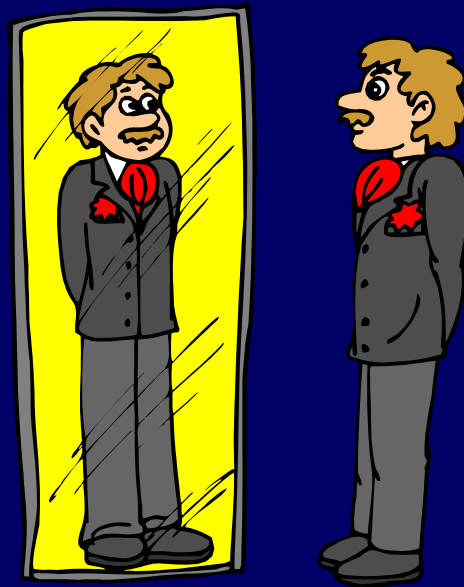


Physics 102: Lecture 16

Introduction to Mirrors



Exam II Tuesday April 1st!

- What will exam cover?
 - Lectures 8 – 15 (Magnetic fields – Polarization)
- What do you need to bring?
 - All you need is a #2 pencil, calculator, and your ID
 - Go to correct room (sign-up for conflict)

**Homework for tomorrow reduced
1/2 problems moved to next assignment
marked optional on this week**

Physics 102 recent lectures

Light as a wave

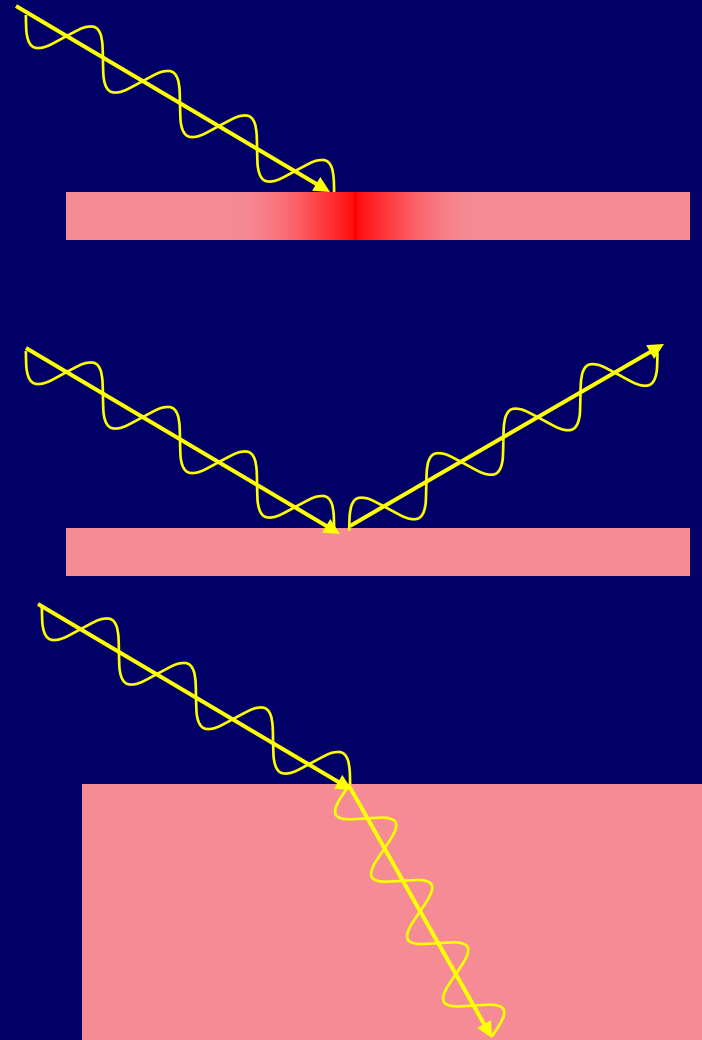
- Lecture 14 – EM waves
- Lecture 15 – Polarization
- Lecture 20 & 21 – Interference & diffraction (coming soon!)

Light as a ray

- Lecture 16 – Reflection
- Lecture 17 – Spherical mirrors & refraction
- Lecture 18 – Refraction & lenses
- Lecture 19 – Lenses & your eye

Light incident on an object

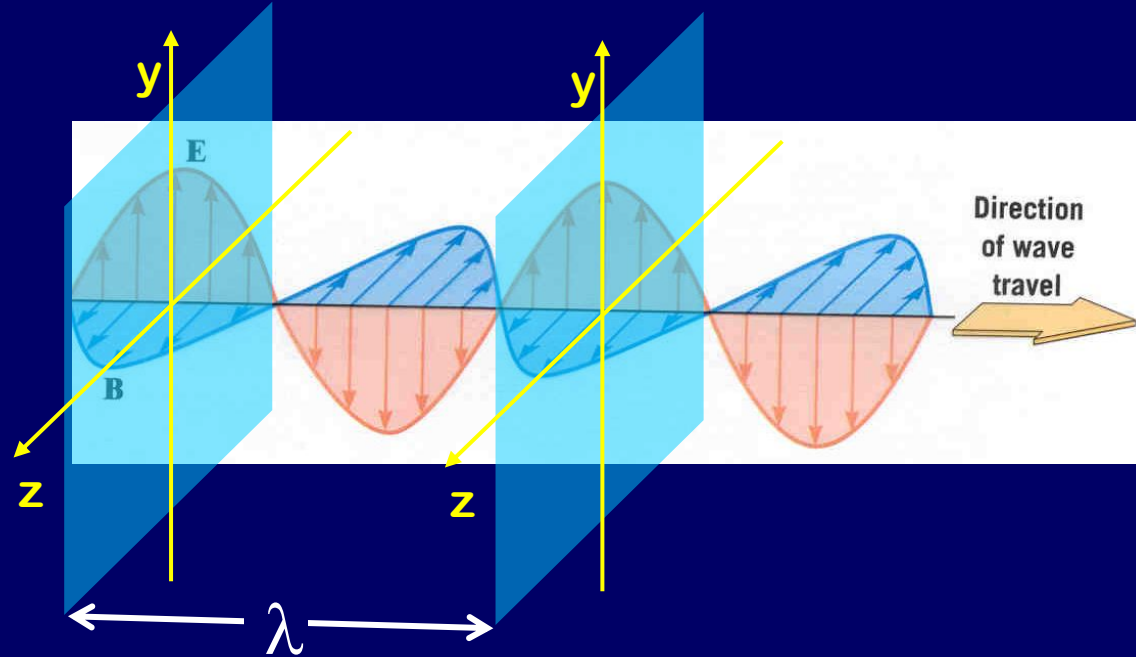
- **Absorption**
- **Reflection** (bounces)
 - See it
 - Mirrors
- **Refraction** (bends)
 - Lenses
- Often some of each



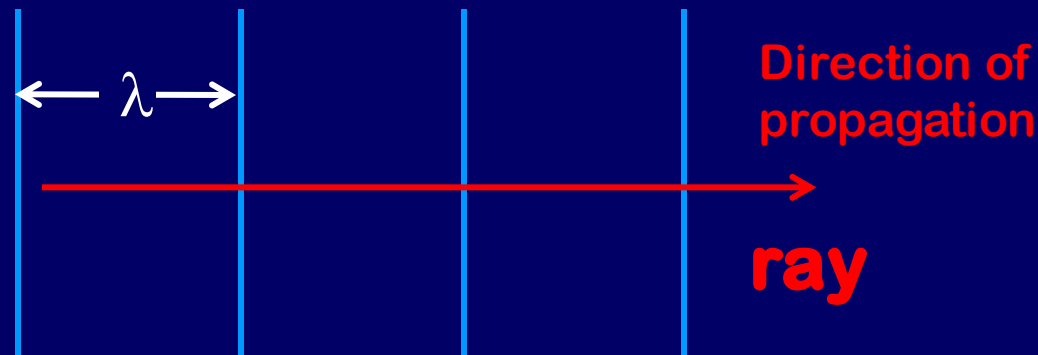
Everything true for wavelengths \ll object size

Recall: wavefronts

Wavefronts represent “crests” of EM wave

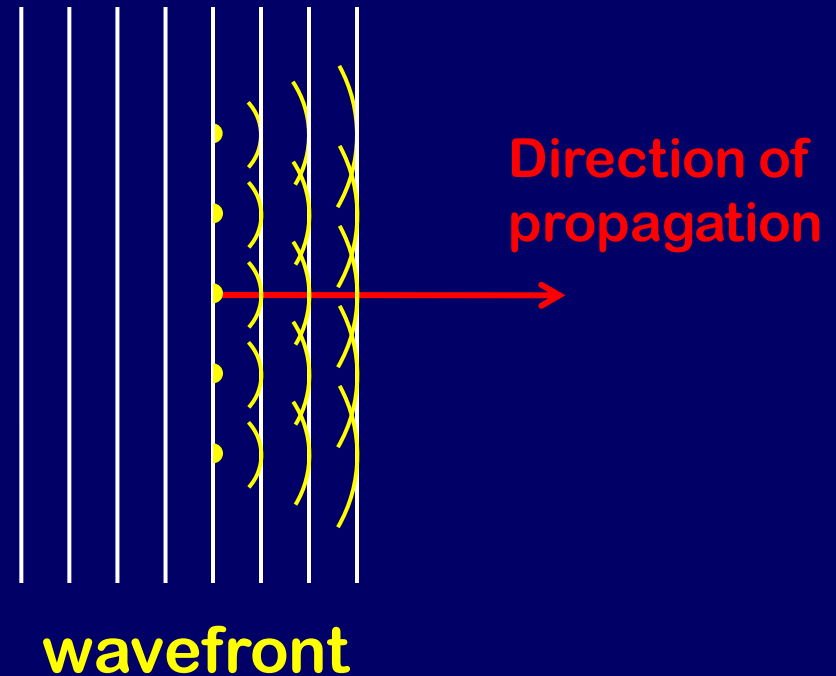


Top view:



Huygens' principle

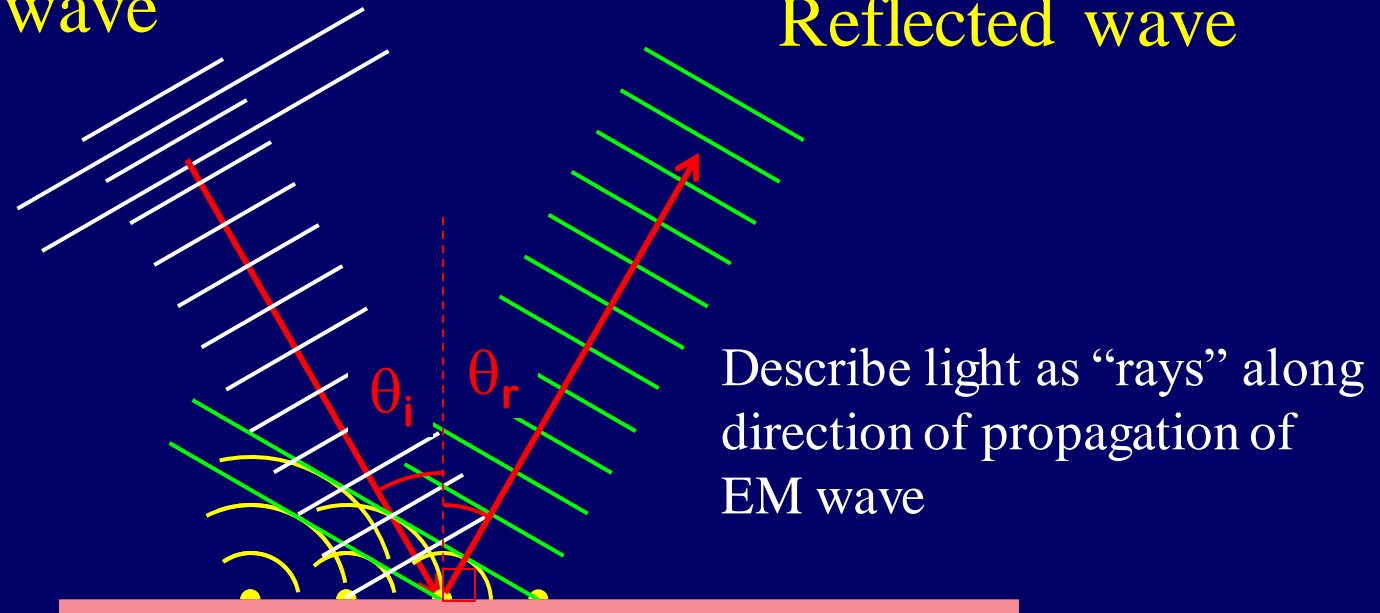
Every point on a wavefront acts as a source of tiny “wavelets” that move forward.



Law of Reflection

Incident wave

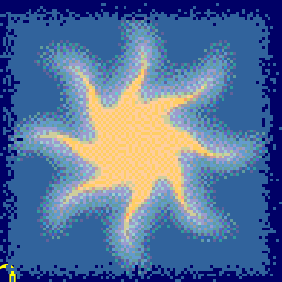
Reflected wave



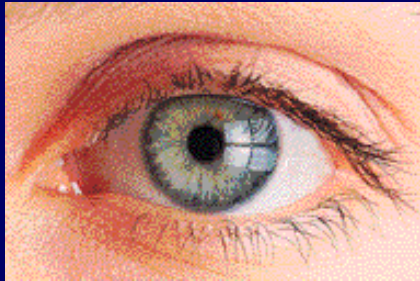
Angle of incidence = Angle of reflection

$$\theta_i = \theta_r$$

Object Location



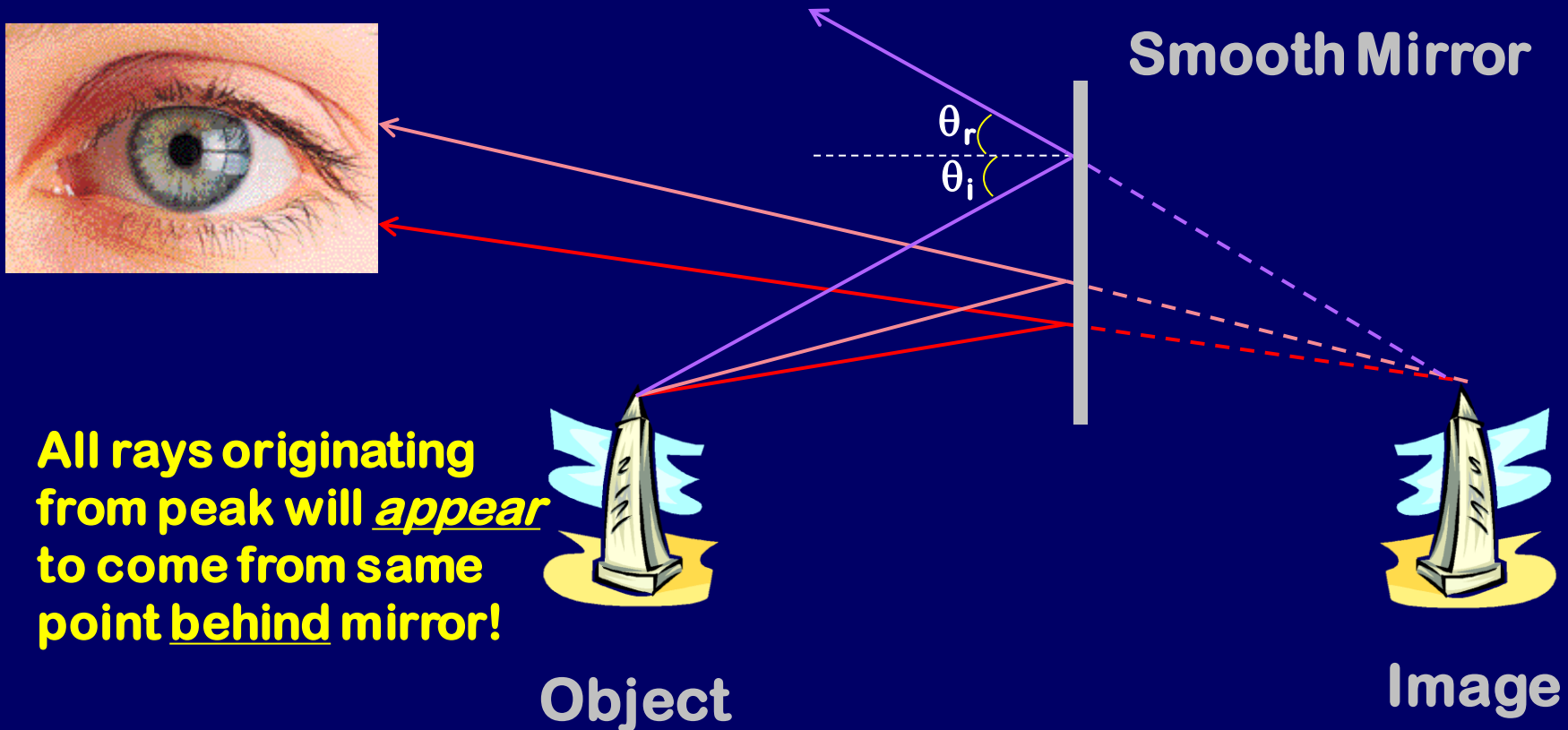
- Light rays from sun bounce off object and go in all directions
 - Some hit your eyes

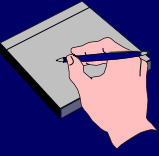


We know object's location by where rays come from.

Flat Mirror

- All you see is what reaches your eyes
 - You think object's location is where rays appear to come from.



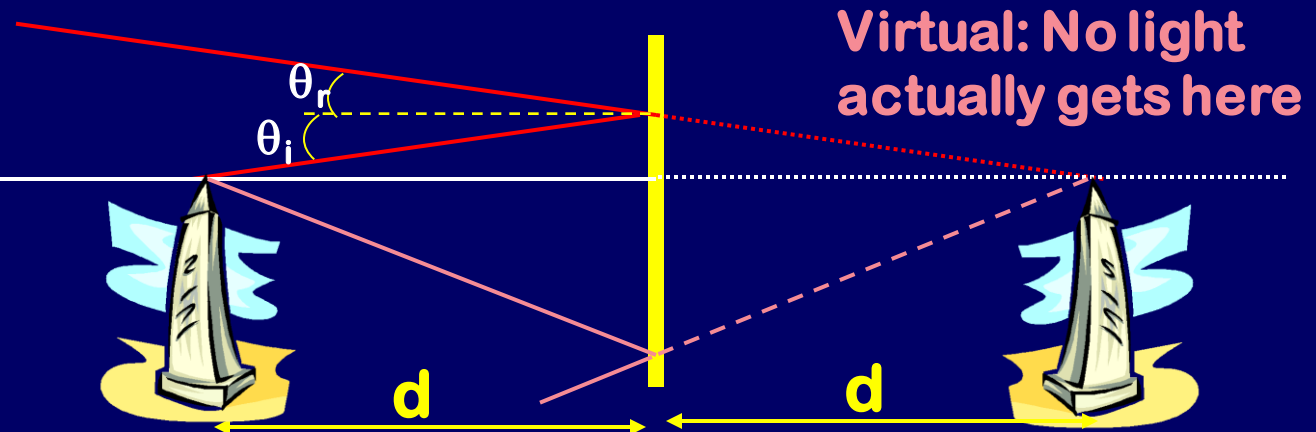


Flat Mirror

- (1) Draw first ray perpendicular to mirror $0 = \theta_i = \theta_r$
- (2) Draw second ray at angle. $\theta_i = \theta_r$
- (3) Lines appear to intersect a distance d behind mirror. This is the image location.

Example

Light rays don't really converge there, so it's a **“Virtual Image”**



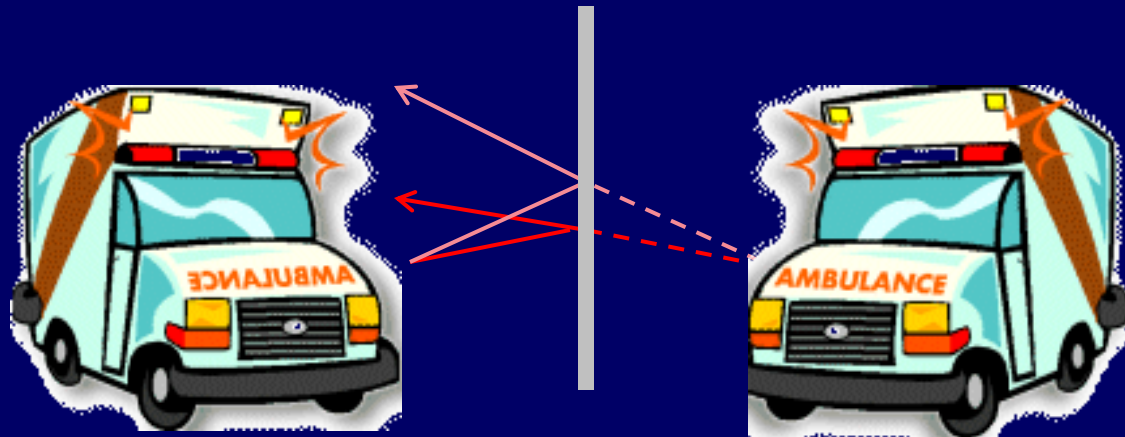
Flat Mirror Summary

- Image appears:
 - Upright
 - Same size
 - Located same distance from, but behind, mirror
 - Facing opposite direction: Left/Right inverted
 - Virtual Image: Light rays don't actually intersect at image location.

Checkpoint 1.1

Why do ambulances have
“AMBULANCE”
written backwards?

So that people in cars
can read it in their
rearview mirrors



Checkpoint 2.1

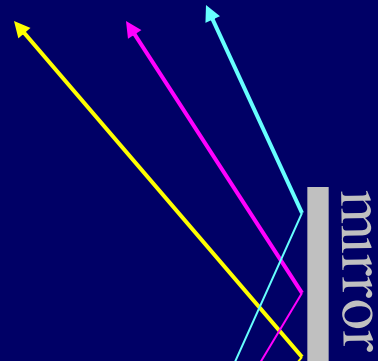
Can you see Fido's tail in mirror?

A) YES B) NO

(You)



(Fido)



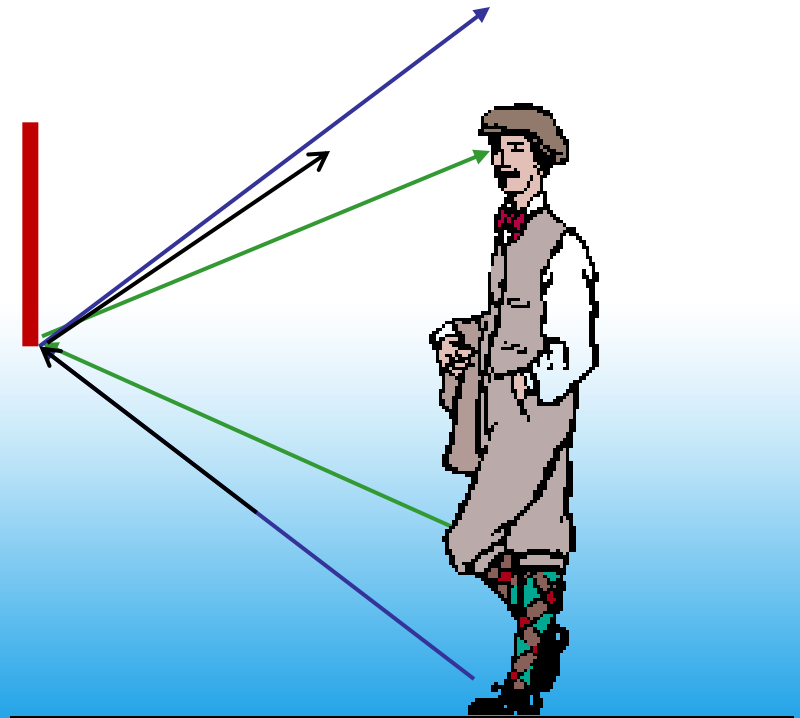
No!

You need light rays from the tail to bounce off mirror and reach your eye!

Mirrors

I am looking at my reflection in a flat vertical mirror. The lowest part of my body I can see is my knee. If I stand closer to the mirror, what will be the lowest part of my reflection I can see in the mirror.

- A. Above my knee
- B. My knee
- C. Below my knee



ACT/Two Mirrors

How many images of money will you see (not including the actual money)?

a. 1

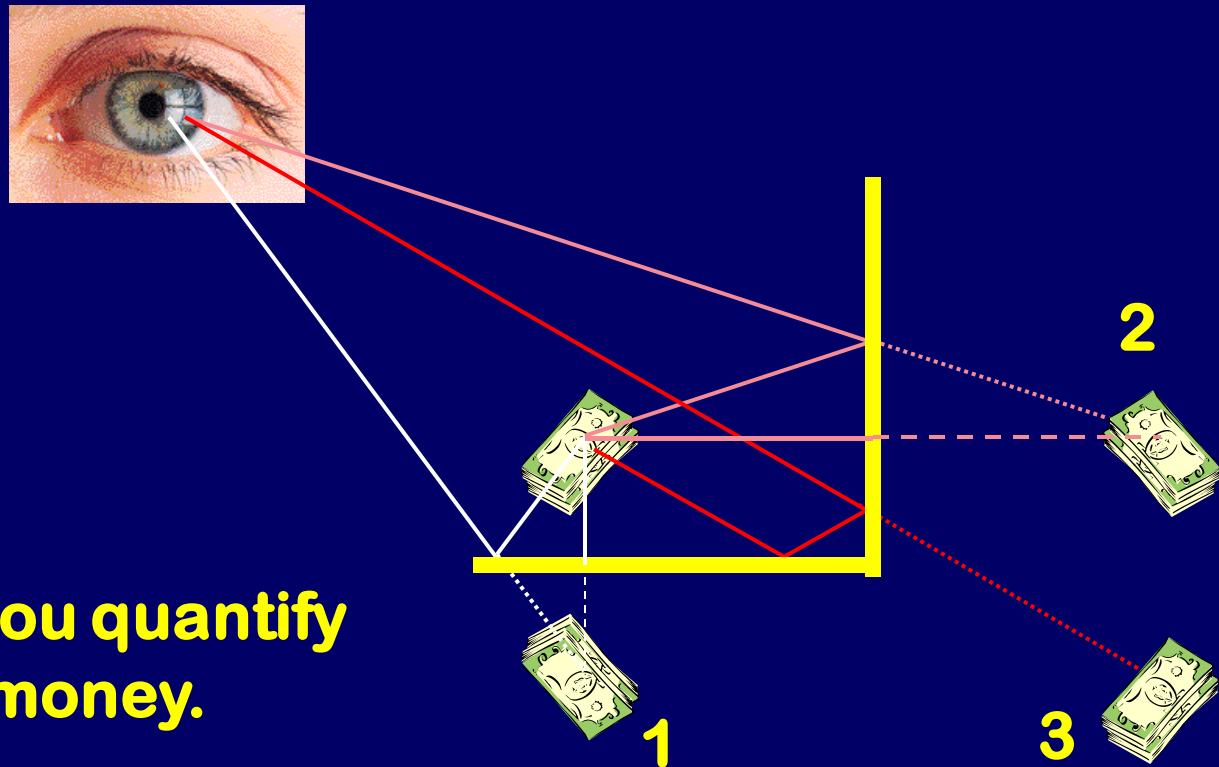
b. 2

c. 3

d. 4

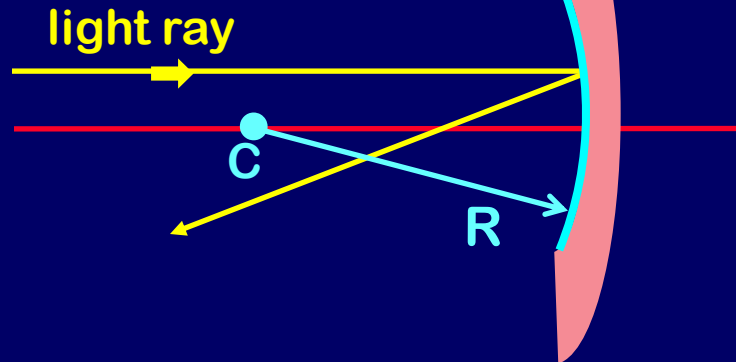
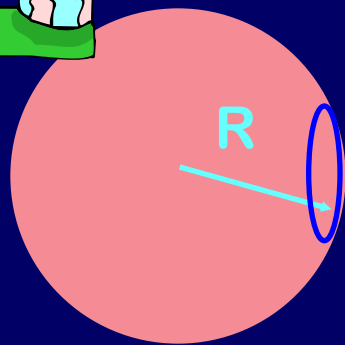
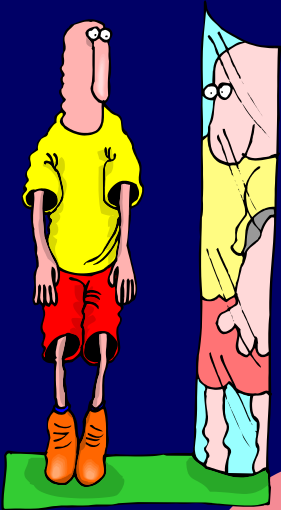
e. 5

Homework lets you quantify positions of the money.



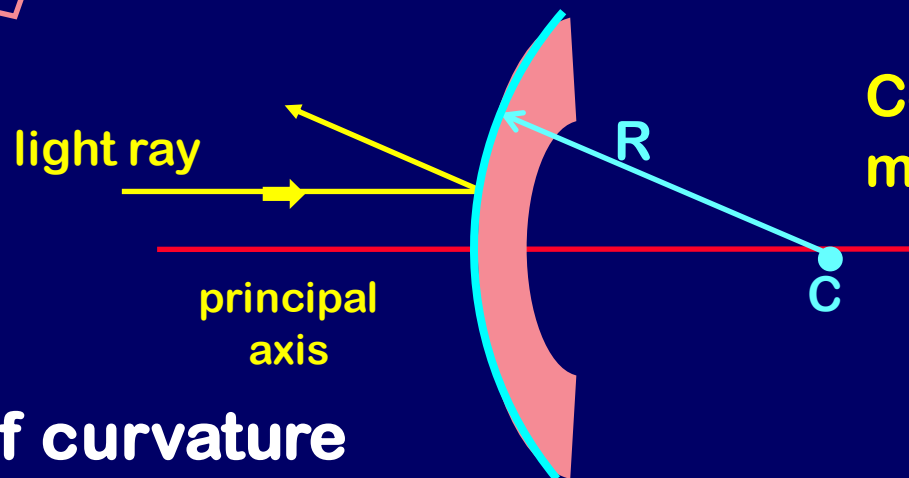
Curved mirrors

A Spherical Mirror: section of a sphere.



Concave
mirror

principal
axis



Convex
mirror

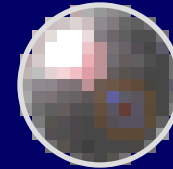
principal
axis

C = Center of curvature

Checkpoint 2.1

An organic chemistry student accidentally drops a glass marble into a silver nitrate mirroring solution, making the outside of the marble reflective.

What kind of mirror is this?

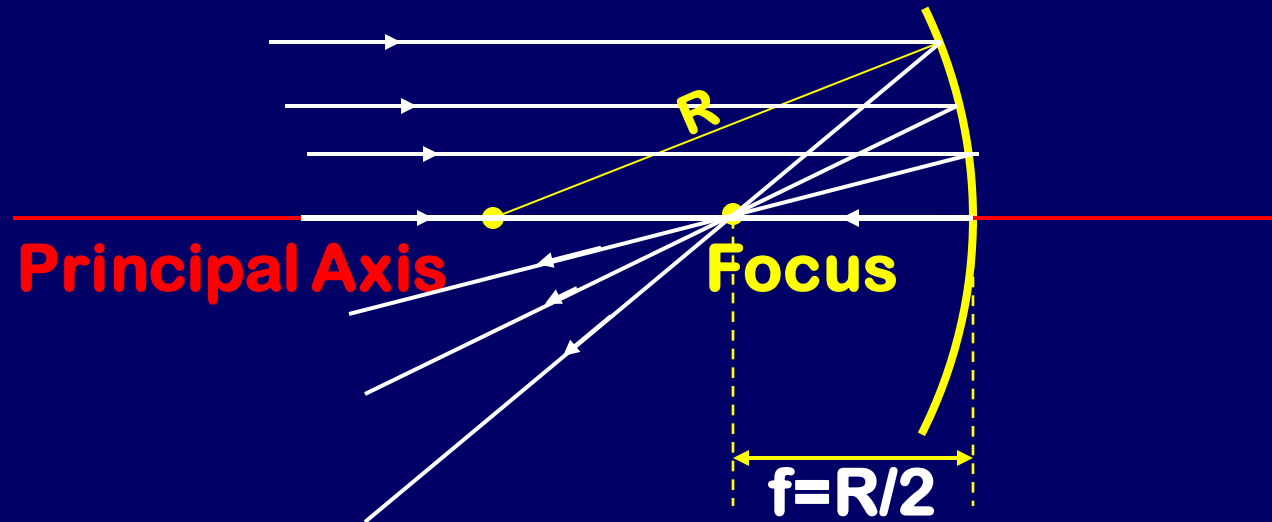


25% (1) concave

71% (2) convex

3% (3) flat

Concave Mirror



Angle of incidence = angle of reflection. Thus rays are bent towards the principal axis.

Rays parallel to **principal axis** and near the **principal axis** (“paraxial rays”) all reflect so they pass through the “Focus” (F).

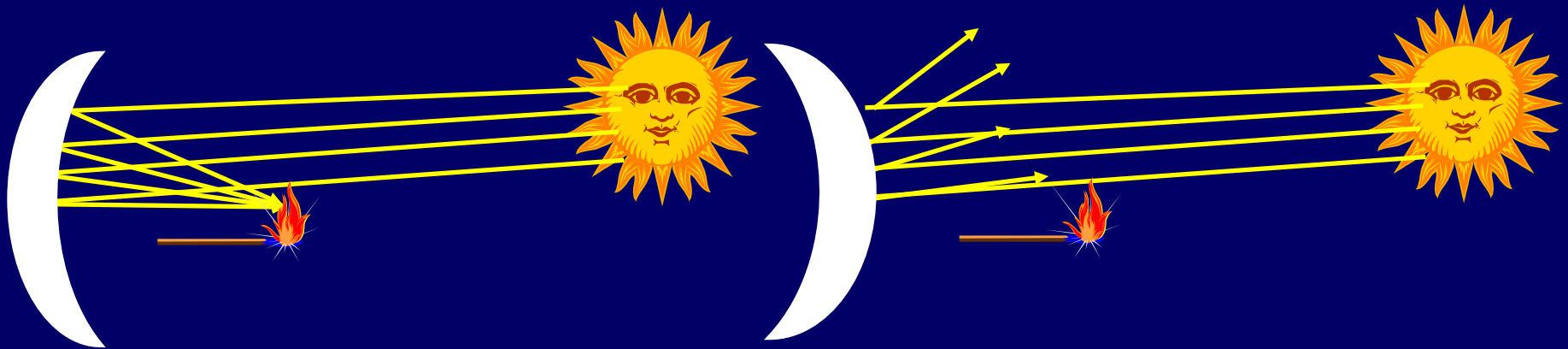
The distance from F to the center of the mirror is called the “Focal Length” (f).

$$f = \frac{R}{2}$$



ACT

A concave mirror can be used to start a fire.

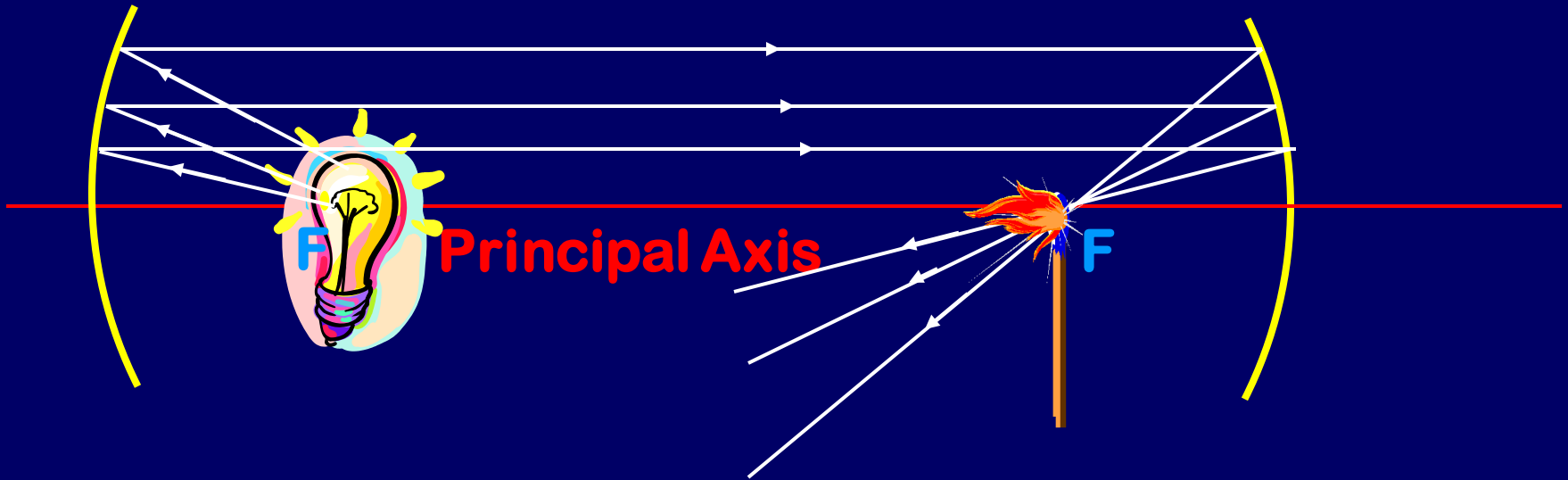


How far from the match to be ignited should the mirror be held?

- A. farther than the focal length
- B. closer than the focal length
- C. at the focal length**



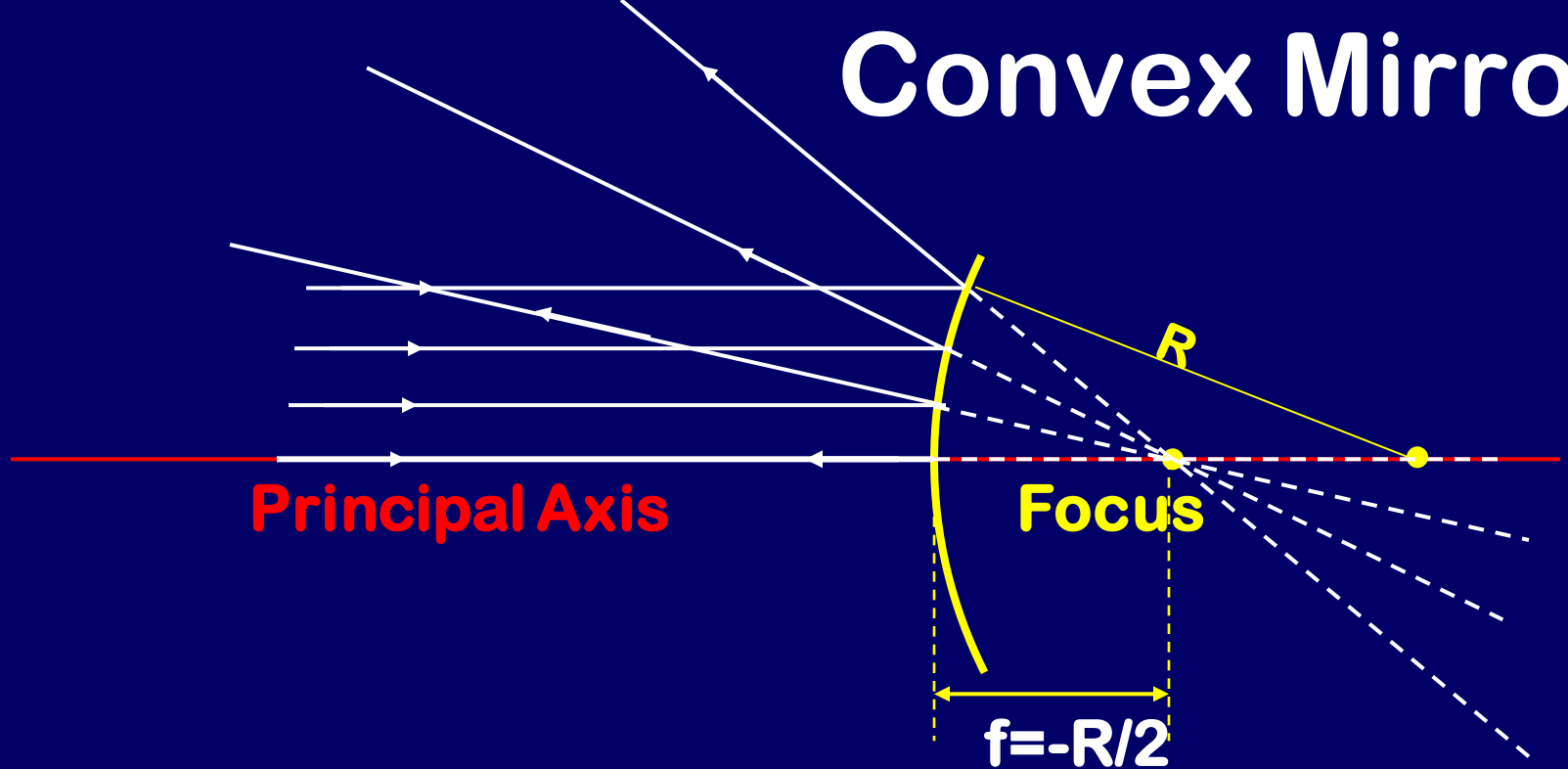
Concave Mirror



Rays traveling through focus before hitting mirror are reflected parallel to **Principal Axis.**

Rays traveling parallel to **Principal Axis before hitting mirror are reflected through focus**

Convex Mirror



Rays are bent away from the principal axis.

Rays parallel to **principal axis** and near the **principal axis** (“paraxial rays”) all reflect so they appear to originate from the “Focus” (F).

The distance from F to the center of the mirror is called the “Focal Length” (f).

$$f = -\frac{R}{2}$$

See You Wednesday.