

Statics - TAM 210 & TAM 211

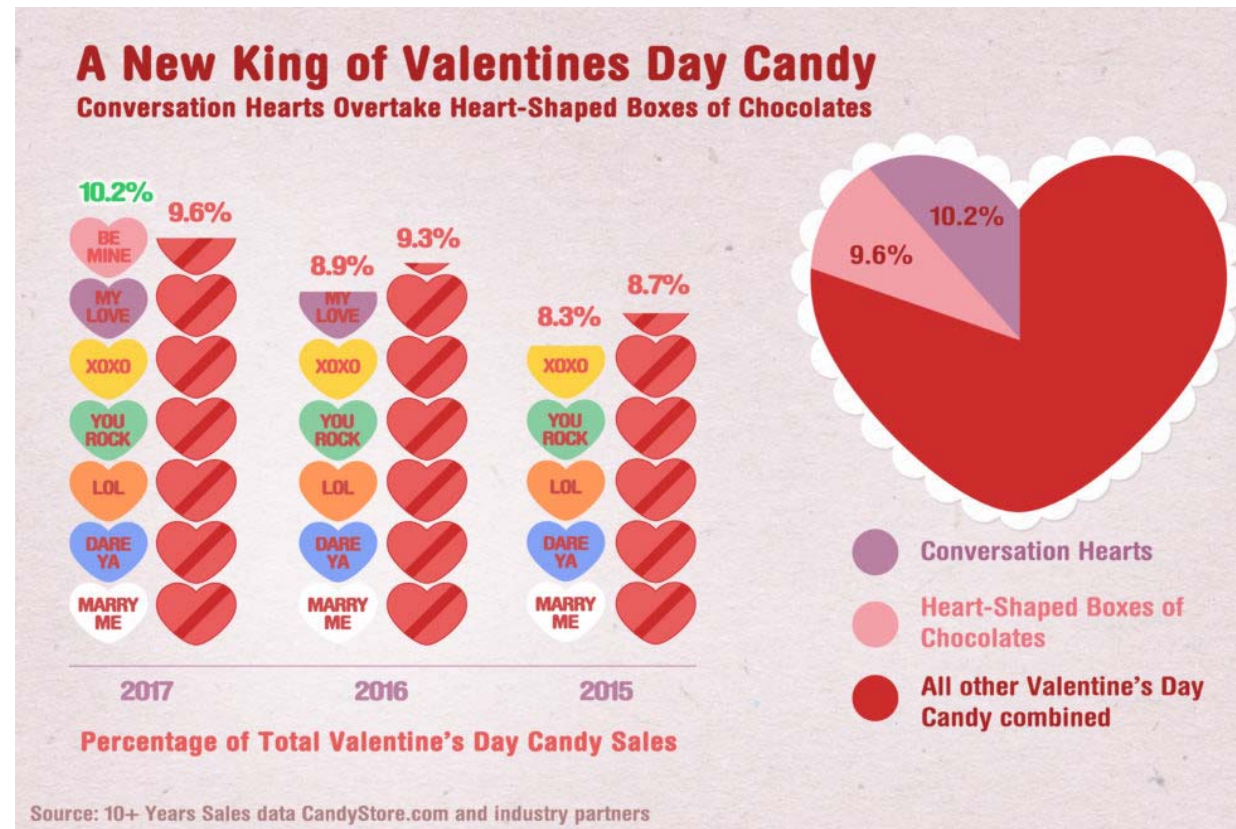
Lecture 13

February 14, 2018

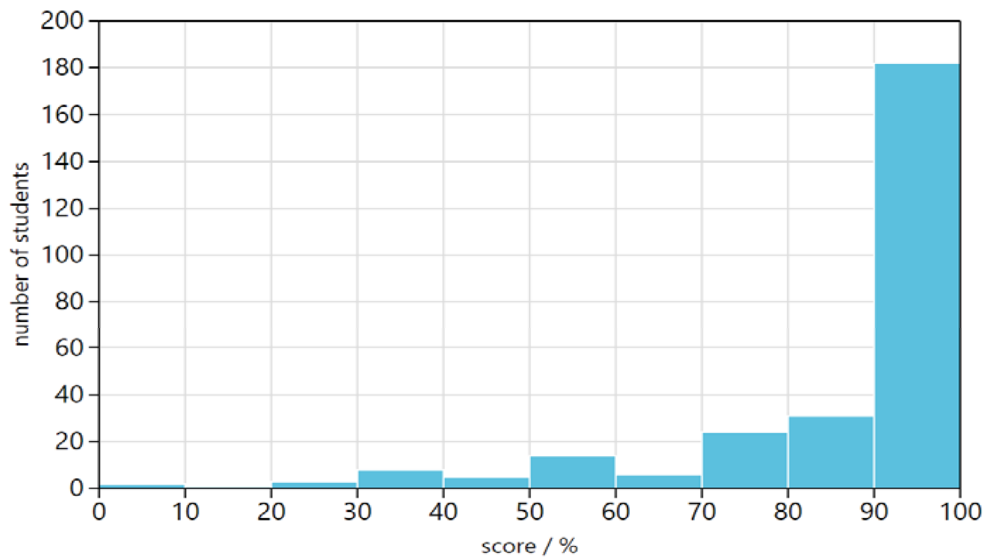
Announcements

- ❑ **READ [Piazza](#) posts!** If you had difficulty with Quiz 2, start reading and creating posts. There is a direct correlation with reviewing posts and quiz grade.
- ❑ Cumulative exam, Thursday, April 5, 7-9pm, 1 Noyes Lab
 - ❑ If you need DRES accommodation, send private message to instructors on Piazza with PDF of DRES letter. You must make your own arrangements at DRES testing facilities.
 - ❑ Conflict exam request: **MUST** send private message instructors on Piazza **now or at least 2 weeks before the exam date**. Only legitimate conflicts will be allowed. See [Information tab > Exam](#)

- ❑ Upcoming deadlines:
 - Written Assignment 2 (2/15)
 - Friday (2/16)
 - Mastering Engineering Tutorial 6

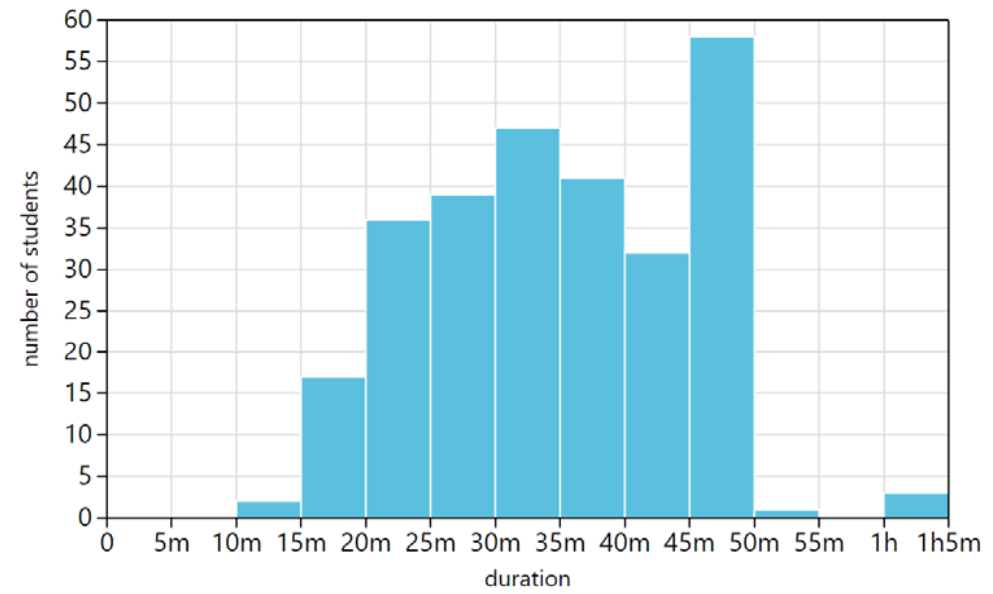


Quiz 1: Score statistics



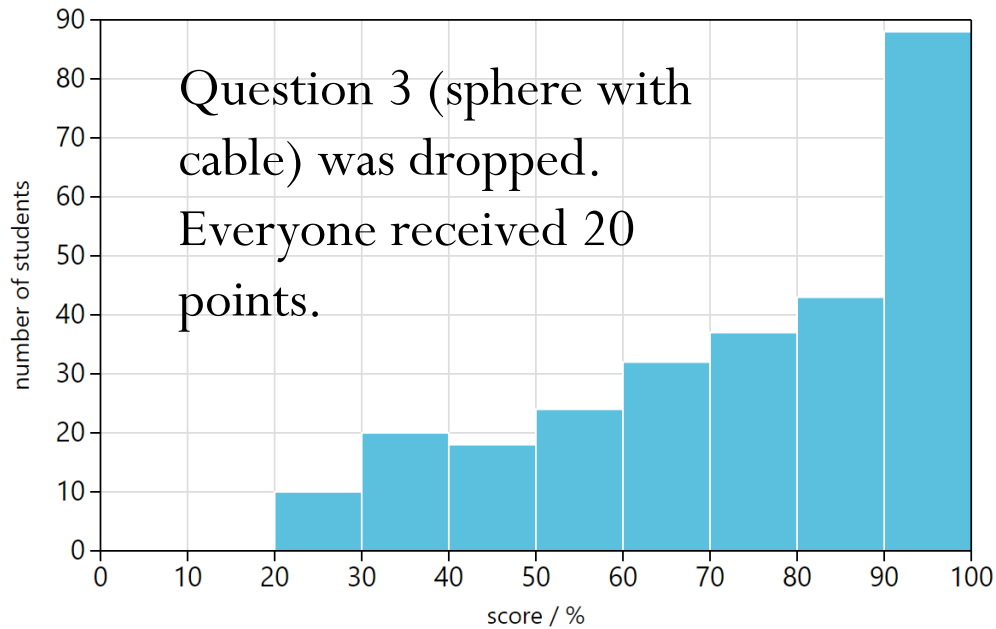
Number of students	276
Mean score	86%
Standard deviation	20%

Quiz 1: Duration statistics



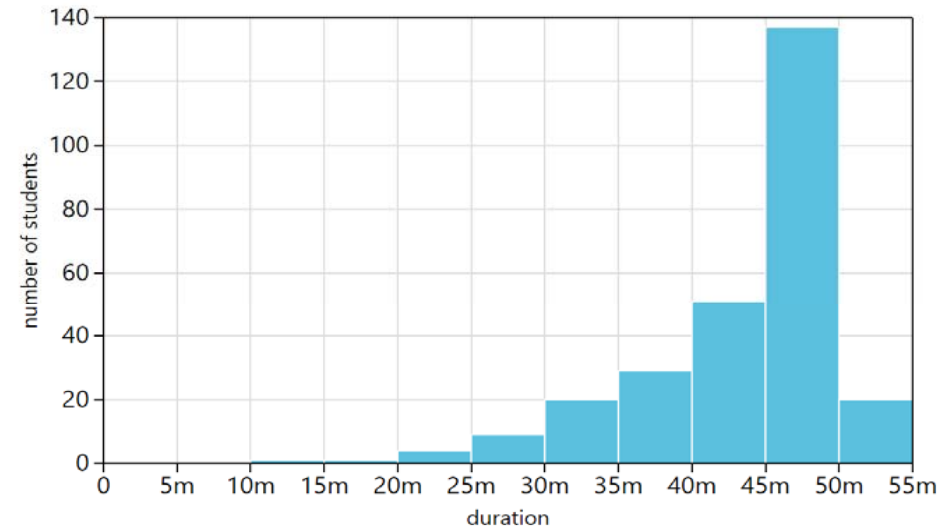
Mean duration	35m
Median duration	34m
Minimum duration	13m

Quiz 2: Score statistics



Number of students	272
Mean score	73%
Standard deviation	23%

Quiz 2: Duration statistics



Mean duration	44m
Median duration	46m
Minimum duration	13m

- Practice PL HW on your own
- Monitor your time
- Read each question, write givens, unknowns, draw FBD, write out equations
- Exam reflections
 - What did you do to prepare for the quiz?
 - What concepts did you struggle with?
 - What can you do differently to prepare for the next quiz?

Chapter 5: Equilibrium of Rigid Bodies

Focus on 2D problems

Sections 5.1-5.4, 5.7

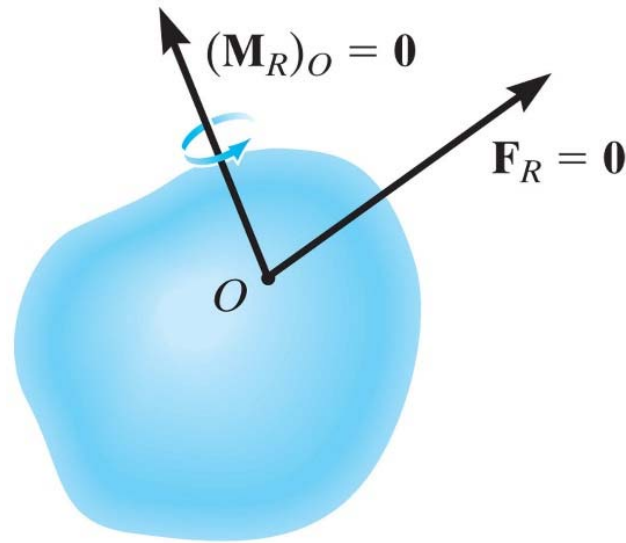
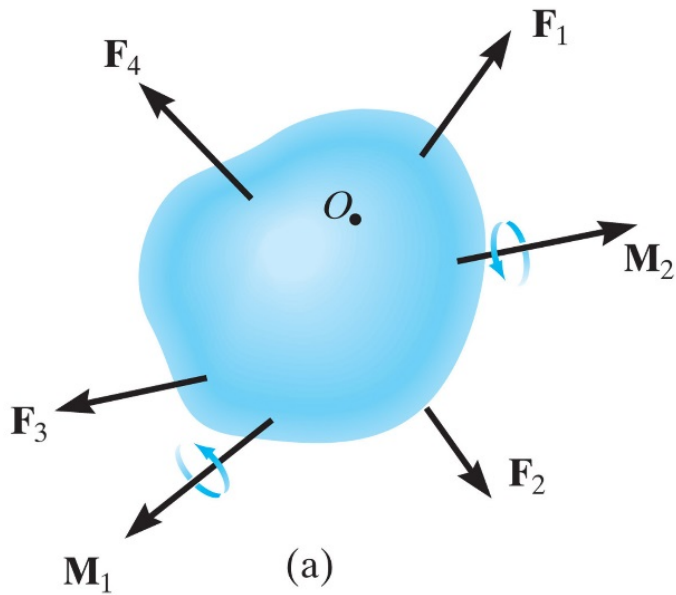
TAM 211 students will cover 3D problems (sections 5.5-5.6) in week 13

Goals and Objectives

- Introduce the free-body diagram for a 2D rigid body
- Develop the equations of equilibrium for a 2D rigid body
- Solve 2D rigid body equilibrium problems using the equations of equilibrium
- Introduce concepts of
 - Support reactions
 - Two- and three-force members
 - Constraints and statical determinacy

Recap: Equilibrium of a Rigid Body

Reduce forces and couple moments acting on a body to an equivalent resultant force and a resultant couple moment at an arbitrary point O .



$$\vec{F}_R = \sum \vec{F} = \mathbf{0}$$

$$(\vec{M}_R)_O = \sum \vec{M}_O = \mathbf{0}$$

Recap: Equilibrium in two-dimensional bodies (Support reactions)

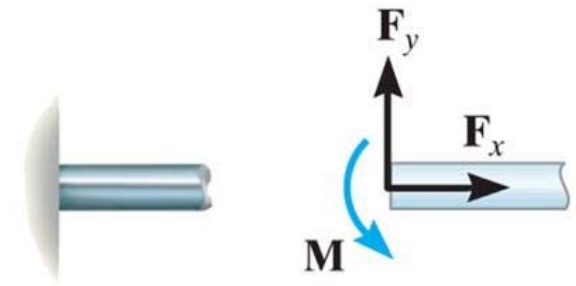
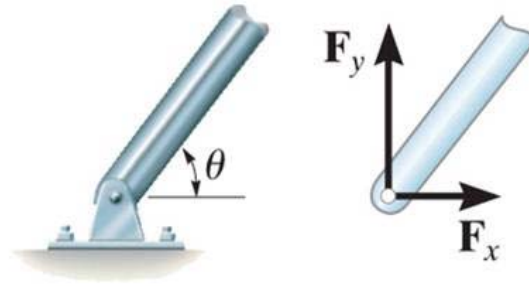
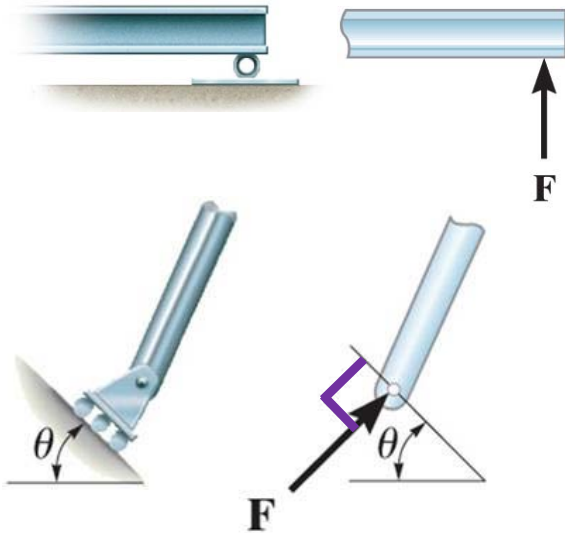
Roller



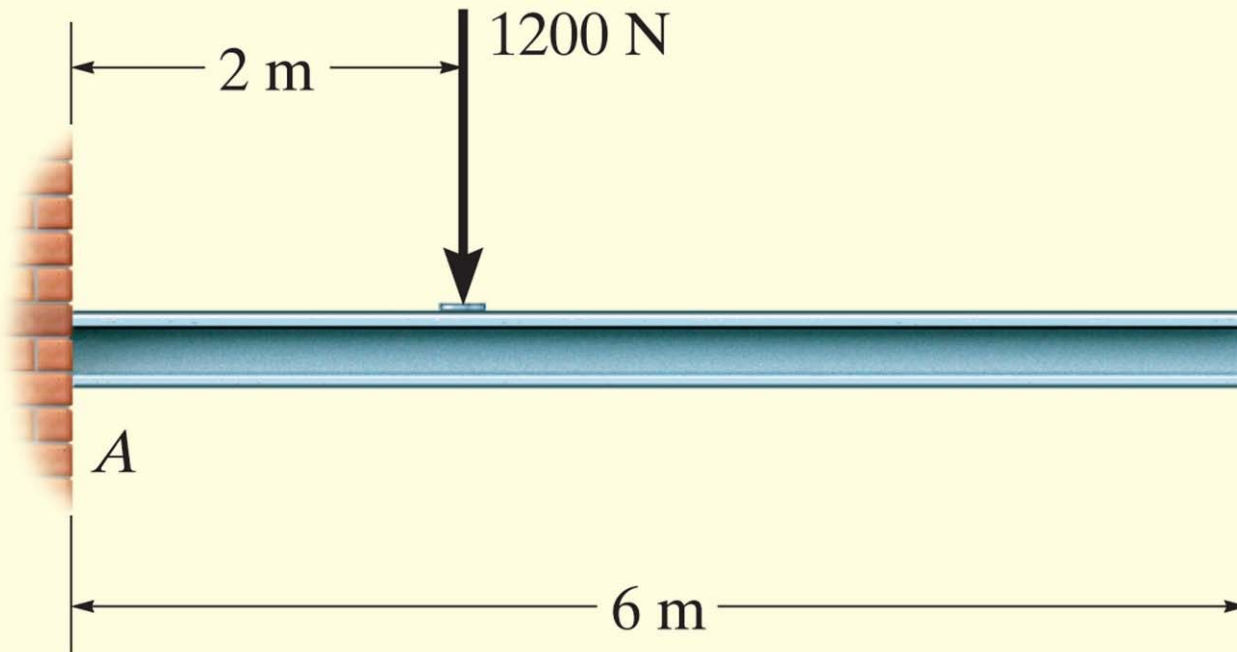
Smooth pin or hinge



Fixed support



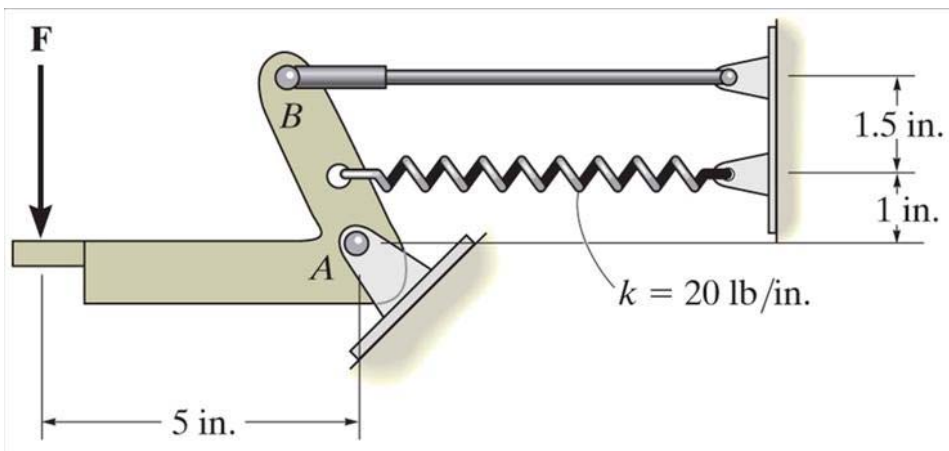
- If a support prevents the translation of a body in a given direction, then a force is developed on the body on that direction
- If a rotation is prevented, a couple moment is exerted on the body



Beam has mass of 100 kg and experiences load of 1200 N. Identify support reaction type. Find support reactions at A.




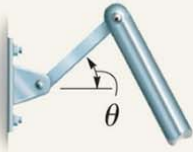
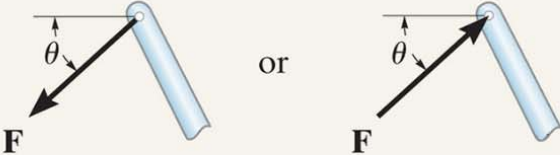

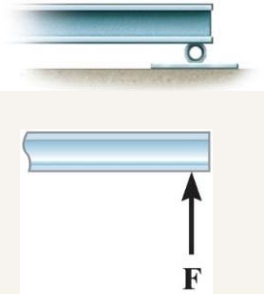
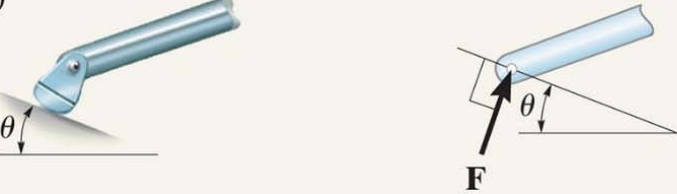
The operator applies a vertical force to the pedal so that the spring is stretched 1.5 in. and the force in the short link at B is 20 lb. Draw the FBD of the pedal



See Example 5.2 in text

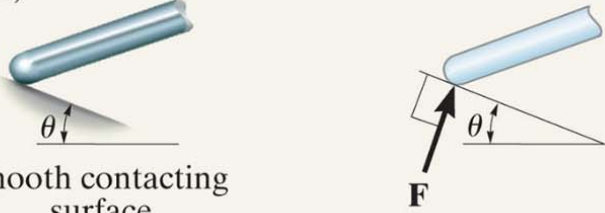
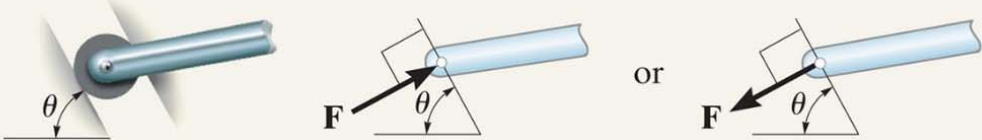
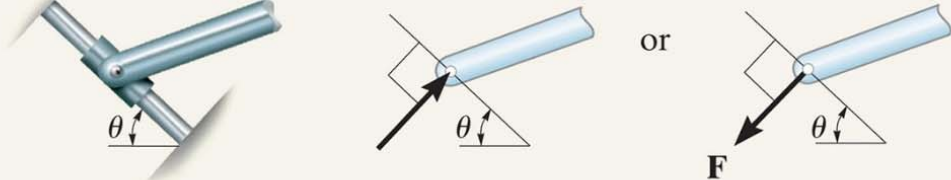
Types of connectors/supports

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

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

Types of connectors/supports

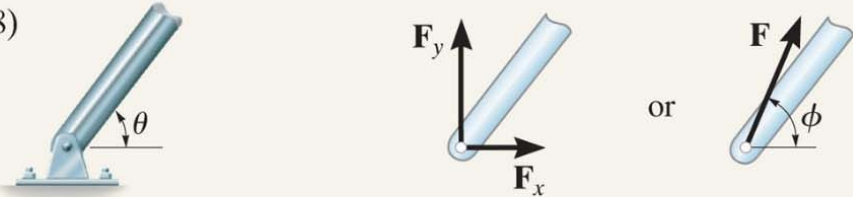

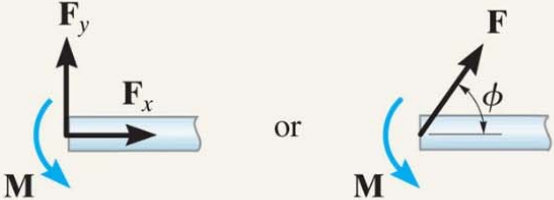
TABLE 5-1 Supports for Rigid Bodies Subjected to Two-Dimensional Force Systems

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

continued

Types of connectors/supports

TABLE 5-1 Continued

Types of Connection	Reaction	Number of Unknowns
<p>(8)</p>  <p>smooth pin or hinge</p>	<p>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)].</p>	
<p>(9)</p>  <p>member fixed connected to collar on smooth rod</p>	<p>Two unknowns. The reactions are the couple moment and the force which acts perpendicular to the rod.</p>	
<p>(10)</p>  <p>fixed support</p>	<p>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.</p>	

Identify support reaction types. Draw the FBD of body AB with forces in Cartesian coordinates.

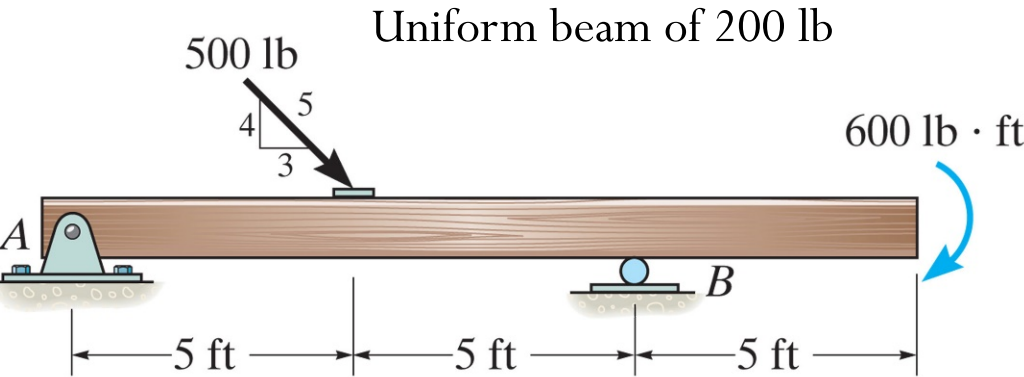


Figure: 05_FP001
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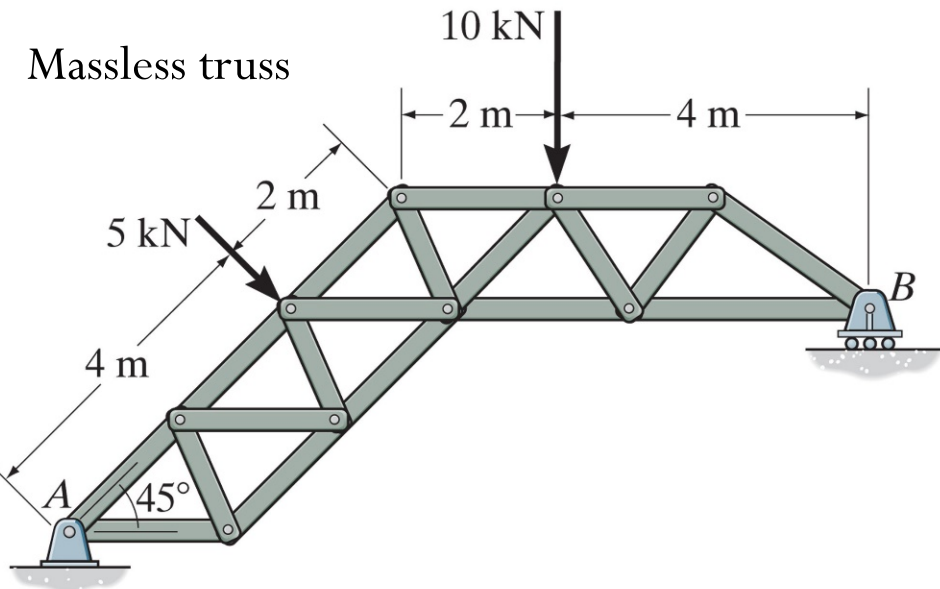


Figure: 05_FP003
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Identify support reaction types. Draw the FBD of rigid body with forces in Cartesian coordinates.

Massless beam

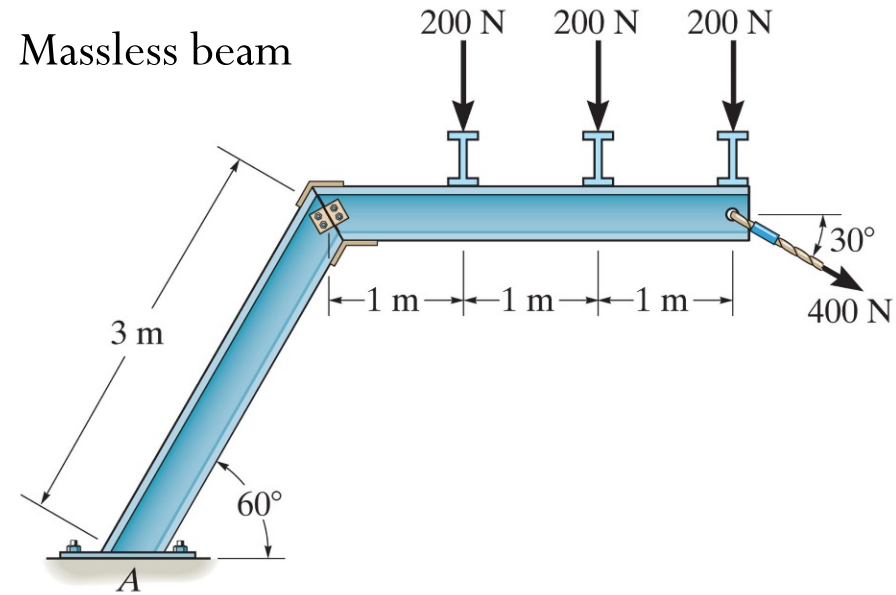


Figure: 05_FP004

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25 kg bar with center of mass at G. Supported by smooth peg at C, roller at A, cord AB

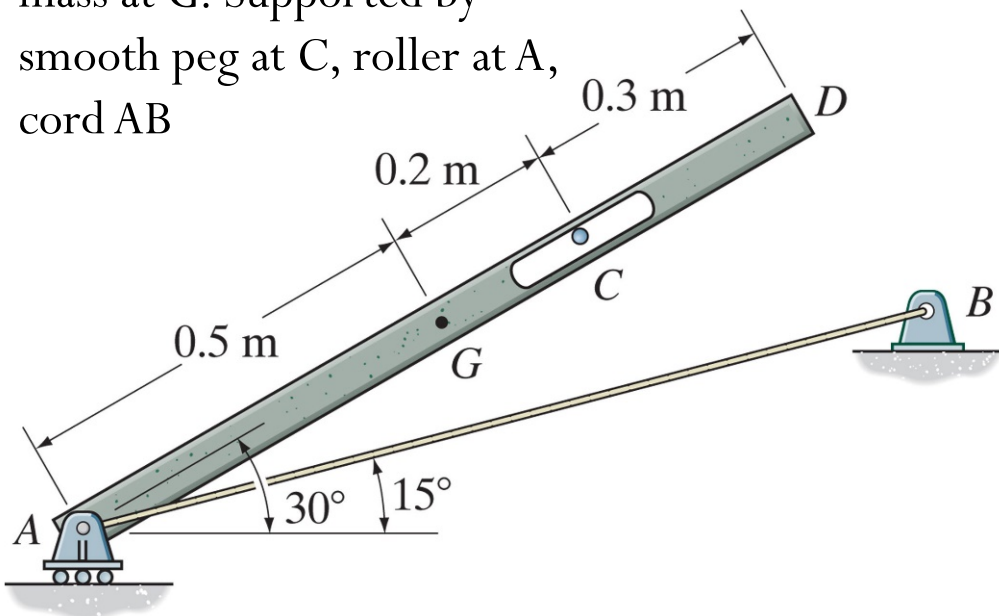
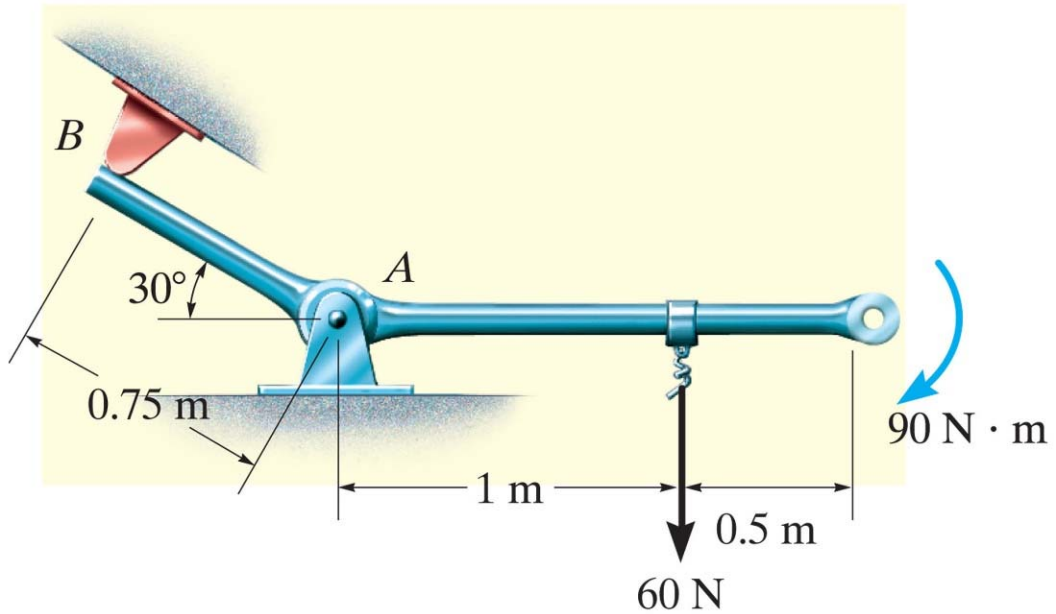


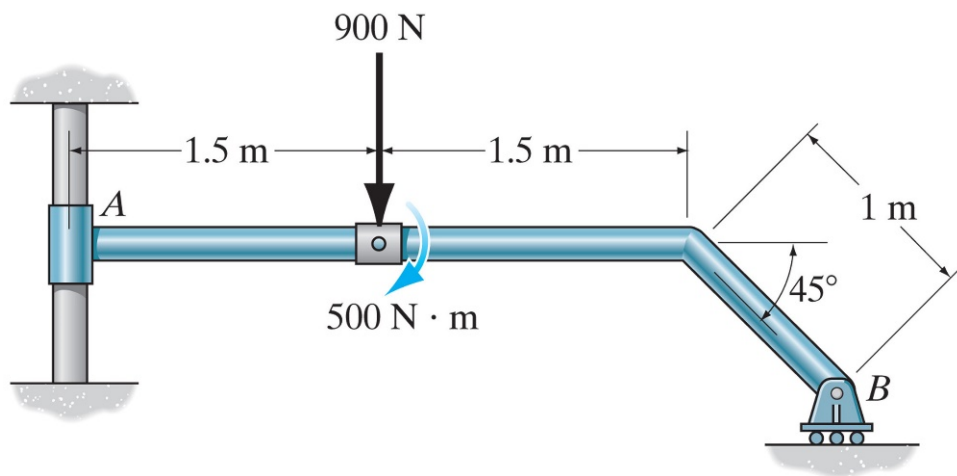
Figure: 05_FP005

Identify support reaction types. Draw the FBD of blue body with forces in Cartesian coordinates.

Pinned at A, smooth support at B. Neglect mass



Collar at A can slide vertically, roller @ B



Can you draw the FBDs of link AB and roller wheel B?

