Week 1 Challenge Homework

Average Quantities and Vector Operations

Submission Details | Submit a digital copy (PDF, jpg, etc.) to Canvas. Please use the interface to associate each page of your submission with the corresponding question number! 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. 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 sensemaking can be found on the Boxsand Sensemaking page, which is linked on the Canvas homepage. There are many different types of sensemaking. In this course, we will focus on evaluative sensemaking. This is often phrased as checking if your answer is reasonable or not. Usually, the evaluative sensemaking process consists of making a prediction with an explanation, then a comparison. First, make a **prediction** of what you would expect your answer or solution to look like, based on one of the techniques below. Then, provide an **explanation** for the prediction using arguments based in physical reasoning. Finally, make a **comparison** between the answer that you did find and your prediction. Briefly explain why they do or do not match.

Short explanations of the various sensemaking techniques we will use in this course are included below. Please see the Boxsand sensemaking page for more complete details.

- *Sign:* Explain a prediction for the **sign** of your answer or a quantity in your solution. Compare your prediction with the found quantity.
- *Dimensionality:* Explain a prediction for the **units or dimensions** of your answer or a quantity in your solution. Compare your prediction with the found quantity.
- *Related Quantities:* Explain a prediction for the **relationship between two quantities** within your solution. Compare your prediction with the found relationship.
- *Proportionality,* also known as *Covariation:* Usually using a symbolic solution, explain a prediction for the **behavior of one quantity in your solution when another or others are changed.** Compare your prediction with the found quantity.
- *Order of Magnitude:* Explain a prediction for the **order of magnitude** of your answer or a quantity in your solution. Compare your prediction with the found quantity.
- *Graphical Analysis:* Explain a prediction for your answer or a quantity in your solution based on arguments made from **analysis of a graph**. Compare your prediction with the found quantity or relationship.
- *Special Cases:* Explain a prediction for your answer or a quantity in your solution by examining the behavior as another quantity is taken to a limit or **special case**, such as 0, infinity, 0 degrees, or 90 degrees. Compare your prediction with the found relationship.
- *Self-consistency:* Explain or show that your answer is **self-consistent**. Usually this involves using your found answer within an earlier part of your solution and showing that the result is as expected.
- *Known Values:* Explain a prediction of your answer or a quantity in your solution based on a **known value**, such as the speed of light or the density of water. This can involve research and citing a source. Compare your prediction with the found quantity.

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 0 Challenge Homework. If you do not have a copy of it anymore, you can find it on Canvas or Gradescope, under the Week 0 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) Write a few sentences answering the following questions.
- Did you use any physical representation or diagram to help you solve or communicate your solution of the Week 0 Challenge Homework?
- If so, how did your diagrams differ from those in the provided solution, or how were they similar?
- In what ways did the figures used in the provided solution help communicate the physics presented?

(b) How confident are you about your solution to the dimensionality sensemaking exercise in the Week 0 Challenge Homework? Were you able to make a prediction, a comparison, and explain one of them? This week's challenge homework also asks you to perform dimensionality sensemaking. Before answering this week's challenge question, what will you do to improve your sensemaking skills, and/or your understanding of sensemaking?

(c) Using the rubric and guidelines provided here and in the solutions archive (click here for link), grade your own Week 0 Challenge Homework submission. How or why did your grading differ from the grading given in Gradescope? What areas of improvement do you see?

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

Question 1:

Deserted on a deserted Island you spot a slightly exposed tin can under a tree. Upon opening it you find it's instructions to a treasure. It reads: "Ten paces from this very tree in a direction twenty degrees south of west lies the first location. Ten paces from this very tree in a direction sixty degrees north of east lies the second location. Walk from this tree exactly the distance and direction you would walk from the first location to the second location and you will find ye treasure. Yar". You are interested in the coordinates of the treasure, because it's treasure and you are a pirate. Yar.

(a) Evaluative sensemaking usually involves making a prediction for some aspect of your solution, explaining that prediction, then comparing your prediction with your solution. We will do the first piece of this now, using *Dimensionality* sensemaking. Before you solve part (c), what units or dimensions do you expect your answer to have?

(b) Draw a physical representation for this problem. Make it at least half a page in size.

(c) Find the coordinates of the treasure.

(d) Check your answer to part (c) of this problem using *Dimensionality* sensemaking by answering the following question. Compare the units of the answer you found in part (c) with your prediction in part (a). Does it have the expected units? Explain how you know. Hint: writing the units in explicitly when the calculations are performed is a good start for dimensionality sensemaking. Asserting "units work out" without showing they do is not adequate.