Laude's CH301 Worksheet 1: EMR and Waves (Sections 1.1-1.9)

*(*The textbook referenced is Jones & Atkins's *Chemical Principle, 3rd edition)*

1. Classical physics predicts that light can be transferred from object to object independent of frequency. This would imply that all matter should emit intense ultraviolet light, x-ray and γ-rays. In other words, our CH301 classroom should be lit with glow-in-the-dark students. (Un)Fortunately this phenomenon is not observed. Chapter 1.2 in the book explains why this doesn't happen. After reading the chapter, how could you clarify this mystery for another CH301 student? Use in your own words in two or three sentences.

2. Throughout the eighteenth century, many great scientists debated tirelessly over whether light was a particle or wave (it is also true that throughout the fourteenth century, many great 'scientists' debated the number of angels that could dance on the head of a pin, but that is neither here nor there). In the end, most scientists agreed that light was a wave because of one major effect observed in light that no particle could demonstrate. If you have finished reading sections 1.2 and 1.3, you already knew what this effect is. Taking things a step further into the physical nature of the phenomenon, what is the distinctive feature of waves that explains the effect ?

3. Agnew the Aggie Chemist was never much for theory. In the lab one day he was on the verge of splitting Bevo atoms, atomic symbol **Be**. He had narrowed down the position of one of the Bevo atoms to a few angstroms and was ready to split it. To his surprise, he discovered that the Bevo atom was still moving and he would either have to chill Bevo down to absolute zero, (well below what would make a tasty steak), or calculate the velocity of Bevo as well. Despite all efforts, after gaining a position, Agnew couldn't get an accurate velocity. If only Agnew had done his homework and read chapter 1.4, he would know why his method would never work. Being the well-versed CH301 student you are, can you explain to Agnew what his problem is?

4. As Dr. Laude said during the first day of class, you will not be tested on your ability to do calculus. However, that doesn't mean you should ignore an integral sign every time you see it in the text. For example, understanding what information is realized from the Schrodinger equation is essential to understanding atomic structure. Take a look at chapter 1.5, and list some examples of what scientists have learned with this equation.

5. Most theories are hypothesized to fit naturally observed phenomena. For example, the atomic hydrogen spectrum of hydrogen is not continuous but is composed of a pattern of discrete lines, called series. Read section 1.6, and provide a simple physical explanation for the origin of these lines.

6. Fill in the blank (Feel free to work similar problems in the text: numbers 1.1-1.4, pg. 47)

Wavelength (m)	Frequency (Hz)	Radiation type
	5.8×10^{14}	
3.5×10^{-2}		
5.0×10^{-10}		
7.0×10^{-8}	4.3×10^{15}	
3.8×10^{-7}	7.9×10^{14}	

7. Use Wien's law to fill in the blanks: (Feel free to work similar problems in the text: numbers 1.5-1.10, pg. 47)

Material	Wavelength(m)	Temperature(K)	Does your answer make sense?
magma	7.0×10^{-7}		
Steam at 1atm	8.2×10^{-6}		
Sodium light		576K	

8. Calculate the wavelength of a baseball with a mass of 100 g moving at 62 miles/hour. Write out all the units. Compare your answer to the typical wavelengths calculated for atomic-sized particles. Does the result explain why we don't observe wavelike properties for objects we see in our daily lives? (Feel free to work similar problems in the text: numbers 1.15-1.18, pg 47)

9. What is wrong with these electrons? (Feel free to work similar problems in the text: numbers 1.41-1.56, pg 48-49)

a. $n = 2$ $l = 1$ $m_l = -2$ $m_s = ½$

b. $n = 1$ $l = -1$ $m_l = 2$ $m_s = -1$

c. $n = 0$ $l = 0$ $m_l = 0$ $m_l = -½$

d. $n = 1$ $l = 1$ $m_l = 0$ $m_s = -½$

e. $n = 5$ $l = 0$ $m_l = 0$ $m_s = ½$