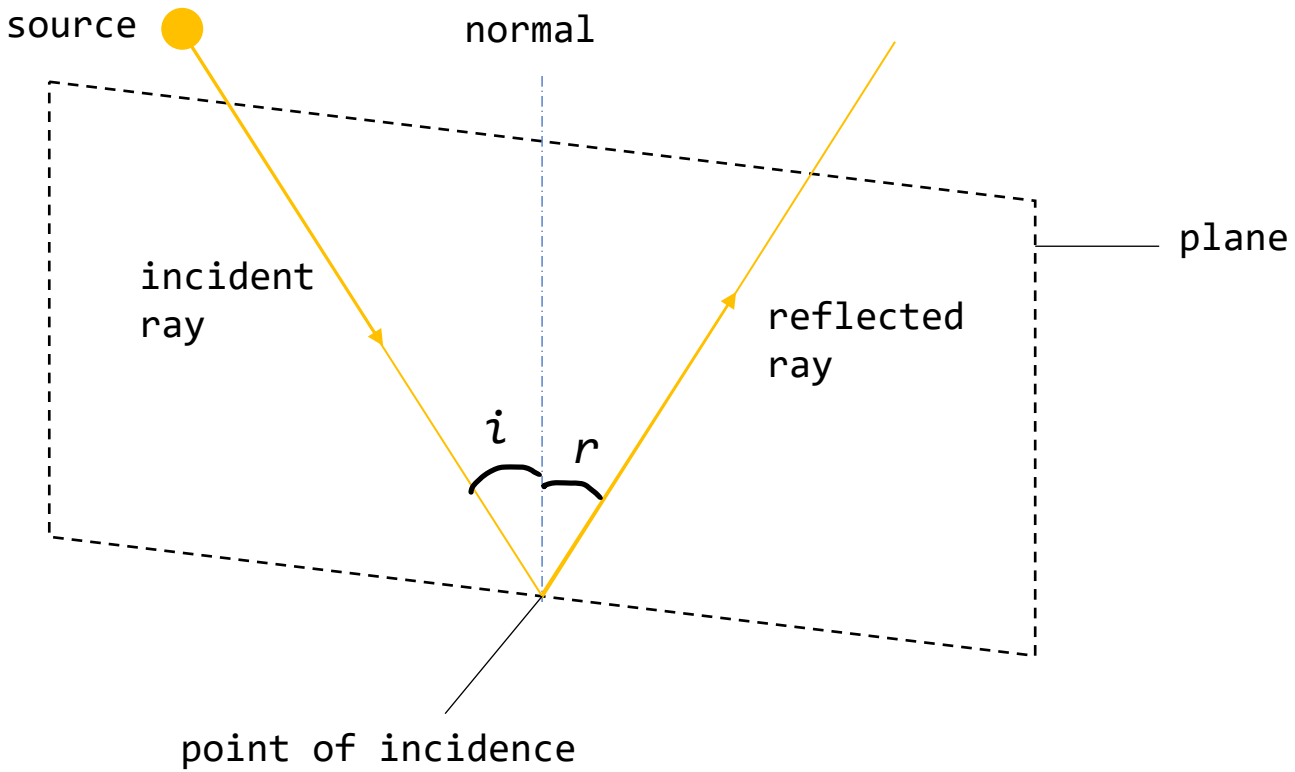
Light

Chapter 13

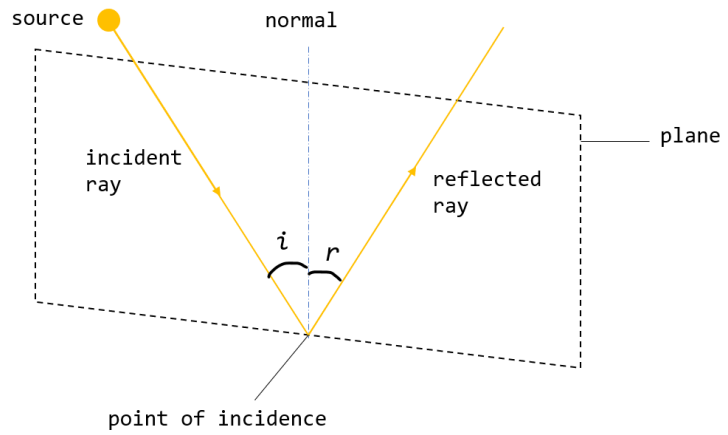
Terminology



Two laws of reflection

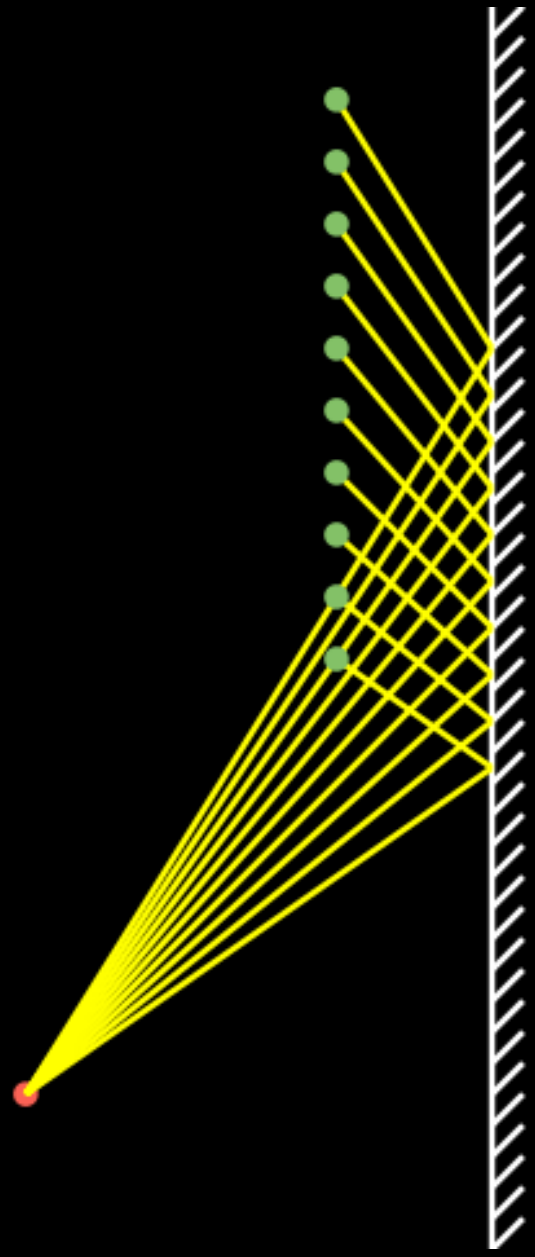
- [1] The incident ray, the reflected ray, and the normal at the point of incidence all lie on the same plane.

- [2] The angle of incidence, i, is equal to the angle of reflection, r. ($i = r$)



Regular v. Diffused Reflection

- Regular reflection
  - Reflection off a smooth surface
- Diffused reflection
  - Reflection off an irregular/rough surface



Ray diagram for plane mirrors

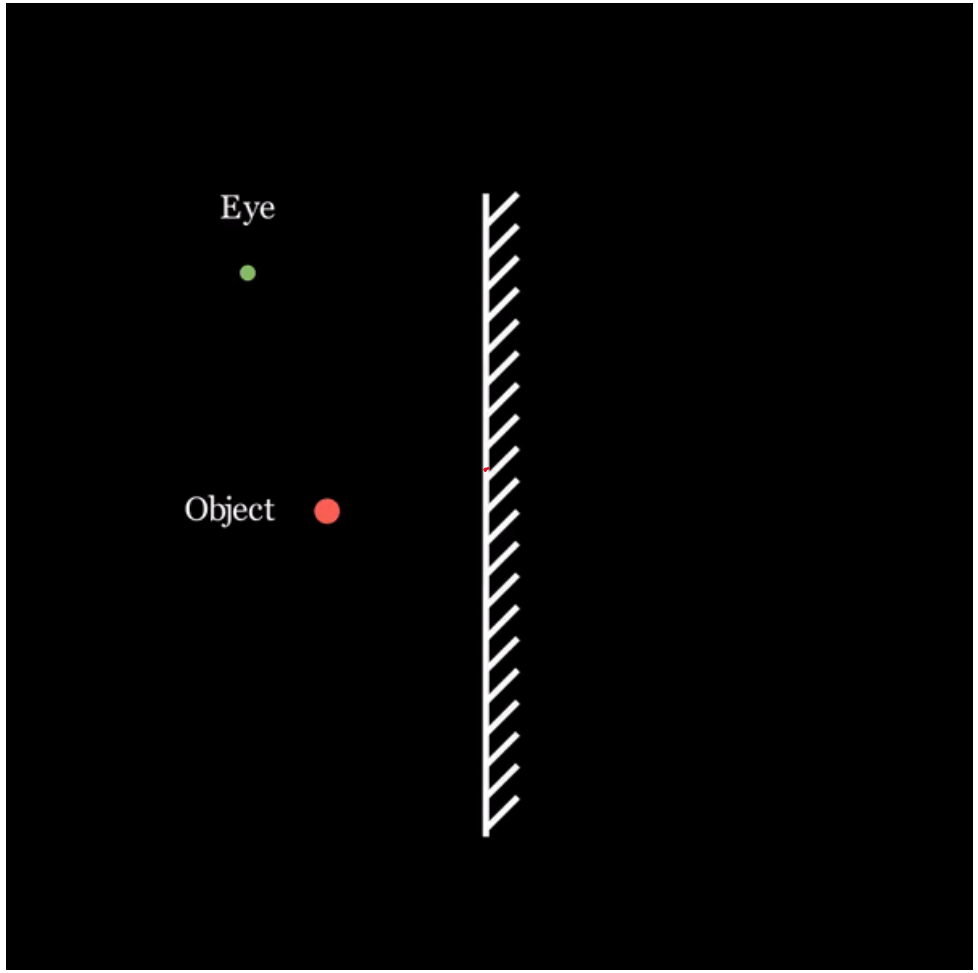
[Single light ray]

(Object and eye are points)

1> Draw image in mirror (should be the same distance from mirror as object)

2> Draw a line from image to eye to determine reflected ray

3> Draw line from object to point of incidence for incident ray



Ray diagram for plane mirrors

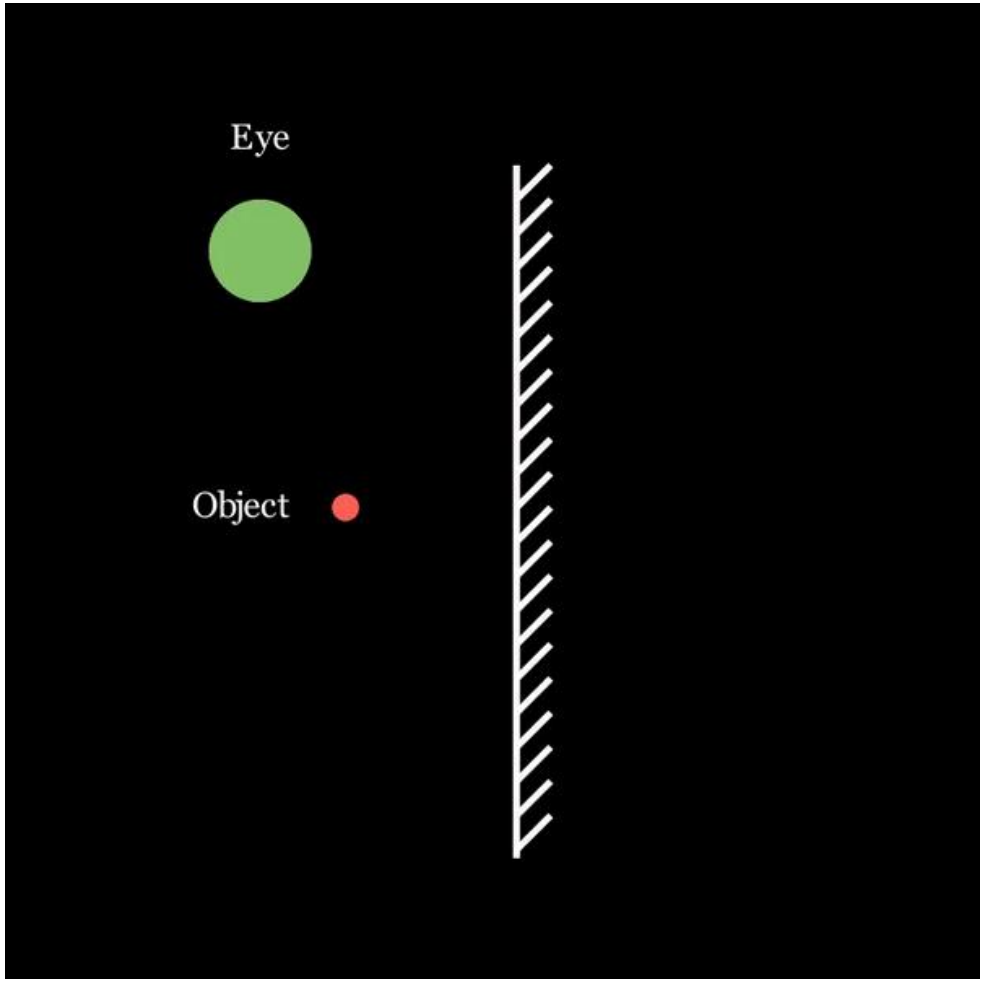
[Cone of light]

(Object is a point, eye is not a point)

1> Draw image in mirror (should be the same distance from mirror as object)

2> Draw two lines from image to eye to determine reflected rays

3> Draw lines from object to point of incidence for incident rays

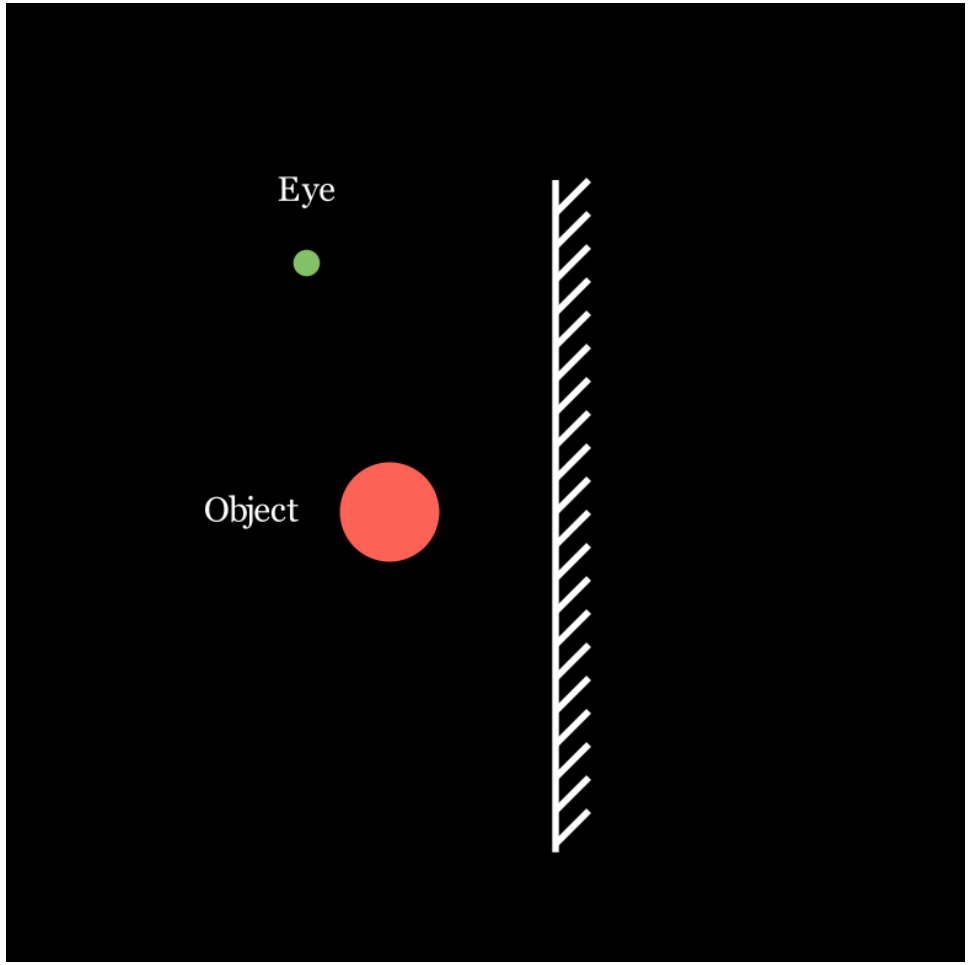


Ray diagram for plane mirrors

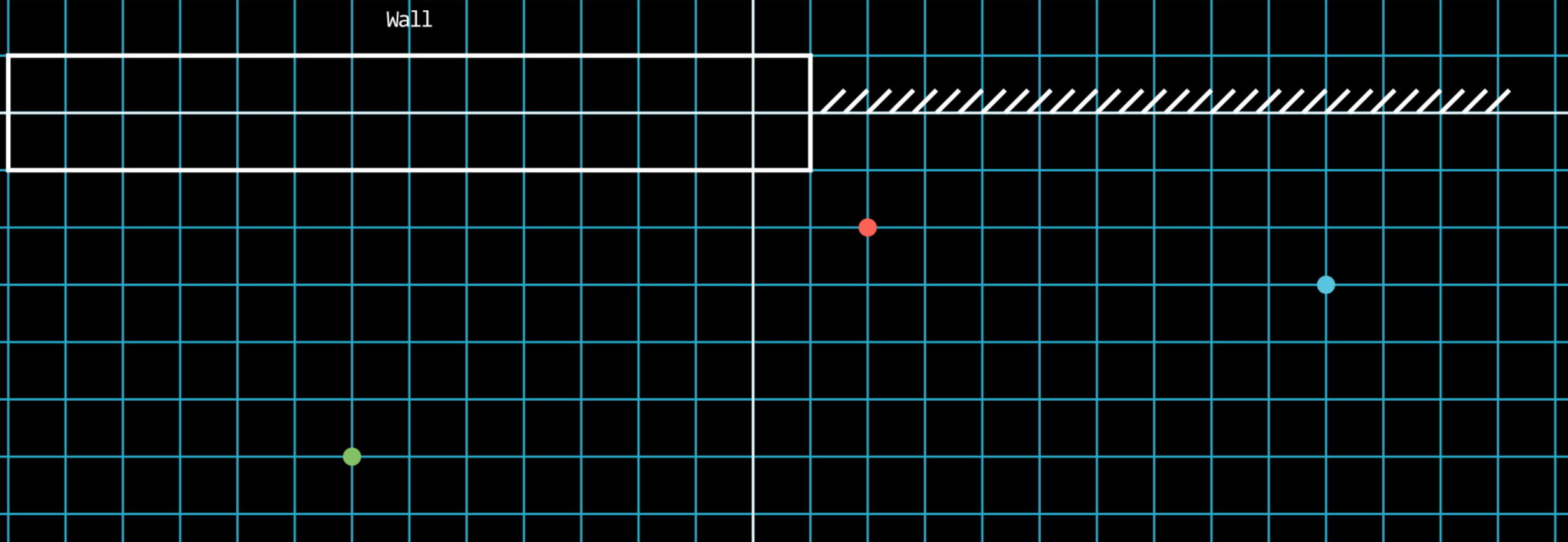
[Large object]

(Object is large, eye is a point)

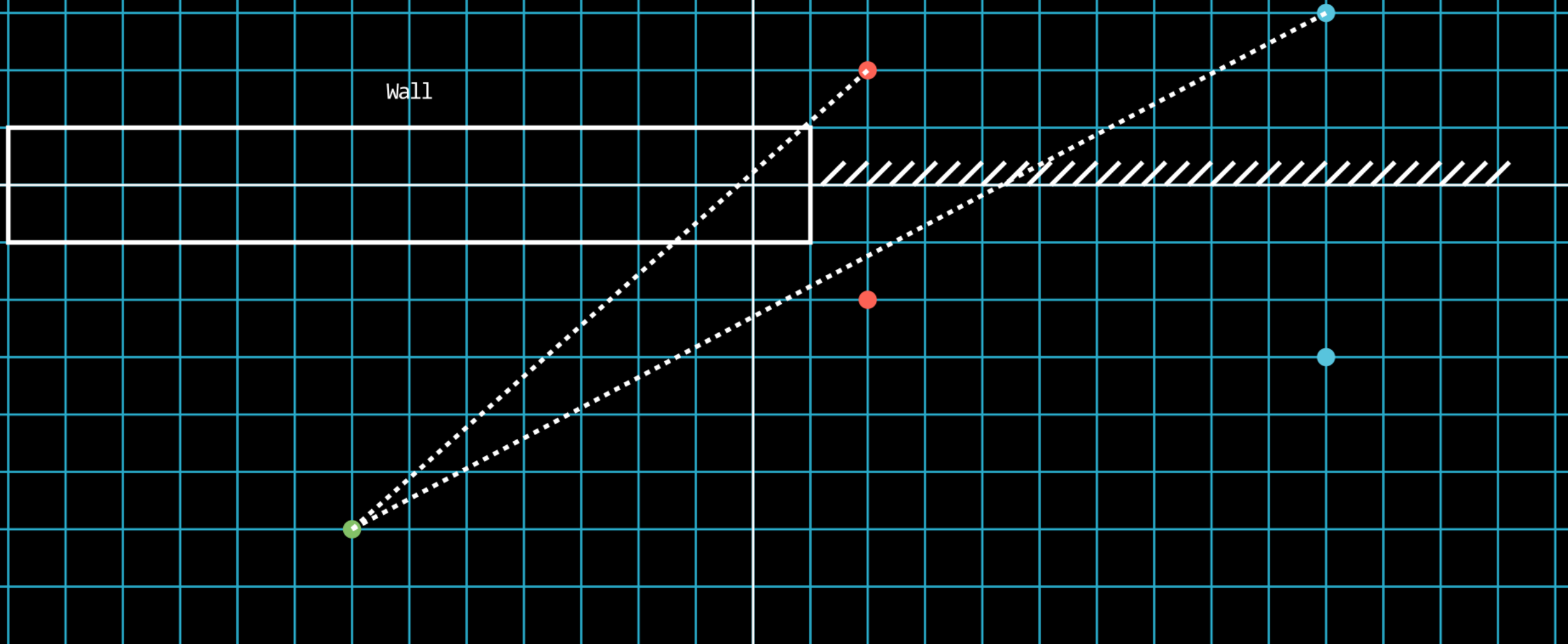
Left as exercise.



Mirror with wall



Mirror with wall



Refraction simulator

Bending Light - Snell's Law | Refraction | Reflection - PhET Interactive Simulations (colorado.edu)

Refractive index (n)

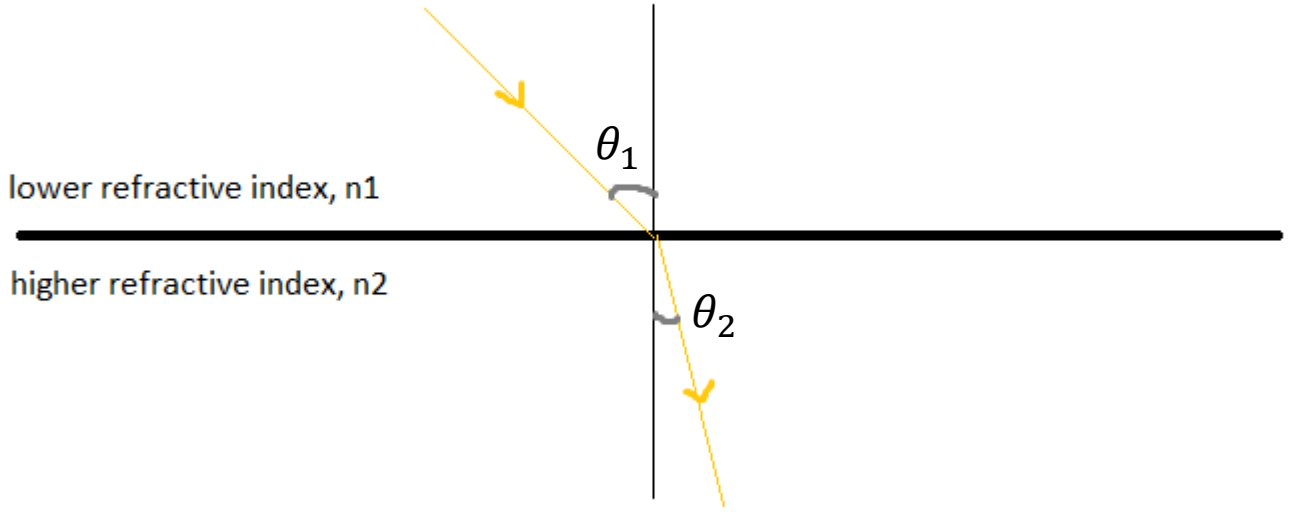
$$n = \frac{c}{v}$$

where

- c = 3.0 x 10^{8} ms^{-1} (speed of light in a vacuum),
- v is the speed of light in the medium, and
- n is the refractive index of the medium

Snell's Law

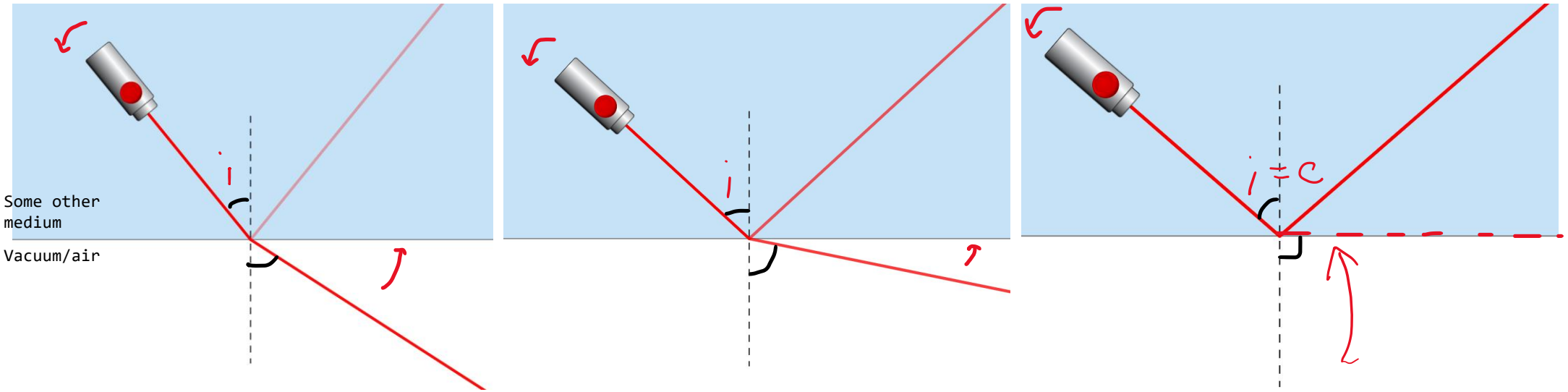
$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$



Note: Refractive index n of vacuum = 1

Critical angle of a medium

$$n = \frac{1}{\sin c}$$

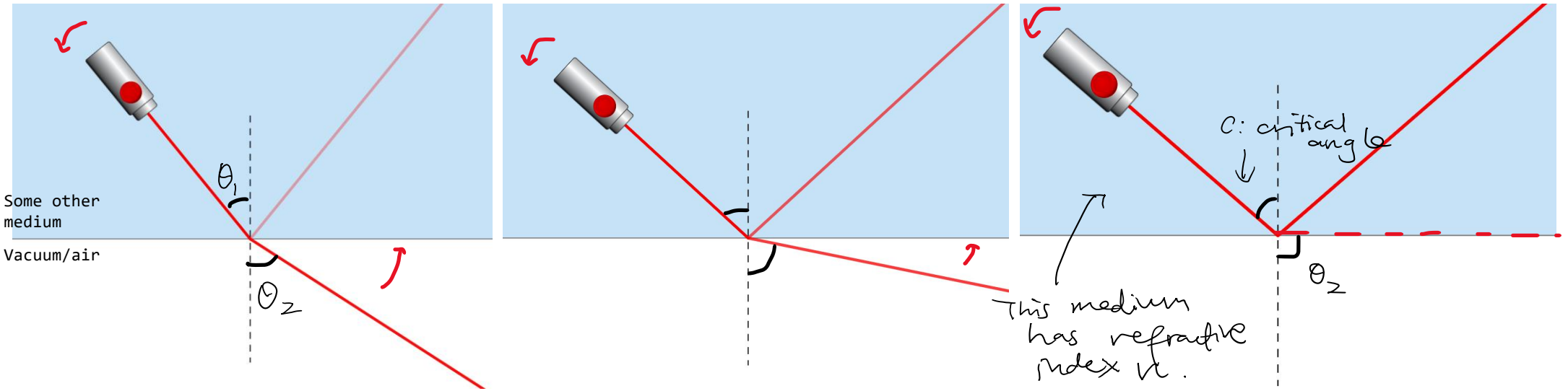


Total Internal Reflection

- Happens when angle of incidence increases beyond critical angle
- Two conditions:
  - [1] Light ray must travel from material with higher refractive index to material with lower refractive index (higher --> lower)
  - [2] Angle of incidence of light ray must be greater than critical angle of the medium ($i > c$)

Critical angle of a medium

$$n = \frac{1}{\sin c}$$



Total Internal reflection

Snell's Law: $n_1 \sin\theta_1 = n_2 \sin\theta_2$

Since $n_2 = 1$, (because refractive index of air = 1)

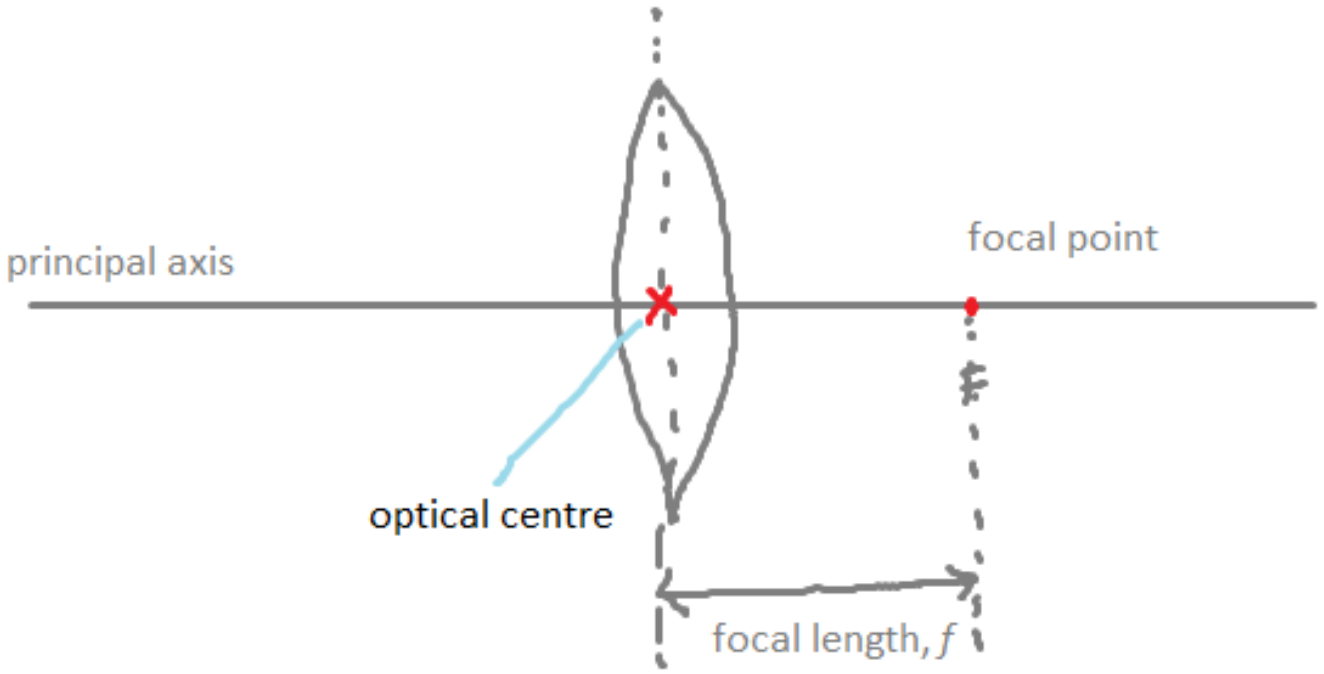
$\theta_2 = 90°$, $\sin 90° = 1$

$n_1 \sin\theta_1 = (1)(1)$

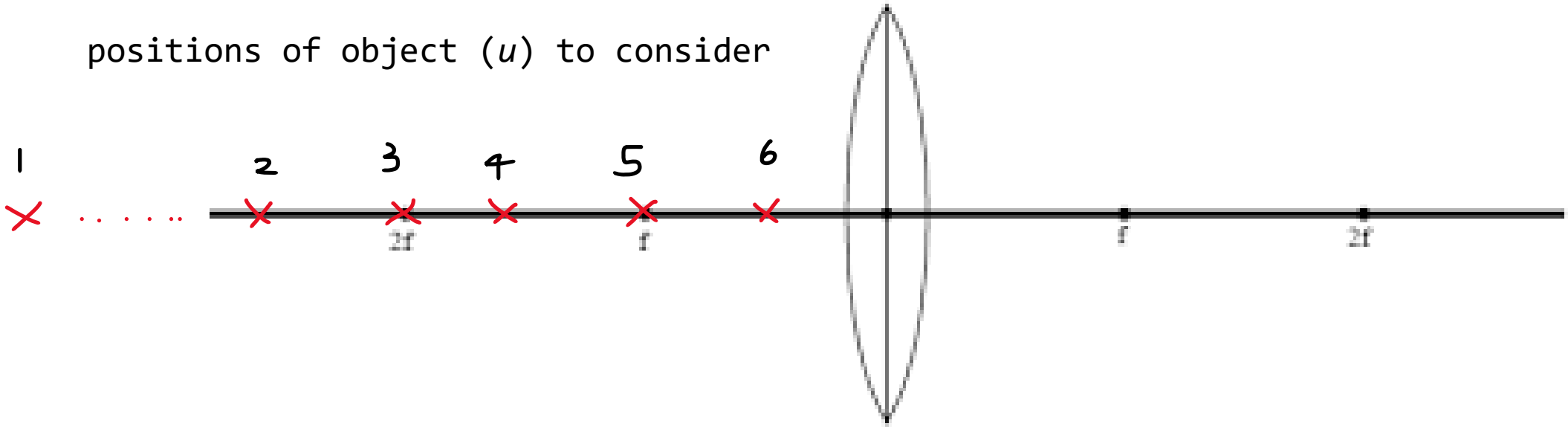
$n_1 = \frac{1}{\sin\theta_1}$

$$n = \frac{1}{\sin c}$$

Thin convex lenses



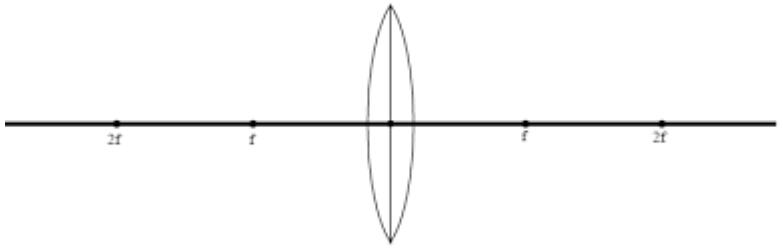
positions of object (u) to consider



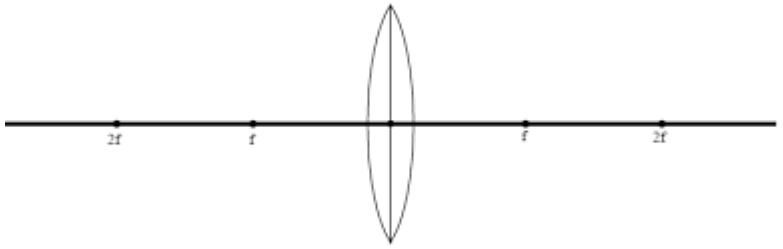
Terminology

- Orientation: Upright / Inverted
- Size: Diminished / Same size / Magnified
- Type: Real / Virtual

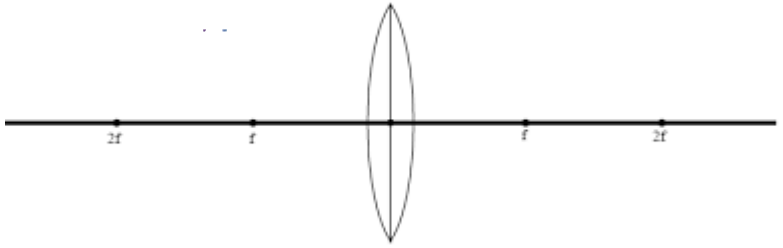
Case #1: u = infinite



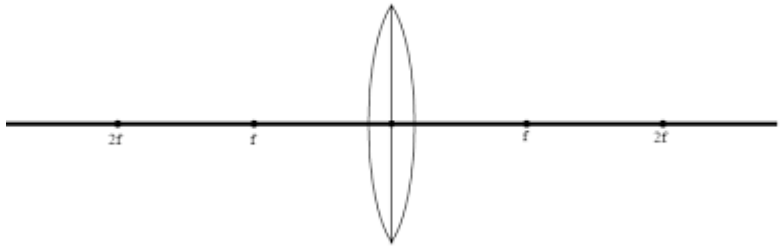
Case #2: u > 2*f*



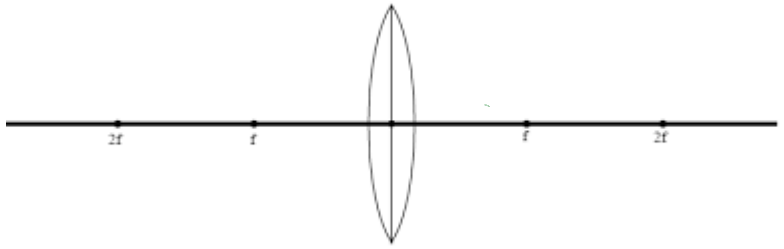
Case #3: u = 2*f*



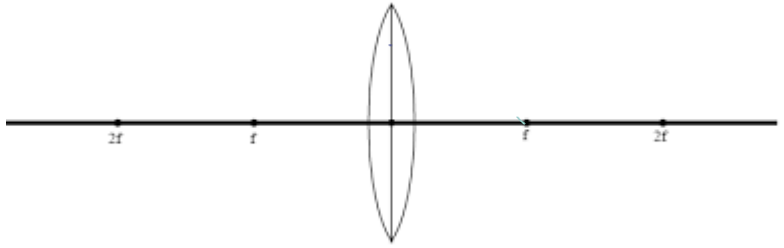
Case #4: *f* < u < 2*f*



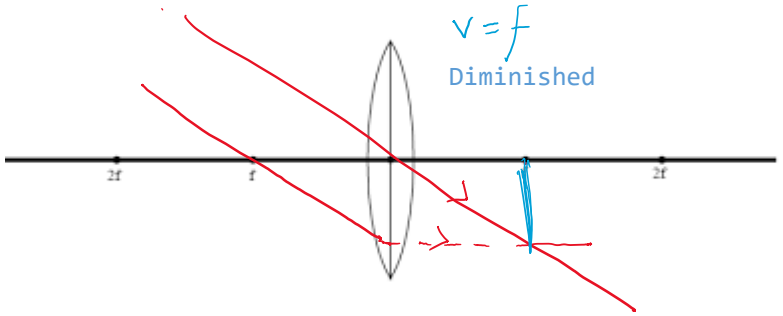
Case #5: u = *f*



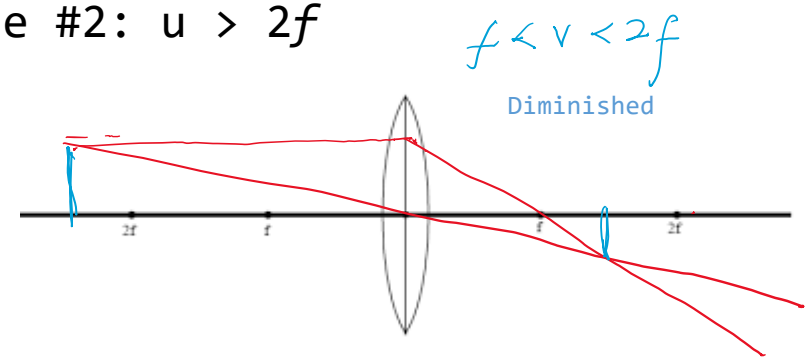
Case #6: u < *f*



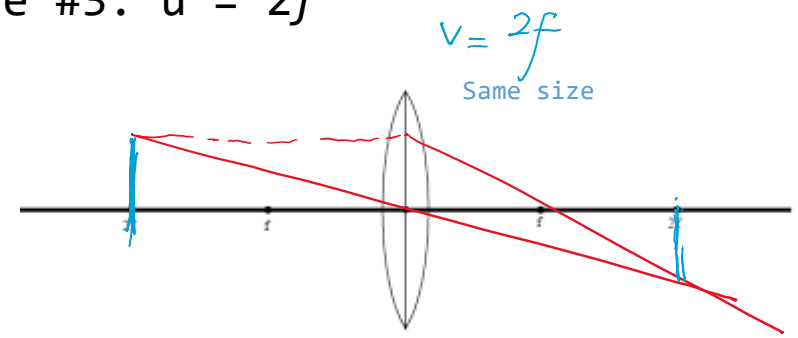
Case #1: u = infinite



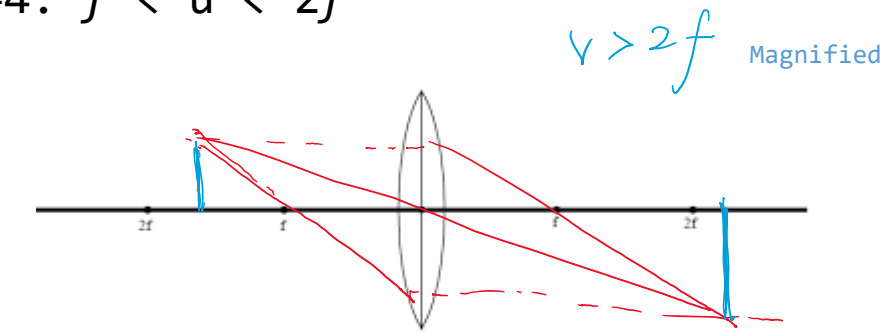
Case #2: u > 2*f*



Case #3: u = 2*f*



Case #4: *f* < u < 2*f*



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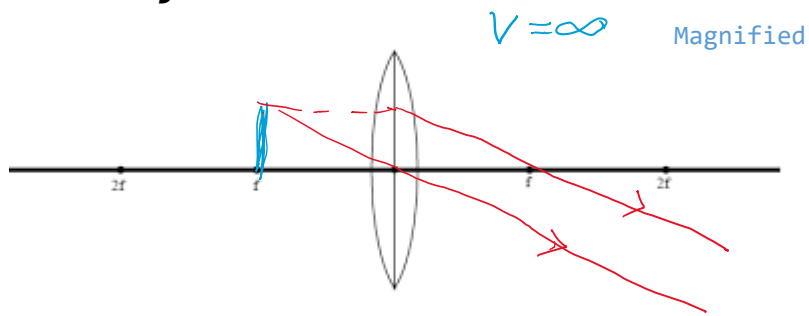
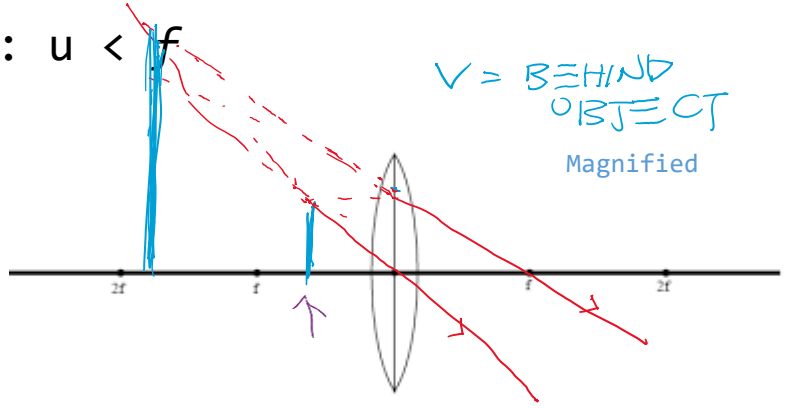


Case #6: u < *f*



Distance, *u*	**Type of Image**	**Direction**	**Size**
$u \leq f$	virtual	upright	magnified
$f < u < 2f$	real	inverted	magnified
$u = 2f$	real	inverted	same
$u > 2f$	real	inverted	diminished
$u = \infty$	real	inverted	diminished