**Problem Set 8**

1) Back in 1977, Bob Dylan was sailing in the Pacific Ocean when a storm came up, wrecked his ship, and left him stranded on a deserted island. His guitar was lost at sea, but he managed to recover a single guitar string with mass density 0.0004132 lb/inch. To make a crude guitar, he ties one end of the string to a branch and the other end to a rock, so that 63cm of guitar string hang between the branch and the rock. His harmonica is also lost at sea, so he cuts a piece of bull kelp to use a simple wind instrument. If he wants his guitar string to play middle C, and his kelp-horn to play the G above middle C (which sounds good together with the C), how heavy a rock should he use, and how long should his kelp horn be (give the two shortest possible lengths)?

(*Note: it may be helpful to read the sections on standing waves and musical acoustics.*)
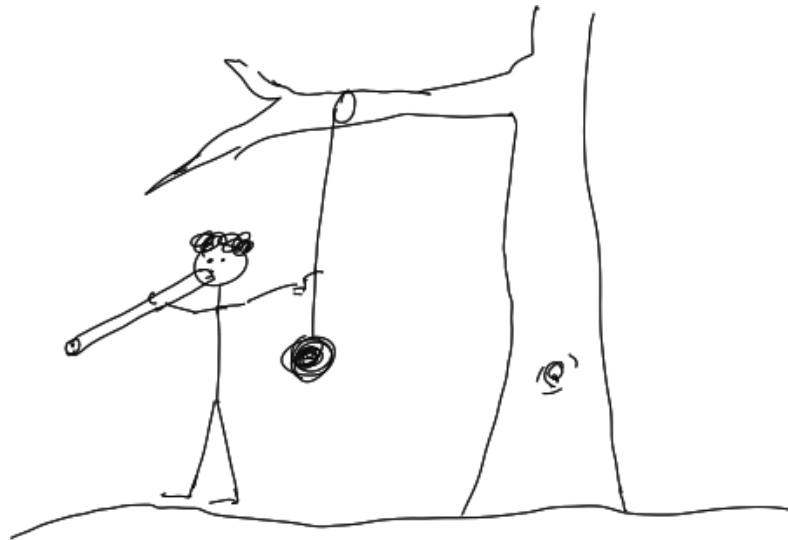
James prefers his drinks to have a particular value for the index of refraction, so he designs an apparatus to monitor it. James's apparatus is shown in the diagram. Light from a laser is split into two beams, and recombined. The paths of the two beams are symmetrical, but one of the beams is passed through a tube of the liquid as shown. As liquid is added to the tube, it is found that the image on the screen becomes darker and brighter repeatedly.
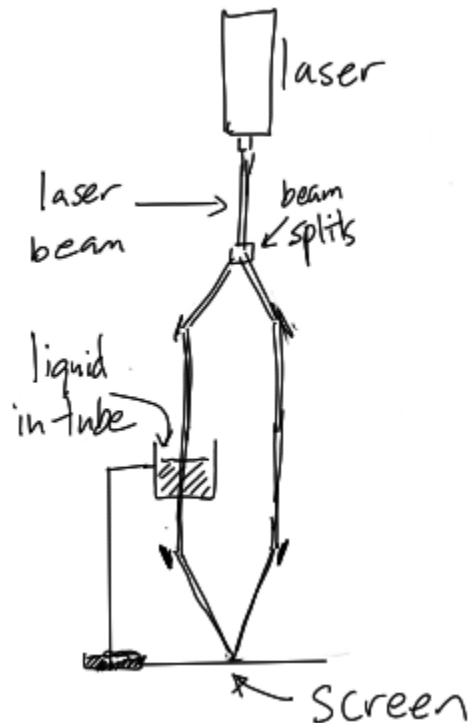
a) Explain why this happens.

b) On a particular day, James determines using a tube with diameter 2cm and light with wavelength 500nm that the image goes from bright to dark to bright again every time 0.5 microliters of liquid is added. What is the index of refraction of James's drink on that day?