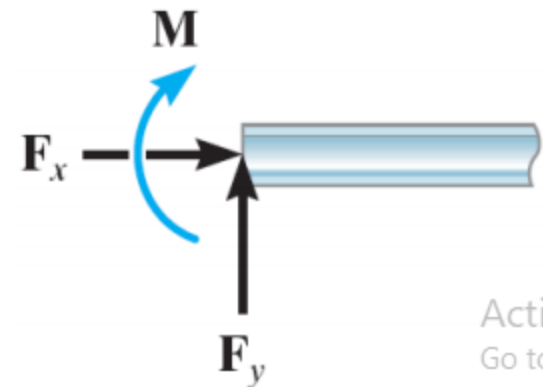
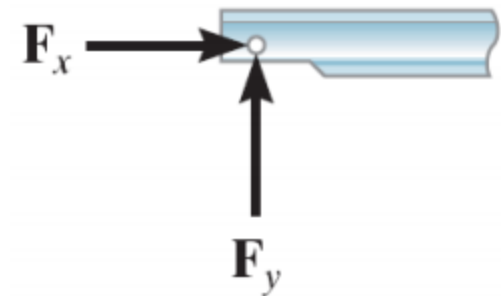
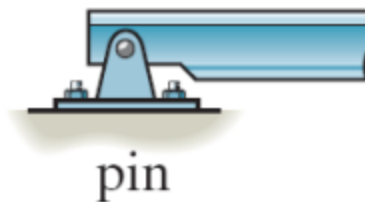
## Free-Body Diagrams













Successful application of the equations of equilibrium requires a complete specification of all the known and unknown external forces that act on the body . The best way to account for these forces is to draw a free-body diagram. As shown in the figures below



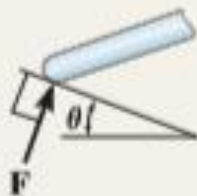
# Rigid Body Equilibrium

Support Reactions  
Prevention of  
Translation or  
Rotation of a body



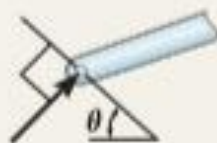
Types of Connection	Reaction	Number of Unknowns
(1)  cable		One unknown. The reaction is a tension force which acts away from the member in the direction of the cable.
(2)  weightless link	 or 	One unknown. The reaction is a force which acts along the axis of the link.
(3)  roller		One unknown. The reaction is a force which acts perpendicular to the surface at the point of contact.
(4)  roller or pin in confined smooth slot	 or 	One unknown. The reaction is a force which acts perpendicular to the slot.
(5)  roller		One unknown. The reaction is a force which acts perpendicular to the surface at the point of contact.

(6)



One unknown. The reaction is a force which acts perpendicular to the surface at the point of contact.

(7)

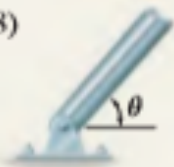


or



One unknown. The reaction is a force which acts perpendicular to the rod.

(8)



or



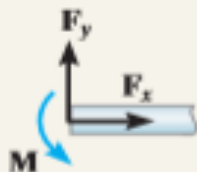
Two unknowns. The reactions are two components of force, or the magnitude and direction  $\phi$  of the resultant force. Note that  $\phi$  and  $\theta$  are not necessarily equal [usually not, unless the rod shown is a link as in (2)].

(9)

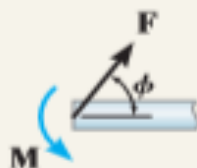


Two unknowns. The reactions are the couple moment and the force which acts perpendicular to the rod.

(10)



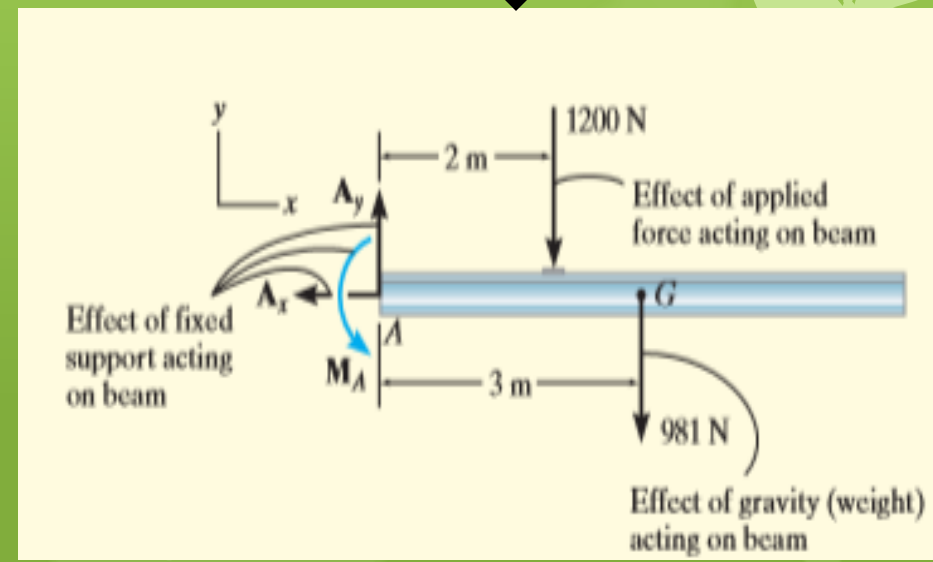
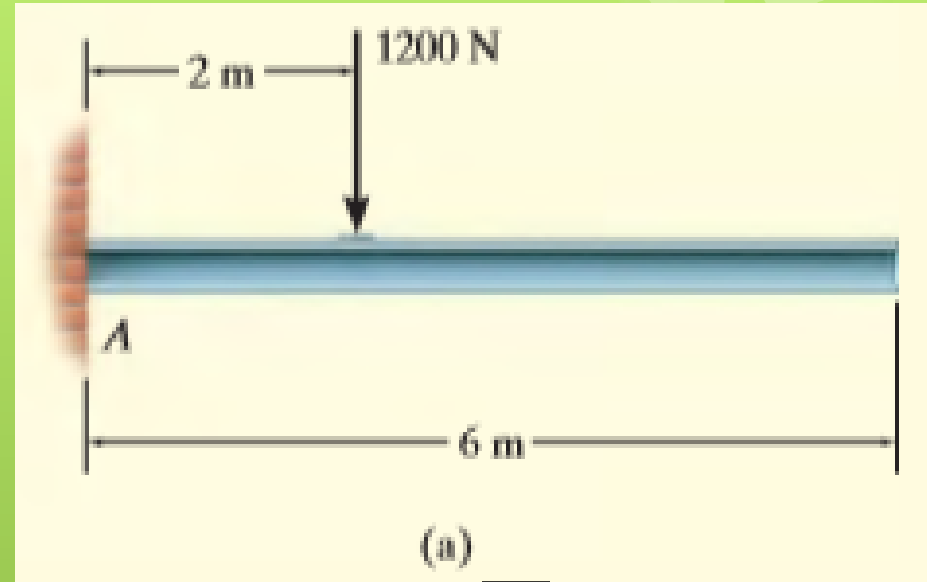
or



Three unknowns. The reactions are the couple moment and the two force components, or the couple moment and the magnitude and direction  $\phi$  of the resultant force.

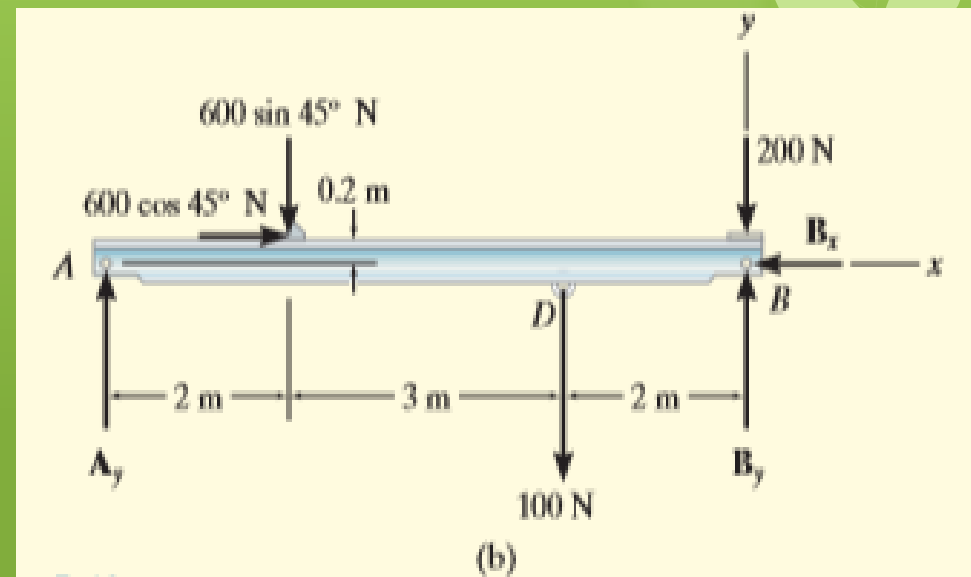
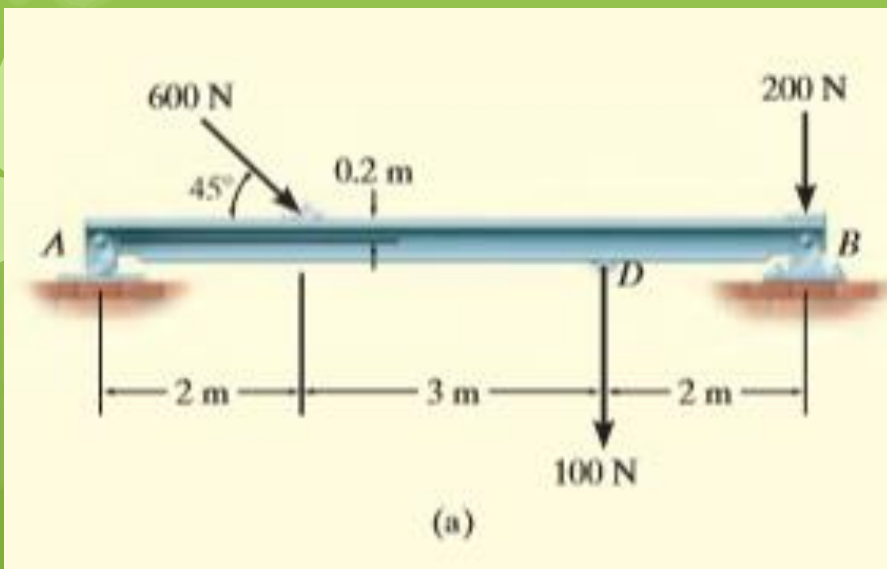
**Ex:** Draw the free-body diagram of the uniform beam shown in Fig.a.

The beam has a mass of 100 kg.



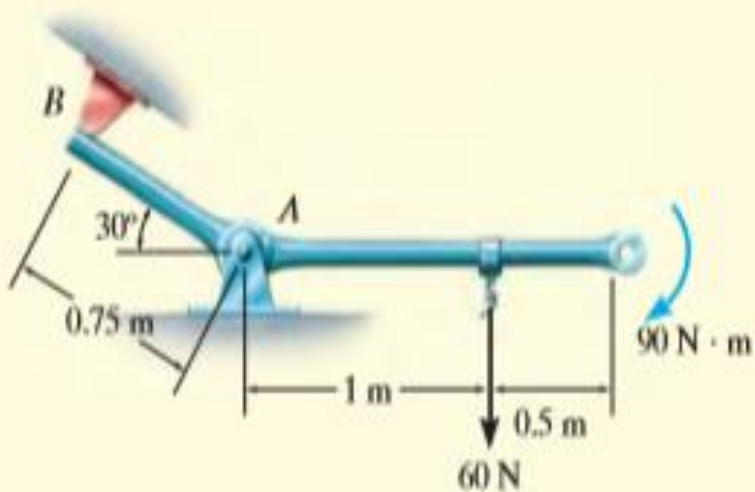
**Ex:** Determine the horizontal and vertical components of reaction on the beam caused by the pin at B and the roller at A as shown in Fig. a. Neglect the weight of the beam.

**Solution:**

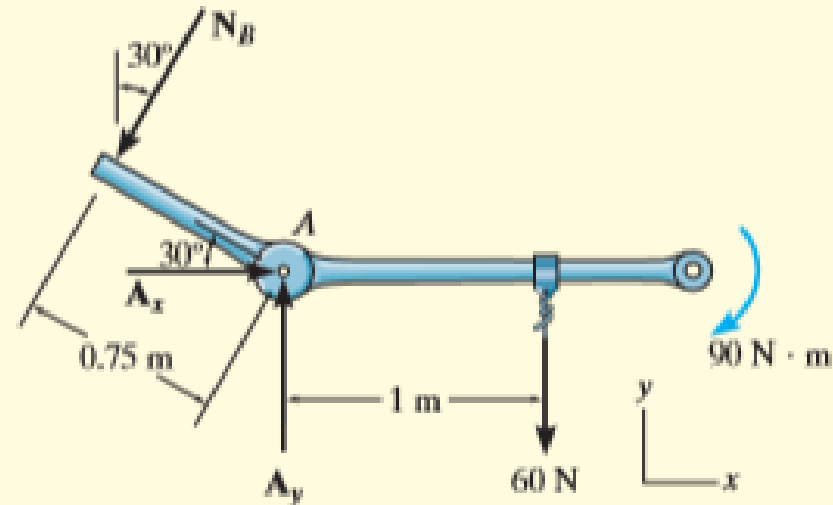


**Ex:** The member shown in Fig. a is pin-connected at A and rests against a smooth support at B. Determine the horizontal and vertical components of reaction at the pin A and B.

**Solution:**



(a)

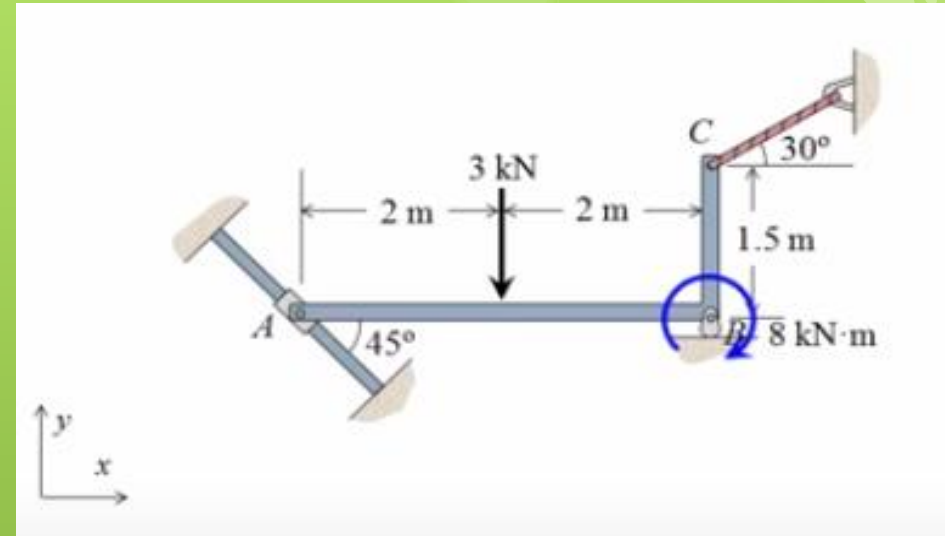


(b)



Ex: Determine the reactions at supports, smooth collar at A, rocker fixed pin member at B and tension at C.  
Neglect the weight and size of members.

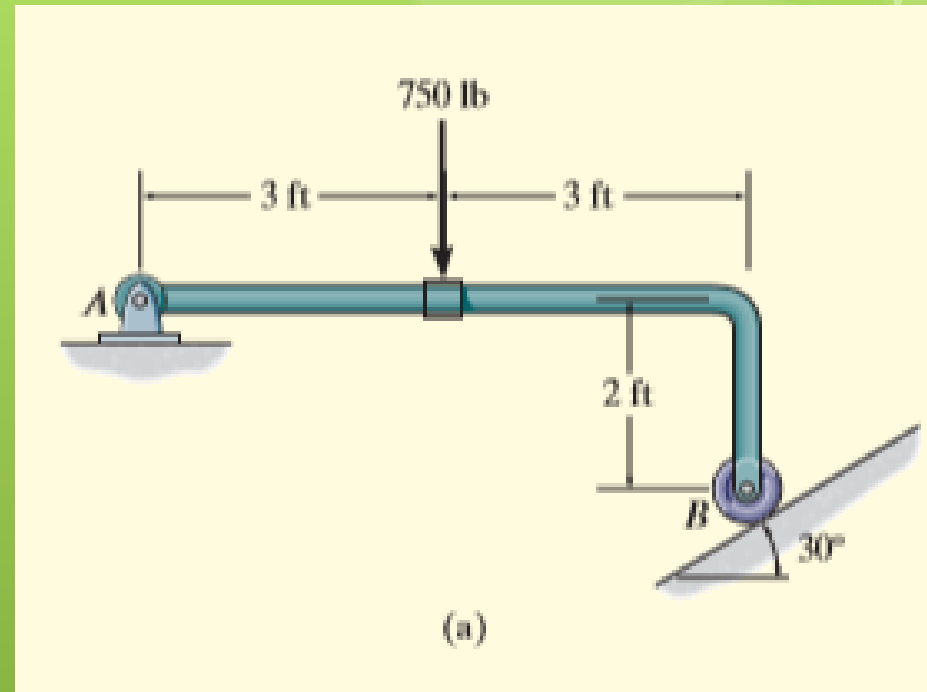
**Solution:**





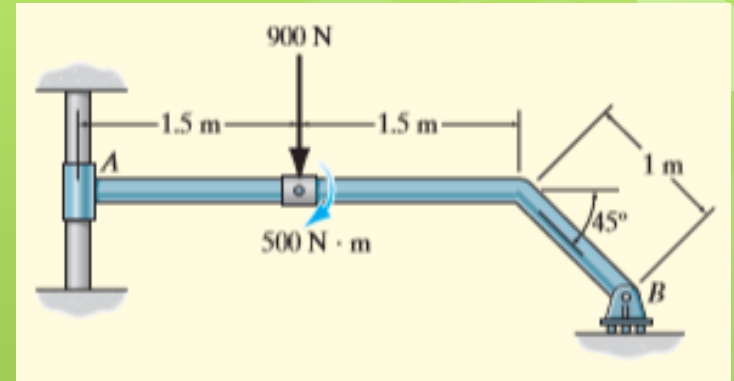
**Example:** Determine the horizontal and vertical components of reaction on the member at the pin A, and the roller at B in Fig. a.

**Solution**

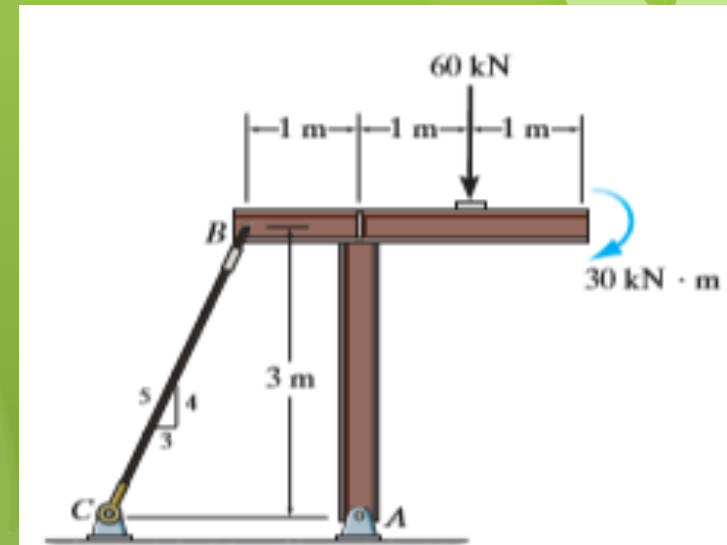


# H.W

1. Determine the support reactions on the member in Fig. The collar at A is fixed to the member and can slide vertically along the vertical shaft.



2. Determine the horizontal and vertical components of reaction at the pin A and the tension developed in cable BC used to support the steel frame



H.W: Determine the horizontal and vertical components of reaction of the pin at B, and roller at point C

