

Circle your lab day and time.

Your name: _____	Tue	Tue	Tue	Wed	Thu	Thu	Fri
TA name: _____	10-12	12-2	2-4	12-2	10-12	12-2	2-2

Written HW 7: Optics

(due Friday, Dec 7th, 2012 at 2 PM)

Turn in this written homework in the appropriate slot in the brown Homework Cabinet at the entrance of the HelpRoom, Duane G2B90. Please STAPLE pages together, and **put your name and TA name at the top of every page!**

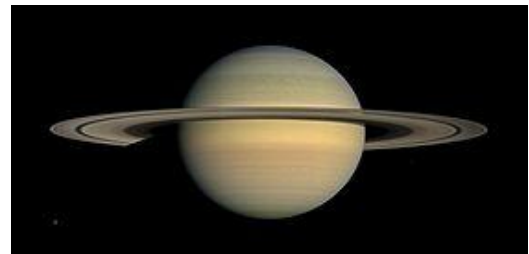
*In all written homework, you will be graded on the clarity and completeness of your answer. **No credit** will be given for an answer in a calculation without a derivation, even if the answer is correct. A calculation without units is also incorrect.*

Hubble

The primary optical element of the Hubble Space Telescope (HST) is 3.2 m in diameter and has a focal length of 62 m. (Treat it as a simple, single lens for this homework) The telescope is aimed at Saturn and the collected light is focused onto a sensitive Charge Coupled Device (CCD) detector, similar to what is in a digital camera. Each pixel in the detector is a $21 \mu\text{m} \times 21 \mu\text{m}$ square, and the full CCD is 4096×4096 pixels. Thus the CCD is about one square inch in size. The HST is in orbit very close to the Earth (compared to other distances in the Solar system).

a) Is the image real or virtual? Magnified or reduced? Upright or inverted?

b) Look up the size of Saturn and the distance to Saturn when it is closest to Earth. Use the lens formula to determine the magnification of the image Hubble takes. How many pixels in diameter is Saturn's image on the CCD? Given this CCD, what is the smallest feature on Saturn you would expect to be able to resolve? (Another way of thinking about that question is: How large a square on the surface of Saturn does one pixel in the image represent?)



c) Repeat your analysis for part (b) for Eris (the largest dwarf planet, bigger than Pluto). Does Hubble have enough resolution to see features on the surface of Eris? Does Hubble have enough resolution to resolve that Eris even has a moon? (For part c you will again need to look up relevant astronomical information about Eris and its moon, called Dysnomia)

