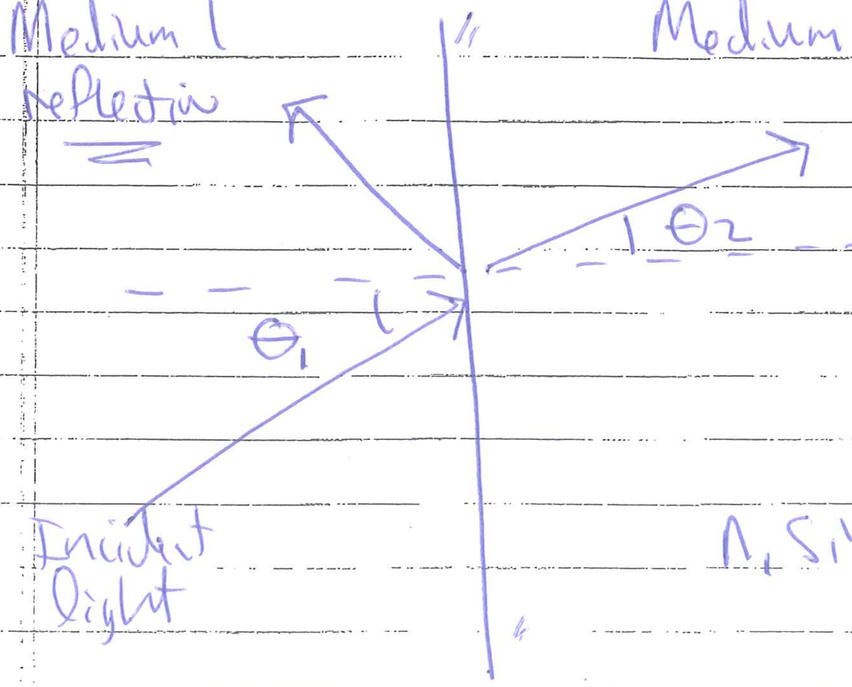
< SEE HANDOUT

~1800(?) Snell



transmission

a.k.a. "refraction"

$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

$n \equiv$ index of refraction

$$n = \frac{\text{speed of light in vacuum}}{\text{speed in the medium.}}$$

$n_{Air} \approx 1$ for this course.

$$\boxed{n = \frac{c}{v}}$$

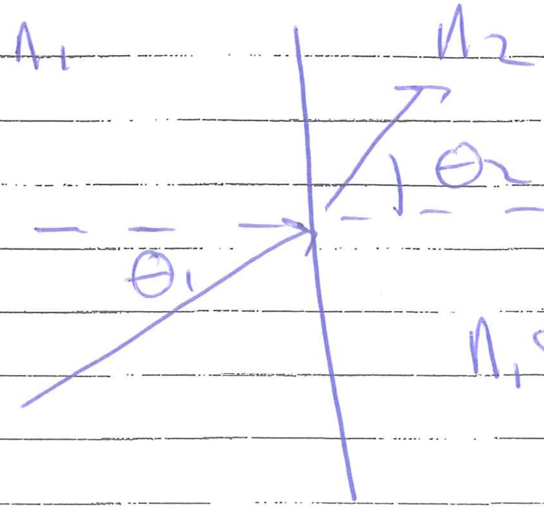
Medium 1 ⇒ air, $n_1 = 1$
Medium 2 ⇒ glass, $n_2 = 1.5$
For $\theta_1 = 37^\circ$, find θ_2.

$1 \sin(37) = 1.5 \sin(\theta_2)$

$\therefore \theta_2 = 23.7^\circ$ Ans.

TIR

Transmission angle is $90°$



$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

θ_1: "critical Angle" θ_c

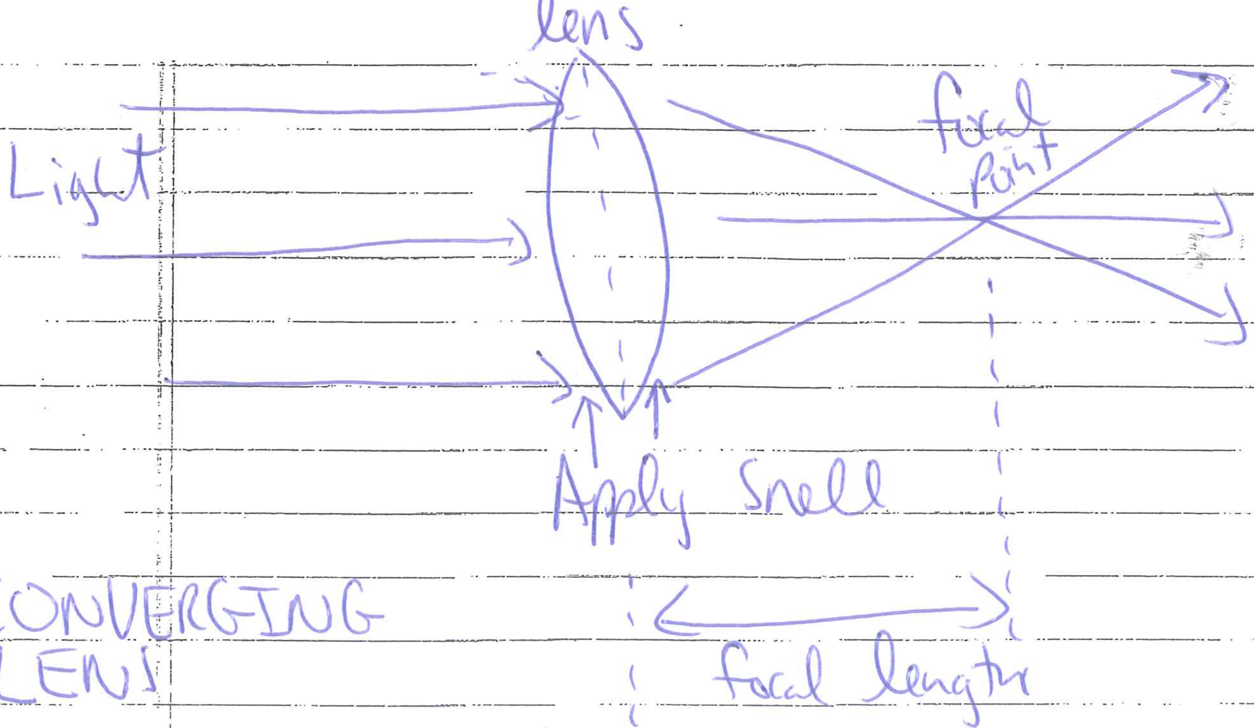
θ_2: $90°$

$$n_1 \sin\theta_c = n_2 (1)$$

$$\theta_c = \text{Arcsin}\left(\frac{n_2}{n_1}\right)$$

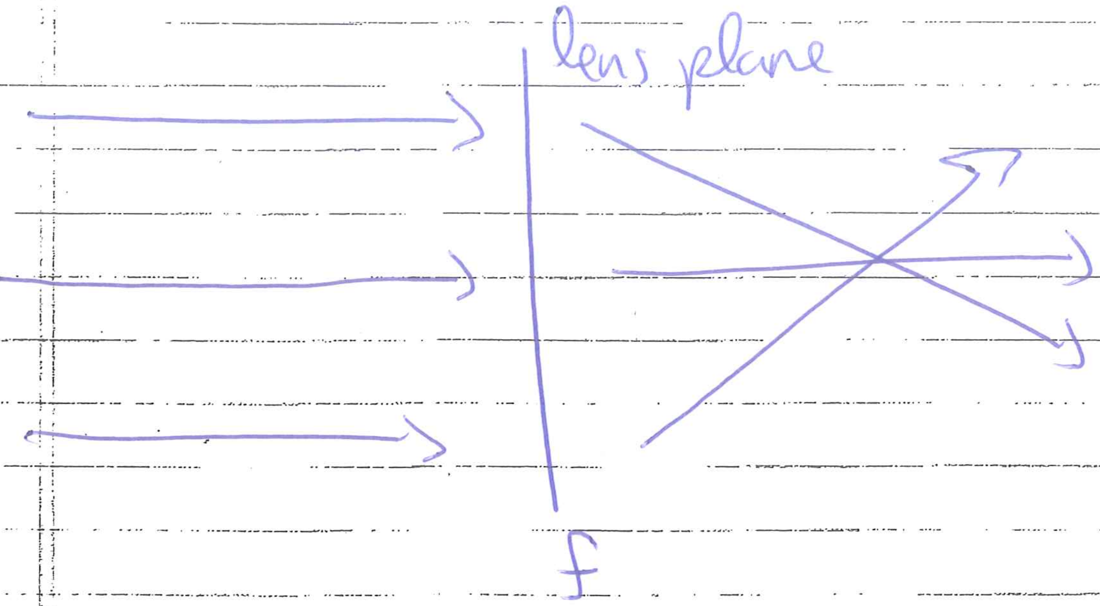
Can only happen if $n_1 > n_2$

Use SNELL to build lenses

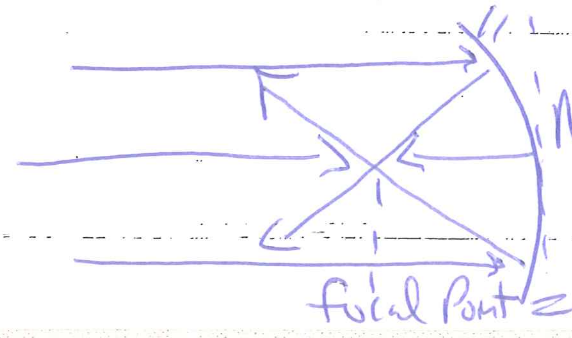


CONVERGING LENS

WE will ignore shapes

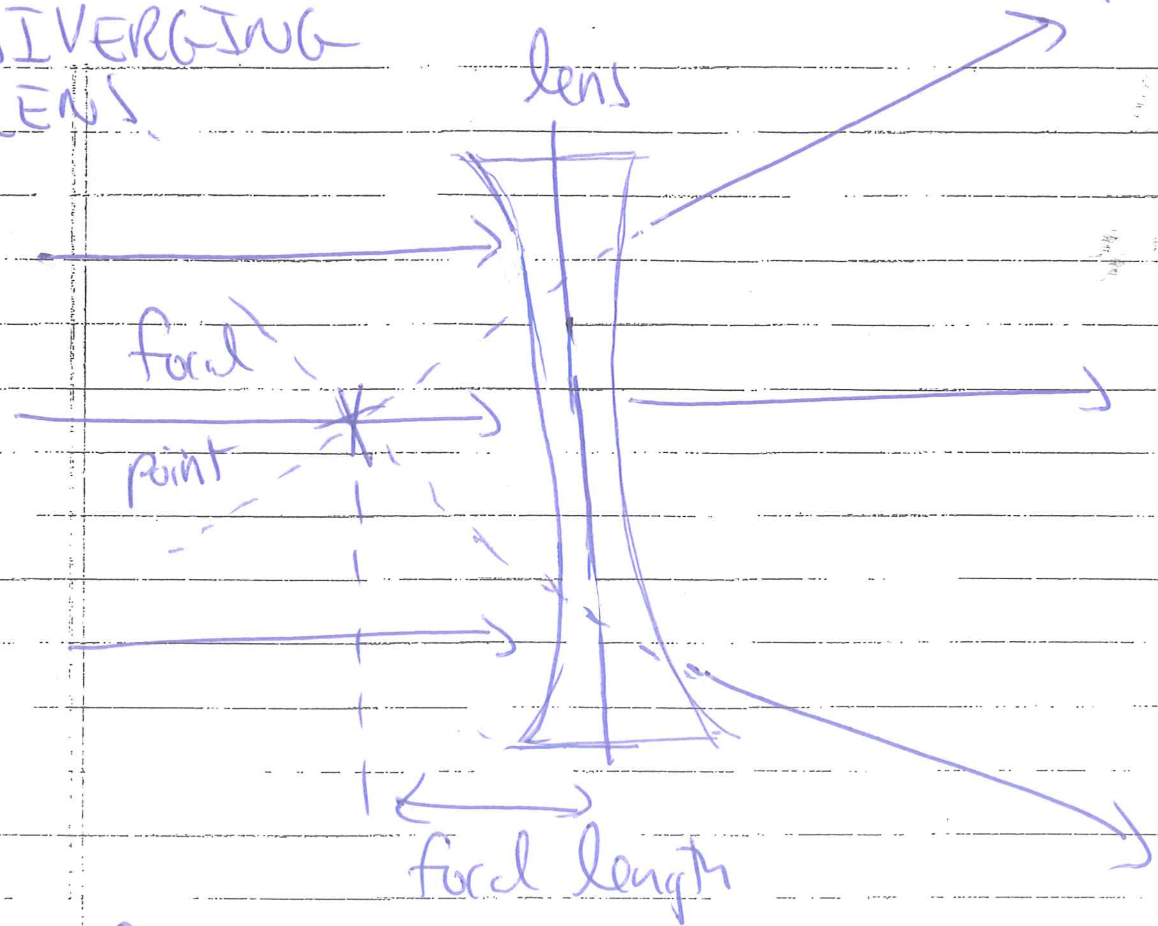


Can also do w/ Mirrors

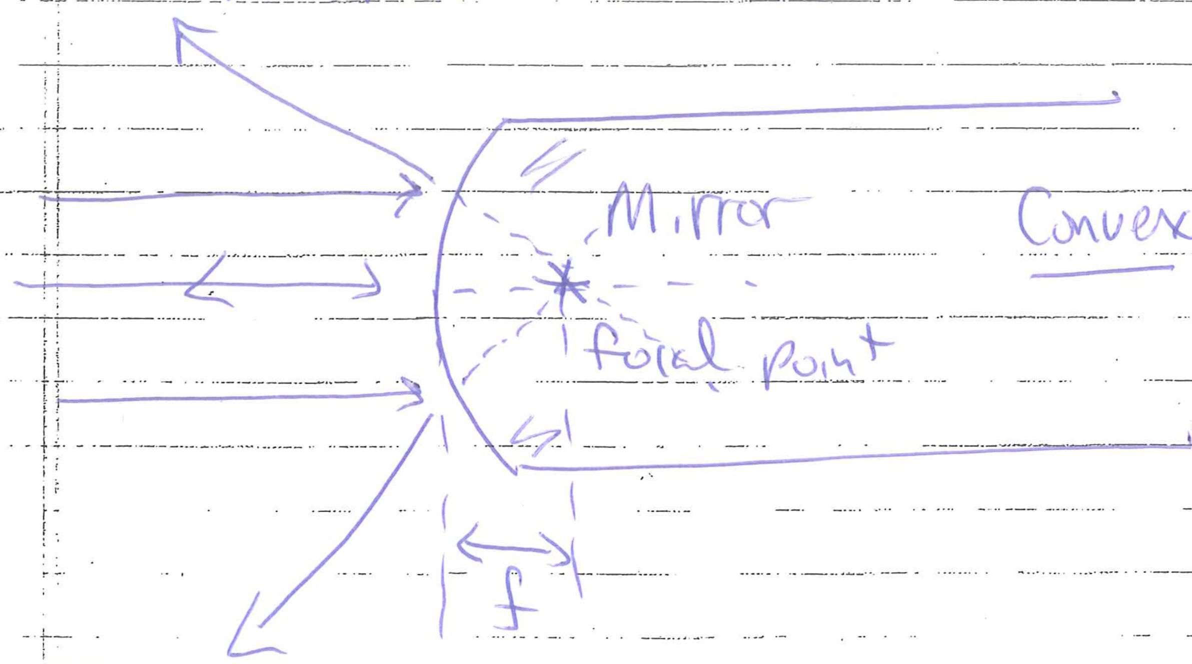


Concave Mirror

DIVERGING LENS



Also for mirrors:

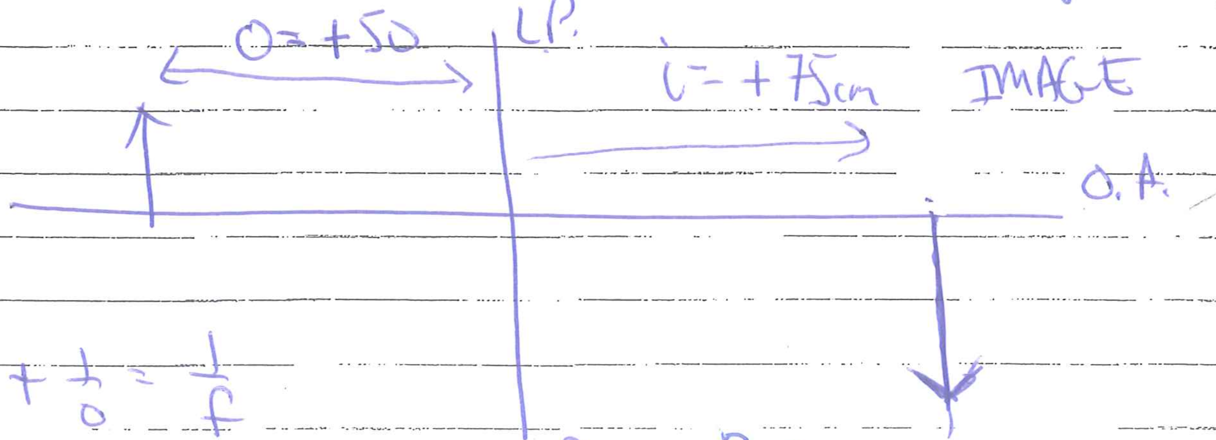


Convex

SEE HANDOUT

EX.) A converging lens has a focal length of 30 cm. A 5 cm tall object is placed 50 cm from the lens.

Find location + size of the image.



$f = +30$

$\frac{1}{i} + \frac{1}{o} = \frac{1}{f}$

$\frac{1}{i} = \frac{1}{30} - \frac{1}{50} = \frac{1}{75}$

$\therefore\ i = +75\text{ cm}$

$M \equiv -\frac{i}{o} = -\frac{75}{50}$

$M = -1.5$

ALSO: $M \equiv \frac{h_i}{h_o}$

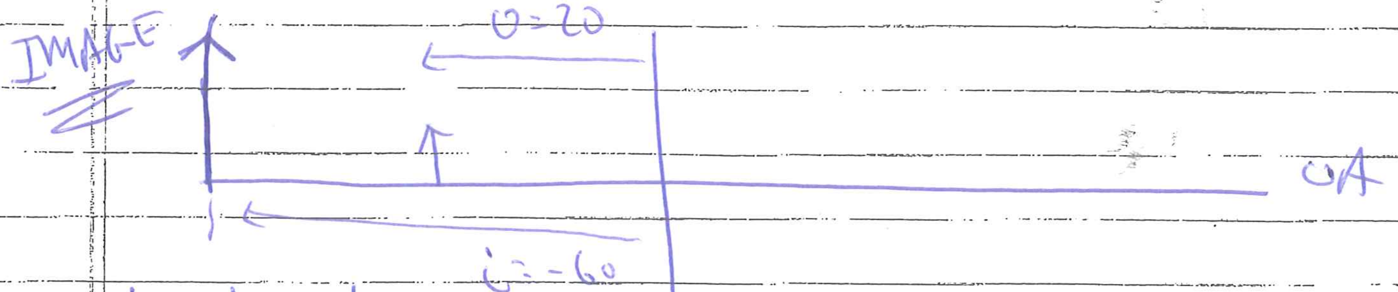
$\therefore\ \frac{h_i}{h_o} = -1.5$

$h_i = -1.5\,h_o = -7.5\text{ cm}$

INVERTED

"REAL" IMAGE

Ex.) Same as before, but $o = 20$ cm.



$$\frac{1}{i} + \frac{1}{o} = \frac{1}{f}$$

$$\frac{1}{i} = \frac{1}{f} - \frac{1}{o} = \frac{1}{30} - \frac{1}{20} \qquad f = +30 \text{ cm}$$

$$\frac{1}{i} = -\frac{1}{60}$$

$$\therefore i = -60 \text{ cm}$$

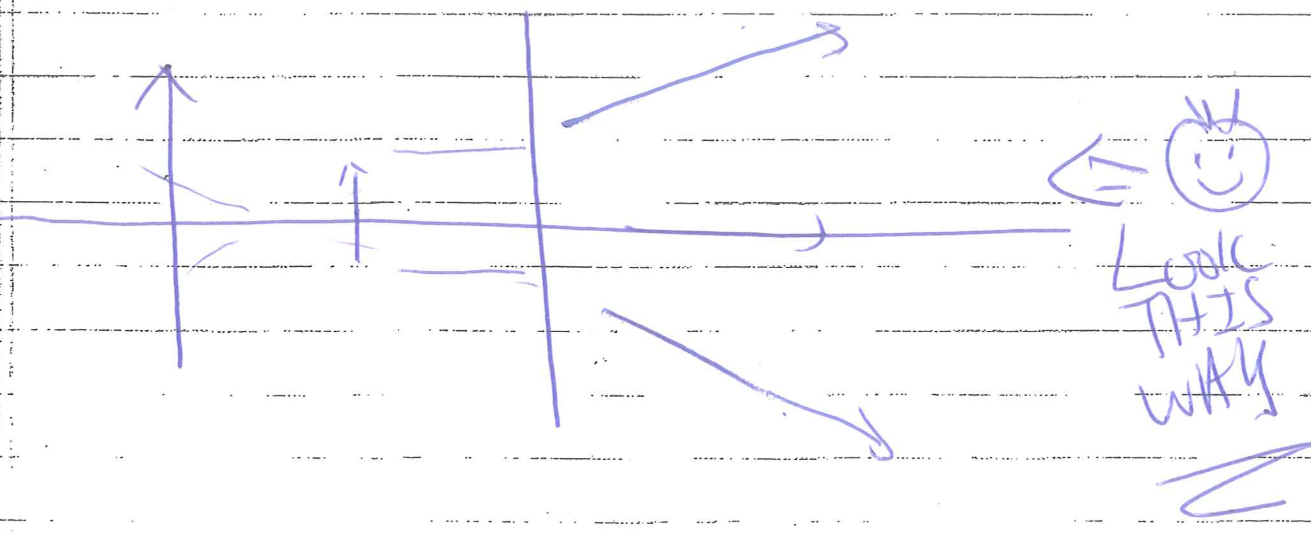
$$M = -\frac{i}{o} = -\frac{(-60)}{20} = +3$$

$$M = \frac{h_i}{h_o} = +3$$

$$h_i = +3 h_o$$

upright

"VIRTUAL IMAGE"



FORMULA SHEET

$\lambda f = v$ $n = c/v$ $n_1 \sin\theta_1 = n_2 \sin\theta_2$

****

$1/i + 1/o = 1/f$

M= image height/object height

$M = - i/o$ Magnification

$\boxed{f = R/2}$

I will use focal lengths.

Lens sign convention

i is + if located in back of the lens

o is + if located in front of the lens

f is + if lens is converging

We will not worry w/ the shape of lens.

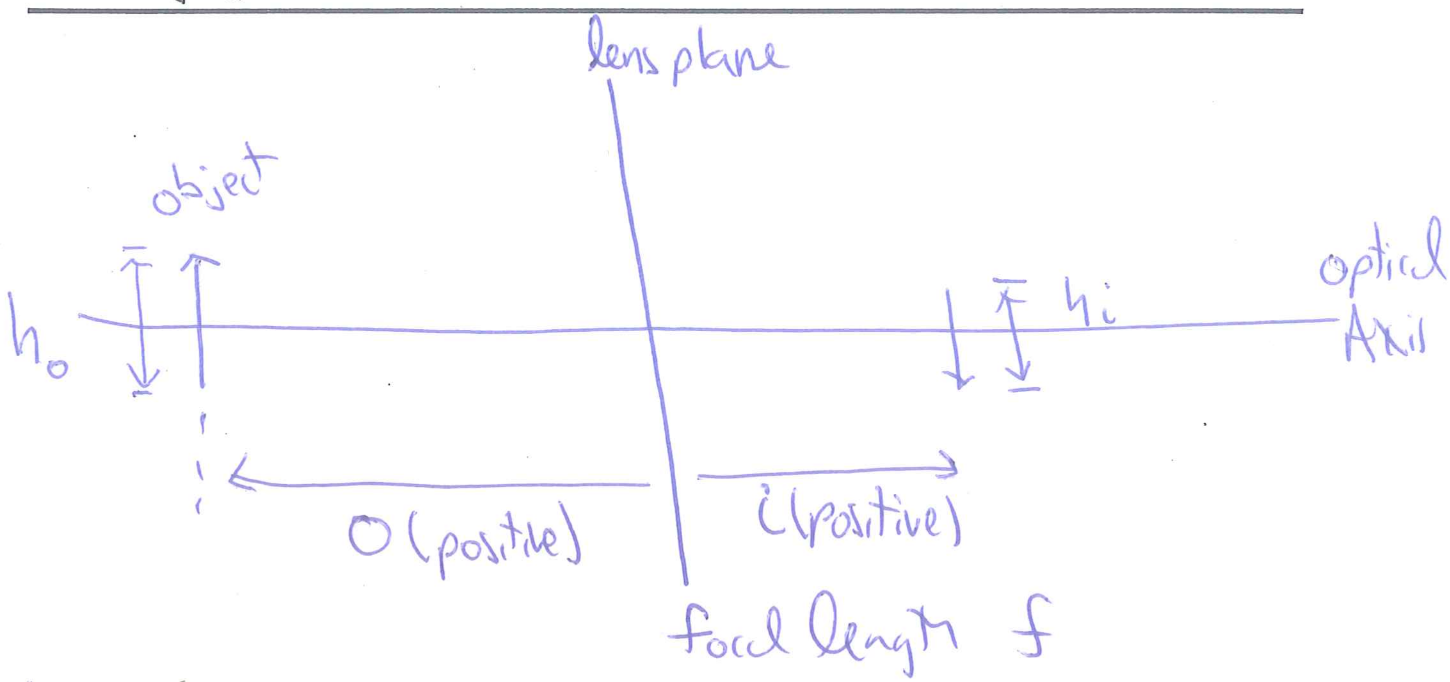
Mirror sign convention

i is + if located in front of the mirror

o is + if located in front of the mirror

f is + if mirror is concave

"front" is the side from which the light is coming



An Animated Walk through Light as a Wave and Geometric Optics

http://www.compadre.org/physlets/ Physlet Physics

Electromagnetic Waves

132.4 EM Wave

chapter

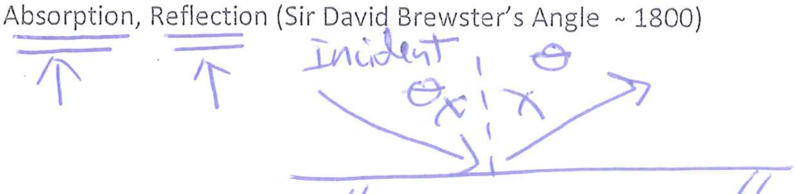
Transverse ($\vec{E}$ and $\vec{B}$ $\perp$ $\vec{v}$)

$\vec{E} \perp \vec{B}$

= Plane waves: ...

132.3 Plane Waves, Linearly Polarized

139.2 Other Polarizations: Absorption, Reflection (Sir David Brewster's Angle ~ 1800)



At or above the Brewster angle, reflected light is linearly polarized.

132.2 Representing the wave crests

132.1 Creating EM Waves: Note on EM Spectrum