Recitation W4
(Mid-term exam 1 prep)

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Topics

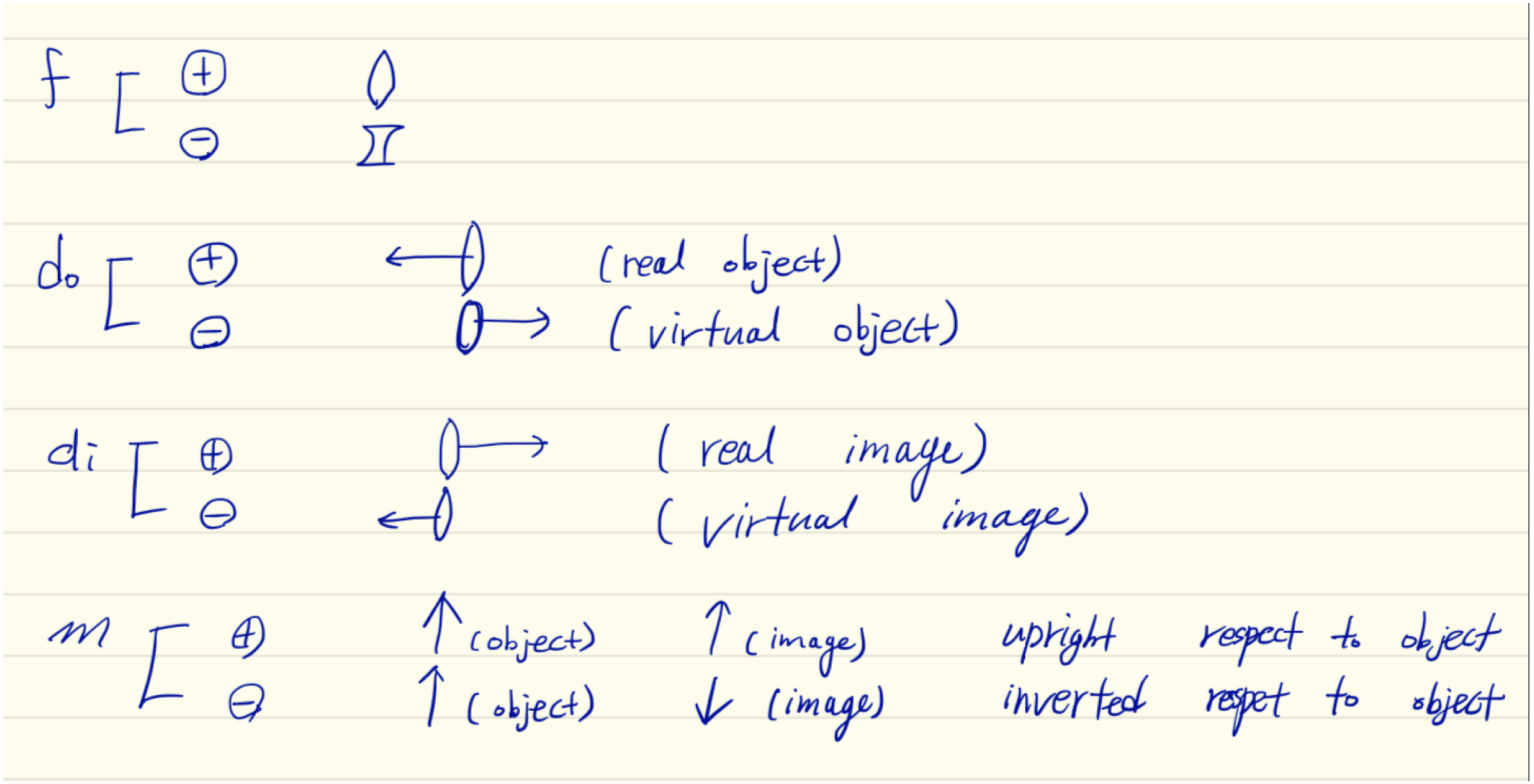
- Ray optics
- Previous midterm problems
- Q&A

- Lens equation

$$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$$

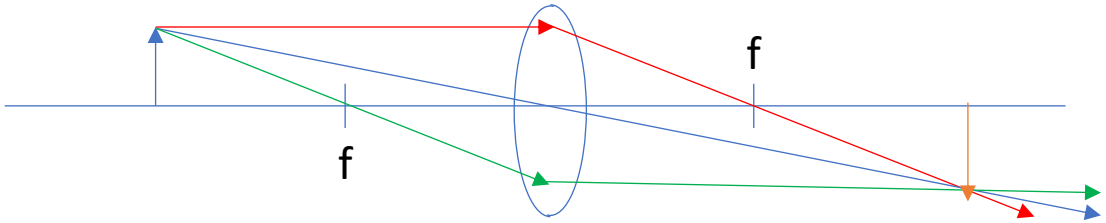
- Magnification

$$m = \frac{h_i}{h_o} = -\frac{d_i}{d_o}, \quad m_{tot} = m1 + m2 + \ldots$$

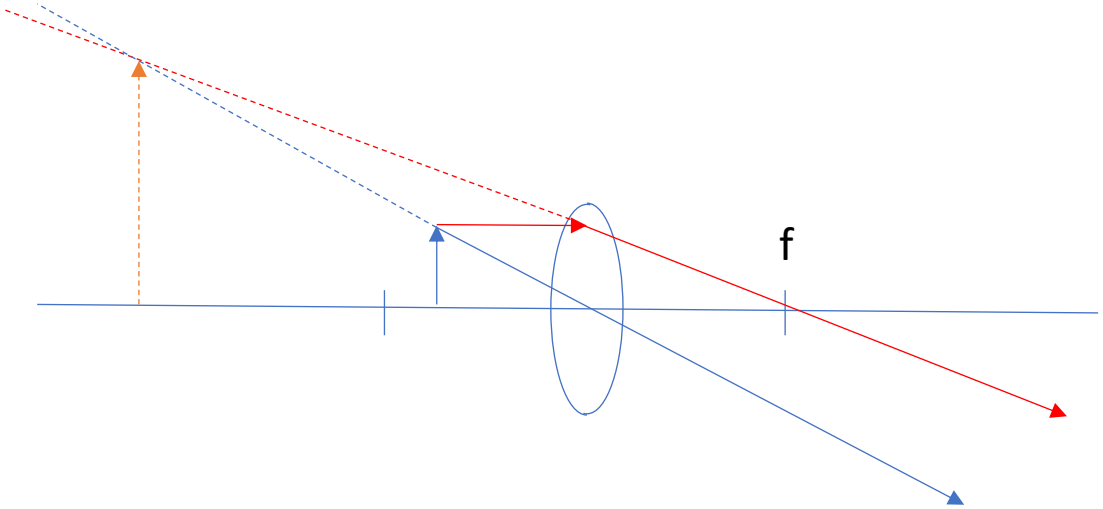


Ray optics (thin lens) – single wavelength

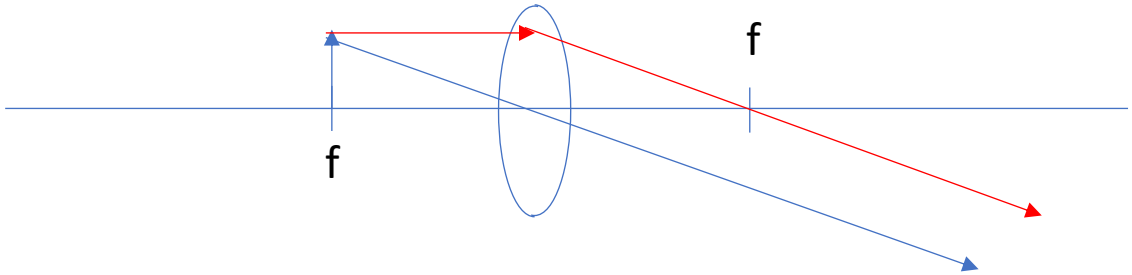
- Convex (converging)



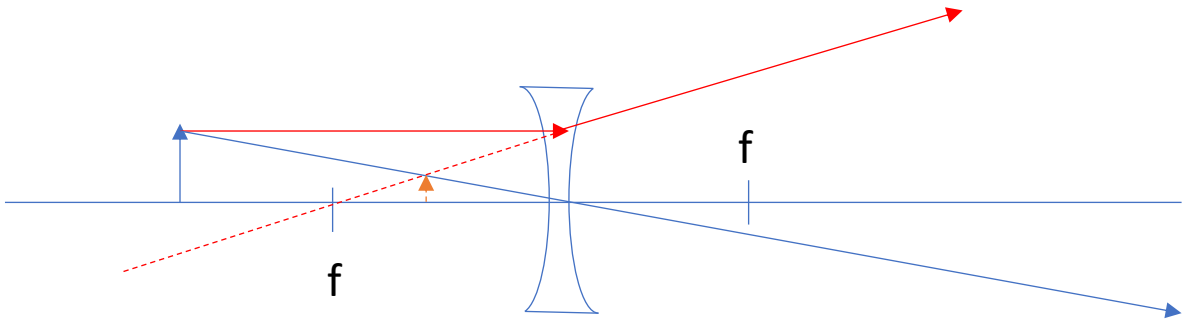
f: +
do: +
di: +
ho: +
hi: -
m: -
Inverted real image

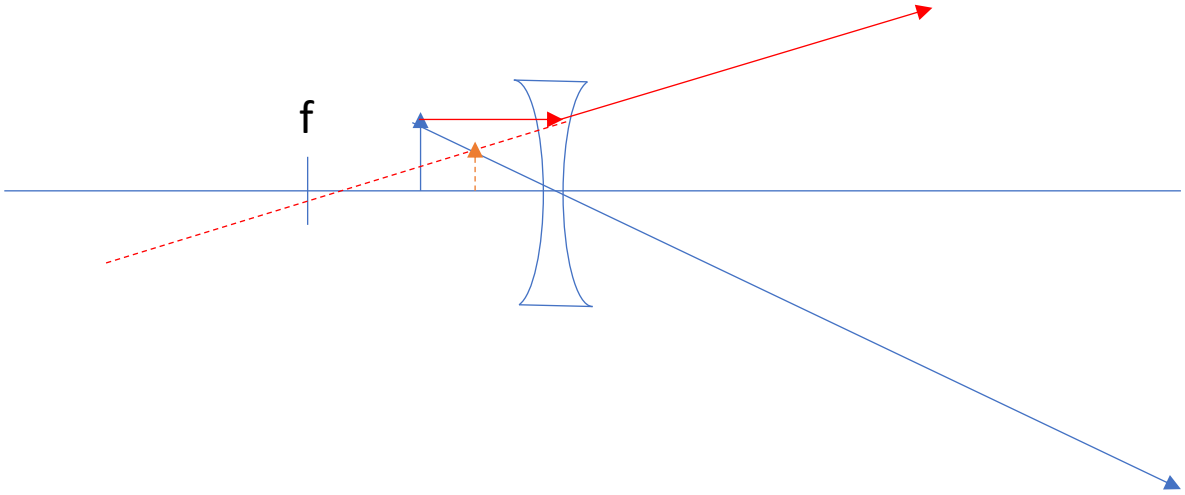


f: +
do: +
di: -
ho: +
hi: +
m: +
Non-inverted virtual image



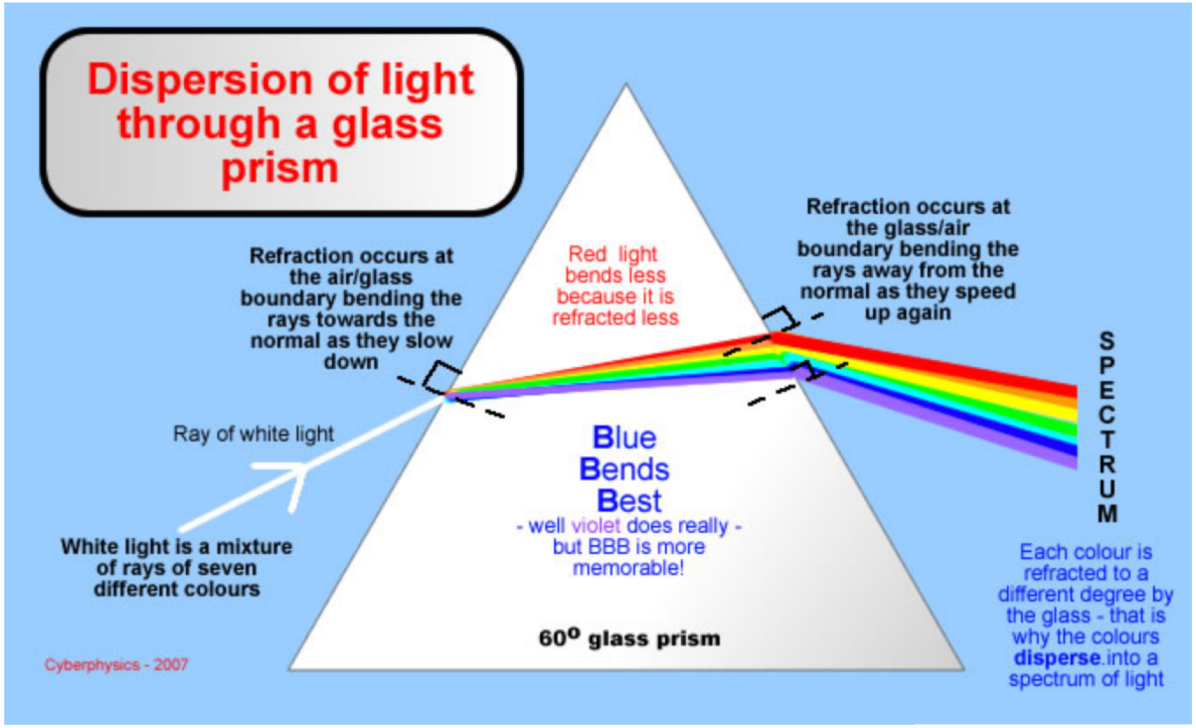
- Concave (diverging)



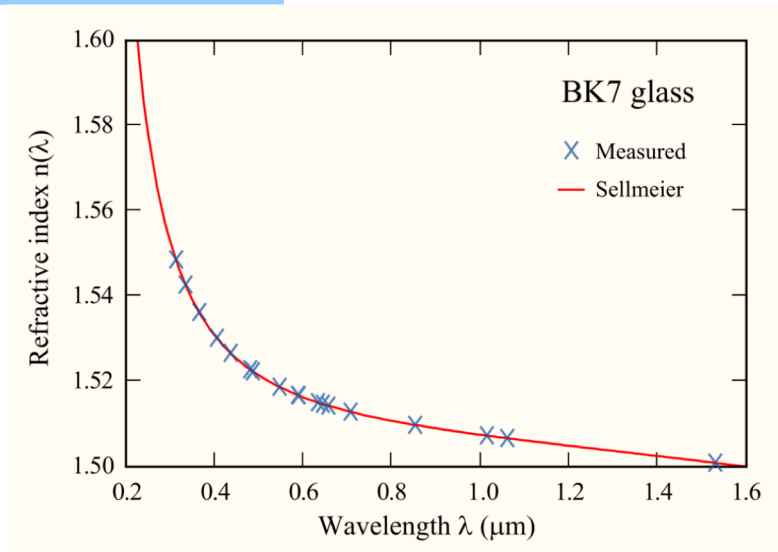


f: -
do: +
di: -
ho: +
hi: +
m: +
Non-inverted virtual image

Dispersion of light



- $\lambda \uparrow \rightarrow n \downarrow \rightarrow \theta_{refraction} \downarrow$



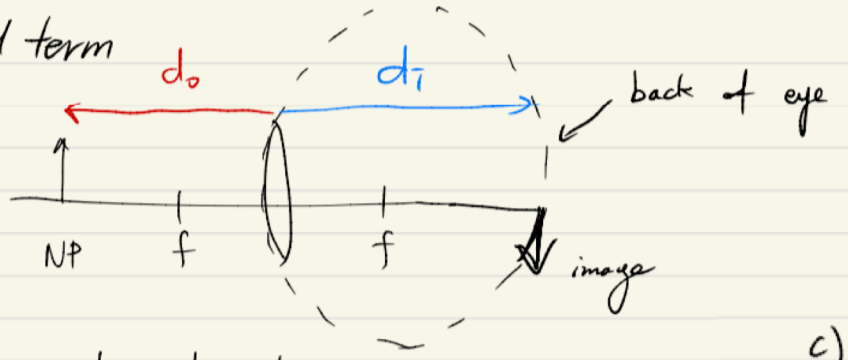
2018 spring

- You can change the shape of the lens inside your eye to create an image on the back of your eye (your retina) of objects at different distances. Since your eye does not change size and the image needs to be made on the retina, the image distance must stay the same. Your near point is the shortest distance from the lens in your eye to an object for which you can make a clear image on your retina. A human with good vision will have a near point of 25 cm. the average eye length from front to back is 24 mm. Assume that your lens is at the front of your eye, the lens is a spherical thin lens, and that your eye is made of air except for the lens.

- A) when looking at an object placed at her near point, what is the focal length of an average human's lens?
- B) what is the focal length of her lens when looking at the moon?
- C) If somebody has an eye length of only 23mm, what is their near point?
- D) you are an eye doctor in charge of prescribing glasses for this hyperopic person. If glasses rest 2.5cm from the eye, what focal length should you prescribe to correct their near point?

mid term

①



A) $\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

$d_o = +25\,cm$, $d_i = +2.4\,cm$

$\frac{1}{25} + \frac{1}{2.4} = \frac{1}{f}$

$f = 2.19\ cm$

B) moon $\rightarrow$ $d_o = \infty$

$\frac{1}{d_i} = \frac{1}{f} \Rightarrow f = 2.4\,cm$

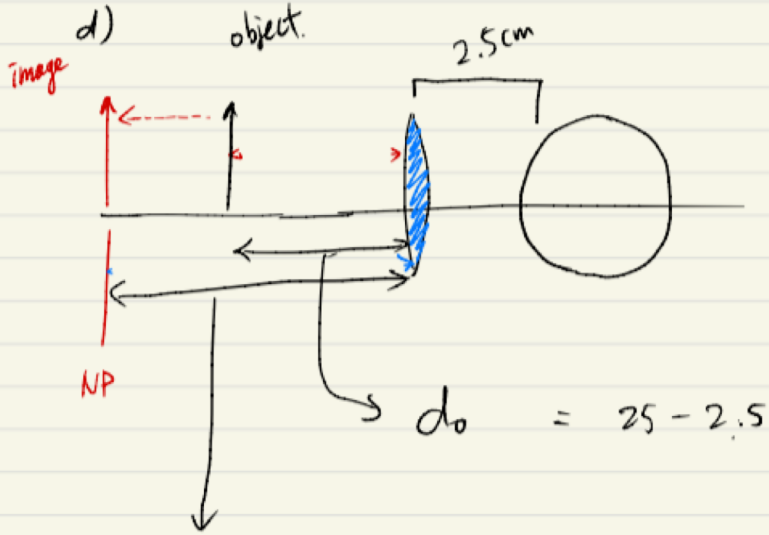
c) $d_i = 2.3\,cm$

$f = 2.19\,cm$

$\frac{1}{d_o} + \frac{1}{d_i} = \frac{1}{f}$

$d_o = 45.7\,cm$

d) object.



$d_o = 25 - 2.5 = 22.5\,cm$

$d_i = 45.7 - 2.5 = 43.2\,cm$

$\frac{1}{f} = -\frac{1}{43.2} + \frac{1}{22.5} = 47\,cm$

2018 summer

- An object is placed 6.0 cm to the left of a lens with focal length -3.0 cm.
- A) carefully draw a ray diagram for the situation.
- B) if another lens of focal length +2.0 cm is placed 4.0cm to the right of the first lens, how far from the second lens and in what direction is the final image?
- C) what is the magnification of the final image?
- D) is the final image real or virtual?

Q & A

3. Which of the following combinations of optical elements CANNOT form a real image?

☐ a) A converging lens followed by a diverging lens
☐ b) A diverging lens followed by a converging lens
☐ c) A converging lens followed by a convex mirror
☐ d) A diverging lens followed by a plane mirror
☐ e) A converging lens followed by a plane mirror
☐ f) A diverging lens followed by a concave mirror
☐ g) All of the above combinations can make a real image

4. A diverging lens is made of a highly dispersive glass. Two toy dinosaurs are placed 10 cm to the left of the lens. One dinosaur is red, the other is blue. Which of the following statements is true?

☐ a) The image of the red dinosaur appears to the left of the blue dinosaur image.
☐ b) The image of the blue dinosaur appears to the left of the red dinosaur image.
☐ c) Both images appear at the same location.
☐ d) Both images are real.
☐ e) Both images are virtual.
☐ f) There is not enough information given to know whether the images are real or virtual.