Homework Assignment Week 1 – Optics and Microscopy, EE 293

This assignment is due at the beginning of class 11.40am on Thursday January 11th 2018 (or before)
If you cannot hand in your homework sheet in class in person, it is OK to email a picture/scan of the sheet with your solution to the Professor: sara@ucsc.edu

1) This black and white print (Fig. 1) is missing the colors of the spectrum that is created when a beam of white light travels through a prism. Assume that the prism is a perfectly like-sided triangle and that the incident white light beam contains all wavelengths in the visible spectrum. You will need to make some additional assumptions yourself, such as the material of the prism and the medium in which it is immersed. Please, state what assumptions you make.

a) With a starting point from Fermat's principle and the different refractive index experienced by each wavelength, explain in a few sentences in your own words why the colors are separated.

b) What is the deviation angle (see Fig. 2) of a yellow beam of light ($\lambda = 589$nm) exiting the prism in Fig. 1?

c) On the right side of Fig. 1, draw arrows and indicate for each exiting beam what color the beam is.

d) What if the incoming white light beam also contained infrared light? Draw an additional arrow and indicate roughly where the infrared light beam would end up after exiting the prism.

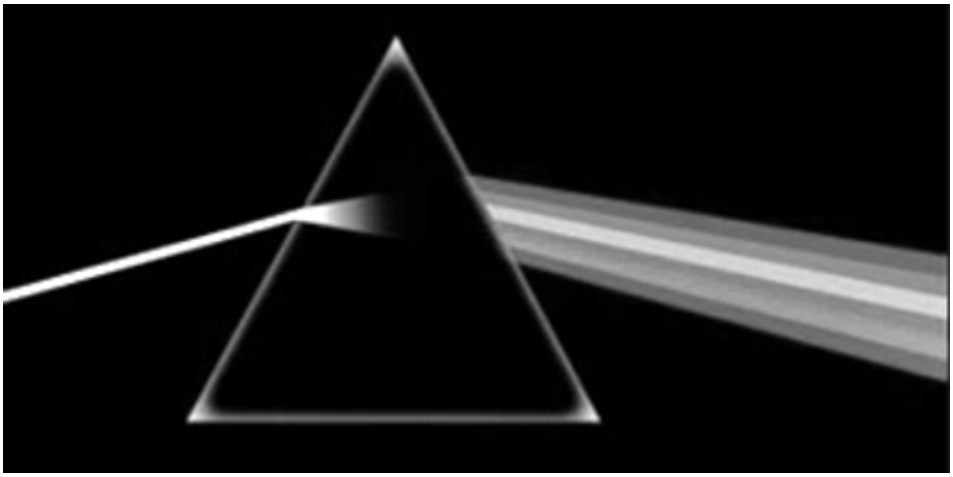

Fig. 1 Classic album cover illustrating chromatic dispersion

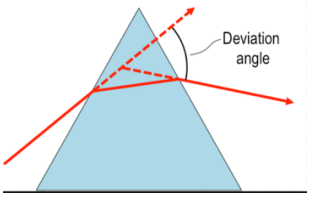

Fig. 2 This is the deviation angle. (Hint: Does it matter what the incoming angle is?)

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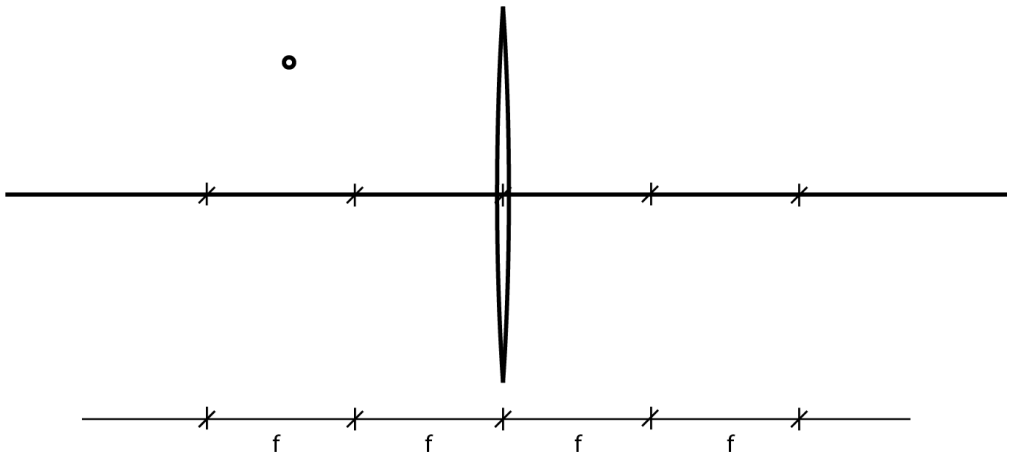
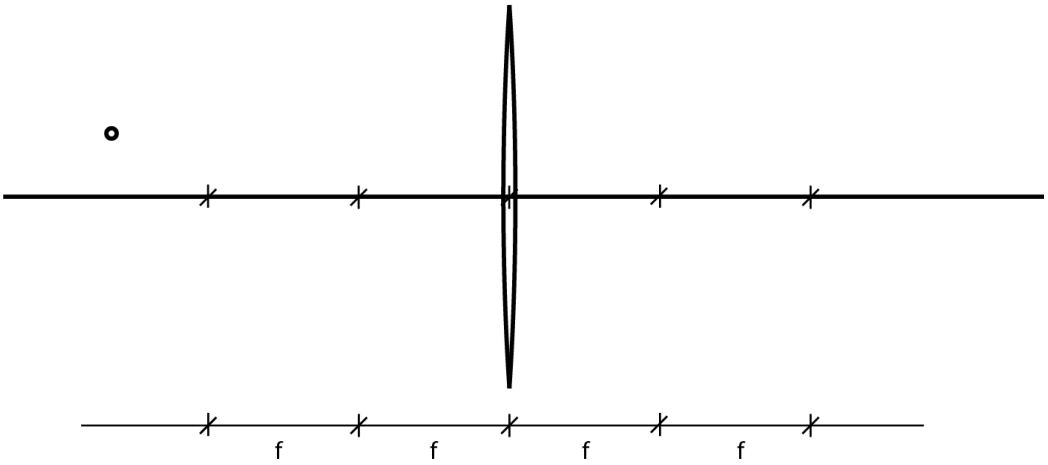
2ab) Using a ruler and a pen, trace the three principal rays from the object point **o** indicated through the ideal, thin lens with focal length *f* in the configurations below and calculate the magnification. You will need to estimate measurements and round off your answers using good engineering sense.

a)



b)



2c) What position along the optical axis should the object be in to produce a real, inverted image with unit magnification (M=1) and at what position will this image be formed? Draw in the figure and state with your own words.