

Homework #1

Name \_\_\_\_\_

Due: Sept. 8

Chemistry 331

Please write the answer in the blank provided for full credit.

1. Calculate a realistic estimate for the temperature at the surface of Mercury using the black body radiation formula. Use the following facts.  
Radius of Mercury: 1510 miles (convert to meters).  
Distance of Mercury from the sun: 35,900,000 miles (convert to meters).  
Note: Mercury does not rotate on its axis. Please calculate the temperature on the sunny side! You may assume that the dark side is very cold (i.e. near  $T = 0$  K).  
(4 points)

**Temperature =** \_\_\_\_\_.

2. What wavelength is the peak of the black body emission from Mercury?  
(3 points)

**Wavelength =** \_\_\_\_\_

3. Which quantum numbers give rise to the transitions in the Lyman series for hydrogen. Show your work.  
The Lyman series is: 121.5 nm, 102.5 nm, 97.2 nm, 94.9 nm, 93.7 nm, 93.0 nm, 92.6 nm etc. (4 points)

**Answer: The quantum numbers for the transition are:**

\_\_\_\_\_ → \_\_\_\_\_ for 121.5 nm

\_\_\_\_\_ → \_\_\_\_\_ for 102.5 nm

\_\_\_\_\_ → \_\_\_\_\_ for 97.2 nm

\_\_\_\_\_ → \_\_\_\_\_ for 94.9 nm

\_\_\_\_\_ → \_\_\_\_\_ for 93.7 nm

\_\_\_\_\_ → \_\_\_\_\_ for 93.0 nm

\_\_\_\_\_ → \_\_\_\_\_ for 92.6 nm

4. What is the DeBroglie wavenumber (in  $\text{cm}^{-1}$ ) of a 2.5 keV electron in an electron microscope? (3 points)

**DeBroglie wavenumber** \_\_\_\_\_

5. What is the DeBroglie wavelength of a truck that weighs 16 tons traveling at 60 miles per hour (you may neglect friction)? (3 points)

**DeBroglie wavelength** \_\_\_\_\_

6. Solve the following integrals (3 points).

$$\int_0^{\infty} e^{-kx} dx = \underline{\hspace{2cm}}$$

$$\int_1^{10} \frac{dx}{x} = \underline{\hspace{2cm}}$$

$$\int_1^{10} x dx = \underline{\hspace{2cm}}$$