

Week 2 Challenge Homework

Wave Optics

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 sensemaking can be found on the BoxSand [Sensemaking](#) page, which is linked on the Canvas homepage.

Metacognitive Exercise

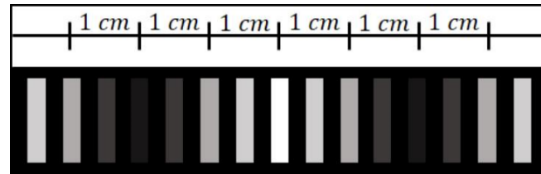
Each week will feature a metacognitive exercise, followed by one or two challenge problems to solve. The metacognitive exercise will usually ask you to reflect on your solution to the previous week's challenge problems.

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](#)). Solutions are posted a few days after the assignment is due.

- (a) After reviewing the provided solution and your own solution to question 2, part (c), describe your thoughts about the clarity of each (yours and the provided) explanation and the use of visual diagrams (physical representations) to enhance communication.

Question 1

Below is an image of the fringe patterns produced by two identical slits and light of wavelength, $\lambda = 600 \text{ nm}$. Notice that there is both a single slit interference pattern and a double slit interference pattern. The pattern is produced on a screen 1.0 meters from the slits. Use the provided scale.



- Determine the separation between the slits. Explain your reasoning.
- Determine the width of one individual slit. Explain your reasoning.
- Use related quantities sensemaking to compare the spatial interference patterns observed and their respective mathematical models. Do this by answering the following prompts
 - Comparing your answers to parts (a) and (b), was the slit separation of the double slit larger, or was the width of the single slit larger?
 - Would you predict that this relationship is always the case? Explain your prediction using the mathematical models. (Hint: slit separation is measured from the center of each slit and slit width is measured from the edges of a slit. Also, a diagram exploring the limits of slit width for a given slit separation may also be helpful here! i.e. if two slits are separated by 1 mm, what is the maximum slit width that makes sense for each.)

Question 2

Muscovite ($n = 1.56$), or better known as mica, is a phyllosilicate mineral of aluminum and potassium. New industrial uses include being an insulator, usually for small electrical components. Fabrication of devices with mica often require high precision in the determination of the mica thickness. If a mica sheet is suspended in air and reflected light shows gaps in the visible spectrum at 450, 525, and 630 nm, what is the thickness of the mica sheet?

Hint for a quality solution: please do not just show calculations for one thickness. Instead, show the entirety of the process you used to find the thickness. How do you rule out the many thicknesses that might work for an individual wavelength?