HW2
DUE: 09/11/2015 – 11:30 AM

Analysis Questions:
1. A convex lens has a radius of curvature of 30 mm.
    a. What is the x location of an image if the object is located at 50 cm away?
    b. If object is 25 cm away?
    c. What is the magnification for a and b?
    d. Draw the ray diagram.

2. Choose 0.5" diameter mirror http://www.thorlabs.us/newgrouppage9.cfm?objectgroup_id=1161
    a. Mirrors marked with Φ1/2". What is the radius of curvature of your mirror?
    b. What is the focal distance?
    c. Where should you place an object to have a magnification of 2?

3. Consider a green leaf.
    a. What color will the leaf appear if you illuminate with only green light?
    b. How much energy does each photon have at the peak of the chlorophyll absorption spectrum?
    c. Find the solar output at the earth surface (watts/nm), and make an estimate of the number of photons per second that would hit a leaf. With 30% efficiency, how much energy could a single leaf absorb during a single day?

4. Design an antireflective coating (thickness, index) for the interface between air and water.

5. Assume a microscope design has a 20x objective with a 200 mm tube lens?
    a. Draw out the placement of the lenses, sample, and detector.
    b. What is the working distance of the objective (distance from the lens to the sample)?
    c. How far away should the camera be from the tube lens?

6. Design a 10x beam expander.
    a. Identify two appropriate lenses from thorlabs.
    b. Draw out the ray diagrams (with distances) for your two lenses.
    c. If a 2 mm beam hits the expander, how big will it be on the other side?
    d. If a 2 mm beam goes backwards through the expander, how big will it be?

7. Assume a bi-convex lens with radii of curvature = 300 mm.
    a. What is the focal distance (assuming 0 thickness) if the lens is made of glass?
    b. What would be the focal distance of an equivalent lens made of sapphire?

Matlab Questions:

1. Take two picture with your cellphone.
   a. Load in both images
   b. Display both images next to each other and use imwrite it to a .jpg
   c. Increase the contrast on just the green image, and redisplay in color
   d. Make a new image where you put the red intensity into the blue channel and vice versa
   e. Display only a sub-image of something interesting in the picture (crop).

2. Load in football.jpg.
   a. Print out the number of y-pixels, x-pixels, and colors
   b. Display just the blue image as a black and white.
   c. Convert the original image to a double, grayscale image.
   d. Display the image with a contrast limits from .1 to .8.