

## Physics 10164 - Exam 4C

Partial credit will be given provided you show all work and are solving parts of the problem correctly. Points will be deducted if you don't show your work even if you get the right answer. Clearly indicate your answer with a circle or a box and remember to include correct units and significant figures.

1. (30 pts) A 12-cm high object is located in front of a converging lens of focal length 24 cm. The lens forms an inverted 9.0-cm high image.

a) Is the image real or virtual? Justify your answer.

b) How far in front of the lens is the object?

a) p+ object in front of lens

M - image is inverted

-  $\frac{q}{p}$  is negative, so q is positive

"real image"

$$b) |M| = \left| \frac{h_i}{h_o} \right| = \left| \frac{q}{p} \right| = |0.75|$$

$$-0.75 = -\frac{q}{p} \quad q = 0.75p$$

$$\frac{1}{p} + \frac{1}{0.75p} = \frac{1}{f}$$

$$1.75f = 0.75p$$

$$\frac{0.75}{0.75p} + \frac{1}{0.75p} = \frac{1}{f}$$

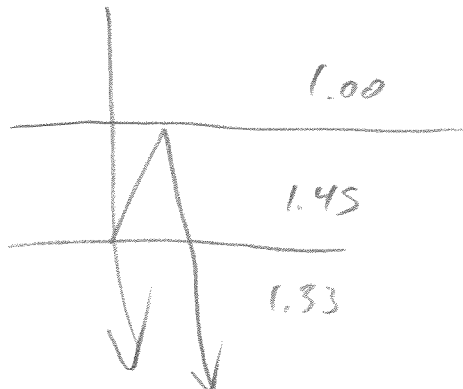
$$p = \frac{1.75}{0.75} f$$

$$\frac{1.75}{0.75p} = \frac{1}{f}$$

$$= \frac{1.75}{0.75} (24) = 56 \text{ cm}$$

2. (40 pts) White light passes through a 540-nm film of oil ( $n = 1.45$ ) on top of water ( $n = 1.33$ ). Determine all wavelengths of visible light (ranging from 400-700 nm) will strongly transmit through the film and into the water.

Remember to show all work, including calculations of phase shifts for different beams of light.



$$\phi_A = 0$$

$$\phi_B = 0 + 0 + \frac{2tn}{\lambda_0} = 0, 1, 2, \dots$$

$$\lambda_0 = 2tn = 1566$$

$$\lambda_0 = tn = 783$$

$$\lambda_0 = \frac{2tn}{3} = 522 \text{ nm}$$

$$\lambda_0 = \frac{2tn}{4} = 392$$

$$\lambda_0 = \frac{2tn}{5}$$

$$\frac{2tn}{\lambda_0} - \frac{1}{2} = 0, 1, 2, \dots$$

$$\frac{2tn}{\lambda_0} = \frac{1}{2}, \frac{3}{2}$$

$$\lambda_0 = 4tn = 3132$$

$$\lambda_0 = \frac{4tn}{3} = 1044$$

$$\lambda_0 = \frac{4tn}{5} = 626$$

$$\frac{4tn}{7} = 447$$

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← Ignore. This is for my use, checking work on other steps for students who got  $\phi_B - \phi_A$  wrong.

3. (30 pts) The normal near point for a person is 25 cm. The normal far point for a person is infinity. Suppose Amanda has a near point of 12 cm and a far point of 22 cm.

a) What focal length lens would be required for her to correct her far point from 22 cm to infinity? You can ignore the distance between the lens and the eye.

b) Given the lenses you found in part (a), what is the new near point for Amanda?

a)  $f = \infty$   
 $q = -22$   
 $f = -22 \text{ cm}$

b)  $f = -22 \text{ cm}$   
 $q = -12 \text{ cm}$

$$\frac{1}{p} = \frac{1}{f} - \frac{1}{q}$$
$$= -\frac{1}{22} - \frac{1}{-12}$$

$p = 26 \text{ cm}$