Chapter 11 Review Questions

Solutions can be found in Chapter 12.

Section I: Multiple Choice

1. According to the theory put forth by Louis de Broglie, all matter has wave-like properties such as interference, but these properties are only seen at a microscopic scale. Why are these properties not typically observed at a macroscopic scale?

   (A) The wavelength of matter is typically too large to observe this interference.
   (B) Interference of matter only occurs when these waves interact with other objects comparable to their wavelength and those things are microscopic.
   (C) There are no energy level transitions available to allow for this interference to be observed.
   (D) At the macroscopic scale, the interference is always destructive so it cannot be observed.

2. An experiment is conducted of the photoelectric effect. A metal whose work function is 6.0 eV is struck with a beam light with power 1.0 mW of a frequency 7.2×10^{15} Hz. A photoelectron is ejected from the surface of the metal and is found to require a stopping potential of 24 eV. Which of the following changes could be made so that a photoelectron was not ejected from the surface of the metal? (Choose two.)

   (A) Alter the work function of the metal
   (B) Alter the power of the light
   (C) Alter the frequency of the light
   (D) Alter the stopping potential

3. An atom with one electron has an ionization energy of 25.0 eV. An electron in this atom makes a transition from an excited energy level, where $E = -16.0$ eV, to the ground state. What is the wavelength of the emitted photon from this transition?

   (A) 138 nm
   (B) 112 nm
   (C) 77.5 nm
   (D) 49.6 nm

4. The single electron in an atom has an energy of –40 eV when it's in the ground state, and the first excited state for the electron is at –10 eV. What will happen to this electron if the atom is struck by a stream of photons, each of energy 15 eV ?

   (A) The electron will absorb the energy of one photon and become excited halfway to the first excited state, then quickly return to the ground state, emitting a 15 eV photon in the process.
   (B) The electron will absorb the energy of one photon and become excited halfway to the first excited state, then quickly absorb the energy of another photon to reach the first excited state.
   (C) The electron will absorb two photons and be excited to the first excited state.
   (D) Nothing will happen.

5. The products of several radioactive decays are being studied. Each particle starts with the same speed and enters into a region with a uniform magnetic field directed perpendicular to the initial velocity of the particles. Which observation could be made?

   (A) A neutron and an electron are deflected in the same direction, but with the electron turning with a larger radius.
   (B) An alpha particle and an electron are deflected in the same direction, but with the alpha particle turning with a larger radius.
   (C) An alpha particle and a neutron are both undeflected.
   (D) An alpha particle is deflected and a neutron is undeflected.

6. A partial energy-level diagram for an atom is shown below. What photon energies could this atom emit if it begins in the $n = 3$ state?

–3 eV ___________ $n = 4$

–5 eV ___________ $n = 3$

–8 eV ___________ $n = 2$

–12 eV ___________ $n = 1$ ground state

(A) 5 eV only
(B) 3 eV or 7 eV only
(C) 2 eV, 3 eV, or 7 eV
(D) 3 eV, 4 eV, or 7 eV

7. Which of the following transitions between energy levels results in emission of the shortest wavelength photon?

(A) A large energy transition to a higher energy level
(B) A small energy transition to a higher energy level
(C) A large energy transition to a lower energy level
(D) A small energy transition to a lower energy level

8. The de Broglie hypothesis, that $\lambda = h/p$, was experimentally confirmed by Davisson, Germer, and Thompson. Which of the following describes this hypothesis?

(A) A photon carries a momentum that depends on the wavelength of that photon.
(B) Momentum will be conserved during quantum mechanical processes.
(C) Photons may behave like particles under certain circumstances.
(D) Electrons will undergo diffraction in certain circumstances.

9. In nuclear reactions, all of the following are true about mass and mass defect EXCEPT

(A) The mass defect is directly proportional to the binding energy.
(B) The mass of the unbound nucleons will be less than their mass when combined.
(C) The energy associated with the mass defect is significantly greater than the energy levels for electrons in the atom.
(D) The mass defect is significantly less than the rest mass of the nucleons.

10. What's the missing particle in the following nuclear reaction?

$$^{2}_{1}\text{H} + {}^{63}_{29}\text{Cu} \longrightarrow {}^{64}_{30}\text{Zn} + (?)$$

(A) Proton
(B) Neutron
(C) Electron
(D) Positron

11. A particular isotope of platinum $^{175}_{78}\text{Pt}$ has a halflife of just over 2.5 seconds. It can decay either via alpha decay or beta(+) decay. What are the daughter nuclei from each of these processes?

(A) Alpha decay results in $^{171}_{76}\text{Os}$ and beta(+) decay results in $^{175}_{75}\text{Ir}$.
(B) Alpha decay results in $^{171}_{76}\text{Os}$ and beta(+) decay results in $^{175}_{79}\text{Au}$.
(C) Alpha decay results in $^{179}_{80}\text{Hg}$ and beta(+) decay results in $^{175}_{75}\text{Ir}$.
(D) Alpha decay results in $^{179}_{80}\text{Hg}$ and beta(+) decay results in $^{175}_{79}\text{Au}$.

Section II: Free Response

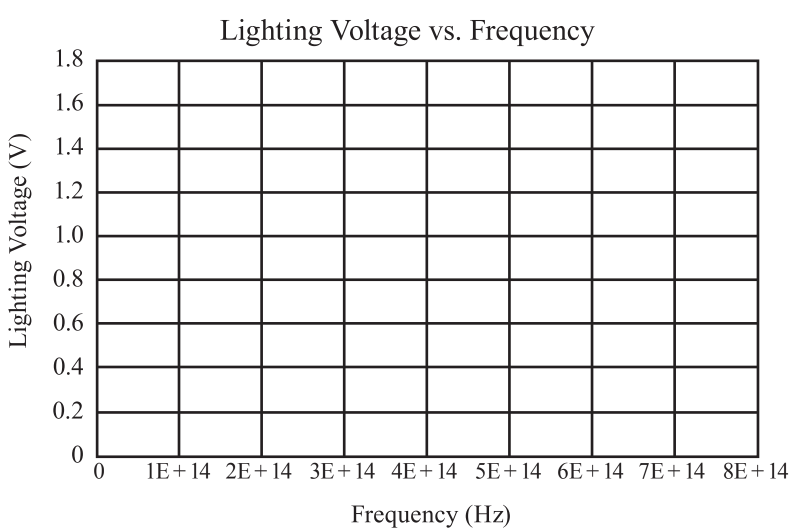
1. An experiment is carried out with a series of different colored LED lights (which glow by emitting photoelectrons) which are connected one at a time to a variable voltage supply. When the voltage supply is set to 0 V, none of the LED bulbs light. As the voltage is increased, each LED turns on at a different voltage setting. As the voltage is further increased, the brightness of the LED increases.

   Data is collected of the color wavelength (and corresponding frequency) for each LED and the smallest value of the voltage where the light is illuminated.

Color	Wavelength	Frequency	Lighting Voltage
Red	650	4.62	0.51
Yellow	580	5.17	0.74
Green	532	5.64	0.93
Blue	400	7.50	1.71

(a) Explain why an increase of $\Delta V = 0.1$ V in the voltage after the light is illuminated causes the brightness to increase, but the bulb remains dark for any of the LEDs with the same voltage increase $\Delta V = 0.1$ V from 0 V to 0.1 V.

(b) Plot the data on the axes below. Then calculate the slope and the y-intercept of the plot.



(c)

i. Explain how, if possible, this experiment could be repeated to get a plot with the same slope but a different intercept. If this is not possible, explain why.

ii. Explain how, if possible, this experiment could be repeated to get a plot with a different slope but the same intercept. If this is not possible, explain why.