Assignment 1

1. How many photons/sec are in a continuous 10 Watt laser beam having wavelengths:

   a) blue light 514 nm

   b) red light 650 nm.

2. How long does it take to raise 1 liter of water by $10°$ C when it fully absorbs a 10 Watt laser beam? Assume that no heat is lost through the top, bottom or sides of the container.

3. Laser cooling refers to slowing or stopping a moving atom by directing a laser at it. The atom loses momentum whenever it absorbs an oncoming photon. Subsequently, the photon is reradiated in no preferred direction.

   a) Estimate the number of photons ($\lambda = 780$ nm) required to stop a rubidium atom initially moving at the speed of sound.

   b) How long does it take to stop one atom if it takes about 25 nsec before the excited atom reradiates the photon?

   c) What distance does the atom travel while the laser slows it down to a stop?

   d) How much laser power is required to stop an atomic beam having 1 billion atoms/sec?

4. Estimate the time for light to travel from Toronto to Paris via

   a) an optical fiber under the ocean

   b) via a satellite in geosynchronous orbit

5. A computer disk is made by focusing light to a spot whose diameter is comparable to the optical wavelength. Find the number of bits that can be stored on a 10 cm diameter optical disk using

   a) an infrared laser

   b) an ultraviolet laser.