Homework 2
Answer the questions 1-5
Project proposals should be ready

ME297

SJSU Eradat

Due Tuesday Sept. 27

2.1) Rules of thumb

- Decisions are made by efficiently applying "rules of thumb" to make quick approximations. Throughout your career, you should make sure to collect these and know how and when to use them (Jime Burge). As part of your homework assignments, **you should review the relevant notes and find at least 4 useful rules of thumb from the last week's lecture notes L3 & L4**. Report them in the following format.

Name for Rule	Small Angle Approximation
The Rule of Thumb	$\sin\theta \cong \theta$ (in radians)
When is this used?	This is used for small angles (< 0.2 radians or 11.5^0) Application of this approximation greatly simplifies analysis and calculation
Limitations	The percent error in the approximation is roughly $\theta^2/6$ x 100% so the approximation is valid to < 1% for angles < 0.24 radians (14°) and is valid to 0.01% (100ppm) for angles < 1.4. (you find this by calculating $(\sin\theta - \theta)*100$ for a range of angles and arguing when if you use it is a situation what kind of error you are signing up for)

2.2) Fitting the parallel plate

We want to fit a 0.500 cm-thick BK7 glass parallel plate at 45^0 in the light path of a spectrometer box to sample 10% of the light for power measurements. Length of the box is 28.000 cm. Focal length of the mirrors are 25 cm. assume the mirrors are aberration-free. Diameter of the mirrors are 5.000 cm. We use this spectrometer mostly for visible light (400-750 nm). Do your calculations for 2 ends of the spectrum of interest. Show the work.

a) How far should we adjust the mirrors? In what direction?
b) How much is the lateral deviation of the focal point?
c) Calculate the exact and the third order astigmatism introduced by inserting the plate. (Use Smith's Modern optical engineering page 103 or L3 and L4 lecture notes).
d) Will there be any astigmatism if the plate was to be inserted on the path of parallel beams? Argue based on the formulas for the astigmatism.
e) Compare the chromatic aberration of the lenses to the chromatic aberration of the parallel plates. What can you conclude? Can we take advantage of this situation? If so what other consequences may ruin the quality of the focus?

2.3

- List the elements in a optical system that control brightness of the image. How do you find location of each?
- List the elements in an optical system that control field of view. How do you find location of each?

2.4 Finding the stops, pupils, windows

The optical system in this figure has a positive thin lens L_1 with f_1=6cm, diameter D=6cm, and a negative thin lens L_2 with f_2=-10cm, diameter D_2=6cm, and an aperture A with diameter D_A=3cm, located 3cm in front of the L_1 which is located 4cm in front of the L_2. The object OP, 3cm high is located 18cm to the left of L_1.

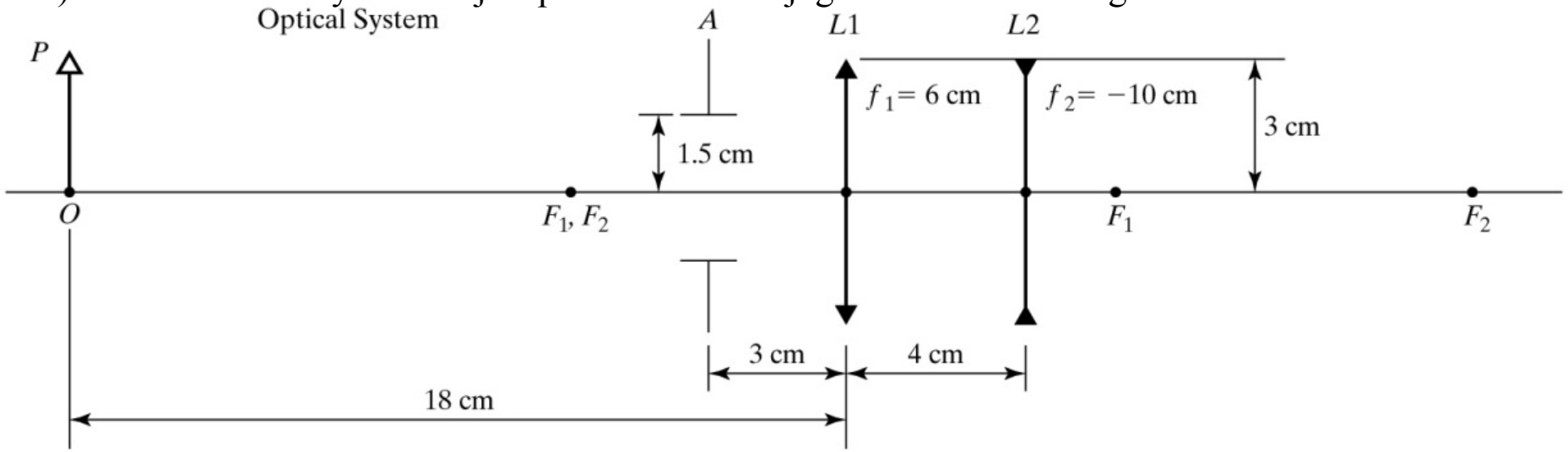
a) Determine which element serves as the aperture stop?

b) Determine size and location of the entrance and exit pupils.

c) Determine location and size of the image OP' of the OP formed by L_1 and the final image OP" formed by the system.

d) Draw a diagram of the system, its pupils and images.

e) Draw the chief ray from object point P to its conjugate in the final image P".



2.5) Application of the Newtonian equation

Calculate the lens motion in a camera with f=10mm if the object moves from 10m to 1m using the Newton's equation.

Conclude a rule of thumb.