Week 2 Challenge Homework

Average Quantities and Graphical Analysis

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 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) a few days after the assignment is due.

(a) Compare the physical representation (diagram) drawn in your solution with that of the provided solution. What differences and similarities do you notice? Do they both contain labels for quantities? Are both diagrams big enough to easily read and understand all information that they contain?
(b) What should a physical representation contain? What have you learned about physical representations that will help you improve the diagram you will be asked to draw in Question 1 of this week's challenge homework?
(c) After completing your first two challenge homework assignments, in which of the grading categories (metacognition, clarity of communication, earnest attempt, physical representation, and sensemaking) do you feel most confident? Least confident? What steps will you take to improve your least confident category?

Question 1:

During the middle of a family picnic, Barry Allen received a message that his friends Bruce and Hal needed to be saved. Barry promised his wife Iris that he would be back in exactly 5 minutes. From that picnic location, Barry runs at a speed of 600 m/s for 2 minutes at a heading of 35° north of west to save Bruce. He then changed his heading to 30° west of north, slows down to 400 m/s and runs for 1 minute to save Hal. (The changes in speed are essentially instantaneous and not part of solving this problem).

(a) Draw a physical representation including each displacement during Barry's full trip.
(b) Evaluative sensemaking usually involves making a prediction for some aspect of your solution, explaining that prediction, then comparing your prediction with your solution. Check your answer to part (a) of this problem using Related Quantities sensemaking by answering the following questions:
    - The total distance traveled by an object will always be larger than or equal to the magnitude of its displacement. Explain why the relationship between these two quantities should always be this way. Use any combination of words, diagrams, algebra, examples, etc to explain.

- Calculate Barry's total distance traveled and the magnitude of his displacement (before his return trip).
- Do Barry's total distance traveled and the magnitude of his displacement have the expected relationship? Explain very briefly.

(c) With what average velocity (magnitude and direction) does Barry need to move to return to the picnic in time to keep his promise to Iris?

(d) What is the maximum known value for a human's running speed? Find and cite a reputable source. Compare this to Barry's speed. Do some quick research to find out who is Barry Allen. Finally, does Barry's speed make sense for this situation? Why or why not?

Question 2:

The graph shows the speed as a function of time for a corvette as it accelerates from rest to its top speed of about 202 mph on a straight horizontal road.

(a) About how many seconds does it take this corvette to go from 0 mph to 60 mph.

(b) About what percentage of the total time does the corvette spend in each gear?

(c) Estimate the average acceleration in 1st gear.

(d) What is the speed of the corvette at 11 seconds?

(e) Estimate the total distance the corvette travels from its starting location to the location when it reaches the top speed (end of curve).

(f) Evaluative sensemaking usually involves making a prediction for some aspect of your solution, explaining that prediction, then comparing your prediction with your solution. Check your answer to part (e) of this problem using Dimensionality sensemaking by answering the following questions:

- Using the axes of the graph, what would you expect to be the units or dimensions for an area on the graph? Explain using any combination of words, diagrams, algebra, etc.
- Compare this expectation to the answer you found for part (e). Do they match? Explain briefly.