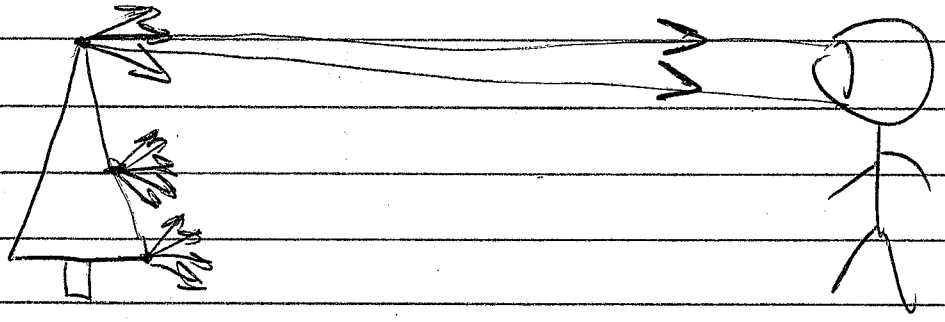
Phys 1402 2017-11-21 Lec 23

How do we "see"?

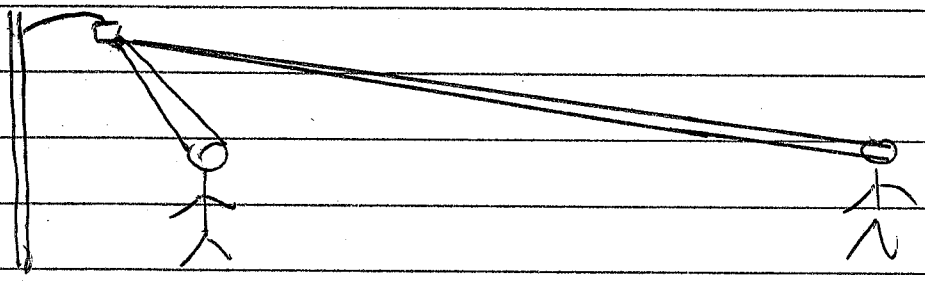
We observe many rays of light.



We see diverging rays coming from a common point.

Note: in drawings, we only trace some rays.

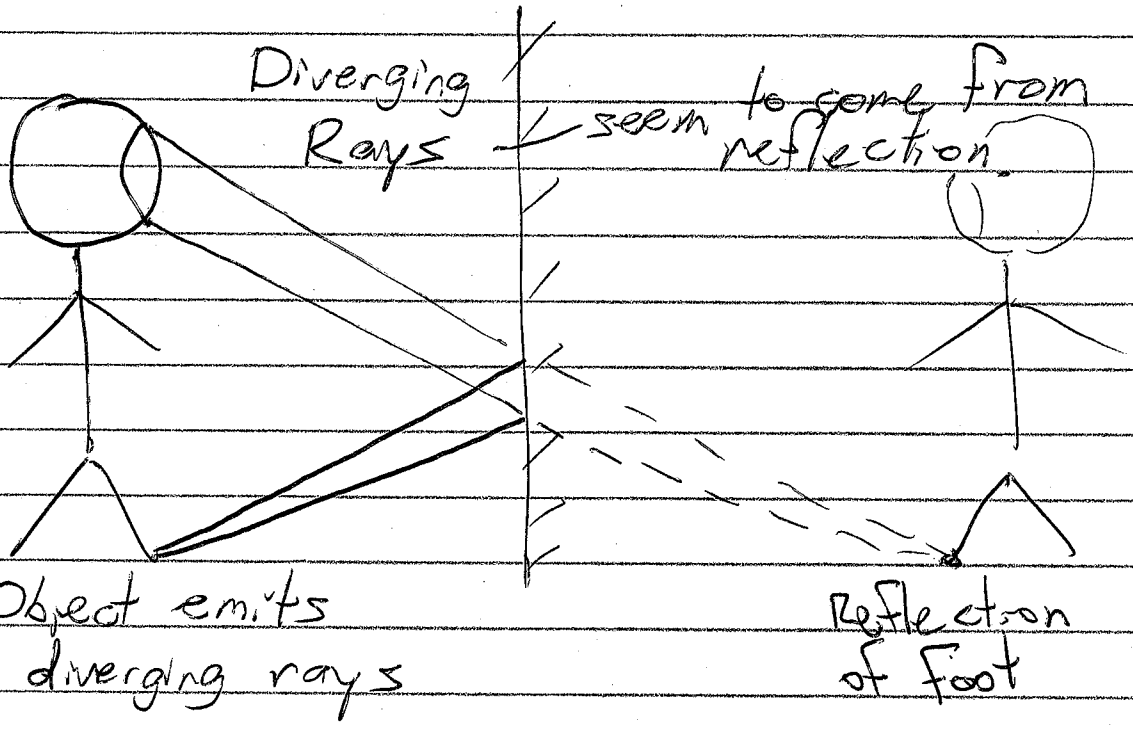
- Point Source
- 2 or 3 rays



Near object
More Diverging Rays

Far object
Less Diverging

The eyes/brain can be fooled.
If we see rays diverging, we extend them mentally back to the apparent source.

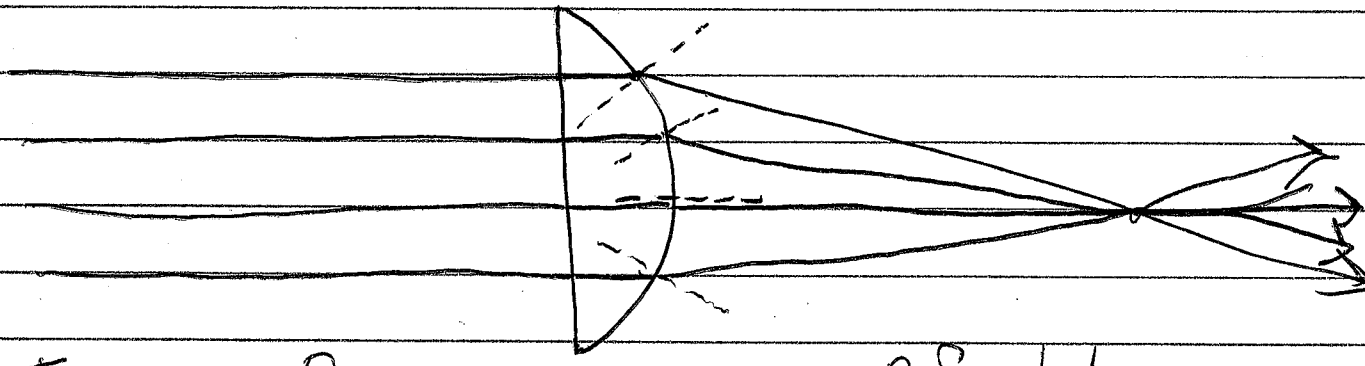


The observer sees the image, which is the apparent source of the rays.

This is a virtual image because the observed rays never actually cross.

(3)

How does curved glass form a lens?



Incoming Rays are parallel

Refracted rays meet

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

At back: $n_1 = 1.5$ (glass) — n decreases

$n_2 = 1.0$ (air) — θ increases

Converging Lens – Nudges rays toward each other.

When parallel rays hit a converging lens the refracted rays cross at a point called the focal point.

④

Lens Math

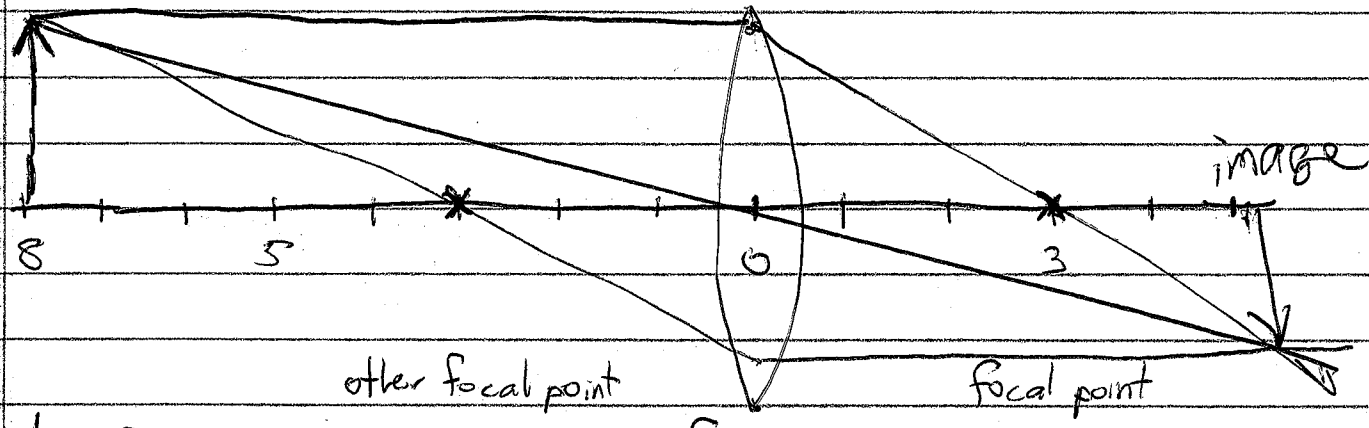
$$\frac{1}{p} + \frac{1}{q} = \frac{1}{f}$$

$p = d_o$ = object dist.

$q = d_i$ = image dist.

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

f = focal length



$d_o = 8$ cm $\qquad f = 3$ cm

$$\frac{1}{8} + \frac{1}{d_i} = \frac{1}{3}$$

$$\frac{1}{d_i} = \frac{1}{3} - \frac{1}{8} = \frac{8}{24} - \frac{3}{24} = \frac{5}{24}$$

$$d_i = 24/5 = 4.8 \text{ cm}$$

Ray Diagram:

- Parallel Ray – refracted thru f.
- Central Ray – goes straight
- Focal Ray – bends parallel

Magnification: $m = \frac{-d_i}{d_o} = \frac{h_i}{h_o}$ $\qquad m = \frac{-4.8}{8} = -0.6$

(5)

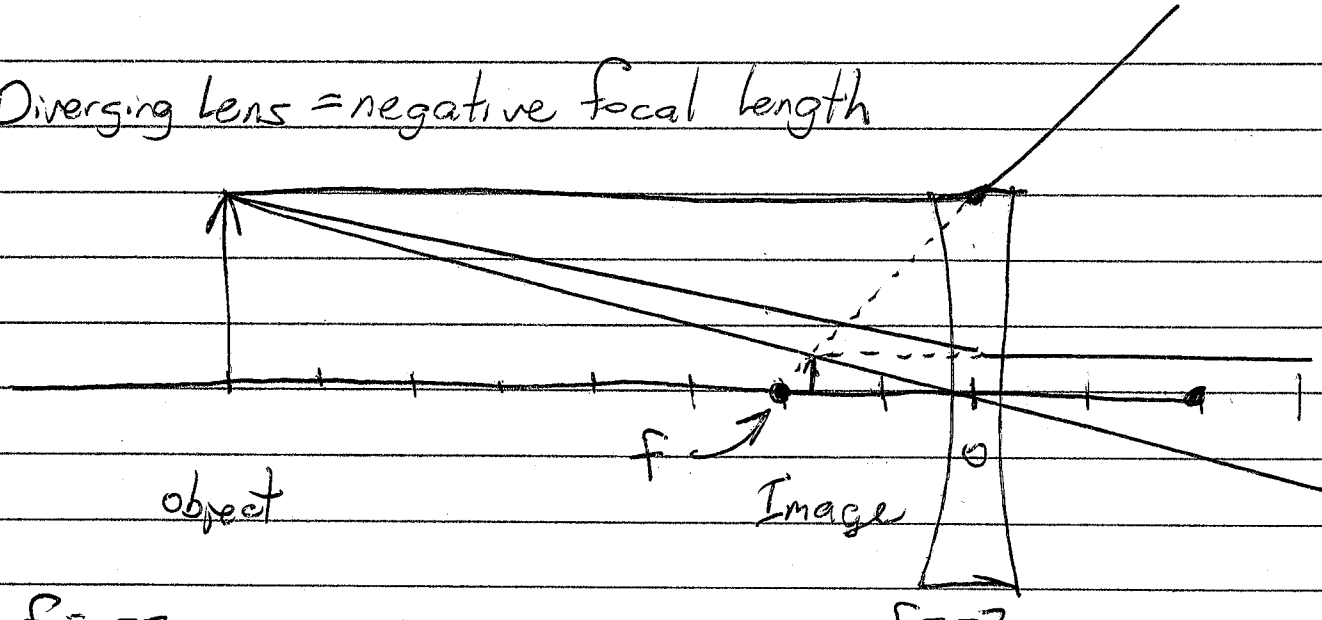
Converging lens, nearby object

$f = 100$ cm
$d_o = 60$ cm

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

$$d_i = \left(\frac{1}{100} - \frac{1}{60}\right)^{-1}$$
$$= -150 \text{ cm}$$

Diverging lens = negative focal length



$f = -2$ cm
$d_o = 8$ cm

$$d_i = \left(\frac{1}{-2} - \frac{1}{8}\right)^{-1} = \left(\frac{-4}{8} - \frac{1}{8}\right)^{-1} = \left(\frac{-5}{8}\right)^{-1} = \frac{-8}{5}$$
$$= -1.6 \text{ cm}$$