

# Week 1 Challenge Homework

## Average Quantities and Vector Operations

Submit a digital copy (PDF, jpg, etc.) to gradescope.com. Please use the Gradescope interface to associate each page of your submission with the corresponding question number! It makes grading much easier.

Every page should be labeled on the top left with the question number and there should be only be one solution per page. If a solution takes more than one page, be sure to label that it is a continuation of the previous page's solution. 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.

You will be asked to apply sense-making in some problems. Use the list below as a reference to the different sense-making techniques. More information about sense-making can be found on the BoxSand menu under Math Tools => [Sense-making](#).

- *Sign*: Check the **sign** of each quantity makes sense.
- *Dimensionality*: Check the **dimensionality** and units of each quantity makes sense.
- *Order of Magnitude*: Check the **order of magnitude** of the final answer and other important quantities is within a factor of 10 of what you think it should be.
- *Graphical Analysis*: Use a **graph** to see if the behavior of a solution makes sense.
- *Proportionality*: Using a symbolic solution, check the behavior of the answer when you change a given quantity on which it is dependent. Does the answer vary **proportionally** to what you expect?
- *Special Cases*: Check the behavior of a derived equation in limiting (**special**) cases makes sense, e.g. as  $x$  goes to 90 degrees in  $\sin(x)$ .
- *Self-consistency*: Check derived equations, functions, or values, are **self-consistent**, e.g. check that the slope of a derived position plot matches the values of the given velocity plot
- *Known Values*: Compare given or derived quantities with common well **known values**.
- *Related Quantities*: Compare the relative magnitude of two **related quantities**.

**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"

- (a) What are the coordinates of treasure?
- (b) Use a physical representation in conjunction with the *Related Quantities* sensemaking technique to check the validity of your answer.