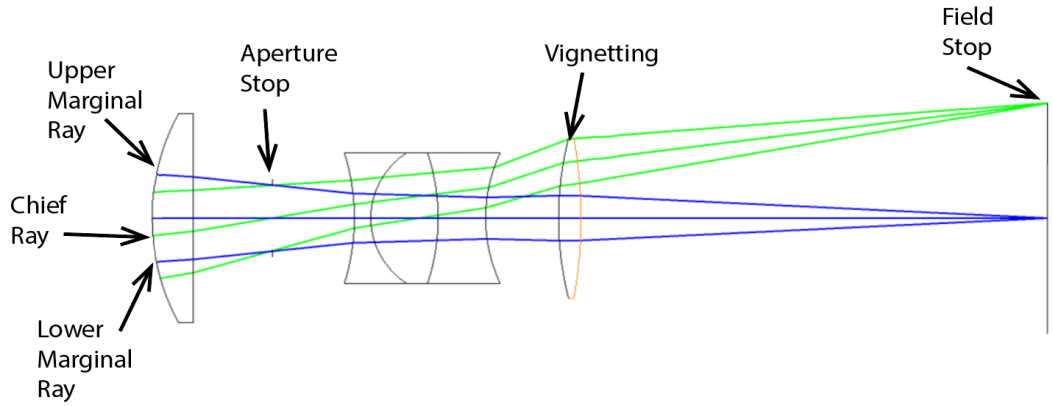
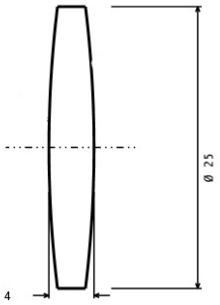
OPTI 415 Homework 1 Due: February 8, 2022

Do all four questions.

1. Below is a raytrace of a telephoto lens. Where is the aperture stop located? Which ray is the chief ray? Which rays are marginal rays? Which surface is the field stop? Which surface is likely to cause vignetting if the field angle is increased?



2. Make a ISO 10110 compliant drawing of Edmund optics part 32-718 on the attached sheet. You only need to take into account the radii, thickness, diameter, optical axis, material, index and Abbe number of the lens. Don't worry about tolerances, coatings or surface effects at this point.



Dimensions in Millimeters

Left Surface	Material	Right Surface
R 103 CX $Ø_E$ 24 Ø 3/ 4/ - 5/ - 6/ -	GLASS: N-BK7 Nd = 1.516800 Vd = 64.17 0/ - 1/ - 2/ -	R 103 CX $Ø_E$ 24 Ø 3/ 4/ - 5/ - 6/ -

ISO Element Drawing Indications According to ISO 10110

DATE	SCALE	DRAWN	APPRV	Zemax Zemax OpticStudio 15.5
1/25/2016	2.5000:1			
PROJECT/TITLE 32718				
PART/DRAWING		REVISION		TEMPSTOK.ZMX Configuration 1 of 1

3. Figure 1 of US Patent 2,171,274 (see attached) gives the prescription for the lens in question 1. Note, the value l_1 in the prescription is the distance between the first and second lens. The aperture stop is located in this space. Specifically, the stop is 8.61 mm to the right of the first lens, or equivalently the stop is 9mm to the left of the second lens. Use commercial raytracing software to determine the locations of the cardinal points of this lens.

   Zemax lists the cardinal points under the Analyze→Rays & Spots menu. Note Zemax measures the image space cardinal points relative to the image plane instead of the last optical surface.

		Object Space	Image Space
Focal Length	:	-100.027673	100.027673
Focal Planes	:	-87.345912	0.000000
Principal Planes	:	12.681761	-100.027673
Anti-Principal Planes	:	-187.373585	100.027673
Nodal Planes	:	12.681761	-100.027673
Anti-Nodal Planes	:	-187.373585	100.027673

4. Create a spreadsheet like the one illustrated in class to do a paraxial raytrace of the system listed in Figure 1 of US Patent 2,171,274. Do not do this by hand.

    - Trace an incident ray with height of 1 at the first surface and slope of 0.
    - Trace a second ray with a height of 0 at the first surface and a slope of 1.
    - Use ray scaling to create a ray with a height of 1 and a slope of 0 leaving the last surface. What are the scaling coefficients?
    - Use ray scaling to create a ray with a height of 0 and a slope of 0.1 at the aperture stop. What are the scaling coefficients?
    - Calculate the cardinal points from these rays. How do these compare to the results found in question 3?
    - Calculate the location of the entrance and exit pupils from these rays.

    See the file *US2171274.xlsx* for solution.