Physics 2610H: Assignment I

Jeremy Favro

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Problem 1. At what wavelength does the human body emit the maximum electromagnetic radiation? Use Wien's law from Exercise 14 and assume a skin temperature of 70°F.

Solution 1.

Problem 2. With light of wavelength 520nm, photoelectrons are ejected from a metal surface with a maximum speed of $1.78 \times 10^5\,\mathrm{m\,s^{-1}}$.

(a) What wavelength would be neededto give a maximum speed of $4.81 \times 10^5\,\mathrm{m\,s^{-1}}$?

(b) Can you guess what metal it is?

Solution 2.

Problem 3. When a beam of monoenergetic electrons is directed at a tungsten target, X-rays are produced with wavelengths no shorter than 0.062nm. How fast are the electrons in the beam moving?

Solution 3.

Problem 4. A 0.057nm X-ray photon "bounces off" an initially stationary electron and scatters with a wavelength of 0.061nm. Find the directions of scatter of

(a) The photon.

(b) The electron.

Solution 4.

Problem 5. The setup depicted in Figure 6 is used in a diffraction experiment using X-rays of 0.26nm$m$ wavelength. Constructive interference is noticed at angles of 23.0° and 51.4°, but none between. What is the spacing d of atomic planes?

Solution 5.

Problem 6. The average kinetic energy of a particle at temperature T is $\frac{3}{2}k_BT$.

(a) What is the wavelength of a room-temperature (22°C) electron?

(b) Of a room-temperature proton?

(c) In what circumstances should each behave as a wave?

Solution 6.