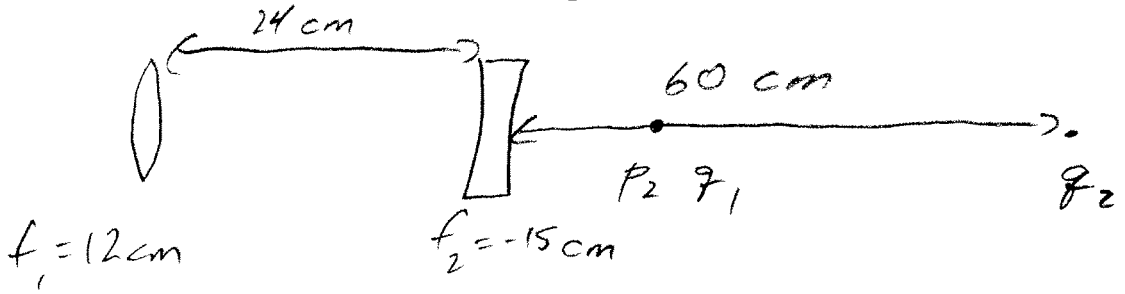
Physics 10164 - Exam 4B

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. (40 pts) Two lenses are separated by 24 cm. The first lens, in front, has a focal length of 12 cm. The second lens has a focal length of -15 cm. The final image is located 60 cm behind the 2nd lens.

Determine the location of the object, and also determine the total magnification of the two-lens system.



lens 2: $\frac{1}{p_2} + \frac{1}{60} = \frac{1}{-15}$

$p_2 = -12$ cm

So $q_1 = 36$ cm

$\frac{1}{p_1} + \frac{1}{36} = \frac{1}{12}$ $\boxed{p_1 = 18 \text{ cm}}$

$M = M_1 * M_2$

$= \left(-\frac{36}{18}\right) * \left(-\frac{60}{-12}\right) = (-2) * (5) = \boxed{-10}$

2. (30 pts) Light of unknown wavelength is incident on two slits separated by 0.30 mm. On the wall 12.5 meters away, a diffraction pattern is measured. The width of the central maximum (the distance from the first dark fringe on either side of the central maximum) is measured to be 2.6 cm.

a) What is the wavelength of the incident light?

b) If the wavelength of the light source is decreased, will the central maximum get broader or narrower or remain the same width? Justify your answer.

$d = 0.30 \times 10^{-3}\ m$

$L = 12.5\ m$

$y(\text{1st dark}) = 1.3\ cm$

a) So $\frac{d_y}{L} = \frac{\lambda}{2}$

$$\lambda = \frac{2d_y}{L} = \frac{2(.30\times10^{-3})(1.3\times10^{-2})}{12.5}$$

$$= 6.24 \times 10^{-7}\ m$$

or $\boxed{624\ nm}$

b) If $\lambda \downarrow$, $y \propto \lambda$, so $y \downarrow$

narrower

3. (30 pts) The normal far point for a person is infinity, and the normal near point is 25 cm. Suppose you measure a person's far point and find it to be 22 cm while that same person's near point is measured to be 12 cm.

a) What is the optical power of the lenses necessary to correct this person's ~~vision?~~ far point.

b) What is the new near point for this person?

For $p = \infty$

Want $q = -22\,cm$

$$\frac{1}{\infty} + \frac{1}{-22} = \frac{1}{f}$$

$$f = -22\,cm$$

or $-0.22\,m$

$$P_{opt} = \frac{1}{f} = \boxed{-4.5\,d}$$

b) For image to be at near point, need

$$q = -12\,cm$$

$$\frac{1}{p} + \frac{1}{-12} = \frac{1}{-22} \qquad p = 26.4\,cm$$

$$\boxed{\text{New near pt} = 26\,cm}$$