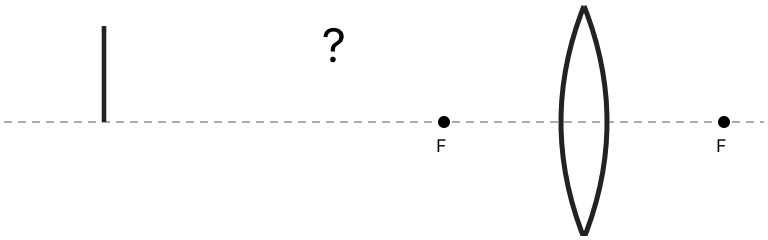
GEOMETRIC OPTICS DAY 8: THIN LENSES AND RAY DIAGRAMS

CED 13.4 · Skill 1.A · FRQ: TBR

PREDICT A PROJECTOR IMAGE

An object is placed beyond $2f$ of a converging lens. Predict the image: **enlarged / reduced** and **upright / inverted**. Commit before a screen image, projected bench, or ray trace is shown.

CONVERGING LENS WITH OBJECT BEYOND 2F - IMAGE WITHHELD



LENS TYPES

- A converging lens has $f > 0$ and brings parallel rays toward the far focal point.
- A diverging lens has $f < 0$ and spreads parallel rays as if they came from the near focal point.
- A thin lens has one focal point on each side.

NOTES / REASONING

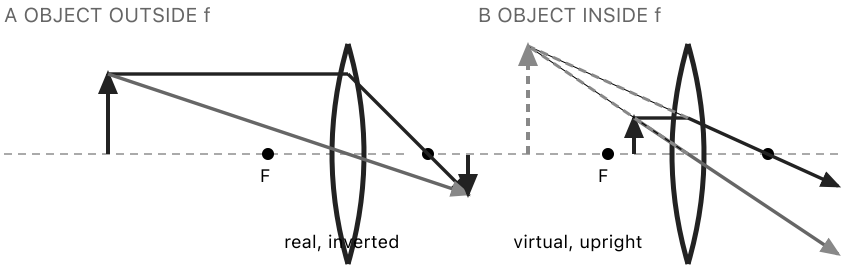
PRINCIPAL RAYS

1. Parallel to the axis → through the far focal point (or away as if from the near focus for a diverging lens).
2. Through the optical center → undeviated in the thin-lens model.
3. Through the near focal point → parallel to the axis after the lens.

DRAW A converging lens has $f = 14\,\text{cm}$. Place an object $42\,\text{cm}$ away. Draw two principal rays and mark the image.

CROSSING THE FOCAL POINT

CONVERGING-LENS CASES

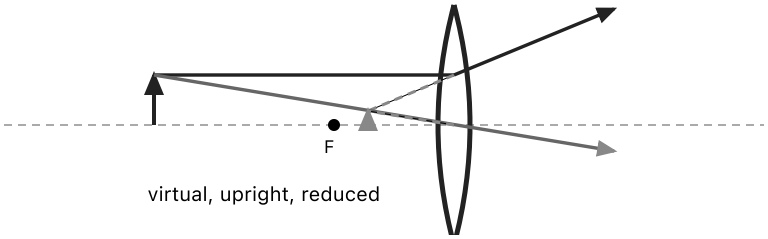


Object position	Converging-lens image
$d_o > 2f$	real, inverted, reduced
$f < d_o < 2f$	real, inverted, enlarged
$d_o = f$	image at infinity
$d_o < f$	virtual, upright, enlarged

For the same $f = 14\,\text{cm}$ lens, move the object to $d_o = 9.0\,\text{cm}$. Draw dashed backward extensions and classify the image.

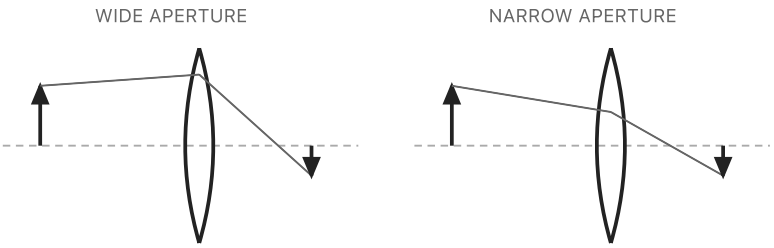
DIVERGING LENSES AND APERTURE

DIVERGING LENS



virtual, upright, reduced

CHANGING APERTURE AT FIXED F AND DO



same f and d_o → same image position and height

1. State the three image properties of a diverging lens for a real object.

2. Explain why a narrower aperture does not move or resize the ideal thin-lens image when f and d_o remain fixed.