To do …

- HW 8 due **Tues**
- HW 9 due **Thurs**

- **Quiz 3 next week, in class, Monday**

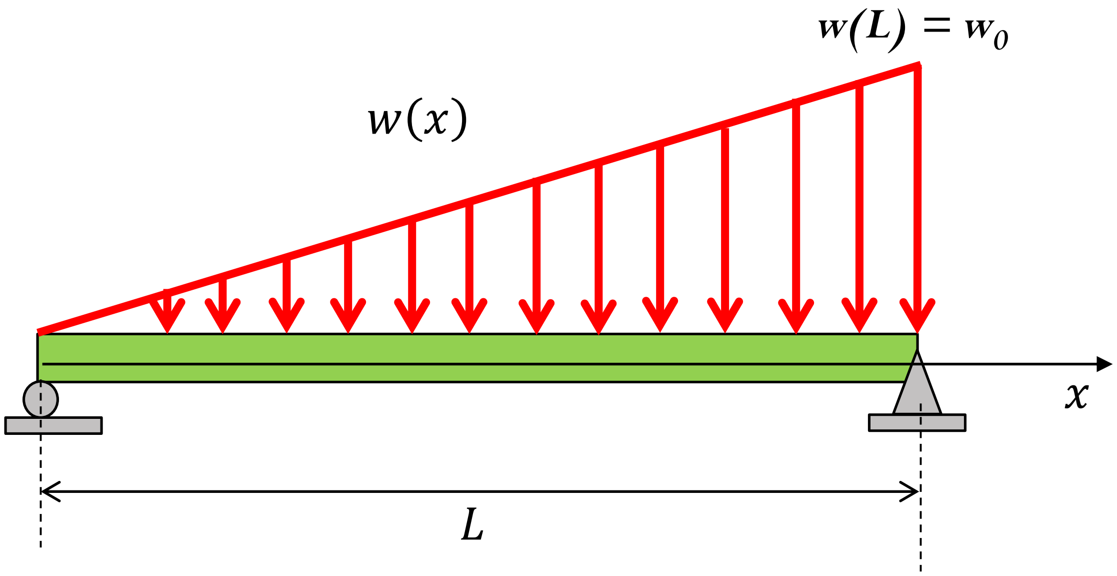
- **DRES accommodations for CBTF** – Take to CBTF proctor ASAP
- **DRES accommodations for in class quiz/final** – send a private message to instructors on piazza with PDF of DRES letter ASAP

Chapter 4: Force System Resultants

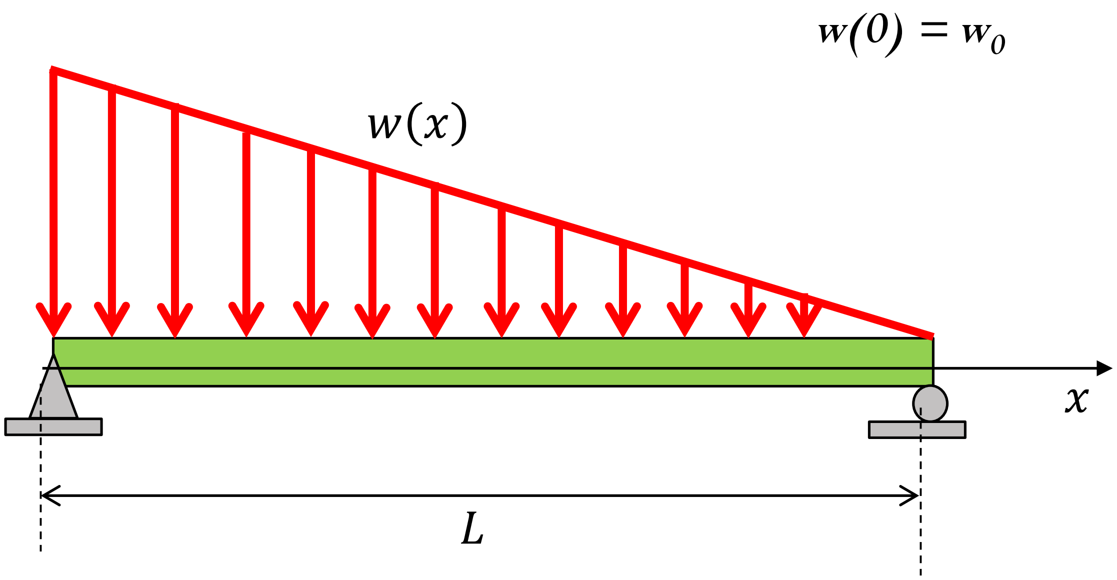
Main goals and learning objectives

- Discuss the concept of the moment of a force and show how to calculate it in two and three dimensions
- Provide a method for finding the moment of a force about a specified axis
- Define the moment of a couple
- Method to simplify a force and couple system to an equivalent system
- Indicate how to reduce a simple distributed loading to a resultant force having a specified location

Triangular loading

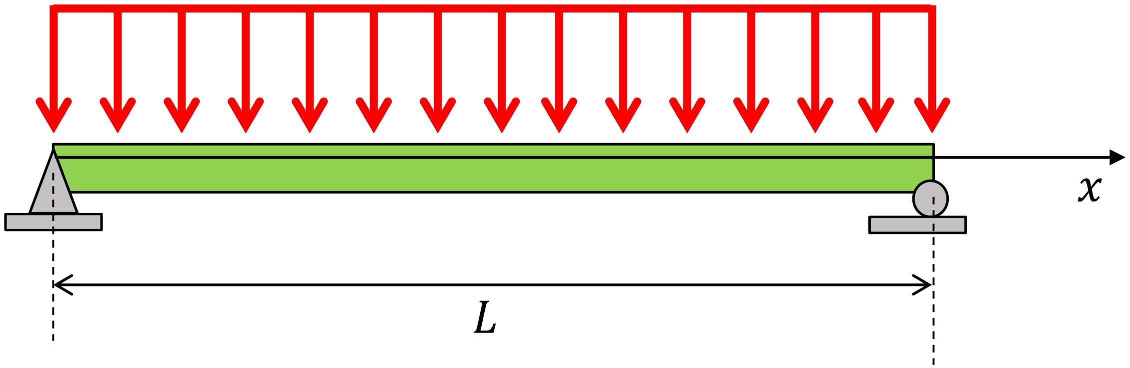


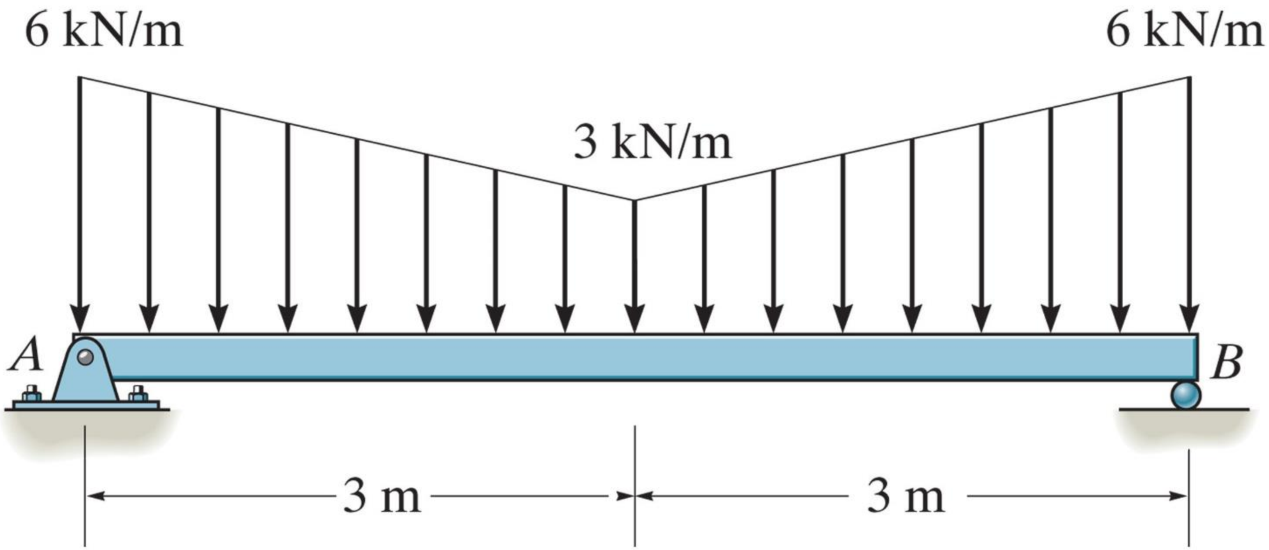
Triangular loading



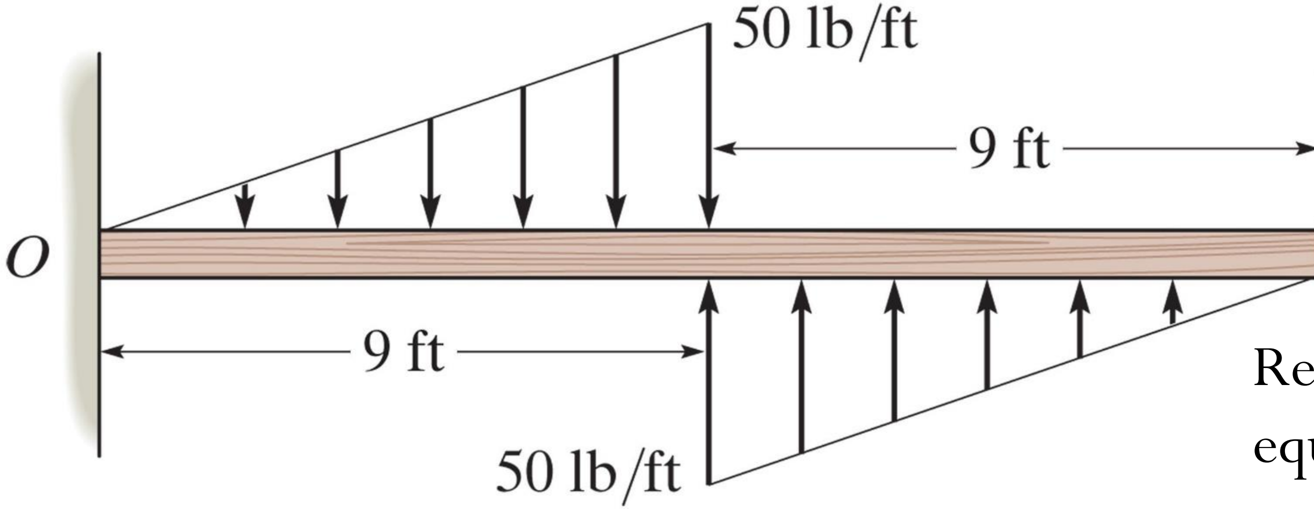
Rectangular loading

$$w(x) = w_0$$





Replace the distributed loading by an equivalent resultant force and couple moment acting at point A.



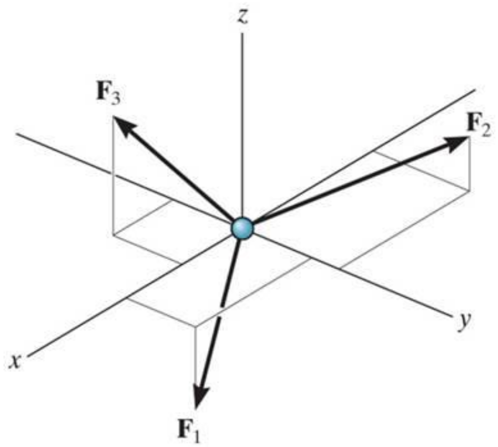
Replace the loading by an equivalent resultant force and couple moment acting at point O.

Chapter 5: Equilibrium of rigid bodies

Main goals and learning objectives

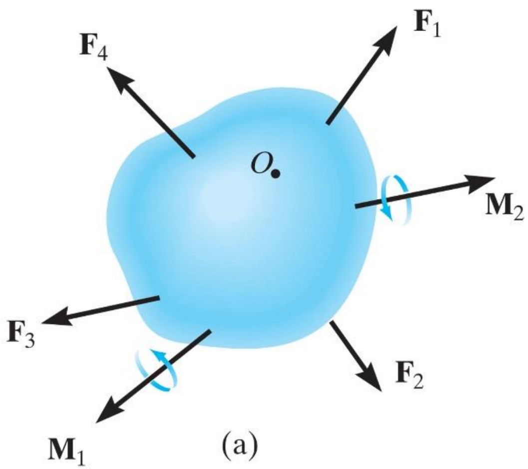
- Develop the equations of equilibrium for a rigid body
- Introduce the concept of the free-body diagram for a rigid body
- Solve rigid body equilibrium problems using the equations of equilibrium

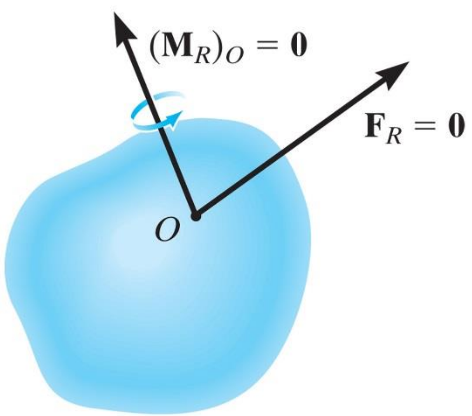
Equilibrium of a Rigid Body



In contrast to the forces on a particle, the forces on a rigid-body are not usually concurrent and may cause rotation of the body.

We can reduce the force and couple moment system acting on a body to an equivalent resultant force and a resultant couple moment at an arbitrary point O.





Equilibrium of a Rigid Body

Static equilibrium:

Maintained by reaction forces and moments

Assumption of rigid body

Process of solving rigid body equilibrium problems

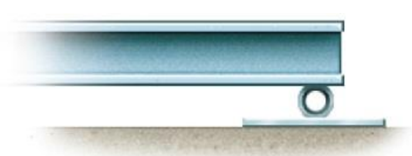
1. Create idealized model (modeling and assumptions)

2. Draw free body diagram showing ALL the external (applied loads and supports)

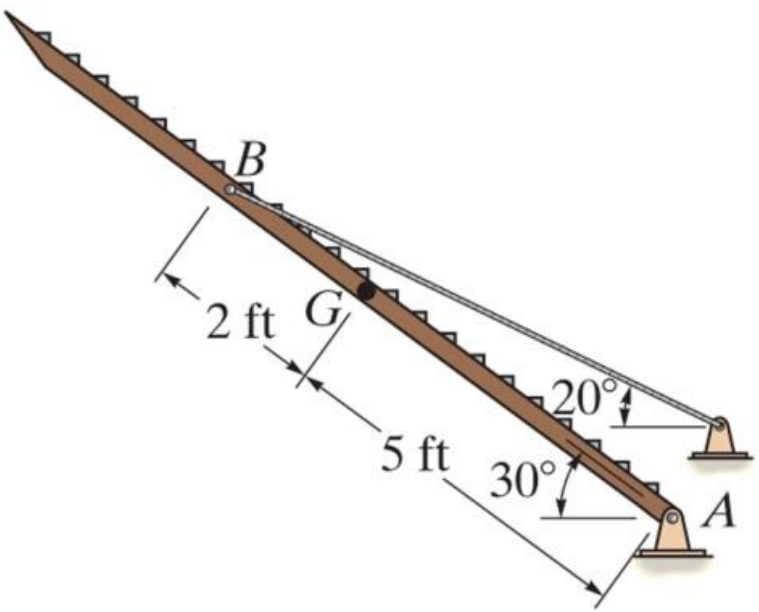
3. Apply equations of equilibrium

Equilibrium in two-dimensional bodies

Support reactions

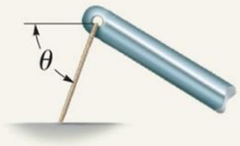
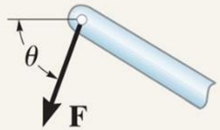
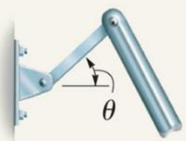
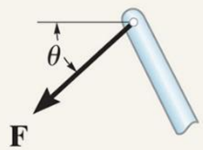
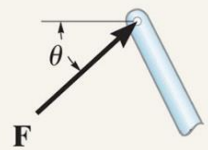
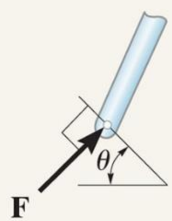
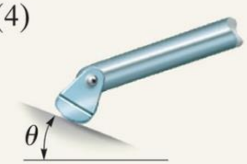
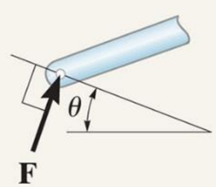


The uniform truck ramp has weight 400 lb and is pinned to the body of the truck at each side and held in the position shown by the two side cables. Determine the reaction forces at the pins and the tension in the cables.



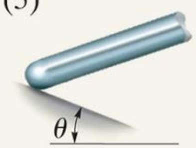
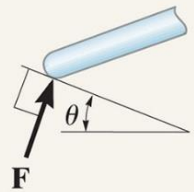
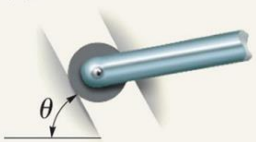
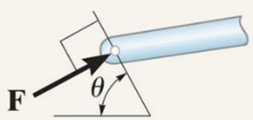
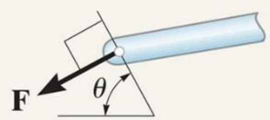
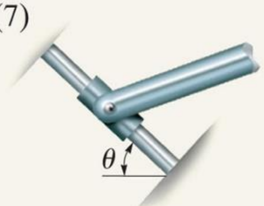
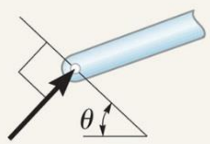
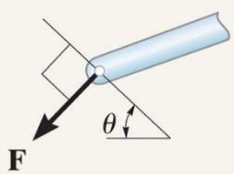
Types of connectors

TABLE 5–1 Supports for Rigid Bodies Subjected to Two-Dimensional Force Systems

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

Types of connectors

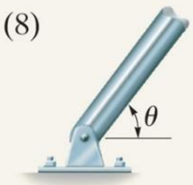
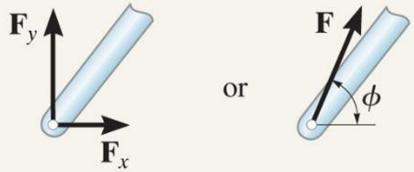
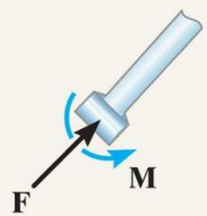
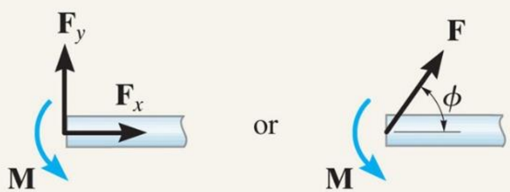
TABLE 5–1 Supports for Rigid Bodies Subjected to Two-Dimensional Force Systems

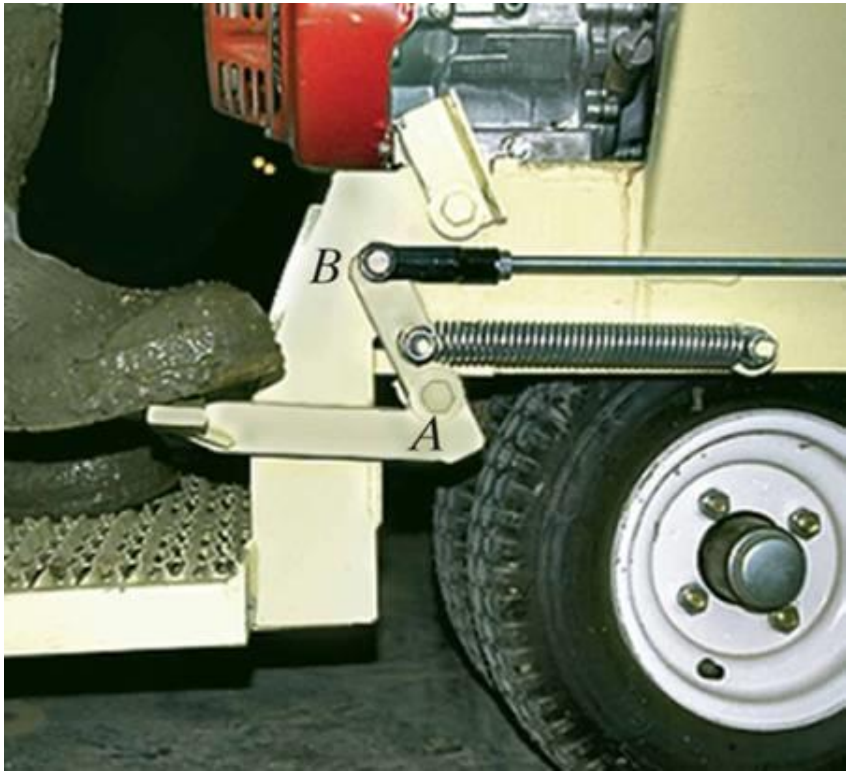
Types of Connection	Reaction	Number of Unknowns
(5)  smooth contacting surface		One unknown. The reaction is a force which acts perpendicular to the surface at the point of contact.
(6)  roller or pin in confined smooth slot	 or 	One unknown. The reaction is a force which acts perpendicular to the slot.
(7)  member pin connected to collar on smooth rod	 or 	One unknown. The reaction is a force which acts perpendicular to the rod.

continued

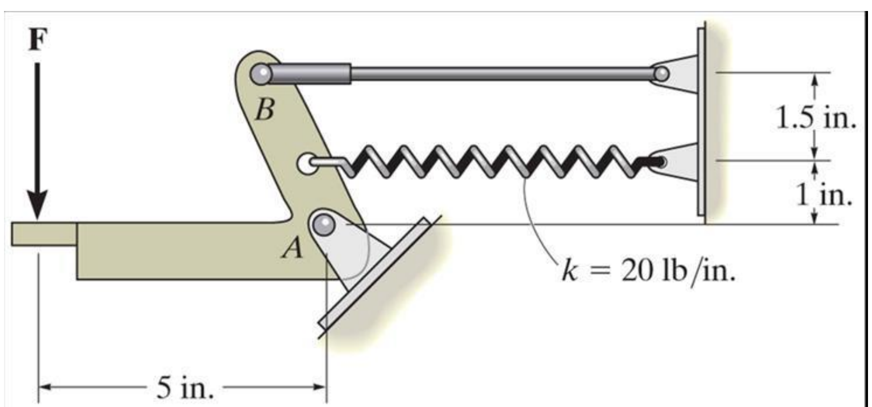
Types of connectors

TABLE 5–1 Continued

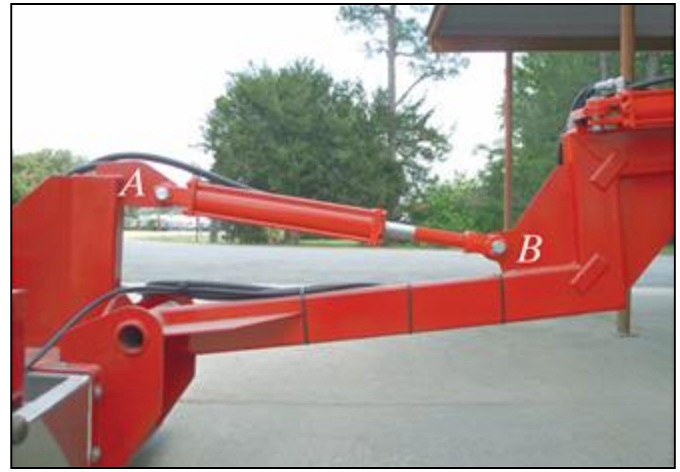
Types of Connection	Reaction	Number of Unknowns
(8)  smooth pin or hinge		Two unknowns. The reactions are two components of force, or the magnitude and direction ϕ of the resultant force. Note that ϕ and θ are not necessarily equal [usually not, unless the rod shown is a link as in (2)].
(9)  member fixed connected to collar on smooth rod		Two unknowns. The reactions are the couple moment and the force which acts perpendicular to the rod.
(10)  fixed support		Three unknowns. The reactions are the couple moment and the two force components, or the couple moment and the magnitude and direction ϕ of the resultant force.



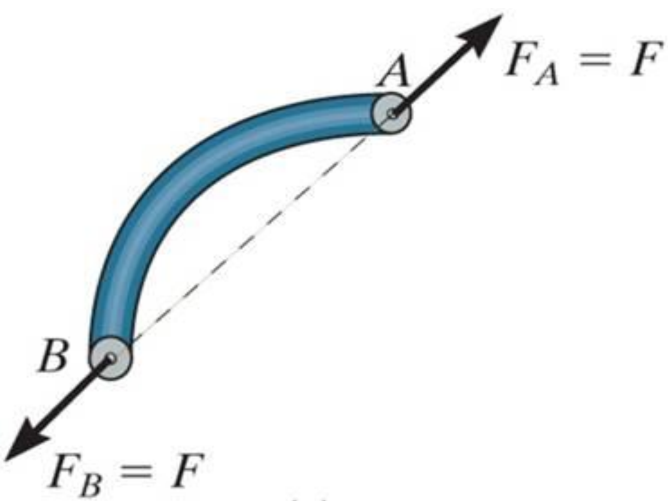
The operator applies a vertical force to the pedal so that the spring is stretched 1.5 in. and the force in the short link at B is 20 lb. Determine the vertical force applied to the pedal.

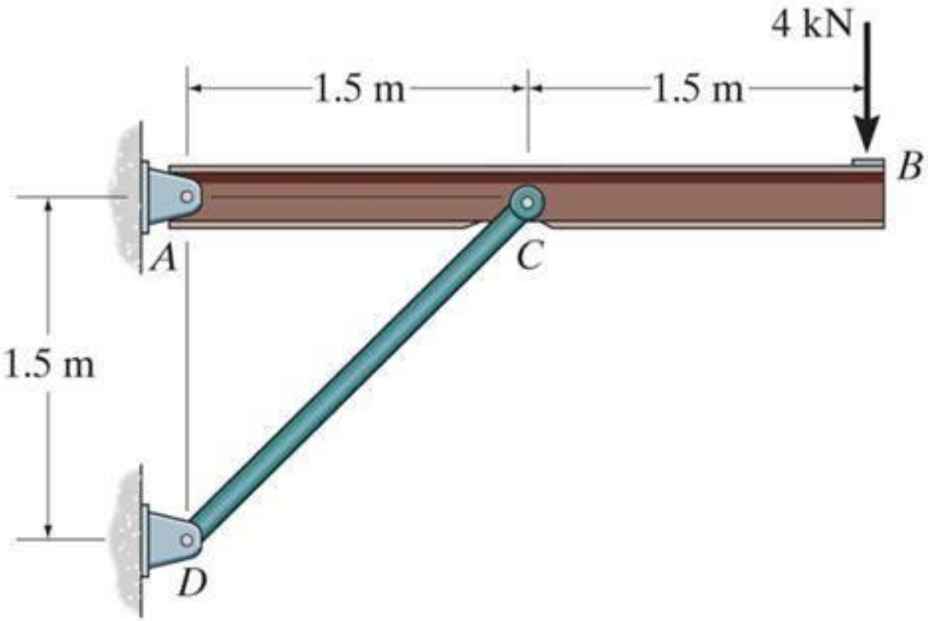


Two-force members

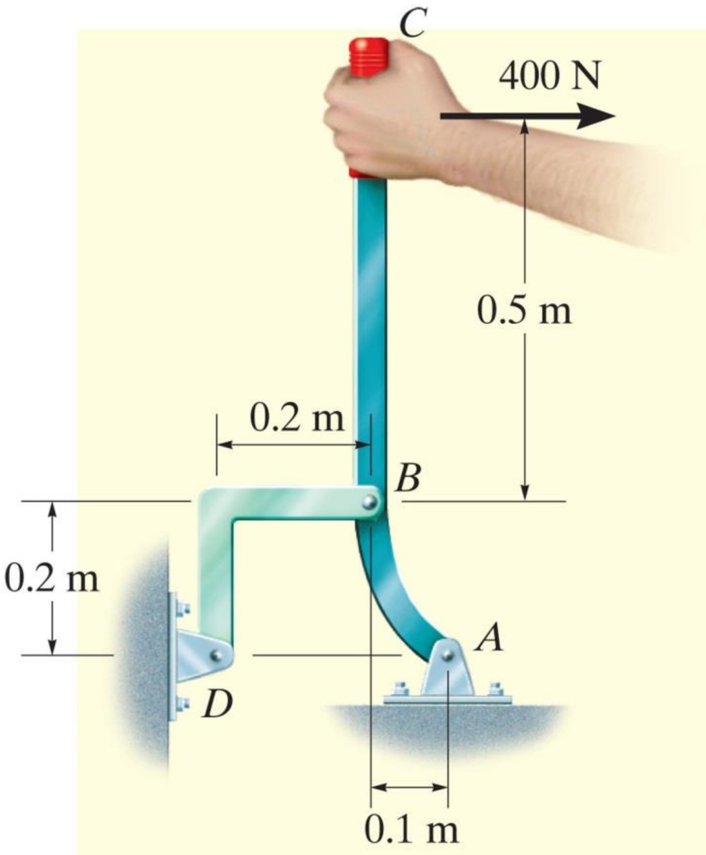


In the cases above, members AB can be considered as two-force members, provided that their weight is neglected.





Given the 4kN load at B of the beam is supported by pins at A and C. Find the support reactions at A and C.



The lever *ABC* is pin supported at *A* and connected to a short link *BD*. If the weight of the members is negligible, determine the reaction forces at pins *D* and *A*.