Short Answer
(8 Points Each)

1. How fast must a meterstick fly past you in order for you to observe its length as only 65.0 cm? (Assume its motion is in the direction of its length.)

2. A ray of light moving through air is incident upon a layer of halite (rock salt). The incident angle of the light ray is 54.0°, and its angle of refraction is 32.2°. What is the speed of light in halite?

3. An object is placed in front of a converging lens with a focal length of 7.00 cm. An image of the object forms 19.4 cm behind the lens. What is the magnification of the image?
4. How fast must a proton \((m_p = 1.67 \times 10^{-27} \text{ kg})\) be traveling in order for it to have as much kinetic energy as it has rest energy?

5. Combing your hair leads to excess electrons on the comb. How fast would you have to move the comb up and down to produce light with wavelength \(\lambda = 550 \text{ nm}\)?
Problems
(20 Points Each)

1. An object is placed 7.00 cm in front of a lens, and an inverted, real image is formed that is 1.80 times larger than the actual object. The object is then moved to a new spot located 5.50 cm in front of the lens. What is the new location, orientation, and magnification of the image?
2. A light ray (in air) is incident upon a 7.50 cm thick, horizontal layer of clear ice \( n_{\text{ice}} = 1.31 \). The light ray makes an incident angle of \( \theta_i = 67.0^\circ \). Below the ice is a perfectly reflective surface.

(a) What is the total amount of time the light ray spends propagating through the ice?

(b) What is the horizontal distance between where the light ray enters the ice and where it exits the ice?
3. Two space ships are approaching Earth from opposite directions. Observers on Earth see ship $A$ approach Earth at 75.0\% the speed of light and see ship $B$ approach Earth at 85.0\% the speed of light. If both ships have a length of 14.0 m when measured while at rest in a docking bay, what is the observed length of ship $B$ according to ship $A$ as they approach Earth?