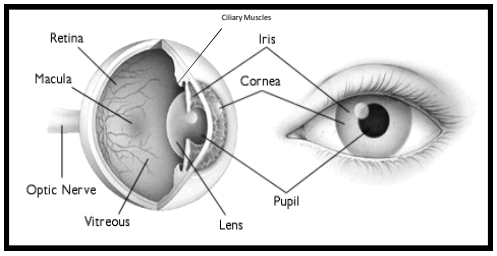
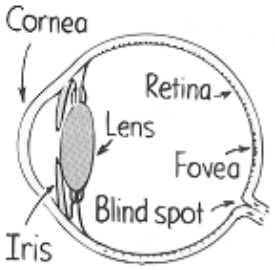
Physics 1161: Lecture 19
Lenses and your EYE

- **textbook sections 27-1 – 27-3**



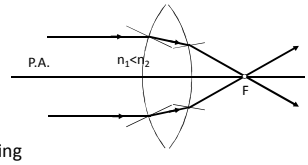
Parts of the Eye



Review of Lenses
Preflight 18.8

Focal point determined by geometry and Snell's Law:

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

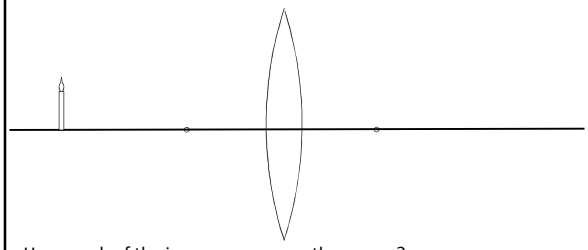


Fat in middle = Converging
Thin in middle = Diverging
Larger n_2/n_1 = more bending, shorter focal length.
$n_1 = n_2$ => No Bending, f = infinity

Lens in water has _____ focal length!

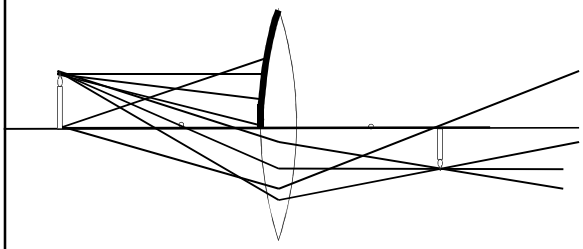
Preflight 19.1

A converging lens is used to project a real image onto a screen. A piece of black tape is then placed over the upper half of the lens.



How much of the image appears on the screen?

Preflight 19.1

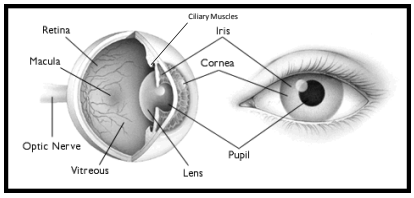


Two very thin converging lenses each with a focal length of 20 cm are are placed in contact. What is the focal length of this compound lens?

1. 10 cm
2. 20 cm
3. 40 cm

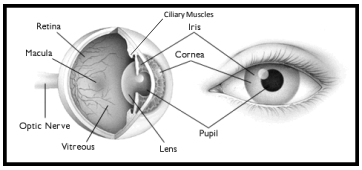
Amazing Eye

- One of first organs to develop.
- 100 million Receptors
  - 200,000 /mm^2
  - Sensitive to single photons!
- http://hyperphysics.phy-astr.gsu.edu/hbase/vision/retina.html#c2



Which part of the eye does most of the light bending?

Cornea n= 1.38
Lens n = 1.4
Vitreous n = 1.33



1. Lens
2. Cornea
3. Retina
4. Cones

Preflight 19.3

A person with normal vision (near point at 26 cm) is standing in front of a plane mirror.

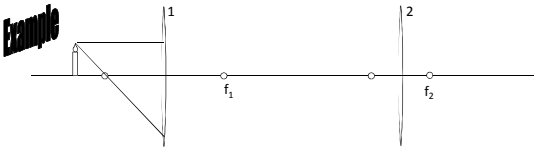
What is the closest distance to the mirror where the person can stand and still see himself in focus?

1) 13 cm
2) 26 cm
3) 52 cm

Multiple Lenses

Image from lens 1 becomes object for lens 2

Example



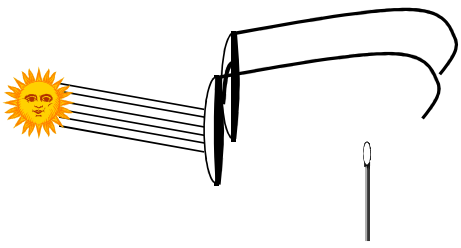
Complete the Rays to locate the final image.

Near Point, Far Point

- Eye's lens changes shape (changes *f*)
  - Object at any d_o can have image be at retina (d_i = approx. 25 mm)
- Can only change shape so much
- "Near Point"
  - Closest d_o where image can be at retina
  - Normally, ~25 cm (if far-sighted then further)
- "Far Point"
  - Furthest d_o where image can be at retina
  - Normally, infinity (if near-sighted then closer)

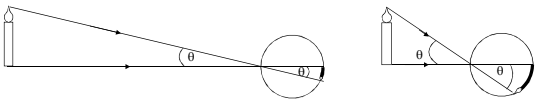
Preflight 19.4

Two people who wear glasses are camping. One of them is nearsighted and the other is farsighted. Which person's glasses will be useful in starting a fire with the sun's rays?



Angular Size
Preflight 19.6, 19.7

Both are same size, but nearer one looks bigger.



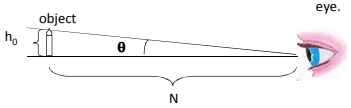
- Angular size tells you how large the image is on your retina, and how big it appears to be.

The focal length of the lens of a simple camera is 40 mm. In what direction must the lens be moved to change the focus of the camera from a person 25 m away to a person 4.0 m away?

1. Away from the film
2. Towards the film

Unaided Eye

How big the object looks with unaided eye.



Bring object as close as possible (to near point N)

$$\tan(\theta) = \frac{h_o}{N} \Rightarrow \theta \approx \frac{h_o}{N}$$

**If θ is small and expressed in radians.