Converging Lenses

1. A converging lens has a focal length of +5.0 cm. Describe the image characteristics if the object is placed:

   a. +10 cm from the lens.

   b. +5 cm from the lens.

   c. +3 cm from the lens.

   a.) Same size, Inverted, Real image, located at 2F

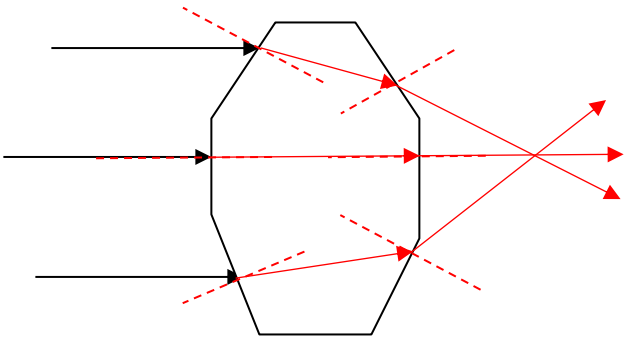
   b.) No clear image will be formed

   c.) larger, upright, virtual, behind object

2. What is the difference between a converging lens and a diverging lens?

   A converging (convex) lens will be wider in the middle and will converge rays toward the parallel axis. A diverging lens will be thinner towards the middle and light rays will diverge (spread apart) the lens away from the parallel axis

3. Use your knowledge of refraction to show the path of the three rays of light as they pass through and out the following medium. The medium has a higher n than than outside the medium.



4. An object 8 cm high is placed 20 cm from a converging lens with a focal length of 15 cm. What is the distance of the image?

$$\frac{1}{f} = \frac{1}{di} + \frac{1}{do}$$

$$\frac{1}{di} = \frac{1}{15cm} - \frac{1}{20cm}$$

$$\frac{1}{di} = \frac{1}{60cm}$$

$$60cm = di$$

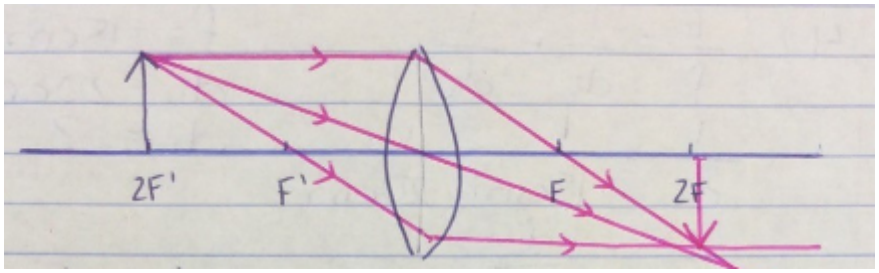
5. An object 8 cm high is placed 20 cm from a converging lens with a focal length of 15 cm. What is the height of the image?

$$M = \frac{-di}{do} = \frac{-60cm}{20cm}$$
$$M = -3$$
$$-3(8cm) = hi$$
$$-24cm = hi$$

6. An object +10 cm tall has a real image that is -5 cm tall. What is the focal length of the converging lens if the object is +10 cm from the lens?

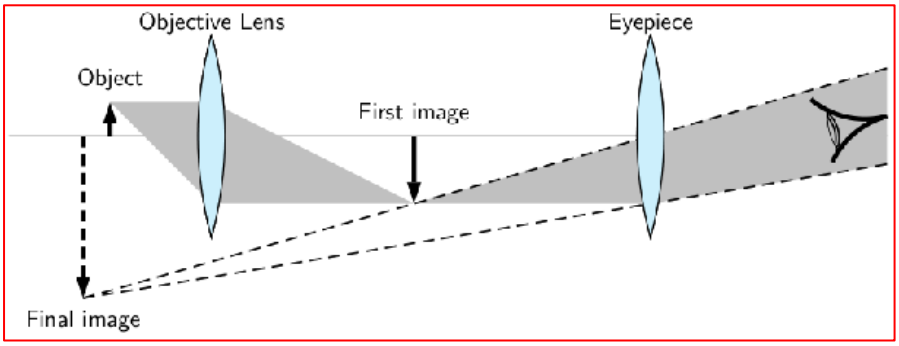
$$M = \frac{hi}{ho} = \frac{-5cm}{10cm} = -0.5cm$$
$$Mdo = -di$$
$$(-0.5cm)(10cm) = -di$$
$$5cm = di$$
$$\frac{1}{f} = \frac{1}{5cm} + \frac{1}{10cm}$$
$$\frac{1}{f} = \frac{3}{10cm}$$
$$f = 3.33cm$$

7. Describe the image characteristics of an object that is place 2F from a converging lens. Solve using either the thin lens equation or a scale ray diagram.



$$\frac{1}{f} = \frac{1}{do} + \frac{1}{di}$$
$$\frac{1}{f} - \frac{1}{2f} = \frac{1}{di}$$
$$\frac{2}{2f} - \frac{1}{2f} = \frac{1}{di}$$
$$\frac{1}{2f} = \frac{1}{di}$$
$$di = 2f$$

8. Use a ray diagram to show how two converging lenses can be used to make a telescope.



9. What is the magnification of a 3 m tall object that is 2 m from a converging lens with a focal length of 0.50 cm?

h_o=300cm d_o=200cm f=0.50cm

$$\frac{1}{f} = \frac{1}{do} + \frac{1}{di}$$

$$\frac{1}{0.5cm} - \frac{1}{200cm} = \frac{1}{di}$$

$$di = 0.5cm$$

$$M = \frac{-di}{do}$$

$$M = \frac{-0.50cm}{200cm}$$

$$m = -0.003cm$$

10. What effect does moving the lens closer to an object have on the size of the image formed? Use optics to explain.

The image gets larger, as angle of incidence increases so does the angle of refraction.

Challenge Question

11. Describe the image characteristics given the following situation. The focal length of the first lens is 2 cm and the focal length of the second lens is 5 cm.

S: Larger
A: Inverted
L: Between Lenses
T: Virtual