

Physics 202, Lecture 26

Today's Topics

■ Lenses

■ Refraction and Lenses

- Ray Diagrams
- Lens Equation

■ Cameras

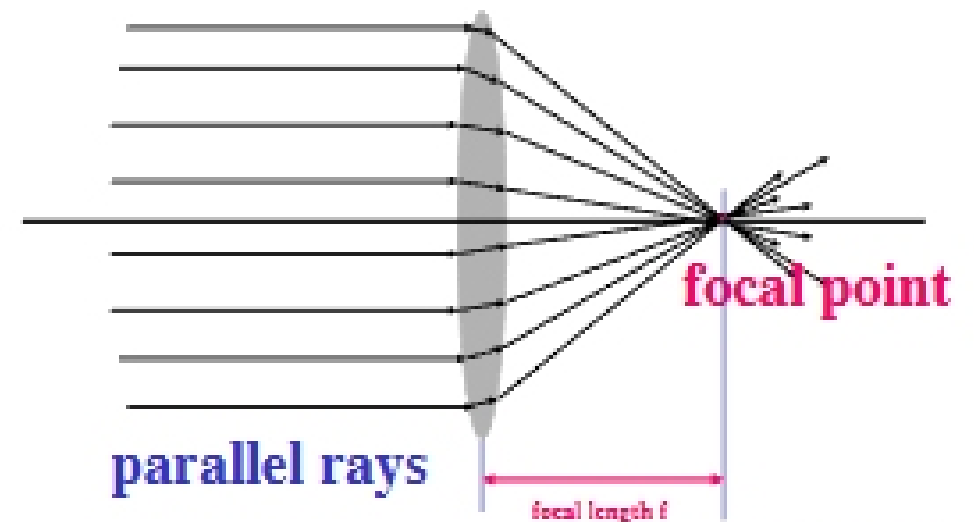
■ The Human Eye, Lenses and Magnifiers

■ Combination of Lenses

- Microscopes
- Telescopes

1

converging lens



demo: white board

converging lens: 3 easy rays

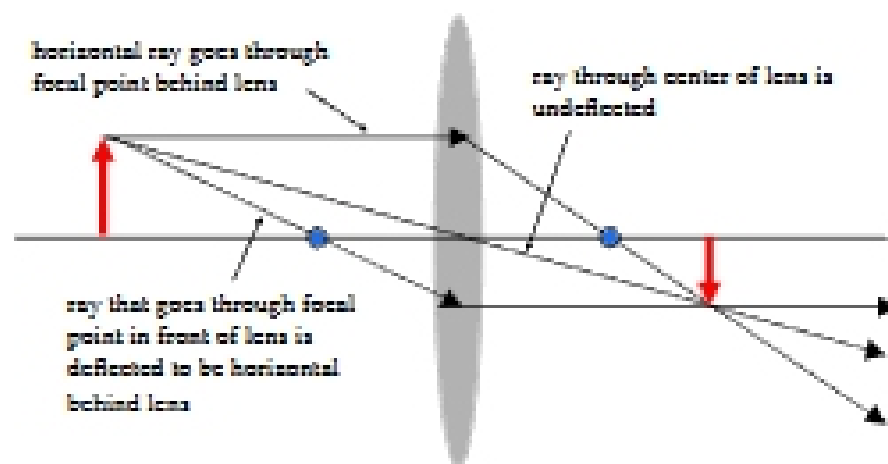


Image of an object in a converging lens

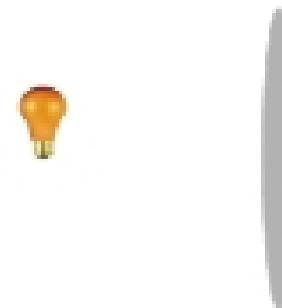
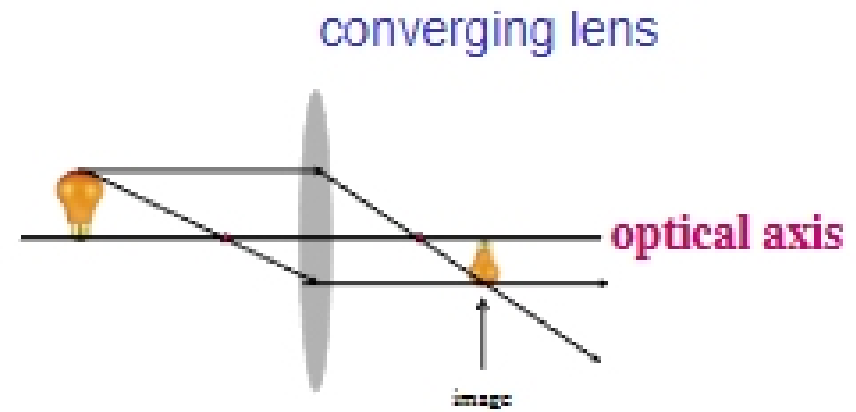
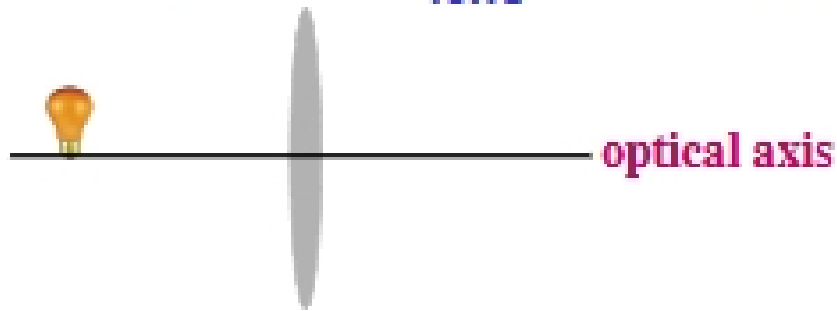
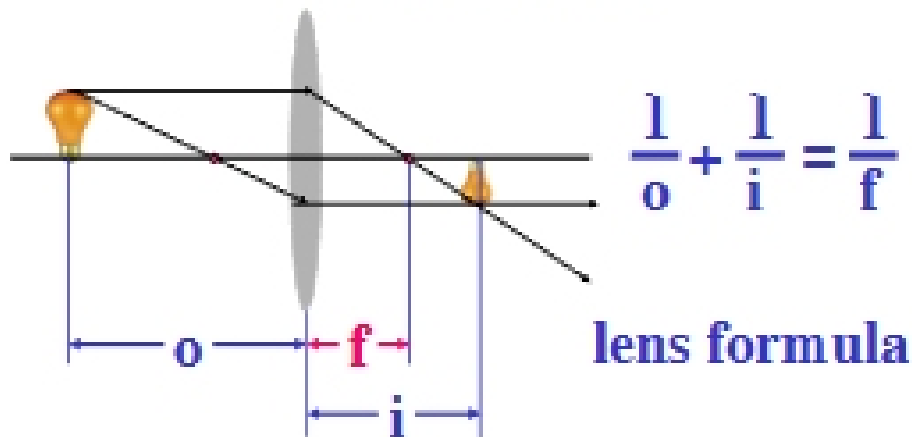


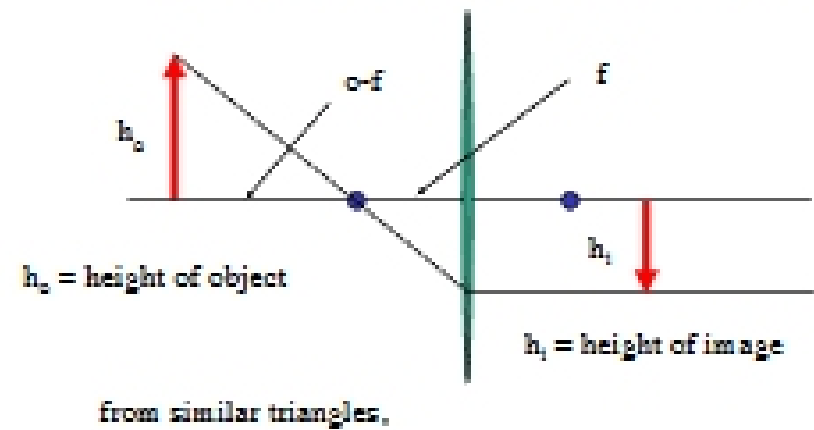
Image of an object in a converging lens



converging lens

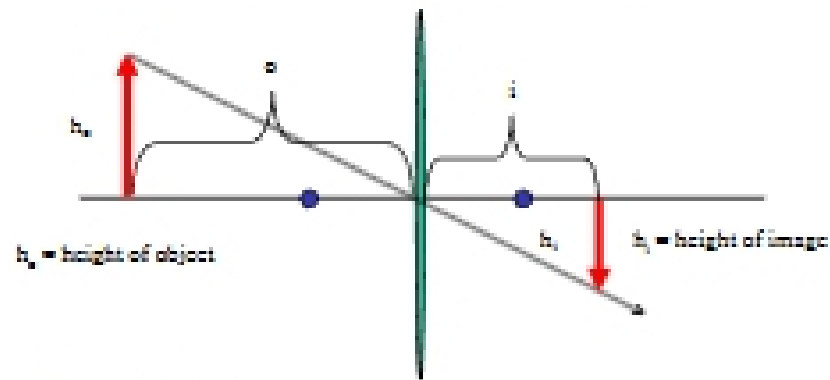


Derivation of lens equation (1)



$$\frac{h_o}{h_i} = \frac{o-f}{f}$$

Derivation of lens equation (2)



from similar triangles,

$$\frac{i}{h_i} = \frac{o}{h_o} \Rightarrow \frac{h_o}{h_i} = \frac{o}{i}$$

Derivation of lens equation (3)

$$\frac{h_o}{h_i} = \frac{o-f}{f} \quad \text{and} \quad \frac{o}{i} = \frac{h_o}{h_i}$$

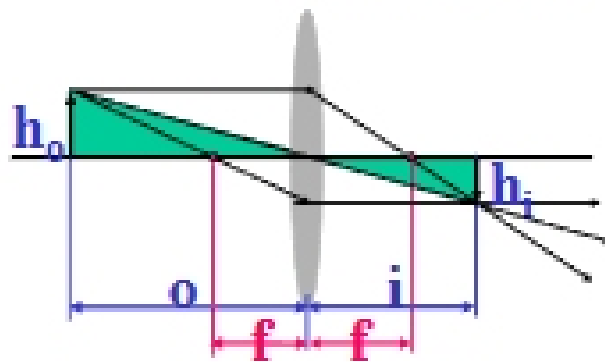
So,
$$\frac{o}{i} = \frac{o-f}{f}$$

$$\frac{o}{i} = \frac{o}{f} - 1$$

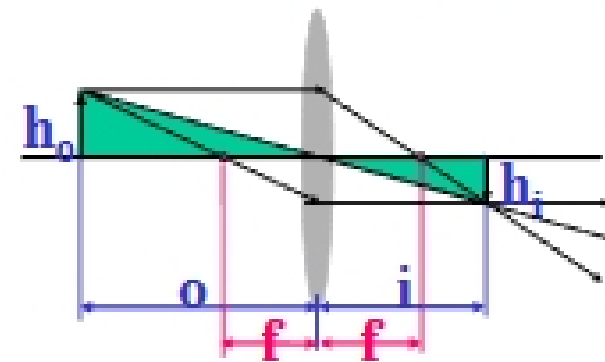
$$\frac{1}{i} = \frac{1}{f} - \frac{1}{o}$$

$$\frac{1}{i} + \frac{1}{o} = \frac{1}{f} \quad \text{Lens equation}$$

magnification



magnification M



$$h_i = \frac{i}{o} h_o$$

$$\frac{h_i}{h_o} = \frac{i}{o} = |M|$$