

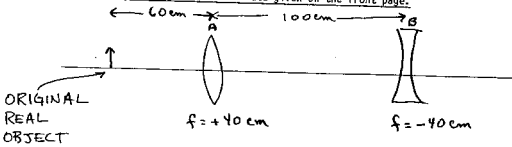
2ND MIDTERM

Name (Print) SAFFER Name (Sign) _____

Discussion Instructor (CIRCLE ONE): Crelly Kao Luty McDonald

Discussion Section # _____ Pollard Saffer

SHOW ALL WORK!! Report all numbers to three significant figures!
Use the conversion constants and data given on the front page.



- Given the lens system shown. The object is 60 cm to the left of lens A.
- Find the position of the final image, measured in cm to the right or left (state clearly) of lens B.
 - Characterize the final image as erect or inverted; real or virtual.
 - If the original object is 1.75 cm high, what is the height of the final image?

I use object & image space: object distances will be positive if the object is to the left of a lens and image distances will be positive if the image is to the right of a lens.

a) First lens: $\frac{1}{p_A} + \frac{1}{q_A} = \frac{1}{f_A} \Rightarrow q_A = \frac{p_A f_A}{p_A - f_A} = \frac{(+60)(+40)}{(+60) - (+40)} \text{ cm}$

$q_A = +120 \text{ cm}$ or 20 cm right of lens B +6 pts.

Use the image from lens A as the object for B:

$$q_B = \frac{p_B f_B}{p_B - f_B} = \frac{(-20)(-40)}{(-20) - (-40)} \quad (f_B \text{ is negative since it's right of B})$$

(virtual)

$q_B = +40 \text{ cm}$

The final image is 40 cm to the right of lens B. +3 pts

You must specifically state this to receive full credit.

b) The magnification is given by

$$m_{\text{final}} = m_A m_B = \left(\frac{-q_A}{p_A}\right) \left(\frac{-q_B}{p_B}\right) = \left(\frac{-(+120)}{(+60)}\right) \left(\frac{-(+40)}{(-20)}\right)$$

$$\boxed{m_{\text{final}} = -4} \quad +3 \text{ pts}$$

Since the magnification is negative,

$\boxed{\text{the final image is inverted}}$ +1 pt

and since the final image is positive,
(that is, to the right of lens B),

$\boxed{\text{the final image is real}}$ +1 pt

c) The height of the final image is
the height of the original object multiplied
by the magnification:

$$h_{\text{final}} = |m| h_{\text{object}} = (4)(1.75 \text{ cm})$$

$$\boxed{h_{\text{final}} = \pm 7.00 \text{ cm}} \quad +5 \text{ pts}$$

↗ either sign OK

Other grading: -1 for units or sig. fig. abuse each time

-2 for first distance sign error, or first
right/left or real/virtual error

Most common error by far was sig. fig. abuse! (~90% of class)