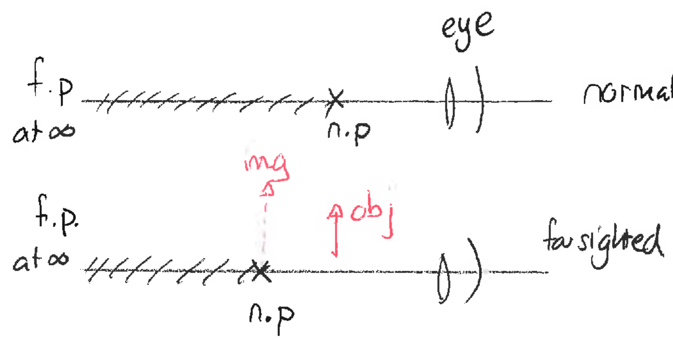
Tues: Review III

Weds: Exam III Ch 17, 18, 19.2 → 19.3
Ch 25.5, 25.7

Vision deficiencies: farsightedness

In farsightedness, the near point has moved beyond 25cm to a location further from the eye. A corrective lens needs to



1) take an object at 0.25m and create an image at the actual near point

2) produce an upright image.

Quiz 1 60%

121 Farsightedness

A farsighted person has a ~~far~~ near point of 0.35 m and a far point at infinity. A single corrective lens is used to allow that person to view objects that are at the normal near point, 0.25 m. Assume that the lens is placed against the eye.

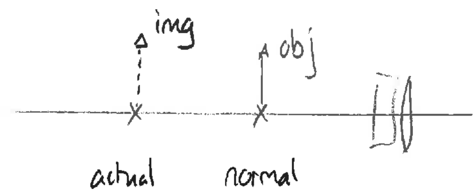
a) Determine the focal length of the lens so that the person can view an object that is at the normal near point. Is the image of this object (created by the corrective lens) larger or smaller than the object?

b) Determine the location of the furthest object that the person can see clearly.

c) With this corrective lens, what is the range of vision of the person?

Answer: a) Object at 0.25 m $\Rightarrow$ $s = 0.25\,m$

Image at 0.35 m $\Rightarrow$ $s' = -0.35\,m$



$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$$

$$\frac{1}{0.25} + \frac{1}{-0.35} = \frac{1}{f} \Rightarrow \frac{1}{f} = 1.14\,m^{-1} \Rightarrow f = 0.875\,m$$

converging!

b) Image at $-\infty$

Object at $s = ?$

$$\frac{1}{s} + \frac{1}{s'} = \frac{1}{f}$$

$$\frac{1}{s} + \frac{1}{-\infty} = \frac{1}{f} \Rightarrow \frac{1}{s} = \frac{1}{f} \Rightarrow s = 0.875\,m \Rightarrow s = 87.5\,m$$

Any object beyond this produces an inverted image on the eye...

c) $0.25\,m \rightarrow 0.875\,m$

Optical instruments: magnifier

A magnifier uses a single lens to increase the apparent size of an object. The image must be:

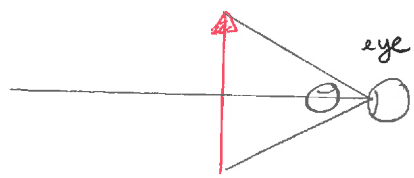
1) upright
2) larger than the object

Demo: Lens on doc cam

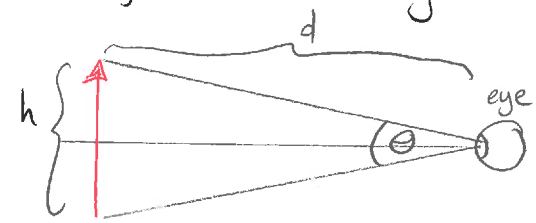
We see that

> A magnifier consists of a convex lens used so that the object is between the lens and focal point.

In order to describe the size of the image and the resulting magnification we consider the angular size of the object as viewed by the eye.



same size, larger ang. size



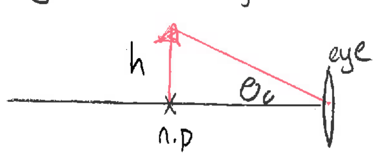
same size, smaller ang. size.

Then for small angles, the angular size in radians is $\theta \approx h/d$

The idea behind a magnifier is to increase the angular size.

no magnifier

largest ang size ⇒ object at n.p.



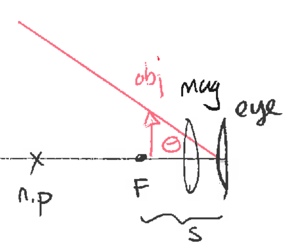
angular size

$$\theta_0 = h/s_{near}$$

using magnifier

object within n.p.

best when object is just inside lens f.p.



ang. size

$$\theta = h/s \approx h/f$$

Then:

1) The optimal magnification occurs when the object is just inside magnifier f.p.

2) the magnification is $M = S_{near}/f$

Warm Up!

122 Magnifier

A magnifier produces an angular magnification of 10 for a person with a normal near point.

a) Determine the focal length of the lens.

b) Determine the angular magnification for someone with a near point of 0.40 m.

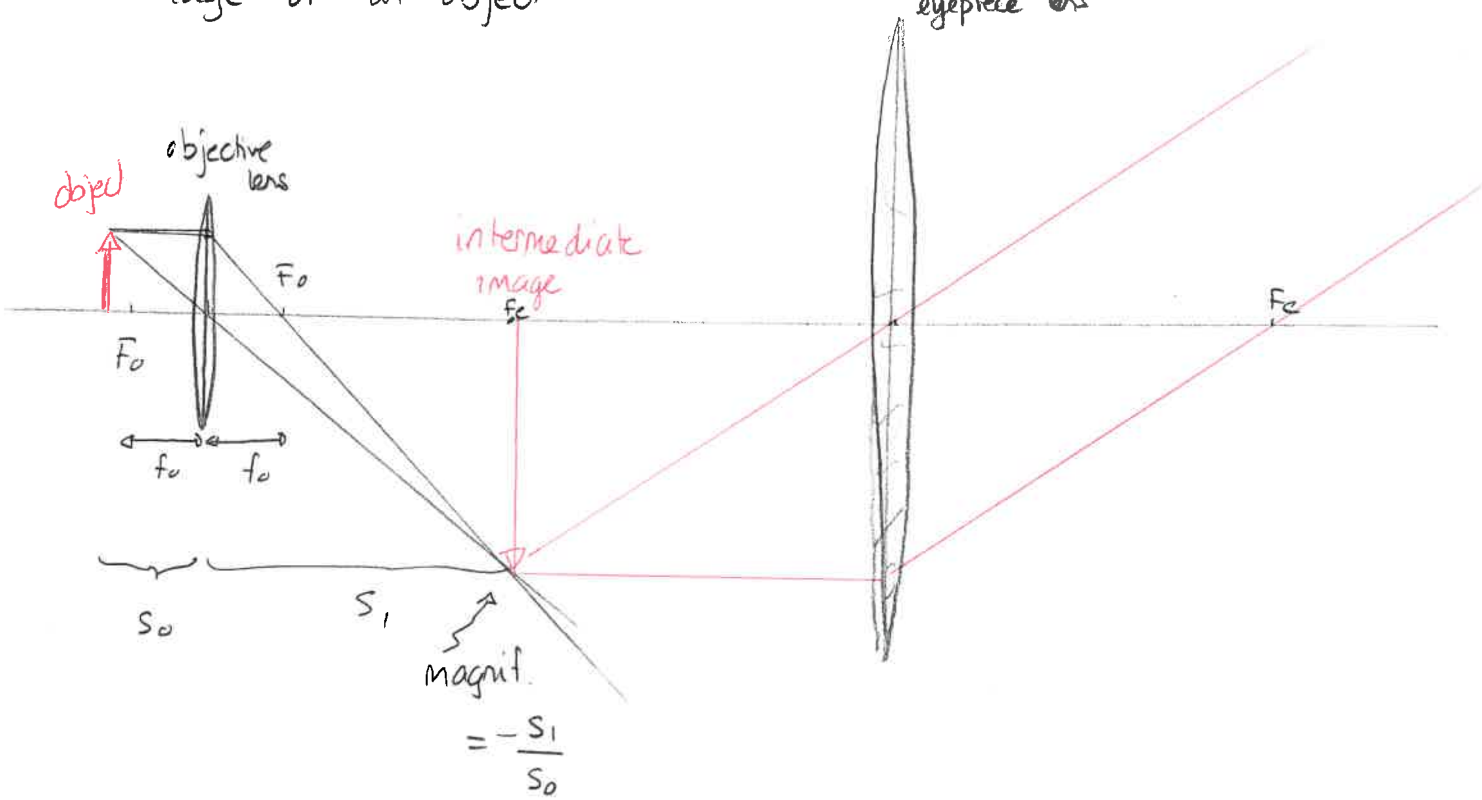
Answer: a) $M = \frac{S_{near}}{f} = \frac{0.25m}{f} \Rightarrow 10 = \frac{0.25m}{f}$

$\Rightarrow f = 0.025m = 2.5cm$

b) $M = \frac{S_{near}}{0.025m} = \frac{0.40m}{0.025m} = 16$

Microscope

A microscope uses two convex lenses to produce an enlarged image of an object



The objective produces a real inverted (intermediate) image. This is the "object" for the eyepiece which is located so that the eyepiece focal point is just beyond the intermediate image. The eyepiece then acts as a magnifier for the intermediate image. The overall magnification is

$$-\frac{S_1}{S_o} \quad \frac{S_{near}}{f_{eyepiece}}$$

We make $S_o \approx f_{obj}$ $\Rightarrow$ $\quad mag = -\frac{S_1 S_{near}}{f_{obj} f_{eye}}$

Warm Up 2