Week 4 Challenge Homework

2-D Kinematics

Submission Details | Submit a digital copy (PDF, jpg, etc.) to Canvas. 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 3 Challenge Homework. If you do not have a copy of it anymore, you can find it on Canvas or Gradescope, under the Week 3 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 3 – 5 sentences, compare your solution with the provided solution to Question 2 from the week 3 challenge homework. What did you do differently than the provided solution? Are there aspects of your solution that you liked better? Are there aspects of the provided solution that you liked better?

(b) What types of representations can you identify in your solution to question 1? (some physics representations include diagrams, symbols, numbers, words, graphs, sounds, etc.) What types of representations can you identify in the provided solution to question 1? How do each of these representations contribute to the problem solution?

Question 1:

At the Ice Capades two ice skaters pass right by each other while doing a routine where they are wearing directional jet packs. At this moment the skater in the red suit is traveling at a speed of **5 m/s** in a direction **30º** from the positive *x* axis towards the negative *y* axis and the skater in the blue suit is traveling at **4 m/s** in the positive *y* direction. As they pass each other their jet packs turn on, shooting flames for effect and providing each of them a constant acceleration. The acceleration of the skater in the blue suit is in the positive *x* direction and has a magnitude of **4 m/s²**, while the acceleration of the skater in the red suit is in the positive *y* direction. With their jet packs turned on the entire time, they eventually meet again and pass right by each other.

(a) Draw a physical representation (a picture with important quantities labeled) for the skaters. Make an attempt to draw and scale the quantities appropriately. You will not be graded on numerical accuracy, only qualitative accuracy for part (a). Include in the drawing:
- The origin
- Initial positions for each skater
- Initial velocity vectors for each skater
- Acceleration vectors for each skater
- A qualitative (not numerical) guess at a reasonable path of motion for each skater
- A qualitative (not numerical) guess at a reasonable final velocity for each skater

(b) Using information from the question prompt, calculate the initial velocities for each skater. Give them in bracket form with x and y components. (ex: $< v_x, v_y >$ m/s) Compare them with your physical representation from part (a). Do they match? Explain why they match or do not match.

(c) In preparation for sign sensemaking, make a prediction for the sign of the final velocity components for each skater. Explain your prediction using any combination of words, diagrams, algebra, etc.

(d) How much time elapses between the two times they are side-by-side?

(e) What was the magnitude of the acceleration of red skater to achieve this feat?

(f) What is their change in position during this time?

(g) What is the final velocity of each skater? Complete your sign sensemaking by explaining briefly how the signs of the final velocity components do, or do not, match your predictions from part (c).