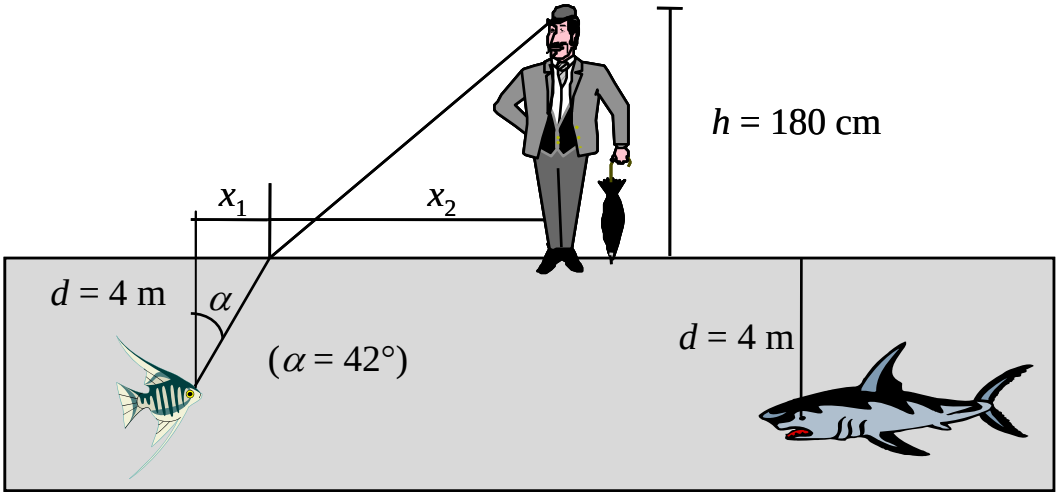
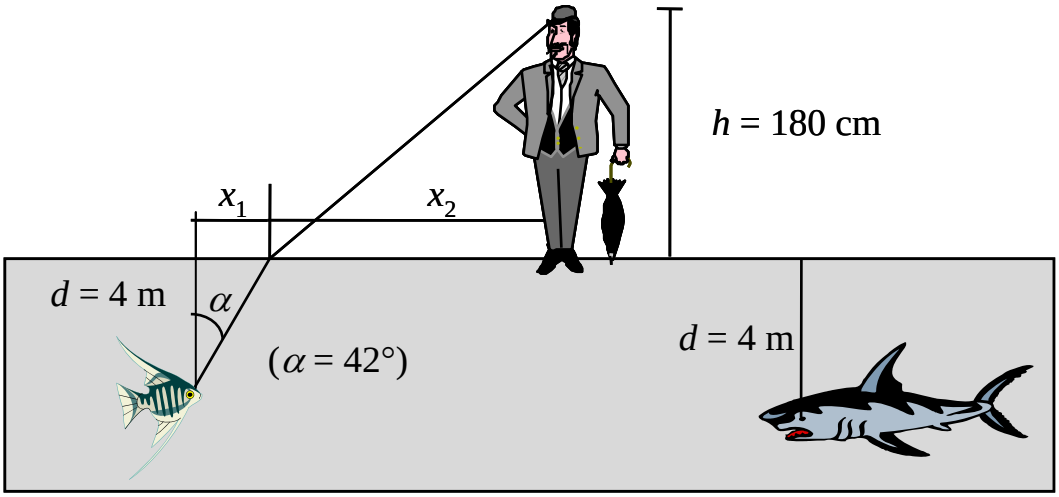
Discussion Question 14A
P212, Week 14
Refraction

In this question, we will take the point of view of a fish swimming d = 4m below the surface of a pond. A man of height h = 180 cm is standing by the side of the pond, and a shark is swimming at the same depth as the fish. If the fish looks up at a viewing angle $\alpha = 42^\circ$ (measured with respect to the vertical), it sees the man's hat. The refractive index of water is 1.33.



(a) What is the horizontal distance $x_1 + x_2$ from the fish to the man?

(b) At what viewing angle α must the fish look to see the man's feet?



(c) Where does the man appear to be? In fact, what does the <u>whole sky</u> look like to the fish?

(d) The fish is astonished to see the shark reflected in the surface of the water, and apparently floating above the pond! How far away must the shark be?

(i.e. what is the minimum horizontal distance between the fish and the shark for *total internal reflection* to occur?)