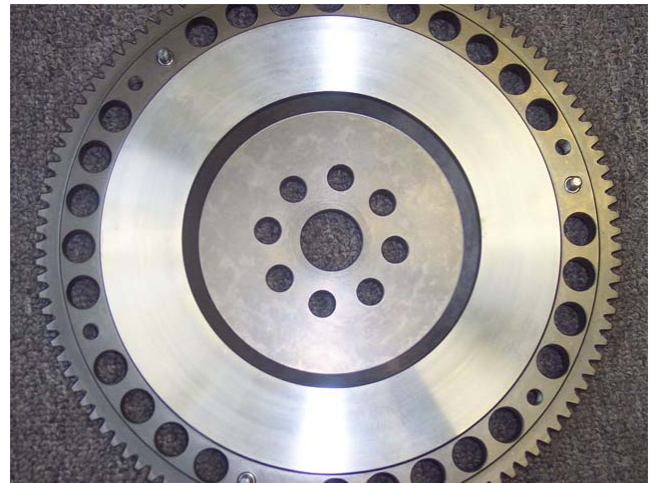


Undergraduates do the first three problems. Graduates Students do all four questions.

1. Does the lens in front of Buddy Holly's left eye have positive or negative power? Explain your answer.



2. You assemble the machine vision system from Homework 1 to inspect a flywheel with diameter 39.6 mm. Your 100 mm focal length lens is at a working distance of 1 meter from the part. The 1/3" CCD camera is at the image plane. You capture the image above and unfortunately, the part doesn't fit on the sensor. The working distance is constrained. Calculate a new lens focal length that will allow the entire part plus 10% to be imaged in the vertical direction. What are the new focal length and image distance?
3. Using raytracing code, find the locations of the cardinal points in the following system. Where are the entrance and exit pupils located? If the physical diameter of the aperture

stop is 13.4 mm, what are the diameters of the entrance and exit pupil? What is the F-Number of the system?

Radius (mm)	Thickness (mm)	Index
24.607	5.080	1.517
-36.347	1.600	1.620
212.138	12.300	1.000
$\infty$ (Stop)	21.700	1.000
-14.123	1.520	1.517
-38.904	4.800	1.620
-25.814	37.934	1.000

4. \*\*\*\*\*Grads Only\*\*\*\*\*

Estimate the diameter of the central hole in the flywheel (the image is available on the course homepage). Point Grey Dragonfly2 cameras have a 1/3" sensor and come with resolutions of 648 x 488, 1036 x 776, and 1296 x 964 pixels. Suppose we can measure the central hole diameter in the image to an accuracy of 1/2 pixel. What accuracy does this correspond to on the part?