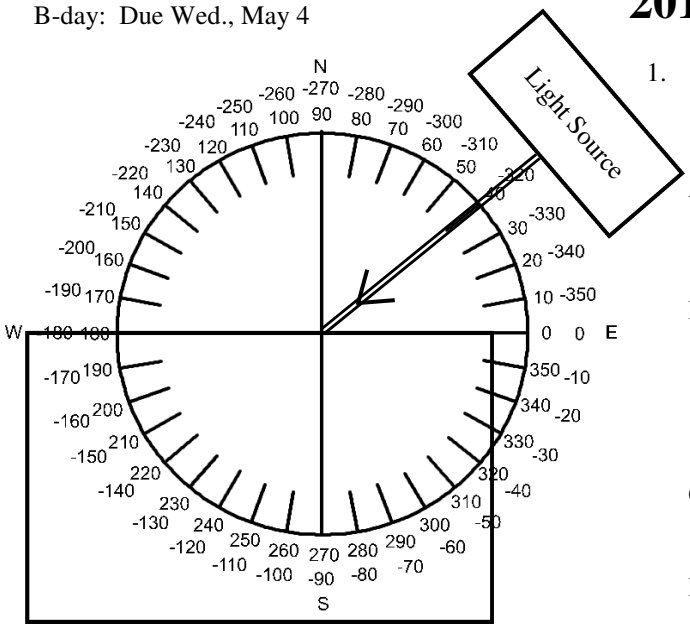
A-day: Due Tues., May 3
B-day: Due Wed., May 4

2011 Light and Optics 7



1. White light is projected into a transparent substance. For this substance the index of refraction of blue light (450 nm) is 1.4 and the index of refraction of red light (720 nm) is 1.3.

   A. Calculate the speed of blue light in the transparent substance.

   B. Calculate the wavelength of blue light in the transparent substance.

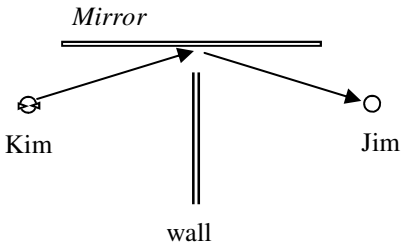
   C. Give the angle of incident (in air) as the light crosses into the substance.

   D. Calculate, draw and label the angle of refraction for blue light in the transparent substance.

   E. Calculate the frequency of red light in the transparent substance.

   F. Calculate, draw, and label the angle of refraction for red light in the transparent substance.

   G. Which bent more: red or blue light?

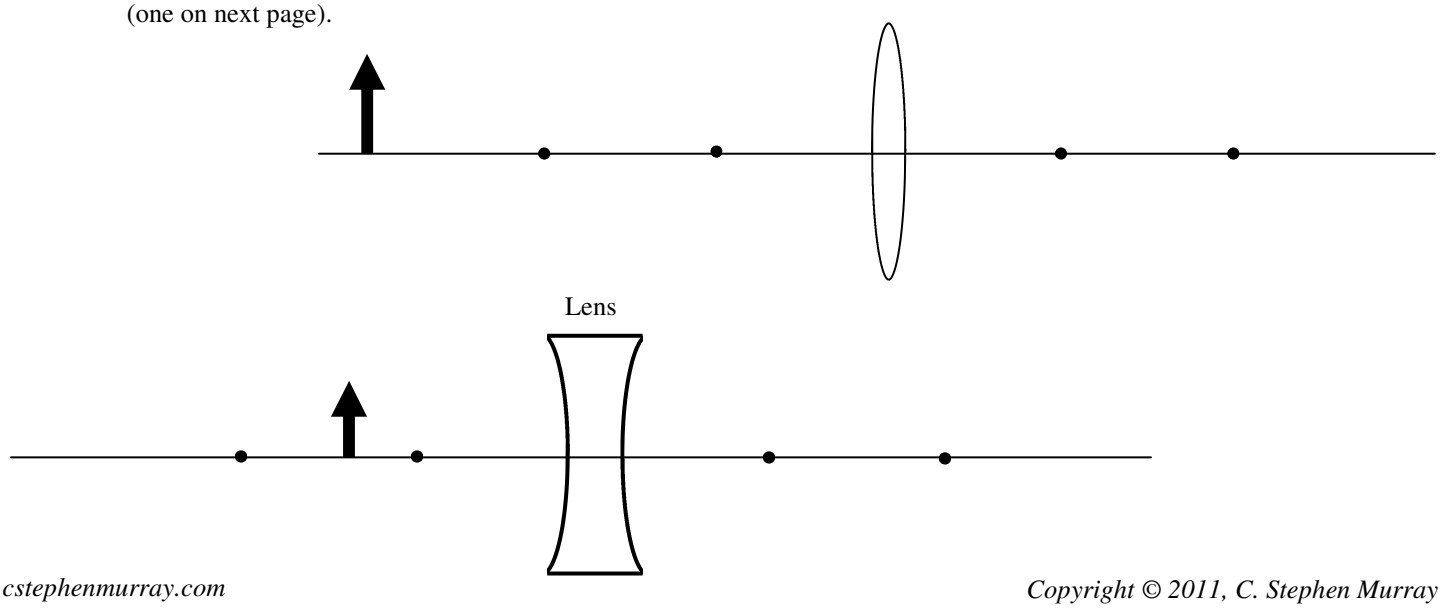


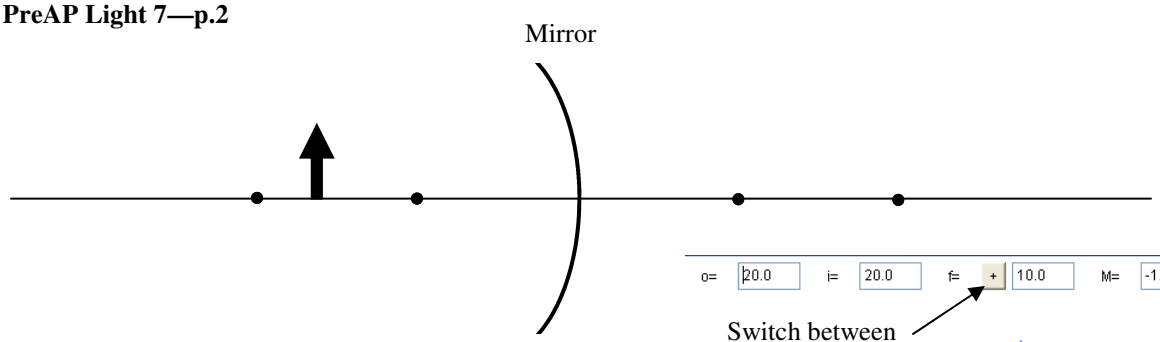
2. Slim Jim is on the other side of a wall from Slim Kim, but Kim can see Jim because of the full length mirror.
   A. Draw where Jim's image is behind the mirror (where Kim sees Jim in the mirror).

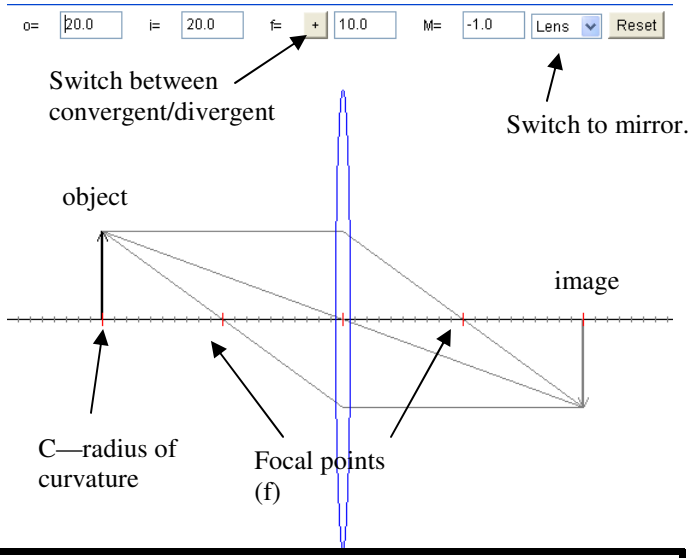
   B. Draw the path of the light to where Kim (the observer) thinks the light comes from (from where the light appears to originate).

   This is because we always assume that light travels in straight lines.

3. With a straight edge, complete the following three ray diagrams (one on next page).







Get ready to spend a little time with our Internet Lens Applet (in Light Links marked VERY IMPORTANT). Get a cup of hot chocolate, your house shoes, a warm blanket….
(The diagram at the right will help you with navigation).

The regions you will use are: outside C; at C; between C and f; at f; inside f. Other descriptions you already know: virtual, real, magnified, reduced, on real side, etc. Be sure to do all of the devices. Some of them go very fast.

4. Fill in the following table using the Lens Applet.

Device	convergent/ divergent	For the object	For the image:		
		location	location	Real/ virtual	magnified/ reduced
Convex Lens		At C			
		outside C			
		between C and f			
		at f			
		inside f			
Concave Lens		At C			
		outside C			
		between C and f			
		at f			
		inside f			
Concave Mirror		At C			
		outside C			
		between C and f			
		at f			
		inside f			
Convex Mirror		At C			
		outside C			
		between C and f			
		at f			
		inside f			

5. Using the table above:
   A. Which kind of optical devices can create virtual images?
   B. Which kind of optical devices can magnify?
   C. Which kind of optical devices only reduce?
   D. Which kind of optical devices can create real images?
   E. Since both convex and concave lenses can produce virtual images, how could you tell the difference just by knowing the distances to the object and image?
   F. Where would you put the object so that the light rays come off the device parallel?

6. A student works the following problem: "*A convex lens with a 4 cm focal length produces an image 10 cm from the right side of the lens. Find the distance of the object.*" The student works the problem and gets an answer of p = 9 cm. WITHOUT WORKING THE PROBLEM, how can you tell that they did it wrong?

These problems can be done WITHOUT a calculator. Remember common denominators and that f is −for divergent devices.

7. A convex lens has a focal length of 10 cm. The 6 cm object is 20 cm in front of the lens.
   A. Without a calculator, calculate the distance to the image.

   B. Is the image real or virtual (and how do you know)?

   C. Calculate the magnification of the image.

   D. Calculate the height of the image.

Notice: the object is at 2f (or C) and the image is at C, which you should have known without calculating at all from the lab.

8. A thin convergent lens has a focal length of 10 cm. An 8 cm object is placed 30 cm to the left of the lens.
   A. What kind of lens is it?
   B. Calculate the distance to the image.

   C. Calculate the height of the image.

   D. Is it a real or virtual image (and how do you know)?

9. A <u>divergent</u> mirror has a 2 cm focal length. A 4 cm object is placed 6 cm to the left of the mirror.
   A. What kind of mirror is it?
   B. Without calculating, describe the image (real, virtual, magnified, reduced, and on what side). Use applet table.

   C. Calculate the image distance.

10. A 5 cm object is placed 4 cm to the left of a convex lens. The image is formed 8 cm on the left side of the lens.
    A. Without calculating, describe the image.

    B. Calculate the focal length of the lens.

    C. Calculate the magnification of the image.

11. A convex mirror has a focal length of 4 cm. A 6 cm object is 12 cm to the left of the mirror.
    A. Without calculating, describe the image.

    B. Calculate the image distance.