

LPR Cup

9.s06.e03

*He is knowledge. He knows Everything.
Or, let's say, almost everything you need.
Pilot. The Tale of the Jumper and the Glider*

Sphinx

It seemed that even the air here was melting from the heat. Seeker ran his tongue over his parched, cracked lips and tasted a metallic, bitter flavor in his mouth. It was unbearably stuffy, and the persistent, inviting shouts of the merchants, together with the chatter of the buyers in the bazaar, merged into a monotonous and unpleasant hum. The endless bustle and haggling, which seemed to hang in the air like a gray, thick, and dark substance visible only to Seeker, made this place unbearably sticky and viscous, and he felt it like a second skin he could not shed.

Pulling the hood of his tattered, sun-bleached cloak deeper over his head, he made his way through the crowd, trying to minimize contact, which at times brought him painfully sharp sensations. Seeker had no idea how long he had been searching, but by his internal clock, it had already been three days without sleep and with no bearings except for the Shadow—something that simply could not be here at this time of day, yet which continued to lead him on, clearly with no intention of stopping.

Entering a dark alley, Seeker was momentarily afraid he was about to lose his only lead, but that did not happen. Shadow, as if nothing had happened, continued moving and slipped behind one of the inconspicuous doors. Seeker pushed it open and found himself inside.

It was chilly here. Seeker walked to the center of a small hall, along the right wall of which stretched shelves filled with books in green bindings adorned with gold embossing, while on the left hung a tapestry—oddly out of place in this room—depicting sleeping lions, grazing bulls, and birds soaring in the sky. Seeker shuddered when he saw, at the far end of the room, mirrors with which he had always had a complicated relationship.

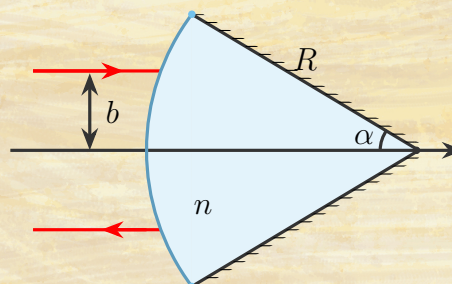
The heavy door slammed shut with a dull thud, swallowing the noisy bustle of the bazaar. Seeker spun around and froze: before him stood a woman with the bearing of a lion and the profile of an eagle. Her unblinking, lashless eyes stared piercingly at him. On her right arm dozed a hairless cat, which she absentmindedly stroked with slender fingers.

“If you leave now, you will never find it. If you answer incorrectly, you will lose what you have found,” she said.

Riddle One

A small segment with an unknown apex angle 2α was cut out from a glass cylinder of radius $R = 10.0$ cm and refractive index n . The side faces of the segment were silvered, after which a narrow beam of light was directed at it parallel to the axis of symmetry, such that the distance between the beam and the axis of symmetry is b (see figure). For which values of the apex angle 2α will the beam exit symmetrically to the incident beam? Provide numerical answers for:

1. (1 point) $n = 1.1$, $b = 5.0$ cm
2. (1 point) $n = 1.1$, $b = 3.5$ cm
3. (1 point) $n = 1.5$, $b = 5.0$ cm
4. (1 point) $n = 1.5$, $b = 2.5$ cm



Riddle Two

Here is a photograph of the waxing Moon against the backdrop of the evening twilight, which is receding below the horizon.

1. (4 points) Determine how much time has passed since sunset. Give your answer to the nearest 5 minutes.

Assume that the observer is located near the city of Quito, and that the daily rotation of the celestial sphere occurs perpendicular to the horizon. Atmospheric refraction at the horizon can be neglected, and the photo was taken from the surface of a plain. Assume the angular sizes of standard astronomical objects are known. The time it takes for the solar disk to disappear below the horizon can be neglected.



Riddle Three

Two mirrors form a dihedral angle of $\pi/3$. A point light source is located on the bisector of this dihedral angle at a distance a from the common edge. One of the mirrors begins to rotate with an angular velocity ω .

1. (*2 points*) Find the velocities of all images of the point source at this moment.

First hint — 12.05.2025 20:00 (Moscow time)

Second hint — 14.05.2025 12:00 (Moscow time)

Final of the third round — 16.05.2025 20:00 (Moscow time)