Model: Standing Waves

Act 8.5.4 Standing Wave Wrap-up (FNT'S) (~40 min)

Learning Goals:

- See DLM07 for Learning goals

Model: Ray Optics

Act 8.6.1 Wavefronts, Rays, and Refraction (~20 min)

Learning Goals:

- Understand the connection between the "ray representation" of a wave and the "wavefront representation of the same wave".
- Understand why a change in wave speed can lead to a change in direction for a wave in 2 or 3 dimensions

Act 8.6.2 The Law of Reflection (~20 min)

Learning Goals:

- Recognize that light is a type of harmonic wave with a wide range of frequencies, traveling at the speed $c = 3.00 \times 10^8$ m/s in a vacuum, and at speed $v = c/n$ in "transparent" media, where n is the index of refraction, a constant characteristic of the medium in question
- Understand that light reflects from the boundary or interface between two "transparent" media in such a way that the angle of incidence equals the angle of reflection

Act 8.6.3 The Law of Refraction (~50 min)

Learning Goals:

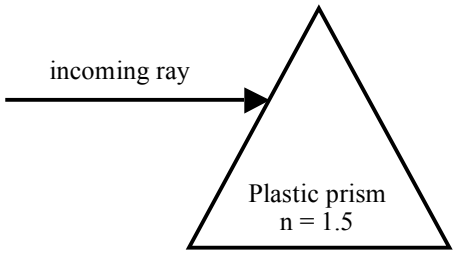
- Understand that light propagating from one "transparent" medium into another will, in general, refract or bend from its initial path in accordance with the law of refraction
- Investigate total internal reflection: when light propagates from an "optically-dense" material to a less "optically-dense" material, there is a minimum value of incident angle (i.e., the critical angle) for which the wave is completely reflected
- Investigate the bending of light as it passes through a prism via the law of refraction
- Use the geometrical properties of simple prisms to model lenses, both with converging or diverging focal points (i.e., convergent or divergent lenses, respectively).

Use "*solidification*" FNTs to assess the level of understanding you gained from DL. These FNTs should not require you to look up much material.
Use "*application*" FNTs to gain a deeper understanding of the content.
Use "*introduction*" FNTs to get the basics of a new idea before arriving, to make DL more productive.

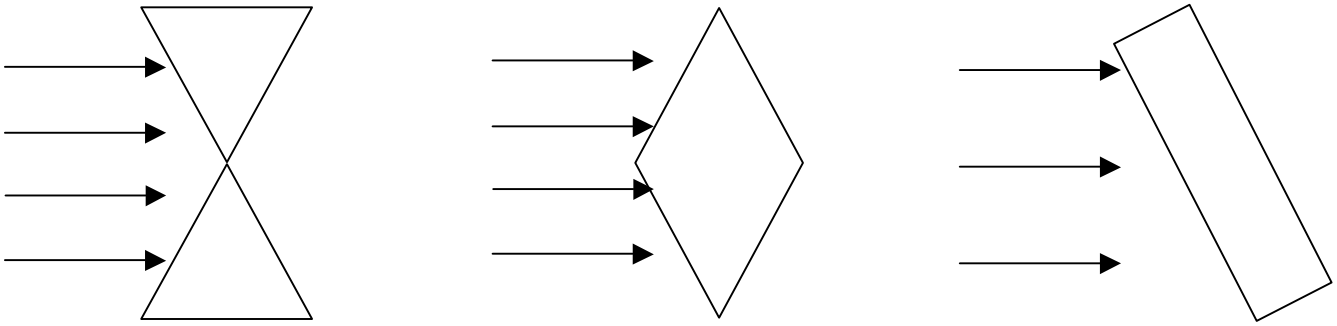
Model: Ray Optics

0) Look at Activity 8.6.3. If you did not finish the activity in DL, do so for homework. This may include Questions 3, 4, 5, and Part B.

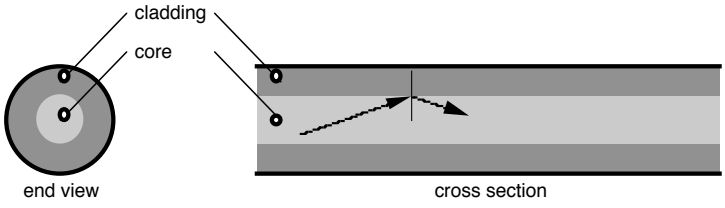
1) (Solidification) Make a large, accurate sketch of an equilateral triangle (such as shown to the right) and draw the incoming horizontal light ray as shown to the right. Suppose this triangle is the cross-section of a plastic prism. Use the mud-marching model and/or the law of refraction to sketch the path of this ray inside the prism and then the path of the ray to the right of this prism.



2) (Application) Sketch the three structures shown below on the board and, for each one separately, show how the three parallel incident light rays bend as they pass through the plastic prism and out the other side. Describe in words what each of these structures does to parallel light rays using the word "focus" as necessary. Which of these shapes would be better for starting a fire with sunlight?



3) (Application) A **fiber optic wire** uses total internal reflection to transmit light down the wire. It is constructed from two types of glass, with indices of refraction $n_1 = 1.45$ and $n_2 = 1.52$. A glass filament forms the core of the wire, with a cladding of the other glass type wrapped around it.



(a) Which glass forms the core, and which forms the cladding? Briefly justify your answer.

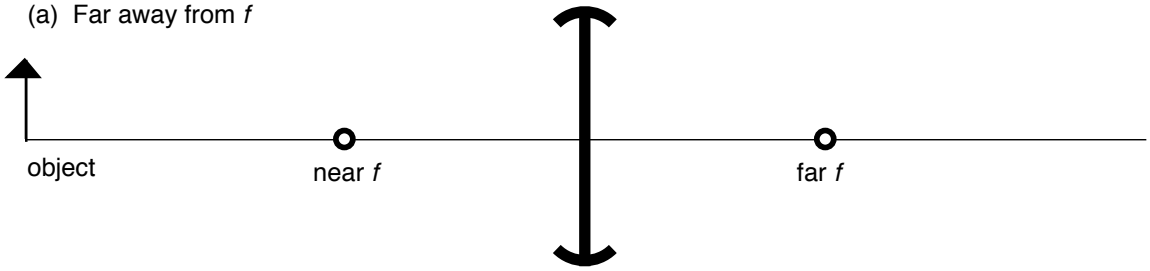
(b) What is the *minimum* incident angle a light ray originating from *within the core* can strike the core/cladding boundary and not be transmitted through it at all?

4) (Introduction) Read the "Content Amplification" section on pages 55-99 in Unit 8 of the Physics 7C course notes. Complete the ten ray tracings for the converging and diverging lenses on the pages provided during this DL Meeting. Use a ruler or straightedge to draw the representative principal light rays. It may take you a little while to get started, but once you understand the principal rays for each lens type, it will go fast!

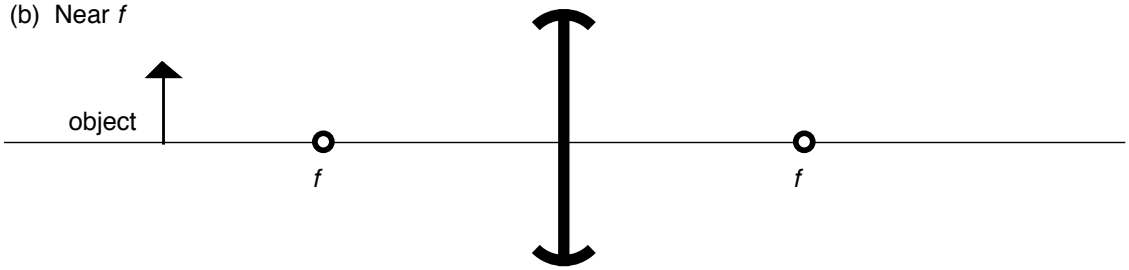
Converging Lens Ray Tracings

1. Straight through the middle.
2. Parallel to axis, then through the far *f*.
3. Through the near *f,* then parallel to axis. (or from near *f* to object, then parallel)

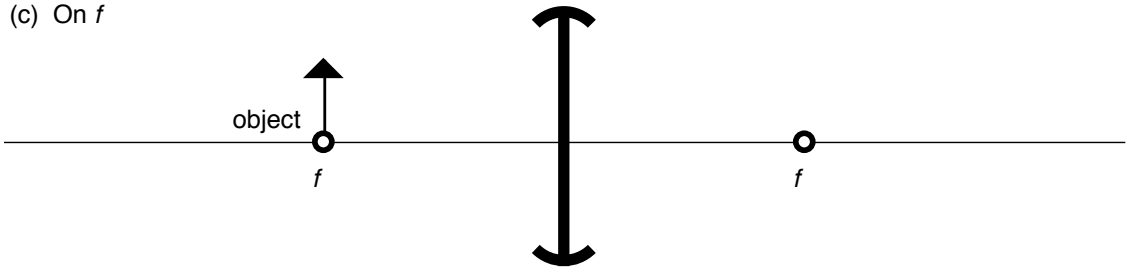
(a) Far away from *f*



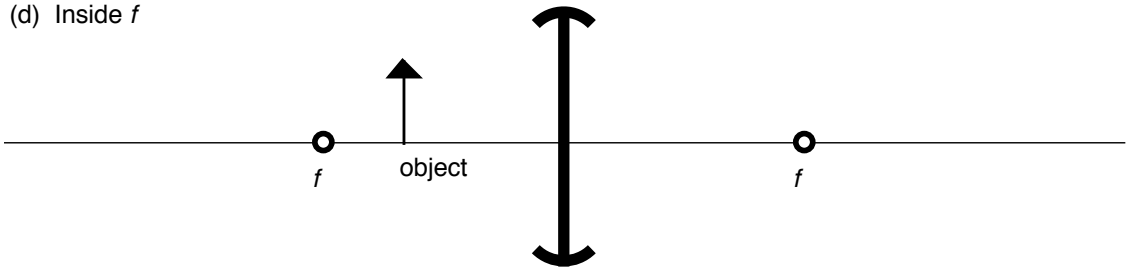
(b) Near *f*



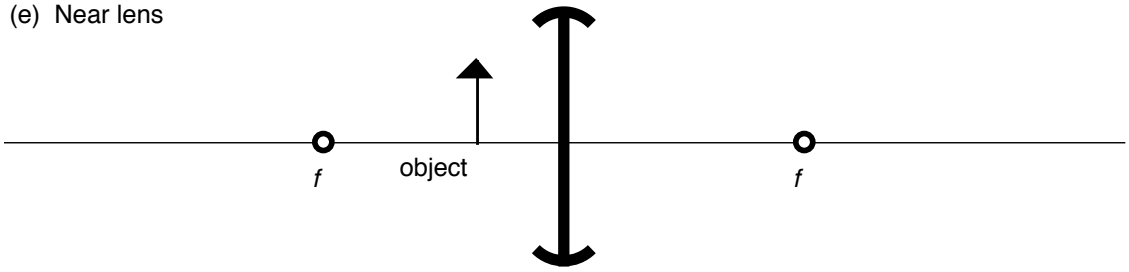
(c) On *f*



(d) Inside *f*



(e) Near lens



Diverging Lens Ray Tracings

1. Straight through the middle.
2. Parallel to axis, then away from the near *f.*
3. Toward the far *f,* then parallel to axis.