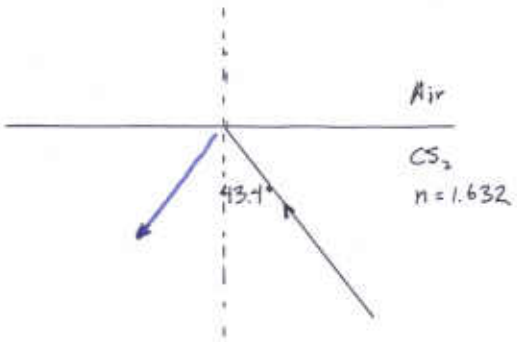
Name_____

Phys 122 — Section 1
Quiz #5



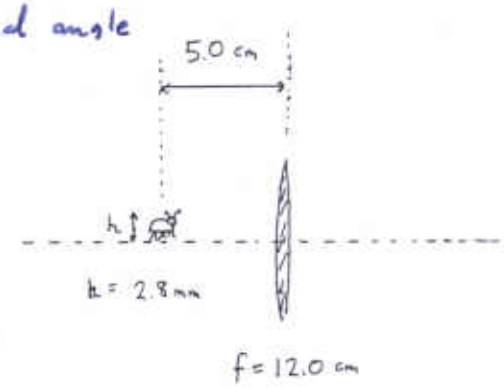
1. A light ray travels through carbon disulfide ($n = 1.632$) toward air at an incidence angle of 43.4°. How is this ray refracted/reflected/whatever? (Show your work and reasons.)

Find the critical angle for CS_2-to-Air:

$$\sin\theta_c = \frac{n_2}{n_1} = \frac{1.000}{1.632} < 0.613$$

$$\rightarrow \theta_c = 37.8°$$

But this angle of incidence is larger than the critical angle so the ray will be totally internally reflected.



2. a) A bug sits 5.0 cm in front of a converging lens having a focal length of 12.0 cm. The height of the bug is 2.8 mm

a) Find the location of the image (that is, find d_i and describe the image location *words*.

With $d_o = 5.0$ cm and $f = 12.0$ cm, we get

$$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{12.0\text{ cm}} - \frac{1}{5.0\text{ cm}} = -1.17\times10^{-1}\text{ cm}^{-1} \rightarrow d_i = -8.6\text{ cm}$$

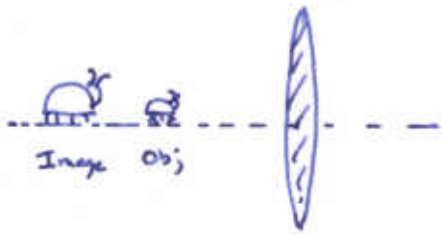
The image is 8.6 cm to the left of the lens.

b) Is the image real or virtual? Is it upright or inverted?

$$m = -\frac{d_i}{d_o} = -\frac{(-8.6\text{ cm})}{(5.0\text{ cm})} = +1.7$$

Image is virtual since it is on the left (object) side of the lens.

It is upright since $m > 0$.

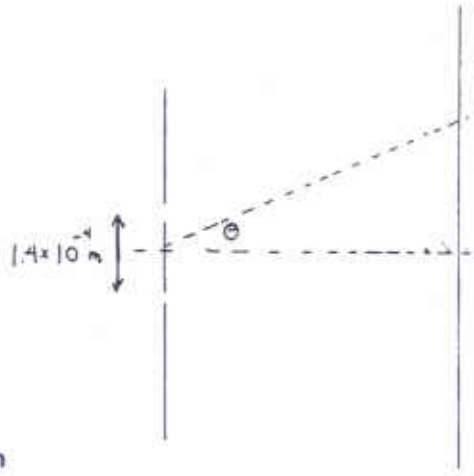


c) Find the height of the image of the bug.

Since $h_i = m h_o$ we have

$h_i = (1.71)(2.8\text{ mm}) = \boxed{4.8\text{ mm}}$

3. A beam of monocromatic coherent is incident on a pair of slits which are separated by 1.4×10^{-4} m. In the interference pattern, the first dark fringe occurs at 0.112° away from the central maximum.



a) Find the wavelength of the light. (Express the results in nanometers.)

At the first dark fringe we have the condition

$\sin\theta = (0 + \frac{1}{2})\frac{\lambda}{d}$ with $\theta = 0.112°$ and $d = 1.4\times10^{-4}$ m

Solve for λ: $\sin\theta = \frac{\lambda}{2d}$ $\quad \lambda = 2d\sin\theta = 2(1.4\times10^{-4}\text{ m})\sin(0.112°)$

$= 5.47\times10^{-7}\text{ m} = 547\times10^{-9}\text{ m} = \boxed{547\text{ nm}}$

b) At what angle does the first–order maximum occur?

At this angle we have the condition

$\sin\theta = (1)\frac{\lambda}{d} = \frac{547\times10^{-9}\text{ m}}{1.4\times10^{-4}\text{ m}} = 3.91\times10^{-3}$

$\rightarrow \boxed{\theta = 0.224°}$ (very close to twice the angle in part (a))

You must show all your work!

$\sin\theta_c = \frac{n_2}{n_1}$ $\quad \tan\theta_B = \frac{n_1}{n_2}$ $\quad \frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$ $\quad m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$ $\quad 1\text{ diopter} = 1\text{ m}^{-1}$

Dark fringe: $\sin\theta = (m + \frac{1}{2})\frac{\lambda}{d}$ $\quad$ Light fringe: $\sin\theta = m\frac{\lambda}{d}$ $\quad m = 0,\ 1,\ \ldots$

$\lambda_{\text{film}} = \frac{\lambda_{\text{vac}}}{n}$ $\quad$ Dark fringe: $\sin\theta = m\frac{\lambda}{w}$ $\quad m = 1,,\ 2,\ \ldots$

Some EM units: Coulomb, Volt, Farad, Ampere, Ohm, Tesla, Weber, Henry