Name ____Answer Key_____ Date _____
Honors Physics Modern WS #2H
Period _____ Mrs. Nadworny

de Broglie Waves

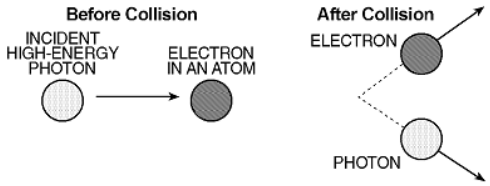
Directions: Read online textbook pages 848 – 854. Solve the following problems using the GUESS method and proper significant figures. Be sure to show ALL work.

1. A photon of light carries

   (A) energy, but not momentum
   (B) both energy and momentum
   (C) momentum, but not energy
   (D) neither energy nor momentum

Questions 2 and 3 refer to the following:

The diagrams below show a photon and an electron before and after their collision.



2. Compared to the wavelength of the photon before its collision with the electron, the wavelength of the photon after the collision is

   (A) longer (B) shorter (C) the same

3. Compared to the total momentum of the photon-electron system before the collision, the total momentum of the photon-electron system after the collision is

   (A) greater (B) less (C) the same

4. Which of the following is evidence for the wave nature of the electron?

   (A) Continuous energy spectrum in B– decay
   (B) Electron diffraction from crystals
   (C) Existence of atomic energy levels
   (D) Existence of nuclear energy levels

5. A photon of energy E and wavelength λ is scattered from an electron initially at rest. What is the energy of the photon and the wavelength of the photon when the electron moves away?

	Energy of photon	Wavelength of photon
A.	greater than *E*	less than λ
B.	less than *E*	less than λ
C.	greater than *E*	greater than λ
D.	less than *E*	greater than λ

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6. What is the momentum of an x-ray photon whose wavelength is 1.3 x 10^{-9} m?

$$p = \frac{h}{\lambda} = \frac{6.63\times10^{-34}\ J\cdot s}{1.3\times10^{-9}\ m} = 5.1\times10^{-25}\ \frac{kg\cdot m}{s}$$

7. Calculate the de Broglie wavelength of an electron that is traveling at 4.7 x 10^{5} m/s.

$$\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}\ J\cdot s}{(9.11\times10^{-31}kg)(4.7\times10^{5}\ \frac{m}{s})} = 1.5\times10^{-9}\ m$$ OR

$$p = mv = (9.11\times10^{-31}kg)(4.7\times10^{5}\ \tfrac{m}{s}) = 4.3\times10^{-25}\ \tfrac{kg\cdot m}{s}$$

$$\lambda = \frac{h}{p} = \frac{6.63\times10^{-34}\ J\cdot s}{4.3\times10^{-25}\ \frac{kg\cdot m}{s}} = 1.5\times10^{-9}\ m$$

8. Calculate the de Broglie wavelength of a 0.37 kg baseball that is traveling at 19 m/s.

$$\lambda = \frac{h}{mv} = \frac{6.63\times10^{-34}\ J\cdot s}{(0.37kg)(19\ \frac{m}{s})} = 9.4\times10^{-35}\ m$$ OR

$$p = mv = (0.37kg)(19\ \tfrac{m}{s}) = 7.0\ \tfrac{kg\cdot m}{s}$$

$$\lambda = \frac{h}{p} = \frac{6.63\times10^{-34}\ J\cdot s}{7.0\ \frac{kg\cdot m}{s}} = 9.5\times10^{-35}\ m$$

Answers in size order: 9.4 x 10^{-35} or 9.5 x 10^{-35}, 5.1 x 10^{-25}, 1.5 x 10^{-9}