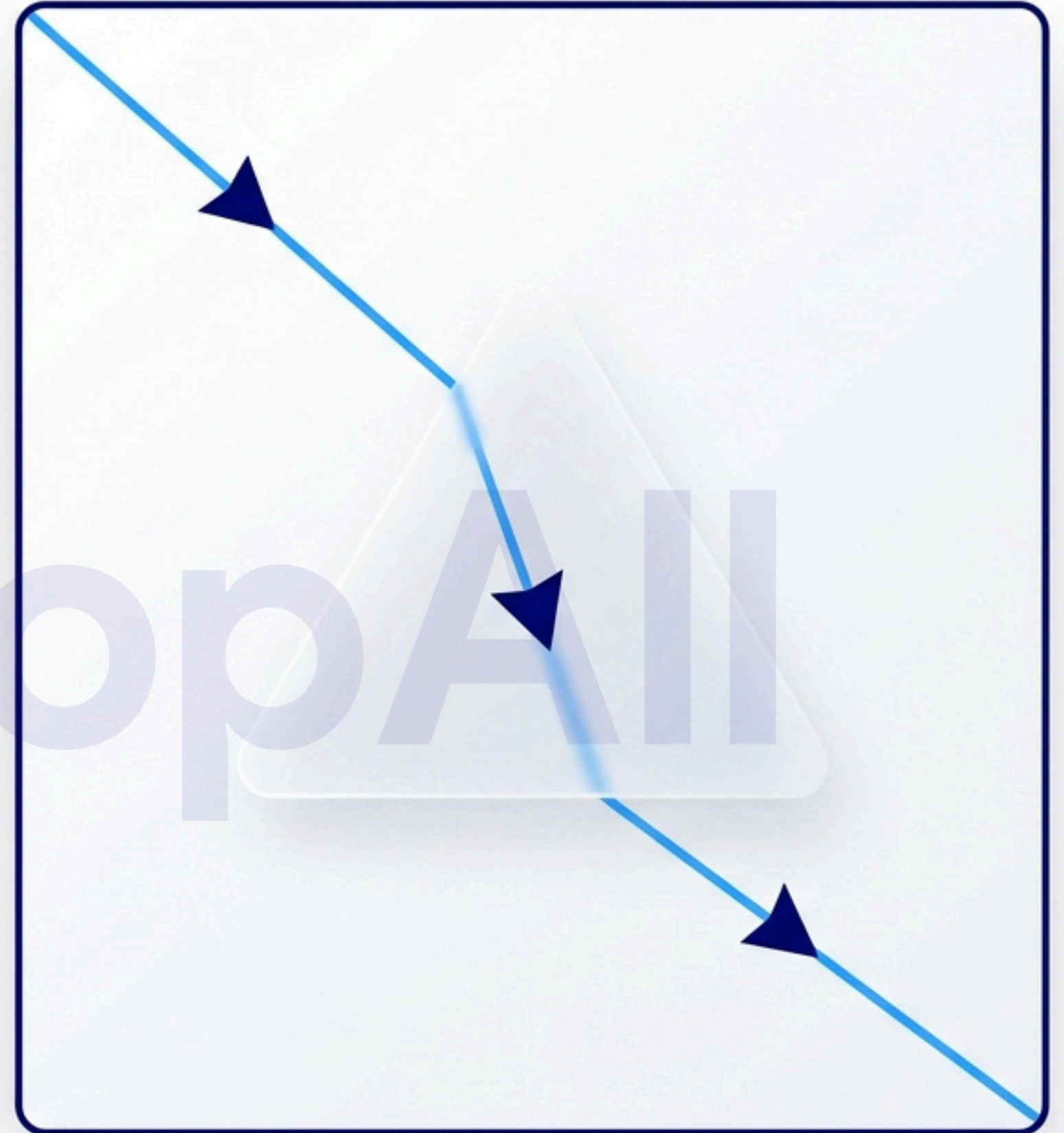




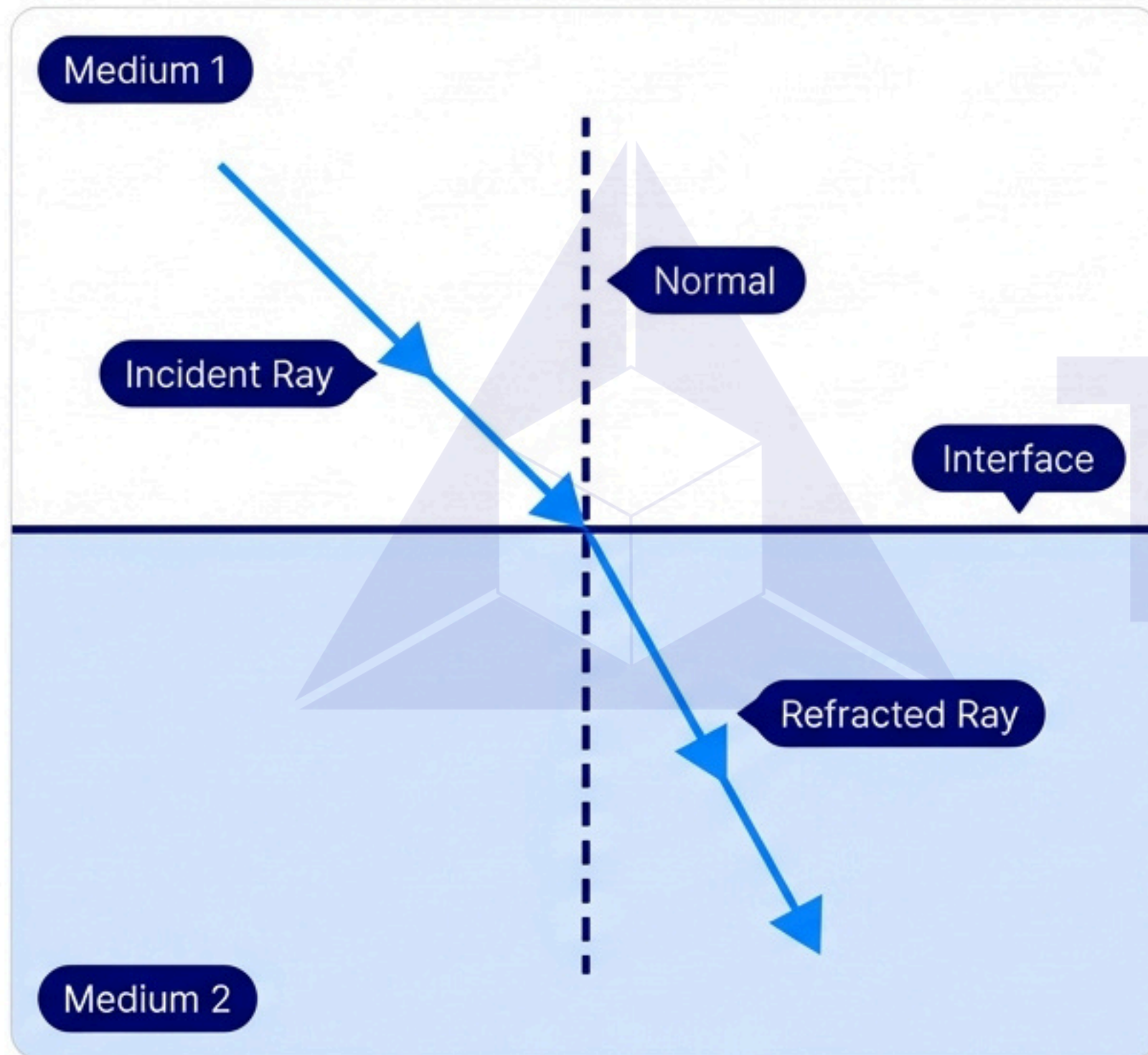
Class 12 Physics • Ray Optics

9.3 Refraction

Bending of light, Snell's Law, and Optical Density.



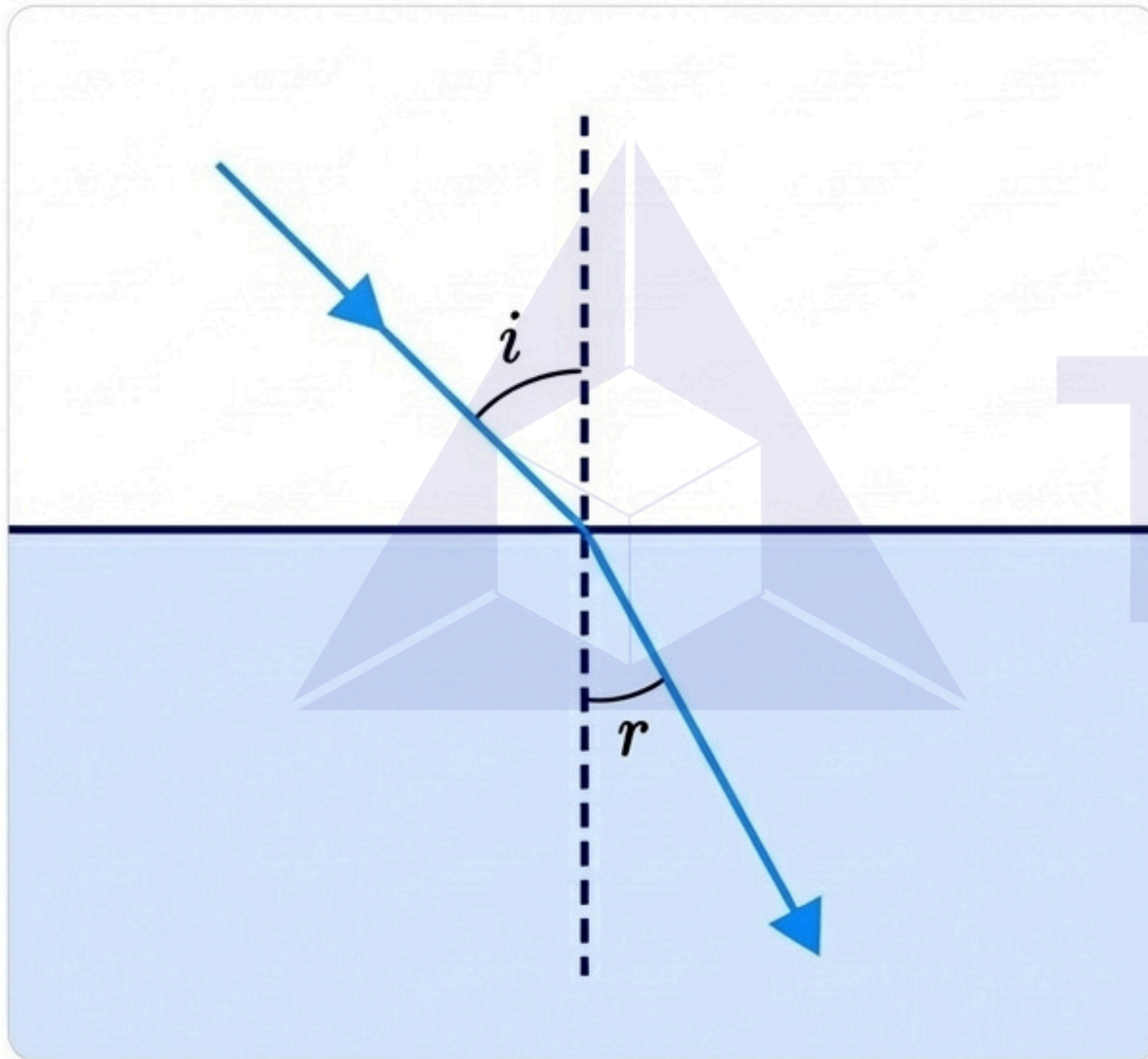
The Bending of Light at a Boundary



When a beam of light encounters another transparent medium, its direction of propagation changes at the interface. This is refraction.

- ✓ Light must encounter a different transparent medium.
- ✓ Light must be obliquely incident ($0^\circ < i < 90^\circ$).

Snell's Law & The Refractive Index



$$\frac{\sin i}{\sin r} = n_{21}$$

n_{21} is the Refractive Index of Medium 2 with respect to Medium 1.

It is a constant for the given pair of media and depends on the wavelength of light, but is completely independent of the angle of incidence.



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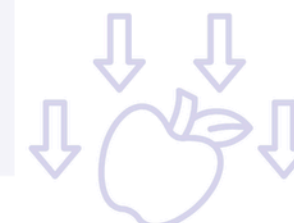
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Key Highlights

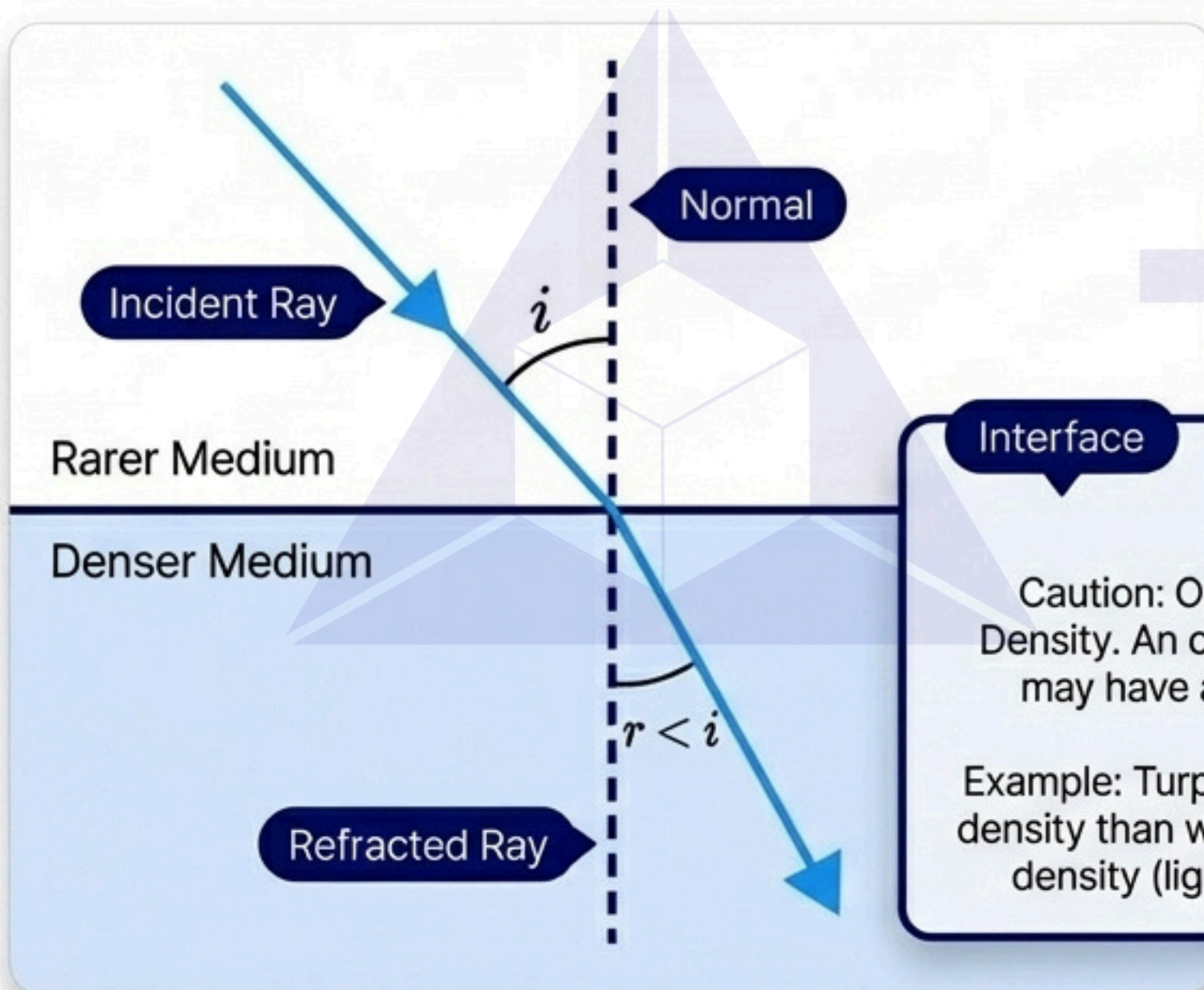
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Denser vs. Rarer Medium Behavior

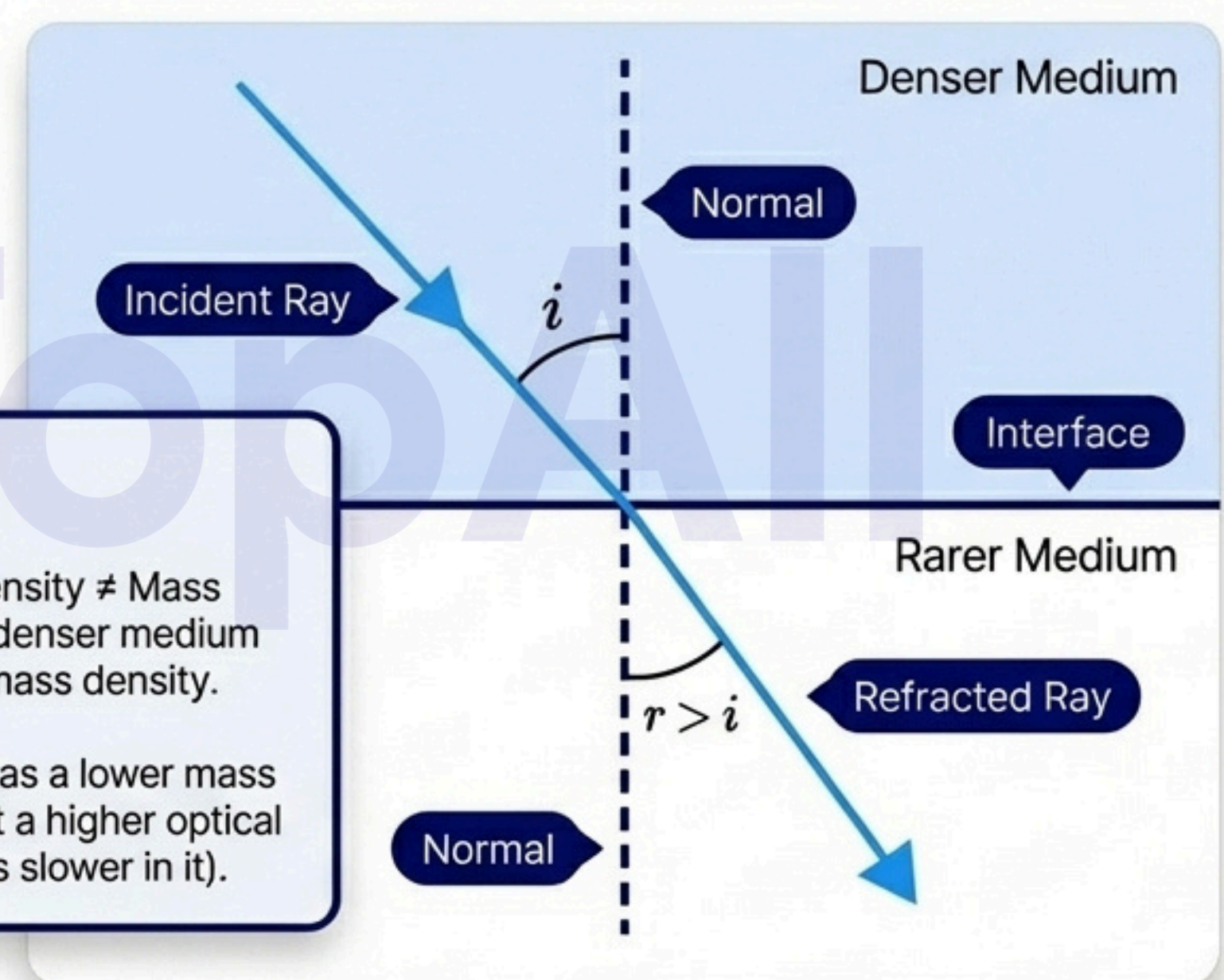
A. Denser Medium ($n_{21} > 1$)

$$n_{21} > 1$$



B. Rarer Medium ($n_{21} < 1$)

$$n_{21} < 1$$



Interface

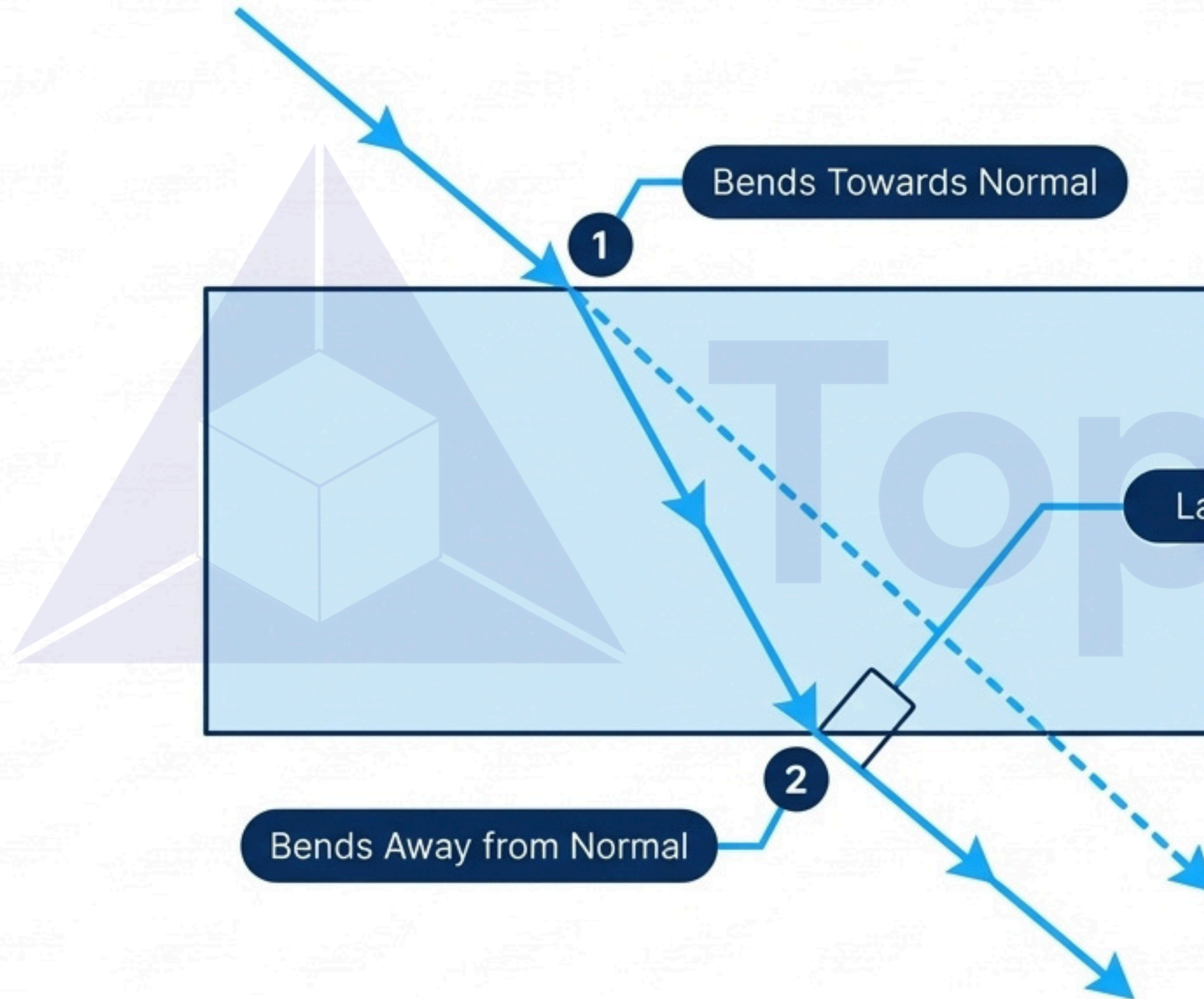
i

Caution: Optical Density $\neq$ Mass Density. An optically denser medium may have a lower mass density.

Example: Turpentine has a lower mass density than water, but a higher optical density (light travels slower in it).

Refraction Through a Glass Slab

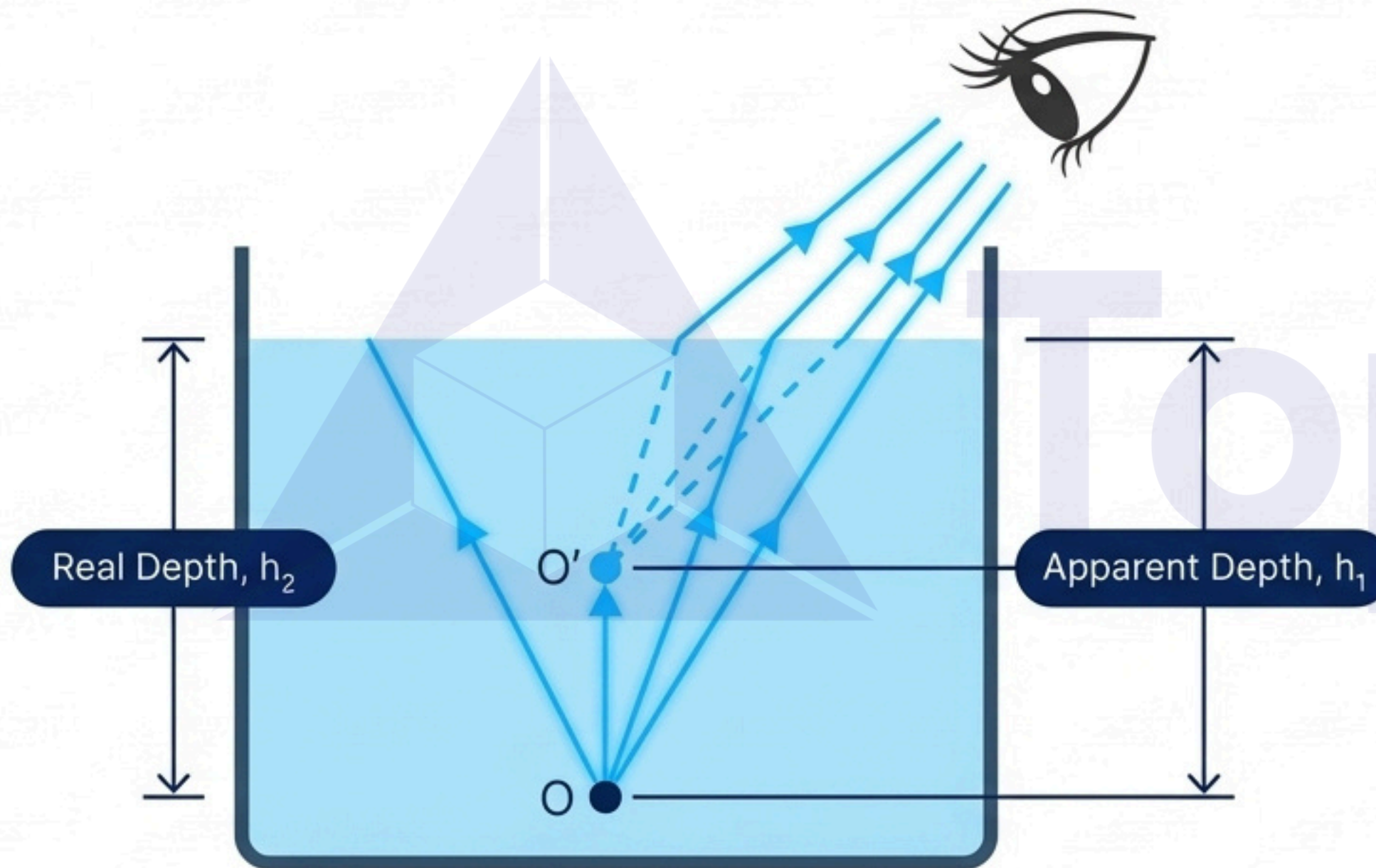
Primary Navy Plus Jakarta Sans



$$r_2 = i_1$$

The emergent ray is perfectly parallel to the incident ray. There is zero angular deviation, only lateral displacement.

The Apparent Depth Concept



$$h_1 = \frac{h_2}{n}$$

(for near-normal viewing)

Because light exiting the denser water bends away from the normal, the observer's brain extrapolates the rays backward, making the bottom of the tank appear raised.

Module Recap: Refraction

- ✓ 1. **The Phenomenon:** Refraction is the bending of obliquely incident light at a boundary between two transparent media.
- ✓ 2. **The Law:** Snell's Law connects angles to the refractive index ($\sin i / \sin r = n_{21}$).
- ✓ 3. **The Rule:** Light bends towards the normal in optically denser media, and away in rarer media.
- ✓ 4. **The Applications:** Parallel-sided slabs cause lateral shift without deviation; optical density differences cause optical illusions like apparent depth.



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