

Name \_\_\_\_\_

Physical Chemistry 332 – Spring 2012 – Homework 2

Answer the following problems in the space provided. Attach any spread sheets and graphs as required (especially problems 3, 4 & 5). Show just enough work in the space provided to indicate how you arrived at the answer. As a general rule for all homework and take-home tests, you may use class lecture notes/slides, any published papers/books, any open source on the web, but **you may not discuss your work or solicit help directly with anyone except the class instructor**. The honor system applies and your name on the problem set indicates your adherence to this code. Problems are due 1-week from when assigned.

1. What is the deBroglie wavelength (in meters, nanometers, picometer and femtometers) associated with a proton in a particle accelerator moving at 1/2 the speed of light? Neglect relativistic effects resulting from velocity approaching the speed of light and use the rest mass.

Wavelength in meters \_\_\_\_\_

Wavelength in nanometers \_\_\_\_\_

Wavelength in picometers \_\_\_\_\_

Wavelength in femtometers \_\_\_\_\_

2. What is the deBroglie wavelength in meters of a 10 gram bullet moving at the speed of sound fired from a gun? (speed of sound at sea level in dry air at 20°C (68 °F) is 343 meters per second or 1,125 ft/s or 1,236 kilometers per hour or 768 mph.)

Wavelength in meters \_\_\_\_\_

3. What is the wavelength maximum in **nanometer** of the spectral distribution of electromagnetic radiation emitted by a black body at the human body temperature of 37°C (98.6 °F), 1000 °C, 3000°C and 5000°C? (Set up a user-friendly Excel spreadsheet and you will only have to do the work once. Save the spread sheet for possible use on other problems, take-home tests and the final.)

37 °C \_\_\_\_\_ nm

1000 °C \_\_\_\_\_ nm

3000 °C \_\_\_\_\_ nm

5000 °C \_\_\_\_\_ nm

4. How much energy in Watts per square centimeter is radiated from a black body at these 4 temperatures?  
(a Watt is a Joule per second)

30 °C \_\_\_\_\_ W/cm<sup>2</sup>

1000 °C \_\_\_\_\_ W/cm<sup>2</sup>

3000 °C \_\_\_\_\_ W/cm<sup>2</sup>

5000 °C \_\_\_\_\_ W/cm<sup>2</sup>

5. Using Bohr Theory for a H-atom, set up a user-friendly Excel spread sheet to calculate energy and wavelength in nm and  $\mu\text{m}$  of a photon of light emitted when an electron drops from level one “n” level to another. Then use this spread sheet to calculate the energy of a photon in Joules and its wavelength in micrometers and nanometers emitted when an electron in a H-atom undergoes a transition from an n=7 level to an n=3 level. Calculate the energy of an Einstein (ie. Avogadro’s number) of these photons.

photon energy \_\_\_\_\_ Joules

photon wavelength \_\_\_\_\_ nm

photon wavelength \_\_\_\_\_  $\mu\text{m}$