# Physics 108 Midterm Exam (Spring of 2016)

1. ***Lens***

A thin *bi-convex* lens ($R_1 = - R_2 = R > 0$) is made of glass with refractive index $n_g = 3/2$. In air, its focal length is $f = + 5$ cm.

(a) (**10 points**) Find the magnitude of the radius of curvature R.

(b) (**10 points**) If you use it as a magnifying glass, what is the angular magnification provided by this lens?

(c) (**20 points**) If the lens is half-submerged in the water with $n_w = 4/3$ so that you use it from the air side to view objects submerged in the water, what are the first and second focal lengths, $f_1$ and $f_2$?

(d) (**Extra 10 points**) Following Part (c), what is the angular magnification now?

2. ***Lenses***

You have a collection of thin lenses with focal lengths of 10 cm and 20 cm.

(a) (**10 points**) If you are to image an object onto a screen that is 60 cm from the object, which lens will you use and at what distance from the object?

(b) (**Extra 10 points**) If you are to image an object onto another screen that is 30 cm away from the screen, what combination of lenses from your collection will you use to accomplish it and at what distance from the object?

3. ***Mirrors***

You have a flat mirror, a convex mirror (curved away from you) and a concave mirror (curved toward you).

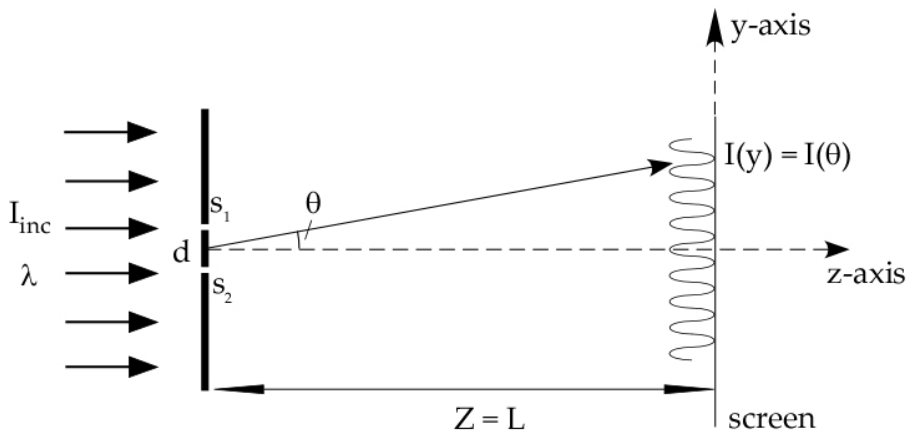
(a) (**10 points**) When an object (such as yourself) is sufficiently close to any of them, you will find that the image has more or less the same linear size and same orientation as the object (as if all three mirrors are the same). Explain why?

(b) (**10 points**) If the concave mirror (the center of curvature in front of the mirror) has a radius of curvature of $|R| = 20$ cm, and you are 8 cm in front of the mirror. Find the location of your image and the linear magnification.

4. ***Interference***

(a) (**15 points**) A pair of glass slides is pressed together so that when you look at the reflection of a fluorescent ceiling light near normal incidence, you see 20 colorful fringes across the 2-cm width of the slides. Estimate the wedge angle $\boldsymbol{\alpha}$ of one slide with respect to the other along the width assuming the central wavelength of the light is $\lambda_0 = 0.5$ μm.

(b) (**15 points**) In a Young's double-slit interference set-up as shown below, the initial phases at the first slit ($S_1$) and the second slit ($S_2$) are the same (normal-incidence illumination). Find the angle $\theta$ along which the phase difference between the wave from $S_2$ and the wave from $S_1$ is $6\pi$.




(c) (**Extra 10 points**) If one manages to increase the initial phase at the first slit ($S_1$) relative to that at the second slit ($S_2$) gradually from zero to $3\pi$, - by illuminating the slits at an angle, which way will the interference fringes (the points on the screen where the phase difference between the waves from the two slits is a constant) move near the center of the screen and by how much in distance along y-axis in term of d, L, and $\lambda$?