Week 5 Challenge Homework

Entropy, Processes and Cycles

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 4 Challenge Homework. If you do not have a copy of it anymore, you can find it on Canvas or Gradescope, under the Week 4 Challenge Homework assignment. Also, review the solution which has been posted to the BoxSand solutions archive (click here for a link). Solutions are posted a few days after the assignment is due.

(a) Week 4's challenge homework asked you to perform a new type of sensemaking called "known value" sensemaking. Do you remember previous times when you have done this sensemaking technique unprompted? (side note: the new sensemaking techniques that will be emphasized this term are known value, order of magnitude, and covariation / proportional reasoning. Though, the last of those was introduced in limited amounts during PH201)

(b) Look back at the times you have graded your own challenge homework in the metacognitive exercises (weeks 2 and 3). How did your grading compare with the grading you received from the PH202 teaching team? What thoughts do you have about bringing your own expectations in line with those of the teaching team?

(c) Once you have worked through question 2 in **this week's** challenge homework, grade yourself using the challenge homework grading rubric. We have provided a table for the rubric here, but you might also find it useful to review the rubric and guidelines posted in the solutions archive (click here).

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

Question 1:

Liquid supersaturated sugar solution can evaporate in an open beaker. What is left is a solid made of sugar crystals.

(a) Did the sugar gain or lose entropy going from a liquid to crystalline form? Explain.

(b) Does this violate the second law of thermodynamics? Explain using *sign* sensemaking. Make sure to state a prediction for whether or not your answer to part (a) violates the second law of thermodynamics. Then provide an explanation making sure to use the signs of the entropies involved.

Question 2:

3.0 moles of an ideal gas are subjected to the following processes. First the volume is tripled in an isobaric process. Then it undergoes an isothermal process to a pressure of 9.0 kPa. The volume is then halved in another isobaric process. Finally, it returns to the original state in an isochoric process.

(a) Draw a PV diagram of the cycle. Label each state (vertex) with a letter (A, B, …) and each transition with a number and arrow showing the direction of the process.

(b) Is this a heat engine or heat pump? Explain **without** using "clockwise" or "counterclockwise".

(c) Begin the *sign* sensemaking process by making a prediction for the sign of the total work done on the gas. Briefly explain your prediction using your answer to part (b)

(d) If the isothermal process occurs at a temperature of 900 K, what is the pressure, temperature, and volume for each state.

(e) Find the work done on the gas, the heat in and out of the gas, and the change in thermal energy for each of the processes.

(f) Complete the *sign* sensemaking process by comparing your answer to part (e) with your prediction in part (c). Explain why this means your answer to part (e) is reasonable (or not).