Week 6 Challenge Homework

Inclined Planes, Friction, and Uniform Circular Motion

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

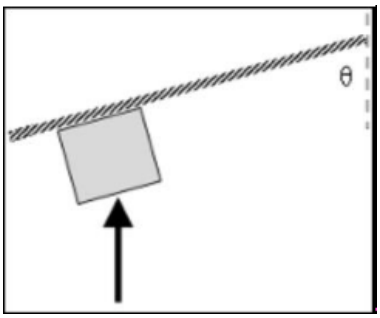
Each week will feature a metacognitive exercise, followed by one or two challenge problems to solve. The metacognitive exercise will usually ask you to reflect on your solution to the previous week's challenge problems.

Review your solution to the Week 5 Challenge Homework. If you do not have a copy of it anymore, you can find it on Canvas or Gradescope, under the Week 5 Challenge Homework assignment. Also, review the solution which has been posted to the BoxSand solutions archive (click here for a link) a few days after the assignment is due.

(a) In the week 5 challenge homework, you were asked to find symbolic solutions to both questions (your answer was expressed in symbols as opposed to a numerical value). Let's reflect on symbolic algebra, briefly. In a few sentences (1 – 2 per prompt), answer the following prompts. (Hint: you don't need to write what you think your instructor wants you to say! Write what you would tell a friend or your dog/cat/iguana)
- How do you feel about symbolic algebra in contrast with doing algebra with numerical values?
- What value, if any, do you see in solving a problem symbolically?
- What do symbols represent? Why do we use symbols at all?

(b) Reflect on your free body diagrams (FBDs) from week 5. Again, briefly.
- What score did you receive for your FBDs on the week 5 challenge homework?
- In what areas could you improve your FBDs?
- In what ways do you use your FBD when performing a force analysis (analyzing $\sum f_x = ma_x$ and $\sum f_y = ma_y$)?

Question 1:



A 2-kg-block is pushed upward from underneath by a constant 50-N vertical force. The block is sliding on the bottom side of an inclined plane that makes an angle of 70º with respect to the vertical. The coefficient of kinetic friction between the block and the plane is 0.2.

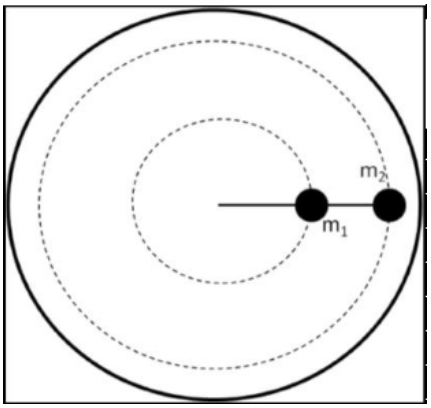
(a) Determine if the net force points up or down the incline. Explain using any combination of words, **diagrams (<— hint: draw a physical representation!)**, algebra, etc.

(b) If after traveling a total distance of 4 m the block is traveling at a speed of 4.443 m/s up the incline, what was the initial velocity of the block?

(c) By answering the following prompts, use *Sign* sensemaking to make sure your answers to parts (a) and (b) are reasonable.

- What are the signs of the net force from part (a), the final velocity, and the initial velocity found in part (b)? Make sure to clearly indicate your coordinate system of choice!
- Explain why these signs do (or do not!) match behavior predicted by the laws of kinematics. Please use any combination of words, diagrams, algebra, etc.

Question 2:



A mass of 3.0 kg is tied via a light string to the center of a table. A second mass of 5.0 kg is tied, also via a light string, to the first mass. Both masses are made to undergo uniform circular motion in the horizontal plane at a rate of 10 revolutions per second. The first mass is 1.2 m from the center of the table and the second mass is 2.0 m from the center of the table.

(a) By answering the following prompts, use *Related Quantities* sensemaking to examine the expected relationship between the tension in each string.

- Make a prediction for a relationship you expect between the tensions in the two strings (i.e. is one bigger or smaller?).
- Explain that prediction using any combination of words, diagrams, algebra, etc.

(b) What is the tension in each string?

(c) Finish the related quantities sensemaking by making a comparison between your prediction and the result you found in part (b).