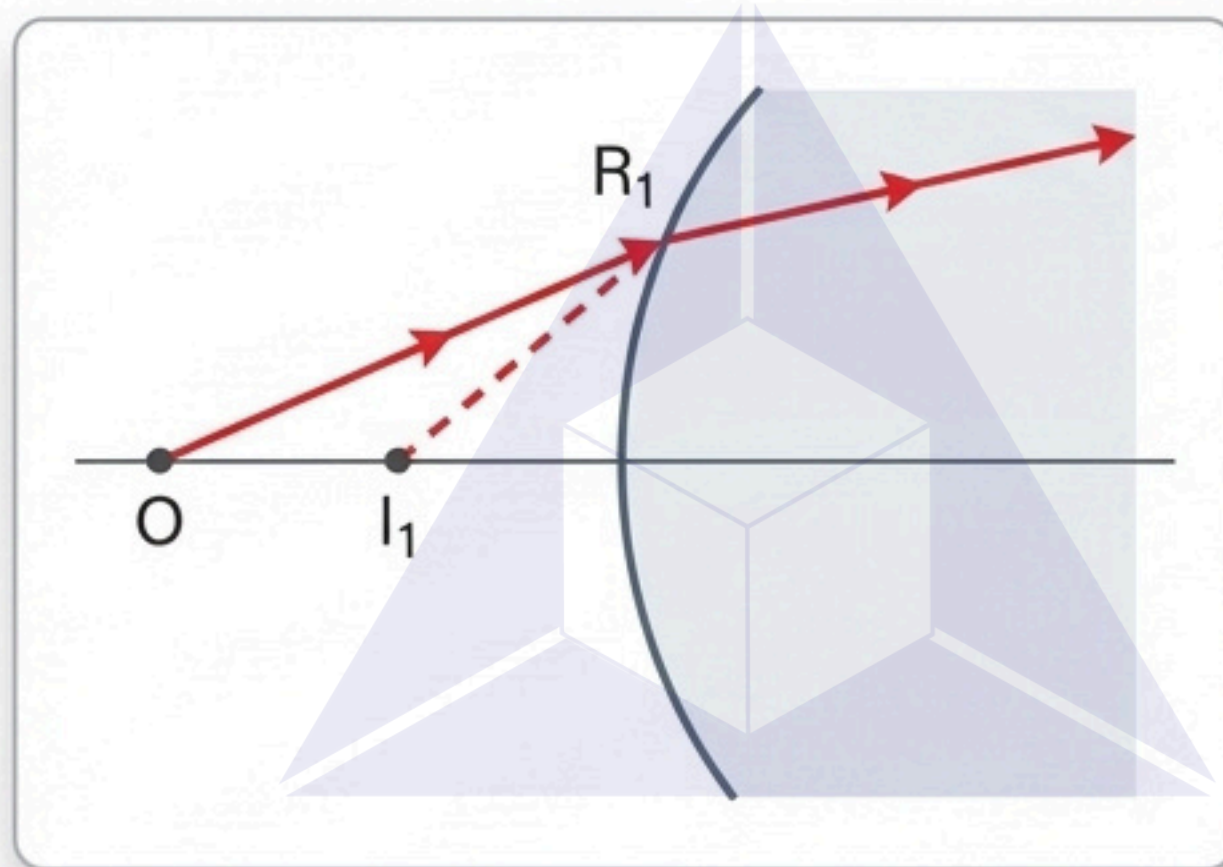


9.5.2 Refraction by a Lens

Mastering thin lenses, principal rays, and the lens formula without the dense derivations.

How a Lens Bends Light Twice

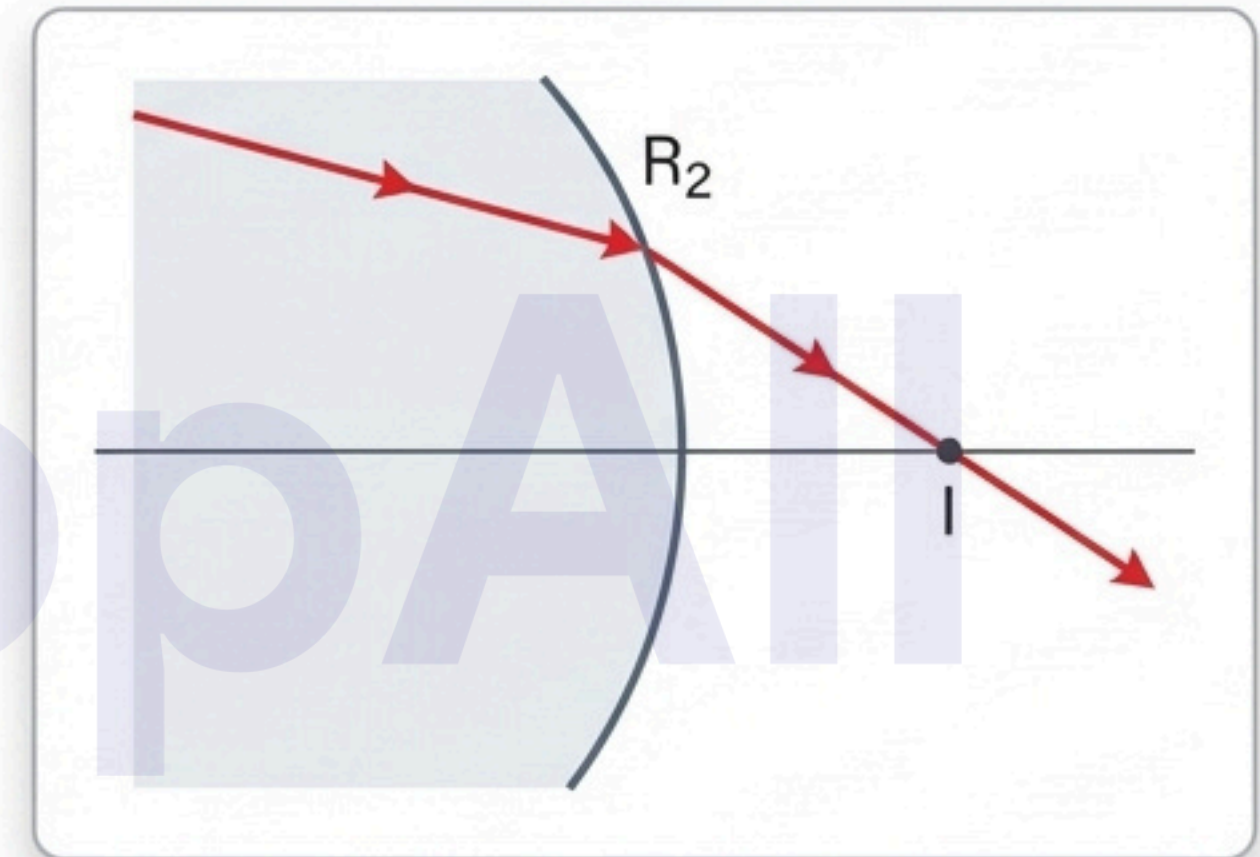
Step 1



Acts as a virtual
object for...

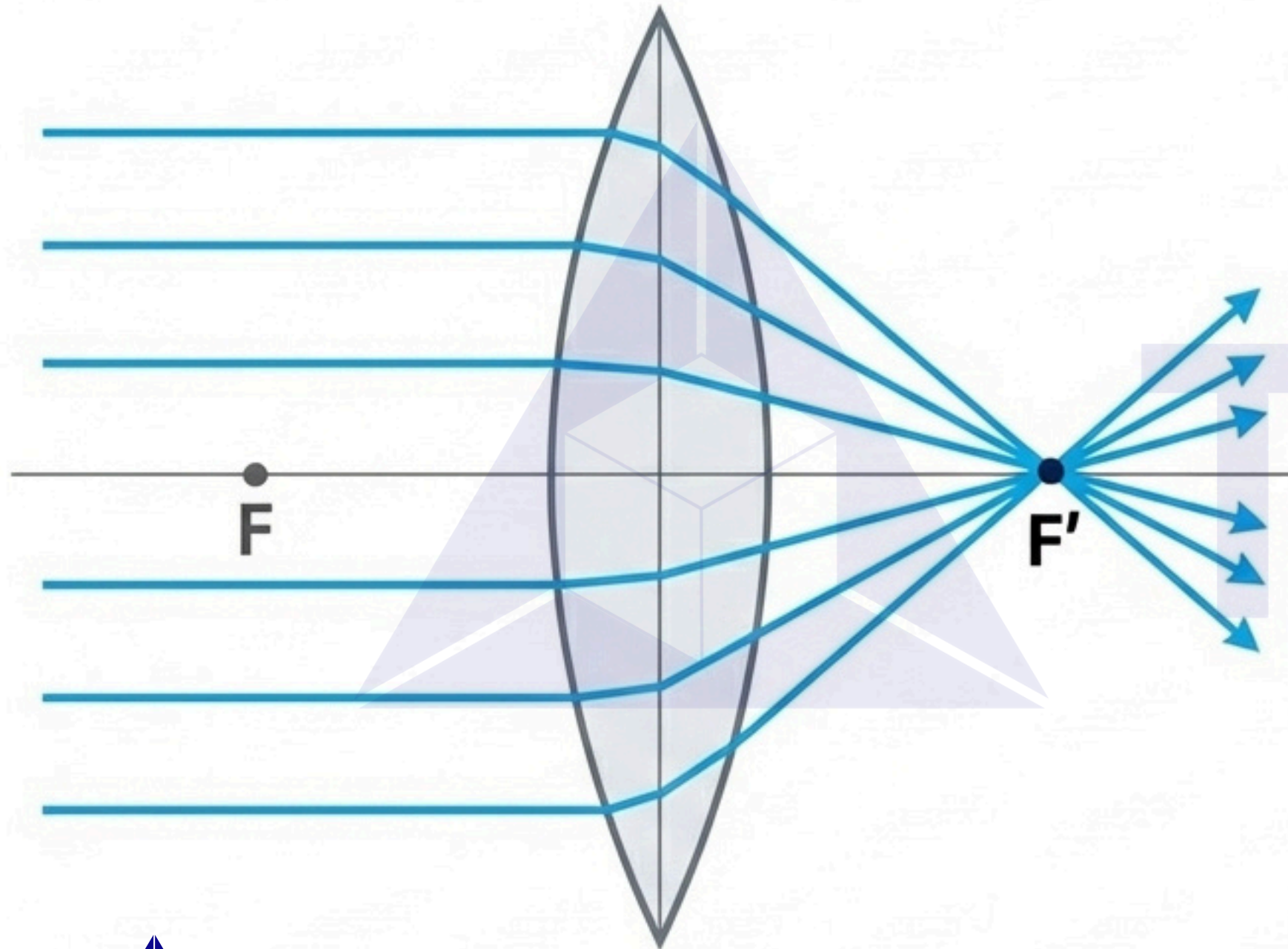


Step 2



A thin lens is simply a transparent optical medium bounded by two surfaces. The image formed by the first surface serves as the virtual object for the second.

Anatomy of a Convex Lens



[Convex Lens] Converging lens. Thicker at the center, thinner at the edges.

[Optical Centre] The geometric center. Rays passing through emerge without deviation.

[First Focal Point (F)] The point on the principal axis where originating rays become parallel after refraction.

[Second Focal Point (F')] The point where incident parallel rays actually converge. (Real Focus -> focal length f is positive).



**You've Learned the Theory.
Let's Test Them Now.**

$$E=mc^2$$



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Practice Now



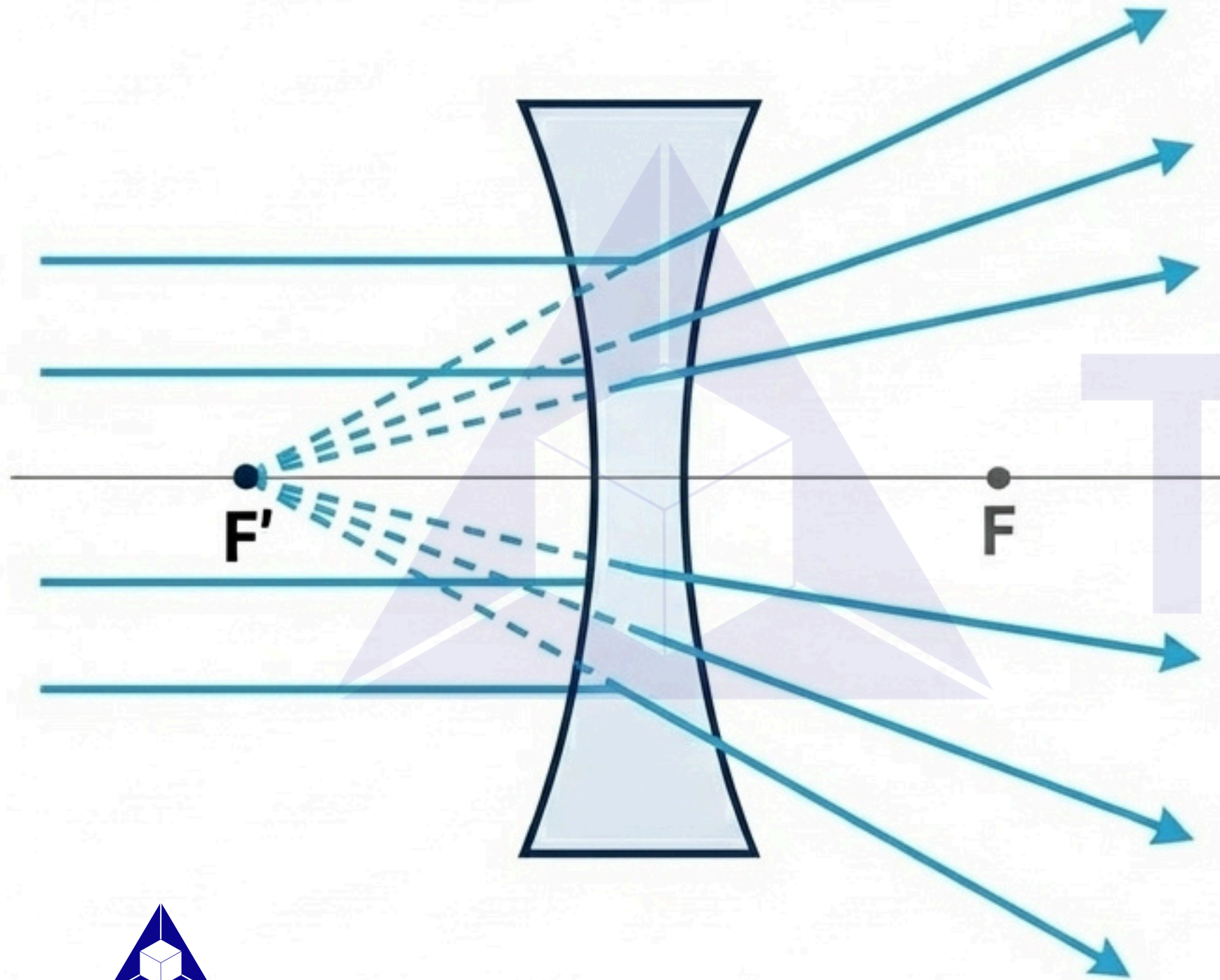
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- » Track Your Performance Smarter



Anatomy of a Concave Lens



[Concave Lens] Diverging lens. Thinner at the center, thicker at the edges.

[Optical Centre] The geometric center. Rays passing through emerge without deviation.

[First Focal Point (F)] The point on the principal axis where converging incident rays would meet to emerge parallel.

[Second Focal Point (F')] The point from which incident parallel rays appear to diverge. (Virtual Focus $\rightarrow$ focal length f is negative).

The Lens Formula & Magnification

Image distance
(Measured from optical centre)

Focal length
(Convex = +, Concave = -)

$$\frac{1}{v} - \frac{1}{u} = \frac{1}{f}$$

$$m = \frac{v}{u}$$

Linear Magnification
(Ratio of image height h'
to object height h)

Focal length
(Convex = +, Concave = -)

Unlike mirrors, one universally valid formula handles all different cases of spherical lenses—both real and virtual images.

Principal Rays for Image Formation

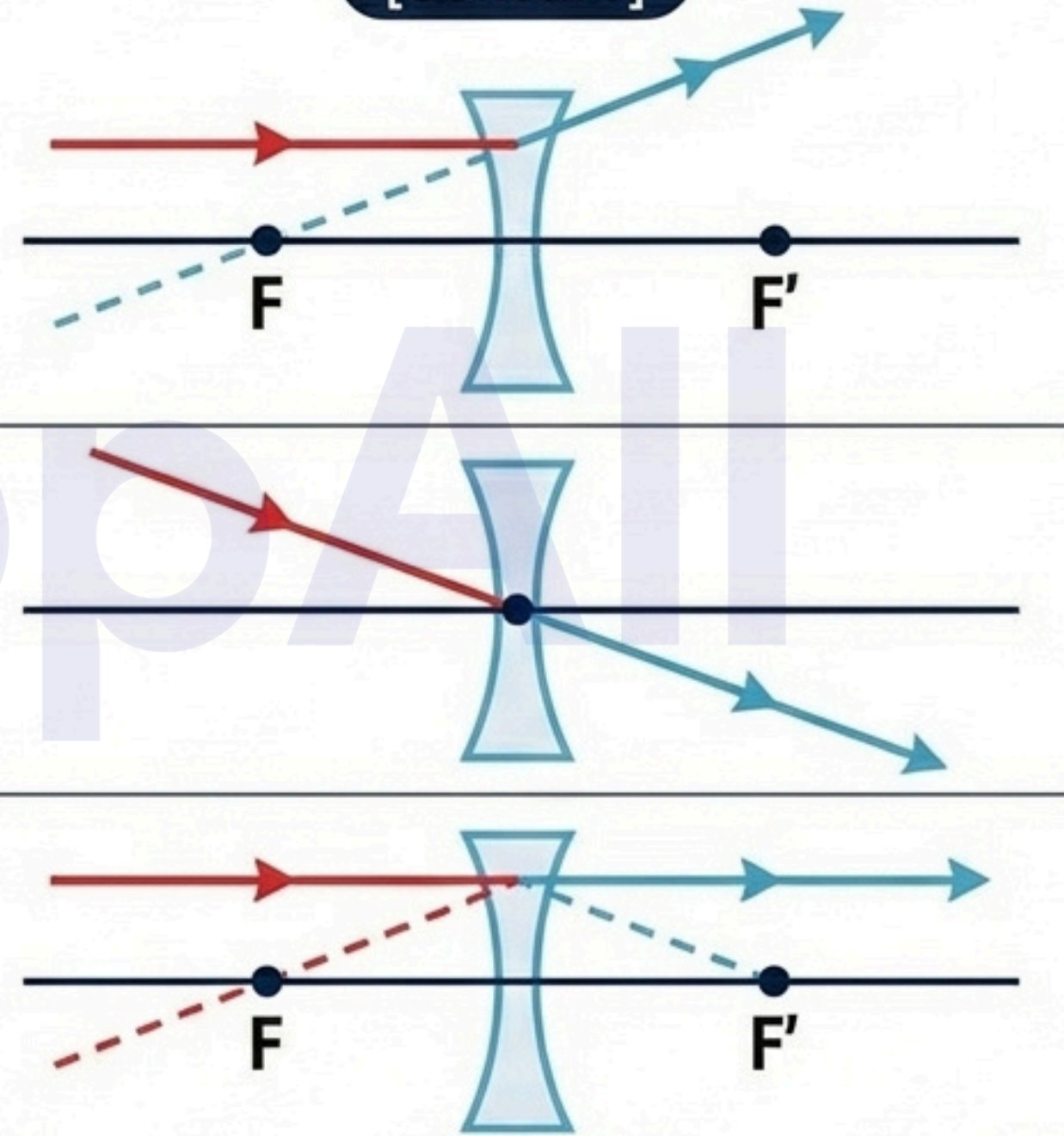
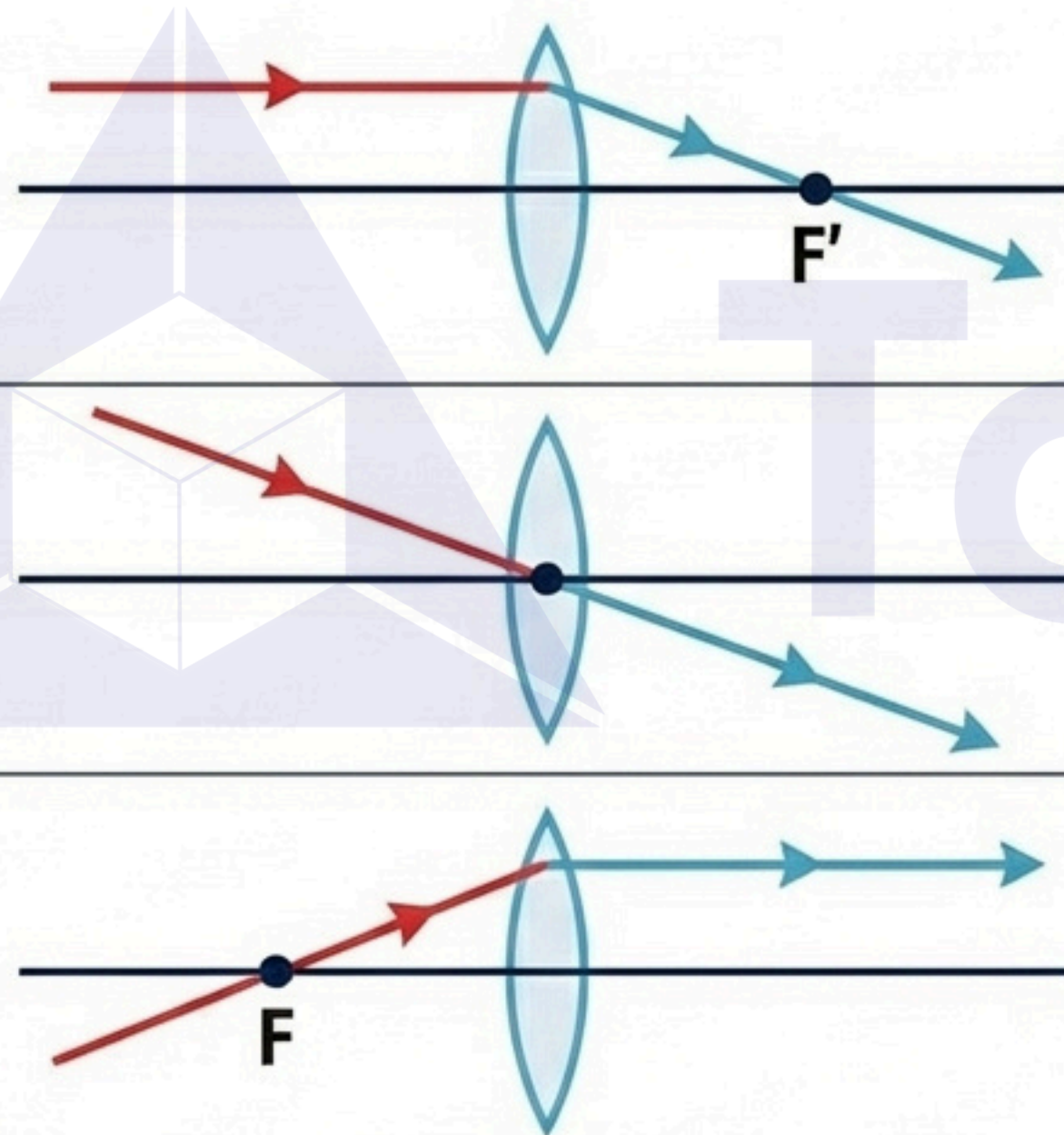
[Convex]

[Concave]

Parallel Ray

Optical
Centre Ray

Focal Ray



Summary & Exam Synthesis

- ✓ A lens features two refracting surfaces; the focal length f is determined by the combination of both radii (R_1 , R_2) and the refractive index.
- ✓ Both foci (F and F') of a double convex or concave lens are equidistant from the optical centre.
- ✓ The thin lens formula ($1/v - 1/u = 1/f$) is universal for both lens types and all image states.

[Exam Trap]

Watch your signs for magnification (m)!
It is positive for erect/virtual images, and negative for inverted/real images.



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