

Questions/Problems

1. Use the Law of Refraction to explain how the shape of a converging lens causes incident light to “converge.”
2. Use the Law of Refraction to explain how the shape of a diverging lens causes incident light to “diverge.”
3. A single point source of light is placed at the focal point of a converging lens. Sketch a picture showing what happens to the light on the far side of the lens. Be as accurate as possible.
4. A single point source of light is placed at the focal point of a diverging lens. Sketch a picture showing what happens to the light on the far side of the lens. Be as accurate as possible.
5. Use the Law of Refraction to explain how the focal length of a lens changes if that lens is immersed in water instead of air. You may find it helpful to make a sketch and independently show what happens to converging and diverging lenses. Have you ever tried to focus clearly on objects located at any distance when you are underwater without goggles on?
6. An object is placed 30cm from an $f = +10\text{cm}$ lens.
 - (a) First using the thin lens equation, determine where the image is formed, and if it is real/virtual, magnified/diminished.
 - (b) Is this a converging or diverging lens?
 - (c) Do a ray tracing for this situation to check your results.
7. An object is placed 10cm from an $f = -30\text{cm}$ lens.
 - (a) First using the thin lens equation, determine where the image is formed, and if it is real/virtual, magnified/diminished.
 - (b) Is this a converging or diverging lens?
 - (c) Do a ray tracing for this situation to check your results.

Q/P Comments

1. Draw a picture of a converging (convex) lens. Show the direction the light bends at each interface (first air \rightarrow glass, then glass \rightarrow air), applying the Law of Refraction each time. Be sure to indicate your normal line!
2. Follow the same process as Q/P 1, for a concave lens.
3. Recall that light rays will travel the same path forwards or backwards. What type of light would you need to shine at a converging lens to get all the light to converge on the focal point?
4. Same advice as Q/P 3.
5. Will the light bend more or less? Draw what happens to parallel light, having the underwater rays bend more or less (whatever is appropriate!). How does this help you determine the focal length?
6. (a) Using the thin lens equation, $i = +15\text{cm}$, which means the image is on the opposite side of the lens from the object, so it is real. Then $M = -0.5$, so the image is inverted and diminished to half the size of the object.
(b) Converging, since f is positive.
7. (a) Using the thin lens equation, $i = -7.5\text{cm}$. The image on the same side of the lens as the object is virtual. Then $M = +0.75$, so the image is upright and diminished to $3/4$ th the size of the object.
(b) Diverging, since f is negative.