Physics 167 – Astronomy

Homework #3

Chapter 5

1. a. Find the emitted power per square meter and wavelength of peak intensity for a 3000 K object that emits thermal radiation.

b. Find the emitted power per square meter and wavelength of peak intensity for a 50,000 K object that emits thermal radiation.

2. Suppose the surface temperature of the Sun were about 12,000 K, rather than 6000 K.
a. How much more thermal radiation would the Sun emit? (By what factor would the Sun's thermal radiation increase?)

b. What would happen to the Sun's wavelength of peak intensity? (Find the new wavelength of peak intensity.)

c. Do you think it would still be possible to have life on Earth? Explain.

3. In hydrogen, the transition from level 2 to level 1 has a rest wavelength of 121.6 nm. Find the speed and direction (toward or away from us) for a star in which this line appears at wavelength of
a. 120.5 nm b. 121.2 nm c. 121.9 nm d. 122.9 nm

4. Large telescopes often have small fields of view. For example, the Hubble Space Telescope's (HST's) advanced camera has a field of view that is roughly square and about 0.06° on a side.
a. Calculate the angular area of the HST's field of view in square degrees.
b. The angular area of the entire sky is about 41,250 square degrees. How many pictures would the HST have to take with its camera to obtain a complete picture of the entire sky?

5. Clearly explain how studying an object's spectrum can allow us to determine each of the following properties of the object.
a. The object's surface chemical composition.
b. The object's surface temperature.
c. Whether the object is a low-density cloud of gas or something more substantial.
d. The speed at which the object is moving toward or away from us.

Chapter 6

6. You are dating rocks by their proportions of parent isotope potassium-40 (half-life 1.25 billion years) and daughter isotope argon-40. Find the age for each of the following:
a. A rock that contains equal amounts of potassium-40 and argon-40

b. A rock that contains three times as much argon-40 as potassium-40.

7. You are dating Moon rocks based on their proportions of uranium-238 (half-life of about 4.5 billion years) and its ultimate decay product, lead. Find the age for each of the following:
a. A rock for which you determine that 55% of the original uranium-238 remains, while the other 45% has decayed into lead
b. A rock for which you determine that 63% of the original uranium-238 remains, while the other 37% has decayed into lead.

8. The half-life of carbon-14 is about 5700 years.
a. You find a piece of cloth painted with organic dye. By analyzing the dye, you find that only 77% of the carbon-14 originally in the dye remains. When was the cloth painted?
b. A well-preserved piece of wood found at an archeological site has 6.2% of the carbon-14 it must have had when it was living. Estimate when the wood was cut.
c. Is carbon-14 useful for establishing Earth's age? Why or why not?

9. Summarize the orderly patterns of motion in our solar system and explain why their existence should suggest that the Sun and the planets all formed at one time from one cloud of gas, rather than as individual objects at different times.