ASSIGNMENT 14

28 Marks Total

Compton, de Broglie, and Wave-Particle Duality

This assignment is worth 28 marks. The value of each question is noted in parentheses in the left margin. Note: The answer areas will expand to fit the length of your response.

1. There are similarities and differences between the Photoelectric Effect and Compton Scattering. Complete each of the six partial statements below using the following guide; all you need to provide for an answer is PE, CS, BOTH, or NEITHER.

- **PE** if the statement only applies to the Photoelectric Effect
- **CS** if the statement only applies to Compton Scattering
- **BOTH** if the statement only applies to both the Photoelectric Effect and Compton Scattering
- **NEITHER** if the statement applies to Neither the Photoelectric Effect or Compton Scattering

(1) a. Energy is conserved in _____.

Answer:

(1) b. Photons are observed before and after the interaction in _____.

Answer:

(1) c. Electrons are observed as the result of the experiment in _____.

Answer:

(1) d. Angles are measured in the experiment in _____.

Answer:

(1) e. Photons with very low energies such as 5.0 to 10.0 eV is observed in _____.

Answer:

(1) f. Ionization occurs in _____.

Answer:

(2) **2.** What quantity measured in the Compton effect experiment show the wave-particle duality of light?

Answer:

(5) **3.** An X-ray with a frequency of 3.74×10^{20} Hz is incident on a thin piece of metal. The lower frequency X-ray on the other side is observed deflected at 48^{o}. What is the frequency of the deflected X-ray?

Answer:

(5) **4.** A scientist changes the frequency of an incident X-ray to 4.50×10^{19} Hz and measures the deflected X-ray frequency of 4.32×10^{19} Hz. What was the angle of deflection?

Answer:

(2) **5.** Can the equation $E = pc$ be applied to particles? Why or why not?

Answer:

(3) **6.** A stationary hydrogen atom with a mass of 1.67×10^{-27} kg absorbs a photon of light with 10.2 eV. What is the velocity of the hydrogen atom after absorbing the photon in a perfectly inelastic collision?

Answer:

(2) **7.** Describe the results of performing Young's experiment with x-rays and then high speed electrons.

Answer:

(2) **8.** How do the results of performing Young's experiment with x-rays and then high speed electrons support the wave-particle model?

Answer:

(1) **9.** All of the following quantities can be measured or calculated for light waves and subatomic particles except _____.

A. momentum
B. velocity
C. frequency
D. energy

Answer:

When you have completed all of the questions in this assignment, submit your work.