Assignment 8
Optics

1. Consider an object of height 1 cm in front of a convex lens having a focal length of 5 cm. Describe the image size, type and position if the object is at the following positions from the lens.

$$\frac{1}{s_i} + \frac{1}{s_o} = \frac{1}{f} \quad \text{and} \quad \frac{y_i}{y_o} = \frac{f}{s_o - f}$$

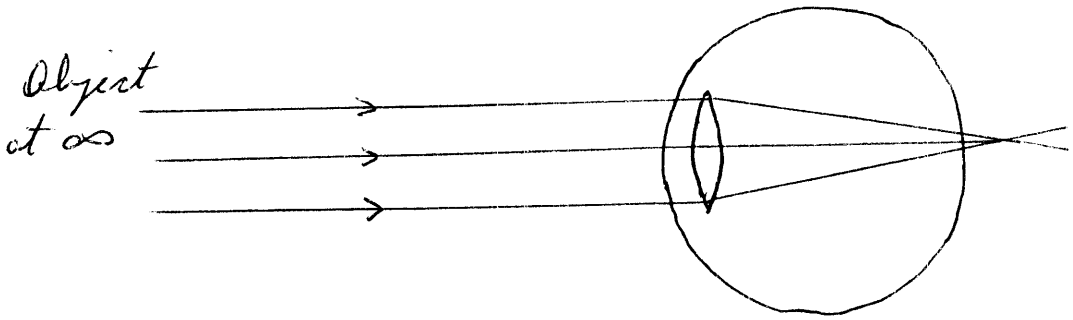
Object Position (cm)	Image Size (cm)	Image Type	Image Position (cm)
20	0.33 (inverted)	Real	6.67
10	1 (inverted)	Real	10
5			No Image
2	1.6 (erect)	Virtual	-3.33

2. What are the approximate wavelengths and frequencies of the following photons?

	Wavelength (nm)	Frequency (Hz)
Red Light	650	4.6×10^{14}
Yellow Light	590	5.1×10^{14}
Blue Light	500	6.0×10^{14}
X ray	0.1	3×10^{18}
Infrared Light	1000	3×10^{14}
Ultraviolet Light	300	1×10^{15}
Gamma Ray	0.001	3×10^{20}

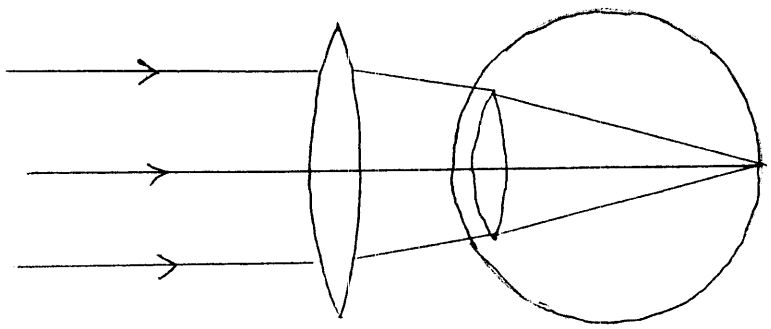
3. a) Explain using diagrams of light entering the eye, what farsightedness is.

Eye focuses objects behind retina.



b) How can glasses correct this problem?

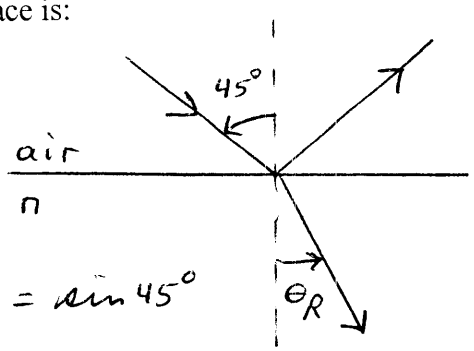
Add convex lens as shown below.



4 A light ray is incident at 45° on a surface. Find the angle of refraction if the reflecting surface is:

a) water

b) glass



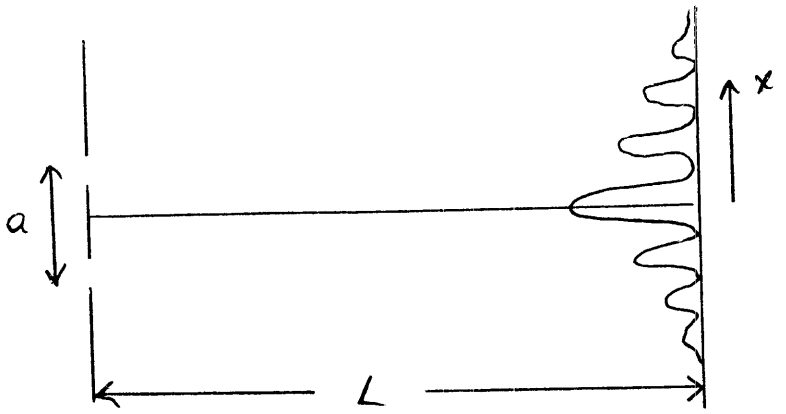
$n \sin\theta_R = \sin 45^\circ$

$\sin\theta_R = \frac{1}{n\sqrt{2}}$

$n_{water} = 1.33 \Rightarrow \sin\theta_R = 0.53$ $\quad n_{glass} = 1.5 \Rightarrow \sin\theta_R = 0.47$

$\theta_R = 32.1^\circ$ $\quad \theta_R = 28.1^\circ$

5 Young's Double slit experiment is done using blue light. How does it differ from using red light?



Dark lines on screen at $x = \frac{L}{a}\left(n - \frac{1}{2}\right)\lambda$.

Blue light λ << Red light λ.

∴ entire pattern for blue light is slightly closer to central axis than for red light.