

(RO.L3.4-212.sols) 212 Mastery Stage Solutions

Tuesday, February 18, 2020 6:01 PM

RO.L3.4 | Thin Lenses | Challenge Homework

Submit a digital copy (PDF, jpg, etc.) to gradescope.com. Every page should be labeled on the top left with the question code (e.g. GR.L1.4-01) and there should be only be one solution per page. The questions should be in order. If a solution takes more than one page, be sure to label that it is a continuation of the previous page's solution (e.g. GR.L1.4-01 continued). One question will be randomly selected and graded. Challenge homework for a given week are due the following week by Tuesday at midnight. 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 most 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**.

RO.L3.4-01

A converging lens of focal length 15 cm is used to produce an inverted image at a distance of 35 cm from the thin lens .

- Calculate the distance the object is from the lens .
- What is the magnification of this system .
- Construct a scaled ray drawing of this system. This must be neatly done with a ruler.

$$a) \quad \frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i}$$

$$\frac{1}{15 \text{ cm}} = \frac{1}{d_o} + \frac{1}{35 \text{ cm}}$$

$$d_o = 26.25 \text{ cm}$$

$$b) \quad m = \frac{-d_i}{d_o} = \frac{-35}{26.25} = -1.33$$