Workshop module 9 - Physics 123, Spring 2013

1. You find that when UV light with a wavelength of 254 nm from a mercury arc falls upon a clean copper surface, the stopping potential necessary to stop emission of photoelectrons is 0.181 V. a) What is the photoelectric threshold wavelength for this copper surface? b) What is the work function for this surface?

2. Which device can resolve smaller details in a sample: an electron microscope or a visible light microscope? Why?

3. Doctors commonly study x-ray photographs of the innards of people. Radio waves pass through bodies too … Why don't we make radio wave photos of the body to study as a diagnostic tool?

4. At what wavelength does a room-temperature object (T=20 degrees c) emit the maximum thermal radiation? To what temperature must it be heated in order that the peak of its emitted thermal radiation fall in the red region of the spectrum?

5. X-rays of wavelength 0.24 nm are Compton scattered and the scattered beam is observed at an angle of 60 degrees relative to the incident beam. What is the wavelength of the scattered X-rays? What is the energy of the scattered X-ray photons? What is the kinetic energy of the scattered electrons? At what angle, relative to the incident beam direction, do the scattered electrons travel?

6. The cosmic microwave background (CMB) which permeates our universe is thermal radiation left from the time that neutral atoms were first formed approximately 400,000 years after the big bang. The photons in the CMB have traveled freely since that time (about 13.4 billion years ago) and have had been redshifted by the expanding space in the universe. Currently the CMB is seen to have a spectrum similar to what would be measured from a blackbody at a temperature of 2.7 K. At what frequency, and in what part of the spectrum, does the CMB have peak intensity? [As it turns out the "temperature", i.e. the spectrum of a blackbody corresponding to that temperature, is not uniform across the sky. It has variations of about 1 part in 10^5. Can you guess why this might be important?]

7. Cell-phone signals are carried on waves with a frequency of 700-800 MHz. Do you think it is true that cell phone signals cause cancer? Defend your answer with basic physical reasoning.

8. Estimate the surface temperature of a yellow star (like the Sun). Estimate the surface temperature of a blue star such as Vega or Rigel.