Announcements

- Quiz 2 re-try this week (Thu-Sat)
  - Same material, different problems
- No lecture Friday (2/15) ☺
  - Friday office hours will still meet as usual

❑ Upcoming deadlines:

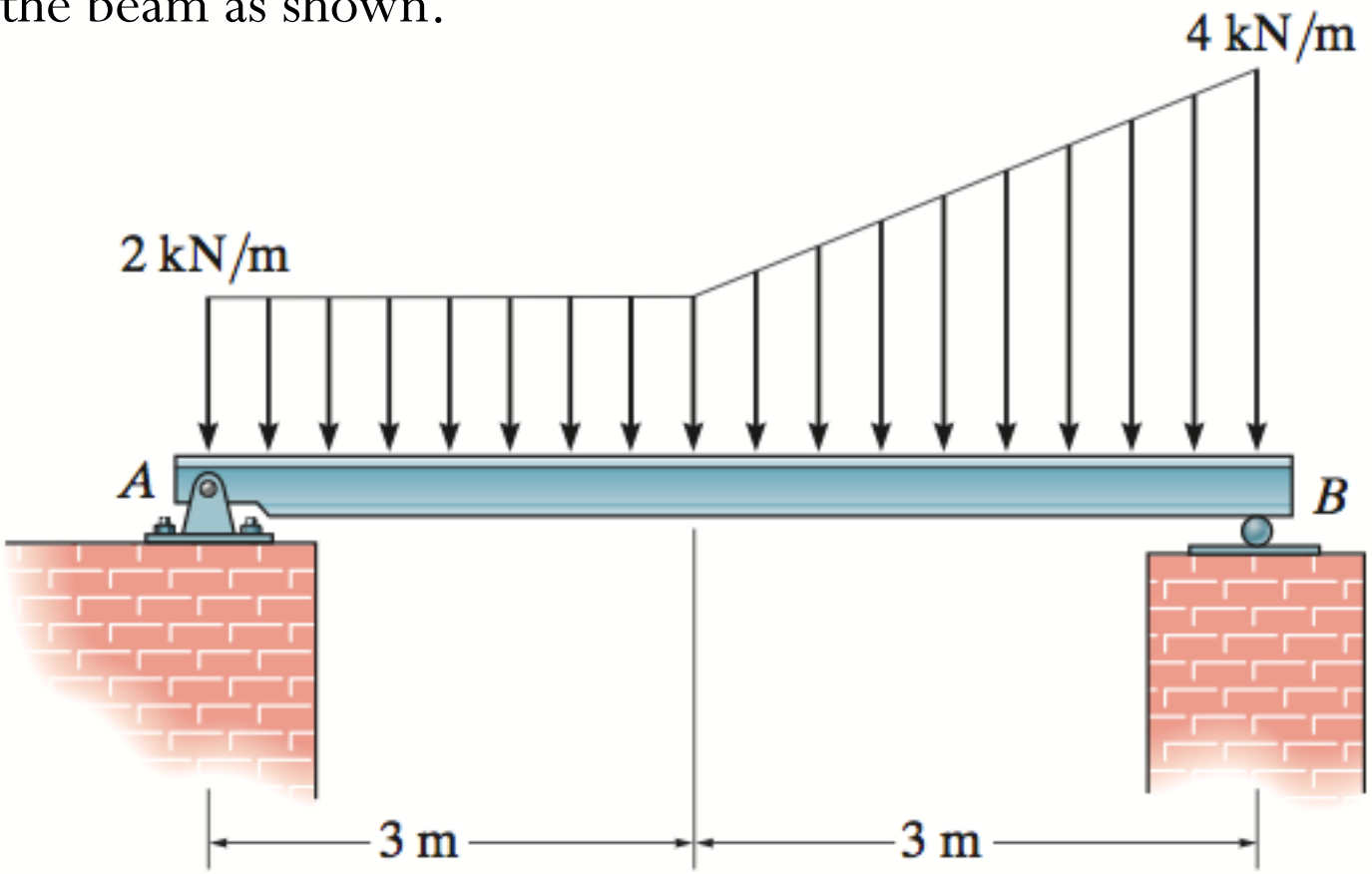
- Tuesday (2/12)
  - PL HW
- Friday (2/15)
  - Written Assignment

Objective

- Distributed loading
  - Composite method
- Rigid body equilibrium
  - Analysis procedures
  - 2D support reactions

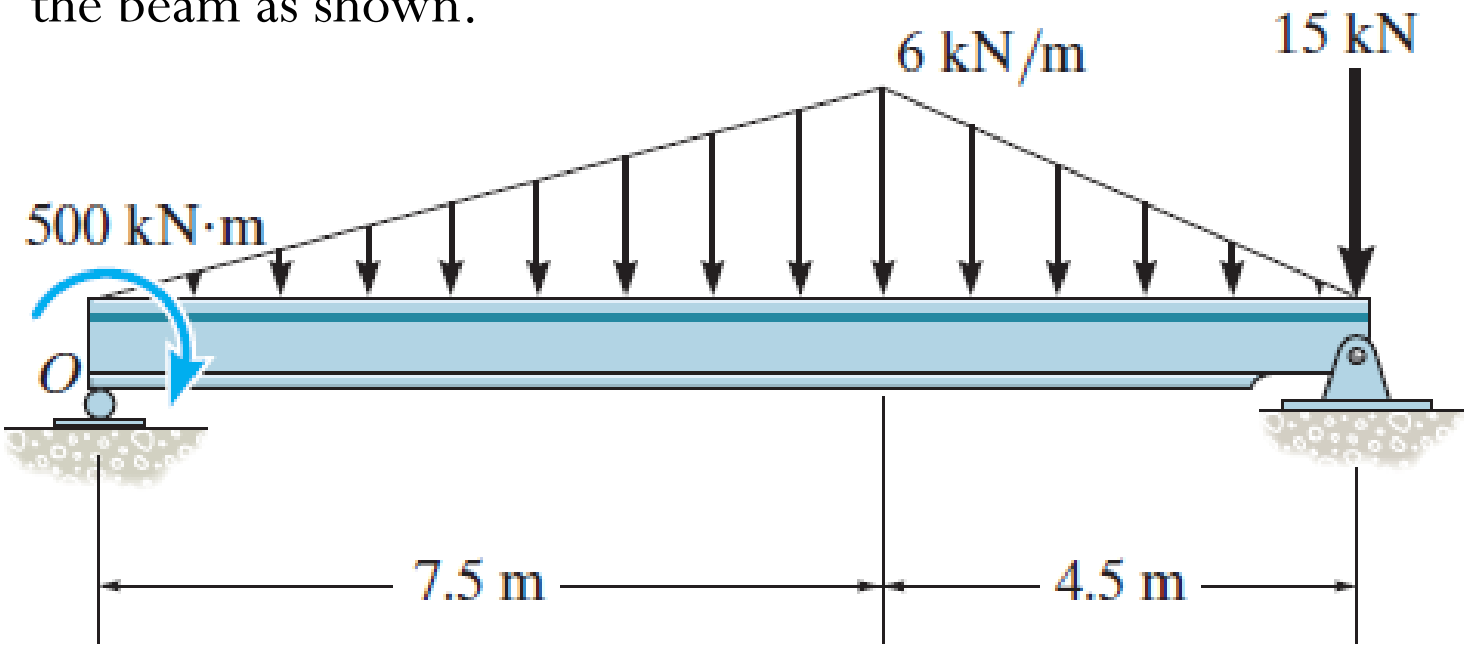
Example – composite method

Find the equivalent force and its location from point *A* for the loading on the beam as shown.



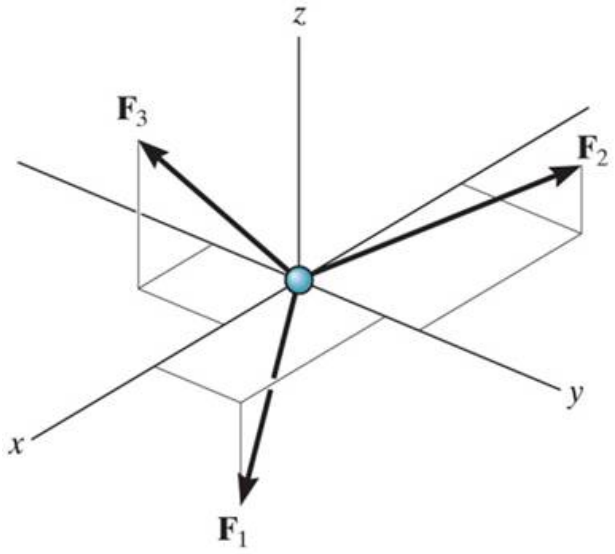
Example

Find the equivalent force and its location from point A for the loading on the beam as shown.

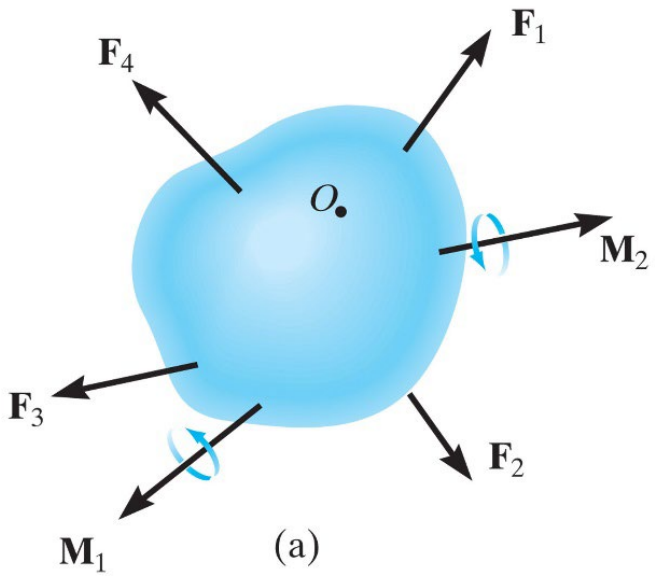


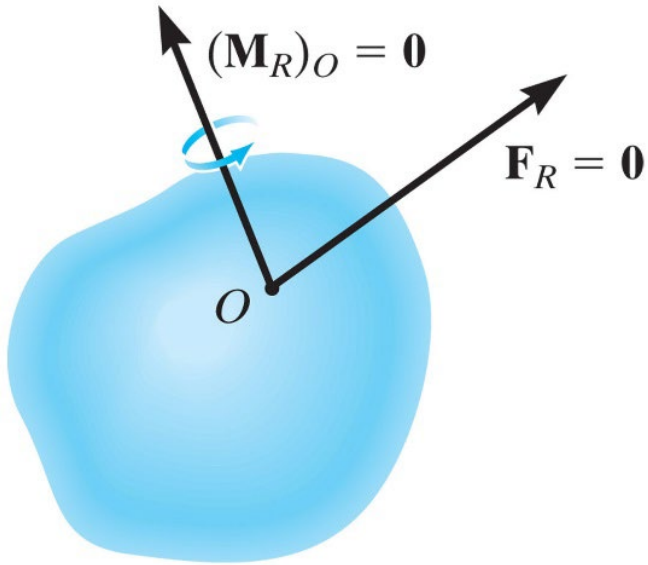
Chapter 5: Equilibrium of Rigid Bodies

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.



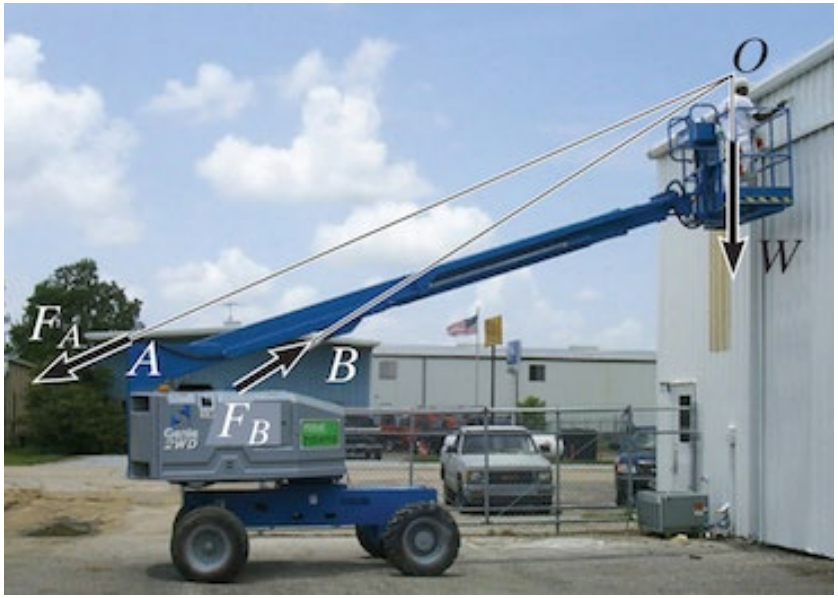


Equilibrium of a Rigid Body

Static equilibrium:

Maintained by reaction forces and moments

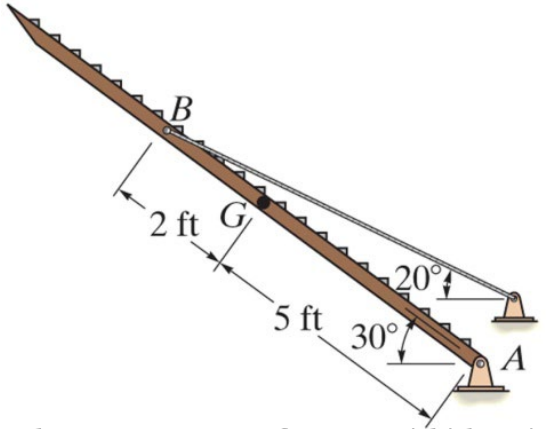
Assumption of rigid body



Process of solving rigid body equilibrium problems

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.

1. Create idealized model (modeling and assumptions)

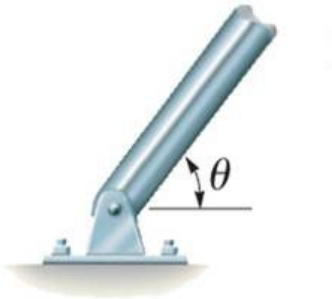


2. Draw free body diagram showing ALL the external (applied loads and supports)

3. Apply eqns of equilibrium

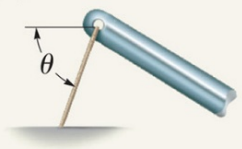
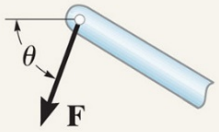
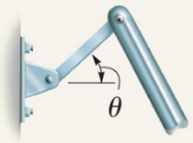
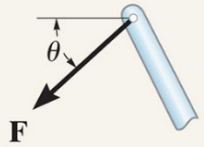
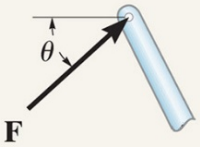
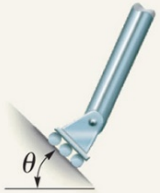
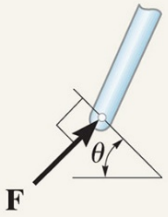
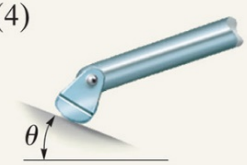
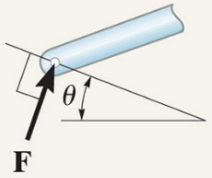
Equilibrium in two-dimensional bodies

Support reactions



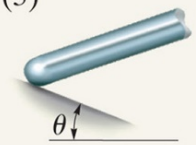
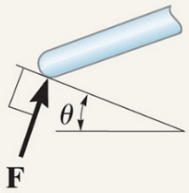
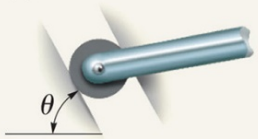
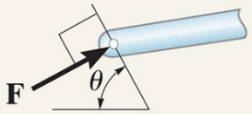
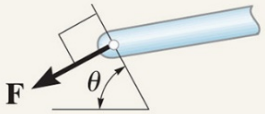
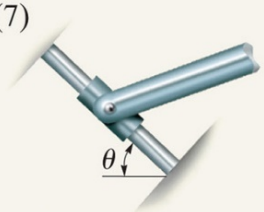
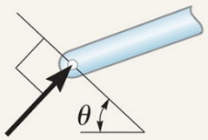
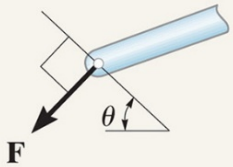
Types of connectors

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

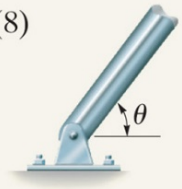
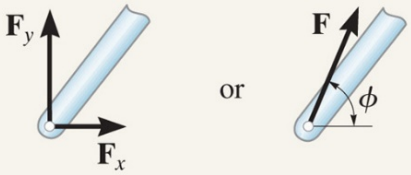
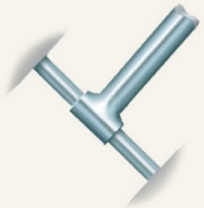
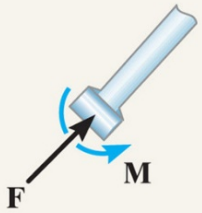
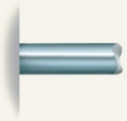
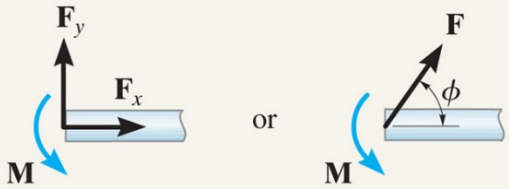
TABLE 5–1 Supports for Rigid Bodies Subjected to Two-Dimensional Force Systems

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.

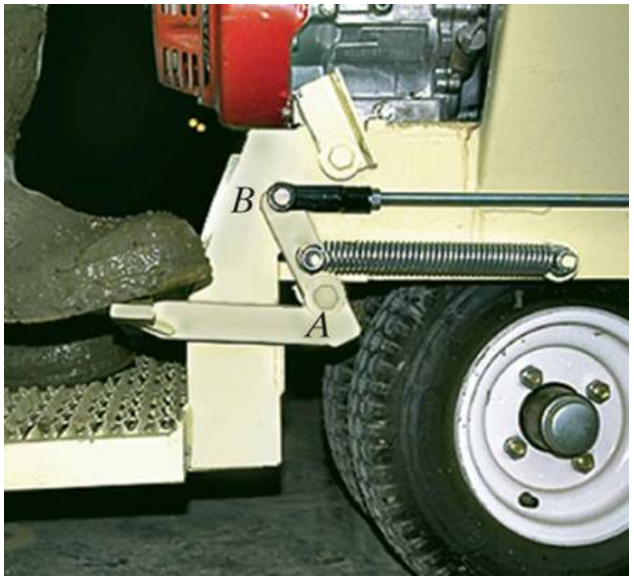
continued

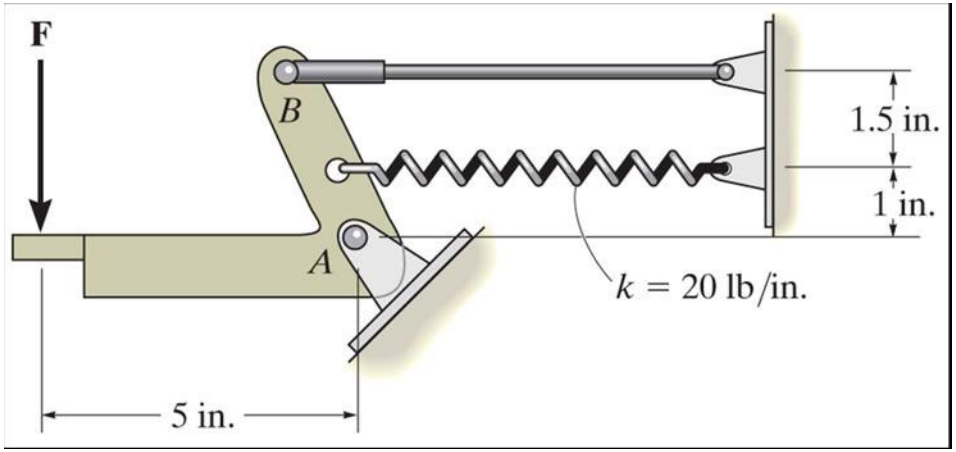
Types of connectors

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.





Find the tension in cable B given the weight of the cage.