People don't just disappear. Other people just stop looking for them.
Sam Winchester, Supernatural

Seeker and Hidden

Part 1

Seeker and Hidden are located on the side surface of the transparent Cylinder ($n = 3/2$, $R = 1$ m) on the same plane perpendicular to the Cylinder axis and never leave it.

1. *(1 point)* Determine the probability that at a random location on the Cylinder the Seeker sees the Hidden.

In order to continue The Game, Seeker moves away from the Cylinder in some way, and at some point starts to see three images of Hidden in it, even though before he saw only one image. Seeker freezes.

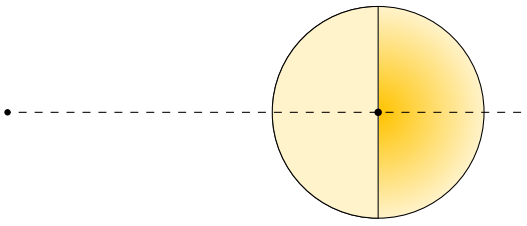
2. *(2 points)* Make a qualitative sketch of where Hidden hides in respect to Seeker. Prove there are no other places.
3. *(2 points)* Find the distance from the Cylinder axes to the Seeker.
4. *(2 points)* What is the minimum Path that Hidden should make on the surface of the Cylinder in order to be unseen?

All numerical answers should be given with an accuracy not less than 5%.

Part 2

The Seeker's attention was attracted by another Cylinder that consists of two half-cylinders, one of which is homogeneous, and the other with a changing refractive index $n = C/r$ (where is an Unknown Constant Value, and r is a distance to the Cylinder axis). The axis of the Cylinder is made of a material that completely absorbs light. Seeker approaches this Cylinder from the Infinity along the line perpendicular to the plane of the two half-cylinders contact, which also goes through the axis of the Cylinder.

5. *(3 points)* Find at least one distance from the axis when Seeker will be able to see himself. Reflections of rays from the Cylinder can be ignored. The homogeneous part of the Cylinder is closer to Seeker than the other part.



First hint — 02.05.2022 14:00 (Moscow time)
Second hint — 04.05.2022 14:00 (Moscow time)

Final of the third round — 06.05.2022 22:00 (Moscow time)