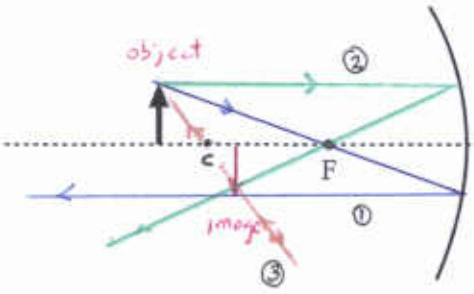
Name_____ Units? Units?

Nov. 24, 2003

Phys 2020, Section 1
Quiz #5 — Fall 2003

1. At the right is shown a concave mirror with an object in front of it; the object is more distant that the focal point F of the mirror.



① : Ray goes thru f.p. reflects back parallel

② Ray goes in parallel reflects back thru f.p.

③ Ray through center of curvature goes back on itself

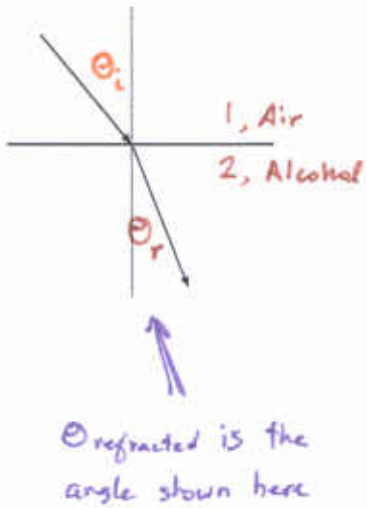
a) Draw a ray diagram which locates the position of the image.

See diagram

b) Is the image real or virtual? Upright or inverted?

Image has rays emerging from a (real) point, in front of the mirror:
Image is **Real.**
Image is upside-down: It is **Inverted**.

2. A beam of light from the air is incident on ethyl alcohol (index of refraction 1.362) at an angle of 45.0°. What is the angle of refraction? On the diagram at the right, indicate the angle of refraction.



With $\theta_{air} = 45.0°$, $n_{air} = 1.000$,
$n_{alcohol} = 1.362$, Snell's Law gives:

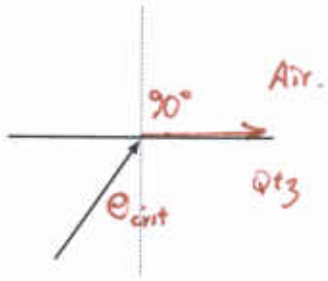
$$n_{air} \sin\theta_{air} = n_{alc} \sin\theta_{alc}$$

$$\sin\theta_{alc} = \frac{n_{air}}{n_{alc}} \sin\theta_{air} = \frac{1.000}{1.362} \sin 45° = 0.519$$

$$\rightarrow \quad \theta_{alc} = 31.3° = \theta_{refracted}$$

$\theta_{refracted}$ is the angle shown here

3. A beam of light passes from quartz (with index of refraction 1.544) to air.



a) What is the critical angle for such a beam of light?

For a ray going from quartz to air,

$$\sin\theta_{crit} = \frac{n_{air}}{n_{qtz}} = \frac{1.000}{1.544} = 0.648$$

$$\rightarrow \theta_{crit} = \boxed{40.4^\circ}$$

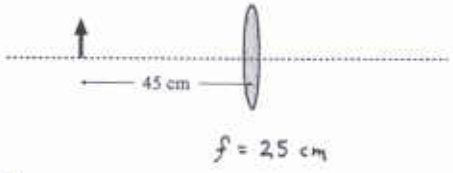
b What is the speed of light in quartz?

Speed of light in quartz is (use $n = c/v$):

$$v = \frac{c}{n} = \frac{(2.998\times10^8\ m/s)}{1.544} = \boxed{1.94\times10^8\ m/s}$$

4. An object is located 45.0 cm in front of a lens with a focal length of 25.0 cm.

a) Give the location of the image. Tell me whether it is on the left (near) or right (far) side of the lens.



Use lens equation with $d_o = 45$ cm, $f = +25$ cm:

$$\frac{1}{d_i} = \frac{1}{f} - \frac{1}{d_o} = \frac{1}{25\,cm} - \frac{1}{45\,cm} = 1.78\times10^{-2}\ cm^{-1}$$

$$\rightarrow d_i = \boxed{56.2\ cm}$$

Positive value says image is on [right (far)] side of lens (a real image).

b) What is the magnification?

$$M = -\frac{d_i}{d_o} = -\frac{56.2\ cm}{45.0\ cm} = \boxed{-1.25}$$

You must show all your work and include the right units with your answers!

$c = 2.998\times10^8\ m/s$

$$|f| = R/2 \qquad \frac{1}{d_o}+\frac{1}{d_i}=\frac{1}{f} \qquad M = \frac{h_i}{h_o} = -\frac{d_i}{d_o}$$

$$v = \frac{c}{n} \qquad n_1\sin\theta_1 = n_2\sin\theta_2 \qquad \sin\theta_c = \frac{n_2}{n_1}$$