Physics 20083 – Spring 2007 Exam #1b

Instructions:

1. Answer the following four questions in the space provided. If you need extra space, please used the back of the page and make an appropriate notation on the front of the page so that I will know where to look for your complete answer.

2. Each question is worth a total of 25 points.

3. Each question requires an answer that is typically no more than two or three sentences long or perhaps a diagram and one or two sentences. Some questions do not require explanations. This will always be explicitly stated.

4. You may **not** use your own paper, book, notes or a calculator for this exam.

5. You will have 30 minutes to complete the exam and turn it in.

Wave Equation: $Frequency(f) = \dfrac{Speed(v)}{Wavelength(\lambda)}$

Energy and Wavelength: $Energy(E) \propto \dfrac{1}{Wavelength(\lambda)}$

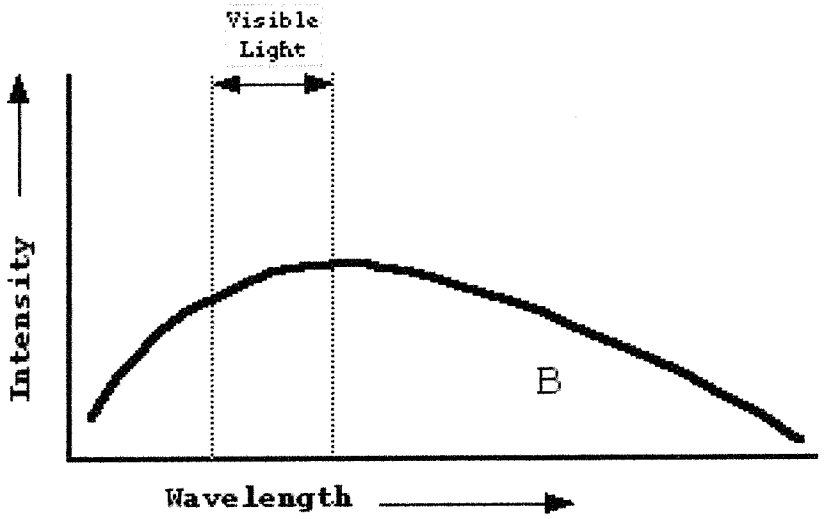
Continuous Radiation: $Temperature(T) \propto \dfrac{1}{\lambda_{peak}}$

Resolution Equation: $Resolution = \dfrac{Diameter(d)}{Wavelength(\lambda)}$

#1. Suppose we are observing some of the stars in the constellation Orion tonight:

a) (14 pts) In the space below, state the approximate altitude and azimuth of Orion in the sky this evening, along with the names of the two brightest stars in Orion.

b) (11 pts) Two of the stars in Orion (call them A and B) have all of the same properties except for temperature. Star A is only about half the temperature of B. Below I've sketched a spectrum for star B. On the same graph, sketch a spectrum for star A that follows the principles of continuous radiation we've discussed in class. No explanation needed.



#2. Explain the two possible resolutions of the "solar neutrino problem". Also, which resolution turned out to be right, and how do we know?

#3. Early in the 20th century, Ernest Rutherford conducted a famous experiment to study the nature of the atom and its nucleus. One of the consequences of this structure is the existence of spectral absorption and emission lines.

a) (10 pts) Explain how we can deduce the composition of an unknown gas by looking at the spectrum of light that has passed through that gas.

b) (15 pts) With Rutherford's experiment, explain (I) what Rutherford expected to see based on the "plum pudding" model of the atom, then explain (II) what was actually observed and what that implied about the structure of the atom.

#4. We can determine the Sun's properties remotely using basic principles of light and energy. For example, we know the Sun's temperature and luminosity simply by carefully measuring its spectrum here on the Earth.

a) (12 pts) Explain why continuous radiation is also called "Blackbody" radiation. Specifically, why that particular name as opposed to, say, "Bluebody" or "Greybody" radiation?

b) (13 pts) Given the Sun's immense luminosity, scientists who were studying it over 100 years ago could not determine the energy source. Lord Kelvin studied the possibility that impacts of small bodies (like comets and asteroids) might be responsible for the Sun's heat, but he eventually ruled that out. Explain why.