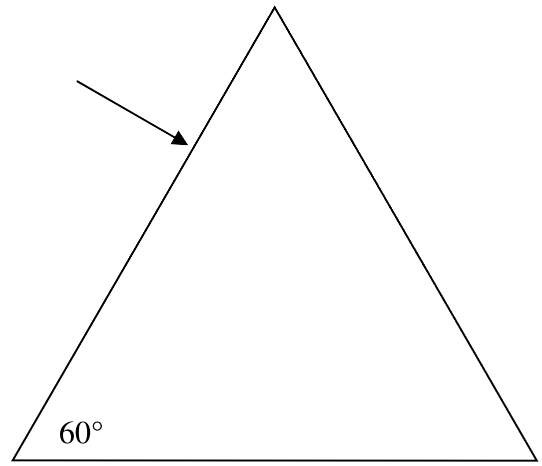
B-day: Due Mon., May 3
A-day: Due Tues., May 4

2009-10 PreAP Light and Optics 5

At this point, I expect you to know about the basic optical shapes and whether they are convergent or divergent, how to find the index of refraction for a substance, how to calculate the speed of light in a substance, and how to calculate f or λ. I will give only one more example of light crossing a boundary.

1. A beam of light of wavelength 560 nm in air hits an equilateral ***glass*** prism perpendicularly. Because it is equilateral, the geometry is pretty easy and you know the index of refraction for glass. (*Fight thru this!)*
   A. Calculate the path of the light into and back out of the prism, including with angles.

   B. What is the wavelength of the light in the prism?

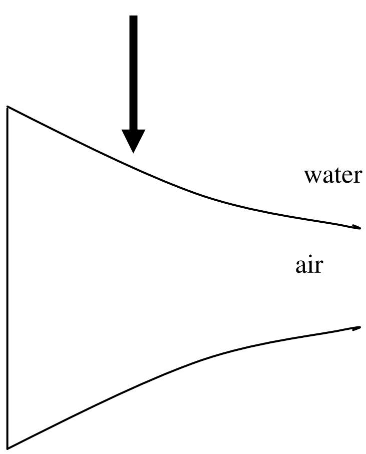


2. A. How much energy does a 250 nm photon have?

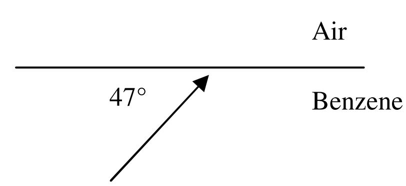
   B. How much energy does a 400 nm photon have?

   C. Which photon had more energy?

   D. To increase the energy of a photon do you increase or decrease its wavelength?

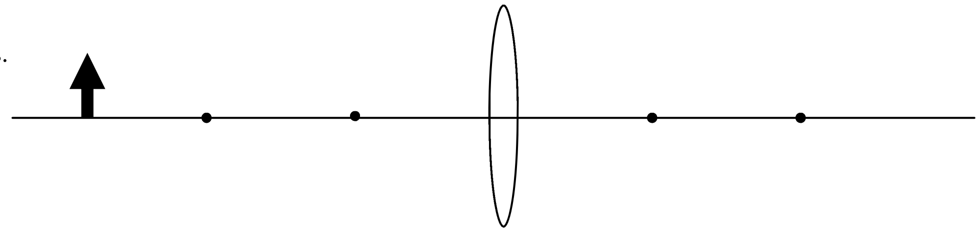


3. Draw the path of the light ray as it passes into the air lens and back out. For each boundary (water to air and then air to water) draw the straight path (SP) and the normal.

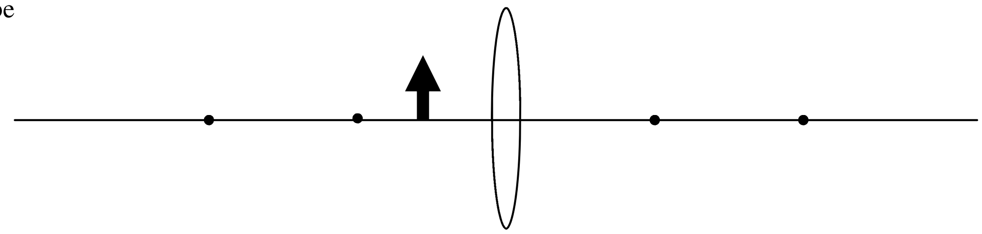


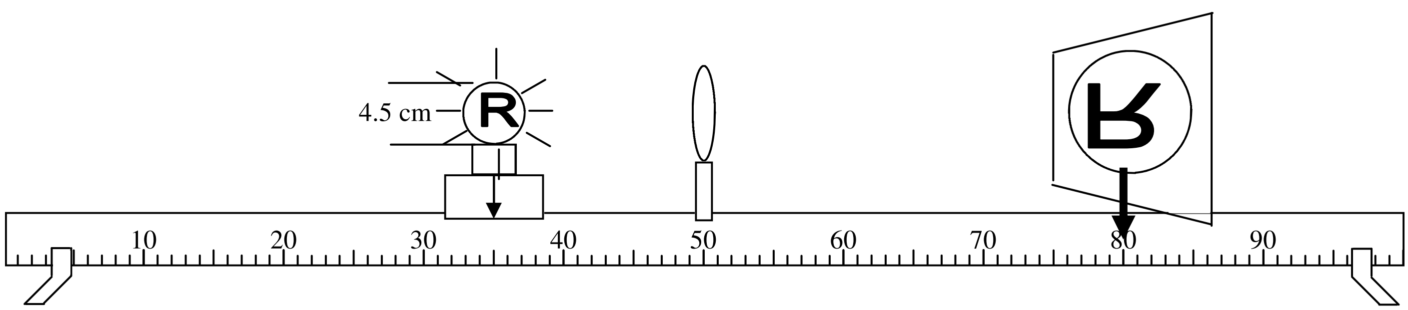
4. A light ray hits a boundary of Benzene (n = 1.5) and air. Draw what happens to the light ray. (*Hint: Make sure you use the correct angle.)*

5. Draw the ray diagram for this lens. (*Use a ruler; be exact.*)
   A. Is the lens convergent or divergent?
   B. If f is 12 cm, what is C?
   C. Label p, q, h, and h'.
   D. Describe the image's location, magnification, etc.)



6. Draw the ray diagram and describe the image.





7. The diagram above shows a meter stick with a lettered light bulb making an image. Since all of the numbers are in cm, you don't have to convert. Just use cm.
   A. Is the image real or virtual?
   B. Is the image magnified or reduced?
   C. Calculate the focal length.

   D. The height of the object is given, so calculate the size of the image.
   E. Calculate the magnification of the image.

   F. What would happen to image if:
      i. you moved the object (*the light source*) to the left (*farther from the lens*)?
      ii. you moved the object to the right (*closer to the lens*)?

   Mark "f" and "C" on the diagram, under the meter stick.
   G. Where is the object in relation to f and C?
   H. Where is the image, in relation to f and C?

   Use the above diagram and the two ray diagrams you drew above answer the following questions. You may also refer to the lab. (If you were not careful with the ray diagrams, now would be a very good time to remedy that.)

8. A. If the object is outside of C (farther from the lens than C) where is the image?
   B. If the image is outside of C, where is the object?
   C. If the object is inside f, where is the image?
   D. If the object is at C, where is the image?
   E. When the object is outside of C, describe the image (magnified or reduced; inverted or erect).
   F. When the object is inside of C, describe the image.
   G. Where is the object if the image is magnified and virtual?

Let's learn how to read magnification. Remember that if the image is inverted (upside down), h' is negative.

9. A. The object is 2 cm tall and the image is 4 cm tall and is inverted. M =

   B. The object is 6 cm tall and the image is 2.5 cm tall and inverted. M =

   C. The object is 10 cm tall and the image is 12 cm tall and is upright. M =

   D. So, if the absolute value of M is greater than 1 the image is magnified or reduced?

   E. If the absolute value of M is between 0 and 1, the image is magnified or reduced?

10. A real image is produced by a convex lens that has a 6 cm focal length. The object is 3.5 cm tall and is 12 cm from the lens.
    A. Where is the image in focus?

    B. What is the size of the image?

    C. What is the magnification?

    D. The object and image are both at 2f, otherwise known as the r_______ of c____________.

Studying for the end-of-course exam…

11. A projectile is launched horizontally from a 12 m tall ledge.
    A. Fill in the blanks.

    B. Calculate the time in the air (hang time).

    C. Calculate its range.

<u>y-dir.</u>
V_i =
V_f =
a_y =
Δy =
t =

<u>x-dir.</u>
V_i =
V_f =
a_x =
Δx =
t =