Assignment # 12

Modern Physics I Photons

Chapter 38: Light Waves Behaving as Particles

Important Formulas and Concepts:

Maximum Kinetic Energy of electron $K_{max} = \frac{1}{2}mV_o$

Energy of a Photon $E = hf = \frac{hc}{\lambda}$

Momentum of a photon $p = \frac{E}{c} = \frac{hf}{c} = \frac{h}{\lambda}$

Uncertainty principle: $\Delta x \Delta p_x \geq \frac{\hbar}{2}$

Question 1:

A laser pointer with a power output of 5.00 mW emits red light having wavelength 650 nm.

(a) What is the magnitude of the momentum of each photon?
(b) How many photons does the laser pointer emit each second?

Question 2:

A photon of green light has a wavelength of 520 nm. Find

(a) the photon's frequency.
(b) Magnitude of momentum.
(c) Energy of photon
(d) Express the energy in both joules and electron volts

Question 3:

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.

Question 4:

A horizontal beam of laser light of wavelength 585 nm passes through a narrow slit that has width 0.0620 mm. The intensity of the light is measured on a vertical screen that is 2.00 m from the slit.

(a) What is the minimum uncertainty in the vertical component of the momentum of each photon in the beam after the photon has passed through the slit?
(b) Use the result of part (a) to estimate the width of the central diffraction maximum that is observed on the screen.