Lecture

4/26/05

Foothold Ideas: Electric and Magnetic Fields

- An electric field is an assignment of a vector to every point in space that tells what force a test charge would feel if placed there.

$$\vec{F}_{elec} = q\vec{E}$$

- Electric fields are set up by charges.
- A magnetic field is an assignment of a vector to every point in space that tells what force a moving test charge would feel if placed at that point in space.

$$\vec{F}_{mag} = q\vec{v} \times \vec{B}$$

- Magnetic fields are set up by currents and bar magnets.

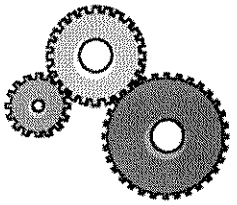
Foothold Ideas of Ray Optics 1: The Physics

- Certain objects (the sun, bulbs,…) give off light.
- Through empty space (or ~air) light travels in straight lines.
- Each point on an object scatters light, spraying it off in all directions.
- A polished surface reflects rays back again according to the rule: *The angle of incidence equals the angle of reflection.*

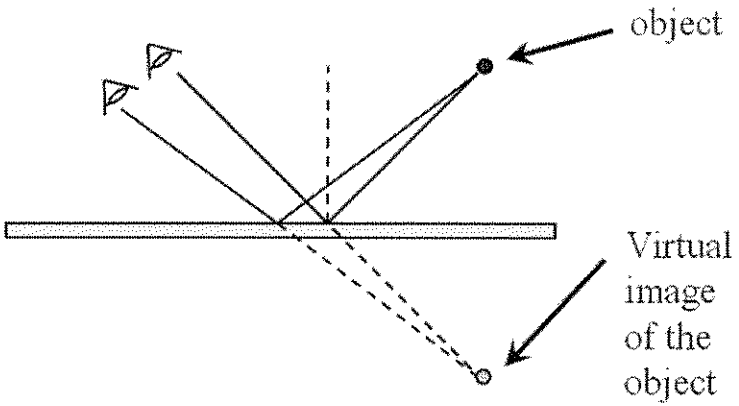
Foothold Ideas of Ray Optics 2: The Psycho-physiology

- We only see something when light coming from it enters our eyes.
- Our eyes identify a point as being on an object when rays traced back converge at that point.
  - Parallax
  - Mel & Taylor method

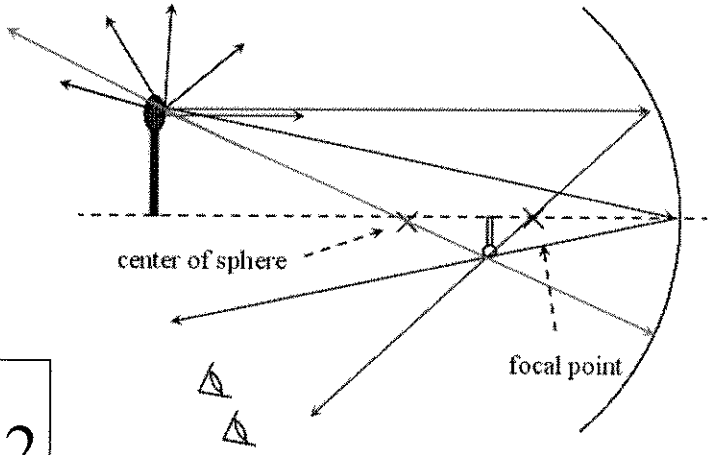
Mirrors



- Plane

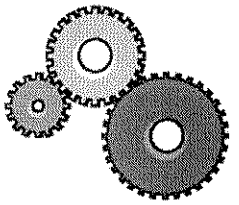


- Curved



$$\frac{1}{f} = \frac{1}{i} + \frac{1}{o} \qquad \frac{h'}{h} = \frac{i}{o} \qquad f = R/2$$

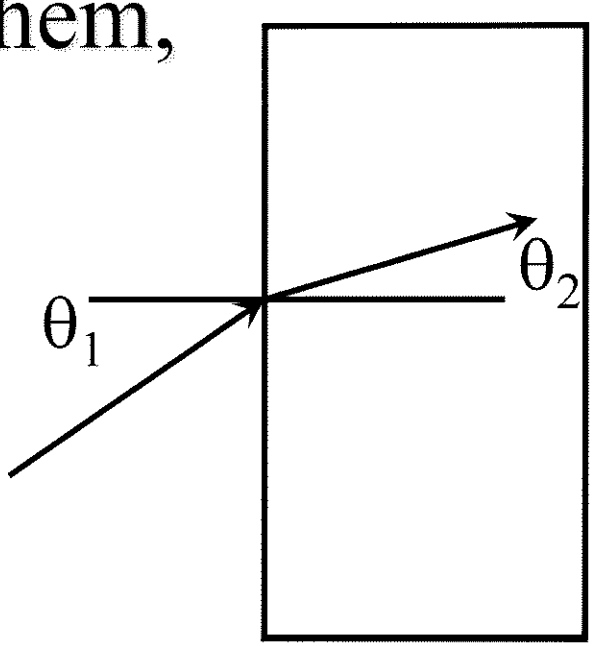
Kinds of Images



- Real
  - When the rays seen by the eye do meet, the image is called *real*.
  - The image can be seen on the screen, just as if it were a real object. (Why?)
- Virtual
  - When the rays seen by the eye extrapolate to a point but don't actually meet, the image is called *virtual*.
  - The image cannot be seen on a screen. (Why not?)

Foothold Ideas of Ray Optics 3: Refraction

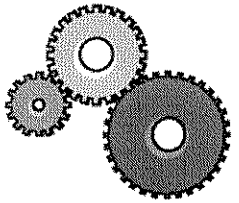
- Transparent media have a number associated with them, *n*. (Newton: *n=v/c)*
- At the boundary of a transparent medium, light is bent by



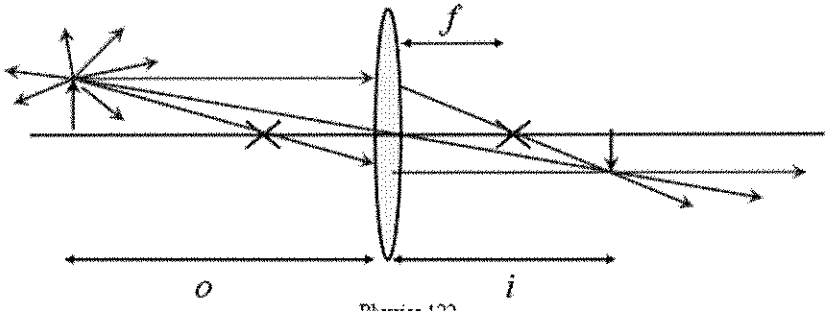
$$n_1 \sin\theta_1 = n_2 \sin\theta_2$$

- You can get total internal reflection!

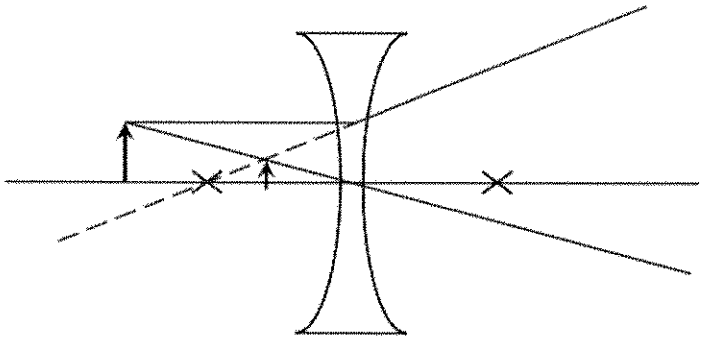
Lenses



- Converging



- Diverging



$$\frac{1}{o}+\frac{1}{i}=\frac{1}{f} \qquad \frac{h'}{h}=\frac{i}{o}$$

Foothold Ideas of Ray Optics 4: Lenses

- A converging lens bends all rays parallel to its axis and brings them through the focal point.
- A diverging lens bends all rays parallel to its axis so that they would project back to the focal point.
- Rays through the center of (either kind of) a lens are not bent.
- A converging lens makes a real image by taking the spray of rays leaving each point on an object that hit the lens and bending them so they come back together at an image point on the other side of the lens. It does this for each point on the object, building up a copy of the object in light.