University of Virginia

Department of Physics

Physics 606: How Things Work II

Lecture #32 Slides:

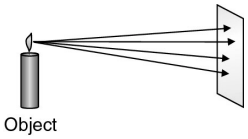
Cameras

Observations About Cameras

- They record the light from a scene on a film or sensor
- Good cameras have to focus, cheap ones don't
- They sometimes have zoom lenses
- Some cameras have bigger lenses than others
- Cameras have ratings like focal length and f-number

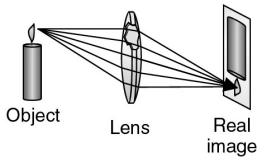
Light from an Object

- An illuminated object reflects or scatters light
- You see object via this reflected or scattered light
- The object's light forms diffuse illumination
- You can't tell what object looks like from this diffuse illumination



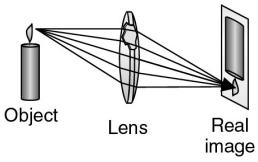
Converging Lenses

- A converging lens uses refraction to bend light rays
- Light rays converge after passing a converging lens
- Rays from a common point on an object converge to a common point on far side of the converging lens



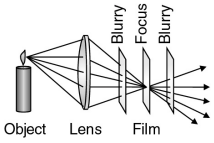
Real Images

- An image forms in space on far side of the lens
- The image is a pattern of light in space that exactly resembles the object, except for size and orientation
- The image is "real" – you can put your hand in it



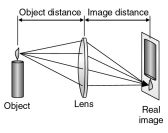
Lenses and Film

- Film records the pattern of light it's exposed to
- If you put film in a real image, it will record a pattern of light resembling the object
- For a good photograph, the real image should be sharply focused on the film and have the right size



Focusing

- Light reaching the lens from an object is diverging
- The nearer the object, the more its light diverges
- Converging lens has trouble with diverging light
  - Real image of nearby object forms farther from lens
  - Real image of distant object forms closer to lens

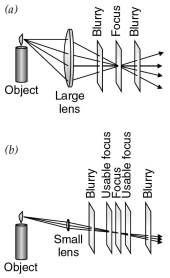


Focal Length

- Focal length measures the lens' converging ability
  - Long focal length: weak convergence, long image distance
  - Short focal length: strong convergence, short image distance
- The larger the object distance, the bigger the image
  - Long focal length: big images
  - Short focal length: small images

Lens Diameter

- Larger lens
  - converges more light
  - brighter image
  - focus becomes more critical
  - less depth of focus
- Smaller lens
  - dimmer image
  - focus becomes less critical
  - more depth of focus



Question:

If you're building a camera and want to make a larger image (a telephoto lens) you should:

1. increase the diameter of the lens
2. decrease the diameter of the lens
3. increase the curvature of the lens
4. decrease the curvature of the lens