Week 2 Challenge Homework

Rotational Mechanics

Submission Details | Submit a digital copy (PDF, jpg, etc.) to Canvas. Include solutions to the metacognitive exercise and each question. Please use the interface to associate each page of your submission with the assignment. It makes grading much easier. Please clearly indicate which question is being solved. If data is needed to complete a problem, be sure to cite the source you've acquired your data from. Typed work will not receive credit. See the course website for further details.

Group Submissions | You may submit a group collaboration to Canvas. Add each group member to the submission. Each group member should contribute to the work. Clearly indicate which part of the submission is written by each member (color or labels are preferable).

Sensemaking | You will be asked to apply sensemaking in some problems. More information about sense-making can be found on the BoxSand Sensemaking page, which is linked on the Canvas homepage.

Metacognitive Exercise

Each week will feature a metacognitive exercise, followed by one or two challenge problems to solve. The metacognitive exercise will usually ask you to reflect on your solution to the previous week's challenge problems.

Review your solution to the Week 1 Challenge Homework. If you do not have a copy of it anymore, you can find it on Canvas or Gradescope, under the Week 1 Challenge Homework assignment. Also, review the solution which has been posted to the BoxSand solutions archive (click here for a link). Solutions are posted a few days after the assignment is due.

(a) Write a few sentences answering the following questions:
   i. Did you use any physical representation or diagram to help you solve or communicate your solution of the Week 1 Challenge Homework?
   ii. If so, how did your diagrams differ from those in the provided solution, or how were they similar?

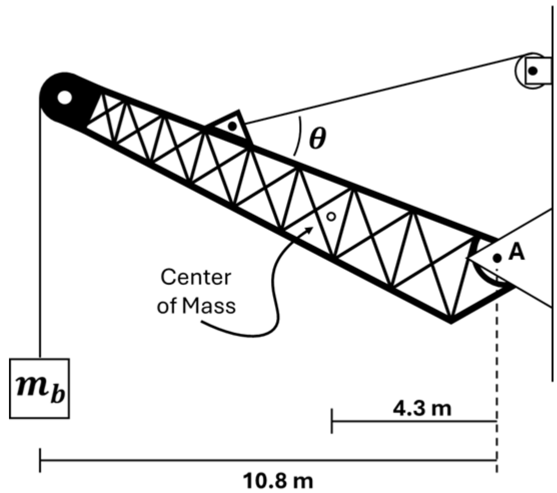
(b) What are your thoughts around Order of Magnitude sensemaking? Were you able to make a prediction and a comparison, then explain one of them in the week 1 challenge homework? This week's challenge homework also asks you to perform Order of Magnitude sensemaking. Before answering this week's challenge question, what will you do to improve your sensemaking skills, and/or your understanding of this type of sensemaking?

(c) Once you have worked through question 1 in this week's challenge homework, grade yourself using the challenge homework grading rubric. We have provided a table for the rubric here, but you might also find it useful to review the rubric and guidelines posted in the solutions archive (click here).

Category	None, attempted, developing, meets, or exceeds expectations	Reasoning (briefly)
Metacognition		
Clarity of Communication		
Earnest Attempt		
Physical Representation		
Sensemaking		

Question 1:

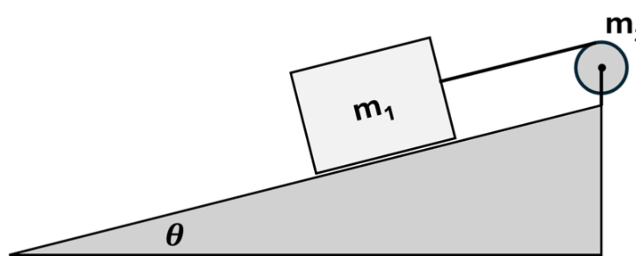
A **1200 kg** crane is supporting a box of mass, $\mathbf{m_b = 890\ kg}$. The crane pivots about a point labeled "A". A cable, holding the system in static equilibrium, attaches and pulls on the crane arm at a point **7.8 m** from the pivot point, A. The angle made between the cable and the crane arm is $\boldsymbol{\theta = 42°}$. The horizontal distance from the pivot point, A, to the center of mass of the crane is **4.3 m**, and the horizontal distance from the pivot point to the box is **10.8 m**.



(a) Draw an extended free body diagram with location A as the reference axis.
(b) What do you expect the *Order of Magnitude* of the force you find in question (c) to be? (hint: what are the *Orders of Magnitude* of the torques from the box and the center of mass of the crane?)
(c) Find the magnitude of the force of tension in the cable between the wall and the crane.
(d) Complete your *Order of Magnitude* sense-making by comparing your found answer in part (c) to your predicted answer in part (b).

Question 2:

A block of mass, $\mathbf{m_1 = 7\ kg}$, is on a ramp and is connected to a light string, the other end of which is wound around a solid disk-shaped pulley of mass, $\mathbf{m_2 = 1.3\ kg}$, and radius, $\mathbf{r = 20\ cm}$. Assume the pulley rotates about its axle without friction. The angle of the ramp is $\boldsymbol{\theta = 25°}$. The static and kinetic coefficients of friction between the block and ramp are **0.4** and **0.3**, respectively.



(a) Show that if the block is placed at rest, it will begin to slide. (hint: what is the maximum force of static friction?)
(b) Draw a free body diagram for the block and an extended free body diagram for the pulley.
(c) What is the angular acceleration of the pulley?
(d) If the system starts from rest, how far does the block travel in 3 s.
(e) After 3 s what is the angular velocity of the pulley?