Physics 202H - Introductory Quantum Physics I **Homework #03**

Fall 2004 Due 5:01 PM, Monday 2004/10/04

[45 points total]

"Journal" questions. Briefly share your thoughts on the following questions:
– Considering your entire history as a student, what course (in any subject) has been the most rewarding for you? Why?
– Any comments about this week's activities? Course content? Assignment? Lab?

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1. (From Eisberg & Resnick, Q 1-12, pg 51) Do you observe a Compton effect with visible light? Why or why not? Limit your discussion to about 50 words or so. Hint: this is related to Eisberg & Resnick, Q 1-10, pg 51 in that the reason for the independence of Compton scattering on the composition of the scatterer is related to the frequency of the incident photons. [10]

2. (From Eisberg & Resnick, P 2-2, pg 52) Light of a wavelength of $\lambda = 2000\,\text{Å}$ falls on an aluminum surface. In aluminum $w_0 = 4.2\,\text{eV}$ are required to remove an electron. What is the kinetic energy of
   (a) the fastest emitted photoelectrons and [5]
   (b) the slowest emitted photoelectrons? [5]
   (c) What is the stopping potential? [5]
   (d) What is the cutoff wavelength for aluminum? [5]
   (e) If the intensity of the incident light is $2.0\,\text{W/m}^2$, what is the average number of photons per unit time per unit area that strike the surface? [5]

3. (From Eisberg & Resnick, P 2-11, pg 53) An ultraviolet lightbulb, emitting at $\lambda_u = 4000\,\text{Å}$, and an infrared lightbulb, emitting at $\lambda_i = 7000\,\text{Å}$ are each rated at 40 W.
   (a) Which bulb radiates photons at the greater rate, and [5]
   (b) how many more photons does it produce each second over the other bulb? [5]

Headstart for next week, Week 04, starting Monday 2004/10/04:
– Read Chapter 2.2 "Light as a Particle" in "Simple Nature" by Crowellk
– Read Chapter 2 "Photons – Particlelike Properties of Radiation" in Eisberg & Resnick
– – Section 2.7 "Pair Production and Pair Annihilation"
– – Section 2.8 "Cross Sections for Photon Absorption and Scattering"
– Read Chapter 2.3 "Matter as a Wave" in "Simple Nature" by Crowellk
– Read Chapter 3 "De Broglie's Postulate – Wavelike Properties of Particles" in Eisberg & Resnick
– – Section 3.1 "Matter Waves"
– – Section 3.2 "The Wave-Particle Duality"