GEOMETRIC OPTICS DAY 4: MIRROR EQUATION AND MAGNIFICATION

CED 13.2 · Skill 2.B · FRQ: MR

PREDICT AT 2F

An object is placed exactly $2f$ from a concave mirror. Predict the image: **at f / at 2f / behind the mirror / at infinity**, and **upright / inverted**.

EQUATIONS

$$\frac{1}{f} = \frac{1}{d_o} + \frac{1}{d_i} \qquad m = -\frac{d_i}{d_o} = \frac{h_i}{h_o}$$

Use centimeters for all distances in one calculation. Magnification has no unit.

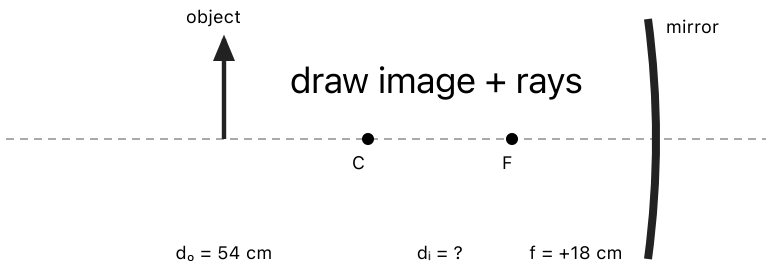
Quantity	Positive	Negative
f	concave (converging)	convex (diverging)
d_i	real image	virtual image
m, h_i	upright	inverted

NOTES / REASONING

CONCAVE-MIRROR EXAMPLE

WE DO A concave mirror has $f = +18\,\text{cm}$. An object is $d_o = 54\,\text{cm}$ away and $h_o = 6.0\,\text{cm}$ tall. Find d_i, m, h_i, and classify the image.

COMPLETE THE RAY DIAGRAM AFTER CALCULATING THE IMAGE



Sequence: solve for d_i, calculate m, use $h_i = mh_o$, then translate the signs into words.

CONVEX-MIRROR EXAMPLE

YOU DO A convex mirror has $f = -16\,\text{cm}$. An object is $32\,\text{cm}$ in front of it and $12\,\text{cm}$ tall. Find d_i, m, and h_i. Classify the image.

Convex sign: write $f < 0$ before using the equation. The resulting $d_i < 0$ locates the virtual image behind the mirror.

READING MAGNIFICATION

Result	Meaning
$\lvert m\rvert > 1$	enlarged
$\lvert m\rvert = 1$	same size
$\lvert m\rvert < 1$	reduced

PRACTICE

1. For the $f = +18\,\text{cm}$ concave mirror, set $d_o = 36\,\text{cm}$. Find d_i and m.

2. For the same mirror, set $d_o = 24\,\text{cm}$. Find d_i and state whether the image is enlarged or reduced.

3. For the $f = -16\,\text{cm}$ convex mirror, set $d_o = 48\,\text{cm}$. Find d_i and m.

4. Explain why a negative d_i and positive m are consistent with the same virtual image.