

## EE119 Discussion Section 5

(03/01/10)

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### 1. Telescope

An objective of an astronomical telescope has a diameter of 12.5cm and focal length of 85.5cm. When it is used with an eyepiece having a focal length of 2.5cm and a diameter of 1.5cm, what will be

- the angular magnification,
- the diameter of the exit pupil,
- the object field angle,
- the image field angle, and
- the distance between the eyepiece and your eye.

Design an astronomical telescope which can resolve an object on the moon which is  $1/50$  the size of the moon (the moon is 3476km in diameter and orbits at roughly 384,300 km from the earth). Assume normal visual acuity and the diameter of the iris of the eye to be 4mm. Make sure the telescope is not diffraction limited. Show your design flow; a ray trace of the system; focal lengths of the lenses; sizes of the aperture stop, entrance pupil, and exit pupil; all pertinent distances. You may use two lenses with any power and any size you desire, but *make the telescope as compact as you can.*

### 2. Microscope

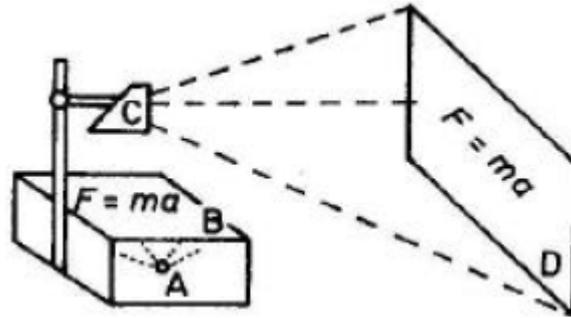
A microscope is fitted with an eyepiece having a focal length of 12.0 mm and an objective with a focal length of 3.20 mm. If the objective forms its image 16.0 cm beyond its secondary focal plane, find the total magnification.

Let's design a microscope

- First, draw a diagram of the microscope and label the objective, the eyepiece, the object, the working distance, the tube length, and the internal image.
- The microscope has a total magnification of 100x with an objective NA of 0.4. If the magnification of the eyepiece is 10x, what is the focal length of the eyepiece?
- If the tube is standardized, what is the focal length of the objective lens?
- What is the working distance for this microscope?
- What is the smallest feature size you can resolve with this microscope? The wavelength is 550nm.

### 3. Projector

A rough sketch of a viewgraph projector (almost obsolete now) is shown on the reverse side of the page.



- a) If the distance from the slide and the projector lens is 20cm, and the focal length of the condenser lens in the illumination system is 4cm, what is the distance between the lamp and the condenser lens?
- b) One of such a projector has a projection lens with focal length 75mm. The image on the screen is sharp when the projector is placed 5 meters from the screen. If the projector is relocated 12m from the screen, find the distance you have to adjust the projection lens to obtain a sharp image on screen and the new magnification.