Question 1 2 / 2 points

A photon of wavelength 200 nm is scattered by an electron that is initially at rest. Which one of the following statements concerning the wavelength of the scattered photon is true?

a) The wavelength is zero nm.

b) The wavelength is less than 200 nm, but greater than zero.

c) The wavelength is 100 nm.

d) The wavelength is 200 nm.

e) The wavelength is greater than 200 nm.

Question 2 2 / 2 points

The work function for a particular metal is 4.0 eV. Which one of the following best describes the wavelength of electromagnetic radiation needed to eject electrons from this metal?

a) 310 nm or smaller

b) 620 nm or greater

c) 800 nm or greater

d) 620 nm or smaller

e) 310 nm or greater

Question 3 2 / 2 points

Which one of the following statements concerning photons is false?

a) The rest energy of all photons is zero.

b) Photons have been brought to rest by applying a very strong magnetic field to them.

c) Photons travel at the speed of light in a vacuum.

d) The energy of a photon is proportional to its frequency.

e) Photons have zero mass.

Question 4 2 / 2 points

Which one of the following phrases best describes the term *work function*?

a) the minimum energy required to remove electrons from a metal surface

b) the minimum energy required to vaporize a metal surface

c) the work required to place a charged particle on a metal surface

d) the work done by electromagnetic radiation when it hits a metal surface

e) the minimum energy required to remove an atom from a metal surface

Question 5 2 / 2 points

Determine the energy of a single photon in a monochromatic beam of light of wavelength 625 nm.

a) 2.32 eV

b) 2.08 eV

c) 1.99 eV

d) 3.49 eV

e) 4.77 eV

Question 6 2 / 2 points

What is the de Broglie wavelength of an electron (m = 9.11 × 10^{-31} kg) in a 2.5 × 10^3-volt X-ray tube?

a)	0.0072 nm
b)	0.031 nm
c)	0.017 nm
d)	0.011 nm
e)	0.025 nm

Question 7 2 / 2 points

The x component of the velocity of an electron (m = 9.11 × 10^{-31} kg) is known to be between 100 m/s and 300 m/s. Which one of the following is a true statement concerning the uncertainty in the x coordinate of the electron?

a) The minimum uncertainty is about 3 × 10^{-7} m.

b) The maximum uncertainty is about 6 × 10^{-9} m.

c) The maximum uncertainty is about 6 × 10^{-7} m.

d) The minimum uncertainty is about 3 × 10^{-9} m.

e) The maximum uncertainty is about 10^6 m.

Question 8 2 / 2 points

A physicist wishes to produce electrons by shining light on a metal surface. The light source emits light with a wavelength of 450 nm. The table lists the only available metals and their work functions.

Metal	W_0 (eV)
barium	2.5
lithium	2.3
tantalum	4.2
tungsten	4.5

Reference: Ref 29-1

Which entry in the table below correctly identifies the metal that will produce the most energetic electrons and their energies?

	Metal	*Maximum electron energy observed*
a)	tungsten	2.8 eV
b)	tungsten	1.8 eV
c)	lithium	0.5 eV
d)	lithium	2.3 eV
e)	tungsten	4.5 eV

Question 9 2 / 2 points

The position of a hydrogen atom (m = 1.7 × 10^{-27} kg) is known to within 2.0 × 10^{-6} m. What is the minimum uncertainty in the atom's velocity?

a)	zero m/s
b)	0.0085 m/s
c)	0.031 m/s
d)	0.016 m/s
e)	0.011 m/s

Question 10 2 / 2 points

For which one of the following problems did Max Planck make contributions that eventually led to the development of the "quantum" hypothesis?

a) the motion of the earth in the ether
b) uncertainty principle
c) the invariance of the speed of light in a vacuum
d) photoelectric effect
e) blackbody radiation curves