

Refraction and the convex lens

Connect Shell’s law of refraction to how a convex lens forms images

- Refraction and lens optics

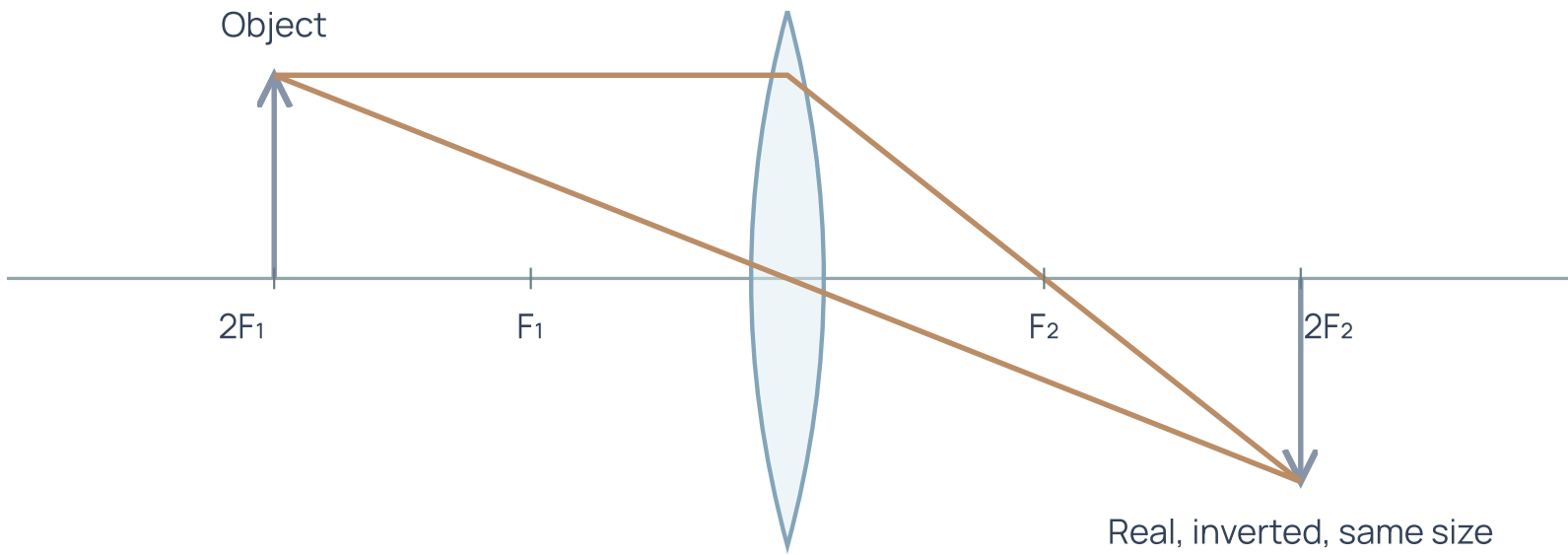


Illustration: object at $2F_1 \rightarrow$ image at $2F_2$

Thin converging lens in air: object at twice the focal length

- ◆ Cause and direction of refraction

- Refraction is the bending of an oblique light ray when its speed changes across media.
- Entering an optically denser medium (slower speed), the ray bends toward the normal.
- Entering a rarer medium, it bends away from the normal; at $i = 0^\circ$, it goes straight.

- Snell's law and refractive index

- The law of refraction is Snell's law: $n_1 \sin i = n_2 \sin r$ (angles from the normal).
- For a given pair of media and wavelength, $\sin i \div \sin r$ is a constant (n_{21}).
- Absolute refractive index $n = c \div v$ compares light speed in vacuum to that in the medium.

- ◇ Convex lens as a converging lens

- A usual glass convex lens in air is thicker centrally and converges parallel rays.
- Refracted rays meet at the principal focus F ; optical power $P = 1 \div f$ (in metres).
- Convex lenses have positive focal length ($+f$) and positive power in dioptres (D).

- Magnifying glass vs real images

- Place the object closer to the lens than its focal length, between the lens and F .
- The eye traces them back to a virtual, erect and magnified image: a magnifying glass.
- Beyond the focal distance, a converging lens can form a real inverted image on a screen.

REMEMBER Measure refraction angles from the normal; magnification as a hand lens needs the object inside F .