PHYS 331 — Problem Set #7

Reading for Friday: Taylor Sections 6.4, 7.1

Reading Journal for Friday: Revisit the material section 6.2. After working with variational ideas for a bit, does this section make more sense? Specifically: Would you like me to go over this section in class, or do fee you have a good understanding from the reading? (Other questions on new material are, of course welcome too.)

Problems to be handed in Friday September 27:

1. Taylor 6.6

2. Taylor 6.7

3. A beam of light is sent into a material that becomes progressively more dense. The material boundary is at $x = 0$, and the index of refraction changes continuously as

$$n(x) = \sqrt{1 + \frac{x}{l}} \quad \text{for } x \geq 0,$$

where l is a constant giving a characteristic length. The beam enters the material at the origin ($x = 0$, $y = 0$) at a 45° angle above the positive x-axis.

   (a) Use Fermat's principle to find the differential equation that must be satisfied by the path of the beam $y = y(x)$.

   (b) Solve the differential equation.

   (c) Sketch the path of the beam. Does the direction of the bending make qualitative sense?