Physics 100
Laser Module

Homework #2

Remember that you can consult with each other on how to approach problems, but that you should write up solutions on your own. *Please write explanations in **words*** for your solutions - do not just write equations and numbers. Also please write the Union College honor pledge (below) on your HW and sign.

1. A high intensity laser with a 1 cm diameter exit aperture and a wavelength of 500 nm is aimed at the moon. Find the approximate cross-sectional area of the laser beam when it reaches the moon, a distance of 3.82×10^8 m. What fraction of the moon's projected area will it cover (the moon's mean radius is 1.74×10^6 m).

2. a. Find the energy of a red photon from a HeNe laser ($\lambda = 632.8$ nm) in Joules and in electron volts (eV).
   b. Find the number of photons per second in a 1 mW (10^{-3} W) red He-Ne laser beam.
   c. If all of these photons were absorbed by 100 g of water in a thermos bottle (no heat losses), how long would it take to heat the water by 1^oC (For this part you need to know that 4.18 J of energy will raise the temperature of 1 g of water by 1^oC. Also assume that the heating is uniform throughout the water).
   d. Repeat part c for a 100 W argon laser beam with $\lambda = 488$ nm (blue).
   e. Now, for the He-Ne laser above, find how long such a beam can be focused on the retina before causing irreversible damage. The beam will be focused by the eye to a diameter of about 100 μm. The threshold for damage to the retina with a He-Ne laser is about 0.5 mJ/cm^2. This problem illustrates one of the dangers in working with lasers.

I affirm that I have carried out my academic endeavors with full academic honesty.
Signed_____