WKS 6-3 Chem Honors
Wave –Particle Duality; Quantum Mechanics

Name: Answer Key
Period _____ Date _____

1) The minimum threshold frequency of zinc for the photoelectric effect is in the ultraviolet range. Which of the following will occur if x-rays are shined on a zinc metal surface?
   (A) No electrons will be emitted from the metal.
   (B) Electrons will be released from the metal but have no kinetic energy
   (C) Electrons will be released from the metal and have high kinetic energy.
   (D) Electrons will be released from the metal but then will immediately be recaptured by the zinc atoms.

2) The metal sodium has a threshold frequency which corresponds to yellow light. Describe what will happen to the electrons in the sodium metal if…..

   (a) yellow light is shined on the sodium surface:
   Electrons will be emitted (as long as $\nu \geq \nu_c$)

   (b) red light is shined on the metal surface:
   Red light is lower energy than yellow, so electrons will NOT be emitted ($\nu_{red} < \nu_c$)

   (c) green light is shined on the metal surface:
   Green light is higher energy than yellow, so electrons will be emitted ($\nu_{green} > \nu_c$)

   (d) green light with a greater intensity (than in previous question) is shined on the metal surface.
   More electrons will be emitted ($\nu_{green} > \nu_c$), higher intensity = more photons = more electrons

3) Which of the following is true of the energy of a photon?
   (A) It is directly proportional to the wavelength of the photon.
   (B) It is inversely proportional to the wavelength of the photon. $E = \frac{hc}{\lambda}$
   (C) It is inversely proportional to the square of the wavelength of the photon.
   (D) It is proportional to the mass of the photon.

4) Describe why the photoelectric effect gives evidence that light can exhibit properties of particles.
   The photoelectric effect shows that when light interacts with matter, one electron can only absorb one quantum, or photon, of light at a time. If the electron does not gain enough energy from the photon, it will not gain enough energy to be emitted from the metal surface.

5) Which statement below best describes Heisenberg's Uncertainty Principle?
   (A) There must always be some uncertainty in energy (wavelength).
   (B) There must always be some uncertainty in location (position).
   (C) There must always be some uncertainty in energy or in location at any one time.

6) Circle the two statements below that correctly describe aspects of Bohr's Model of the atom.
   (A) Electron paths are controlled by probability.
   (B) Electrons travel in circular paths called orbits.
   (C) Electrons can have any energy.
   (D) Electron energies are quantized.

well defined
positron

7) Which of the two statements that you circled (in previous question) is now known to be false? B
Rewrite that statement so that it is true. Explain why, in terms of the Heisenberg Uncertainty Principle.
Electrons are described by a probability function showing the probability of existing in a region of space. This uncertainty in position is needed because the energy is well-defined, and the HUP says there is a minimum uncertain to their product.

8) What is the significance of the square of the wavefunction?
The square of the wavefunction is the probability of finding the electron within a region of space.

9) Explain how our concept of an electron orbital satisfies Heisenberg's uncertainty principle.
In the orbital, the energy of the electron is well defined but its location is uncertain.