Problem 1

When ultraviolet light with a wavelength of 400.0 nm falls on a certain metal surface, the maximum kinetic energy of the emitted photoelectrons is measured to be 1.10 eV. What is the maximum kinetic energy of the photoelectrons when light of wavelength 300.0 nm falls on the same surface?

Problem 2

The photoelectric work function of potassium is 2.3 eV. If light having a wavelength of 250 nm falls on potassium, find
(a) the stopping potential in volts
(b) the kinetic energy in electron volts of the most energetic electrons ejected
(c) the speed of these electrons.

Problem 3

Protons are accelerated from rest by a potential difference of 4.00 kV and strike a metal target. If a proton produces one photon on impact, what is the minimum wavelength of the resulting x rays?

Problem 4

A photon scatters in the backward direction from a free proton that is initially at rest. What must the wavelength of the incident photon be if it is to undergo a 10.0% change in wavelength as a result of the scattering?

Problem 5

A photon with wavelength $\lambda = 1.385$ Å scatters from an electron that is initially at rest. What must the angle between the direction of propagation of the incident and scattered photons be if the speed of the electron immediately after the collision is 8.90×10^6 m/s?

Problem 6

A 2.50 W beam of light of wavelength 124 nm falls on a metal surface. You observe that the maximum kinetic energy of the ejected electrons is 4.16 eV. Assume that each photon in the beam ejects a photoelectron.
(a) What is the work function (in electron volts) of this metal?
(b) How many photoelectrons are ejected each second from this metal?

Problem 7

An ultrashort Gaussian ($\Delta x \Delta p = \hbar/2$) pulse of light has a duration of 9.00 fs and produces light at a wavelength of 556 nm. What are the momentum and momentum uncertainty of a single photon in the pulse?

Problem 8

An electron and a positron are moving toward each other and each has speed 0.500*c* in the lab frame.
(a) What is the kinetic energy of each particle?
(b) The e+ and e- meet head-on and annihilate producing two photons of equal energy traveling in opposite directions. What is the energy of each photon that is produced?
(c) What is the wavelength of each photon?

Problem 9

Electrons are ejected from a metallic surface with speeds of up to 4.60×10^5 m/s when light with a wavelength of 625 nm is used.
(a) What is the work function of the surface?
(b) What is the cutoff frequency for this surface?

Problem 10

A photon having wavelength λ scatters off a free electron at *A*, producing a second photon having wavelength λ'. This photon then scatters off another free electron at *B*, producing a third photon having wavelength λ'' and moving in a direction directly opposite the original photon as shown. Determine the value of $\Delta\lambda = \lambda'' - \lambda$.